RAK3112/RAK3312 WisDuo Module Datasheet

Overview

Description

The RAK3112 is a low-power, long-range LoRaWAN module based on the Espressif ESP32-S3 MCU with an integrated Semtech SX1262 LoRa transceiver. Supporting LoRa, BLE, and Wi-Fi, this module is ideal for various IoT applications such as home automation, sensor networks, building automation, and other IoT network applications.

NOTE

There are two variants available for the RAK3112 Module:

1. With MHF4 IPEX connector to connect external antennas.
2. No IPEX connector but with RF pinout to connect custom antenna.

Features

- Based on Espressif ESP32-S3
  - Xtensa® 32-bit LX7 dual-core microprocessor
  - 16 MB Flash
  - 512 kB SRAM
  - 512 kB RAM
  - 8 MB PSRAM
  - 16 kB RTC SRAM
- LoRa transceiver Semtech SX1262
  - LoRa and LoRaWAN support
  - Frequency support from 863 MHz to 928 MHz
- **LoRaWAN 1.0.2** specification compliant (LoRaWAN **BasicModem** support in preparation)
- **Supported bands**: IN865, EU868, AU915, US915, KR920, RU864, and AS923-1/2/3/4
- LoRaWAN Activation by OTAA/ABP
- LoRa Point-to-Point (P2P) communication
- BLE 5.0 support
- Wi-Fi support
- Custom firmware using Arduino
- I/O ports: UART/I2C/SPI/ADC/GPIO
- Long-range: greater than 10 km with optimized antenna
- **Supply Voltage**: 3.0 V ~ 3.6 V
- **Temperature range**: -40° C ~ 85° C

Specifications

Overview

Hardware

The hardware specification is categorized into three parts: RF, electrical, and mechanical parameters. These include tabular data of the functionalities and standard values for the RAK3112 WisDuo LPWAN Module.

Interfaces

Interfaces
USB (Default for AT command and FW update)
2 x I2C
1 x UART
1 x SPI

Pin Definition

INFO

- GPIO33 to GPIO37 are on the stamp modules pins, but with the 16 MB Flash chip, these GPIO's are not available.
- GPIO4 is used internally and not available.

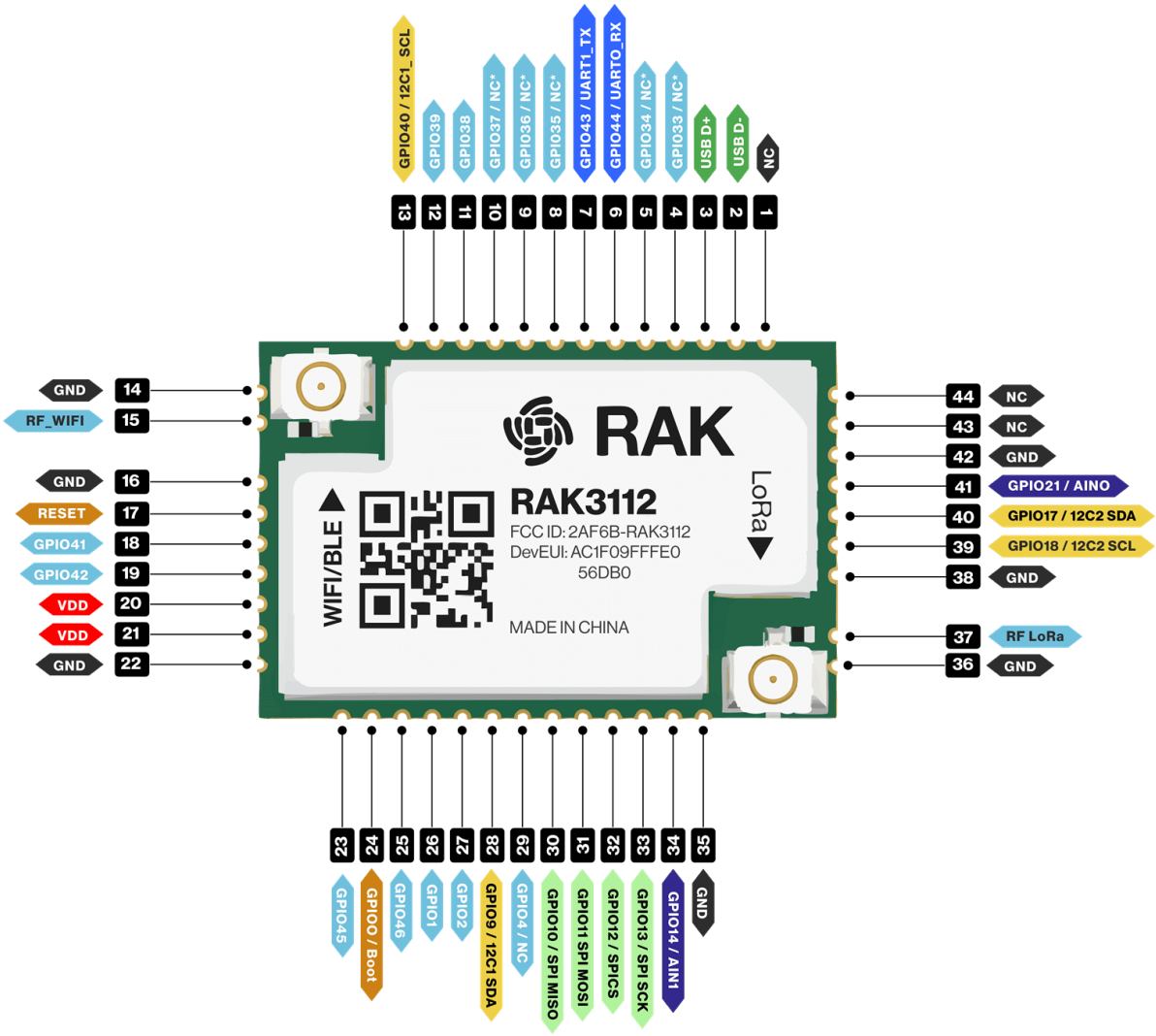

Figure 2: RAK3112 module pinout diagram

Pin No.	Name	Type	Description
1	NC	--	Not connected
2	USB_D-	USB	USB -
3	USB_D+	USB	USB +
4	GPIO33 / NC*	--	GPIO (not available with 16MB Flash)
5	GPIO34 / NC*	--	GPIO (not available with 16MB Flash)
6	GPIO44 / UART0_RX	I/O UART	GPIO / UART RX
7	GPIO43 / UART1_TX	I/O UART	GPIO / UART TX
8	GPIO35 / NC*	--	GPIO (not available with 16MB Flash)
9	GPIO36 / NC*	--	GPIO (not available with 16MB Flash)
10	GPIO37 / NC*	--	GPIO (not available with 16MB Flash)

Pin No.	Name	Type	Description
11	GPIO38	I/O	GPIO
12	GPIO39	I/O	GPIO
13	GPIO40 / I2C1_SCL	I/O I2C	GPIO / I2C SCL
14	GND	POWER	Ground connections
15	RF_WiFi	RF	Wi-Fi RF Port (only available on **RAK3112 NO-IPEX connector variant**)
16	GND	POWER	Ground connections
17	RESET	Reset	ESP32S3 Reset
18	GPIO41	I/O	GPIO
19	GPIO42	I/O	GPIO
20	VDD	POWER	VDD - Voltage Supply
21	VDD	POWER	VDD - Voltage Supply
22	GND	POWER	Ground connections
23	GPIO45	I/O	GPIO
24	GPIO0 / Boot	I/O Boot	GPIO Bootloader force
25	GPIO46	I/O	GPIO
26	GPIO1	I/O	GPIO
27	GPIO2	I/O	GPIO
28	GPIO9 / I2C1_SDA	I/O I2C	GPIO / I2C SDA
29	GPIO4 / NC	I/O	GPIO (not available)
30	GPIO10 / SPI_MISO	I/O SPI	GPIO / SPI MISO
31	GPIO11 / SPI_MOSI	I/O SPI	GPIO / SPI MOSI
32	GPIO12 / SPI_CS	I/O SPI	GPIO / SPI CS
33	GPIO13 / SPI_SCK	I/O SPI	GPIO / SPI SCK

Pin No.	Name	Type	Description
34	GPIO14 / AIN1	I/O Analog In	GPIO / Analog In
35	GND	POWER	Ground connections
36	GND	POWER	Ground connections
37	RF_LoRa	RF	LoRa RF Port (only available on **RAK3112 NO-IPEX connector variant**)
38	GND	POWER	Ground connections
39	GPIO18 / I2C2_SCL	I/O I2C	GPIO / I2C SCL
40	GPIO17 / I2C2_SDA	I/O I2C	GPIO / I2C SDA
41	GPIO21 / AIN0	I/O Analog In	GPIO / Analog In
42	GND	I/O	Ground connections
43	NC	--	Not connected
44	NC	--	Not connected

Warning
When using `RF_LoRa`, `RF_WIFI` pins for antenna and not the IPEX connector variant, there are design considerations to make sure optimum RF performance.

- RF traces must be away from interference (switching nodes of DC-DC supplies, high-current/voltage pulses from controllers of inductive loads like motors, signal generators, etc.).
- RF traces must have 50 Ω impedance. It is advisable to use an impedance simulation software tool to achieve this requirement.
- If using an external antenna connector, place it close to the LoRa RF and BLE RF pins.
- Ground plane optimization is critical for certain antenna types like monopoles.
- The GND trace used for the RF return path must be directly connected to the GND plane and not treated as a thermal relief.
- It is recommended that RF traces be routed in curves, not sharp 90 degree angles.

In addition, with our commitment to making IoT easy, we offer dedicated service for Antenna RF Design which includes PCB design, tuning, matching and RF testing.

RF Characteristics

LoRa Transceiver

The RAK3112 module supports many LoRaWAN bands as shown in the table below.

Module	Region	Frequency
RAK3112 (H)	Europe	EU868
	North America	US915
	Australia	AU915
	Korea	KR920
	Asia	AS923-1/2/3/4
	India	IN865
	Russia	RU864

TX Power

Transmitter output power, programmable up to +22 dBm.

RX Sensitivity

- -124 dBm for LoRa（BW = 125 kHz, SF = 7）
- -121 dBm for LoRa (BW = 250 kHz, SF = 7)
- -137 dBm for LoRa (BW = 125 kHz, SF = 12)
- -134 dBm for LoRa（BW = 250 kHz, SF = 12）

Wi-Fi

Operating Frequencies

2400-2483.5 MHz

TX Power

Rate	Type (dBm)
802.11b, 1 Mbps	21.0
802.11b, 11 Mbps	21.0
802.11g, 6 Mbps	20.5
802.11g, 54 Mbps	19.0
802.11n, HT20, MCS0	19.5
802.11n, HT20, MCS7	19.0
802.11n, HT40, MCS0	19.5
802.11n, HT40, MCS7	18.0

RX Sensitivity

Rate	Type (dBm)
802.11b, 1 Mbps	–98.4
802.11b, 11 Mbps	-88.6
802.11g, 6 Mbps	–93.2
802.11g, 54 Mbps	–76.5
802.11n, HT20, MCS0	–92.6
802.11n, HT20, MCS7	–74.2
802.11n, HT40, MCS0	–90.0
802.11n, HT40, MCS7	–71.4

Bluetooth

Operating Frequencies

2402 ~ 2480 MHz

TX Power

Rate	Type (dBm)
BLE @1 Mbps	Programmable from -24 dBm to 20 dBm
BLE @2 Mbps	Programmable from -24 dBm to 20 dBm
BLE @125 Kbps	Programmable from -24 dBm to 20 dBm
BLE @500 Kbps	Programmable from -24 dBm to 20 dBm

RX Sensitivity

Rate	Type (dBm)
BLE @1 Mbps	–97.5
BLE @2 Mbps	–93.5
BLE @125 Kbps	–104.5
BLE @500 Kbps	–101

Electrical Characteristics

Operating Voltage

Feature	Minimum	Typical	Maximum	Unit
VDD	3.0	3.3	3.6	Volts (V)

Operating Current

The current consumption measurements are taken with a 3.3 V supply at 25° C of ambient temperature.

Work Mode	Condition	Peak current	Unit
Wi-Fi TX	802.11b, 1 Mbps, @21 dBm	340	mA
	802.11g, 54 Mbps, @19 dBm	291	mA
	802.11n, HT20, MCS7, @18.5 dBm	283	mA
	802.11n, HT40, MCS7, @18 dBm	286	mA
Wi-Fi RX	802.11b/g/n, HT20	88	mA
	802.11n, HT40	91	mA
Lora TX	+22 dBm@ 868 to 915Mhz	140	mA
	+20 dBm@ 868 to 915 Mhz	127.5	mA
	+17 dBm@ 868 to 915 Mhz	118	mA
	+14 dBm@ 868 to 915 Mhz	112	mA
Lora RX	LoRa 125 kHz	25.46	mA

Sleep Current

The current consumption measurements are taken with a 3.3 V supply at 25° C of ambient temperature.

Feature	Condition	Maximum	Unit
Light-sleep	VDD_SPI and Wi-Fi are powered down, and all GPIOs are high-impedance.	241	uA
Deep-sleep 1	RTC memory and RTC peripherals are powered up.	9	uA
Deep-sleep 2	RTC memory is powered up. RTC peripherals are powered down.	8	uA
Power off	CHIP_PU is set to low level. The chip is shut down.	2	uA

Mechanical Characteristics

Module Dimensions

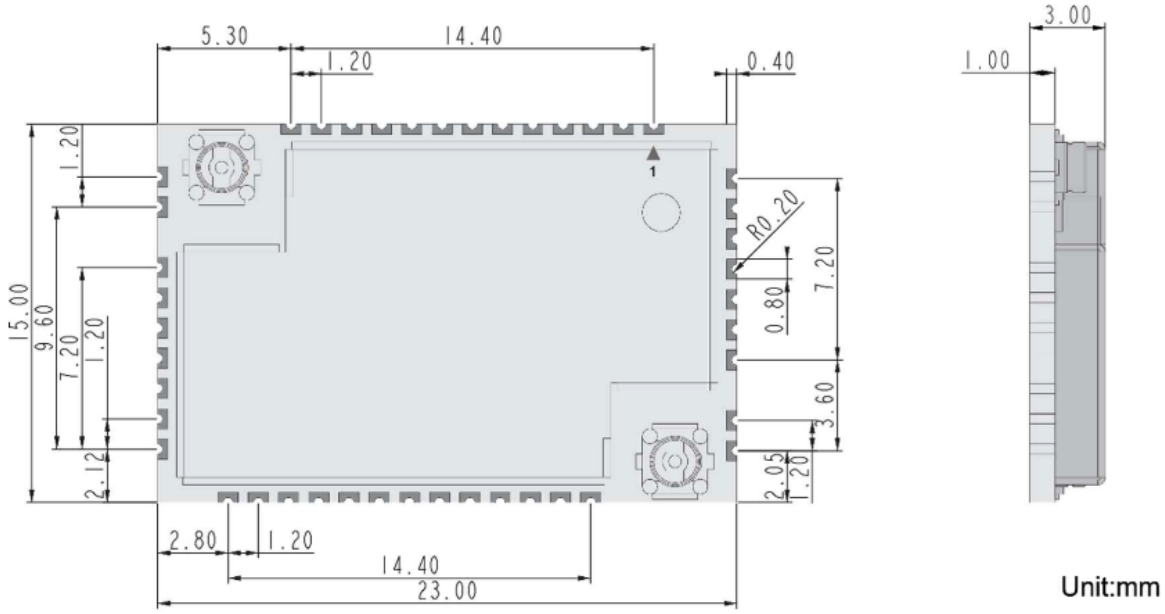

Figure 3: RAK3112 board dimension

Layout Recommendation

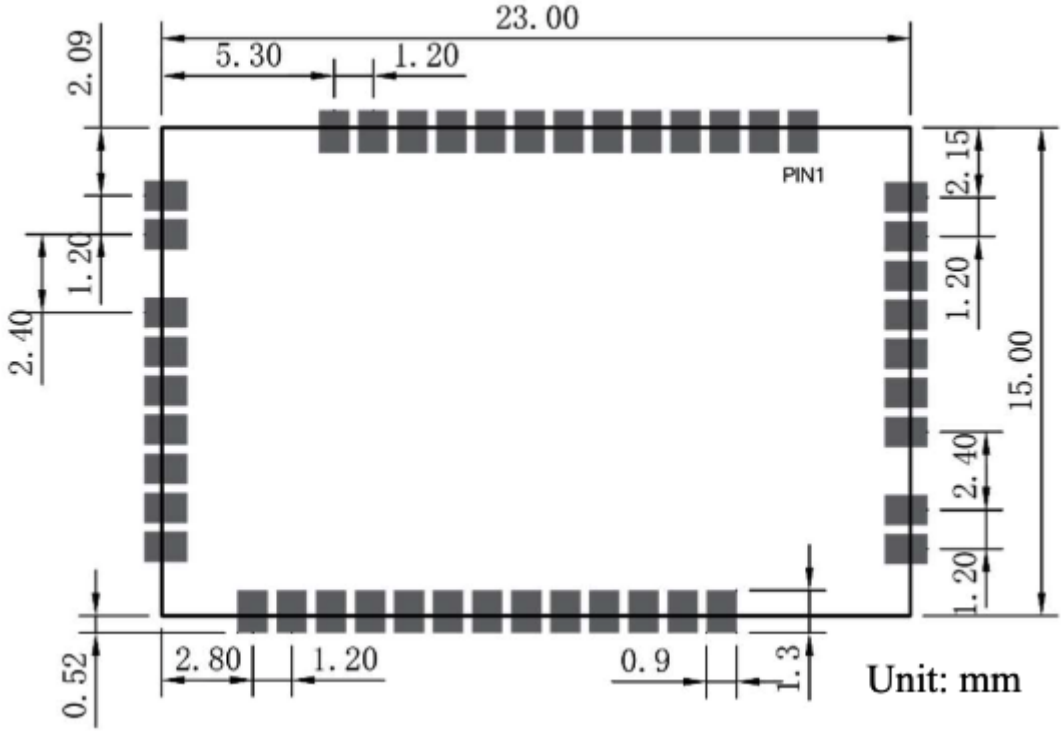

Figure 4: RAK3112 PCB footprint and recommendations

Environmental Characteristics

Operating Temperature

Feature	Minimum	Typical	Maximum	Unit
Operating Temperature	-40	25	65	° C

Storage Temperature

Feature	Minimum	Typical	Maximum	Unit
Storage Temperature	-40	-	65	° C

Recommended Reflow Profile

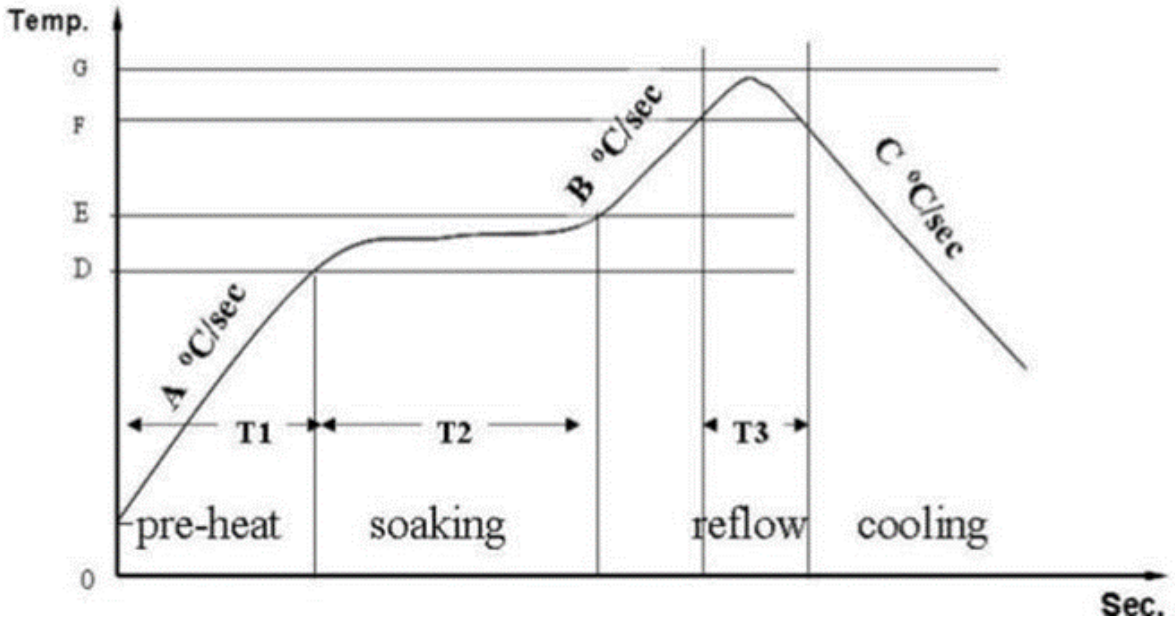

Figure 5:Reflow Profile for RAK3112

Standard conditions for reflow soldering:

- Pre-heating Ramp (A) (Initial temperature: 150° C): **1 ~ 2.5° C/sec**
- Soaking Time (T2) (150 ~ 180° C): **60 ~ 100 sec**
- Peak Temperature (G): **230 ~ 250° C**
- Reflow Time (T3) (> 220° C): **30 ~ 60 sec**
- Ramp-up Rate (B): **0 ~ 2.5° C/sec**
- Ramp-down Rate (C): **1 ~ 3° C/sec**

Schematic Diagram (Minimal)

Hereby, Shenzhen RAKwireless Technology Co.,Ltd. declares that the radio equipment type RAK3112/RAK3312 is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address: XXXX

Federal Communication Commission Interference Statement

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.

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.

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 Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and

2. The transmitter module may not be co-located with any other transmitter or antenna,

IMPORTANT NOTE:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID 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 Labelling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users.

The final end product must be labelled in a visible area with the following:

"Contains FCC ID: 2AF6B-3112".

Manual Information to the End User

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.

Canada Statement

This device complies with Industry Canada licence-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.

The device meets the exemption from the routine evaluation limits of RSS 102 and compliance with RSS-102 RF exposure, users can obtain Canadian information on RF exposure and compliance.

Le dispositif rencontre l'exemption des limites courantes d'évaluation dans de RSS 102 et la conformité à l'exposition de RSS-102 rf, utilisateurs peut obtenir l'information canadienne sur l'exposition et la conformité de rf.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

Cet émetteur ne doit pas être Co-placé ou ne fonctionnant en même temps qu'aucune autre antenne ou émetteur. Cet équipement devrait être installé et actionné avec une distance minimum de 20 centimètres entre le radiateur et votre corps.

The final end product must be labeled in a visible area with the following:

The Industry Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the Industry Canada certification number of the module, preceded by the words "Contains transmitter module" , or the word "Contains" , or similar wording expressing

the same meaning, as follows:

Contains transmitter module IC: 25908-3112

where 25908-3112 is the module’ s certification number.

This device has been designed to operate with the antenna listed below, and having a peak gain of 3.12dBi @ 2.4GHz, 0.8dbi @lora PCB antenna, 2.37dBi @lora dipole antenna. Antennas not of the same type and having a higher gain specified above are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Wifi antenna：

Model：S2B1BH2A1B01000

Tpye：PCB Antenna / 3.12dBi

Vendor: Unictron Technologies Corporation

Address: 09, 6F, Building B, New Compark, Pingshan 1st Road, Nanshan, Shenzhen,

Lora PCB antenna：

Model：S 2B 1O D 3A1L02000

Type: PCB Antenna/ 0.8dbi

Vendor: Unictron Technologies Corporation

Address: 09, 6F, Building B, New Compark, Pingshan 1st Road, Nanshan, Shenzhen, Guangdong, China

LORA DIPOLE ANTENNA:

MODEL: 81800V294/ 81800V296

TYPE: DIPOLE ANTENNA/2.37dbi

Vendor:

Electric Connector Technology Address : Electric Connector Technology Park, No. 171 Changfeng Road, Yutang Street, Guangming District, Shenzhen City, Guangdong Province, China