

## *Blumod BMD-200 Module for Bluetooth 4.0 LE*

The blumod **BMD-200** from Rigado is a powerful, highly flexible *Bluetooth* Smart module based on the nRF51822 SoC from Nordic Semiconductor. With a 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 2.1V to 3.6V, the **BMD-200** can be powered directly from a coin cell or two AAA batteries with ultra-low power consumption.

## 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
- 256 kB embedded flash program memory
- 16 kB RAM
- 8/9/10 bit ADC - 8 configurable channels
- 15 General Purpose I/O Pins
- FCC ID: 2AA9B03
- One 32-bit and two 16-bit timers with counter mode
- SPI Master/Slave (4 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)
- IC: 12208A-01

## Applications

- App-cessories
- iBeacons™
- Low-Power Sensors
- Connected Appliances
- Lighting Products
- Health/Fitness devices
- Wearables

# Quick Specifications

<b>Bluetooth</b>	
Version	4.0 ( <i>Bluetooth Smart</i> )
Security	AES-128
LE connections	up to 8

<b>Radio</b>	
Frequency	2.402GHz to 2480GHz
Modulations	GFSK at 250 kbps, 1 Mbps, 2 Mbps data rates
Transmit power	+4 dBm
Receiver sensitivity	-93 dBm
Typical line-of-sight range	30 - 150 meters
Antenna	Integrated ceramic chip

<b>Current Consumption</b>	
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 uA, 1.2 uA, 0.6 uA

<b>Dimensions</b>	
Length	17.00 mm
Width	17.00 mm
Height	2.89 mm

<b>Hardware</b>	
Interface	SPI Master/Slave, UART, Two-Wire Master, GPIO
Power supply	2.1V to 3.6V

<b>Certifications</b>	
FCC	FCC part 15 modular qualification

# Absolution Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit
V <sub>CC_MAX</sub>	Voltage on supply pin	-0.3	3.9	V
V <sub>IO_MAX</sub>	Voltage on GPIO pins	-0.3	V <sub>CC</sub> + 0.3	V
T <sub>S</sub>	Storage Temperature Range	-40	125	°C

# Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V <sub>CC</sub>	Operating supply voltage	2.1	3.0	3.6	V
T <sub>R_VCC</sub>	Supply rise time (0V to 1.8V)	-	-	60	ms
T <sub>A</sub>	Operating Ambient Temperature Range	-25	25	75	°C

# GPIO Specifications

Symbol	Parameter	Min.	Typ.	Max.	Unit
V <sub>IH</sub>	Input High Voltage	0.7 x V <sub>CC</sub>	-	V <sub>CC</sub>	V
V <sub>IL</sub>	Input Low Voltage	V <sub>SS</sub>	-	0.3 x V <sub>CC</sub>	V
V <sub>OH</sub>	Output High Voltage	V <sub>CC</sub> - 0.3	-	V <sub>CC</sub>	V
V <sub>OL</sub>	Output Low Voltage	V <sub>SS</sub>	-	0.3	V
R <sub>PU</sub>	Pull-up Resistance	11	13	16	kΩ
R <sub>PD</sub>	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.

# 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.	$\pm 250$	-	ppm
$C_l$	Load Capacitance	-	12.5	pF
$C_o$	Shunt Capacitance	-	2	pF
$R_s$	Equivalent series resistance	50	80	k $\Omega$
$C_{pin}$	Input Capacitance on XTAL1 & XTAL2	5	-	pF

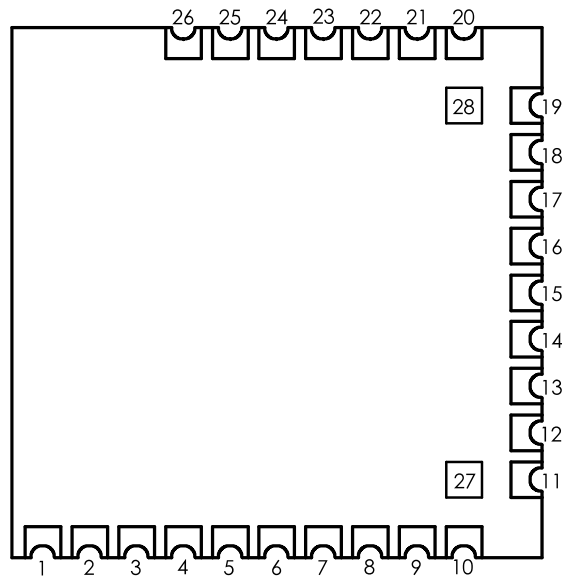
### 32.768 kHz Oscillator Comparison

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

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

# Pinout

Top View

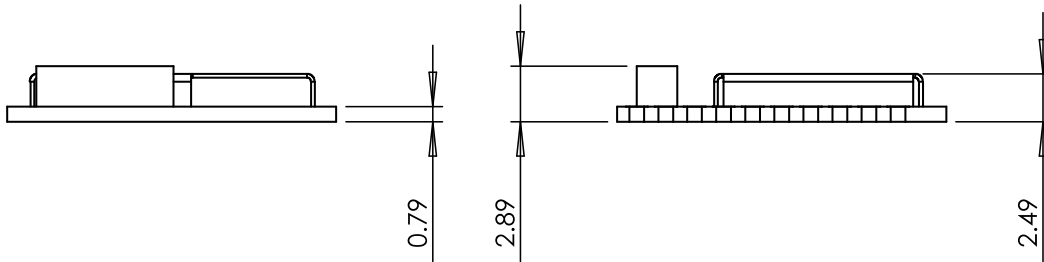
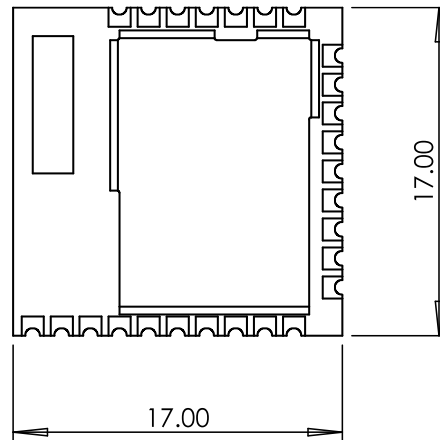
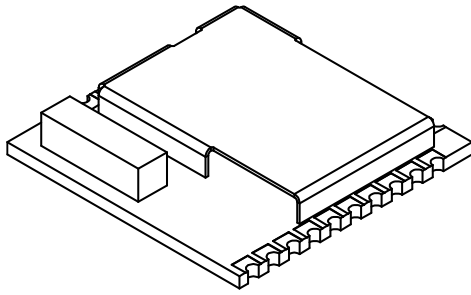


Pin description (PRELIMINARY)

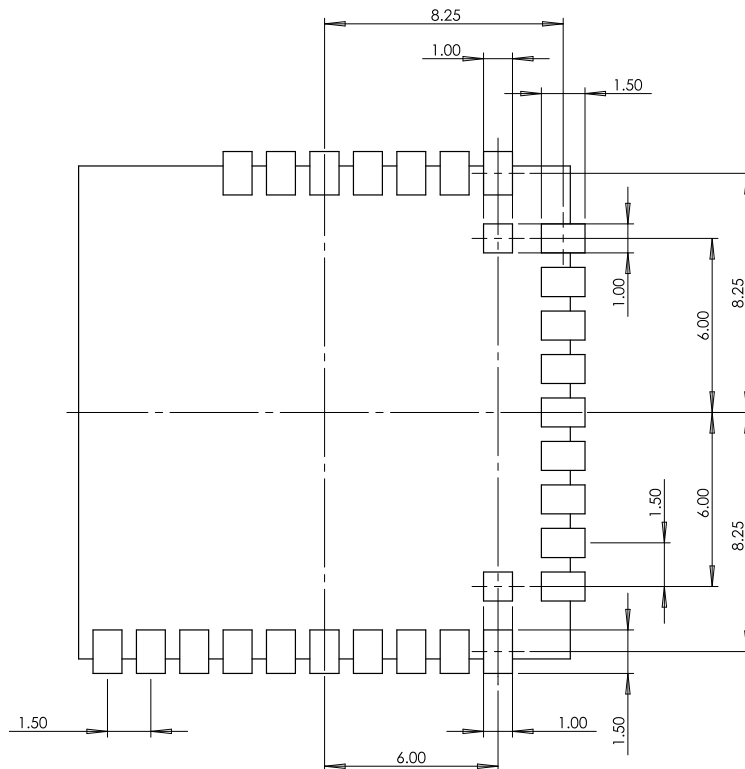
Name	Pin	Direction	Description
P0.24	5	In/Out	GPIO
P0.25	6	In/Out	GPIO
P0.26	8	In/Out	GPIO/AIN1/XTAL2 (32.768kHz)
P0.27	9	In/Out	GPIO/AIN0/XTAL1(32.768kHz)
P0.00	11	In/Out	GPIO/AREF0
P0.01	12	In/Out	GPIO/AIN2
P0.02	13	In/Out	GPIO/AIN3
P0.03	14	In/Out	GPIO/AIN4
P0.04	15	In/Out	GPIO/AIN5
P0.05	16	In/Out	GPIO/AIN6
P0.06	17	In/Out	GPIO/AIN7/AREF1
P0.08	20	In/Out	GPIO
P0.09	21	In/Out	GPIO
P0.10	22	In/Out	GPIO
P0.11	23	In/Out	GPIO
SWDIO	24	In/Out	SWD IO/ $\overline{\text{RESET}}$
SWDCLK	25	In	SWD Clock
VCC	18	Pwr	+2.1 to +3.6VDC input <sup>1</sup>
GND	1, 2, 3, 4, 7, 10, 19, 26, (27, 28 opt.)	Pwr	Electrical Ground

Note 1: An external capacitor for V<sub>CC</sub> is not strictly required, however using a 1μF - 4.7μF ceramic capacitor is recommended.

# Mechanical Dimensions



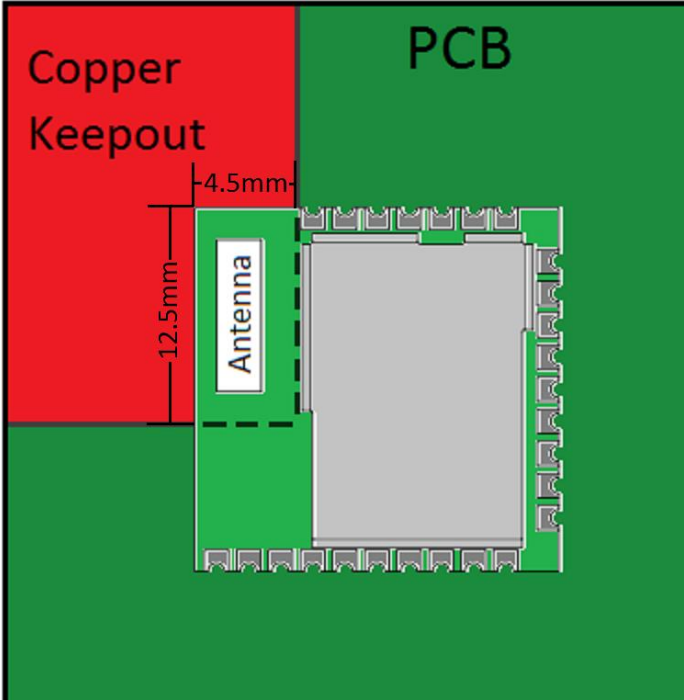
# Recommended PCB Land Pad (Top view)



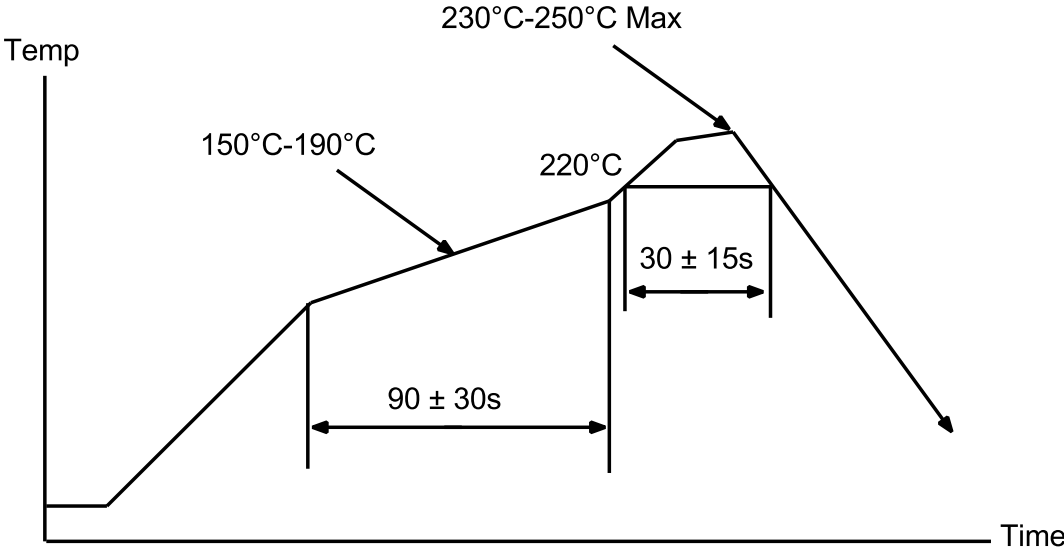
(All dimensions are in mm)

# Recommended Copper Keepout

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.



# Solder Temperature-Time Profile (for reflow soldering)



## Packaging

Modules come in 800 piece, 330mm reels.



# Regulatory Statements

## 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.

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## 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 should be installed and operated with a minimum distance of 20 centimeters between the radiator and any human body and 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 must be installed such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmit 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 three (3) 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.)

#### **(4) OEM integration instructions :**

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.

#### **(5) 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.”

#### **(6) Information that must be placed in 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.

## **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 .

## 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 be installed to provide a separation distance of at least 20 cm from all persons and 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.

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# 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 (see section 7.0).
- 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 5°C or higher than 35°C.

## 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.

## Document History

Revision	Date	Changes / Notes
0.1	05/22/14	Initial internal document draft.
0.2	07/29/14	Updated for IC, other support information
0.3	07/30/14	Updated for IC warning, changed FCC ID to 2AA9B03

## Related Documents