RF-star RF-BM-2642B1 SimpleLink Bluetooth 5 Low Energy Wireless Module User Manual

Contents

RFSTAR

RF-star RF-BM-2642B1 SimpleLink Bluetooth 5 Low Energy Wireless Module

TI CC264X BLE Module List

Chipset	Core	Flash (Byte)	RAM (KB)	TX Power (dBm)	Model	Antenna	Dimension (mm)	Range (M)	Photo
CC2640 R2FRSM	M3	128	28	2	RF-BM-4044B2	PCB	11.2 × 16.6	300	
					RF-BM-4044B3	IPEX	11.2 × 15.2	500	
					RF-BM-4044B4	CHIP	8 × 8	150	
CC2640 R2FRGZ	M3	128	28	5	RF-BM-4077B1	PCB	17 × 23.5	500	
CC2640 R2FRGZ – Q1					RF-BM-4077B2	PCB	17 × 23.5	500	
CC2642R	M4F	352	80	5	RF-BM-2642B1	PCB	17 × 23.5	500	
CC2652R	M4F	352	80	5	RF-BM-2652B1	PCB	17 × 23.5	BLE: 500 ZigBee: 300	
CC1352R	M4F	352	80	5 / 14	RF-TI1352B1	IPEX	16.8 × 26.5	BLE: 500 ZigBee: 300 868 MHz: 1500	

Note:

1. The communication distance is the longest distance obtained by testing the module's maximum transmission power in an open and interference-free environment in sunny weather.
2. Click the picture to buy modules.

Device Overview

Description

RF-BM-2642B1 is an RF module based on TI lower-power CC2642R SoC. It integrates a 48 MHz crystal and a 32.768 kHz crystal, 352 KB of in-system Programmable Flash, 256 KB ROM, 8 KB of cache SRAM, 80 KB of ultra-low leakage SRAM. Its ARM® Cortex®-M4F core application processor can operate at an extremely low current at flexible power modes. Its 2.4 GHz RF transceiver is compatible with Bluetooth 5 Low Energy. It features a small size, robust connection distance, and rigid reliability.

Key Features

- RF Section
  - 2.4GHz RF transceiver compatible with Bluetooth 5 Low Energy
  - Excellent receiver sensitivity
  - 105 dBm for BLE 125 kbps (LE coded PHY)
  - 97 dBm for 1 Mbps PHY
  - Output power up to +5 dBm with temperature compensation
  - Suitable for systems targeting compliance with worldwide radio frequency regulations
- Microcontroller
  - Powerful 48 MHz ARM® Cortex®-M4F processor
  - EEBMC CoreMark® score: 148
  - 352 KB of in-system programmable flash
  - 256 KB of ROM for protocols and library functions
  - KB of cache SRAM
  - 80 KB of ultra-low leakage SRAM
  - Support OTA upgrade
- Ultra-low-power sensor controller with 4 KB of SRAM
  - Sample, store, and process sensor data
  - Operation independent from system CPU
  - Fast wake-up for low-power operation
- Peripherals
  - Digital peripheral pins can be routed to 31 GPIOs
  - 4 × 32-bit or 8 × 16-bit general-purpose timers
  - 12-bit ADC, 200 ksamples/s, 8 channels
  - 2 × comparators with internal reference DAC
  - Ultra-low-power analog comparator
  - Programmable current source
  - 2 × UART
  - 2 × SSI (SPI, Microwave, TI)
  - I2C

- I2S
        - Real-time clock (RTC)
        - AES 128 and 256 bit Crypto accelerator
        - ECC and RSA public key hardware accelerator
        - SHA2 accelerator (full suite up to SHA-512)
        - True random number generator (TRNG)
        - Capacitive sensing, up to 8 channels
        - Integrated temperature and battery monitor
- External system
        - On-chip buck DC/DC converter
- Low Power
        - Wide supply voltage range: 1.8 V ~ 3.8 V
        - Active-mode RX: 6.9 mA
        - Active-mode TX at 0 dBm: 7.3 mA
        - Active-mode TX at +5 dBm: 9.6 mA
        - Active-mode MCU 48 MHz (CoreMark): 3.4 mA (71 µA/MHz)
        - Sensor controller, low power-mode, 2 MHz, running infinite loop: 30.8 µA
        - Sensor controller, active-mode, 24 MHz, running infinite loop: 808 µA
        - – Standby: 0.94 µA (RTC on, 80 KB RAM and CPU retention)
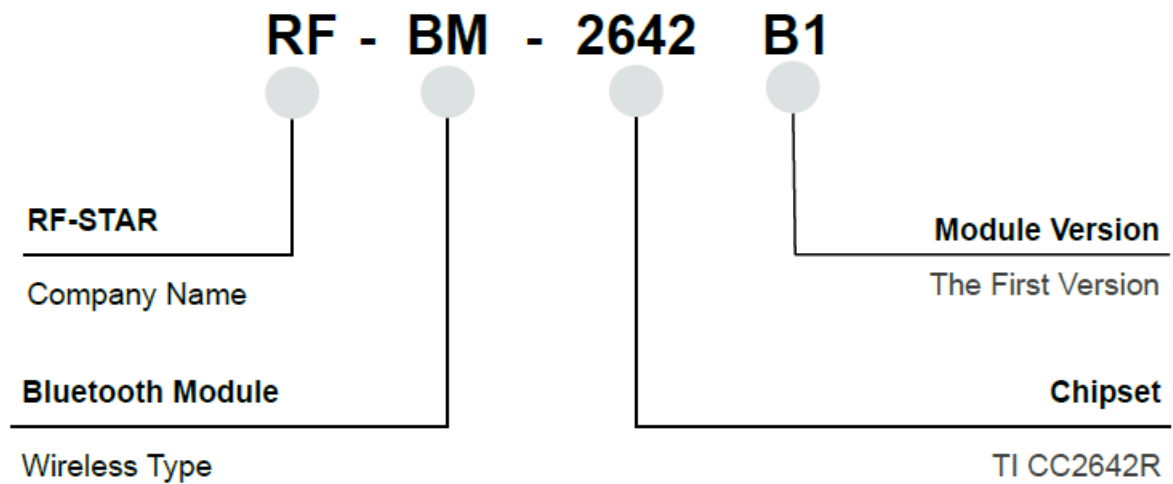   - – Shutdown: 150 nA (wakeup on external events)

Applications

- Personal electronics
- Mobile phone accessories
- Sports and fitness equipment
- HID applications
- Smart grid and automatic meter reading
- Wireless sensor networks
- Active RFID
- Energy harvesting applications
- Electronic Shelf Label (ESL)
- Home and building automation
- Wireless alarm and security systems
- Long-range sensor applications

Functional Block Diagram
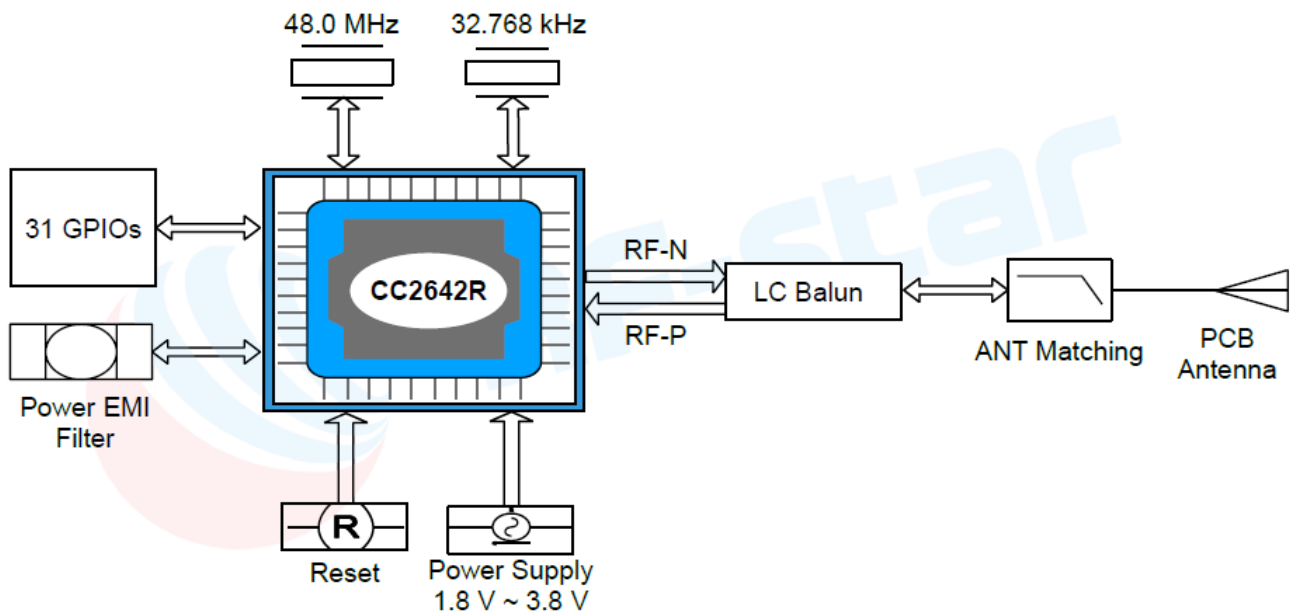
Part Number Conventions

The part numbers are of the form of RF-BM-2642B1 where the fields are defined as follows:

RF - BM - 2642 B1

RF-STAR

Company Name

Bluetooth Module

Wireless Type

Module Version

The First Version

Chipset

TI CC2642R

Module Configuration and Functions

Module Parameters

Chipset	CC2642R
Supply Power Voltage	1.8 V ~ 3.8 V, recommended to 3.3 V
Frequency	2402 MHz ~ 2480 MHz
Maximum Transmit Power	+5.0 dBm
Receiving Sensitivity	-97 dBm
GPIO	31
Power Consumption	RX current: 6.9 mA TX current: 7.3 mA @ 0 dBm 9.6 mA @ 5 dBm MCU 48 MHz (CoreMark):3.4 mA (71 µA/MHz) Sensor Controller 30.8 µA @ low power-mode, 2 MHz 808 µA @ active-mode, 24 MHz Standby: 0.94 µA Shutdown: 150 nA
Support Protocol	Bluetooth 5 Low Energy
Crystal	48 MHz, 32.768 kHz
Package	SMT packaging (Half hole)
Communication Interface	UART, SPI, I2C, I2S
Dimension	23.50 mm × 17.0 mm × (2.2 ± 0.1) mm
Type of Antenna	PCB Antenna
Operating Temperature	-40 ℃ +85 ℃
Storage Temperature	-40 ℃ +125 ℃

Module Pin Diagram

Figure 3. Pin Diagram of RF-BM-2642B1

Pin Functions

Pin	Name	Function	Description
1	P00	GPIO	GPIO, Sensor Controller
2	P01	GPIO	GPIO, Sensor Controller
3	P02	GPIO	GPIO, Sensor Controller
4	P03	GPIO	GPIO, Sensor Controller
5	P04	GPIO	GPIO, Sensor Controller
6	P05	GPIO	GPIO, Sensor Controller, high-drive capability
7	P06	GPIO	GPIO, Sensor Controller, high-drive capability
8	P07	GPIO	GPIO, Sensor Controller, high-drive capability
9	P08	GPIO	GPIO
10	P09	GPIO	GPIO
11	P10	GPIO	GPIO
12	P11	GPIO	GPIO
13	P12	GPIO	GPIO
14	P13	GPIO	GPIO

15	P14	GPIO	GPIO
16	P15	GPIO	GPIO
17	JTAG_TMSC	JTAG_TMSC	JTAG TMSC, high-drive capability
18	JTAG_TCKC	JTAG_TCKC	JTAG TCKC
19	P16	GPIO	GPIO, JTAG_TDO, high-drive capability
20	P17	GPIO	GPIO, JTAG_TDI, high-drive capability
21	P18	GPIO	GPIO
22	P19	GPIO	GPIO
23	P20	GPIO	GPIO
24	P21	GPIO	GPIO
25	P22	GPIO	GPIO
26	P23	GPIO	GPIO, Sensor Controller, Analog
27	P24	GPIO	GPIO, Sensor Controller, Analog
28	P25	GPIO	GPIO, Sensor Controller, Analog
29	P26	GPIO	GPIO, Sensor Controller, Analog
30	P27	GPIO	GPIO, Sensor Controller, Analog
31	P28	GPIO	GPIO, Sensor Controller, Analog
32	P29	GPIO	GPIO, Sensor Controller, Analog
33	P30	GPIO	GPIO, Sensor Controller, Analog
34	VDD_EB	VDD	Power Supply: 1.8 V ~ 3.8 V, recommend to 3.3 V
35	GND	GND	Ground
36	NRESET	RESET_N	Reset, active-low. No internal pullup

Specifications

Recommended Operating Conditions

The functional operation does not guarantee performance beyond the limits of the conditional parameter values in the table below. Long-term work beyond this limit will affect the reliability of the module more or less.

Items	Condition	Min.	Typ.	Max.	Unit
Operating Supply Voltage	/	1.8	3.3	3.8	V
Operating Temperature	/	-40	+25	+85	°C

Handling Ratings

Items	Condition	Min.	Typ.	Max.	Unit
Storage Temperature	Tstg	-40	+25	+125	°C
Human Body Model	HBM		±2000		V
Moisture Sensitivity Level			2		
Charged Device Model			±500		V

Power Consumption

Power Mode

Measured on the RF-BM-2642B1 reference design with Tc = 25°C, VDDS = 3.0 V with internal DC/DC converter, unless otherwise noted.

Parameter		Test Conditions	Typ.	Unit
Core Current Consumption				
Icore	Reset and Shutdown	Reset. RESET_N pin asserted or VDDS below power-on-reset threshold	150	nA
		Shutdown. No clocks running, no retention	150	nA
	Standby without cache	RTC running, CPU, 80 KB RAM and (partial) register retention.	0.94	µA

	retention	RCOSC_LF		
		RTC running, CPU, 80 KB RAM and (partial) register retention.	1.09	µA
		XOSC_LF		
	Standby with cache retention	RTC running, CPU, 80 KB RAM and (partial) register retention.	3.2	µA
		RCOSC_LF		
		RTC running, CPU, 80 KB RAM and (partial) register retention.	3.3	µA
		XOSC_LF		

	Idle	Supply Systems and RAM powered RCOSC_HF	675	µA
	Active	MCU running CoreMark at 48 MHz RCOSC_HF	3.39	mA

Peripheral Current Consumption

	Peripheral power domain	Delta current with domain enabled	97.7	µA
	Serial power domain	Delta current with domain enabled	7.2	µA
	RF Core	Delta current with power domain enabled, clock enabled, RF core idle	210.9	µA
	µDMA	Delta current with clock enabled, module is idle	63.9	µA
	Timer	Delta current with clock enabled, module is idle	81.0	µA
	I2C	Delta current with clock enabled, module is idle	10.1	µA
	I2S	Delta current with clock enabled, module is idle	26.3	µA
	SSI	Delta current with clock enabled, module is idle	82.9	µA
	UART	Delta current with clock enabled, module is idle	167.5	µA
	CRYPTO (AES)	Delta current with clock enabled, module is idle	25.6	µA
Iperi	PKA	Delta current with clock enabled, module is idle	84.7	µA
	TRNG	Delta current with clock enabled, module is idle	35.6	µA

Sensor Controller Engine Consumption

	Active mode	24 MHz, Infinite loop	808.5	µA
ISCE	Low-power mode	2 MHz, Infinite loop	30.1	µA

Radio Mode

Measured on the RF-BM-2642B1 reference design with Tc = 25°C, VDDS = 3.0 V with internal DC/DC converter, unless otherwise noted.

Parameter	Test Conditions	Typ.	Unit
Radio Receive Current	2440 MHz	6.9	mA
Radio Transmit Current	+5 dBm output power setting 2440 MHz	7.3	mA
	+5 dBm output power setting 2440 MHz	9.6	mA

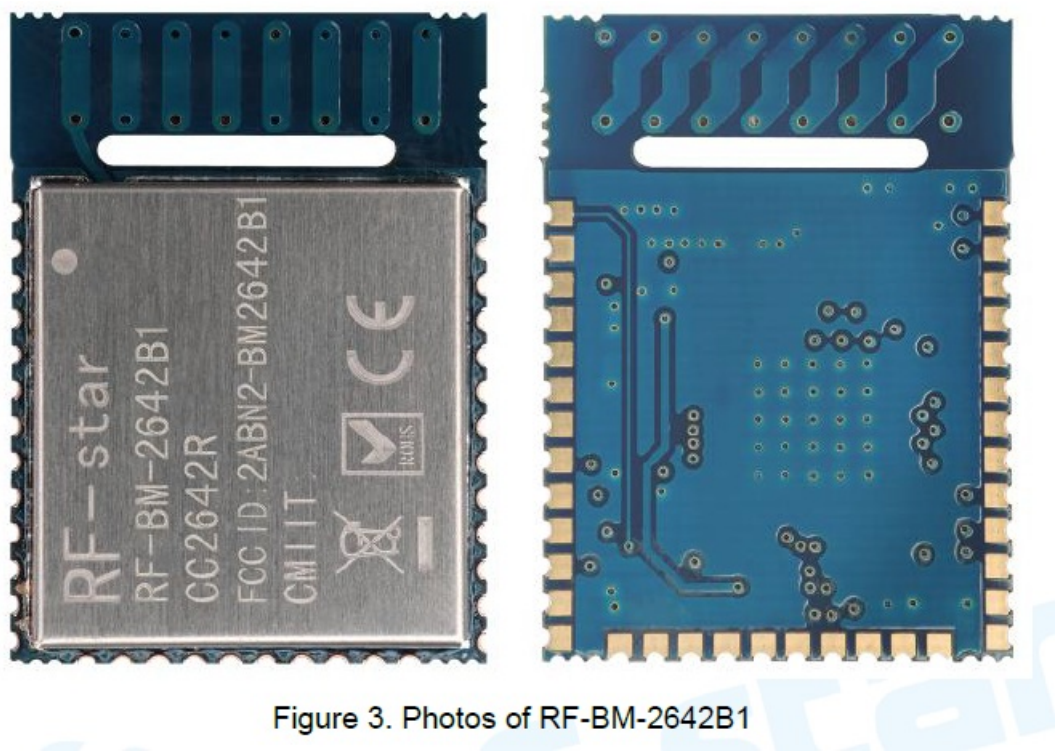## Application, Implementation, and Layout

Module Photos

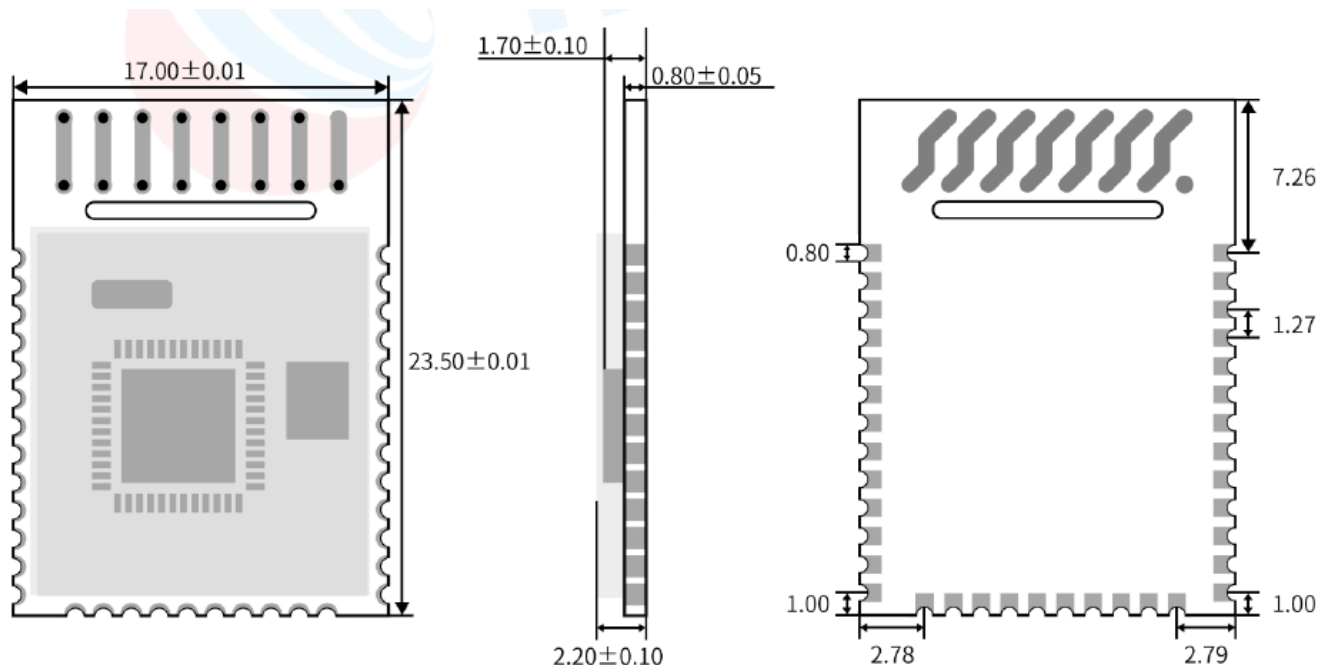Figure 3. Photos of RF-BM-2642B1

Recommended PCB Footprint

Figure 4. Recommended PCB Footprint of RF-BM-2642B1
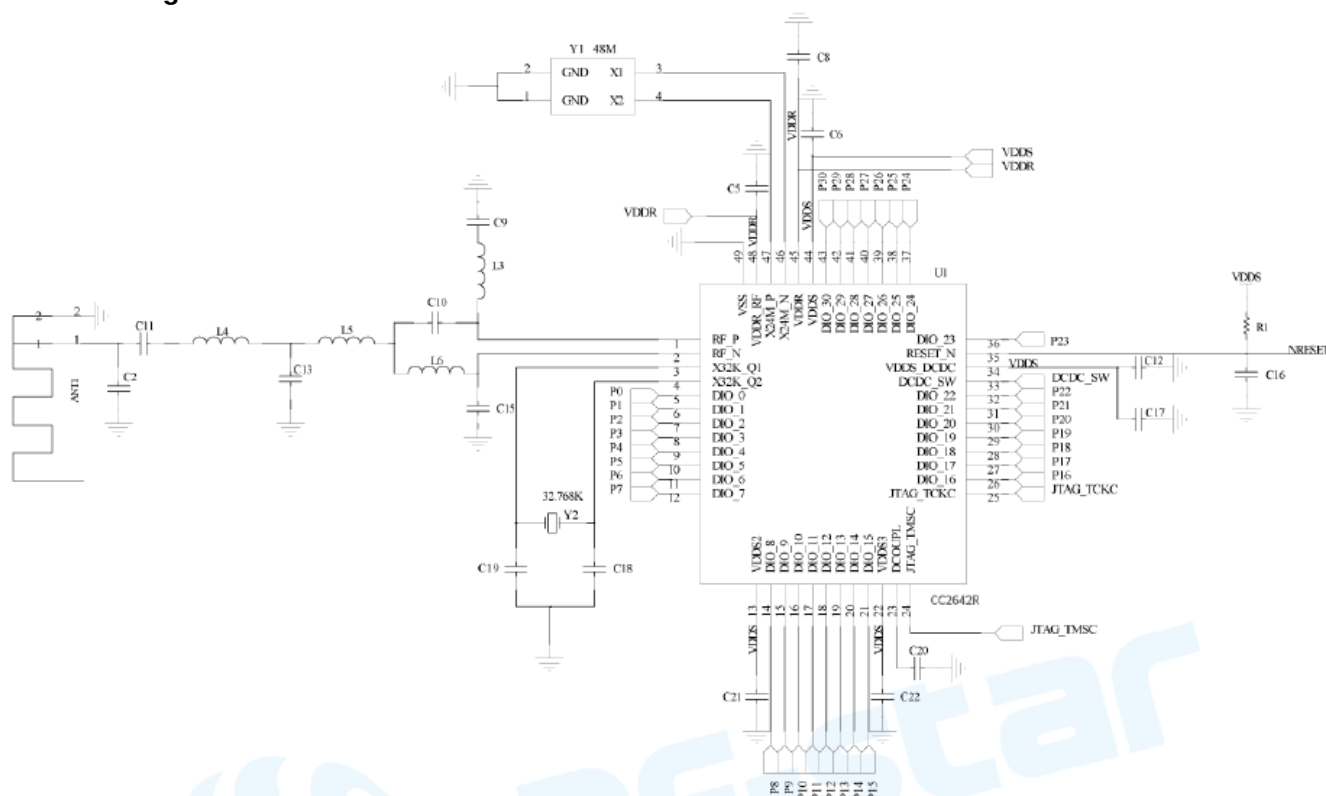
Schematic Diagram

Figure 5. Schematic Diagram of RF-BM-2642B1

Basic Operation of Hardware Design

1. It is recommended to offer the module with a DC stabilized power supply, a tiny power supply ripple coefficient, and reliable ground. Please pay attention to the correct connection between the positive and negative poles of the power supply. Otherwise, the reverse connection may cause permanent damage to the module;

2. Please ensure the supply voltage is between the recommended values. The module will be permanently

damaged if the voltage exceeds the maximum value. Please ensure a stable power supply and no frequently fluctuating voltage.

3. When designing the power supply circuit for the module, it is recommended to reserve more than 30% of the margin, which is beneficial to the long-term stable operation of the whole machine. The module should be far away from the power electromagnetic, transformer, high-frequency wiring, and other parts with large electromagnetic interference.

4. The bottom of the module should avoid high-frequency digital routing, high-frequency analog routing, and power routing. If it has to route the wire on the bottom of the module, for example, it is assumed that the module is soldered to the Top Layer, the copper must be spread on the connection part of the top layer and the module, and be close to the digital part of the module and routed in the Bottom Layer (all copper is well-grounded).

5. Assuming that the module is soldered or placed in the Top Layer, it is also wrong to randomly route the Bottom Layer or other layers, which will affect the spurs and receiving sensitivity of the module to some degree;

6. Assuming that there are devices with large electromagnetic interference around the module, which will greatly affect the module performance. It is recommended to stay away from the module according to the strength of the interference. If circumstances permit, appropriate isolation and shielding can be done.

7. Assuming that there are routings of large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power routings), which will also greatly affect the module performance. It is recommended to stay away from the module according to the strength of the interference. If circumstances permit, appropriate isolation and shielding can be done.

8. It is recommended to stay away from the devices whose TTL protocol is the same 2.4 GHz physical layer, for example, USB 3.0.

9. The antenna installation structure has a great influence on the module performance. It is necessary to ensure the antenna is exposed and preferably vertically upward. When the module is installed inside of the case, a high-quality antenna extension wire can be used to extend the antenna to the outside of the case.

10. The antenna must not be installed inside the metal case, which will cause the transmission distance to be greatly weakened.

11. The recommendation of antenna layout. The inverted-F antenna position on PCB is free-space electromagnetic radiation. The location and layout of the antenna is a key factor to increase the data rate and transmission range. Therefore, the layout of the module antenna location and routing is recommended as follows:

    1. Place the antenna on the edge (corner) of the PCB.
    2. Make sure that there is no signal line or copper foil in each layer below the antenna.
    3. It is the best to hollow out the red part of the antenna position in the following figure so as to ensure that the S11 of the module is minimally affected.
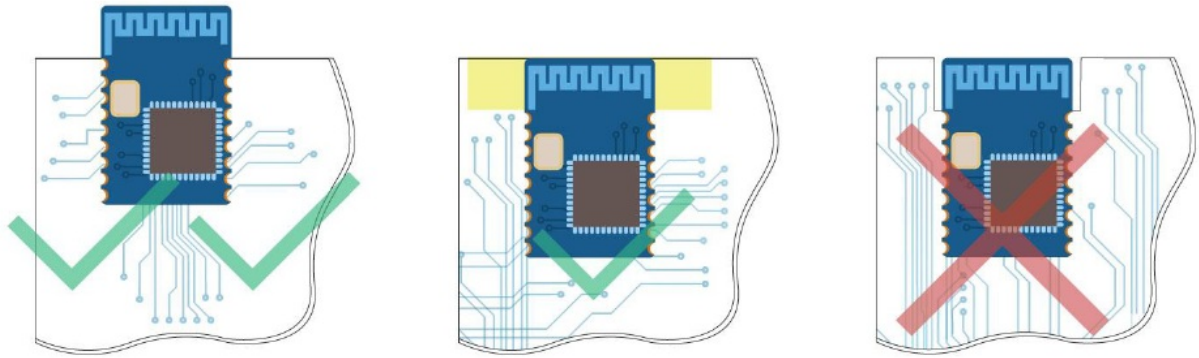
Figure 4. Recommendation of Antenna Layout

Trouble Shooting

Unsatisfactory Transmission Distance

1. When there is a linear communication obstacle, the communication distance will be correspondingly weakened. Temperature, humidity, and co-channel interference will lead to an increase in the communication packet loss rate. The performances of ground absorption and reflection of radio waves will be poor when the module is tested close to the ground.
2. Seawater has a strong ability to absorb radio waves, so the test results by the seaside are poor.
3. The signal attenuation will be very obvious if there is a metal near the antenna or the module is placed inside of the metal shell.
4. The incorrect power register set or the high data rate in an open air may shorten the communication distance. The higher the data rate, the closer the distance.
5. The low voltage of the power supply is lower than the recommended value at ambient temperature, and the lower the voltage, the smaller the power is.
6. The unmatchable antennas and module or the poor quality of antenna will affect the communication distance.

Vulnerable Module

1. Please ensure the supply voltage is between the recommended values. The module will be permanently damaged if the voltage exceeds the maximum value. Please ensure the stable power supply and no frequently fluctuated voltage.
2. Please ensure the anti-static installation and the electrostatic sensitivity of high-frequency devices.
3. Due to some humidity-sensitive components, please ensure the suitable humidity during installation and application. If there is no special demand, it is not recommended to use at too high or too low a temperature.

High Bit Error Rate

1. There are co-channel signal interferences nearby. It is recommended to be away from the interference sources or modify the frequency and channel to avoid interferences.
2. The unsatisfactory power supply may also cause garbled. It is necessary to ensure the power supply reliability.
3. If the extension wire or feeder wire is of poor quality or too long, the bit error rate will be high.

Electrostatics Discharge Warnings

The module will be damaged for the discharge of static. RF-star suggest that all modules should follow the 3 precautions below:

1. According to the anti-static measures, bare hands are not allowed to touch modules.
2. Modules must be placed in anti- static areas.
3. Take the anti-static circuitry (when inputting HV or VHF) into consideration in product design. Static may result in the degradation in performance of module, even causing the failure.

Soldering and Reflow Condition

1. Heating method: Conventional Convection or IR/convection.
2. Temperature measurement: Thermocouple d = 0.1 mm to 0.2 mm CA (K) or CC (T) at soldering portion or equivalent methods.
3. Solder paste composition: Sn/3.0 Ag/0.5 Cu
4. Allowable reflow soldering times: 2 times based on the following reflow soldering profile.
5. Temperature profile: Reflow soldering shall be done according to the following temperature profile.
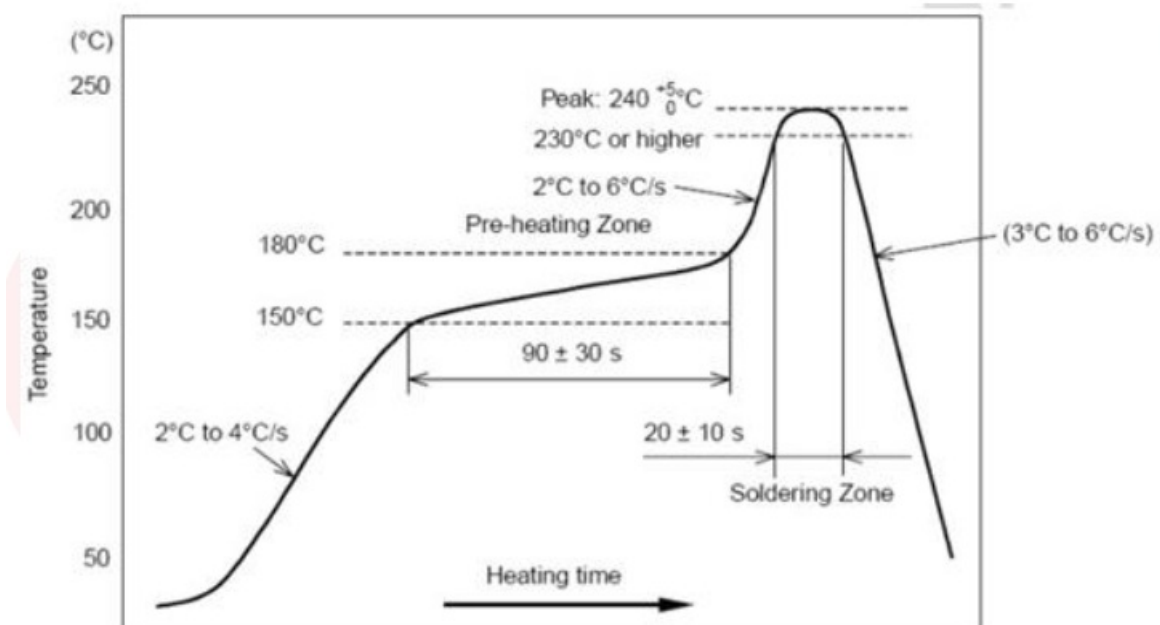6. Peak temperature: 245 °C.

Figure 6. Recommended Reflow for Lead Free Solder

Optional Packaging

Figure 5. Optional Packaging Mode

Revision History

Date	Version No.	Description	Author
2019.09.11	V1.0	The initial version is released.	Aroo Wang
2020.01.19	V1.0	Add TI CC264X BLE module list.	Sunny Li

Contact Us

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FCC 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. Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
Note: 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 or more 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 Radiation Exposure Statement

This modular 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.

Documents / Resources

RF-star RF-BM-2642B1 SimpleLink Bluetooth 5 Low Energy Wireless Module [pdf] User Manual
BM2642B1, 2ABN2-BM2642B1, 2ABN2BM2642B1, RF-BM-2642B1 SimpleLink Bluetooth 5 Low Energy Wireless Module, RF-BM-2642B1, SimpleLink Bluetooth 5 Low Energy Wireless Module

References

- 🌐 **UWB| |Wi-Fi|Wi-SUN|LoRa|ZigBee|Thread|Matter-**
- 🌐 **UWB| |Wi-Fi|Wi-SUN|LoRa|ZigBee|Thread|Matter-**
- ⓐ **Source CC2640R2F BLE module CC2640 BLE Module IoT module CC2640R2F on m.alibaba.com**
- ⓐ **Source cc2652 CC2652R ZigBee2MQTT module Multiprotocol 2.4 GHz Wireless Module BLE 5 module and IEEE 802.15.4 PHY and MAC on m.alibaba.com**
- ⓐ **Wholesale ble CC2642R CC2642 Long distance CC2642 low power cheap BT5.0 BLE module ble CC2642R CC2642 From m.alibaba.com**
- ⓐ **Wholesale Low-power Sub-1G 868mhz 920mhz 2.4 G Dual-band Multi-protocol CC1352 Module From m.alibaba.com**
- ⓐ **Wholesale BLE CC2640 module 100m BLE 4.2 TI CC2640R2F module BLE CC2640 From m.alibaba.com**
- ⓐ **Source CC2640R2F Industry temperature BLE 5.0 TI CC2640R2F-Q1 module for automotive BLE CC2640 CC2640R2F on m.alibaba.com**
- ⓐ **Source CC2640 Tiny BLE module BLE4.2 CC2640R2F Module CC2640 GPIO on m.alibaba.com**