



## BM15\_AN R2 BLE Single Mode Module Product Specification

|                     |                        |
|---------------------|------------------------|
| <b>Model Name</b>   | BM15_AN R2             |
| <b>Project code</b> |                        |
| <b>Description</b>  | BLE Single Mode Module |
| <b>Revision</b>     | 1.4                    |
| <b>Issue Date</b>   | 2017/09/26             |

|                    |                    |                  |
|--------------------|--------------------|------------------|
| <b>Approved by</b> | <b>Reviewed by</b> | <b>Issued by</b> |
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## Revision History

| Revision | Released Date | Comments/Remark                                      | Author    |
|----------|---------------|------------------------------------------------------|-----------|
| 1.0      | 2017/03/07    | Initial release                                      | Aaron Lai |
| 1.1      | 2017/03/29    | Update reflow profile                                | Aaron Lai |
| 1.2      | 2017/06/07    | Update module photo and correct content typo         | Aaron Lai |
| 1.3      | 2017/07/10    | Update GPIO pin 31 description and Reference Circuit | Aaron Lai |
| 1.4      | 2017/09/26    | Update ME drawing, layout and placement section      | Aaron Lai |

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# 1. INTRODUCTION

Based on TI's outstanding CC2640R2 BLE technology, Innocomm's BM15\_AN R2 module is a wireless microcontroller (MCU) targeting Bluetooth® 4.2 and Bluetooth 5 low-energy applications.

It is with very low active RF and MCU current and low-power mode current consumption provide excellent battery lifetime and allow for operation on small coin cell batteries and in energy-harvesting applications and embedded PCB antenna.

BM15\_AN R2 module contains a powerful 32-bit Cortex M3 running up to 48 MHz as the main processor and a rich peripheral feature set that includes a unique ultra-low power sensor controller.

Bluetooth low energy controller and host libraries are embedded in ROM and run partly on an ARM® Cortex®-M0 processor. This architecture improves overall system performance and power consumption and frees up significant amounts of flash memory for the application.

## 2. General Information

### 2.1 Key Features

#### RF

- 2.4-GHz RF Transceiver Compatible With Bluetooth low energy (BLE) 4.2 and 5 Specifications
- Supports data rates between 1 Mbps
- Programmable output power up to +5 dBm
- Excellent Receiver Sensitivity (–97 dBm for BLE), Selectivity, and Blocking Performance
- Suitable for Systems Targeting Compliance With Worldwide Radio Frequency Regulations
  - ETSI EN 300 328 (Europe)
  - EN 300 440 class 2 (Europe)
  - FCC CFR47 Part 15 (US)
  - ARIB STD-T66 (Japan)

#### Layout

- Few External Components
- 18.0 mm × 10.5 mm × 2.0 mm, 26 pin LCC Package

#### Low Power

- Wide supply voltage range : 1.9 – 3.8V
- Differential RF mode : 6.4±3 mA
- Differential RF mode TX at 0 dBm: 6.8±0.3 mA
- Differential RF mode TX at +5 dBm: 8.9±0.3mA
- Low Power Mode: 1 µA (RTC Running + RAM/CPU retention)
- Low Power Mode: 100 nA (Flash retention)

#### Peripherals

- Integrated Temperature Sensor
- Four General-Purpose Timer Modules (Eight 16-Bit or Four 32-Bit Timers, PWM Each)
- 12-bit ADC, 200-ksamples/s, 8-Channel Analog MUX
- Ultra-Low-Power Analog Comparator
- UART
- 2x SSI (SPI, MICROWIRE, TI)
- Ultra-low power
- I2C, I2S
- Real-time clock
- AES-128 security module
- 15 GPIOs
- Support for 8 capacitive sensing channels

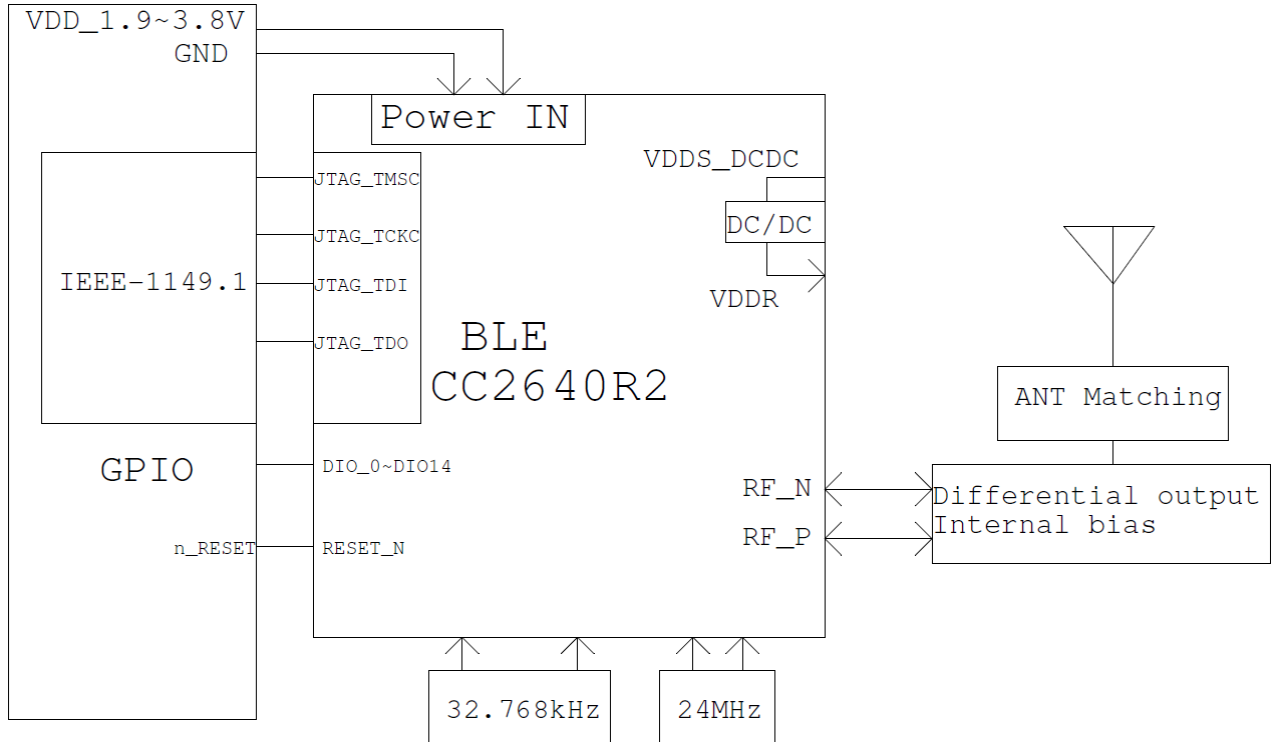
#### Application

- Home and Building Automation
  - Connected Appliances
  - Lighting
  - Locks
  - Gateways
  - Security Systems
- Industrial
  - Logistics
  - Production and Manufacturing Automation
  - Asset Tracking and Management

- HMI and Remote Display
  - Access Control
- Retail
  - Beacons
  - Advertising
  - ESL and Price Tags
  - Point of Sales and Payment Systems
- Health and Medical
  - Thermometers
  - SpO2
  - Blood Glucose and Pressure Meters
  - Weight Scales
  - Hearing Aids
- Sports and Fitness
  - Activity Monitors and Fitness Trackers
  - Heart Rate Monitors
  - Running and Biking Sensors
  - Sports Watches
  - Gym Equipment
  - Team Sports Equipment
- HID
  - Voice Remote Controls
  - Gaming
  - Keyboards and Mice

## 2.2 Block Diagram

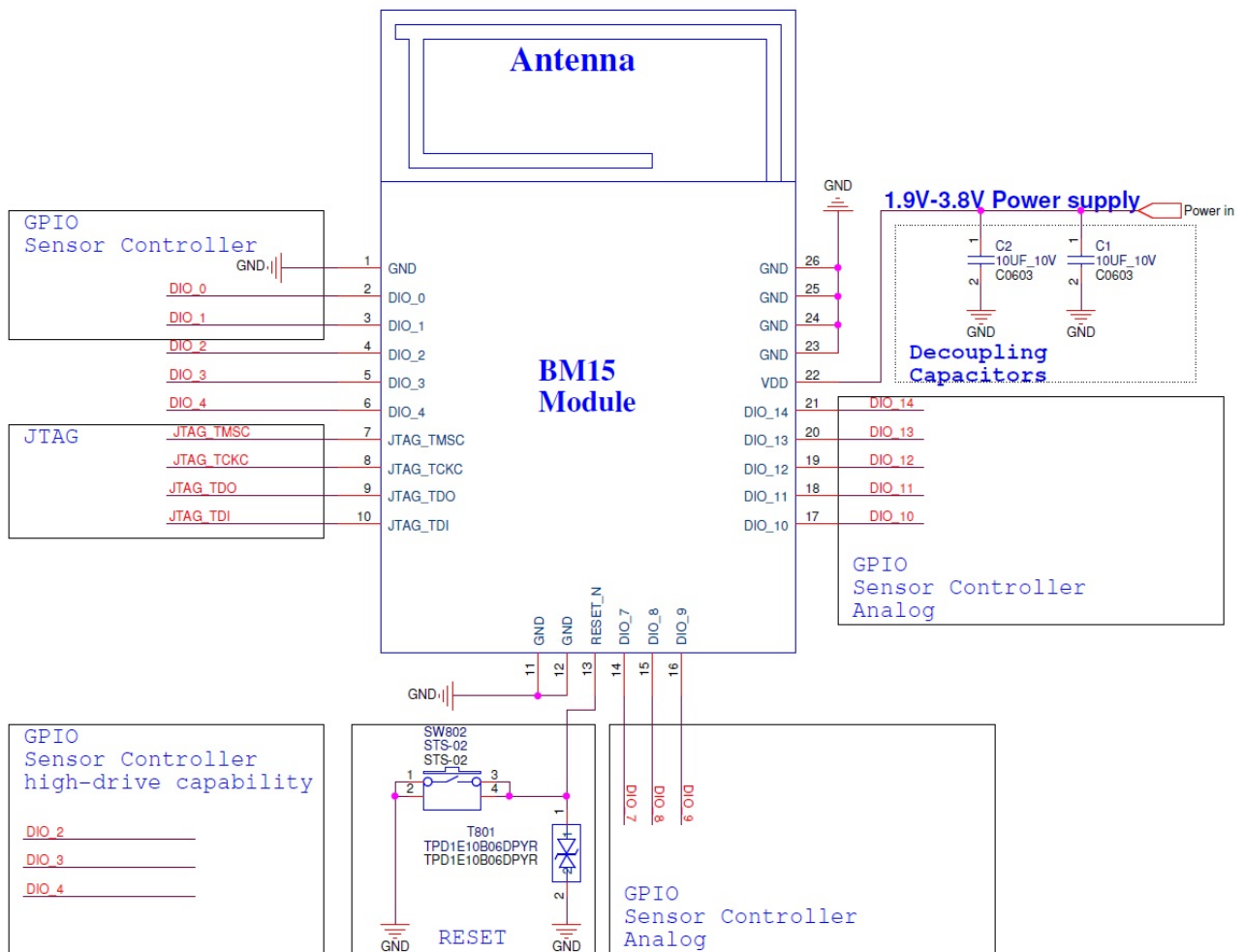
BLE-MODULE-LGA-PIN26



### 3. PIN Map and Signal Description

| Pin # | Pin Name  | Direction/Type     | Description                                    |
|-------|-----------|--------------------|------------------------------------------------|
| 1     | GND       | Power              | Ground                                         |
| 2     | DIO_0     | Digital I/O        | GPIO, Sensor Controller                        |
| 3     | DIO_1     | Digital I/O        | GPIO, Sensor Controller                        |
| 4     | DIO_2     | Digital I/O        | GPIO, Sensor Controller, high-drive capability |
| 5     | DIO_3     | Digital I/O        | GPIO, Sensor Controller, high-drive capability |
| 6     | DIO_4     | Digital I/O        | GPIO, Sensor Controller, high-drive capability |
| 7     | JTAG_TMSC | Digital I/O        | JTAG TMS, high-drive capability                |
| 8     | JTAG_TCKC | Digital I/O        | JTAG TCKC                                      |
| 9     | JTAG_TDO  | Digital I/O        | GPIO, High drive capability, JTAG_TDO          |
| 10    | JTAG_TDI  | Digital I/O        | GPIO, High drive capability, JTAG_TDI          |
| 11    | GND       | Power              | Ground                                         |
| 12    | GND       | Power              | Ground                                         |
| 13    | nRESET    | Digital input      | Reset, active-low, with internal pull-up       |
| 14    | DIO_7     | Digital/Analog I/O | GPIO, Sensor Controller, Analog                |
| 15    | DIO_8     | Digital/Analog I/O | GPIO, Sensor Controller, Analog                |
| 16    | DIO_9     | Digital/Analog I/O | GPIO, Sensor Controller, Analog                |
| 17    | DIO_10    | Digital/Analog I/O | GPIO, Sensor Controller, Analog                |
| 18    | DIO_11    | Digital/Analog I/O | GPIO, Sensor Controller, Analog                |
| 19    | DIO_12    | Digital/Analog I/O | GPIO, Sensor Controller, Analog                |
| 20    | DIO_13    | Digital/Analog I/O | GPIO, Sensor Controller, Analog                |
| 21    | DIO_14    | Digital/Analog I/O | GPIO, Sensor Controller, Analog                |
| 22    | VDD       | Power              | 1.9V to 3.8V main chip supply                  |
| 23    | GND       | Power              | Ground                                         |
| 24    | GND       | Power              | Ground                                         |
| 25    | GND       | Power              | Ground                                         |
| 26    | GND       | Power              | Ground                                         |

## 3.1 Reference Circuit



## 4. ELECTRICAL CHARACTERISTICS

### 4.1 Recommended Operating Range

| PARAMETER                                           | CONDITIONS                                        | MIN | NOM | MAX | UNIT |
|-----------------------------------------------------|---------------------------------------------------|-----|-----|-----|------|
| Operating ambient temperature range, T <sub>A</sub> |                                                   | −40 |     | 85  | °C   |
| Operating supply voltage                            | For operation in battery-powered and 3.3V systems | 1.9 |     | 3.8 | V    |

### 4.2 Power Consumption

Unless noted, all specifications are at 25 °C and Vbat = 3.0 V.

| PARAMETER                     | TEST CONDITIONS                                     | MIN | TYP | MAX | UNIT |
|-------------------------------|-----------------------------------------------------|-----|-----|-----|------|
| Low Power Mode (LPM4.5)       | Shutdown. No clocks running, no retention           |     | 100 |     | nA   |
| Low Power Mode (LPM3)         | With RTC, CPU, RAM and (partial) register retention |     | 1   |     | uA   |
| Power consumption radio RX(2) | With DC/DC                                          | 6.1 | 6.4 | 6.7 | mA   |
| Power consumption radio TX(2) | With DC/DC, 0 dBm output power                      | 6.5 | 6.8 | 7.1 | mA   |
| Power consumption radio TX(2) | With DC/DC, 5 dBm output power                      | 8.6 | 8.9 | 9.2 | mA   |

## 5. RF Characteristics

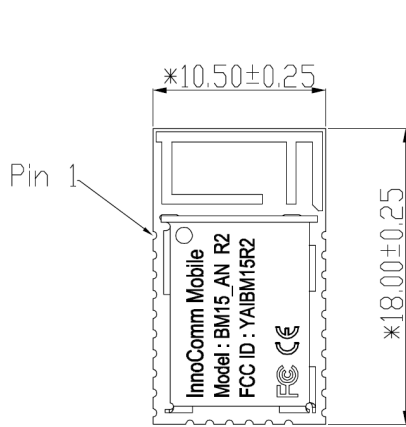
### 1 Mbps GFSK (Bluetooth low energy)

Unless noted, all specifications are at 25 °C, Vbat = 3.0 V and  $f_{RF} = 2440\text{MHz}$ .

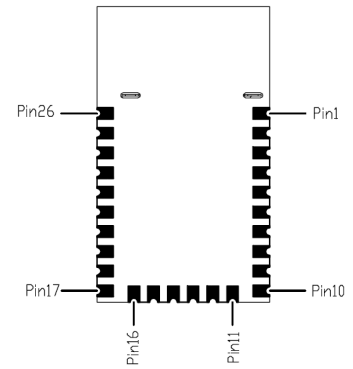
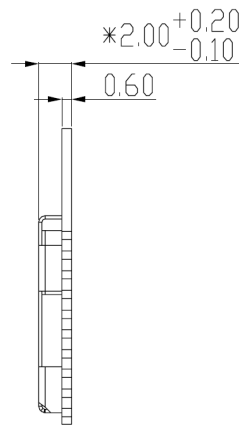
| PARAMETER                        | TEST CONDITIONS                                                                                                                            | MIN | TYP | MAX | UNIT |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| RX Receiver sensitivity          | Differential mode, measured in 50Ω single-ended, BER=10 <sup>-3</sup>                                                                      |     | -97 |     | dBm  |
| TX Output power, highest setting | Differential mode, delivered to a single ended 50 Ω load                                                                                   |     | +5  |     | dBm  |
| TX Output power, lowest setting  | Delivered to a single ended 50Ω load                                                                                                       |     | -20 |     | dBm  |
| Spurious emission 30-1000 MHz    | Conducted measurement in a 50Ω single ended load.<br>Complies with EN 300 328, EN 300 440 class 2, FCC CFR47,<br>Part 15 and ARIB STD-T-66 |     |     | -57 | dBm  |
| Spurious emission 1-12.75 GHz    |                                                                                                                                            |     |     | -47 | dBm  |

**Note:** BM15\_AN R2 module is with “Internal bias” mode design and related SW setting need to match with “Internal bias” mode.

## 6. Mechanical Information



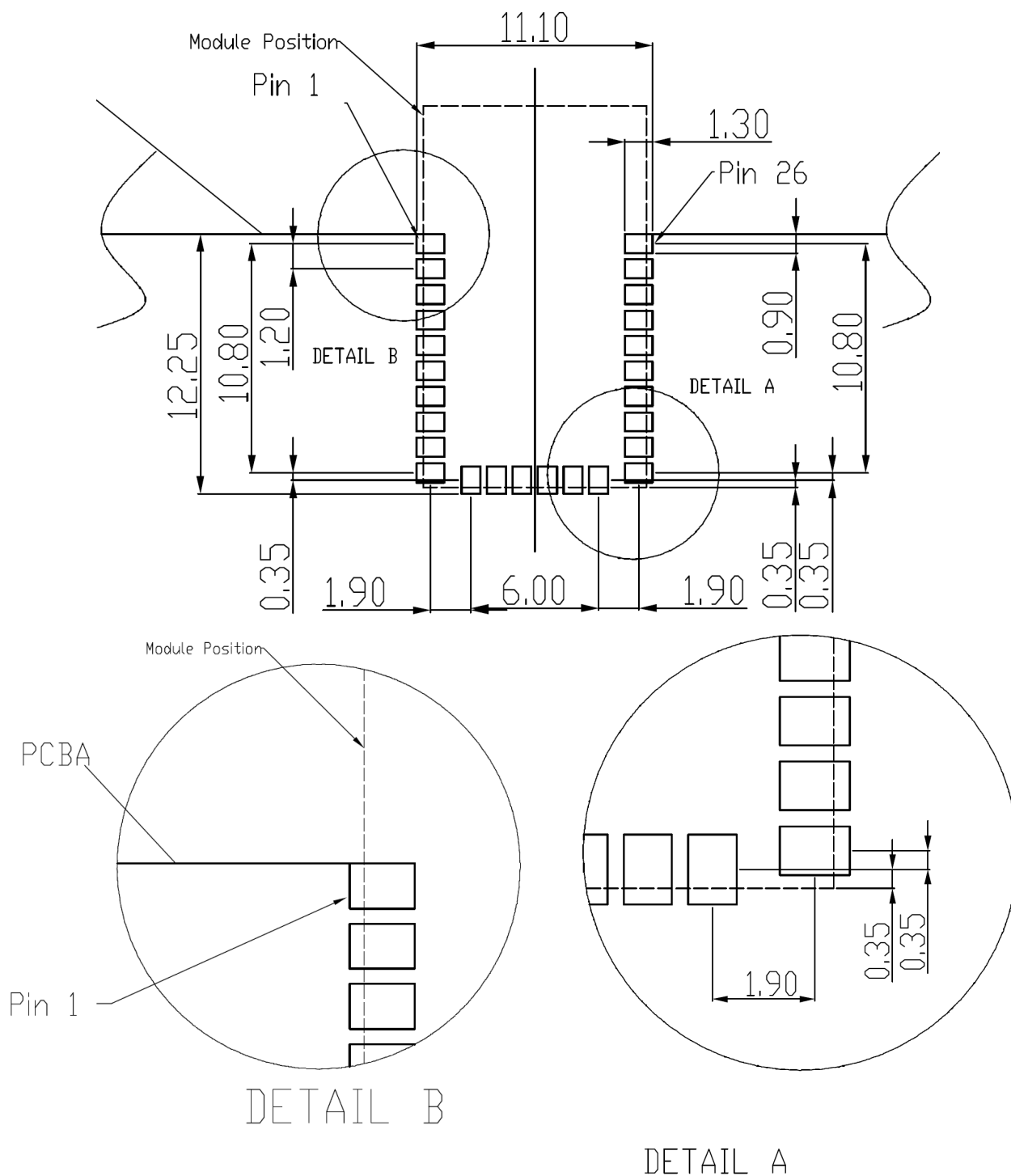
TOP VIEW



BOTTOM VIEW

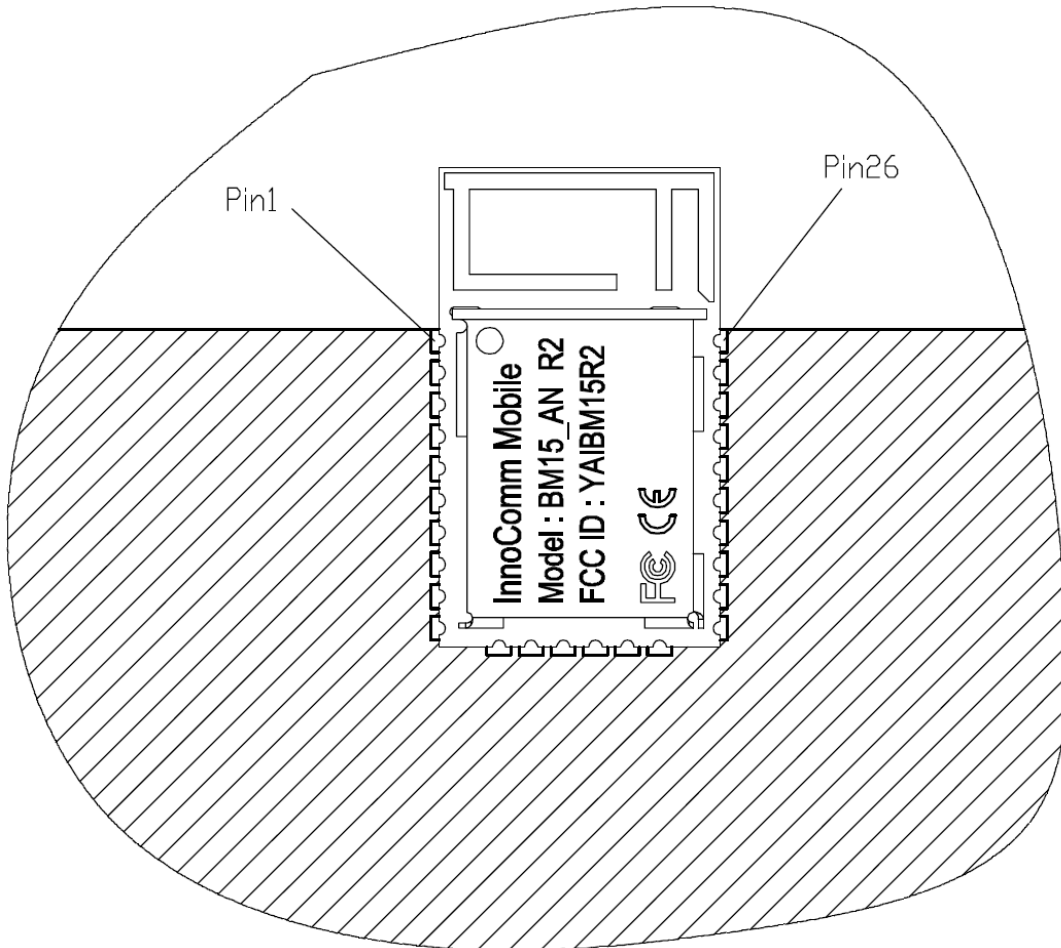
## 7. PCB Layout Recommendation

### TOP VIEW

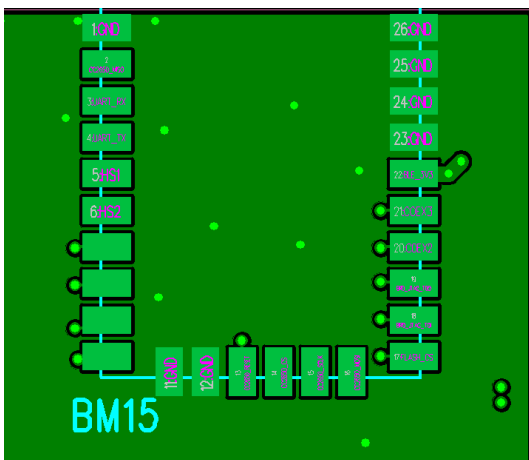


## 8. Module Placement Layout Guide

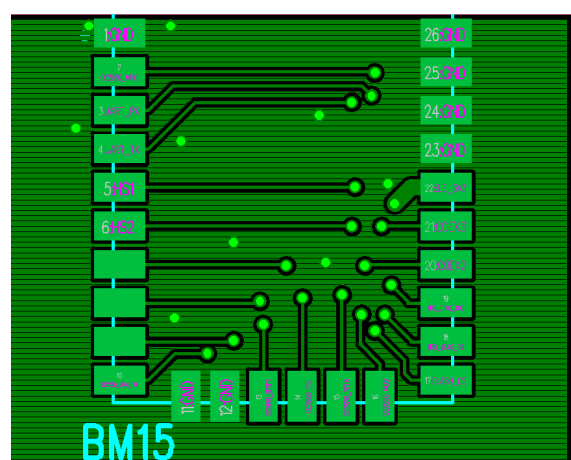
**Placement Note:** Please refer to “BM15\_AN Module\_Placement guideline v1.0.pdf”.



**Layout Note:** Do not route any trace under module to avoid interference.

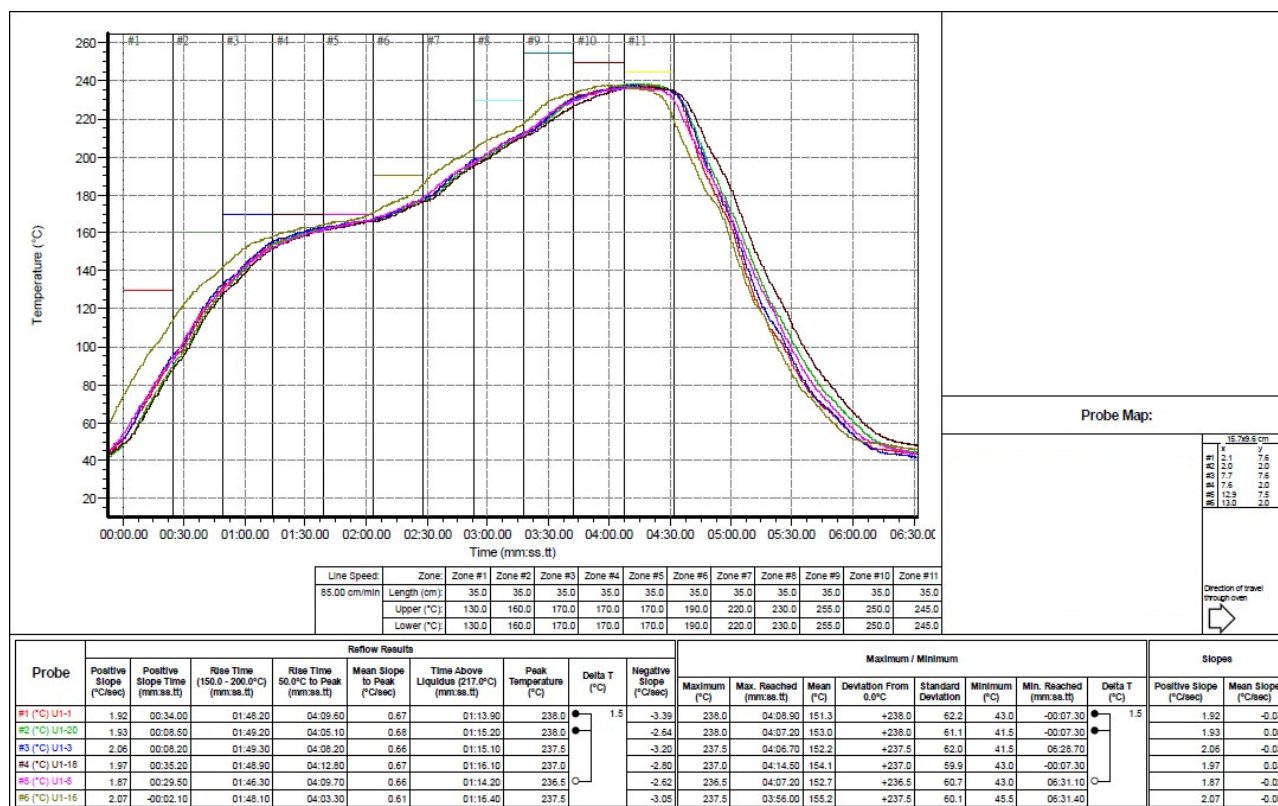


(O)



(X)

# 9. SMT Solder Reflow Recommendation



**Note:** Allowable reflow soldering times: 2 times base on recommended reflow profile.

# 10. Product and Documentation Support

## 10.1. Development Support

TI offers an extensive line of development tools, including tools to evaluate the performance of the processors, generate code, develop algorithm implementations, and fully integrated and debug software and hardware modules.

The following products support development of the CC2640 R2 device applications:

### Software Tools:

[SmartRF™ Studio 7](#) is a PC application that helps designers of radio systems to easily evaluate the RF-IC at an early stage in the design process.

- Test functions for sending and receiving radio packets, continuous wave transmit and receive
- Evaluate RF performance on custom boards by wiring it to a supported evaluation board or debugger
- Can also be used without any hardware, but then only to generate, edit and export radio configuration settings
- Can be used in combination with several development kits for Texas Instruments' CCxxxx RF-ICs

[Sensor Controller Studio](#) provides a development environment for the CC26xx Sensor Controller.

The Sensor Controller is a proprietary, power-optimized CPU in the CC26xx, which can perform simple background tasks autonomously and independent of the System CPU state.

- Allows for Sensor Controller task algorithms to be implemented using a C-like programming language
- Outputs a Sensor Controller Interface driver, which incorporates the generated Sensor Controller machine code and associated definitions
- Allows for rapid development by using the integrated Sensor Controller task testing and debugging functionality. This allows for live visualization of sensor data and algorithm verification.

### IDEs and Compilers:

Code Composer Studio:

- Integrated development environment with project management tools and editor
- Code Composer Studio (CCS) 7.0 and later has built-in support for the CC26xx device family
- Best support for XDS debuggers; XDS100v3, XDS110 and XDS200
- High integration with TI-RTOS with support for TI-RTOS Object View

IAR Embedded Workbench for ARM

- Integrated development environment with project management tools and editor
- IAR EWARM 7.80.1 and later has built-in support for the CC26xx device family
- Broad debugger support, supporting XDS100v3, XDS200, IAR I-Jet and Segger J-Link
- Integrated development environment with project management tools and editor
- RTOS plug in available for [TI-RTOS](#)

For a complete listing of development-support tools for the CC2640 R2 platform, visit the Texas Instruments website at [www.ti.com](http://www.ti.com). For information on pricing and availability, contact InnoComm Mobile Technology Corporation sales office or authorized distributor.

## 10.2. Documentation Support

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://ti.com) ([CC2640R2F](#)). In the upper right corner, click on Alert me to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

The current documentation that describes the CC2640R2F devices, related peripherals, and other technical collateral is listed in the following.

### Technical Reference Manual

[SWCU117](#) *Technical Reference Manual*. Texas Instruments CC26xx Family of Products

## 10.3. Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

[TI E2E™ Online Community](#) *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

[TI Embedded Processors Wiki](#) *Texas Instruments Embedded Processors Wiki*. Established to help developers get started with Embedded Processors from Texas Instruments and to foster innovation and growth of general knowledge about the hardware and software surrounding these devices.

## Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

**Radiation Exposure Statement:**

The product comply with the FCC portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

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

- 1) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 1 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed

**IMPORTANT NOTE:** In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

**End Product Labeling**

The product can be kept as far as possible from the user body or set the device to lower output power if such function is available. The final end product must be labeled in a visible area with the following: “Contains FCC ID: YAIBM15R2”. The grantee's FCC ID can be used only when all FCC compliance requirements are met.

**Manual Information To the End User**

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.