BMD-SRA-1 Module for Bluetooth 4.2 LE

1. Ordering Information

Email modules@rigado.com for quotes.

Part Number	Description
BMD-SRA-1-A-T	BMD-SRA-1 module, nRF52832-QFAA, IS25LQ032B-JBLE, tray packaging

Table 1 – Ordering Part Numbers

2. Block Diagram

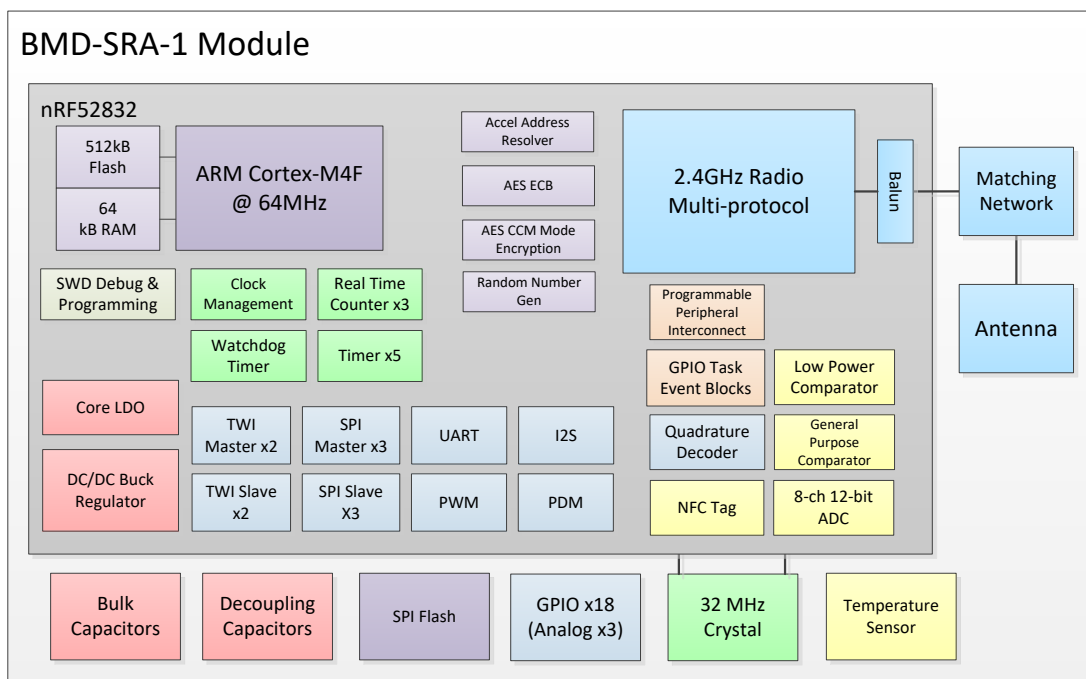*Figure 1 – Block Diagram*

Table of Contents

3. Quick Specifications

Bluetooth	
Version	4.2 (*Bluetooth* Smart) Concurrent Central & Peripheral (S132)
Security	AES-128
LE connections	Up to 8 as Central, 1 as Peripheral, Observer, Broadcaster (S132)

Radio	
Frequency	2.360GHz to 2.500GHz
Modulations	GFSK at 1 Mbps, 2 Mbps data rates
Transmit power	+4 dBm
Receiver sensitivity	-96 dBm (BLE mode)
Antenna	Integrated

Current Consumption	
TX only @ +4 dBm, 0 dBm	16.6 mA, 11.6 mA
RX only @ 1 Mbps	11.7 mA
CPU @ 64MHz from flash, from RAM	7.4 mA, 6.7 mA
System Off , On	0.7µA, 1.2 µA
Additional current for RAM retention	20 nA / 4K block

Dimensions		
BMD-SRA-1	Length Width Height	37.7 mm ± 0.3mm 14.5 mm ± 0.3mm 2.5 mm ± 0.1mm

Hardware		
Interfaces	SPI Master/Slave x 3 UART Two-Wire Master/Slave (I2C) x 2 GPIO x 18	I2S PWM PDM
Power supply	2.3V to 3.6V	
Temperature Range	-40 to +85℃	

Certifications		
FCC	FCC part 15 modular certification BMD-SRA-1 FCC ID: 2AA9B06	
IC	Industry Canada RSS-210 modular certification BMD-SRA-1 IC: 12208A-06	
CE	EN 60950-1: 2011-01 EN 301 489-1 V1.9.2 & EN 301 489-17 V2.2.1 EN 300 328 V1.9.1	3.1 (a): Health and Safety of the User (*pending*) 3.1 (b): Electromagnetic Compatibility 3.2: Effective use of spectrum allocated
Japan (MIC)	Ministry of Internal Affairs and Communications (MIC) of Japan pursuant to the Radio Act of Japan BMD-SRA-1: TBD	
Australia / New Zealand	AS/NZS 4268 :2012+AMDT 1:2013, Radio equipment and systems – Short range devices	

Table 2 – Quick Specifications
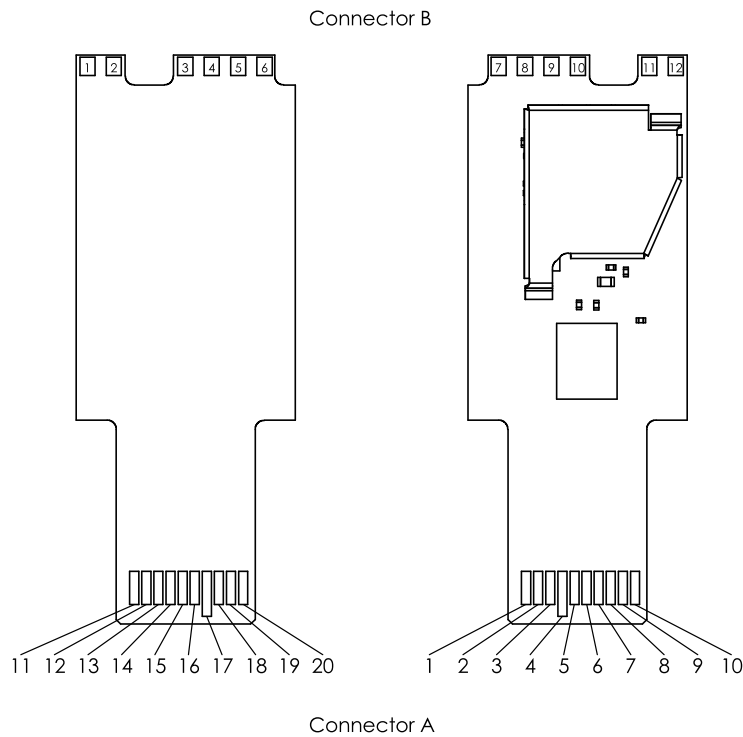
4. Pin Descriptions

4.1 BMD-SRA-1

Connector B

Figure 2 – BMD-SRA-1 Pin out

Pin description

Pin	Name	Direction	Description
A-1	P0.28	In/Out	GPIO/AIN4
A-2	P0.31	In/Out	GPIO/AIN7
A-3	P0.00	In/Out	GPIO/XTAL1 (32.768kHz)
A-8	P0.01	In/Out	GPIO/XTAL2 (32.768kHz)
A-9	P0.02	In/Out	GPIO/AIN0
A-10	P0.03	In/Out	GPIO/AIN1
A-12	P0.21	In/Out	GPIO/$\overline{\text{RESET}}$
A-18	P0.30	In/Out	GPIO/AIN6
A-19	P0.29	In/Out	GPIO/AIN5
A-20	P0.27	In/Out	GPIO
B-2	P0.12	In/Out	GPIO
B-4	P0.18	In/Out	GPIO/TRACEDATA[0]/SWO
B-5	P0.20	In/Out	GPIO/TRACECLK
B-8	P0.19	In/Out	GPIO
B-9	P0.17	In/Out	GPIO/TRACEDATA[3]
B-10	P0.16	In/Out	GPIO/TRACEDATA[1]
B-11	P0.11	In/Out	GPIO
B-12	P0.05	In/Out	GPIO/AIN3
A-13	SWCLK	In	SWD Clock

Pin	Name	Direction	Description
A-11	SWDIO	In/Out	SWD IO
A-17, B-6	VCC	Power	+2.3V to +3.6V
A-4, B-1, B-3, B-7	GND	Power	Electrical Ground
A-5, A-6, A-7, A-14, A-15, A-16	NC	N/A	No Connect

Table 3 – BMD-SRA-1/301 Pin Descriptions

5. Electrical Specifications

5.1 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 (V_{CC} > 3.6V)	-0.3	3.9	V
V_{IO_MAX}	Voltage on GPIO pins (V_{CC} ≤ 3.6V)	-0.3	V_{CC} + 0.3V	V
T_S	Storage Temperature Range	-40	125	°C

Table 4 – Absolute Maximum Ratings

5.2 Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{CC}	Operating supply voltage	2.3	3.0	3.6	V
T_{R_VCC}	Supply rise time (0V to 2.3V)	-	-	60	ms
T_A	Operating Ambient Temperature Range	-40	25	85	°C

Table 5 – Operating Conditions

5.3 General Purpose I/O

The general purpose I/O is organized as one port enabling access and control of the 18 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} – 0.4	-	V_{CC}	V
V_{OL}	Output Low Voltage	V_{SS}	-	V_{SS} + 0.4	V

R_{PU}	Pull-up Resistance	11	13	16	kΩ
R_{PD}	Pull-down Resistance	11	13	16	kΩ

Table 6 – GPIO

5.4 Module RESET

GPIO pin P0.21 may be used for a hardware reset. In order to utilize P0.21 as a hardware reset, the UICR registers PSELRESET[0] and PSELRESET[1] must be set alike, to the value of 0x7FFFFF15. When P0.21 is programmed as $\overline{\text{RESET}}$, the internal pull-up is automatically enabled. Rigado and Nordic example applications and development kits program P0.21 as $\overline{\text{RESET}}$.

5.5 Debug & Programming

The BMD-SRA-1 supports 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.

The BMD-SRA-1 also supports ETM and ITM trace. Trace data from the ETM and the ITM is sent to an external debugger via a 4-bit wide parallel trace port. In addition to parallel trace, the TPIU supports serial trace via the Serial Wire Output (SWO) trace protocol.

5.6 Clocks

The BMD-SRA-1 utilizes two internal clock sources that are required for BLE operation.

The high frequency clock is provided on-module by a high-accuracy 32-MHz crystal as required by the nRF52832 for radio operation.

The low frequency clock is be provided internally by an RC oscillator or synthesized from the fast clock. Using the internal RC oscillator with calibration provides acceptable performance for BLE. Note: the ANT protocol requires the use of an external crystal.

32.768 kHz Oscillator Comparison

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{LFXO}	Current for 32.768kHz Crystal Oscillator	-	0.25	-	µA
I_{LFRC}	Current for 32.768kHz RC Oscillator	-	0.6	1	µA
I_{LFSYNT}	Current for 32.768kHz Synthesized Oscillator	-	100	-	µA
$f_{TOL\_LFXO\_BLE}$	Frequency Tolerance, 32.768kHz Crystal Oscillator (BLE Stack)[1]	-	-	±250	ppm
$f_{TOL\_LFXO\_ANT}$	Frequency Tolerance, 32.768kHz Crystal Oscillator (ANT Stack)[1]	-	-	±50	ppm
f_{TOL_LFRC}	Frequency Tolerance, 32.768kHz RC Oscillator	-	-	±2	%
$f_{TOL\_CAL\_LFRC}$	Frequency tolerance, 32.768kHz RC after calibration	-	-	±250	ppm
f_{TOL_LFSYNT}	Frequency Tolerance, 32.768kHz Synthesized Oscillator	-	-	±48	ppm
Note 1: $f_{TOL\_LFXO\_BLE}$ and $f_{TOL\_LFXO\_ANT}$ are the max allowed for BLE and ANT applications. Actual tolerance depends on the crystal used.					

Table 7 – 32.768 kHz Oscillator

5.7 Integrated SPI Flash IC

All modules are shipped with blank from the factory, except the Rigado MAC address is programmed into the UICR.
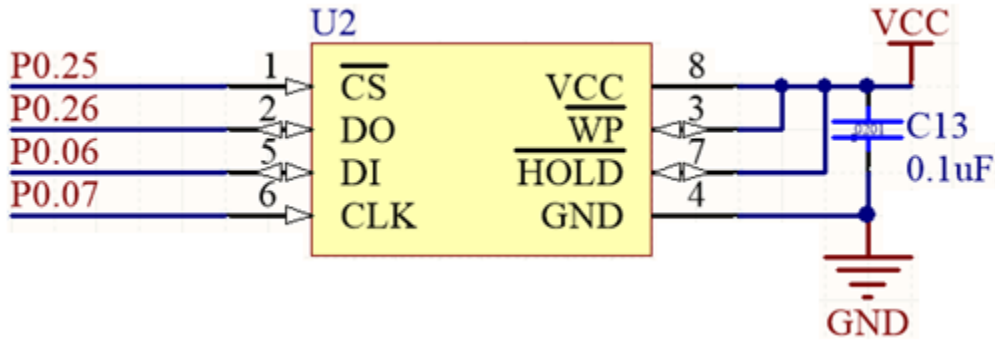
Figure 3 – SPI Flash Circuit

5.8 RTC Thermistor

The module includes a NTC thermistor circuit for measuring on board temperature. The circuit can be found in Figure 4. The RTC thermistor is the Murata NCP15WM474J03RC and is connected to AIN4 (P0.04) on the nRF52832.
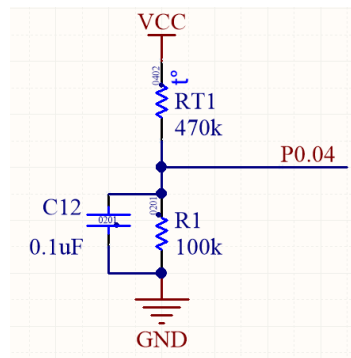

Figure 4 – RTC Thermistor Circuit

6. Firmware

All modules are shipped with blank from the factory, except the Rigado MAC address is programmed into the UICR.

6.1 SoftDevices

Nordic Semiconductor protocol stacks are known as SoftDevices. SoftDevices are pre-compiled, pre-linked binary files. SoftDevices can be programmed in nRF52 series SoCs and are downloadable from the Nordic website. The BMD-SRA-1 with the nRF52832 SoC supports the S132 (BLE Central & Peripheral) SoftDevice.

6.1.1 S132

The S132 SoftDevice is a Bluetooth® low energy (BLE) Central and Peripheral protocol stack solution supporting up to three Central and one Peripheral simultaneous connections and concurrent Observer and Broadcaster roles. It integrates a 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 4.2 compliant low energy single-mode protocol stack suitable for Bluetooth Smart products*
- *Concurrent Central, Observer, Peripheral, and Broadcaster roles with up to:*
    - *Three connections as a central*
    - *One connection as a peripheral*
    - *Observer*
    - *Broadcaster*
- *Link layer*

- *L2CAP, ATT, and SM protocols*
- *GATT and GAP APIs*
- *GATT Client and Server*
- *Complementary nRF52 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 ARM® CortexTMM4F project configuration for application development*
- *Support for concurrent and non-concurrent multiprotocol operation*
  - *Concurrent with the Bluetooth stack using concurrent multiprotocol timeslot API*
- *Alternate protocol stack in application space*

6.2 MAC Address Info

The BMD-SRA-1 modules 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.

The 6-byte BLE Radio MAC address is stored in the nRF52832 UICR at NRF_UICR_BASE+0x80 LSB first. Please read the MAC Address Provisioning application note 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)

7. Mechanical Data
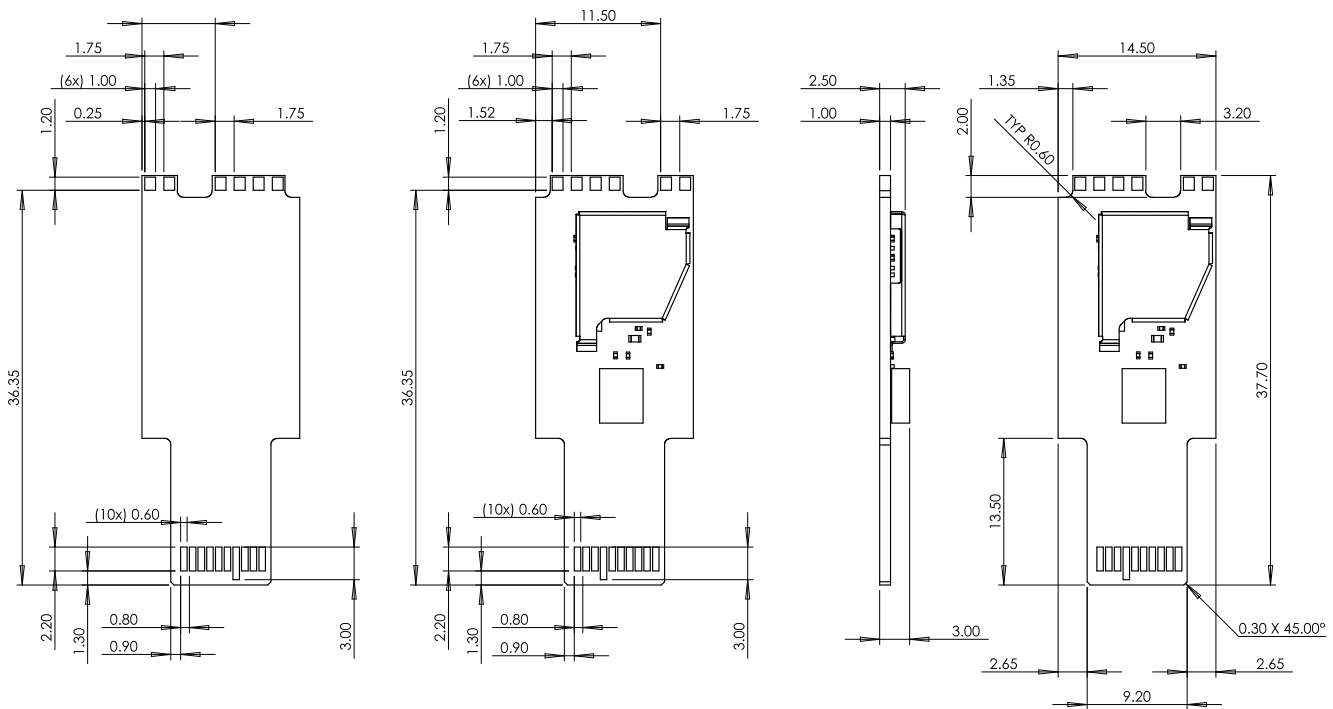
7.1 BMD-SRA-1 Dimensions

Figure 5 – BMD-SRA-1 Module Dimensions

(All dimensions are in mm)

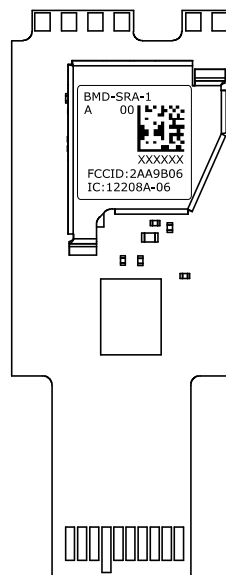# 8. Module Marking

8.1 BMD-SRA-1 Module Marking

Figure 6 – BMD-SRA-1 Module Marking – Rev A

9. Regulatory Statements

9.1 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.

9.2 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 this document.

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 transmitter antenna.

(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 an accredited test facility.

(4) End product labeling :
The final end product must be labeled in a visible area with the following:
- BMD-SRA-1: "Contains **FCC ID: 2AA9B06**"
- 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)).

9.3 IC Statement:

This device complies with Industry Canada license-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 .

9.4 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:
- BMD-SRA-1: "Contains **IC: 12208A-06**"

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 license-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."

9.5 CE Regulatory:

The BMD-SRA-1 modules are tested and 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 300 328 V 1.9.1

From Directive 2004/108/EC:
- ETSI EN 301 489-1 V1.9.2
- ETSI EN 301 489-17 V2.2.1

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

9.6 Japan (MIC)

The BMD-SRA-1 modules have received type certification and is labeled with its own technical conformity mark and certification number as required to conform to the technical standards regulated by the Ministry of Internal Affairs and Communications (MIC) of Japan pursuant to the Radio Act of Japan. Integration of this module into a final end product does not require additional radio certification provided installation instructions are followed and no modifications of the module are allowed. Additional testing may be required:

- If the host product is subject to electrical appliance safety (for example, powered from an AC mains), the host product may require Product Safety Electrical Appliance and Material (PSE) testing. The integrator should contact their conformance laboratory to determine if this testing is required.
- There is a voluntary Electromagnetic Compatibility (EMC) test for the host product administered by VCCI: http://www.vcci.jp/vcci_e/index.html

Note: Japan Certifications for the BMD-SRA-1 are pending.

The label on the final end product which contains a BMD-SRA-1 module must follow the MIC marking requirements. Labeling requirements for Japan available at the Ministry of Internal Affairs and Communications (MIC) website: http://www.tele.soumu.go.jp/e/index.htm.

The BMD-SRA-1 module is labeled with its assigned technical conformity mark and certification number. The final end product in which this module is being used must have an external label referring to the type certified module inside:

Contains transmitter module with certificate number:
TBD

9.7 Australia / New Zealand

The BMD-SRA-1 modules have been tested to comply with the AS/NZS 4268 :2012+AMDT 1:2013, Radio equipment and systems – Short range devices – Limits and methods of measurement. The report may be downloaded from www.rigado.com, and may be used as evidence in obtaining permission to use the RCM. Information on registration as a Responsible Party, license and labeling requirements may be found at the following websites:

Australia: http://www.acma.gov.au/theACMA/radiocommunications-short-range-devices-standard-2004

New Zealand: http://www.rsm.govt.nz/compliance

The A-Tick and C-Tick marks are being migrated to the Regulatory Compliance Mark (RCM). Only Australian-based and New Zealand-based companies who are registered may be granted permission to use the RCM. An Australian-based or New Zealand-based agent or importer may also register as a Responsible Party to use the RCM on behalf of a company not in Australia or New Zealand.

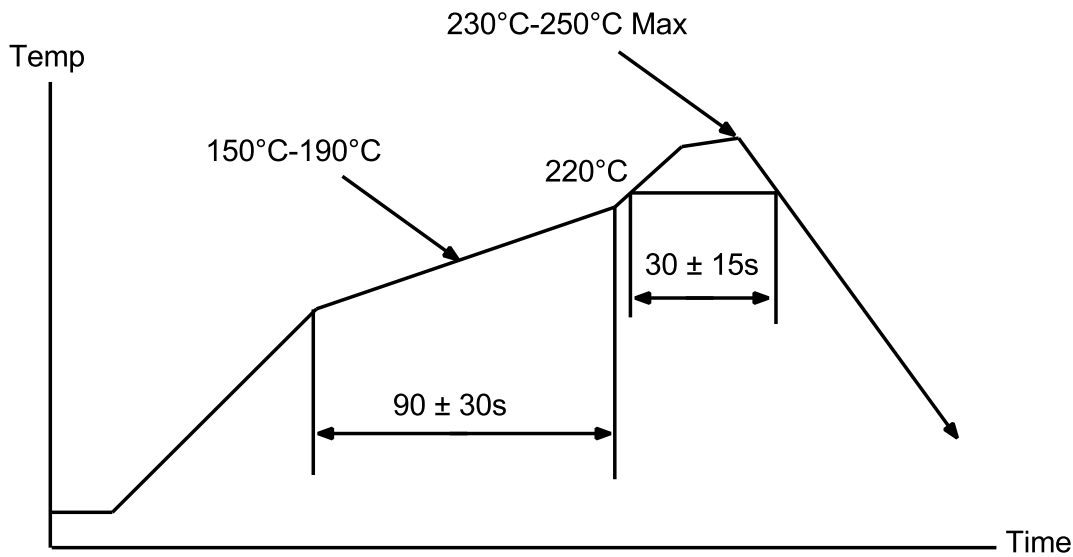# 10. Solder Reflow Temperature-Time Profile

Figure 7 – Reflow Profile for Lead Free Solder

10.1 Moisture Sensitivity Level

The BMD-SRA-1 is rated for MSL 3, 168-hour floor life after opening.

11. 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) If hand soldering is used, be sure to use the precautions outlined in this document.
9) This module should be kept away from heat, both during storage and after installation.
10) Do not drop or physically shock the module.
11) Do not damage the interface surfaces of the module.
12) The module should not be mechanically stressed at any time (storage, handling, installation).
13) 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 125°C.

12. 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.

13. Document History

Revision	Date	Changes / Notes
0.8	9/22/2016	Initial preliminary release
0.9	9/29/2016	Updated mechanical drawing
1.0	10/25/2016	Updated certification status

14. Related Documents

Nordic Documents:

Visit infocenter.nordicsemi.com for a comprehensive library of Nordic technical documentation.

- nRF52832 – nRF52832 Product Specification
- S132-SDS – nRF52832 S132 Soft Device Specification