

## General Description

BDE-RFM208P-S1 is a multi-band wireless module which supports Sub-1G and 2.4G band. It also supports multiprotocol, such as Thread, Zigbee, Bluetooth 5.0 Low Energy, IEEE 802.15.4g, IPv6-enabled smart objects (6LoWPAN), Wireless M-Bus, Wi-SUN, KNX RF, proprietary systems, SimpleLink TI 15.4-Stack (Sub-1 GHz), and Dynamic Multiprotocol Manager (DMM) driver.



BDE-RFM208P-S1 has an integrated power amplifier which enables 20dBm output power.

BDE-RFM208P-S1 highly integrates radio, stack, profile and applications in a SoC, without the need of using an external MCU. The module also offers flexible hardware interfaces for the sensor application.

It enables ultra-low power connectivity and data transfer for the applications that are sensitive to power consumption, size and cost.

## Key Features

- Multi-Band, supports 2.4G and Sub-1G band
- Powerful ARM Cortex-M4F processor
  - Clock speed: up to 48MHz
  - 352KB of In-System programmable flash
  - 80KB SRAM
  - 8KB of cache SRAM
  - 2-Pin cJTAG and JTAG debugging
  - Support Over-the-Air upgrade (OTA)
  - Ultra-Low power sensor controller with 4KB of SRAM
  - 26 GPIOs
  - 4 x 32-Bit or 8 x 16-Bit general purpose timer
  - 12-Bit ADC, 200 kSamples/s, 8 channels
  - 2 x comparator with internal reference DAC
  - Programmable current source
  - 2 x UART
  - 2 x SSI (SPI, MICROWIRE, TI)
  - IIC, IIS
  - Real-Time-Clock (RTC)
  - AES 128- and 256-bit crypto accelerator
  - ECC and RSA public key hardware accelerator
  - SHA2 accelerator (Full suite up to SHA-512)
  - True Random Number Generator (TRNG)
  - Capacitive sensing, up to 8 channels
  - Integrated temperature and battery monitor

**Multi-Band Wireless Module with PA**

- On-Chip buck DC/DC converter
- RF performance
  - TX power: Output power up to +20 dBm with temperature compensation
  - RX sensitivity: -121 dBm for SimpleLink long-range mode, -110 dBm at 50 kbps, -105 dBm for Bluetooth 125 kbps (LE Coded PHY)
- Communication range: about 250 meters (LOS) – Long Range Mode (2.4G), upto 2000 meters (LOS) – Long Range Mode (Sub-1G) (TBD)
- Antenna: UFL connector for Sub-1G, UFL or PCB antenna for 2.4G
- Size: 29.86 mm x 19.97 mm x 2.15 mm (With Shielding)
- Ultra low power consumption:
  - Shutdown: 150nA (Wake up on external events)
  - Standby: 0.85uA (RTC running and RAM/CPU retention)
  - RX current: 5.8mA (3.6 V, 868 MHz), 6.9 mA (3.0 V, 2.4 GHz)
  - TX current @ 20 dBm: 63 mA (3.3 V, 915 MHz), 85 mA (3.0 V, 2.4 GHz)
- Certifications
  - FCC ID: 2ABRU-RFM208PS1
  - IC: 25657-RFM208PS1
  - CE-RED

## Applications

- 433, 470 to 510, 868, 902 to 928, and 2400 to 2480 MHz ISM and SRD systems with down to 4 kHz of receive bandwidth
- Building automation
- Grid infrastructure
- Industrial transport – asset tracking
- Factory automation and control
- Medical
- Electronic point of sale (EPOS) – Electronic Shelf Label (ESL)

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## 1. References

- [1] CC1352P resources: <https://www.ti.com/product/CC1352P>

## 2. Block Diagram

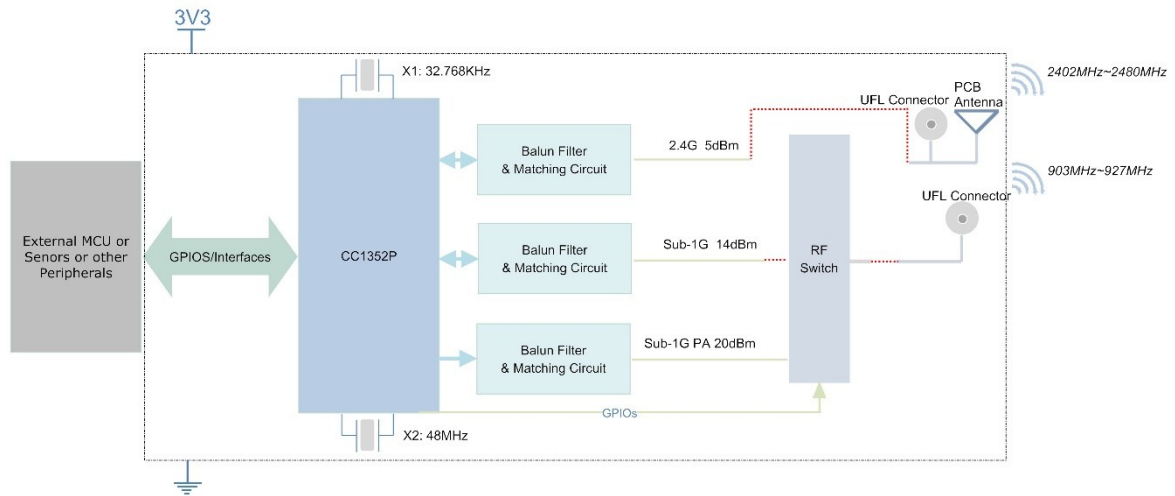


Figure 2-1. BDE-RFM208P-S1 Module Block Diagram

### 3. Pinout

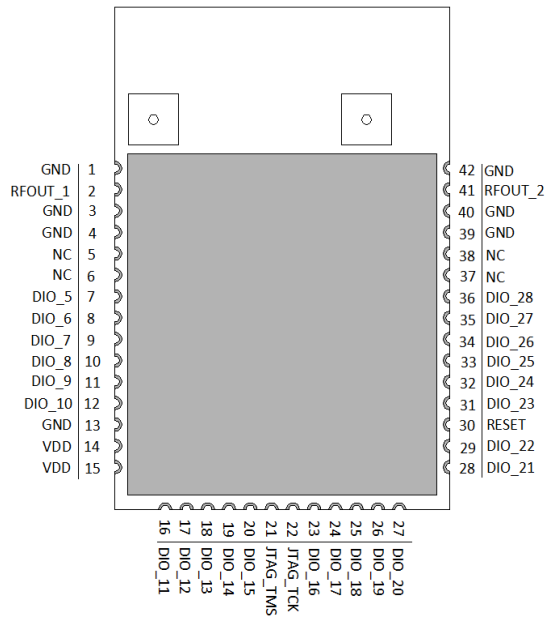


Figure 3-1. The pinout of BDE-RFM208P (TOP VIEW)

#### 3.1 Pin Attributes

Table 3-1. Pin Description

Pin Number	Pin Name	Definitions
1	GND	Power Ground
2	RFOUT_1	Sub-1G RF Output Port
3	GND	Power Ground
4	GND	Power Ground
5	NC	NC
6	NC	NC
7	DIO_5	GPIO, High-drive Capability
8	DIO_6	GPIO, High-drive Capability
9	DIO_7	GPIO, High-drive Capability
10	DIO_8	GPIO
11	DIO_9	GPIO
12	DIO_10	GPIO
13	GND	Power Ground
14	VDD	Supply Power
15	VDD	Supply Power
16	DIO_11	GPIO
17	DIO_12	GPIO
18	DIO_13	GPIO
19	DIO_14	GPIO
20	DIO_15	GPIO
21	JTAG_TMSC	JTAG TMS, High-drive Capability

Pin Number	Pin Name	Definitions
22	JTAG_TCKC	JTAG TCKC
23	DIO_16	GPIO, JTAG_TDO, High-drive Capability
24	DIO_17	GPIO, JTAG_TDI, High-drive Capability
25	DIO_18	GPIO
26	DIO_19	GPIO
27	DIO_20	GPIO
28	DIO_21	GPIO
29	DIO_22	GPIO
30	RESET	Reset, Active Low
31	DIO_23	GPIO, Analog Capability
32	DIO_24	GPIO, Analog Capability
33	DIO_25	GPIO, Analog Capability
34	DIO_26	GPIO, Analog Capability
35	DIO_27	GPIO, Analog Capability
36	DIO_28	GPIO, Analog Capability
37	NC	NC
38	NC	NC
39	GND	Power Ground
40	GND	Power Ground
41	RFOUT_2	2.4G RF Output Port
42	GND	Power Ground



## 4. Electrical Characteristics

### 4.1 Absolute maximum rating

Rating	Min	Typ	Max	Unit	Notes
Storage Temperature	-40	-	125	°C	
VDD	-0.3	-	4.1	V	
Other Digital Terminals	-0.3	-	$V_{DD5}+0.3 \leq 4.1$	V	
Voltage on ADC input	-0.3	-	V <sub>DD5</sub>	V	Voltage scaling enabled
	-0.3	-	1.49	V	Voltage scaling disabled, internal reference
	-0.3	-	$V_{DD5}/2.9$	V	Voltage scaling disabled, V <sub>DD5</sub> as reference

### 4.2 Recommended operating conditions

Rating	Min	Typ	Max	Unit
Operating Temperature	-40	-	85	°C
VDD	2.1	3.3	3.8	V

## 5. Module Location

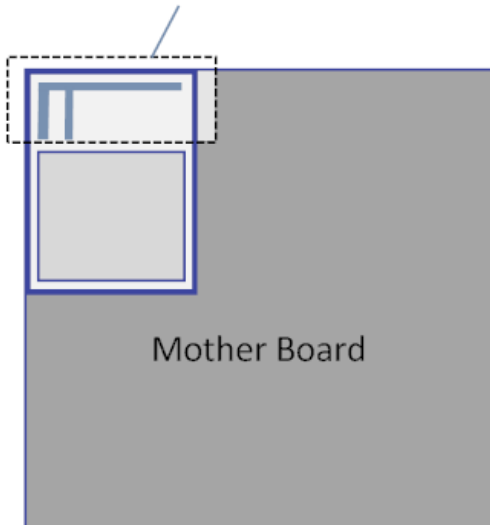
### Module Location

In order to get the best performance when integrating the module to your product, it is advised to use the recommended module location to the mother board.

#### ■ Location in X-Y plane

Antenna area.

This area of the mother board should be cut off or copper free.



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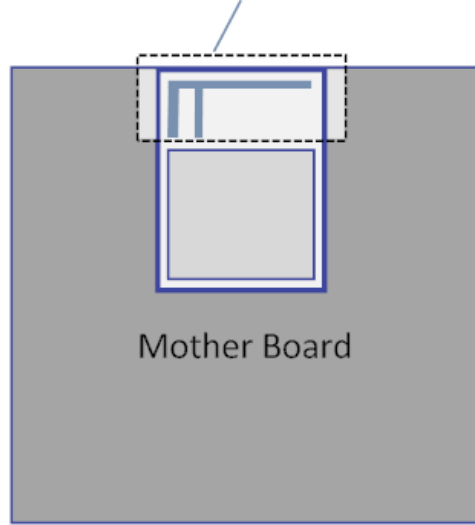


Figure 5-1. Recommended location in X-Y plane

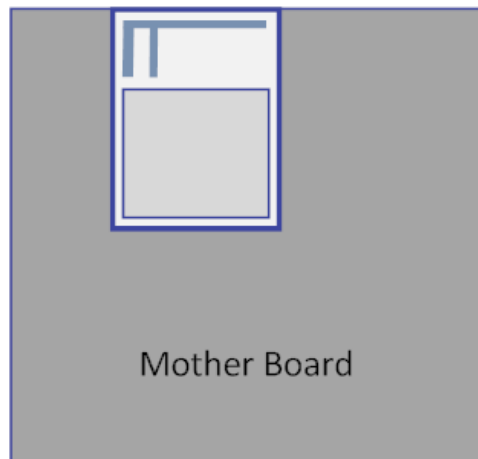
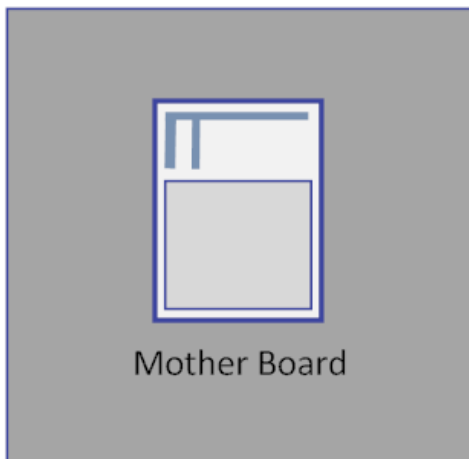


Figure 5-2. Not recommended location in X-Y plane

■ Location in Z plane

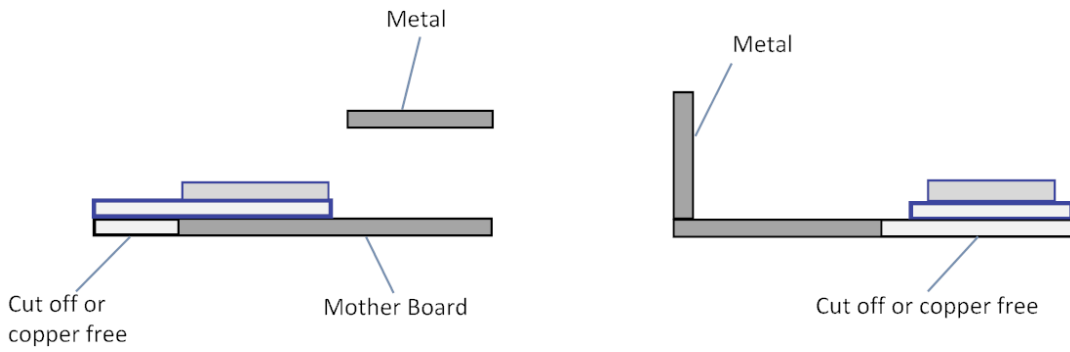


Figure 5-3. Recommended location in Z plane

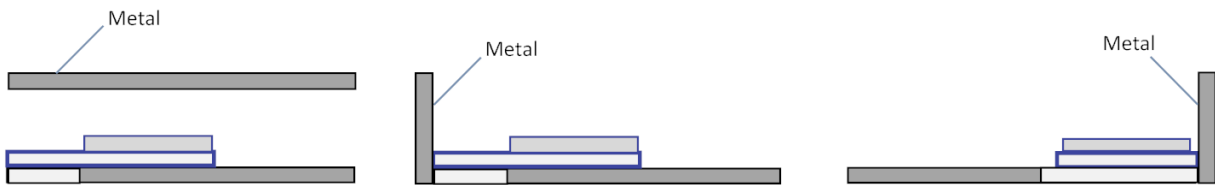


Figure 5-4. Not recommended location in Z plane

### 6. Dimensions

Figure 6-1 shows the overall dimensions of BDE-RFM208P-S1. The module measures 29.86mm long by 19.97mm wide by 2.15mm high with the shield.

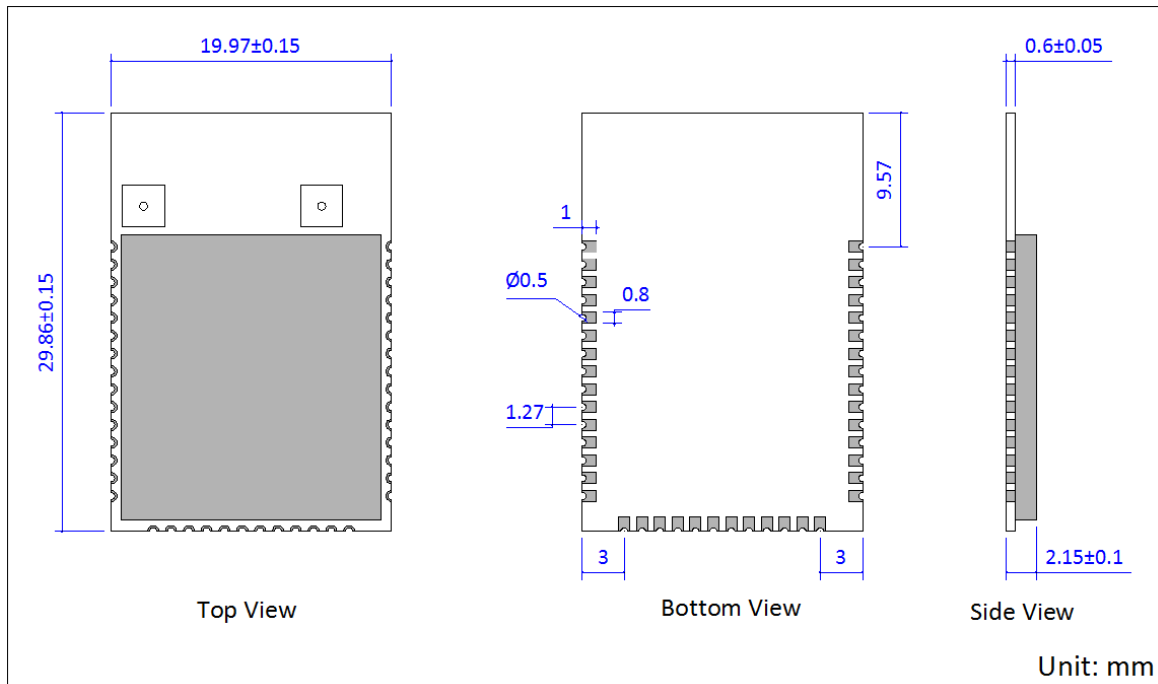


Figure 6-1: Overall Dimensions of BDE-RFM208P-S1

### 7. Typical Solder Reflow Profile

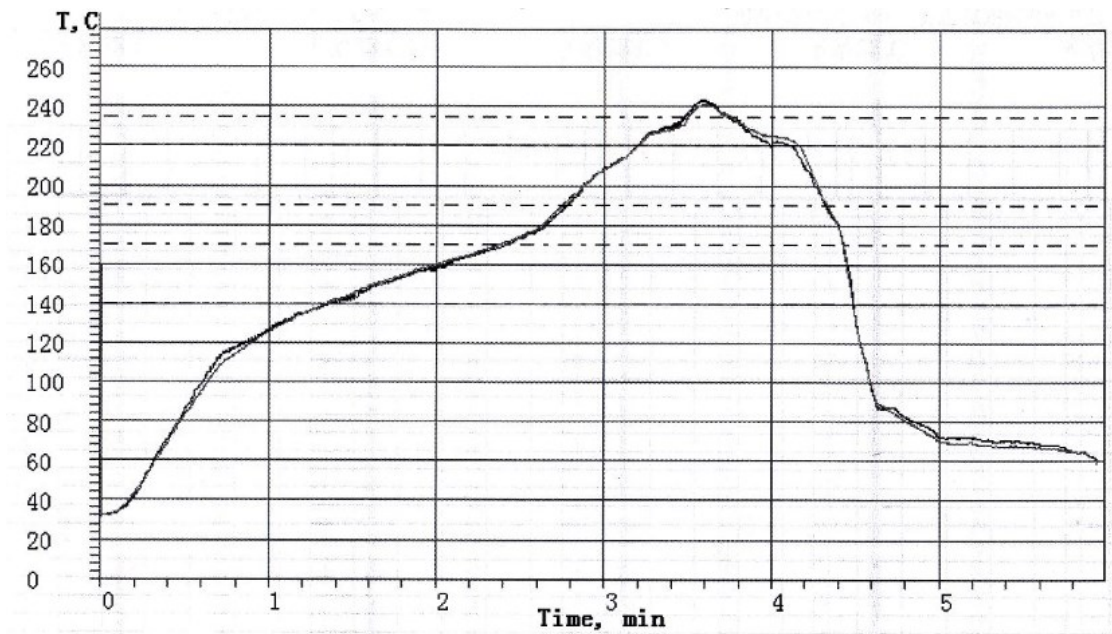


Figure 7-1. Typical Solder Reflow Profile

### 8. Package Information



Figure 8-1. Package

## 9. Ordering Information

Part Number	Size (mm)	Shipping Form	MOQ
BDE-RFM208P-S1	29.86 x 19.97 x 2.15	Tape & Reel	1000

## 10. Revision History

Revision	Date	Description
V1.0	15-Feb-2020	Initial Released
V2.0	14-Apr-2021	Changed template
V2.1	23-Apr-2022	Correct some mistakes

## 11. FCC Warning

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

### 1. List of applicable FCC rules

FCC Part 15.247

### 2. Specific operational use conditions

This transmitter/module and its antenna(s) must not be co-located or operating in conjunction with any transmitter. This information also extends to the host manufacturer's instruction manual.

### 3. Limited module procedures

Not applicable

### 4. Trace antenna designs

It is "not applicable" as trace antenna which is not used on the module.

### 5. RF exposure considerations

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This compliance to FCC radiation exposure limits for an uncontrolled environment, and minimum of 20cm separation between antenna and body.

The host product manufacturer would provide the above information to end users in their end-product manuals.

### 6. Antennas

PCB Antenna; 2.9dBi; 2402-2480GHz; 2405-2480MHz

External Antenna; 3dBi; 903-927MHz

### 7. Label and compliance information

The end product must carry a physical label or shall use e-labeling followed KDB784748D01 and KDB 784748 stating "Contains Transmitter Module FCC ID: 2ABRU-RFM208PS1".

### 8. Information on test modes and additional testing requirements

For more information on testing, please contact the manufacturer.

### 9. Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for the specific rule parts (FCC Part 15.247) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed when contains digital circuitry.

## 12. FCC Statements

(OEM) Integrator has to assure compliance of the entire end-product incl. the integrated RF Module. For 15 B (§15.107 and if applicable §15.109) compliance, the host manufacturer is required to show compliance with 15 while the module is installed and operating.

Furthermore the module should be transmitting and the evaluation should confirm that the module's intentional emissions (15C) are compliant (fundamental / out-of-band). Finally the integrator has to apply the appropriate equipment authorization (e.g. Verification) for the new host device per definition in §15.101.

Integrator is reminded to assure that these installation instructions will not be made available to the end-user of the final host device.

The final host device, into which this RF Module is integrated" has to be labeled with an auxiliary label stating the FCC ID of the RF Module, such as "Contains FCC ID: **2ABRU-RFM208PS1**

"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 to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."

The Integrator will be responsible to satisfy SAR/ RF Exposure requirements, when the module integrated into the host device.

### 13. Module statement

The single-modular transmitter is a self-contained, physically delineated, component for which compliance can be demonstrated independent of the host operating conditions, and which complies with all eight requirements of § 15.212(a)(1) as summarized below.

- 1) The radio elements have the radio frequency circuitry shielded.
- 2) The module has buffered modulation/data inputs to ensure that the device will comply with Part 15 requirements with any type of input signal.
- 3) The module contains power supply regulation on the module.
- 4) The module contains a permanently attached antenna.
- 5) The module demonstrates compliance in a stand-alone configuration.
- 6) The module is labeled with its permanently affixed FCC ID label.
- 7) The module complies with all specific rules applicable to the transmitter, including all the conditions provided in the integration instructions by the grantee.
- 8) The module complies with RF exposure requirements.

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

## 14. IC Statements

The final host device, into which this RF Module is integrated" has to be labeled with an auxiliary label stating the IC of the RF Module, such as" Contains transmitter module IC: **2ABRU-RFM208PS1**

Le périphérique hôte final, dans lequel ce module RF est intégré "doit être étiqueté avec une étiquette auxiliaire indiquant le CI du module RF, tel que" Contient le module émetteur IC: **25657-RFM208PS1**

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference.
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique 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;
- (2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RF Exposure Warning Statements:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment shall be installed and operated with minimum distance 20cm between the radiator & body.

Radio Frequency Exposure Statement for IC:

The device has been evaluated to meet general RF exposure requirements. The device can be used in mobile exposure conditions. The min separation distance is 20cm.

Déclaration d'exposition aux radiofréquences pour IC:

L'appareil a été évalué pour répondre aux exigences générales en matière d'exposition aux RF. L'appareil peut être utilisé dans des conditions d'exposition mobiles. La distance de séparation minimale est de 20 cm.

## Contacts

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