

General Description

BDE-BDM209 is a Bluetooth 5.1 BR/EDR & BLE Dual Mode module.

The module offers a unique combination of Bluetooth classic and Bluetooth Low Energy radio TI's CC2564C and an ARM 32-bit Cortex-M4F CPU MSP432, with integration of all external components including antenna at a very affordable cost.

The module provides the best-in-class RF performance with transmit power and receive sensitivity that provides twice the range and higher throughput than other Bluetooth-low-energy-only solutions. The power-management hardware and software algorithms provide significant power savings in all commonly used Bluetooth BR/EDR and low energy modes of operation.

The certified and royalty free Dual-mode Bluetooth 4.2 protocol stack software provides a complete Bluetooth BR/EDR, and Bluetooth Low Energy sample applications that reduce design effort and ensure a faster time to market.

Key Features

- Processing and memories
 - Arm® 32-bit Cortex®-M4F CPU with floating point unit and memory protection unit
 - Frequency up to 48 MHz
 - 256KB flash main memory (organized into two banks enabling simultaneous read or execute during erase)
 - 16KB of flash information memory
 - 64KB of SRAM (including 6KB of backup memory)
 - 32KB of ROM with MSP432™ peripheral driver libraries
- Bluetooth 5.1 Declaration ID D049226
- BR and EDR Features Include:
 - Up to Seven Active Devices
 - Scatternet: Up to Three Piconets Simultaneously, One as Master and Two as Slaves
 - Up to Two Synchronous Connection Oriented (SCO) Links on the Same Piconet
 - Support of Multiple Bluetooth Profiles with Enhanced QoS
- Bluetooth Low Energy Features Include:
 - Support of up to 10 Simultaneous Connections
 - Multiple Sniff Instances Tightly Coupled to Achieve Minimum Power Consumption
- Independent Buffering for Low Energy Allows Large Numbers of Multiple Connections Without Affecting BR or EDR Performance
- Built-In Coexistence and Prioritization Handling for BR, EDR, and Low Energy
- Best-in-Class Bluetooth (RF) Performance (TX Power, RX Sensitivity, Blocking)
 - Class 1.5 TX Power up to +10 dBm
 - -93 dBm Typical RX Sensitivity
 - Internal Temperature Detection and Compensation to Ensure Minimal Variation in RF Performance Over Temperature, No External Calibration Required
 - Improved Adaptive Frequency Hopping (AFH) Algorithm with Minimum Adaptation Time
 - Provides Longer Range, Including Twice the Range of Other Low-Energy-Only Solutions
- Advanced Power Management for Extended Battery Life and Ease of Design
 - Low Power Consumption for Active, Standby, and Scan Bluetooth Modes
 - Shutdown and Sleep Modes to Minimize Power Consumption
- MCU Ultra-low-power operating modes when Bluetooth is Shutdown
 - Active: 80 µA/MHz

- Low-frequency active: 83 μ A at 128 kHz
- LPM3 (with RTC): 660 nA
- LPM3.5 (with RTC): 630 nA
- LPM4: 500 nA
- LPM4.5: 25 nA
- Operating characteristics
 - Wide supply voltage range: 2.05V to 3.7V
 - Temperature range: -40° C to 85° C
- Flexible clocking features
 - Tunable internal DCO (up to 48 MHz)
 - 32.768-kHz low-frequency crystal support (LFXT)
 - High-frequency crystal support (HFXT) up to 48 MHz
 - Low-frequency internal reference oscillator (REFO)
 - Very low-power low-frequency internal oscillator (VLO)
 - Module oscillator (MODOSC)
 - System oscillator (SYSOSC)
- Code security features
 - JTAG and SWD lock
 - IP protection (up to four secure flash zones, each with configurable start address and size)
- Enhanced system features
 - Programmable supervision and monitoring of supply voltage
 - Multiple-class resets for better control of application and debug
 - RTC with calendar and alarm functions
- Timing and control
 - Up to four 16-bit timers, each with up to five capture, compare, PWM capability
 - Two 32-bit timers, each with interrupt generation capability
- Physical Interfaces:
 - UART with automatic baud-rate detection
 - I2C (with multiple-slave addressing)
 - Up to 10 GPIOs for users
 - All GPIOs with capacitive-touch capability
 - Ultra-low-leakage I/Os (± 20 nA maximum)
- Up to 8 I/Os with interrupt and wake-up capability
- Two I/Os with glitch filtering capability
- Antenna: Chip antenna or U.FL connector
- Encryption and data integrity accelerators
 - 128-, 192-, or 256-bit AES encryption and decryption accelerator
 - 32-bit hardware CRC engine
- Bluetooth 4.2 Dual-mode stack
 - dual-mode Bluetooth 4.2 certified and royalty free
 - Fully qualified Bluetooth stack (QDID 85355 and QDID 69886)
- Classic Bluetooth Profiles Available
 - A2DP1.2, AVDTP1.2, AVRCP1.3, HSP1.2, GAP, HID1.0, MAP1.0, PBAP1.0, RFCOMM, SDP, SPP.
- Bluetooth low energy Profiles Available
 - ANS1.0, BAS1.0, CSCS1.0, DIS1.0, FMP1.0, GAPS1.0, GATT1.0, HTS1.0, HRS1.0, HIDS1.0, IAS1.0, LLS1.0, PASS1.0, PXP1.0, TPS1.0.
- MFi Support
 - iAP Protocol (iAP 1/iAP 2) provided as an add-on upon request
- Packaging
 - 12 mm x 22 mm x 2.1 mm package
- Large variety of Sample Applications
 - Classic Bluetooth Sample Applications include: HID, MAP, PBAP, SPP application demos.
 - BLE Sample Applications include: ANP, iBeacon, HRP, HTP, PASP, HOGP, PXP, FMP, CSCP application demos.
 - Classic Bluetooth + Bluetooth low energy Sample Applications include: SPP+SPPLE, SPPDMMulti application demos.
- Development Environment supports:
 - CCS, Keil[®], and IAR Embedded Workbench[®] IDEs.
- Standards Conformance
 - BQB
 - ETSI EN 300 328 and EN 300 440 Class 2 (Europe)
 - FCC CFR47 Part 15 (US)
 - ISED

Applications

- Mobile Accessories
- Sports and Fitness Applications
- Wireless Audio Solutions
- Set-Top Boxes and Remote Controls
- Toys
- Test and Measurement
- Industrial: Cable Replacement
- Wireless Sensors
- Automotive Aftermarket
- Wellness and Health

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1. References

- [1]. CC2564C Dual-Mode Bluetooth® Controller, Datasheet, Texas Instruments.
<https://www.ti.com/lit/ds/symlink/cc2564.pdf?ts=1603789296732>
- [2]. MSP432P401R/MSP432P401M SimpleLink™ Mixed-Signal Microcontrollers Datasheet, Texas Instruments.
<https://www.ti.com/lit/gpn/msp432p401r>
- [3]. CC2564C Dual-mode Bluetooth® stack on MSP432™ microcontroller unit (MCU) User's Guide, Texas Instruments.
https://www.ti.com/lit/ug/swru453b/swru453b.pdf?ts=1603868491588&ref_url=https%253A%252F%252Fwww.google.com%252F

2. Pinout

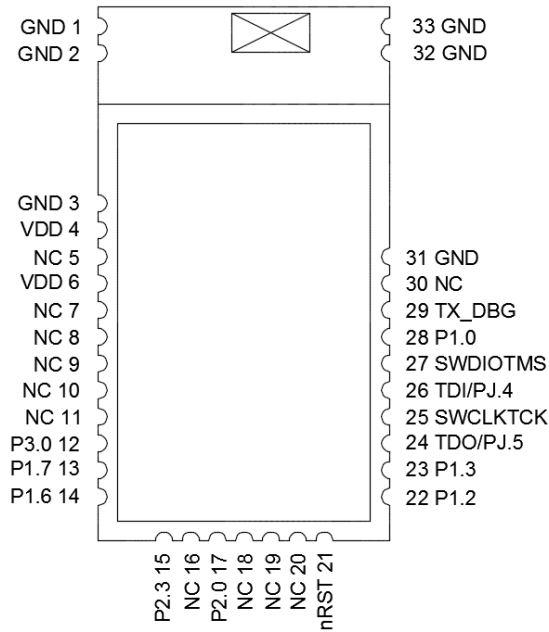


Figure 2: Pinout Diagram Top View

Table 1: Pin Description

Pin #	Pin Name	Type	Reset State	Description
1	GND	GND	N/A	Ground
2	GND	GND	N/A	Ground
3	GND	GND	N/A	Ground
4	VDD	GND	N/A	3.3V DC voltage supply
5	NC	N/A	N/A	No connect
6	VDD	PWR	N/A	3.3V DC voltage supply
7	NC	N/A	N/A	No connect
8	NC	N/A	N/A	No connect
9	NC	N/A	N/A	No connect
10	NC	N/A	N/A	No connect
11	NC	N/A	N/A	No connect
12	P3.0	DIO	OFF	General-purpose digital I/O with port interrupt, wakeup, and glitch filtering capability.
13	P1.7	P1.7	OFF	General-purpose digital I/O with port interrupt and wake-up capability
		UCB0SCL	N/A	I2C clock – eUSCI_B0 I2C mode
14	P1.6	P1.6	OFF	General-purpose digital I/O with port interrupt and wake-up capability
		UCB0SDA	N/A	I2C data – eUSCI_B0 I2C mode

Pin #	Pin Name	Type	Reset State	Description	
15	P2.3	P2.3	DIO	OFF	General-purpose digital I/O with port interrupt and wake-up capability and with reconfigurable port mapping secondary function. This I/O can be configured for high drive operation with up to 20-mA drive capability.
		PM_UCA1TXD	DO	N/A	eUSCI_A1 UART TXD (direction controlled by eUSCI – output)
		PM_UCA1SIMO	DIO	N/A	eUSCI_A1 SPI slave in master out (direction controlled by eUSCI)
16	NC	N/A	N/A	No connect	
17	P2.0	P2.0	DIO	OFF	General-purpose digital I/O with port interrupt and wake-up capability and with reconfigurable port mapping secondary function. This I/O can be configured for high drive operation with up to 20-mA drive capability.
		PM_UCA1STE		N/A	eUSCI_A1 SPI slave transmit enable (direction controlled by eUSCI)
18	NC	N/A	N/A	No connect	
19	NC	N/A	N/A	No connect	
20	NC	N/A	N/A	No connect	
21	nRST	nRST	DI	PU	External reset (active low)
		NMI		N/A	External nonmaskable interrupt
22	P1.2	P1.2	DIO	OFF	General-purpose digital I/O with port interrupt and wake-up capability
		UCA0RXD	DI	N/A	Receive data – eUSCI_A0 UART mode
		UCA0SOMI	DIO	N/A	Slave out, master in – eUSCI_A0 SPI mode
23	P1.3	P1.3	DIO	OFF	General-purpose digital I/O with port interrupt and wake-up capability
		UCA0TXD	DO	N/A	Transmit data – eUSCI_A0 UART mode
		UCA0SIMO	DIO	N/A	Slave in, master out – eUSCI_A0 SPI mode
24	TDO	TDO	DO	N/A	JTAG test data output
		SWO	DO		Serial wire trace output
		PJ.5	DIO		General-purpose digital I/O
25	SWCLKTCK	TCK	DI	PD	JTAG clock input (TCK)
		SWCLK			Serial wire clock input (SWCLK)
26	TDI	TDI	DI	PU	JTAG test data input
		PJ.4	DIO	N/A	General-purpose digital I/O
27	SWDIOTMS	TMS	DIO	PU	JTAG test mode select (TMS)
		SWDIO			Serial wire data input/output (SWDIO)
28	P1.0	P1.0	DIO	OFF	General-purpose digital I/O with port interrupt, wakeup, and glitch filtering capability
		UCA0STE		N/A	Slave transmit enable – eUSCI_A0 SPI

Pin #	Pin Name	Type	Reset State	Description
				mode
29	TX_DBG	DO		CC2564C Internal debug messages
30	NC	N/A	N/A	No connect
31	GND	GND		Ground
32	GND	GND		Ground
33	GND	GND		Ground

- Type:
DIO = Digital Input-Output, DI = Digital Input, DO = Digital Output, AI = Analog Input, AO = Analog Output, PWR = Power, GND = Ground, HY = Input Hysteresis, x mA = Typical output current.
- Reset States:
 - OFF = High-impedance with Schmitt trigger and pullup or pulldown (if available) disabled
 - PD = High-impedance input with pulldown enabled
 - PU = High-impedance input with pullup enabled
 - N/A = Not applicable
- For detail information, please refer to [References](#).

Table 2. Connection for Unused Pins

PIN	POTENTIAL	COMMENT
Px.0 to Px.7	Open	Set to port function in output direction, and leave unconnected.
RSTn/NMI	DVCC or VCC	47-kΩ pullup with 1.1-nF pulldown.
PJ.4/TDI	Open	The JTAG TDI pin is shared with general-purpose I/O function (PJ.4). If not being used, this pin should be set to port function in the output direction. When used as JTAG TDI pin, it should remain open.
PJ.5/TDO/SWO	DVCC or VCC	The JTAG TDO/SWO pin is shared with general-purpose I/O function (PJ.5). If not being used, this pin should be set to port function in the output direction. When used as JTAG TDO/SWO pin, it should be pulled down externally.
SWDIOTMS	DVCC or VCC	This pin should be pulled up externally.
SWCLKTCK	DVSS or VSS	This pin should be pulled down externally.
TX_DUG	Open	Remain open.

- For any unused pin with a secondary function that is shared with general-purpose I/O, follow the guidelines for the Px.0 to Px.7 pins. Refer to [References](#).

3. Characteristics

All MIN/MAX specification limits are guaranteed by design, production testing and/or statistical characterization. Typical values are based on characterization results at default measurement conditions and are informative only.

Default measurement conditions (unless otherwise specified): VDD= 3.0 V, TA = 25 °C. All radio measurements are performed with standard RF measurement equipment.

4.1. Absolute Maximum Ratings

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, so functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification are not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Table 3: Absolute Maximum Ratings

Parameter	Description	Conditions	Min	Max	Unit
VDD	Power Supply voltage at VDD pins		-0.3	4.17	V
T _{STG}	Storage temperature		-40	125	°C

4.2. Recommended Operating Conditions

Table 4: Recommended Operating Conditions

Parameter	Description	Conditions	Min	Typ	Max	Unit
VDD	Power supply voltage		2.05	3.0	3.7	V
T			-40		85	°C
I _{INRUSH}	Inrush current into the VDD pins				100	mA

4.3. Device Characteristics

Table 5: Digital IO - Recommended Operating Conditions

Parameter	Description	Conditions	Min	Typ	Max	Unit
V _{IT+}	Positive-going input threshold voltage	VDD = 3V	1.35		2.25	V
V _{IT-}	Negative-going input threshold voltage	VDD = 3V	0.75		1.65	V
V _{OH}	High-level output voltage	VDD = 3V, I _{OHmax} = -6mA	VDD-0.6		VDD	V
V _{OL}	Low-level output voltage	VDD = 3V, I _{OLmax} = 6mA	VSS		VSS+0.6	

Table 6: Radio for Bluetooth BR EDR - Recommended Operating Conditions

Parameter	Description	Conditions	Min	Typ	Max	Unit
f _{OPER}	Operating frequency		2402		2480	MHz
N _{CH}	Number of channels			79		1
f _{CH}	Channel frequency	K = 0 to 78		2402+K		MHz

Table 7: Radio for Bluetooth Low Energy - Recommended Operating Conditions

Parameter	Description	Conditions	Min	Typ	Max	Unit
f _{OPER}	Operating frequency		2402		2480	MHz
N _{CH}	Number of channels			40		1
F _{CH}	Channel frequency	K = 0 to 39		2402+K*2		MHz

Table 8: RF - AC Characteristics

Parameter	Description	Conditions	Min	Typ	Max	Unit
TX _{GFSK}	Maximum RF output Power - GFSK	GFSK		12		dBm
TX _{EDR}	Maximum RF output Power - EDR	EDR		10		dBm
RX _{SEN_1}	RX sensitivity - GFSK	GFSK, BER = 0.1%		-95		dBm
RX _{SEN_2}	RX sensitivity - $\pi/4$ -DQPSK	$\pi/4$ -DQPSK, BER = 0.01%		-94.5		dBm
RX _{SEN_3}	RX sensitivity - DPSK	8DPSK, BER = 0.01%		-87.5		dBm

4. Mechanical Specifications

5.1. Dimensions

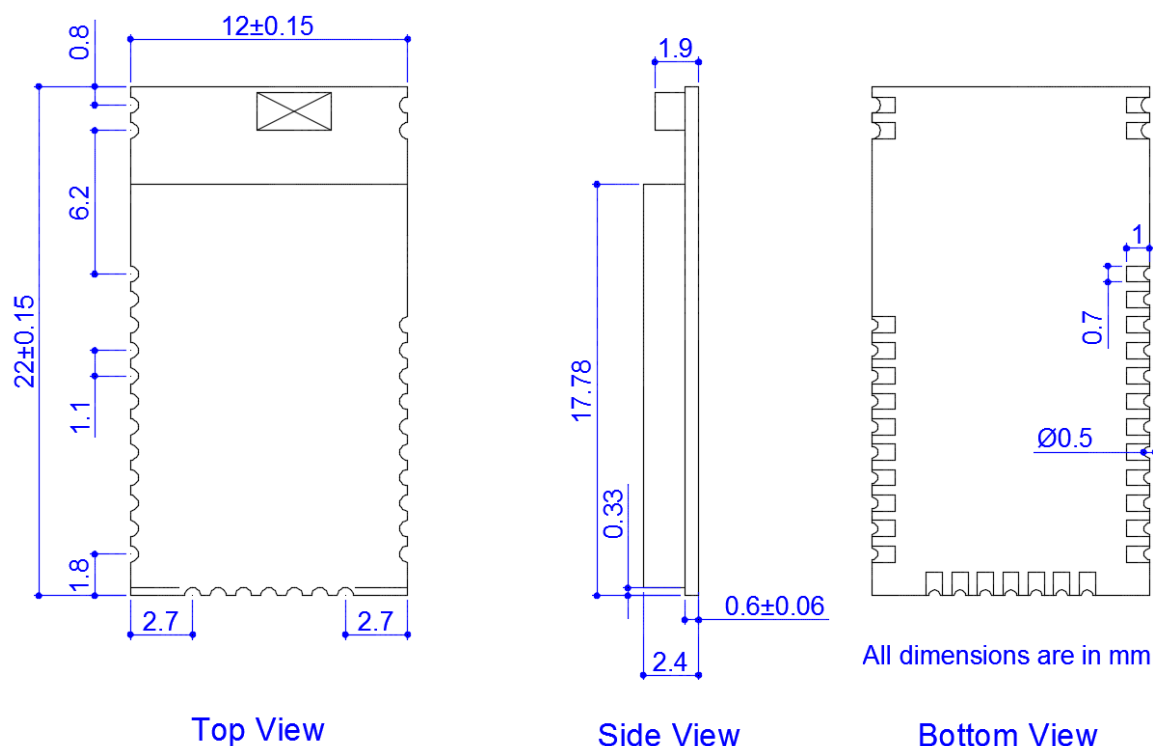


Figure 3: Mechanical Drawing

5.2. PCB Footprint

The footprint for the PCB is presented in the following figure:

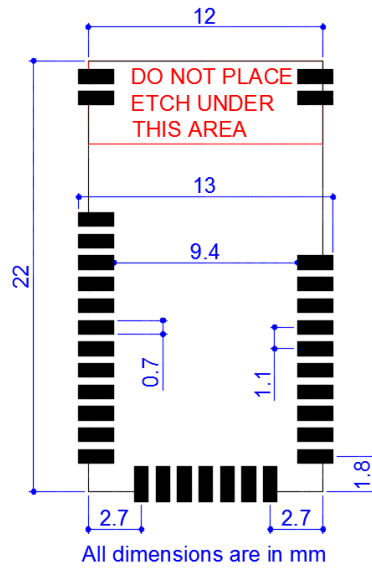


Figure 4: Module Footprint Top View

5.3. Marking



Figure 5: Indicative Module Shield Marking

5. Ordering Information

Table 11: Ordering Information

Part Number	Size (mm)	Shipping Form	MOQ
BDE-BDM209	12 x 22 x 2.4	Tape & Reel	1000

6. 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

Multilayer Chip Antenna; 0.5dBi; 2402-2480GHz

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-BDM209".

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.

7. 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-BDM209**

"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.

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

8. 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: **25657-BDM209**

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-BDM209**

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' 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.

Revision History

Revision	Date	Description
V1.0	20-October-2020	First release
V1.1	28-December-2020	Added Bluetooth 5.1 Declaration ID D049226