
BT938 Bluetooth Specification

V1.0

Version Record

Version	Date	Author	Content
V1.0			Initial Release

FCC Statement

FCC standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247
PCB antenna with antenna gain 1.2dBi

A:

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.

B:

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

C:

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.

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: " Contains Transmitter Module FCC ID: 2BAMT-BT938-2 Or Contains FCC ID: 2BAMT-BT938-2 "

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.

Any company of the host device which install this modular with modular approval should perform the test of radiated & conducted emission and spurious emission,etc. according to FCC part15B Class B requirement, Only if the test result comply with FCC part 15B Class B requirement , then the host can be sold legally. When the module is installed inside another device, the user manual of the host must contain above Paragraphs A, B, and C warning statements.

1. Introduction

1.1 Overview

The BT938 Bluetooth module is a BLE4.2 module designed based on the CH592 chip. It supports serial transparent transmission and AT commands. When in Bluetooth connection mode, the module enters transparent transmission mode. When in the disconnected state, AT commands can be used to configure module parameters such as advertising interval and device name.

1.2 Key Features

- Completed with Bluetooth Low Energy 5.4 standard
- RF power class II, ultra-low power consumption with microampere-level working current
- Ultra-low voltage operation, compatible with 3V button batteries
- Multiple interfaces: GPIO/UART/I²C/SPI/USB
- RoHS compliant, lead-free manufacturing process
- Dimensions: 16.5mm (L) × 13.3mm (W)
- BT938-1 module without shielding case, BT938-2 module with shielding case

1.3 Application Fields

The BT938 module is designed for IoT and HID (Human Interface Devices) applications, including but not limited to:

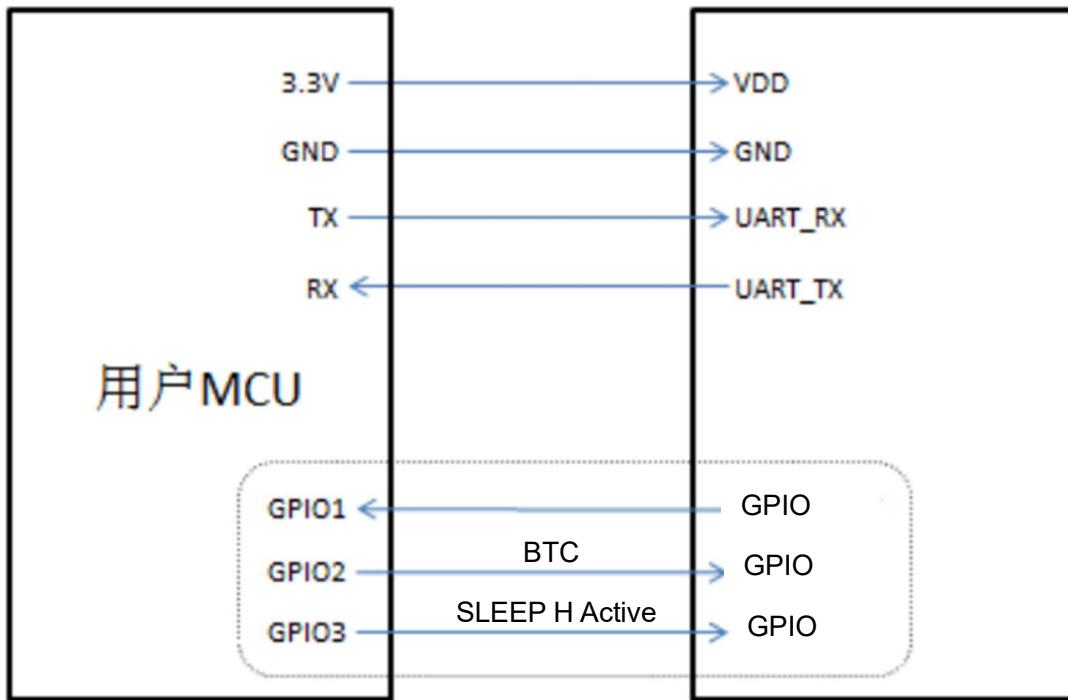
- Smart home devices (access control, LED lighting control)
- Fitness equipment (treadmills, exercise machines)
- Medical devices (pulse meters, blood pressure monitors)
- Home entertainment devices (remote controls, toys)
- Office equipment (printers, scanners)
- Commercial equipment (cash registers, QR code scanners)
- Mobile peripherals (for phones, tablets, and computers)
- Automotive equipment (automotive diagnostic tools)
- RF and infrared remote controls

1.4 Hardware Highlights

- QingKe 32-bit RISC-V4C core
- Supports up to 19 GPIO pins in addition to serial communication pins
- UART interface with hardware flow control and dual-wire debug interface
- 4 channels of 26-bit PWM and 8 channels of 8-bit PWM
- 12 channels of 12-bit ADC supporting differential and single-ended inputs

- Programmable TX output power up to +4.5dBm

Hardware connection diagram



The functional pins of the module can be reconfigured according to specific applications. For example, PB3 can be set as a Bluetooth control pin (BTC) to switch other devices on/off, and PA1 can be configured as a low-power control wake-up pin (P_SLEEP) to wake up the Bluetooth module or perform other functions.

2. Electrical Parameters

2.1 Absolute Maximum Ratings

Item	Sym.	Min.	Max	Unit	Conditions
Supply Voltage	V_{DD}	-0.4	4.2	V	V_{DD33} and V_{IO33} pin must have the same voltage
Voltage on input pin	V_{IN}	-0.3	$V_{DD}+0.4$	V	-
Output voltage	V_{OUT}	0	V_{DD}	V	-
Storage temperature range	T_{Str}	-65	150	°C	-
Soldering temperature	T_{Sld}	-	260	°C	-

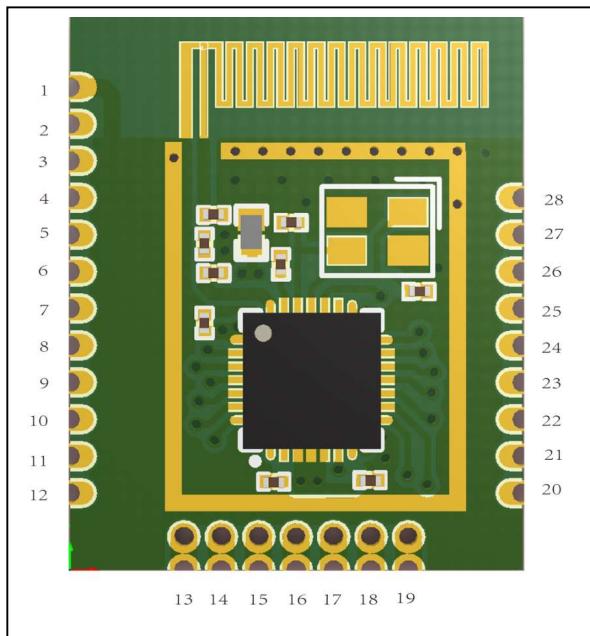
2.2 Recommended Operating Conditions

Item	Sym.	Min	Typ.	Max	Unit	Conditions
Power-supply voltage	V_{DD}	1.7	3.3	3.6	V	-
Operating temperature range	T_{Opr}	-40	-	85	°C	-

2.3 Current Consumption ($V_{DD} = 3.3$ V, $T = 25^\circ\text{C}$)

Mode	Sym.	Min	Typ.	Max	Unit	Conditions
TX	I_{Tx}	-	12.9	-	mA	4.5dBm Continuous Tx transmission
RX	I_{Rx}	-	11.5	-	mA	Continuous Rx reception
Idle Mode	I_{Idle}	1.1		1.3-	mA	Clock enabled
Pause Mode	I_{pause}	-	180	-	µA	Clock disabled
Sleep Mode	I_{Deep1}	-	0.7	-	µA	PMU+Core+PAM2K, GPIO Wakeup, W/O RTC
Power Down Mode	I_{Down}	-	1.7	--	µA	PMU Only, Reset after GPIO Wakeup, W/O RTC

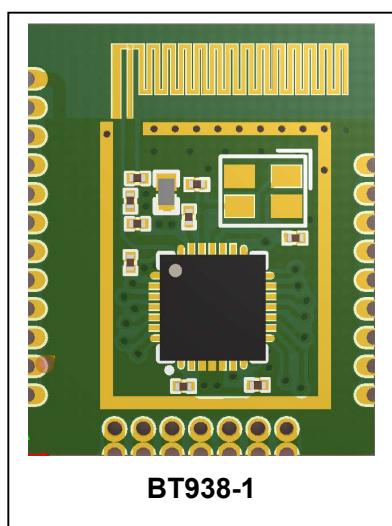
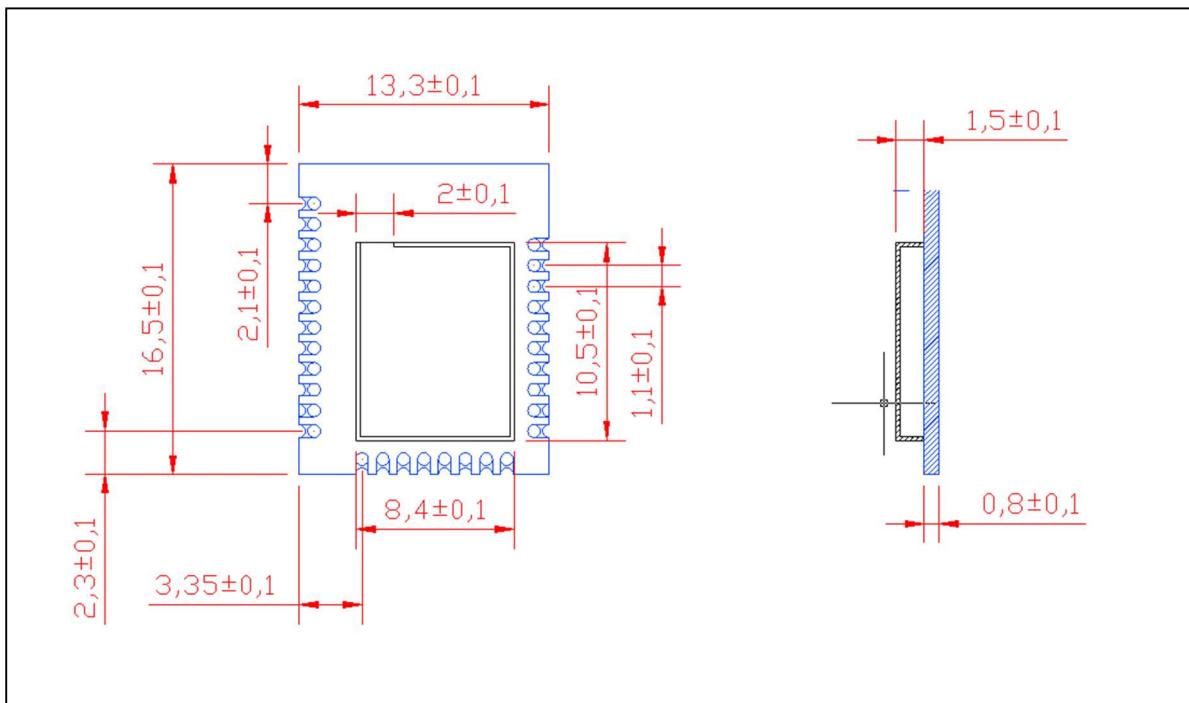
3. Module Pins and Descriptions



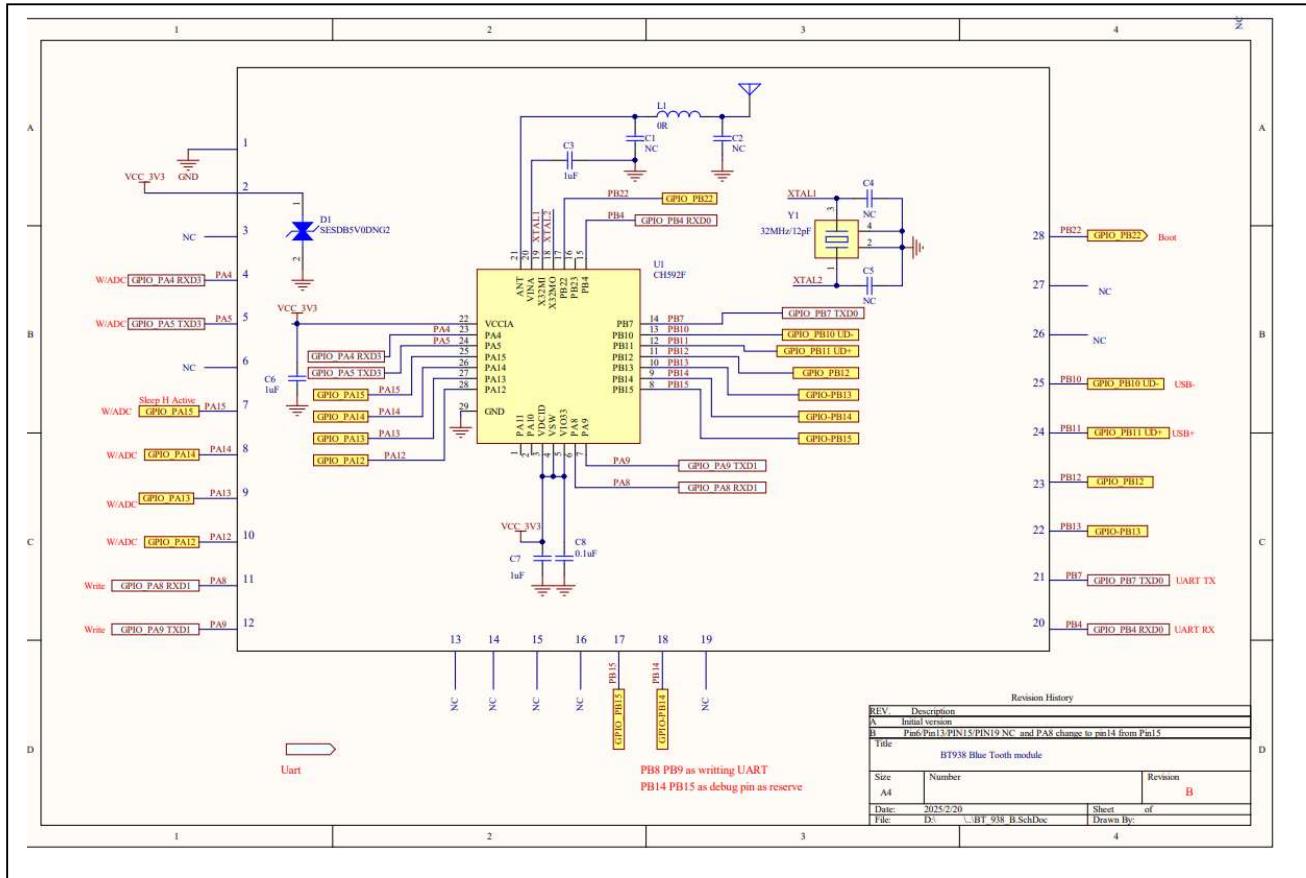
NO.	名称	描述
1	GND	Groudn
2	VCC	3.3V Power Supply
3	NC	NC
4	PA4	General-purpose bidirectional digital I/O, RXD3 (UART3 serial data input), AIN0 (ADC analog signal input channel 0)
5	PA5	General-purpose bidirectional digital I/O, TXD3 (UART3 serial data output), AIN1 (ADC analog signal input channel 1)
6	NC	NC
7	PA15	General-purpose bidirectional digital I/O, MISO (SPI0 serial data, master input/slave output), RXD0_ (UART0 RXD0 mapping), AIN5 (ADC analog signal input channel 5), sleep mode (pull high to enter sleep)
8	PA14	General-purpose bidirectional digital I/O, MOSI (SPI0 serial data, master output/slave input), TXD0_ (UART0 TXD0 mapping), AIN4 (ADC analog signal input channel 4)
9	PA13	General-purpose bidirectional digital I/O, SCK0 (SPI0 serial clock, master output/slave input), PWM5 (PWM output channel 5), AIN3 (ADC analog signal input channel 3)
10	PA12	General-purpose bidirectional digital I/O, SCS (SPI0 slave select input, active low), PWM4 (PWM output channel 4), AIN2 (ADC analog signal input channel 2)
11	PA8	General-purpose bidirectional digital I/O, RXD1 (UART1 serial data input), AIN12 (ADC analog signal input channel 12), UART programming RX
12	PA9	General-purpose bidirectional digital I/O, TMR0 (Timer 0 capture input 0 and PWM output channel 0), TXD1 (UART1 serial data output), AIN13 (ADC analog signal input channel 13), UART programming TX
13	NC	NC
14	NC	NC
15	NC	NC
16	NC	NC

17	PB15	General-purpose bidirectional digital I/O, TCK (two-wire emulation debug interface serial clock input), MISO_ (SPI0 MISO mapping), SCL (I2C serial clock, master output/input/slave input), DTR (UART0 MODEM output signal, data terminal ready), Debug
18	PB14	General-purpose bidirectional digital I/O, TIO (emulation debug interface serial data I/O with internal pull-up), MOSI_ (SPI0 MOSI mapping), SDA (I2C serial data, open-drain output/input), PWM10 (PWM output channel 10), DSR (UART0 MODEM input signal, data set ready), Debug
19	NC	NC
20	PB4	General-purpose bidirectional digital I/O, RXD0 (UART0 serial data input), PWM7 (PWM output channel 7), UART interface RX
21	PB7	General-purpose bidirectional digital I/O, TXD0 (UART0 serial data output), PWM9 (PWM output channel 9), UART interface TX
22	PB13	General-purpose bidirectional digital I/O, SCK0_ (SPI0 SCK mapping), TXD1_ (UART1 TXD1 mapping), DCD_ (UART0 DCD mapping)
23	PB12	General-purpose bidirectional digital I/O, SCS_ (SPI0 SCS mapping), RXD1_ (UART1 RXD1 mapping), RI_ (UART0 RI mapping)
24	PB11	General-purpose bidirectional digital I/O, UD+ (USB D+ data line), TMR2_ (Timer 2 TMR2 mapping)
25	PB10	General-purpose bidirectional digital I/O, UD- (USB D- data line), TMR1_ (Timer 1 TMR1 mapping)
26	NC	NC
27	NC	NC
28	PB22	General-purpose bidirectional digital I/O, TMR3 (Timer 3 capture input 3 and PWM output channel 3), RXD2 (UART2 serial data input), UART programming Boot

4. Module Mechanical Dimensions



5. Module Circuit Diagram



6.BOM

PCB assembly parts				
Part Name	Description	QTY.	Unit	Remark
Capacitor	ROHS 1μF/10V, 0201, X5R, ±10%	3		C3,C6,C7
Capacitor	ROHS 0.1μF/10V, 0201, X5R, ±10%	1		C8
Resistor	ROHS 0R 0201, +/-5%	1		L1
ESD diode	ESD Protection Diode SESDB5V0DNG2 DFN1006-2	1		D1
IC	Bluetooth IC QFN28 4*4 CH592F QFN28	1		U1
Crystal	32 MHz 12pF 20ppM 2016 Package	1		Y1
PCB	ROHS double-sided FR4, thickness 0.8mm, dimensions 16.5mm×13.3mm	1		Main PCB
Shielding case	Nickel silver, thickness 0.2mm, laser-etched QR code	1		Same as BT628

7. Module Installation Requirements

The BT638 module operates at 2.4GHz, so its placement on the product is critical to antenna performance. Avoid the following:

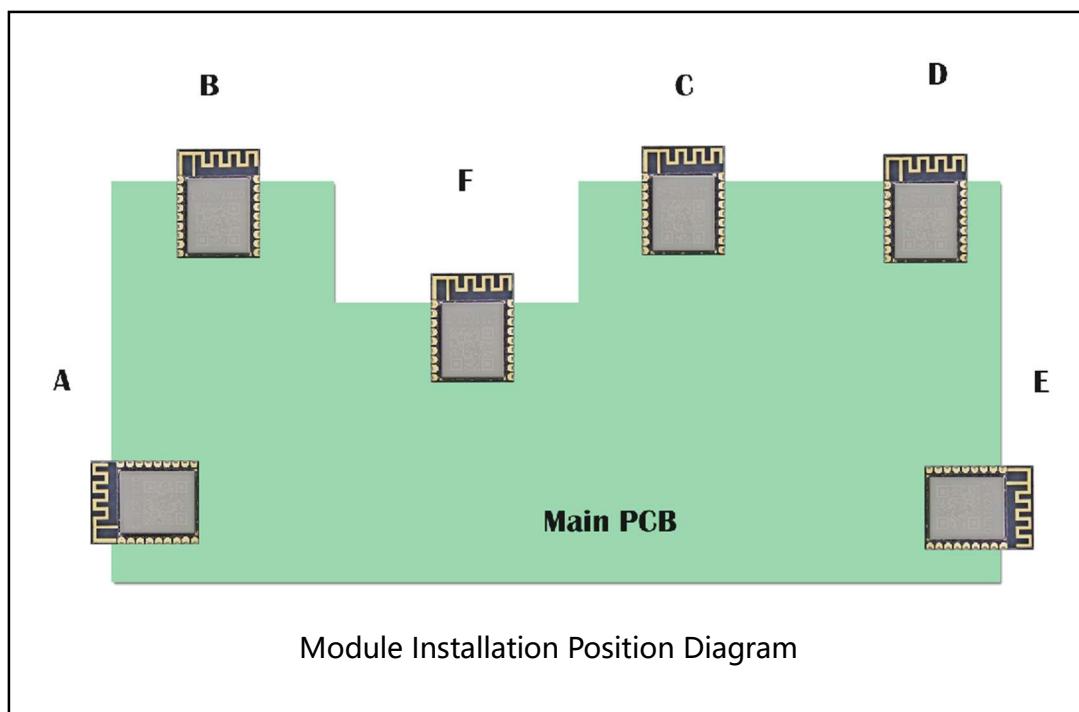
Metal enclosures can shield RF signals and prevent the module from working properly.

Keep internal metal components away from the module's RF section.

Place the module around the edges of the mainboard, with the antenna part near the edge or corner.

Avoid copper pours or traces under the antenna.

It's recommended to extend the antenna area outward from the main PCB to position the module as close to the edge as possible.



A, B: Strongly recommended. C, D, E: Acceptable but not recommended.

F: If the main PCB lacks space, maintain a 15mm gap between the module and the main PCB

8. Module Reflow Soldering Recommendations

Module Welding Guidance (Refer to IPC/JEDEC Industry Standard)

Preheating process	
Ramp up rate:	2°C/s (Max)
From T_s (25°C Room temperature) to T_L (Preheating temperature)	150°C (Min.) 175°C (Typ.) 200°C (Max.)
Preheating temperature T_L	
Preheat time	60~120 s
Soldering	
Heating rate for soldering: from (Preheating temperature) T_L to T_P (Peak temperature)	1~2°C/s
Tolerance of T_P	245°C +0/-5°C
Duration of T_P	10 s
Duration of soldering (Above 217°C)	40~60 s
Ramp down rate	2.5°C/s (Max.)

The reflow curve recommended:

