

## ***BMD-ICN-1 Module for Bluetooth 4.1 LE***

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## 1. Quick Specifications

| <b>Bluetooth</b>                                  |  |
|---|--|
| Version   | 4.1 ( <i>Bluetooth</i> Smart) Peripheral/Central (S130)  |
| Security  | AES-128  |
| LE connections                                    | up to 3 as Central, up to one a Peripheral (S130, simultaneous)  |
| <b>Radio</b>                                      |  |
| 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   | PCB Trace Antenna  |
| <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  | 18.5mm   |
| Width   | 13.25 mm   |
| Height  | 2.0 mm   |
| <b>Hardware</b>                                   |  |
| Interface   | SPI Master/Slave, UART, Two-Wire Master, GPIO  |
| Power supply                                      | 1.8V to 3.6V   |
| Temperature Range                                 | -25 to +75°C   |
| <b>Certifications</b>                             |  |
| FCC   | FCC part 15 modular qualification – FCC ID: OMCBMD1  |
| IC  | Industry Canada RSS-210 modular qualification – IC: 3673A-BMD1   |
| CE  | EN 60950-1: 2011-01 3.1 (a) : Health and Safety of the User<br>EN 301 489-17 V2.2.1 3.1 (b) : Electromagnetic Compatibility<br>EN 300 328 V1.8.1 3.2 : Effective use of spectrum allocated |
| Bluetooth   | End Product with S130 1.0.0 – DID: TBD   |

Table 1- Quick Specifications

## 2. Pin Descriptions

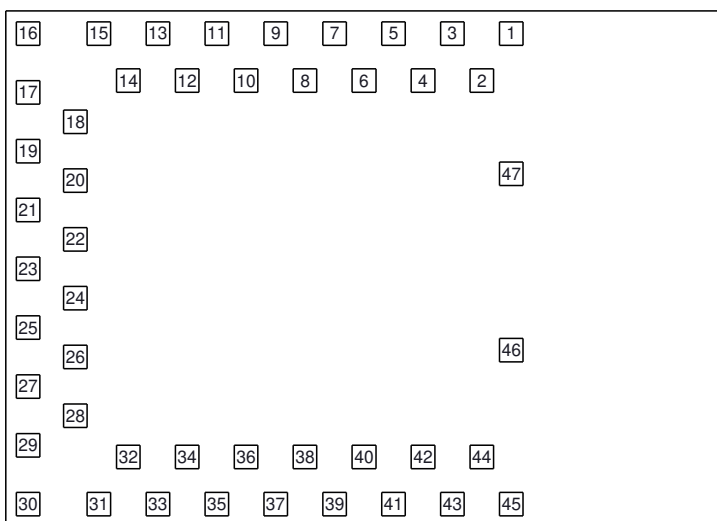


Figure 1- Pin out (Top View)

### Pin description

| Name  | Pin  | Direction | Description           |
|-------|--|-----------|-----------------------|
| P0.21 | 7  | In/Out    | GPIO                  |
| P0.22 | 8  | In/Out    | GPIO                  |
| P0.23 | 9  | In/Out    | GPIO                  |
| P0.24 | 10   | In/Out    | GPIO                  |
| P0.25 | 11   | In/Out    | GPIO                  |
| P0.26 | 12   | In/Out    | GPIO                  |
| P0.27 | 13   | In/Out    | GPIO                  |
| P0.28 | 14   | In/Out    | GPIO                  |
| P0.29 | 15   | In/Out    | GPIO                  |
| P0.30 | 19   | In/Out    | GPIO                  |
| P0.00 | 20   | In/Out    | DTM UART RX           |
| P0.01 | 21   | In/Out    | DTM UART TX           |
| P0.02 | 22   | In/Out    | GPIO                  |
| P0.03 | 23   | In/Out    | GPIO                  |
| P0.04 | 24   | In/Out    | GPIO                  |
| P0.05 | 25   | In/Out    | GPIO                  |
| P0.06 | 26   | In/Out    | GPIO                  |
| P0.07 | 27   | In/Out    | GPIO                  |
| P0.08 | 28   | In/Out    | GPIO                  |
| P0.09 | 31   | In/Out    | GPIO                  |
| P0.10 | 32   | In/Out    | GPIO                  |
| P0.11 | 33   | In/Out    | GPIO                  |
| P0.12 | 34   | In/Out    | GPIO                  |
| P0.13 | 35   | In/Out    | GPIO                  |
| P0.14 | 36   | In/Out    | GPIO                  |
| P0.15 | 37   | In/Out    | GPIO                  |
| P0.16 | 38   | In/Out    | GPIO                  |
| SWDIO | 39   | In/Out    | SWDIO/ RESET          |
| SWCLK | 40   | In        | SW Clock              |
| P0.17 | 41   | In/Out    | GPIO                  |
| P0.18 | 42   | In/Out    | GPIO                  |
| P0.19 | 43   | In/Out    | GPIO                  |
| P0.20 | 44   | In/Out    | GPIO                  |
| VCC   | 17   | Pwr       | +1.8 to +3.6VDC input |
| GND   | 1, 2, 3, 4, 5, 6, 16, 18, 29, 30, 45, 46, 47 | Pwr       | Electrical Ground     |

Table 2 – Pin Descriptions

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

## 3. Electrical Specifications

### 3.1. Absolute 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   |

Table 3 – Absolute Maximum Ratings

### 3.2. Operating Conditions

| Symbol             | Parameter   | Min. | Typ. | Max. | Unit |
|--------------------|---|------|------|------|------|
| V <sub>CC</sub>    | Operating supply voltage                          | 1.8  | 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   |
| T <sub>Aext</sub>  | Extended Operating Temperature Range <sup>1</sup> | -25  | 25   | 85   | °C   |

Note 1: V<sub>CC</sub> 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 (QFAC variant).

Table 4 – Operating Conditions

### 3.3. General Purpose I/O

The general purpose I/O is organized as one port enabling access and control of the 31 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 <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   |

Table 5 - GPIO

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.

### 3.4. Debug & Programming

The BMD-ICN-1 supports the two pin Serial Wire Debug (SWD) interface and allows for debugging of program code. Breakpoints, single stepping, and instruction trace capture of code execution flow are part of this support.

### 3.5. Clocks

The BMD-ICN-1 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. The internal RC oscillator is sufficient for BLE operation and most designs, unless more accurate time keeping is required.

#### 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         |

Table 6 - 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         | $\mu A$ |
| $I_{RC32k}$       | 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     |

Table 7 - 32.768 kHz Oscillator

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

## 4. Mechanical Data

### 4.1. Module Dimensions

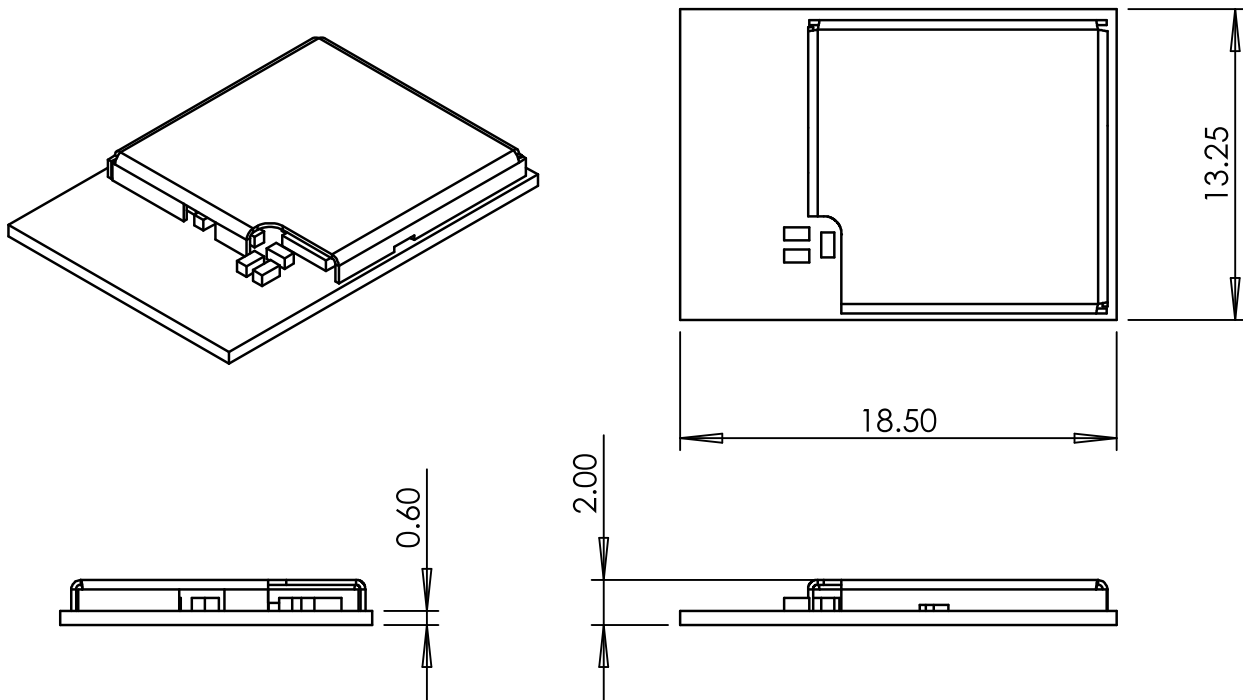


Figure 2- Module Dimensions

(All dimensions are in mm)

### 4.2. Recommended PCB Land Pad

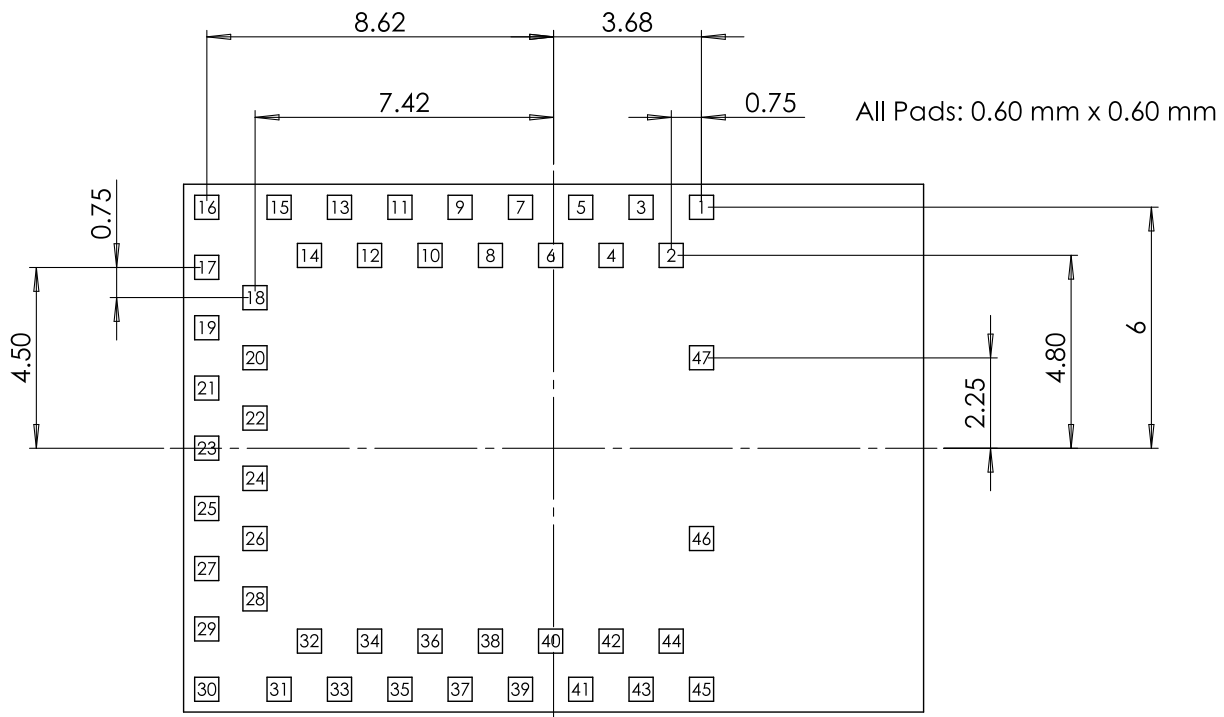


Figure 3- Module Dimensions

(All dimensions are in mm)

## 5. Module Marking

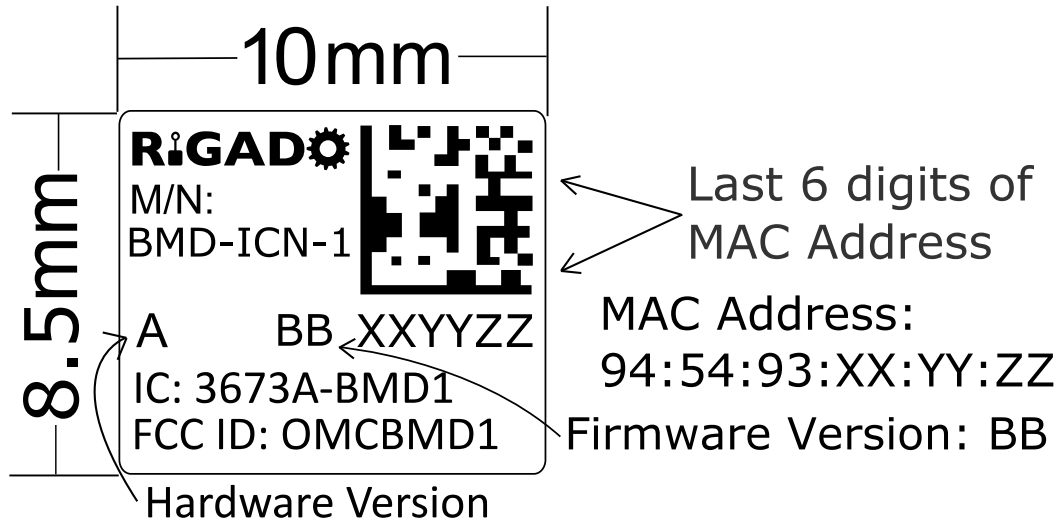


Figure 4 – Module Marking – Rev A – BMD-ICN-1-A (16kB)

Figure 5- Recommended RF Layout

### 5.1. 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.

## 6. Regulatory Statements

### 6.1. 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.**

### 6.2. 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: OMCBMD1**”. 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)).

### **6.3. 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 .

## 6.4. 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: 3673A-BMD1**".

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."

## 6.5. 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

## 7. Solder Reflow Temperature-Time Profile

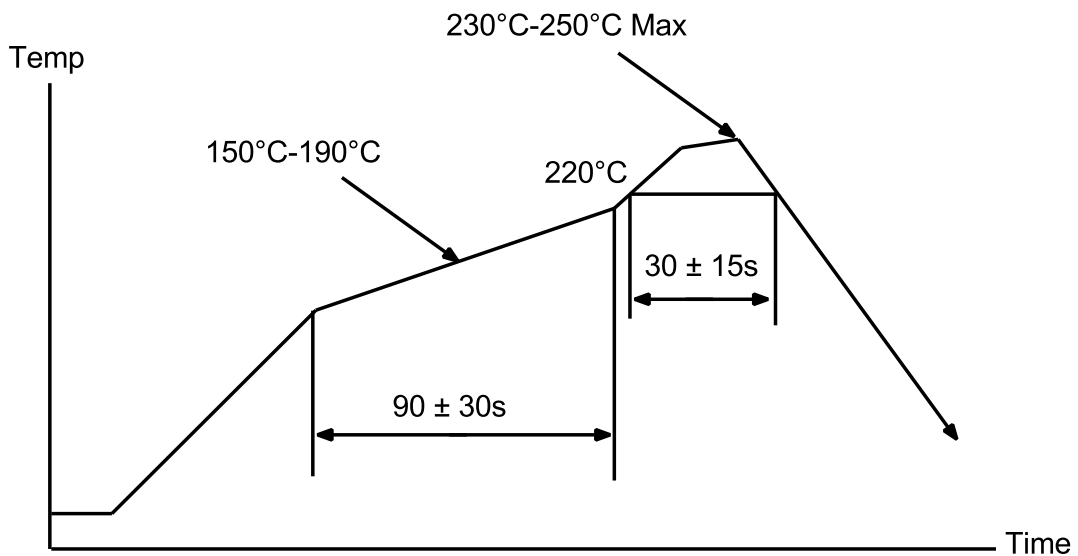


Figure 6 - Reflow Profile for Lead Free Solder