HCTBLE42S1D Specification

nRF51822 2.4GHz BLE4.2 Low Power Consumption Bluetooth Module

Chapter 1 Overview

1.1 Introduction

HCTBLE42S1D is a small-sized SMD Bluetooth module developed based on nRF51822 produced by Nordic of Norway. It uses a 16Mhz industrial grade crystal to ensure its industrial characteristics and stability.

nRF51822 comes with high-performance ARM CORTEX-M0 core and Bluetooth 4.2 radio frequency transceiver and protocol stack, and has rich peripheral resources such as UART, I2C, SPI, ADC, DMA, and PWM. This module redeveloped some IO ports. For details, please refer to the pin definition, which is convenient for users to carry out multi-directional development. The module has built-in on-board PCB antenna, it does not require external antennas.

1.2 Features

. BLED4.2 compatible;
. Fixed transmit rate 0dB, software adjustment not available
. Global license-free ISM 2.4GHz band compatible
. Built-in high-performance low-power Cortex-M0 core processor
. Power supply 2.0 ~ 3.6V.
. Industrial standard design, be able to function during temperature range from -40 ℃ to 85 ℃

1.3 3 Applications

.Remote Game Control

.Medical and healthcare product

.Wireless Head phones

Chapter 2 Specifications

2.1 Parameter Range

Parameters	Range		Note
	Min	Max	
Power Supply Volt（V）	0	3.6	Permanent damage to module if power supply exceeds 3.6 V
Blocking Power（dBm）	0	10	low rate of burn in near site use
Working Temperature（℃）	-40	+85	Industrial standard design

2.1 Working parameter

| Parameters		Range			Note
		Min	Standard	Max	
Operating Voltage（V）		1.8	3.3	3.6	≥3.3V be able to stable output
Output level（V）			3.0		Using 5V TTL risk of burn
Working Temperature（℃）		-40	-	+85	
Working Frequency（MHz）		2379	2430	2496	
Power Consumption	Emission current（mA）		14		Instant power consumption
	Receive current（mA）		12		
	Sleep current（μA）		1		Software shut down
Max Transmit power（dBm）			0	0.3	
Receiving sensitivity（dBm）		-95.4	-96.0	-96.8	1Mbps in the air

Parameters	description	Note
Reference distance	100m	Clear and open, antenna gain 0dBi, antenna height 2.5 meters, air speed 1Mbps
Crystal frequency	16MHz	
Protocol	BLE4.2	
Packaging method	SMD	2496 Support ISM band
Interface method	1.2mm	Instantaneous power
IC Description	nRF51822-QFACA/QFN48	
Size	13.5mm*20.5mm	

Antenna interface	PCB	PCB Antenna，Equivalent resistance 50Ω
Module communication method	Full-duplex serial transmission	Only supports 115200 baud rate

Chapter 3 Mechanical Size and Pin Definition
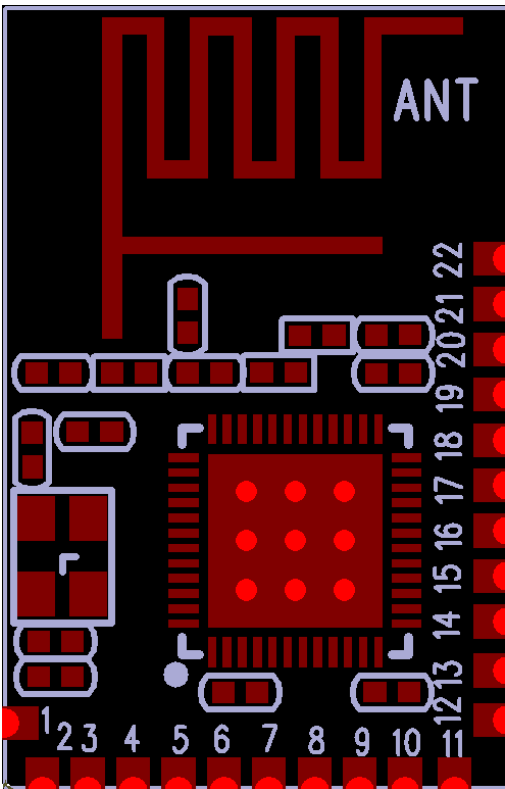
TOP PAD
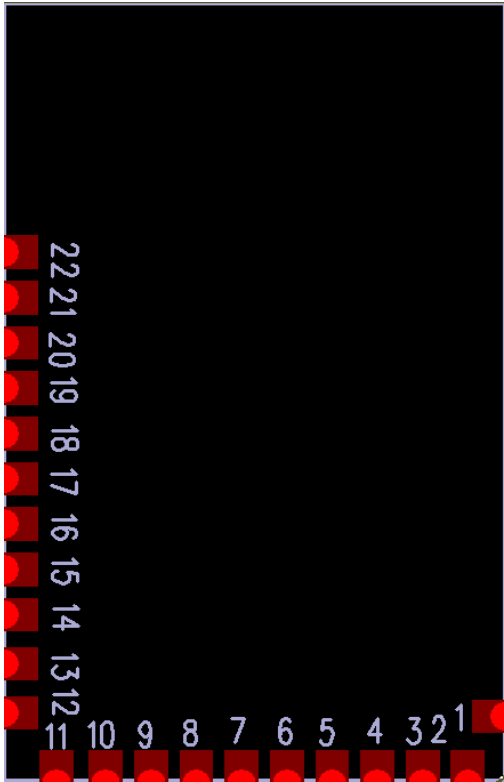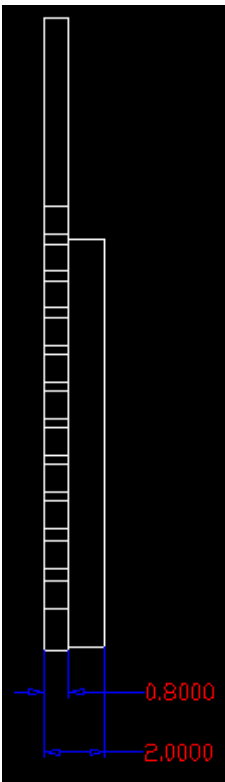
BOTTOM PAD
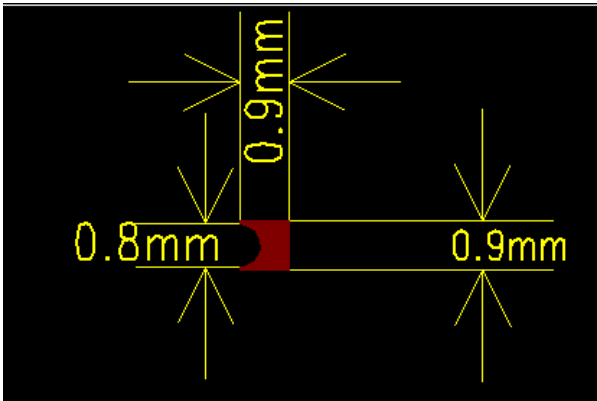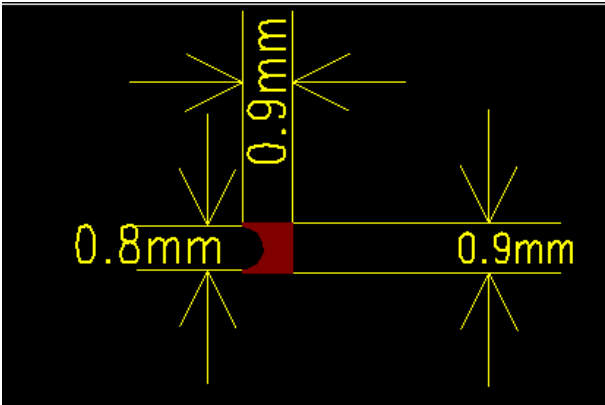
Pin No.	Pin Name	Pin Direction	Pin Usage
1	XL2	Output	Connect 32.768 KHz external crystal
2	GND		Ground, connected to power reference ground
3	XL1	Input	Connect 32.768 KHz external crystal
4	PO28	Input/ Output	MCU GPIO
5	PO29	Input/ Output	MCU GPIO
6	DVDD		Power 1.8V-3.6V DC
7	PO02	Input/ Output	MCU GPIO
8	PO03	Input/ Output	MCU GPIO
9	PO04	Input/ Output	MCU GPIO
10	PO08	Input/ Output	MCU GPIO
11	PO09	Input/ Output	MCU GPIO
12	PO10	Input/ Output	MCU GPIO
13	PO11	Input/ Output	MCU GPIO
14	PO14	Input/ Output	MCU GPIO
15	PO15	Input/ Output	MCU GPIO
16	PO16	Input/ Output	MCU GPIO
17	SWD_DAT	Input/ Output	System reset (low active) hardware debugging and programming Flash。
18	SWD_CLK	Input	Hardware debugging and programming Flash。
19	PO17	Input/ Output	MCU GPIO
20	PO18	Input/ Output	MCU GPIO
21	PO19	Input/ Output	MCU GPIO
22	PO20	Input/ Output	MCU GPIO

Chapter 4 Operation Instruction

4.1 Software Architecture

4.1.1   BLE4.2 protocol stack

- Standard BLE protocol stack
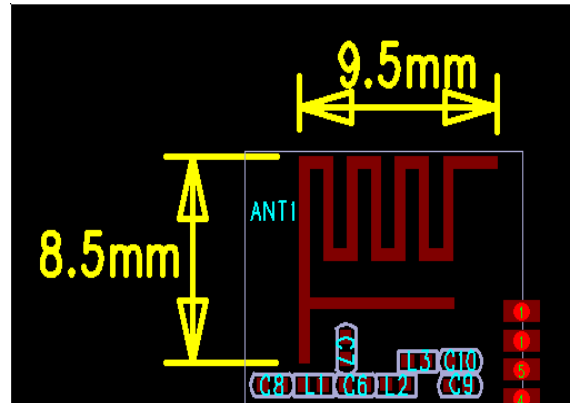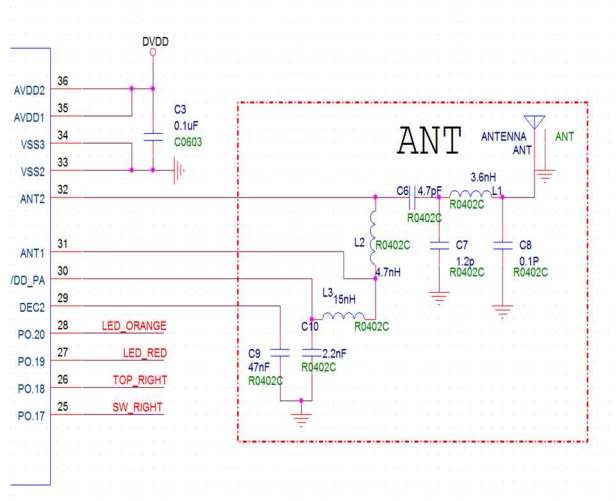- SOC Libray
- Soft Device Manager

4.1.2 Underlying hard drive

- nRF51822 Wireless API
- Protocol API

4.1.3 App-Specific periphereal drivers

- BLE4.2 protocol stack initialization
- Serial command processing
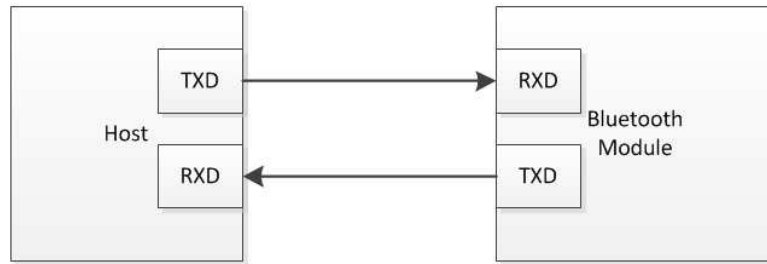
4.2 Antenna designs

a) Antenna size chart

b) Component list

Serial number	Tag number	Device package	Device parameters	Note
1	C6	0402	4.7PF	
2	C7	0402	1.2PF	
3	C8	0402	0.1PF	
4	C9	0402	47NF	
5	C10	0402	2.2NF	
6	L1	0402	3.6nH	
7	L2	0402	4.7nH	
8	L3	0402	15nH	

c) UART Interface

The UART interface provides two signals. TXD and RXD pins are used for data, fixed baud rate, support 115200bps.

Connection to Host Device

4.3 Hardware Design

1. It is recommended to use a DC stabilized power supply to power the module. The ripple factor of the power supply should be as small as possible and the module should be reliably grounded;

2. Please pay attention to the correct connection of the positive and negative poles of the power supply, such as reverse connection may cause permanent damage to the module;

3. Please check the power supply to ensure that between the recommended power supply voltages, if the maximum value is exceeded, the module will be permanently damaged;

4. Please check the stability of the power supply, the voltage cannot fluctuate greatly and frequently;

5. When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, as the whole machine is conducive to long-term stable work;

6. The module should be far away from the parts with large electromagnetic interference such as power supply, transformer, high-frequency wiring;

7. High-frequency digital routing, high-frequency analog routing, and power routing must be avoided under the module. If it is necessary to pass under the module, it is assumed that the module is soldered to the top layer, and copper is laid on the top layer of the module's contact part (all copper and Good grounding), must be close to the digital part of the module and routed in the Bottom Layer;

8. Assuming that the module is soldered or placed on the Top Layer, it is also wrong to arbitrarily route the Bottom Layer or other layers, which will affect the spurs and receiving sensitivity of the module to varying degrees;

9. It is assumed that there are devices with large electromagnetic interference around the module, which will greatly affect the performance of the module. According to the strength of the interference, it is recommended to stay away from the module appropriately. If the situation allows, you can do proper isolation and shielding;

10. It is assumed that there are large electromagnetic interference traces around the module (high-frequency digital, high-frequency analog, and power supply traces), which will greatly affect the performance of the module. It is recommended to stay away from the module according to the strength of the interference. Isolation and shielding;

11. If the communication line uses 5V level, a 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage);

12. Try to stay away from some physical layer which is also 2.4GHz TTL protocol, such as: USB3.0;

13. The installation structure of the module has a large impact on the performance of the module, it is best to go vertically. When the module is installed inside the case, try to choose a material that has less attenuation to the signal number, such as ABS, etc., and the antenna can be exposed directly when the receiving sensitivity is high;

14. The module cannot be installed inside the metal case, which will greatly reduce the transmission distance.

4.4 Protocol

Important statement: This module is only for internal use, and the specific protocol of communication is not described in detail;

. Support "Disconnect Bluetooth", "Bluetooth Reconnect" commands;
. Support "power-down sleep", "stop sending broadcast code" commands;
. Support "Bluetooth Name Rename", "Reset Bluetooth Mode" commands;
. Support "Bluetooth function switching", "2.4G transparent transmission switching" commands;
. Support "HID data transmission" transmission command;
. Support "2.4G transparent data transmission" command;

Chapter 5 Trouble Shooting

5.1 Transmission distance is not ideal

1. When there is a linear communication obstacle, the communication distance will be reduced correspondingly;

2. Temperature, humidity, and co-channel interference will increase communication packet loss rate;

3. The ground absorbs and reflects radio waves, and the test results near the ground are poor;

4. Sea water has a strong ability to absorb radio waves, so the test results at the seaside are poor;

5. There is a metal object near the module antenna, or it is placed in a metal shell, the signal attenuation will be very serious;

6. The power register is set incorrectly and the air speed is set too high (the higher the air speed, the closer the distance);

7. The low voltage of the power supply at room temperature is lower than the recommended value, the lower the voltage, the smaller the power output;

8. The use of the antenna and the module is poorly matched or the quality of the antenna itself is a problem.

5.2 Module is easily damaged

1. Please check the power supply to ensure that it is under the recommended power supply voltage, if the maximum value is exceeded, the module will be permanently damaged;

2. Please check the stability of the power supply, the voltage cannot fluctuate greatly and frequently;

3. Please ensure the anti-static operation during installation and use, and the electrostatic sensitivity of high-frequency devices;

4. Please ensure that the humidity during installation and use should not be too high, and some components are humidity sensitive devices;

5. If there is no special requirement, it is not recommended to use it at too high or too low temperature.

## 5.3 3 Bit error rate is too high

1. Co-channel signal interference nearby, stay away from the interference source or modify the frequency and channel to avoid interference;

2. Unsatisfactory power supply may also cause garbled characters. Be sure to ensure the reliability of the power supply;

3. Poor quality or long extension cables or feeders can also cause high bit error rates.

Chapter 6 Solder Instruction

6.1 Reflow Solder temperature

Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min （Tsmin）	100℃	150℃
Preheat temperature max (Tsmax)	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	3℃/second max	3℃/second max
Liquidous Temperature (TL)	183℃	217℃
Time（tL）Maintained Above（TL）	60-90 sec	30-90 sec
Peak temperature（Tp）	220-235℃	230-250℃
Aveage ramp-down rate（Tp to Tsmax）	6℃/second max	6℃/second max
Time 25℃ to peak temperature	6 minutes max	8 minutes max

6.1 Reflow Solder Curve
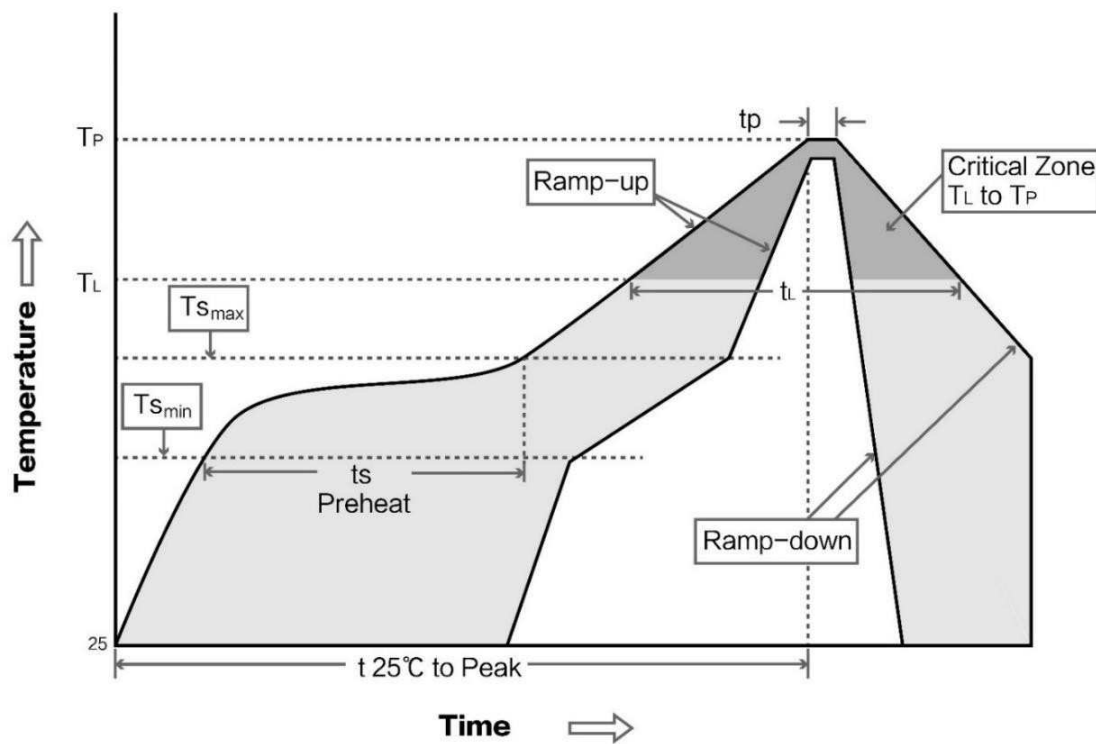
Chapter 7 FCC Instruction

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the 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.

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.

Regulation Information
1) List of applicable FCC rules:
   FCC part 15.247

2) Summarize the specific operational use conditions
   This Device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter. The host product manufacturer should state this information to the host instruction manual.

3)Limited module procedures:
   This module is only use for battery-powered product and the shielding for RF module will be provided in the host. The modular transmitter is only approved for use by the grantee in its own products and not intended for sale to third parties.

4)Trace antenna designs
   No applicable.

5) RF exposure considerations
   This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment without any restriction.

6) Antennas
   Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.
   Antenna type: Integral Antenna
   Antenna Gain: 0dBi

7)Label and compliance information
   A host product shall use a physical label stating "Contains FCC ID:2AAUWHBT42A20N"

8)Information on test modes and additional testing requirements
The host manufacturer can use the software " nRFgo " for access to the test modes.
Connected to the computer through the serial port of the host product, the channel and
power controlling software provided by the applicant was used to control the operating
channel as well as the output power level. The RF output power selection is for the setting
of RF output power expected by the application and is going to be fixed on the firmware of
the end product.

9)Additional testing, Part 15 Subpart B disclaimer
The modular transmitter is only FCC authorized for the specific rule parts (FCC Part 15.247)
list on the grant, and that the host product manufacturer is responsible for compliance to
any other FCC rules that apply to the host not covered by the modular transmitter grant
of certification. The final host product still requires Part 15 Subpart B compliance testing
with the modular transmitter installed when contains digital circuity.