

BB901S

Ultra Low-Power Bluetooth 6.0 Module

Introduction

BB901S is a high-performance, industrial, ultra low-power BLE6.0 module, which based on Nordic SoC nRF54L15. It integrates a 32-bit 128MHz ARM®Cortex®-M33 core and a 128 MHz RISC-V core, configurations up to 1524 KB NVM and up to 256 KB RAM. BB901S provides rich interfaces such as UART, SPI, I²S, I²C, ADC, NFC, PDM, QDEC, PWM. At the same time, it adopts a small stamp package and convenient for engineers to develop.

Key features

- **Frequency band**
 - BLE: 2402~2480MHz
 - IEEE802.15.4: 2405~2480MHz
 - Operating frequencies: 2400~2500MHz
- **Ultra low-power consumption**
 - VDD 1.7~3.6V
 - < 5mA peak current in TX (@0dBm/1Mbps)
 - < 10mA peak current in TX(@+8dBm/1Mbps)
 - < 3.2mA peak current in RX
 - 0.6μA @3V in System OFF mode (no RAM retention)
 - 3.1μA @3V in System ON mode (256KB RAM retention, wake on RTC)
- **High sensitivity**
 - 96dBm sensitivity(1Mbps, BER<0.1%)
 - 104dBm sensitivity(125kbps, BER<0.1%)
 - 40 to +8dBm TX power (1dB step size from -8dBm to +8dBm)
- **Advanced security**
 - Including TrustZone® isolation, tamper detection, and cryptographic engine side-channel leakage protection
- **Protocol support**
 - BLE6.0 / 5.x / 4.x compatible: 2Mbps / 1Mbps / 500kbps / 125kbps
 - Proprietary 2.4GHz: 4Mbps / 2Mbps / 1Mbps
 - IEEE 802.15.4-2020: Thread, Matter, and Zigbee
- **Microprocessor & Memory**
 - 32-bit 128MHz ARM®Cortex®-M33 & 128 MHz RISC-V Coprocessor
 - 1524KB NVM & 256KB RAM
- **Interface**
 - 20*General purpose I/O
 - 5*I²C / 1*I²S / 3*PWM / 2*PDM / 1*NFC
 - 2*QDEC / 7* 32-bit timer / 2*WDT / 1*RTC
 - 4*UART up to 1MHz
 - 1*high-speed UART up to 4MHz
 - 4*SPI up to 8MHz
 - 1*high-speed SPI up to 32MHz
 - 1*14bit ADC(6 channels)
- **Dimension**
 - 13mm×17.5mm×2.3mm(BB901SS)

Applications

- Internet of things (IoT)
- Interactive entertainment devices
- Advanced computer peripherals and I/O devices

Ordering information

Part No.	Temperature	Package	MOQ	Shield	Antenna
BB901S	-40°C ~ +85°C	SMD	1000	Yes	ANT on Board

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1. Introduction

1.1 Description

BB901S is a high-performance, industrial, ultra low-power BLE6.0 module, which based on Nordic SoC nRF54L15. It integrates a 32-bit 128MHz ARM®Cortex®-M33 core and a 128 MHz RISC-V core, configurations up to 1524KB NVM & 256KB RAM.

The module provides rich interfaces such as UART, SPI, I²S, I²C, ADC, NFC, PDM, QDEC, PWM. At the same time, it adopts a small stamp package and convenient for engineers to develop.

1.2 Electrical specification

Specifications are shown in the following **Table 1.1**.

Table 1.1 Specifications of BB901S

Function	Description
Flash	1524KB NVM
RAM	256KB
Microprocessor	32-bit 128MHz ARM®Cortex®-M33 & 128 MHz RISC-V Coprocessor
Protocol support	BLE6.0 / 5.x / 4.x
Frequency Band	2402MHz ~ 2480MHz (BLE) 2405MHz ~ 2480MHz (IEEE 802.15.4-2020)
On-air data rate	2Mbps / 1Mbps BLE mode 500kbps / 125kbps Long Range mode 4Mbps / 2Mbps / 1Mbps Proprietary mode
TX power	-40~+8dBm(1dB step size from -8dBm to +8dBm)
Sensitivity	-96dBm(1Mbps, BER<0.1%)@BLE -104dBm(125kbps, BER<0.1%)@LongRange
Power consumption	TX peak current: 10mA@+ 8dBm / 1Mbps / BLE TX peak current: 5mA@0dBm / 1Mbps / BLE RX peak current: 3.2mA 0.6 µA in System OFF mode, no RAM retention 0.8 µA in System OFF mode with RTC 3.1 µA in System ON IDLE mode, 256KB RAM retention
Digital interfaces	1*I ² S / 3*PWM / 2*PDM / 2*QDEC / 1*NFC / 5*I ² C(up to 400KHz) 4*UART up to 1MHz & 1*high-speed UART up to 4MHz 4*SPI up to 8MHz & 1*high-speed SPI up to 32MHz
Analog interfaces	1*14-bit ADC(6 channels)
Timer	7*32-bit timer / 1*Global RTC / 2*WDT
Advanced security	Including TrustZone® isolation, tamper detection, and cryptographic engine side-channel leakage protection
GPIO	20
Operation temperature	-40°C~85°C
Package	SMD
Dimension	W13*L17.5*H2.3mm

14	P1.05	Analog input / Digital I/O
15	P2.00	Digital I/O
16	P2.01	Digital I/O
17	P2.02	Digital I/O
18	P2.04	Digital I/O
19	P2.05	Digital I/O
20	P2.08	Digital I/O
21	P0.00	Digital I/O
22	P0.01	Digital I/O
23	SWDIO	Serial wire data for debug and programming
24	SWCLK	Serial wire clock input for debug and programming
25	nRESET	Module reset(active low) ^{[Note]①} ; Pin reset with on-chip pull-up
26	GND	Power ground
27	P2.03	Digital I/O
28	P2.07	Digital I/O
G1~G4	GND	Power ground

① The nRESET pin of BB901S can be used according to the product requirements.

3. Specifications and parameters

3.1 Absolute maximum ratings

The absolute maximum ratings of BB901S is shown in **Table 3.1**.

Item	Parameter			Description
	Min	Max	Unit	
VDD	-0.3	3.9	V	Exposure to absolute maximum ratings for prolonged periods of time may affect the reliability of the device.
I/O pin voltage	-0.3	3.9	V	VDD voltage $\leq$ 3.8V
RF input level	-	10	dBm	*
Reference transmission distance	-	60	m	Module to module ^{[Note]②}
Operating temperature	-40	+85	°C	*
Storage temperature	-40	+125	°C	Normal temperature storage is recommended

Table 3.1 Absolute maximum ratings

3.2 ESD parameters

The ESD parameters of BB901S is shown in Table 3.2.

Table 3.2 ESD parameters

Item		Minimum	Maximum	Unit	Description
ESD	Human Body Model (HBM)	-	1000	V	
	Moisture Sensitivity Level (MSL)	-	2		
	Charged Device Model (CDM)	-	500	V	

^② The reference communication distance is closely related to hardware construction, test site environment, etc, which is for reference only.

3.3 Operating conditions

The operating conditions of BB901S is shown in Table 3.3.

Table 3.3 Recommended operating conditions

Item	Min	Typical	Max	Unit	Description
Operating temperature	-40	+25	+85	°C	
VDD	1.7	3.3	3.6	V	
VDD _{POR}	-	1.75	-	V	Power-on threshold
V _{BOR-SYSOFF}	1.56	-	1.64	V	System OFF
V _{BOR-SYSON}	1.57	-	1.64	V	System ON

3.4 Power consumption

The power consumption of BB901S is shown in Table 3.4.

Table 3.4 Reference power consumption

Item	Typical	Unit	Description	Conditions
I _{tx,peak}	10	mA	TX only run current, @+8 dBm, 1Mbps	VDD=3.3V, temperature=25°C
I _{tx,peak}	5	mA	TX only run current, @0 dBm, 1Mbps	
I _{Rx,peak}	3.2	mA	RX only run current, @1 Mbps	
I _{Sleep}	3.1	μA	Sleep mode, System ON IDLE, 256KB RAM retention, Wake on pin+GRTC, LFXO.	
I _{Deep Sleep1}	0.8	μA	System OFF, no RAM retention. Wake-up by wake on pin+GRTC, LFXO.	
I _{Deep Sleep2}	0.6	μA	System OFF, no RAM retention. Wake-up by wake on pin.	

3.5 RF parameters

The parameters of BB901S is shown in Table 3.5.

Item	Typical	Unit	Remarks
Frequency band	2402~2480	MHz	BLE mode
Frequency band	2405~2480	MHz	IEEE 802.15.4-2020
TX Power	-40~+8	dBm	1dB step size from -8dBm to +8dBm
Receiving sensitivity	-96	dBm	BLE mode, 1Mbps, BER<0.1%
Receiving sensitivity	-104	dBm	LongRange mode, 125kbps, BER<0.1%

Table 3.5 RF parameters of BB901S

4. Typical application

The typical application circuit of BB901S is shown in **Figure 4.1**.

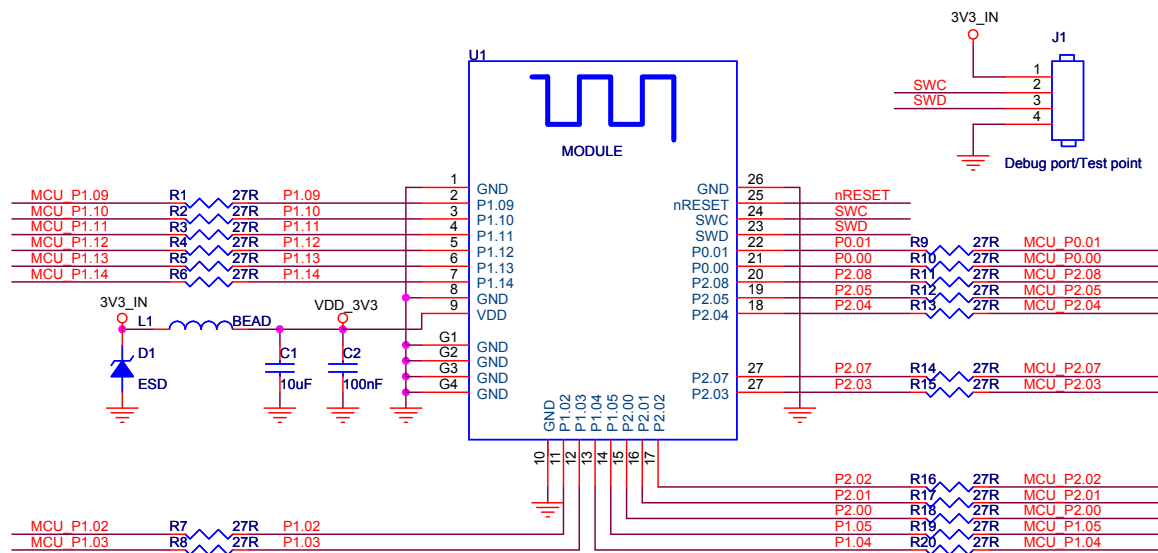


Figure 4.1 Typical application circuit

5. Mechanical specifications

5.1 Dimensions

The dimensions of BB901S is shown in the **Figure 5.1**.

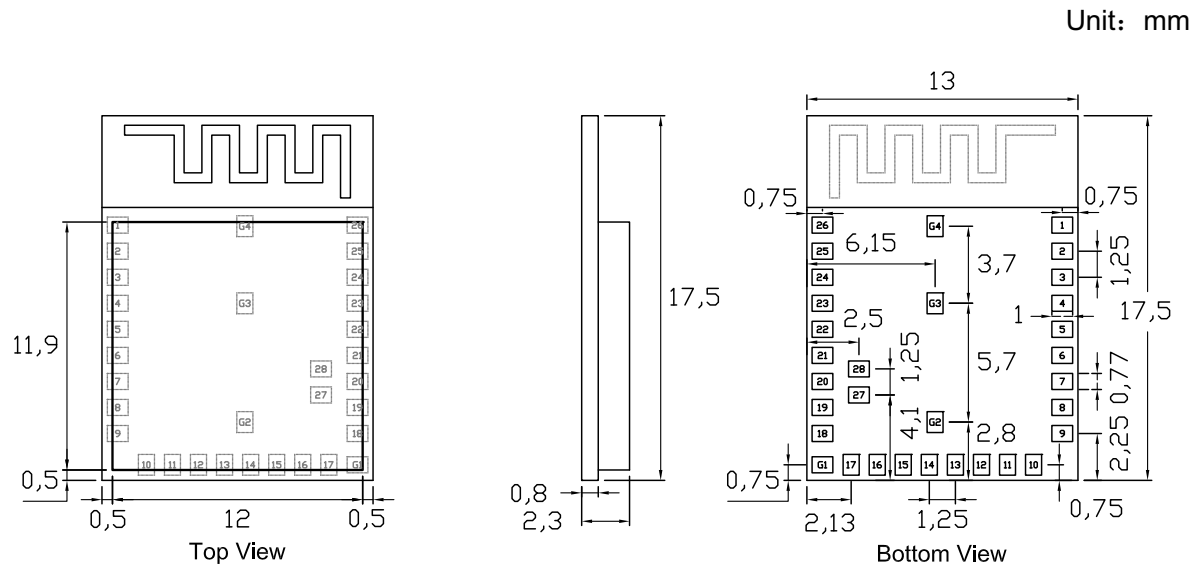
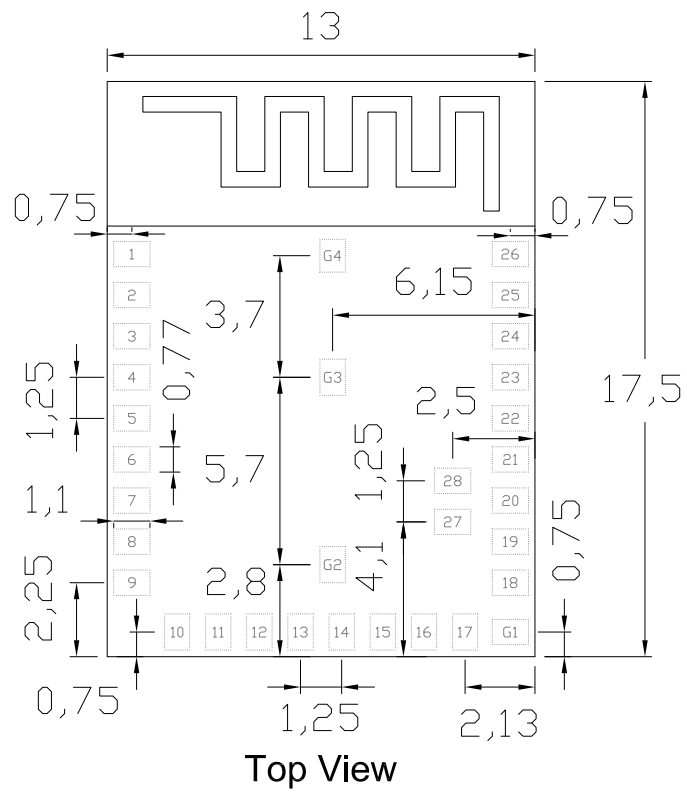


Figure 5.1 Dimensions of BB901S

Table 5.1 Dimensions of BB901S

Model	Length	Width	Height	PCB Thickness	PAD Size	PIN Spacing	Shield
BB901S	17.5mm	13mm	2.3mm	0.8mm	0.77mm×1mm	1.25mm	Yes

The recommended PCB footprint of BB901S is shown in **Figure 5.2**.



Unit: mm

Figure 5.2 Recommended PCB footprint

6. Welding instructions

6.1 Recommended temperature reflow profile

The recommended SMT temperature reflow profile of BB901S is shown in **Figure 6.1**.

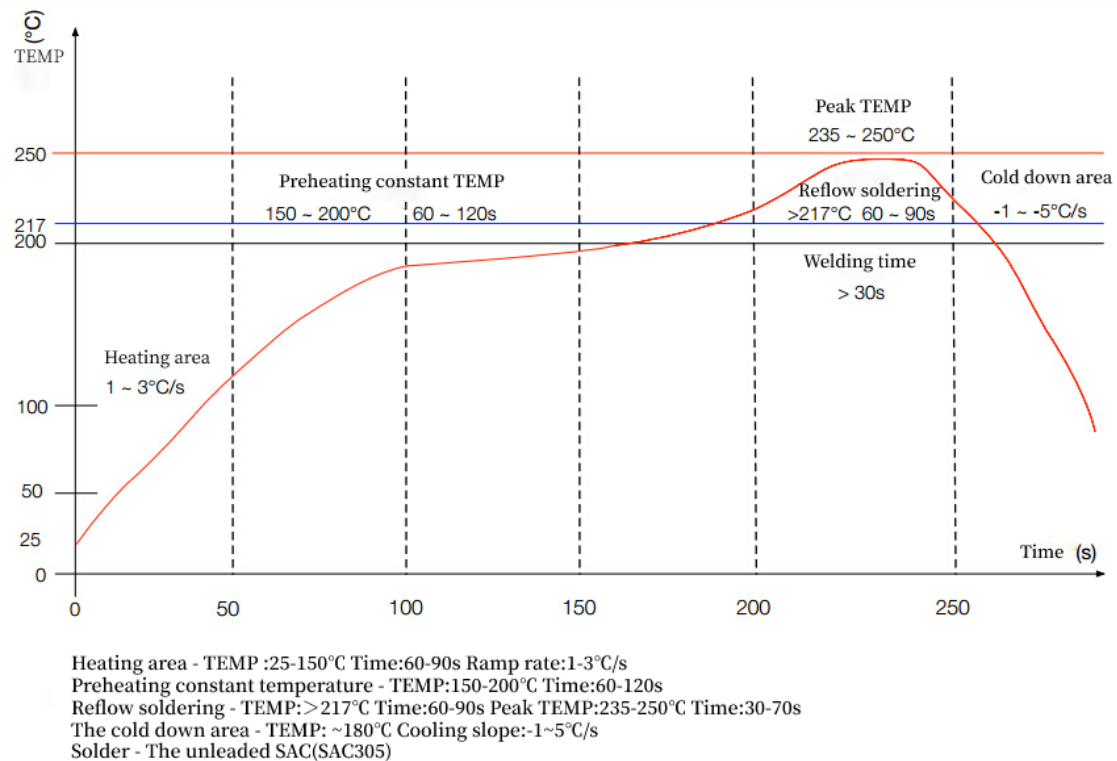


Figure 6.1 Temperature reflow profile

7. Part number & Selections

The selection list related to BB901S is shown in **Table 7.1**.

Part No.	Frequency band	Max transmission power	Bluetooth protocol	Dimensions	Antenna	Shield
BB901S	2.4GHz	+8dBm	BLE6.0	13×17.5×2.3mm	ANT on board	Yes

Table 7.1 List of selections

8. Revision history

Version	Date	Description	Reviser
V1.0	2025/08/04	Initial version	Wesley/Damon

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 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 device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

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.

Modular Usage Conditions:

- This modular transmitter (FCC ID: 2A6CI-BB901S) is approved for integration only into host devices where the antenna can maintain a minimum distance of 20 cm from all persons.
- The final end-product must display a label with the phrase:
"Contains Transmitter Module FCC ID: 2A6CI-BB901S".
- The host manufacturer is responsible for additional FCC compliance (e.g., unintentional radiator testing under Part 15B) and any modifications beyond the module's original authorization.

FCC Certification

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01r01

2.2 List of applicable FCC rules

The BB901S are high-performance, industrial, ultra low-power BLE6.0 modules, which based on Nordic SoC nRF54L15. Module. It is within U.S. FCC part 15.247 standard

2.3 Specific operational use conditions

The EUT is a BLE Module Operation Frequency: 2402-2480MHz for BT;
Modulation Type: GFSK

2.4 Limited module procedures

Not applicable; Single Modular Approval Request

2.5 Trace antenna designs

The BB901S are high-performance, industrial, ultra low-power BLE6.0 modules beams signals and communicates with its antenna, which is PCB Antenna that fix it directly on the module circuit .

2.6 RF exposure considerations

To maintain compliance with FCC's RF Exposure guidelines, This equipment should be installed and operated with minimum distance between 20cm the radiator your body: Use only the supplied antenna.

2.7 Antennas

The BB901S are high-performance, industrial, ultra low-power BLE6.0 modules beams signals and communicates with its antenna, which have PCB Antenna

Antenna Type: PCB Antenna

Antenna Gain:0.51dBi

2.8 Label and compliance information

The product is too small in size, so the label is printed in the outer packaging and the user manual. the It must Contains FCC ID: 2A6CI-BB901S

2.9 Information on test modes and additional testing requirements

Data transfer module demo board can control the EUT work in RF test mode at specified test channel.

2.10 Additional testing, Part 15 Subpart B disclaimer

The module without unintentional-radiator digital circuit, so the module does not required an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B

2.11 OEM integration instructions:

This device is intended only for OEM integrators under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the external antenna(s) that has been originally tested and certified with this module. As long as the 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 (for example, digital device emissions, PC peripheral requirements, etc.).

2.12 Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations 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 circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

ATTENTION

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

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) This device and its antenna(s) must not be co - located with any other transmitters except in accordance with FCC multi - transmitter product procedures. Referring to the multi - transmitter policy, multiple transmitter(s) and module(s) can be operated simultaneously without C2PC.
- 3) For all products market in US, OEM has to limit the Operating Frequency: 2402-2480MHz

. OEM shall not supply any tool or info to the end - user regarding to Regulatory Domain change.

USERS MANUAL OF THE END PRODUCT:

In the user manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio - frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.