BMD-200 Module for Bluetooth 4.1 LE

The **BMD-200** from Rigado is a powerful, highly flexible *Bluetooth* Smart module based on the nRF51822 SoC from Nordic Semiconductor. With an ARM® Cortex™ M0 CPU, embedded 2.4GHz transceiver, and on-module chip antenna, the **BMD-200** provides a complete RF solution with no additional RF design, allowing faster time to market. The **BMD-200** provides full use of the nRF51822's on-chip peripherals, allowing for a wide range of applications without the need for an external host microcontroller; simplifying designs and reducing BOM costs. With an internal DC-DC converter and a voltage supply range of 1.8V to 3.6V, the **BMD-200** can be powered directly from a coin cell or two AAA batteries with ultra-low power consumption.

1. Features

- Based on the Nordic nRF51822 SoC
- Complete RF solution with integrated chip antenna
- Integrated DC-DC converter
- No external components required
- ARM® Cortex™-M0 32-bit processor
- Serial Wire Debug (SWD)
- S100 series SoftDevice ready
- Over-the-Air (OTA) firmware updates
- 256 kB embedded flash program memory
- 32/16 kB RAM
- 15 General Purpose I/O Pins
- 8/9/10 bit ADC - 8 configurable channels
- FCC ID: 2AA9B03

- One 32-bit and two 16-bit timers with counter mode
- SPI Master/Slave (4 Mbps/2 Mbps)
- Low power comparator
- Temperature sensor
- Two-wire Master (I2C compatible)
- UART (w/ CTS/RTS)
- CPU independent Programmable Peripheral Interconnect (PPI)
- Quadrature Decoder (QDEC)
- AES HW encryption
- Real Timer Counter (RTC)
- Dimensions: 17x17x2.9mm
- IC: 12208A-01

2. Applications

- Appcessories
- iBeacons™
- Low-Power Sensors
- Connected Appliances
- Lighting Products
- Fitness devices
- Wearables

BMD-200-DS-V1.3

3. Ordering Information

Email modules@rigado.com for quotes and ordering or visit www.rigado.com/BMD-200

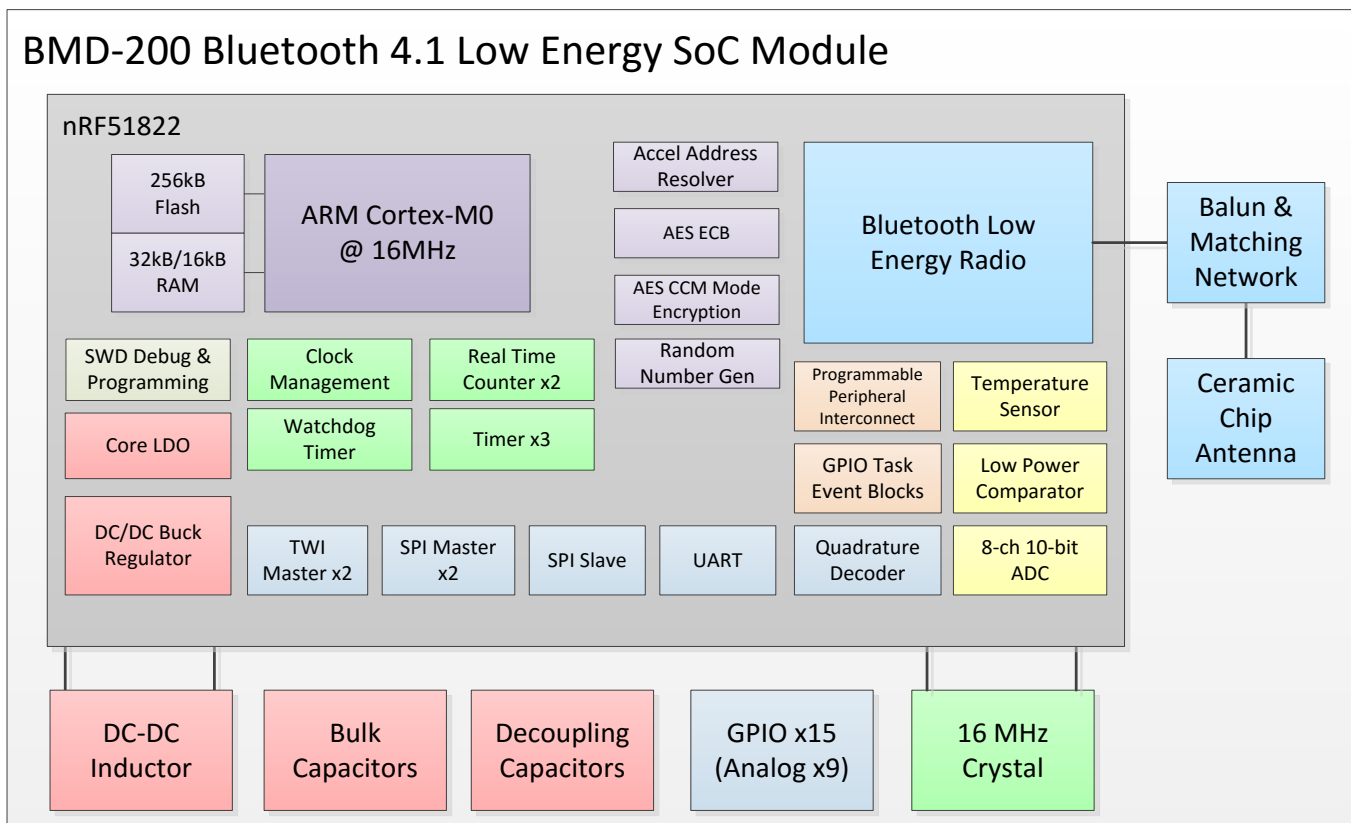| Part Number	Description
BMD-200-A-CT	BMD-200 module, 16kB, Rev A, Cut Tape
BMD-200-A-R	BMD-200 module, 16kB, Rev A, Tape & Reel, 1000 piece multiples
BMD-200-B-CT	BMD-200 module, 32kB, Rev B, Cut Tape
BMD-200-B-R	BMD-200 module, 32kB, Rev B, Tape & Reel, 1000 piece multiples
BMD-200-EVAL-S	BMD-200 Evaluation Kit with Segger JLink-OB programmer
BMD-200-EVAL-M	BMD-200 Evaluation Kit with mbed programmer

Table 1 - Ordering Part Numbers

4. Block Diagram

Figure 1 – Block Diagram

Table of Contents

5. Quick Specifications

Bluetooth	
Version	4.1 (*Bluetooth* Smart) Peripheral (SD110) / 4.0 Central (SD120)
Security	AES-128
LE connections	up to 8 (SD120)

Radio	
Frequency	2.402GHz to 2.480GHz
Modulations	GFSK at 250 kbps, 1 Mbps (BLE), 2 Mbps data rates
Transmit power	+4 dBm
Receiver sensitivity	-93 dBm (BLE mode)
Antenna	Integrated ceramic chip

Current Consumption	
TX only @ +4 dBm, 0 dBm, -4 dBm	16 mA, 10.5 mA, 8 mA
RX only @ 2 Mbps, 1 Mbps, 250 kbps	13.4 mA, 13 mA, 12.6 mA
CPU @ 16MHz from flash, from RAM	4.4 mA, 2.4 mA
System Off , w/ 16K RAM, 8K RAM, no RAM retention	1.8 µA, 1.2 µA, 0.6 µA

Dimensions	
Length	17.0 mm
Width	17.0 mm
Height	2.9 mm

Hardware	
Interface	SPI Master/Slave, UART, Two-Wire Master, GPIO
Power supply	1.8V to 3.6V
Temperature Range	-25 to +75°C (-40 to +85°C with reduced specifications, 16kB only)

Certifications	
FCC	FCC part 15 modular qualification – FCC ID: 2AA9B03
IC	Industry Canada RSS-210 modular qualification – IC: 12208A-01
CE	EN 60950-1: 2011-01 3.1 (a) : Health and Safety of the User EN 301 489-17 V2.2.1 3.1 (b) : Electromagnetic Compatibility EN 300 328 V1.8.1 3.2 : Effective use of spectrum allocated
Bluetooth	RF-PHY Component (Tested) – DID: D024097 End Product with S110 7.0.0 – DID: D024117

Table 2- Quick Specifications

6. Pin Descriptions
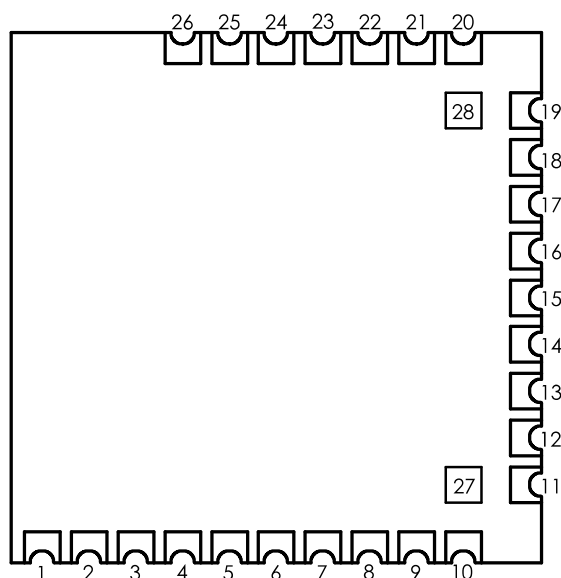
Figure 2- Pin out (Top View)

Pin description

Pin	Name	Direction	Description
5	P0.24	In/Out	GPIO
6	P0.25	In/Out	GPIO
8	P0.26	In/Out	GPIO/AIN1/XTAL2 (32.768kHz)
9	P0.27	In/Out	GPIO/AIN0/XTAL1 (32.768kHz)
11	P0.00	In/Out	GPIO/AREF0
12	P0.01	In/Out	GPIO/AIN2
13	P0.02	In/Out	GPIO/AIN3
14	P0.03	In/Out	GPIO/AIN4
15	P0.04	In/Out	GPIO/AIN5
16	P0.05	In/Out	GPIO/AIN6
17	P0.06	In/Out	GPIO/AIN7/AREF1
20	P0.08	In/Out	GPIO
21	P0.09	In/Out	GPIO
22	P0.10	In/Out	GPIO
23	P0.11	In/Out	GPIO
24	SWDIO	In/Out	SWD IO/ $\overline{RESET}$
25	SWDCLK	In	SWD Clock
18	VCC	Power	+1.8V to +3.6V[1]
1, 2, 3, 4, 7, 10, 19, 26, (27, 28 opt.)	GND	Power	Electrical Ground

Note 1: An external capacitor for V_{CC} is not strictly required, however using a 1μF - 4.7μF ceramic capacitor is recommended.

Table 3 – Pin Descriptions

6.1 RigDFU Pin Functions

Rigado RigDFU is programmed on the BMD-200 at the factory. Two GPIO pins are configured as UART pins for transferring new firmware images to the BMD-200. Pins are configured only when bootloader is running, and are fully available to the application firmware. RigDFU can be removed from the BMD-300 by performing a full-chip erase.

Pin	Name	RigDFU Functions
22	P0.10	UART TX for bootloader *HI-Z until bootloader activation message received on UART RX.*
21	P0.09	UART RX for bootloader *Internal 12kΩ pull-down enabled*

Table 4 – RigDFU Functions

If RigDFU bootloader is erased or over written, then there are no power-up state restrictions on the GPIO pins.

6.2 BMDware Pin Functions

Rigado BMDware is programmed on the BMD-200 at the factory. BMDware provides UART-to-BLE Bridge, beaconing, and Direct Test Mode (DTM) functionality. The pins in Table 5 below describe the pin functionality in BMDware. DTM Mode, Beacon-Only Mode, and AT Command Mode pin states are checked at BMDware start-up to configure BMDware as required by the user, and are then set to Hi-Z to conserve power. For further details on BMDware operation, please see the BMDware Datasheet that can be found at www.rigado.com. BMDware can be overwritten by RigDFU with customer application firmware, or removed along with RigDFU by a full chip erase.

Pin	Name	Direction	BMDware Functions
23	P0.11	Out	Bridge UART RTS Disabled in Beacon-Only & DTM modes, N/C if not used.
22	P0.10	Out	Bridge UART TX Disabled in Beacon-Only & DTM modes, N/C if not used.
20	P0.08	In	Bridge UART CTS Disabled in Beacon-Only & DTM modes, N/C if not used.
21	P0.09	In	Bridge UART RX Disabled in Beacon-Only & DTM modes, N/C if not used.
12	P0.01	Out	DTM UART TX Only enabled in DTM mode; N/C if not used.
11	P0.00	In	DTM UART RX / DTM Mode Only enabled in DTM mode; N/C if not used. On BMDware Start-up: **High** = Enter DTM mode; **Low** = Enter Normal Operation *Internal 12kΩ pull-down during BMDware start-up, then Hi-Z*
16	P0.05	In	Beacon Only Mode On BMDware Start-up: **High** = Bridge UART enabled; **Low** = Bridge UART disabled *Internal 12kΩ pull-up during BMDware start-up, then Hi-Z*
17	P0.06	In	UART AT Command Mode On BMDware Start-up: **High** = Full pass-through mode; **Low** = AT command mode *Internal 12kΩ pull-up during BMDware start-up, then Hi-Z*

Table 5 – BMDware Functions at Start-up

If BMDware firmware is erased or over written, then there are no power-up state restrictions on the GPIO pins.

7. Electrical Specifications

7.1 Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit
V_{CC_MAX}	Voltage on supply pin	-0.3	3.9	V
V_{IO_MAX}	Voltage on GPIO pins	-0.3	V_{CC} + 0.3	V
T_S	Storage Temperature Range	-40	125	°C

Table 6 – Absolute Maximum Ratings

7.2 Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{CC}	Operating supply voltage	1.8	3.0	3.6	V
T_{R_VCC}	Supply rise time (0V to 1.8V)	-	-	60	ms
T_A	Operating Ambient Temperature Range	-25	25	75	°C
T_{Aext}	Extended Operating Temperature Range [1,2]	-40	25	85	°C

Note 1: Valid only for BMD-200-A-R (16kB)

Note 2: V_{CC} range reduced to **1.9V** to 3.6V. Some degradation in RF performance. See Nordic Semiconductor's 'nRF51822 specification for Industrial Temperature Range' Addendum for full details (QFAA variant).

Table 7 – Operating Conditions

7.3 General Purpose I/O

The general purpose I/O is organized as one port enabling access and control of the 15 available GPIO pins through one port. Each GPIO can be accessed individually with the following user configurable features:

- Input/output direction
- Output drive strength
- Internal pull-up and pull-down resistors
- Wake-up from high or low level triggers on all pins
- Trigger interrupt on all pins
- All pins can be used by the PPI task/event system; the maximum number of pins that can be interfaced through the PPI at the same time is limited by the number of GPIOTE channels
- All pins can be individually configured to carry serial interface or quadrature demodulator signals

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{IH}	Input High Voltage	0.7 x V_{CC}	-	V_{CC}	V
V_{IL}	Input Low Voltage	V_{SS}	-	0.3 x V_{CC}	V
V_{OH}	Output High Voltage	V_{CC} - 0.3	-	V_{CC}	V
V_{OL}	Output Low Voltage	V_{SS}	-	0.3	V
R_{PU}	Pull-up Resistance	11	13	16	kΩ
R_{PD}	Pull-down Resistance	11	13	16	kΩ

Note: GPIO have a standard drive strength of 0.5 mA, and a high drive strength of 5 mA. Maximum number of high drive strength pins is 3.

Table 8 - GPIO

7.4   Debug & Programming

The BMD-200 support the two pin Serial Wire Debug (SWD) interface and offers flexible and powerful mechanism for non-intrusive debugging of program code. Breakpoints, single stepping, and instruction trace capture of code execution flow are part of this support.

7.5   Clocks

The BMD-200 module requires two clocks, a high frequency clock and a low frequency clock.

The high frequency clock is provided internally by a high-accuracy 16-MHz crystal as required by the nRF51822 for radio operation.

The low frequency clock can be provided internally by an RC oscillator or synthesized from the fast clock; or externally by a 32.768 kHz crystal. An external crystal provides the lowest power consumption.

32.768 kHz Crystal Specification Requirements

Symbol	Parameter	Typ.	Max.	Unit
f_{nom}	Crystal frequency	32.768	-	kHz
$F_{tol,BLE}$	Frequency tolerance, Bluetooth low energy applications.	±250	-	ppm
C_l	Load Capacitance	-	12.5	pF
C_o	Shunt Capacitance	-	2	pF
R_s	Equivalent series resistance	50	80	kΩ
C_{pin}	Input Capacitance on XTAL1 & XTAL2	5	-	pF

Table 9 - 32.768 kHz Crystal

32.768 kHz Oscillator Comparison

Symbol	Parameter	Typ.	Max.	Unit
I_{X32k}	Current for 32.768kHz Crystal Oscillator	0.4	1	µA
I_{RC32k}	Current for 32.768kHz RC Oscillator	0.8	1.1	µA
$I_{SYNT32k}$	Current for 32.768kHz Synthesized Oscillator	15	-	µA
$F_{TOL,X32k}$	Frequency Tolerance, 32.768kHz Crystal Oscillator	-	±250	ppm
$F_{TOL,RC32k}$	Frequency Tolerance, 32.768kHz RC Oscillator	±2	-	%
$F_{TOL,SYNT32k}$	Frequency Tolerance, 32.768kHz Synthesized Oscillator	±34	-	ppm

Note: $F_{TOL,X32k}$ is max tolerance allowed for BLE applications. Actual tolerance depends on the crystal used.

Table 10 - 32.768 kHz Oscillator

8. Firmware

8.1 Factory Image

All modules are shipped with factory programmed firmware. The factory programmed firmware version is indicated on the label, see Figure 3 - MAC Address on Label.

8.1.1 Firmware Version 'AA' (Deprecated)

Factory firmware version 'AA' contains an older version of the Rigado RigDFU OTA bootloader (non-encrypted), Nordic S110 version 6.0.0 SoftDevice, and factory test application. The module should be erased and reprogrammed with desired SoftDevice and customer application. Note: Full erase will clear the Rigado assigned MAC address from memory; see section 8.3 "MAC Address Info" on how to retain it.

8.1.2 Firmware Version 'AB'

Factory firmware version 'AB' contains the Rigado RigDFU OTA and Serial bootloader, Nordic S110 version 8.0.0 SoftDevice, and BMDware. Modules can be programmed with customer code with a via BLE and serial using Rigado provided tools. Examples apps for iOS and Android are provided that utilize the Rigablue Library for easy OTA updates. Visit the BMD Software Suite page at www.rigado.com for more information. Note: A full chip erase will clear the Rigado assigned MAC address from memory; see section 8.3 "MAC Address Info" on how to retain it.

8.1.3 Firmware Version 'AC'

Factory firmware version 'AC' contains the Rigado RigDFU OTA 3.1.0 and Serial bootloader, Nordic S110 SoftDevice 8.0.0, and BMDware 3.0.0. Modules can be programmed with customer code with a via BLE and serial using Rigado provided tools. Examples apps for iOS and Android are provided that utilize the Rigablue Library for easy OTA updates. Visit the BMD Software Suite page at www.rigado.com for more information. Note: A full chip erase will clear the Rigado assigned MAC address from memory; see section 8.3 "MAC Address Info" on how to retain it.

8.2   SoftDevices

Nordic Semiconductor protocol stacks are known as SoftDevices. SoftDevices are pre-compiled, pre-linked binary files. SoftDevices can be programmed in nRF51 series SoCs and are downloadable from the Nordic web. The BMD-200 with the nRF51822 SoC supports the S110, S120, and S130 SoftDevices.

8.2.1 S110

The S110 SoftDevice is a Bluetooth® low energy (BLE) Peripheral/Broadcaster protocol stack solution. It integrates a Bluetooth low energy controller and host, and provides a full and flexible API for building Bluetooth low energy System on Chip (SoC) solutions.

Key Features

- *Bluetooth 4.1 compliant low energy single-mode protocol stack*
- *Link layer*
- *L2CAP, ATT, and SM protocols*
- *GATT, GAP, and L2CAP*
- *Concurrent Peripheral and Broadcaster roles*
- *GATT Client and Server*
- *Full SMP support including MITM and OOB pairing*
- *Complementary nRF51 SDK including Bluetooth profiles and example applications*
- *Master Boot Record for over-the-air device firmware update*
- *Memory isolation between application and protocol stack for robustness and security*
- *Thread-safe supervisor-call based API*
- *Asynchronous, event-driven behavior*
- *No RTOS dependency*
- *Any RTOS can be used*
- *No link-time dependencies*
- *Standard ARMR Cortex™-M0 project configuration for application development*
- *Support for concurrent and non-concurrent multiprotocol operation*
- *Concurrent multiprotocol timeslot API*
- *Alternate protocol stack running in application space*

8.2.2 S120

The S120 SoftDevice is a Bluetooth® low energy (BLE) Central protocol stack solution supporting up to eight simultaneous Central role connections. It integrates a Bluetooth low energy controller and host, and provides a full and flexible API for building Bluetooth low energy System on Chip (SoC) solutions.

Key Features

- *Bluetooth 4.1 compliant low energy single-mode protocol stack*
- *Link layer*
- *L2CAP, ATT, and SM protocols*
- *GATT, GAP, and L2CAP APIs*
- *Central and Observer roles - up to 8 simultaneous connections*
- *GATT Client and Server*
- *SM including MITM and OOB pairing*
- *Complementary nRF51 SDK including Bluetooth profiles and example applications*
- *Memory isolation between application and protocol stack for robustness and security*
- *Thread-safe supervisor-call based API*
- *Asynchronous, event-driven behavior*
- *No RTOS dependency*
- *Any RTOS can be used*
- *No link-time dependencies*
- *Standard ARM® Cortex™-M0 project configuration for application development*
- *Support for non-concurrent multiprotocol operation*
- *Alternate protocol stack running in application space*

8.2.3 S130

S130 SoftDevice is a Bluetooth® Smart concurrent multi-link protocol stack solution supporting simultaneous Central/Peripheral/Broadcaster/Observer role connections. It integrates a Bluetooth Smart controller and host, and provides a full and flexible API for building Bluetooth Smart System on Chip (SoC) solutions.

Key Features

- *Bluetooth 4.1 compliant low energy single-mode protocol stack*
- *Central/Peripheral/Broadcaster/Observer roles with concurrent operation*
- *Link layer*
- *L2CAP, ATT, and SM protocols*
- *GATT, GAP, and L2CAP APIs*
- *GATT Client and Server*
- *SM including MITM and OOB pairing*
- *Complementary nRF51 SDK including Bluetooth profiles and example applications*

- *Memory isolation between application and protocol stack for robustness and security*
- *Thread-safe supervisor-call based API*
- *Asynchronous, event-driven behavior*
- *No RTOS dependency*
- *Any RTOS can be used*
- *No link-time dependencies*
- *Standard ARM® Cortex™-M0 project configuration for application development*
- *Support for concurrent multiprotocol Bluetooth Smart/2.4GHz operation*
- *Alternate protocol stack running in application space*

8.3 MAC Address Info

The BMD-200 module comes preprogrammed with a unique MAC address from the factory. The MAC address is also printed on a 2D barcode on the top of the module.
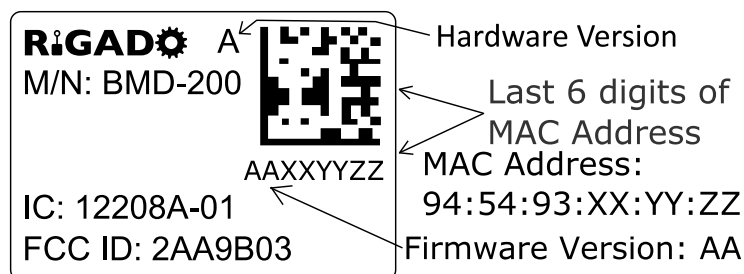

Figure 3 - MAC Address on Label

The 6-byte BLE Radio MAC address is stored in the nRF51822 UICR at NRF_UICR_BASE+0x80 LSB first. Please read the MAC Address Provisioning application note if you are not using the built in bootloader to avoid erasing/overwriting the MAC address during programming.

UICR Register:

NRF_UICR + 0x80 (0x10001080): MAC_Addr [0] (0xZZ)
NRF_UICR + 0x81 (0x10001081): MAC_Addr [1] (0xYY)
NRF_UICR + 0x82 (0x10001082): MAC_Addr [2] (0xXX)
NRF_UICR + 0x83 (0x10001083): MAC_Addr [3] (0x93)
NRF_UICR + 0x84 (0x10001084): MAC_Addr [4] (0x54)
NRF_UICR + 0x85 (0x10001085): MAC_Addr [5] (0x94)

9. Mechanical Data

9.1 Module Dimensions

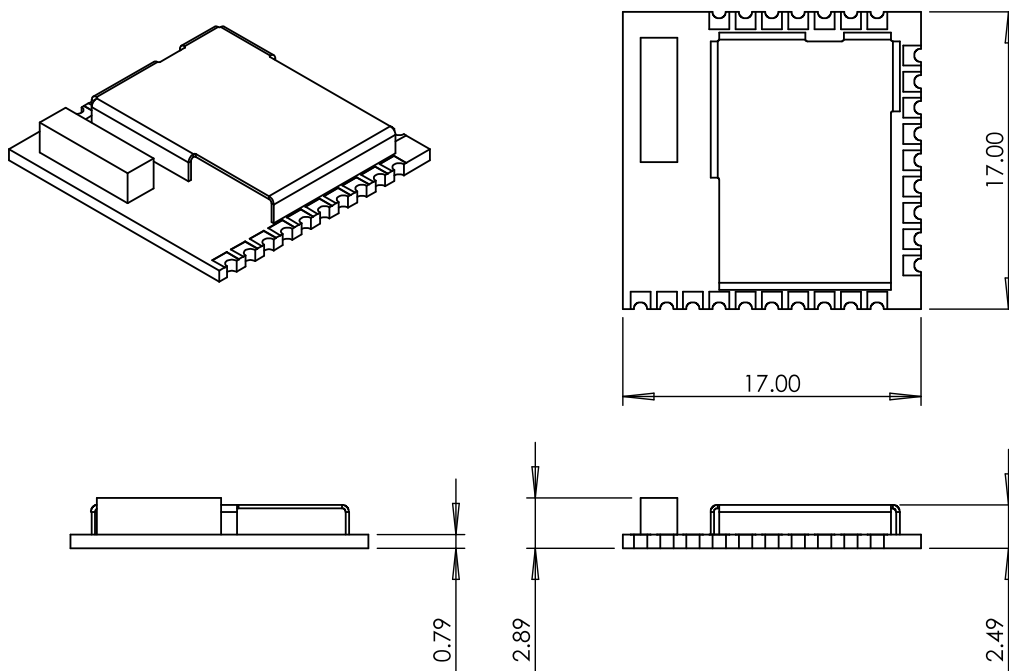Figure 4- Module Dimensions

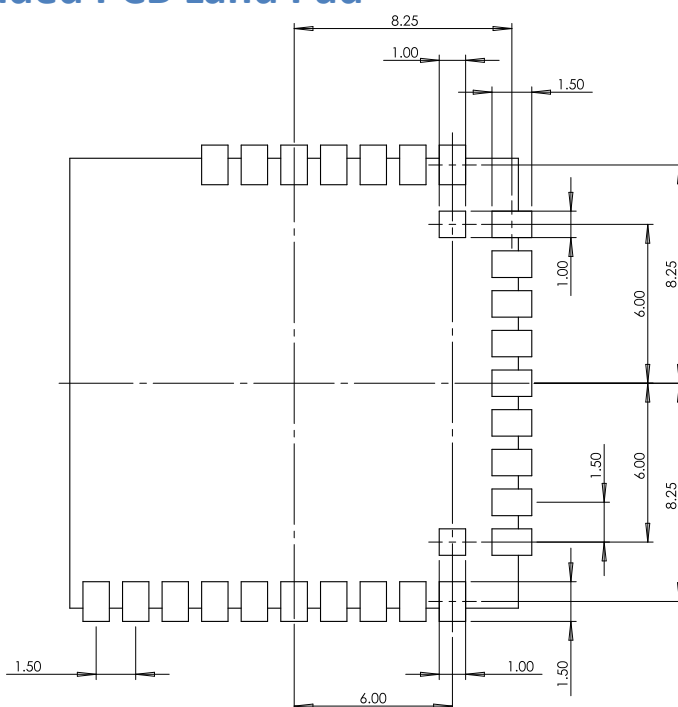**(All dimensions are in mm)**

9.2 Recommended PCB Land Pad

Figure 5- Module Dimensions

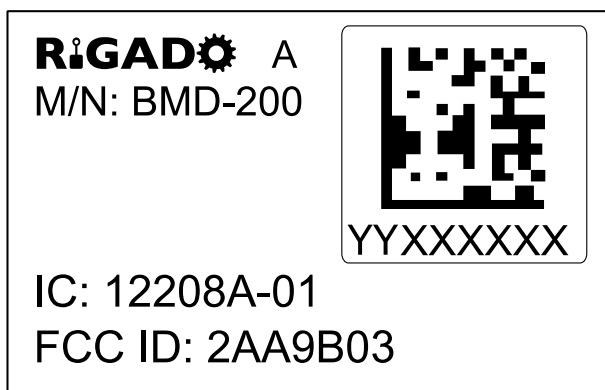**(All dimensions are in mm)**

10. Module Marking

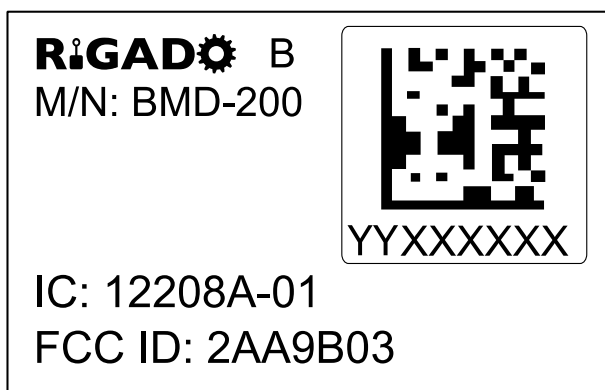*Figure 6 – Module Marking – Rev A – BMD-200-A (16kB)*

Figure 7 – Module Marking – Rev B – BMD-200-B (32kB)

11. RF Design Notes

11.1 Recommended RF Layout & Ground Plane

The integrated ceramic chip antenna requires a suitable ground plane to radiate effectively. Reducing the ground plane from that shown in figure 7 will reduce the effective radiated power.

The area under and extending out from the antenna portion of the module should be kept clear of copper and other metal. The module should be placed at the edge or, ideally, at the corner of the PCB with the antenna edge facing out.
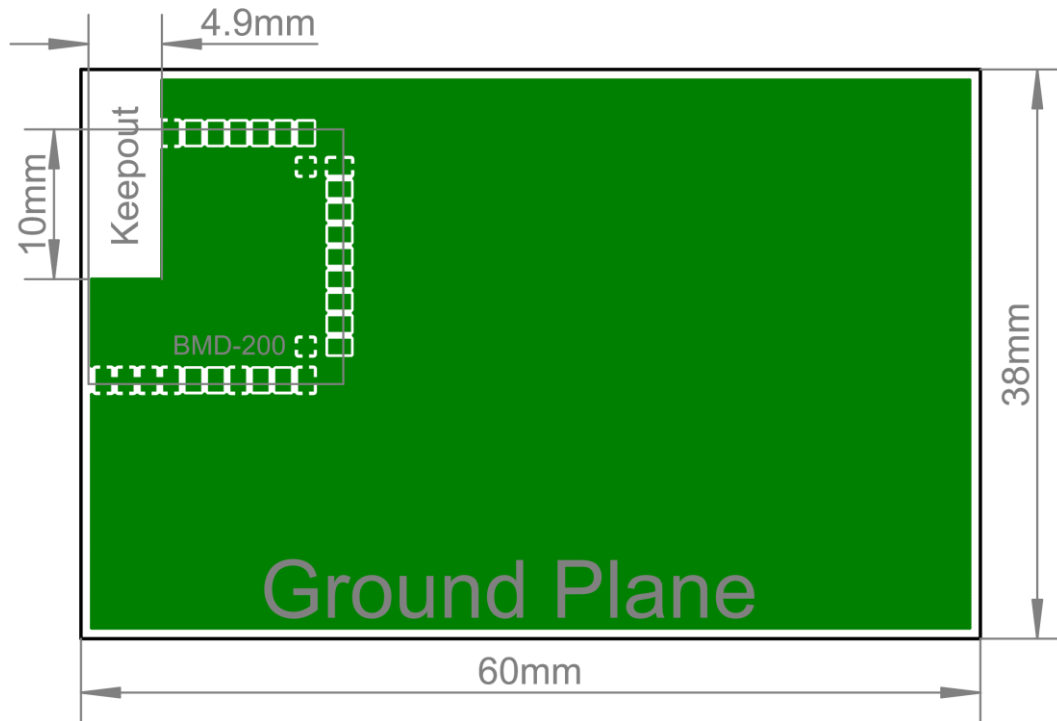
Figure 8- Recommended RF Layout

11.2 Mechanical Enclosure

Care should be taken when designing and placing the module into an enclosure. Metal should be kept clear from the antenna area, both above and below. Any metal around the module can negatively impact RF performance.

The module is designed and tuned for the antenna and RF components to be in free air. Any potting, epoxy fill, plastic overmolding, or conformal coating can negatively impact RF performance and must be evaluated by the customer.

11.3 Antenna Pattern

Antenna patterns are based off of the BMD-200 Evaluation board v1.1 with a ground plane size of 38mm x 60mm. X-Y-Z orientation is shown in Figure 9.
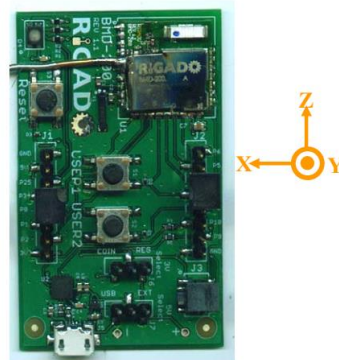

Figure 9 - XYZ Antenna Orientation
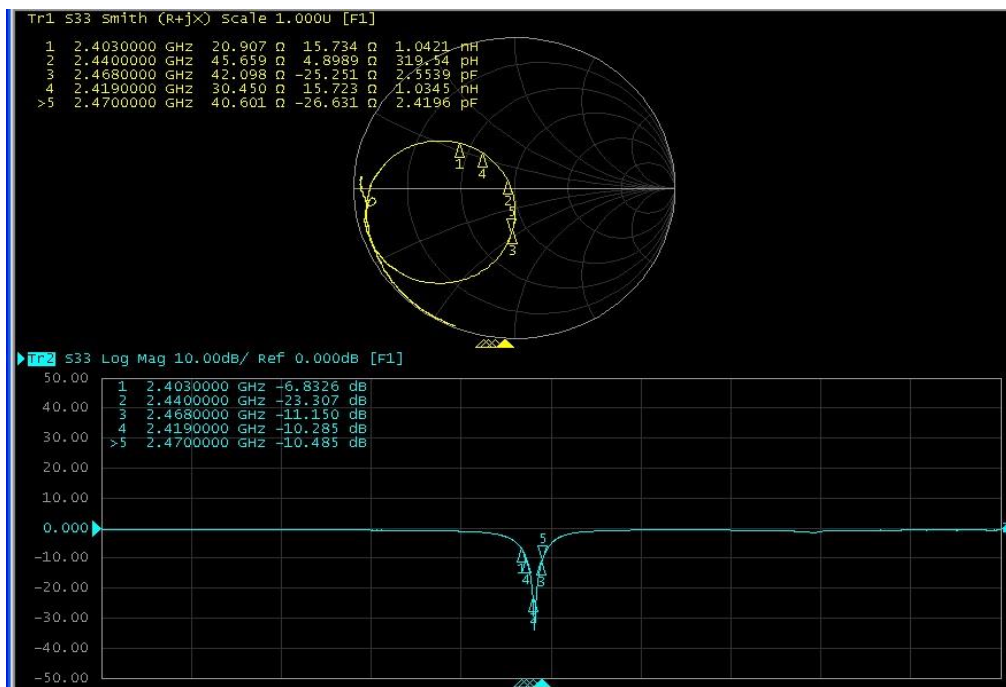
11.3.1   S33 Smith Chart

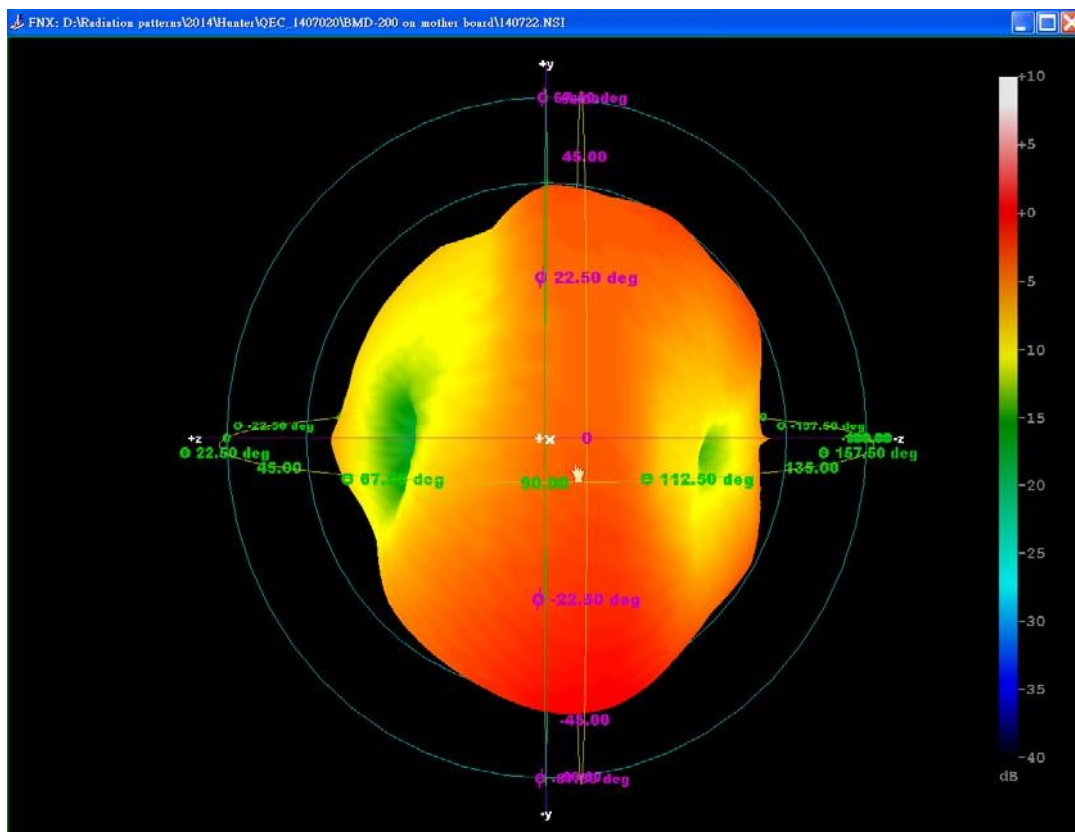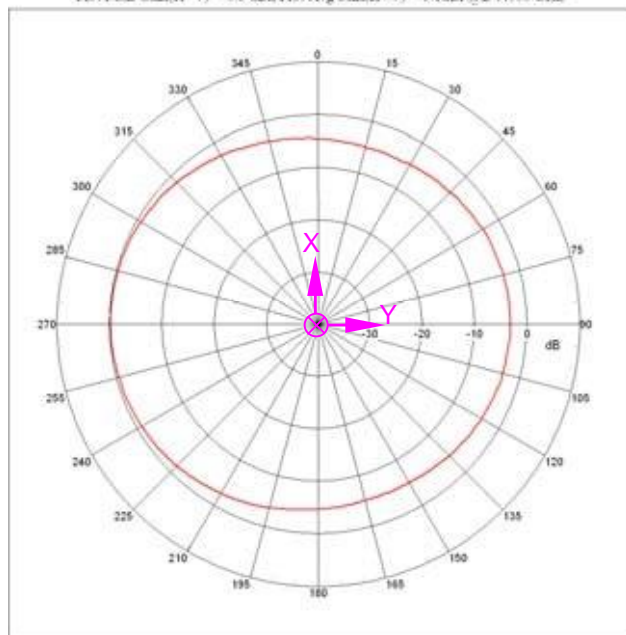*Figure 10 – S33 Antenna Smith Chart*

11.3.2   3D Radiation Pattern

Figure 11 – 3D Radiation Pattern

11.3.3   XY-plane

Unit : dBi

	Peak gain	Avg. gain
XY-plane	-0.3	-3.1

Figure 12 – XY-plane Radiation Pattern

11.3.4   XZ-plane
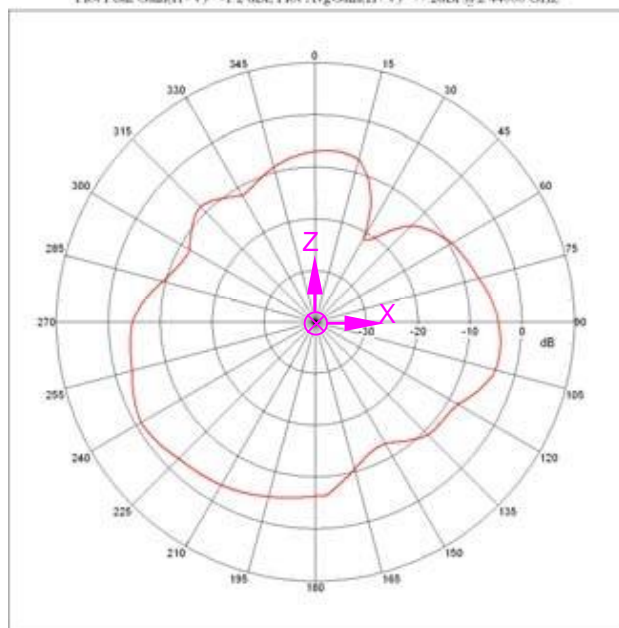
Unit : dBi

	Peak gain	Avg. gain
XZ-plane	-1.2	-7.2

Figure 13 – XZ-plane Radiation Pattern

11.3.5   YZ-plane
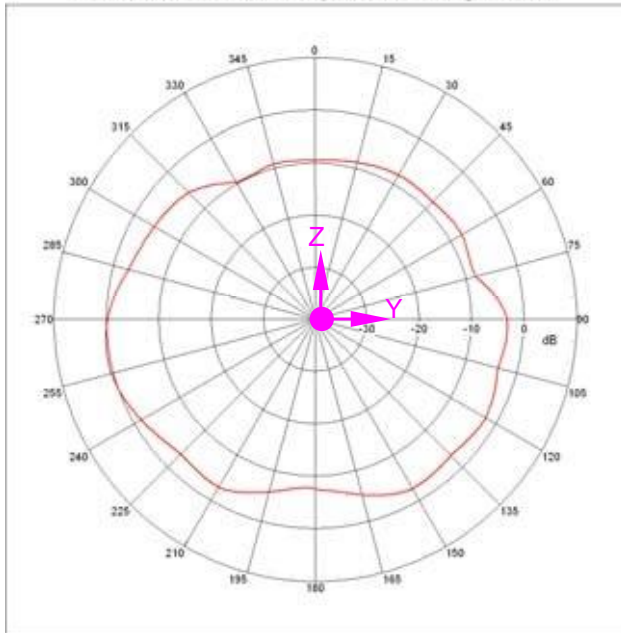
Figure 14 – YZ-plane Radiation Pattern

12. Evaluation Boards

Rigado has developed full featured evaluation boards that provide a complete I/O pin out to headers, on-board programming and debug, 32.768 kHz crystal, power and virtual COM port over USB, along with a 3-axis accelerometer, ambient light sensor, RGB LED, two user buttons, and a SPI EEPROM. The evaluation boards also provide the option to be powered off of a CR2032 coincell battery, and have a current sensor resistor and header to allow for convenient current measurements.

13. Custom Development

Project specific firmware and hardware for the BMD-200 can be created or modified for customers.   Custom embedded development is available upon request. Please contact Rigado at info@rigado.com or 1-866-6-RIGADO for custom engineering options and fees.

14. Bluetooth Certification

The BMD-200 module is certified as a Bluetooth End Product with Declaration ID D024117 using Nordic's S110 version 7.0.0 SoftDevice (Bluetooth 4.1). The BMD-200 has also been certified as a Component (tested) for RF-PHY with Declaration ID D024097. This allows customers to use different SoftDevices that have been certified by Nordic without the need to complete additional RF-PHY testing, provided that the design is not changed.

15.   Regulatory Statements

15.1 FCC Statement:

This device has been tested and found to comply with 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 the 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.

Operation is subjected to the following two conditions: (1) This device may no cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Note: Modification to this product will void the user's authority to operate this equipment.

Note: Modification to this product will void the users' authority to operate this equipment.

15.2 FCC Important Notes:

(1) FCC Radiation Exposure Statement

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
This equipment complies with Part 15 of the FCC Rules. Operation is subject 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.

The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

Caution!

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

(2) Co-location Warning:

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

(3) OEM integration instructions：

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

The antenna and transmitter must not be co-located with any other transmitter or antenna. The module shall be only used with the integral antenna(s) that has been originally tested and certified with this module.

As long as the two (2) conditions above are met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements with this module installed (for example, digital device emission, PC peripheral requirements, etc.)

In the event that these conditions cannot be met (for example certain laptop configuration 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 and circumstance, the OEM integrator will be responsible for re-evaluating. The end product (including the transmitter) and obtaining a separate FCC authorization.

Caution!
The OEM is still responsible for verifying compliance with FCC Part 15, subpart B limits for unintentional radiators through a qualified test house.

(4) End product labeling：
The final end product must be labeled in a visible area with the following: "Contains **FCC ID: 2AA9B03**".
Any similar wording that expresses the same meaning may be used.

The FCC Statement below should also be included on the label. When not possible, the FCC Statement should be included in the User Manual of the host device.

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

(5) Information regarding 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 (Section 15.2(4)).

15.3 IC 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.

RF exposure warning: The equipment complies with RF exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Avertissement d'exposition RF: L'équipement est conforme aux limites d'exposition aux RF établies pour un incontrôlés environnement. L'antenne (s) utilisée pour ce transmetteur ne doit pas être co-localisés ou onctionner en conjonction avec toute autre antenne ou transmetteur .

15.4 IC Important Notes:

1. 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 manual of the end product.
The user manual which is provided by OEM integrators for end users must include the following information in a prominent location.

2. To comply with IC RF exposure compliance requirements, the antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter, except in accordance with IC multi-transmitter product procedures.

3. The final system integrator must ensure there is no instruction provided in the user manual or customer documentation indicating how to install or remove the transmitter module except such device has implemented two-ways authentication between module and the host system.

4. The host device shall be properly labelled to identify the module within the host device. The final end product must be labeled in a visible area with the following: "Contains **IC: 12208A-01**".
Any similar wording that expresses the same meaning may be used.

The IC Statement below should also be included on the label. When not possible, the IC Statement should be included in the User Manual of the host device.

"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 onctionnement."

15.5 CE Regulatory:

This device has been tested and have been found compliant against the following standards. OEM integrators should consult with qualified test house to verify all regulatory requirements have been met for their complete device.
From Directive 2006/95/EC:
- EN 60950-1: 2006 + A11: 2009 + A1: 2010 + A12: 2011
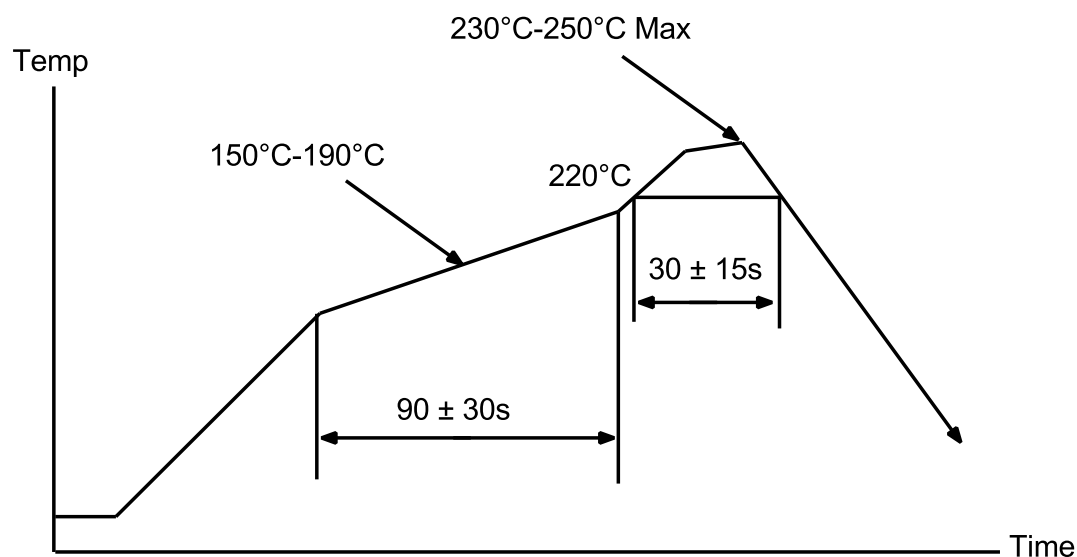
From R&TTE Directive 1999/5/EC:
- ETSI EN 300 440-1 V 1.6.1
- ETSI EN 300 440-2 V 1.4.1
- EN 62479:2010

From Directive 2004/108/EC:
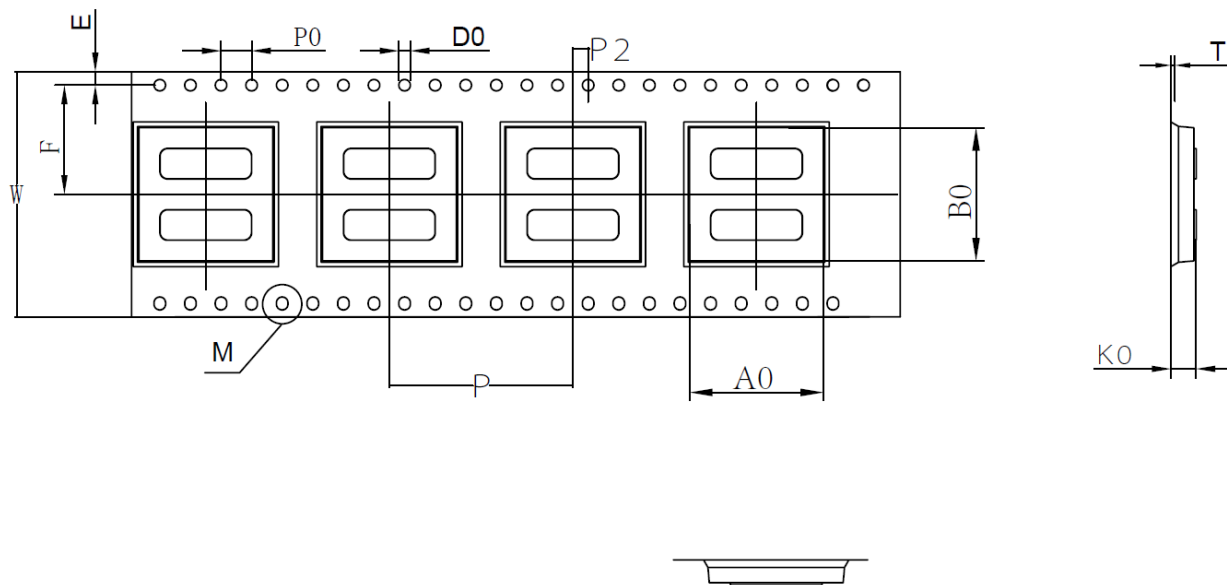- ETSI EN 301 489-3 V1.6.1
- ETSI EN 301 489-1 V1.9.2

Declarations of Conformity and supporting test reports are available at www.rigado.com.

16. Solder Reflow Temperature-Time Profile

Figure 15 - Reflow Profile for Lead Free Solder

17. Packaging and Labeling

17.1 Carrier Tape Dimensions

ITEM	W	A_0	B_0	K_0	K_1	P	F	E	D_0	D_1	P_0	P_2	T
DIM	$32.0^{+0.30}_{-0.30}$	$17.50^{+0.10}_{-0.10}$	$17.40^{+0.10}_{-0.10}$	$3.00^{+0.10}_{-0.10}$	$0.00^{+0.00}_{-0.00}$	$24.00^{+0.10}_{-0.10}$	$14.2^{+0.10}_{-0.10}$	$1.75^{+0.10}_{-0.10}$	$1.50^{+0.10}_{-0.00}$	$0.00^{+0.10}_{-0.00}$	$4.00^{+0.10}_{-0.10}$	$2.00^{+0.10}_{-0.10}$	$0.30^{+0.05}_{-0.05}$

Figure 16 – Carrier Tape Dimensions

17.2 Reel Packaging

Modules come on 380mm reels loaded with 1000 modules. Each reel is placed in an antistatic bag with a desiccant pack and humidity card and placed in a 390x400x65mm box. On the outside of the bag an antistatic warning and reel label are adhered.
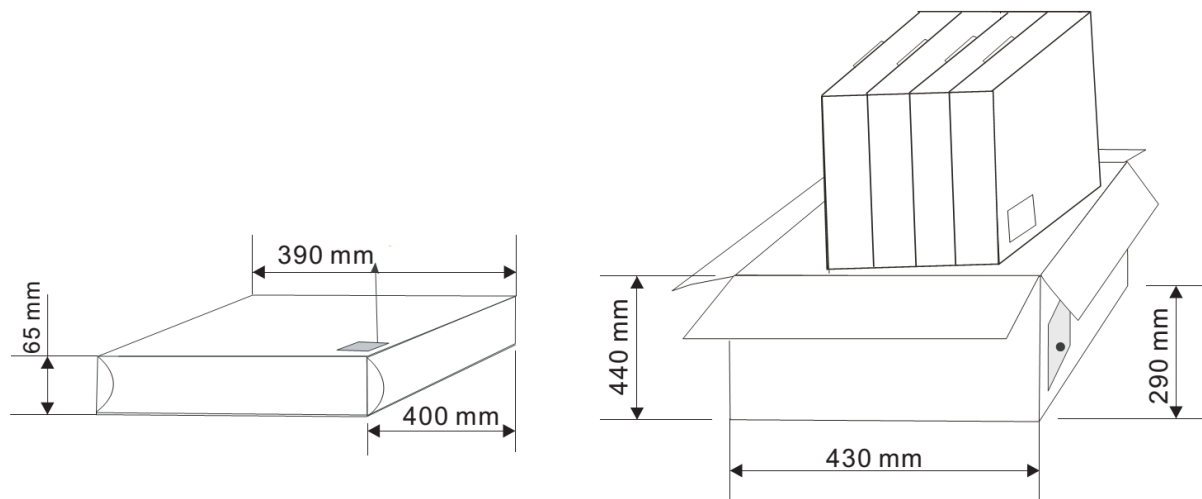

Figure 17 - Reel Cartons
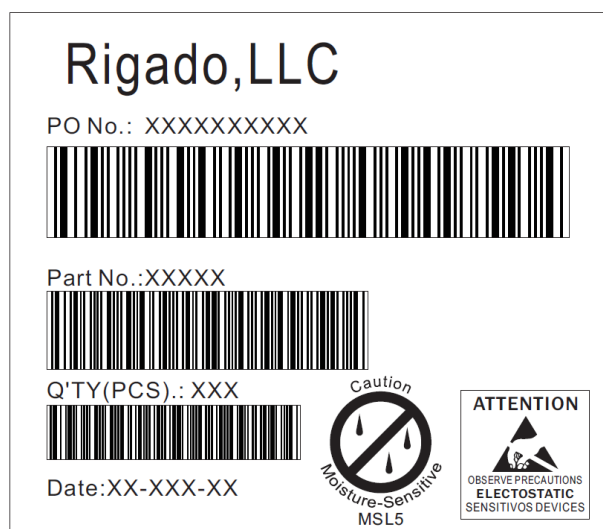
17.3 Packaging Label

Figure 18 – Packaging Label

18. Cautions

1) The guidelines of this document should be followed in order to assure proper performance of the module.
2) This product is for use in office, business, and residential applications, but not medical devices.
3) This module may short-circuit. If a short circuit can result in serious damage or injury, then failsafe precautions should be used. This could be accomplished by redundant systems and protection circuits.
4) Supply voltage to the module should not be higher than the specified inputs or reversed. Additionally, it should not contain noise, spikes, or AC ripple voltage.
5) Avoid use with other high frequency circuits.
6) Use methods to eliminate static electricity when working with the module as it can damage the components.
7) Contact with wires, the enclosure, or any other objects should be avoided.
8) Refer to the recommended pattern when designing for this module.
9) If hand soldering is used, be sure to use the precautions outlined in this document.
10) This module should be kept away from heat, both during storage and after installation.
11) Do not drop or physically shock the module.
12) Do not damage the interface surfaces of the module.
13) The module should not be mechanically stressed at any time (storage, handling, installation).
14) Do not store or expose this module to:
    - Humid or salty air conditions
    - High concentrations of corrosive gasses.
    - Long durations of direct sunlight.
    - Temperatures lower than -40°C or higher than 105°C.

19. Life Support Policy

This product is not designed to be used in a life support device or system, or in applications where there is potential for a failure or malfunction to, directly or indirectly, cause significant injury. By using this product in an application that poses these risks, such as described above, the customer is agreeing to indemnify Rigado for any damages that result.

20. Document History

Revision	Date	Changes / Notes
1.0	10/20/14	Initial Release
1.1	1/20/15	Added BMD-200-B, Corrected Section 7.2 'Operating supply voltage', other minor edits
1.2	6/12/15	Added new factory firmware, reel size changed to 1000 units
1.3	12/01/15	Added sections 6.1 and 6.2 for RigDFU and BMDware pin assignments, Added section 8.1.3 for Firmware version AC, other minor edits

21. Related Documents

Rigado Documents:

- BMD-200-AN-1: MAC Address Provisioning
- BMD-200-AN-2: Programming Guide
- BMD-200-EVAL-UG: Evaluation Kit User Guide
- RIGDFU-DS-1: RigDFU Secure Bootloader Datasheet
- BMDWARE-DS-1: BMDware Datasheet

Nordic Documents:

- nRF51822-PS: nRF51822 Product Specification
- nRF51 RM: nRF51 Series Reference Manual
- S110-SDS: nRF51822 S110 SoftDevice Specification
- S120-SDS: nRF51822 S120 SoftDevice Specification
- S130-SDS: nRF51822 S130 SoftDevice Specification
- nRF51822-PSA-ITEMP: nRF51822 Product Specification Addendum for industrial temperature range