Hardware Design Manual

Version：Rev1.0

Date：24/03/14

State：Controlled version

Document revision history

Document version	Date of change	proposer	auditor	Changes
Rev1.0	24-03-14	LY		Initial version

Safety instructions

It is the user's responsibility to follow the relevant regulations of other countries and the specific environmental regulations for the use of wireless communication modules and equipment. By observing the following safety principles, you can ensure your personal safety and help to protect the product and the working environment from potential damage. We are not liable for damages related to the customer's failure to comply with these regulations.

	Safety on the road comes first! When you are driving, do not use hand-held mobile terminal devices unless they have a hands-free function. Please stop the car before making a call!
	Please turn off your mobile devices before boarding the airplane. The wireless function of mobile devices is prohibited on board to prevent interference with the aircraft's communication system. Ignoring this reminder may lead to flight safety or even violate the law.
	When in a hospital or health care setting, note if there are restrictions on the use of mobile devices.RF interference can cause medical equipment to malfunction, so it may be necessary to turn off the mobile device.
	The mobile device does not guarantee a valid connection in all circumstances, for example if the mobile device is out of credit or the SIM is invalid. When you are in an emergency situation, please remember to use the emergency call and make sure that your device is switched on and in an area with sufficient signal strength.
	Your mobile device receives and transmits RF signals when it is switched on, which can cause RF interference when near a TV, radio computer or other electronic device.
	Keep the mobile terminal unit away from flammable gases. Turn off the mobile device when you are near gas stations, oil depots, chemical plants, or explosive workplaces. It is a safety hazard to operate electronic devices in any place where there is a potential explosion hazard.

Applicable modules Options

serial number	Module Model	Supported Frequency Bands	sizes	Module Introduction
1	0344 0500	2.4 GHz ISM Band	15.0x20.0x2.3mm	

1 Introduction

A communication module designed based on STM32WB55RGV6, which uses an external PA to enhance transmission power and an internal LNA to enhance reception performance. This module introduces the vast majority of IO ports for users to use, allowing them to develop their own application firmware.

2 Product Overview

2.1 Key Features

connector	Stamp Interface
wireless standard	BLE5.4
Module Packaging	15.0x20.0x2.4mm
operating voltage	1.7V~3.6V，type 3.3V
operating frequency	2402~2480MHZ(2.4 GHz ISM Band)
operating temperature	-40 ~ +85℃
Storage temperature	-40 ~ +85℃

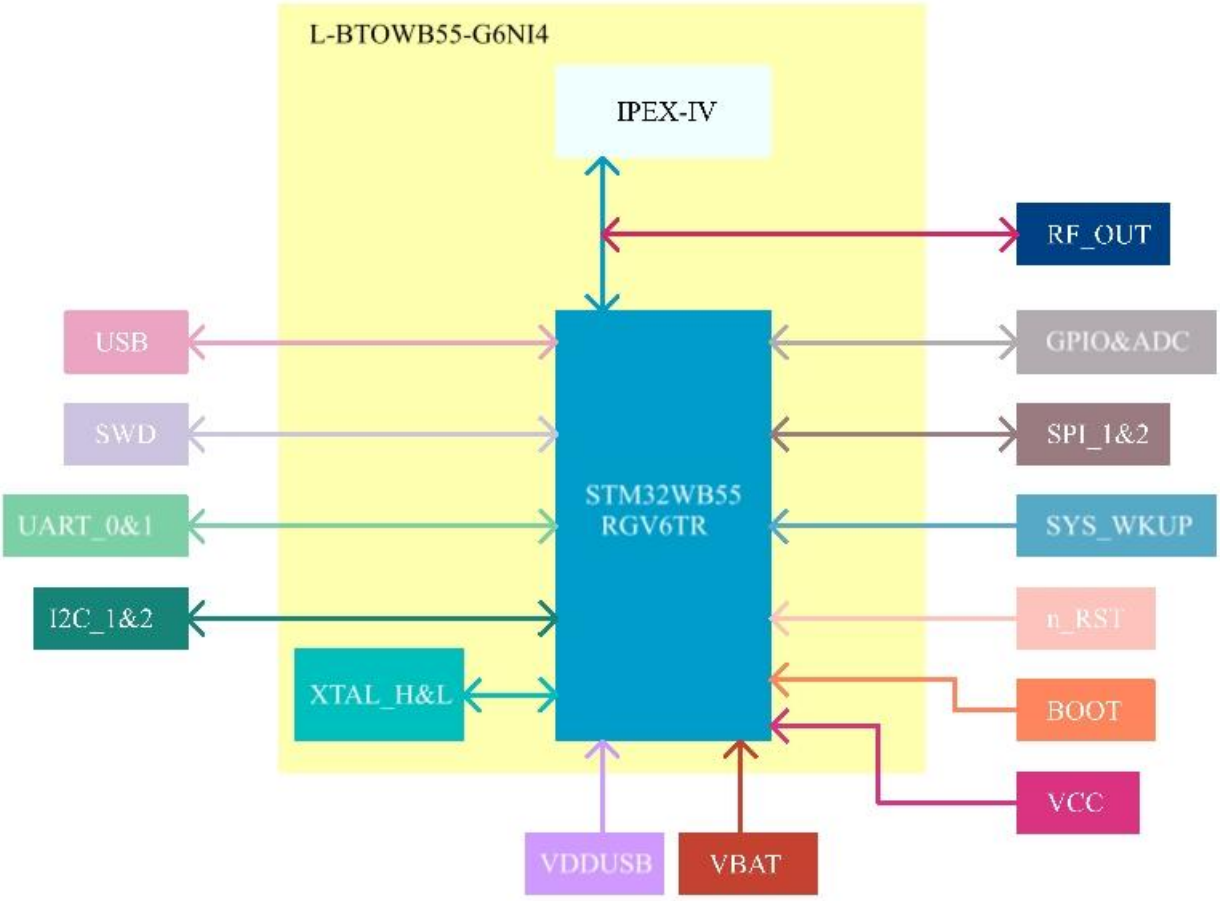
2.2 Product Advantages

- Protocol stack version：Bluetooth 5.4
- Chip core：ARM® Cortex®-M3 32-bit processor, 64 MHz
- Storage Resources：1MB Flash + 256 KB RAM
- Physical layer rate：1 Mbps，2Mbps
- Receiving sensitivity：-97dBm in 1Mbps
- Output power：MAX +10dBm
- Operating voltage：1.8 - 3.6V，type 3.3V
- Interface resources：1GPIOs，UART，SPI，USB，LCD，IIC
- Working temperature：-40 ~ 85℃

2.3 application scenario

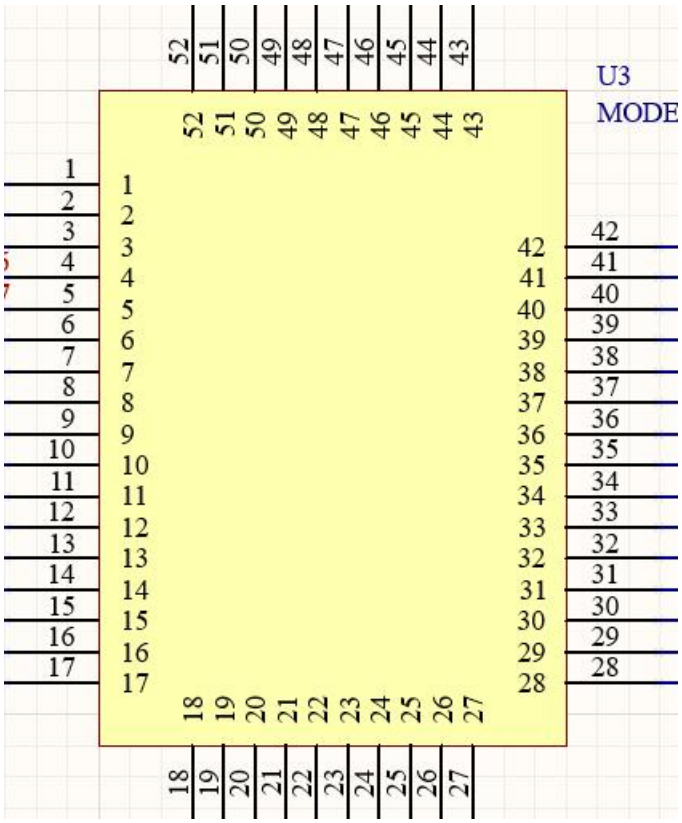
- 2.4GHz low power Bluetooth system;
- PCs, tablets, cell phones, handhelds, and other low-power peripherals (HIDs, remote controls, etc.);
- Sports, healthcare and other consumer electronics;
- Wireless sensor networks for smart meters, data acquisition, etc;
- Photovoltaic, charging pile, industrial instrumentation and other industries;
- Smart home, LAN, interactive devices, beacon lights;

2.4 functional block diagram



PIC 2.1 block diagram

2.5 Pinouts



PIC 2.2 Pinout

2.6 Pin Description Table

PIN	PIN Define	PIN Mode	Pin structure	Fun
1	PB1	IO	TT	
2	PE4	IO	FT	
3	PB2	IO	FT_a	
4	PA6	IO	FT_la	
5	PA7	IO	FT_fla	
6	PA4	IO	FT_a	
7	PA1	IO	FT_la	
8	PB6	IO	FT_fla	

9	PB7	IO	FT_fla	
10	PB10	IO	FT_fl	
11	PB11	IO	FT_fl	
12	PB8	IO	FT_fl	
13	PB9	IO	FT_fla	
14	PA13	IO	FT_u	
15	PA14	IO	FT_l	
16	VDD	IO	-	
17	GND	S	-	
18	PA11	IO	FT_u	
19	PA12	IO	FT_u	
20	VDDUSB	S	-	
21	PA15	IO	FT_l	
22	PA10	IO	FT_fl	
23	PA9	IO	FT_fla	
24	PA8	IO	FT_la	
25	PC1	IO	FT_fla	
26	PC0	IO	FT_fla	
27	VBAT	S	-	
28	NRST	IO	RST	
29	PH3	IO	FT	
30	PC5	IO	FT_la	
31	PC12	IO	FT_l	
32	PC13	IO	FT	
33	PA0	IO	FT_a	
34	PB3	IO	FT_la	
35	PB4	IO	FT_fla	
36	PA3	IO	FT_la	

37	PA2	IO	FT_la	
38	PB13	IO	FT_fl	
39	PB12	IO	FT_l	
40	PC3	IO	FT_a	
41	PC2	IO	FT_la	
42	GND	IO	S	
43	GND	IO	S	
44	RF1	IO	RF	
45	PA5	IO	FT_a	
46	PB5	IO	FT_l	
47	PC4	IO	FT_la	
48	PC11	IO	FT_l	
49	PC10	IO	FT_l	
50	PB14	IO	FT_fl	
51	PB15	IO	FT_l	
52	PC6	IO	FT_l	

3 Application interface

3.1 UART Communication

3.2 SPI Communication

3.3 USBCommunication

3.4 LCD interface

3.5 IIC interface

4 Specification

Table 4-1 Product Limit Parameters

Main Parameter	performances		Note
	Min	Max	
Supply Voltage (V)	-0.3	4.0	including VDD,, VDDUSB, VLCD,VBAT,)
IO Voltage (V)	-0.3	min (VDD, VDDUSB, VLCD) + 4.0 (3)	FT(1)
	-0.3	4.0	TT(2) or Other
Storage temperature (℃)	-40	85	/
Working temperature (℃)	-40	85	/
V_{ESD}	TBD		VBAT&ANT PIN ESD performance

Table 4-2 Module operating parameters@25℃

Main parameters	performances			note
	minimum value	typical value	maximum values	
Operating voltage (V)	1.8	3.3	3.6	Ripple V_{PP} Less than 30mV
Vbat(V)	1.55	3.3	3.6	VBAT
Operating frequency band (MHz)	2402	/	2480	/
Emission current (mA)	/	TBD	/	@1Mbps,10dbm,DC/DC
	/	TBD	/	@1Mbps,0dbm,DC/DC
Receiving current (mA)	/	TBD	/	@1Mbps,DC/DC
		TBD		@2Mbps,DC/DC
Sleep current (μ A)	/	2.6	/	StandbyMode
operating mode	1Mbps\2Mbps			/
communications protocol	BLE 5.4			/

Number of channels	40			/
Modulation Type	GFSK			/
Transmit power (dbm)	-20	/	10	/
Receiving sensitivity (dbm)	/	-97	/	@1Mbps,PER=30.8%

5 Application Notes

5.1 Baseboard Layout Considerations

If the customer needs to use an external antenna, a matching circuit needs to be reserved on the customer's motherboard. The following diagram shows the circuit from the module ANT pin to the external antenna. The thick red wire should ensure an impedance control of 50 Ω. The wiring should be as short as possible, without perforations or sharp corners. Make more GND vias around the RF wiring. C3 defaults to using a 220pF capacitor or 0R resistor, while C1 and C2 make matching reservations and adjustments based on the actual antenna and substrate

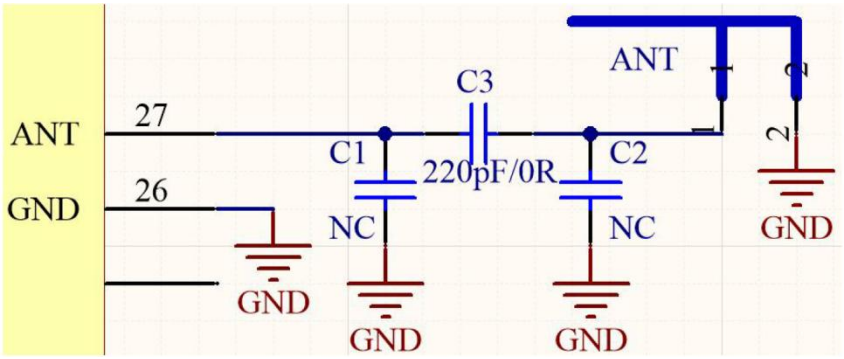


图 5.1 Schematic diagram of impedance matching circuit for external antenna

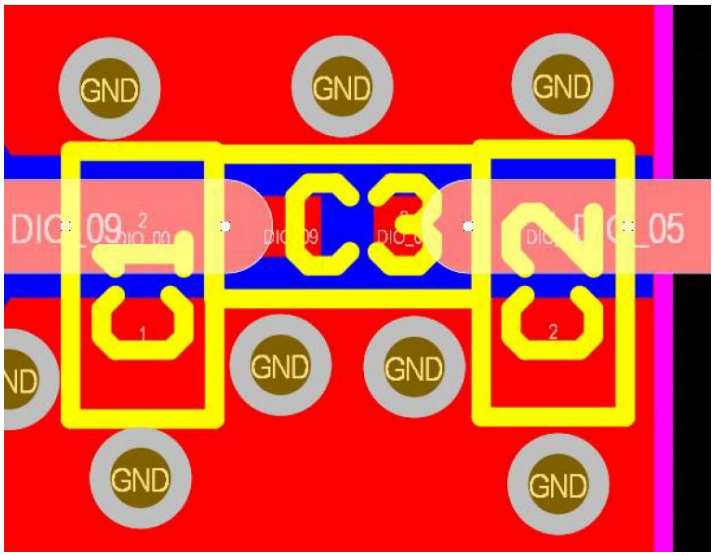


图 5.2 External antenna impedance matching circuit PCB schematic diagram and wiring instructions

The highlighted part of the wiring needs to control an impedance of 50 Ω, and the

relationship between board thickness, line width, and line spacing can be referred to：

FR4 Recommended values for dual panels

(H=Plate thickness，W=line width，D=Distance between wiring and copper plating)

H=1.0mm，W=0.8mm，D=0.2mm

H=1.0mm，W=1.0mm，D=0.254mm(recommendation)

H=1.2mm，W=1.0mm，D=0.2mm(recommendation)

H=1.6mm，W=1.0mm，D=0.2mm(推荐 recommendation)

(You can consult Lierda Technology for more design support。)

5.2 Bottom plate layout precautions

The WB55 module BOTTOM layer does not have high-speed or sensitive signal wiring, but it is still recommended to design wiring for the TOP layer of the bottom board to avoid the module to avoid unexpected influencing factors.

There are no excessive requirements for hollow treatment in the design of the bottom plate. In addition to the general requirement of avoiding interference sources mentioned earlier, the bottom plate can almost be made of whole board copper.

5.3 Matters needing attention

(1) Power supply

It is recommended to use a DC regulated power supply to power the module, the power supply ripple is as small as possible, usually requires a ripple of less than 30mV, the ripple is too large will lead to poor sensitivity and other connection anomalies. At the same time, the Bluetooth transmitting signal will be coupled into the interference signal, resulting in RF indicators beyond the Bluetooth specification, which will cause serious failure to connect and communicate. Try to use LDO to provide power to the module, and at the same time, LDO should be far away from DC-DC power supply and inductance to prevent DC-DC radiation from polluting the power supply of LDO. The module needs to be grounded reliably, and please pay attention to the correct connection of the positive and

negative poles of the power supply, such as reverse connection may lead to permanent damage to the module.

A 10uF and 0.1uF decoupling capacitor is recommended for the SB16 module power pin (VBAT). The capacitor should be as close as possible to the VDD power supply pin. The power supply voltage range is 1.8~4.3V, and when using 3.3V power supply, we need to ensure that the power supply voltage is not lower than 1.8V. The VDD pin needs to meet the power supply capacity of 150mA peak current, and the power supply ripple is recommended to be less than 30mV, so as to avoid excessive ripple caused by the degradation of RF performance. The recommended circuits for power supply are as follows:

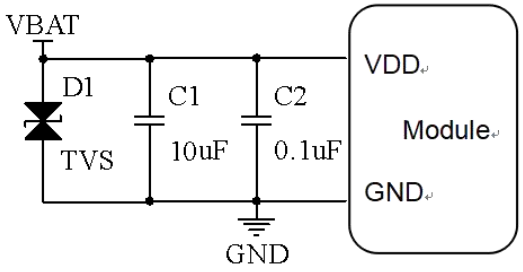


图 5.3 电源推荐设计

NOTE

D1 TVS is used for electrostatic protection, and users need to pay attention to the electrostatic requirements of the product during design, as shown in Table 4-1. There is TVS protection at the VBAT and RF ends inside the module. If there are higher protection requirements, it is recommended to place TVS tubes for electrostatic protection.

(2) MAC Address Description

For the pure hardware version of the module, a 6-byte MAC address was written at FLASH address 0X7E000. If using this MAC, please do not erase this area. For versions with software, please refer to the software manual for details.

6 Mechanical dimensions

PIC 6.1 Outline dimension diagram of the module

7 Production and Packaging Information

7.1 Production Welding

7.1.1 Production Guidelines

It is recommended that the stamp port encapsulated module be mounted using SMT machine and the mounting should be completed within 24 hours after unpacking, otherwise it should be re-vacuum-packed to avoid moisture leading to poor mounting.

If the package contains a humidity indication card, it is recommended to judge whether the module needs to be baked according to the humidity card indication, and the conditions during baking are as follows:

Baking temperature: 125℃±5℃;

The alarm temperature is set to 130°C;

After cooling <36℃ under natural conditions, it is ready for SMT placement;

If the unpacking time is more than 3 months, you need to pay special attention to whether the product is affected by moisture, because the PCB immersed gold process, more than 3 months may lead to oxidation of the pads, the patch may lead to false soldering, leakage of soldering and other problems.

In order to ensure that the reflow soldering pass rate, the first patch is recommended to take 10% of the products for visual inspection, AOI testing to ensure that the furnace temperature control, device adsorption method, placement of the rationality of the way;

Operators at each station must wear electrostatic gloves during the entire production process.

7.1.2 Module location requirements at the base plate

It is recommended that the base plate module location of the green oil thickness of less than 0.02mm, to avoid excessive thickness, padding module can not effectively contact with the solder paste affects the welding quality. Also need to consider the interface board

module location within 2mm around the layout of other devices, in order to protect the maintenance of the module.

7.1.3 Stencil opening design

The thickness of the stencil on the base plate is selected in principle according to the type of packaging of the device on the board to be selected, need to focus on the following requirements:

Module pad locations can be locally thickened to 0.15~0.20mm to avoid void soldering.

7.1.4 Production Precautions

- During the production process, each operator must wear electrostatic gloves;
- Baking should not exceed the specified baking time;
- It is strictly prohibited to add explosive, flammable and corrosive substances during baking;
- During baking, modules should be placed in high temperature trays to maintain air circulation between modules;
- The door of the baking box needs to be closed during baking to ensure that the baking box is closed and to prevent the temperature from leaking out;
- Try not to open the door when the oven is running, if you have to open it, try to shorten the time you can open the door;
- After baking, wait until the module cools down naturally to below 36℃ before taking it out with electrostatic gloves to avoid burns;
- When operating, do not allow the bottom surface of the module to get wet or dirty;

7.1.5 Reflow soldering work instructions

Note: This work instruction is suitable for lead-free work only and is for reference only.

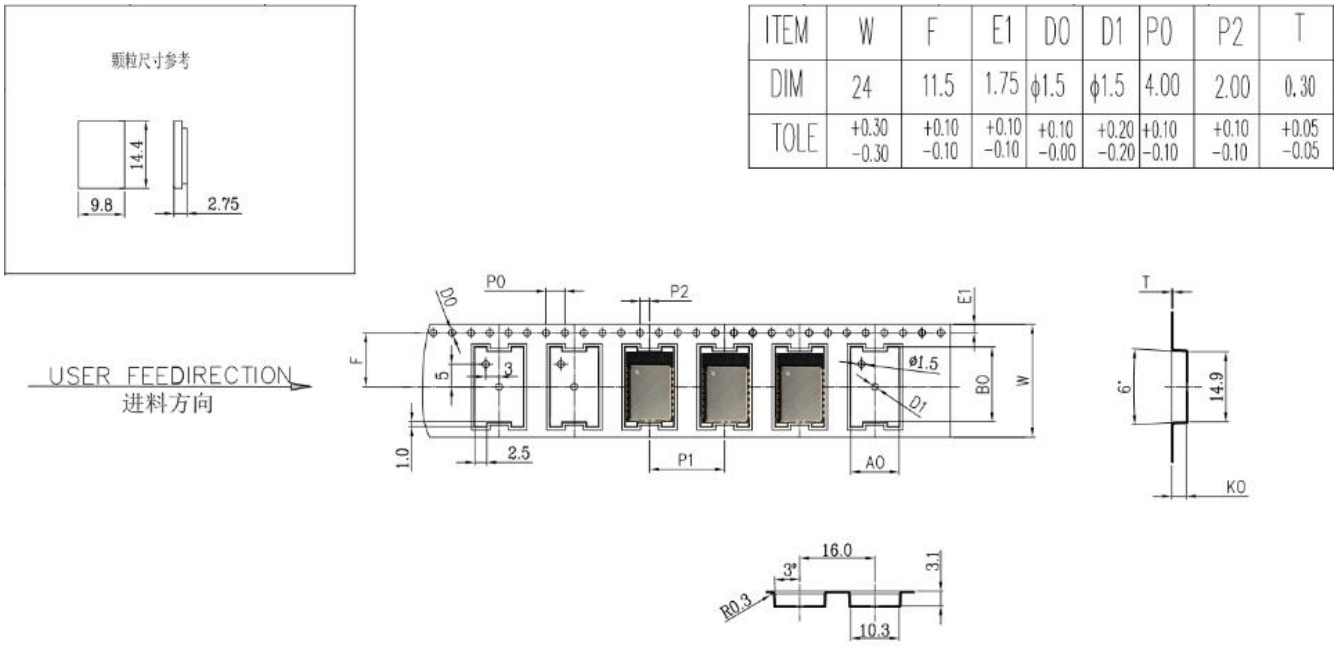
Figure 7-1 Reflow Soldering Operating Instructions

7.2 Packaging specification

7.2.1 Packaging

model number	Packaging	Full Carton(PCS)	Minimum Packing Quantity (PCS)	Number of reels per case
L-BTMSB16-G0BP4	reel	6500	1300	5

7.2.2 Belt size and product orientation



ITEM	W	F	E1	D0	D1	P0	P2	T
DIM	24	11.5	1.75	ϕ1.5	ϕ1.5	4.00	2.00	0.30
TOLE	+0.30 −0.30	+0.10 −0.10	+0.10 −0.10	+0.10 −0.00	+0.20 −0.20	+0.10 −0.10	+0.10 −0.10	+0.05 −0.05

Figure 7-2 Belt Size and Product Orientation

Federal Communication Commission (FCC) Radiation Exposure Statement

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction Federal Communication Commission (FCC) Radiation.

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.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications or changes to this equipment. Such modifications or changes could void the user's authority to operate the equipment.

NOTE: 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 or more 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.

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.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) NOTES

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: WAF-03440050. Additionally, the following statement should be included on the label and in

the final product's user manual: "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 interferences, and

(2) this device must accept any interference received, including interference that may cause undesired operation."

The module is allowed to be installed in mobile and portable applications A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end‐use operational conditions, including simultaneous transmission operations. When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application. When having a module grantee file a permissive change is not practical or feasible, the following

guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCCapplication filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is full modular approval, it is limited to OEM installation ONLY. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module. Additional measurements (15B) and/or equipment authorizations(e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable.(OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user.

IC Statement:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device .

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) l'appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Radiation Exposure Statement:

The product comply with the Canada portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

Déclaration d'exposition aux radiations:

Le produit est conforme aux limites d'exposition pour les appareils portables RF pour les Etats-Unis et le Canada établies pour un environnement non contrôlé.

Le produit est sûr pour un fonctionnement tel que décrit dans ce manuel. La réduction aux expositions RF peut être augmentée si l'appareil peut être conservé aussi loin que possible du corps de l'utilisateur ou que le dispositif est réglé sur la puissance de sortie la plus faible si une telle fonction est disponible.