WT05511A-S8 Datasheet

Version V1.0.4

About this document

This document provides users with the WT05511A-S8 specifications.

Document version

Please go to official website to download the latest version of the document

Revise history

Please go to the document revision page to view the revision history

Disclaimer and Copyright Notice

The information in this document, including URL references, is subject to change without notice.

The document is provided "as is" without warranty of any kind, including any warranty of merchantability, fitness for a particular purpose or non-infringement, and any warranty otherwise provided by any proposal, specification or sample. No liability is assumed with respect to this document, including liability for infringement of any patent arising from the use of the information in this document. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document.

All trade names, trademarks and registered trademarks mentioned herein are the property of their respective owners and are hereby acknowledged.

illustrate

The contents of this manual may change due to product version upgrades or other reasons. Wireless-Tag Technology Co., Limited. reserves the right to modify the contents of this manual without any notice or prompt. This manual is only used as a guide. Wireless-Tag Technology Co., Limited. makes every effort to provide accurate information in this manual. However, Wireless-Tag Technology Co., Limited. does not ensure that the content of the manual is completely error-free. All statements and information in this manual and recommendations do not constitute any express or implied warranty.

Document revision history

serial number	version number	changing state	Change (+/-) description	author	date
1	V1.0.0	C	Create document	Wang Baoshan	2022-07-25
2	V1.0.1	M		Zhong Qingliang	2023-04-18
3	V1.0.2	M	Modify Table 1: Pin description definition	Lu Zongde	2023-04-27
4	V1.0.3	M	Modify typesetting	Dong Pengfei	2023-07-13
5	V 1.0.4	M	Update section description	Mark	2023-08-08

*Change status: C - Create, A - Add, M - Modify, D - Delete

Table of contents

1 Overview

WTO5511A-S8 is a high-performance industrial-grade low-power BLE module that supports the full Bluetooth 5.1 protocol stack. It can be widely used in energy industry, industrial control, automotive electronics, smart cities and other scenarios.

● Industrial-grade BLE SoC, supporting the full BLE 5.1 protocol stack;

● Built-in high-speed memory FLASH: 512kB, SRAM: 64kB;

● Excellent electrostatic discharge (ESD) performance, HBM≥2KV;

● Contains a 32-bit MCU core with adjustable clock frequency up to 64MHz;

● RF radio frequency performance indicators;

   Maximum receiving sensitivity of -105dBm
   Maximum transmit power of +13dBm (default 6dBm)

● Ultra-low power consumption design, with SRAM and RTC running, the standby current is as low as 1.1μA;

● Supports various Profiles defined by L2CAP, GAP, GATT, SMP and SIG organizations;

● Integrate rich peripherals, including complementary PWM output, capacitive touch interface, high-precision ADC, AES/DES/ECC security unit, high-speed serial port, etc. ;

● Small package, strong performance, and wide application scenarios.

2 Module size diagram

Figure 1Module size diagram
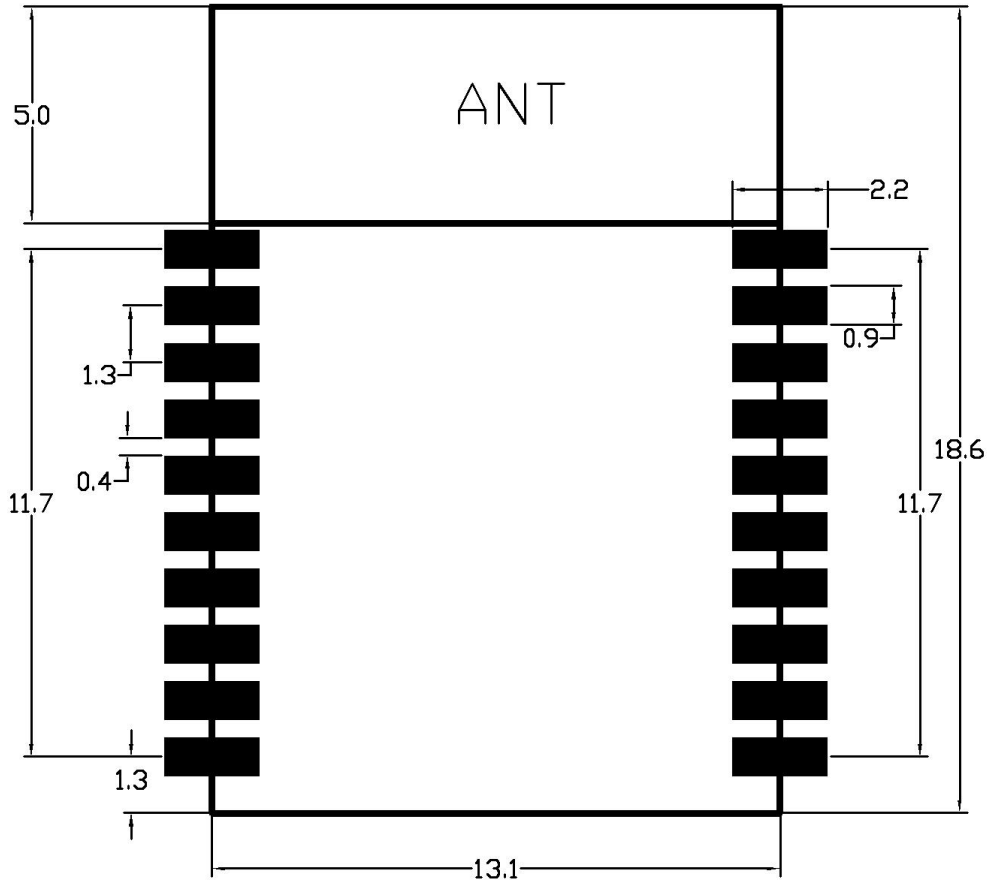
3 Pin definition

3.1 Pin layout

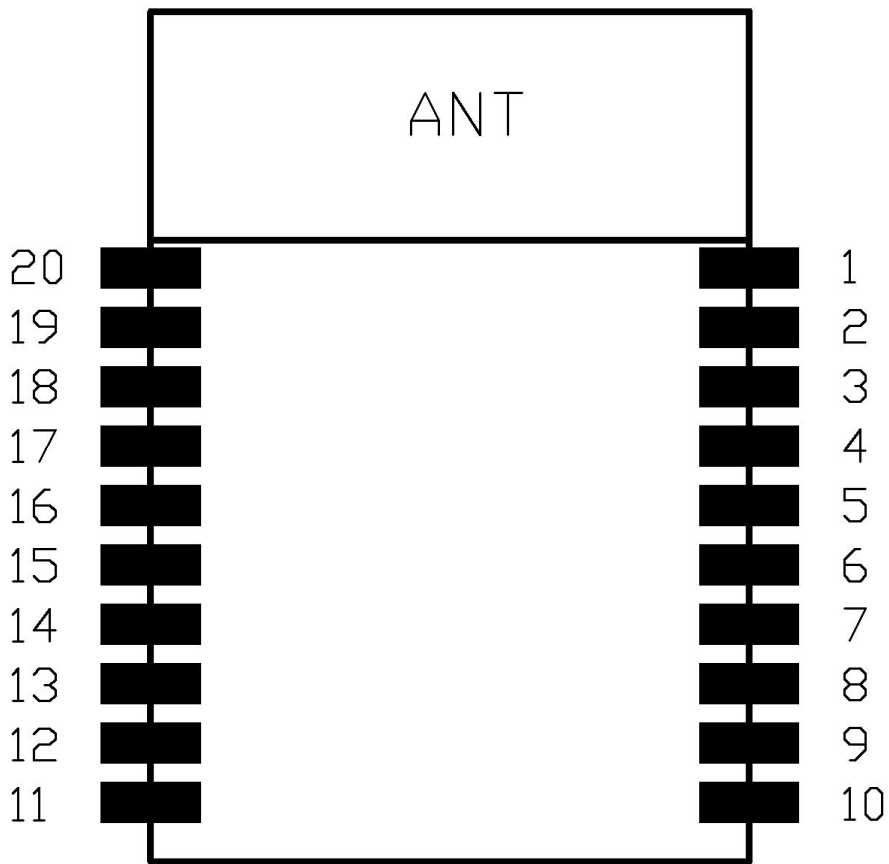**Figure 2 Pin top view**

3.2 Pin description

The module has a total of 20 pins , please refer to Table 1 for detailed description .

Table 1pin definition

Pin number	Pin name	describe
1	GND	Module power ground
2	PA15	Serial port 1 TXD (TTL level)
3	PA14	Serial port 1 R XD (TTL level)
4	PB05	GPIO (SWDIO by default)
5	PB06	GPIO (default is SWCLK)
6	PA07	GPIO
7	NC	Dangling
8	PB 00	Serial port 0 TXD (TTL level)
9	P B01	Serial port 0 R XD (TTL level)
10	VCC	Module power supply input
11	PA02	GPIO/ADC
12	PB10	GPIO/second pulse input (SE)
13	PB14	GPIO (BOOT pin, needs to provide low level when burning program)
14	PB08	GPIO/reactive pulse input (QP)
15	PB09	GPIO/active pulse input (AP)
16	NC	Dangling
17	NC	Dangling
18	NC	Dangling
19	NRST	Reset input pin, active low (built-in 10 K pull-up resistor)
20	GND	Module power ground

4 Peripheral application design and precautions

The use of the WT05511A-S8 module needs to meet basic working requirements. This chapter will introduce how to design each functional interface circuit, precautions, and provide design reference.

4.1 Power interface

Power circuit design and layout are very important links in the entire product design. The quality of the power supply design affects the performance of the entire product. Please read the power supply design requirements carefully and follow correct power supply design principles to ensure optimal circuit performance.

Table 2 Power interface

| Pin name	Pin number	Function description	Remark
VCC	1 0	Module power input	2.6-3.6V (Default: 3.3 V)
GND	1.20	Module power input ground	Please ensure that all ground pins are well grounded

4.1.1 VCC design instructions

Power supply design consists of two parts: circuit design and PCB layout.

Power supply design

The WT05511A-S8 power supply supports 2.6-3.3V power input (typical value 3.3V). Recommended power supply design suggestions are shown in Figure 3;

Figure 3 Recommended power supply design
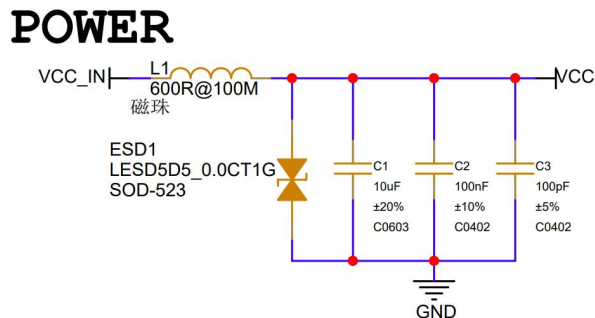
4. 1. 2 Power supply design considerations:

● It is recommended to place magnetic bead L1 on the power input to filter out high-frequency noise from the power supply.

● The maximum input voltage of the module power supply is 3.6V, and the typical value is 3.3V; the VCC recommended trace width is ≥1mm;

● an ESD tube to the module power supply. The ESD clamping working voltage VRWM=5V should be placed close to the power input interface to ensure that the power surge voltage is clamped before it enters the back-end circuit to protect the back-end devices and modules;

● C1 can choose 10uF aluminum electrolytic capacitor or ceramic capacitor, which can improve the instantaneous large current freewheeling capability of the power supply. The capacitor withstand voltage value must be greater than 1.5 times of the input power supply voltage;

● Place low- ESR bypass capacitors C2 and C3 close to the module to filter out high-frequency interference in the power supply;

4.2 Control interface

Table 3 Control interface

Pin name	Pin number	Function description	Remark
PB14	13	GPIO (BOOT pin)	A low level needs to be provided when burning the program
NRST	19	reset input pin	Active low
SWCLK	5	S WD Clock	Used when customers develop their own programs
S WDIO	4	SWD data	Used when customers develop their own programs

4. 2. 1 Special function pin description

The module defaults to serial port downloading, which requires the use of the BOOT pin of PB14 and a low level when burning the program.

| Function	Electric meter terminal general version firmware
Meritorious	PB09
No use	PB08

Second pulse (electricity meter does not have this function)	PB10
Communication serial port TXD	PA15
Communication serial port RXD	PA14
Program Download TXD	PB00
Program Download RXD	PB01

4.2.2 NRST

Reset is achieved through the NRST pin. In the normal working state of the module, the module reset can be triggered when the NRST pin inputs a low level. The pin has an internal pull-up, and the typical high-level voltage is 3.3V. It should be left floating when not in use. If you need to reset the button, please refer to Figure 4. It is recommended to connect a 100nF capacitor in parallel to the button to filter out the level jitter after the button is triggered.

Note that due to the internal pull-up of the module, low-power applications need to pay attention to whether the power consumption of this pin meets the requirements.

Figure 4 Button reset reference design
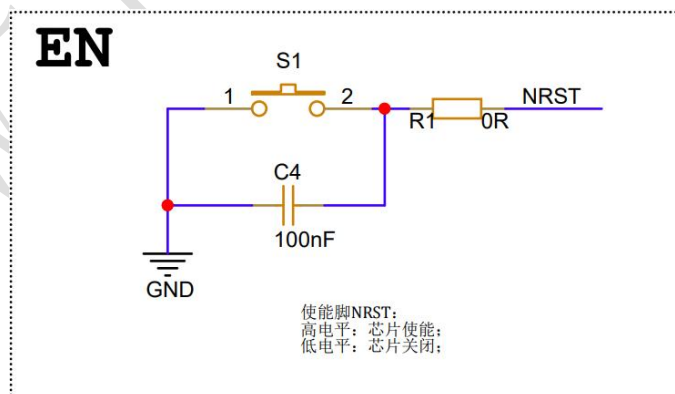
4.3 Peripheral interface

The module provides a variety of commonly used peripheral interfaces

4.3.1 Serial interface

Table 4 Serial port interface

Pin name	Pin number	Function description	Remark
TxD	8	Serial port sending	
RxD	9	Serial port receiving	

The module can realize program download, data communication and debugging functions through the serial port. Customers can choose to use it according to their needs. The recommended serial port connection circuit is shown in Figure 5. It is recommended to reserve pull-up resistors (R6, R7) to prevent the chip serial communication drive capability from being insufficient. It is recommended to connect a 100ohm current limiting resistor in series on the RXD and TXD signal lines to prevent pulse current from burning the chip.

Figure 5 Serial port connection reference design
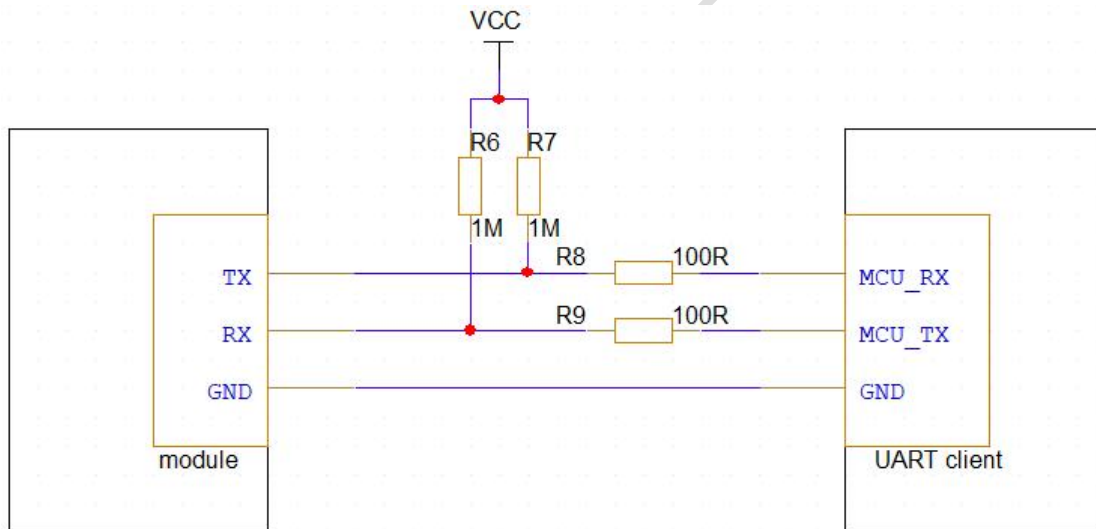
4. 3. 2 **Notes on serial port schematic design:**

- Please note the correspondence between signal flow and connection.
- The module serial port level is 3.3V. If the UART and MCU logic levels do not match, level conversion is required.

4. 4 RF design considerations:

The module has its own PCB antenna, which is located above the module and outside the shielding cover. The module antenna area should be close to the edge of the product.

The onboard antenna will be affected by the customer's chassis, causing the resonant frequency to shift. If the communication distance is very high, the customer needs to prepare the finished product with the module and submit it to our company for testing and verification. The reference layout is shown below:

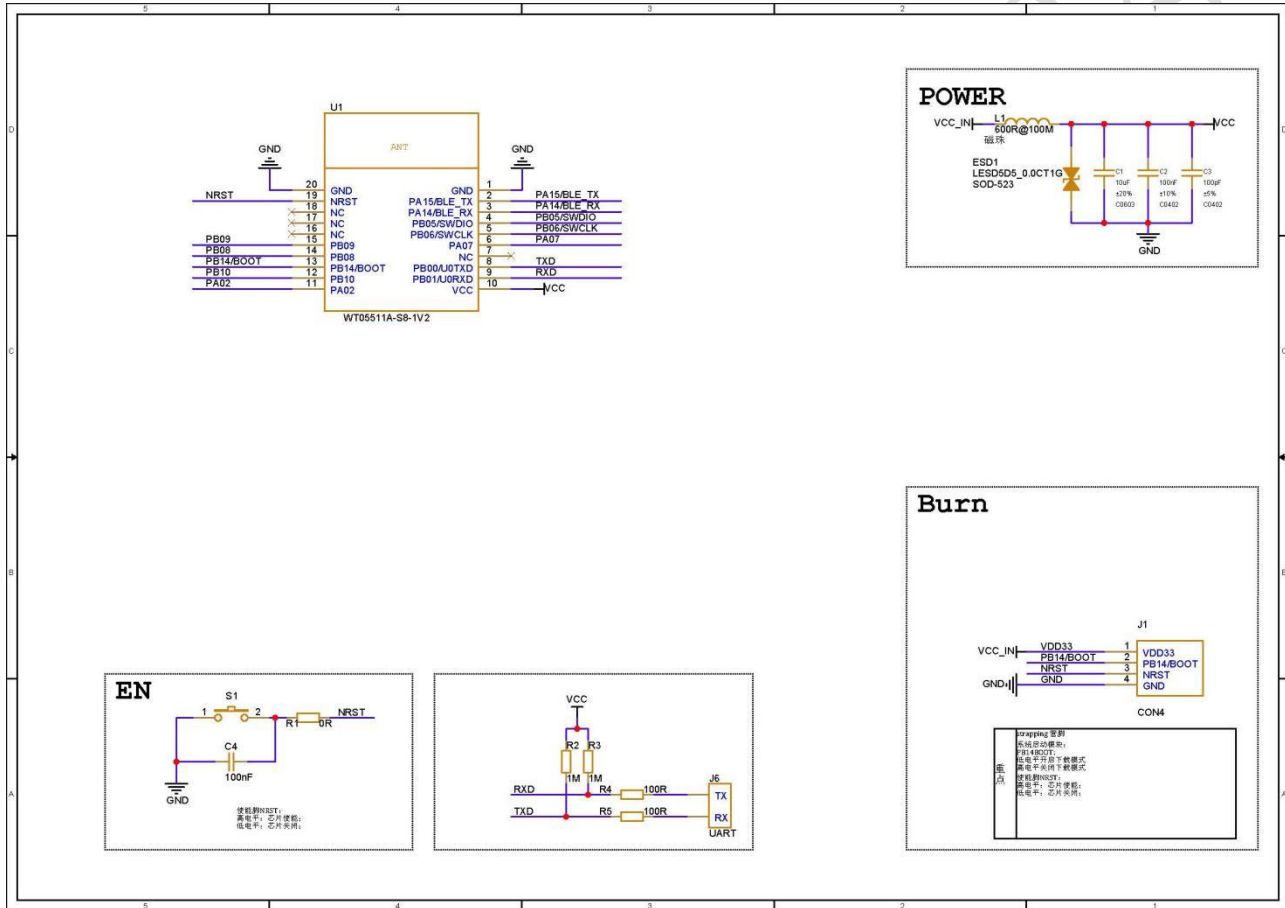**Figure 6 RF reference layout one**

Figure 7 RF reference layout 2

注：阴影区不能有任何走线、铺铜及金属器件
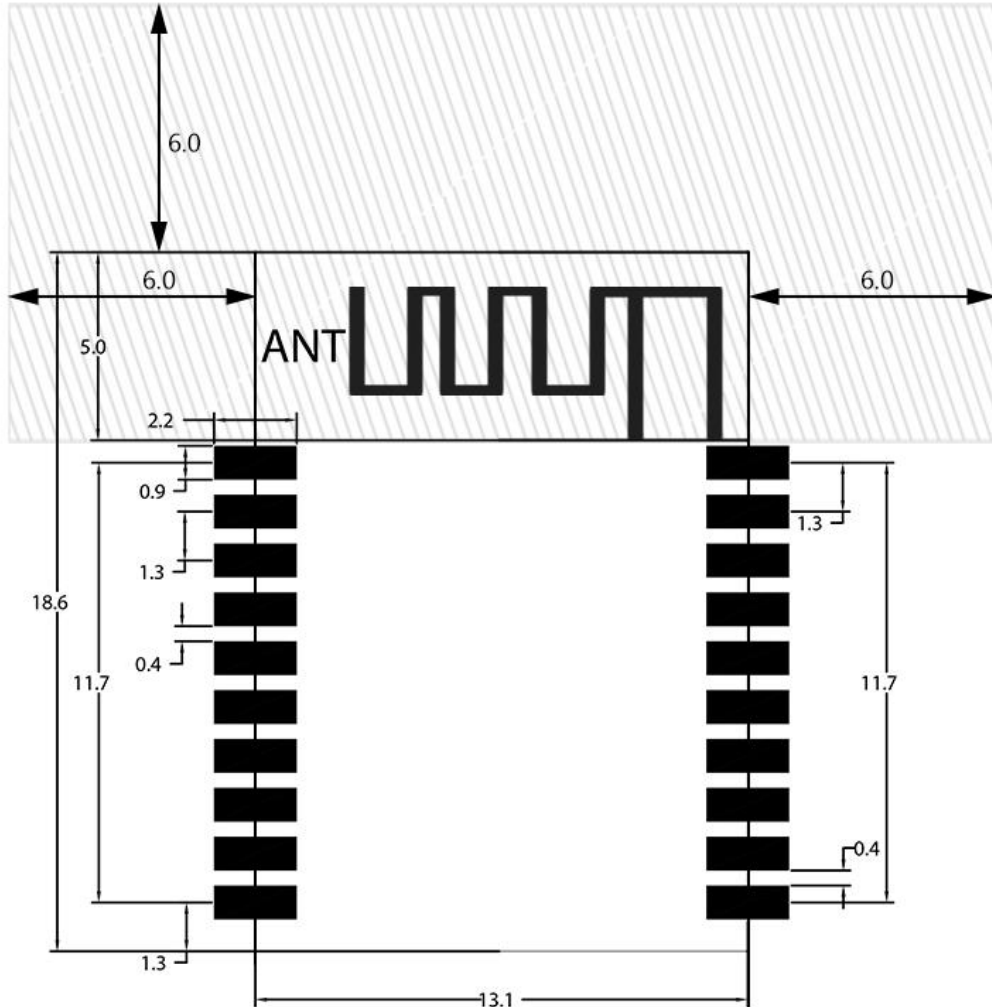
单位：*mm*

4.5 Module peripheral reference design

Figure 8 Application module peripheral design schematic diagram

5 Electrical characteristics

Table 5 Electrical Characteristics

parameter	describe	minimum value	Typical value	maximum value	unit
Operating temperature	/	-40		80	℃
voltage	/	2.6	3.3	3.6	V
Working current	Broadcast mode @ 0dBm output (DCDC ON)		6.7 (average)	21.09	mA
	Connection mode (DCDC ON)		4.5 (average)	19.9	mA
VIH	Input high level voltage range	0.8*VDD33		VDD33	V
vIL	Input low level voltage range	0		0.2*VDD33	V
VOH	Output high level voltage range	VDD33-0.4		VDD33	V

VOL	Output low level voltage range			0.4	V
VESD	Electrostatic discharge voltage		± 4000		V

6 Patch notes

6.1 Steel mesh

When customers produce stencils, it is recommended to make ladder stencils with a thickness of 0.12~ 0.15mm. Users can make fine adjustments according to the actual patch effect.

6.2 Solder paste

The thickness of the solder paste and the flatness of the PCB both play a key role in the production qualification rate;

In principle, we do not recommend customers to use leaded solder paste that is different from our module process. The reasons are as follows:

the LCC in the module to be in a semi-molten state during the secondary reflow, resulting in virtual soldering;

If the customer recommends using a lead-based process, please ensure that the reflow temperature is at 220 °C for more than 45S and the peak reaches 240 °C;

If there are environmental protection requirements, please fine-tune the temperature curve according to the actual situation;

6.3 SMD oven temperature curve

If the user's PCB is thin or slender, there is a potential risk of warping during the SMT process. It is recommended to use a carrier during the SMT and reflow process to prevent poor soldering caused by PCB warping.

Figure 9 Furnace temperature curve
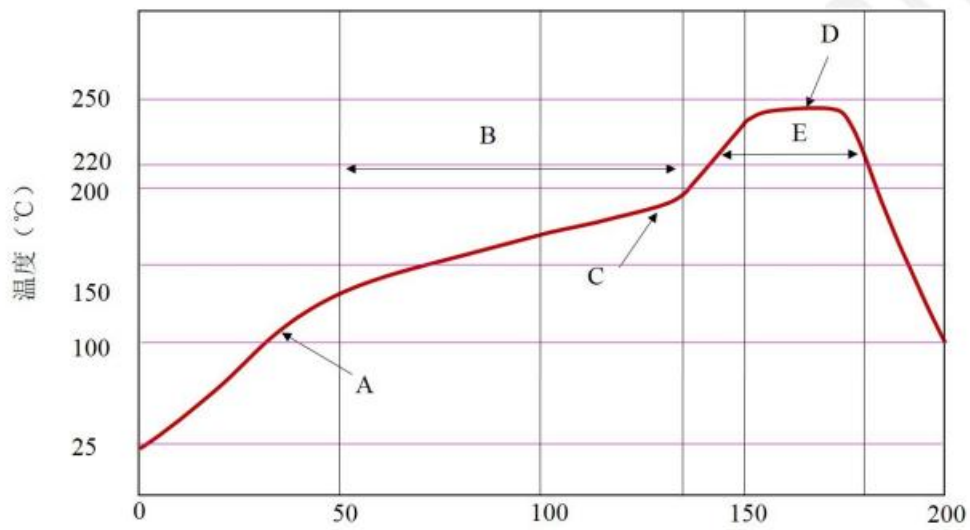
The process parameter requirements are as follows:

● Rising slope: 1～4℃/sec; falling slope: −3～−1℃/sec;
● Constant temperature zone: 150-180℃ Time: 60-100S;
● Reflow zone: greater than 220℃ time: 40-90S;
● Peak temperature: 235-250

7 Function description

7.1 Working mode

Bluetooth works in the two-master and three-slave working mode, and can simultaneously establish concurrent connections with 2-channel (collector, automatic line of the platform, handheld device) host and 3-channel slave (external load switch, alarm device, various external sensors) Data connection, typical network topology is as follows:

Figure 10 Bluetooth network topology diagram
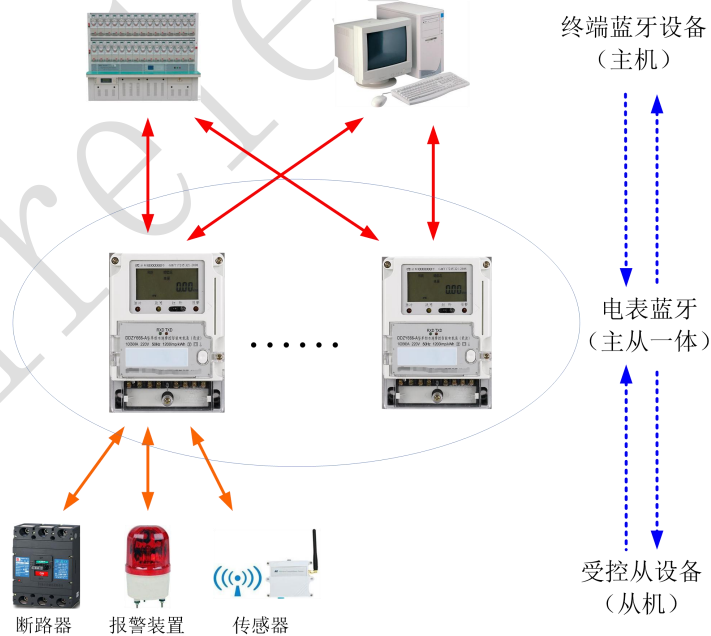
7.2 Supported BLE standards

1) The chip and software protocol stack obtain the QDID from the SIG organization

7.3 Interoperability requirements

1) Communication service U UID:
LSB: {0x79, 0x41, 0xDC, 0x24, 0x0E, 0xE5, 0xA9, 0xE0, 0x93, 0xF3, 0xA3, 0xB5, 0x01, 0x00, 0x40, 0x6E}

2) Data receiving U UID
LSB: {0x79, 0x41, 0xDC, 0x24, 0x0E, 0xE5, 0xA9, 0xE0, 0x93, 0xF3, 0xA3, 0xB5, 0x02, 0x00, 0x40,

0x6E}

Property: writewithoutresponse

Descriptor: None

Access: open

3) Data sent to UID

LSB: {0x79, 0x41, 0xDC, 0x24, 0x0E, 0xE5, 0xA9, 0xE0, 0x93, 0xF3, 0xA3, 0xB5, 0x03, 0x00, 0x40, 0x6E}

Attribute: notification

Descriptor: C CCD (the UUID of this item is 0x 2902)

Access: open

7.4 MAC address format

1）Use the standard 48-bit format, with the highest two bits being "11";

2）The remaining 46 bits cannot be all 0 or all 1;

3）Bits 41-46 are device type description bits, which are used to distinguish device types such as collectors, handheld devices, and energy meters to avoid conflicts, as shown below:

Equipment type	Logo
Meter	0
Collection equipment: collector, concentrator, etc.	1
Operation and maintenance handheld device	2
Testing equipment: table, automatic testing line	3
Load switch	4

4）Bits 1-40 are address contents, which correspond to the communication address of the electric energy meter one by one and are encoded in Hex format. For example, if the communication address of the electric energy meter is 123456789999, the MAC 1-40 bits of this part of Bluetooth are 1CBE991DEF.

5）The Bluetooth MAC address of the energy meter is read-only and cannot be set. When the communication address of the energy meter changes, the Bluetooth MAC address of the energy meter changes at the same time.

7.5 Broadcast payload convention

| Payload #	content	Example (31 bytes)
Advertising data flag	Length-Type-Value	0x02 0x01 0x06
Advertising TX Power	Length-Type-Value	0x02 0x0A 0x00
Slave Connection Interval Range	Length-Type	0x05 0x12
	Min Connection Interval	0x00 0x18, 1.25ms*24=30ms
	Max Connection Interval	0x00 0x50, 1.25ms*80=100ms
Broadcast specified dataManufactorySpecify Data	Length-Type	0x09 0xFF
	Company ID (2 bytes)	0xFFFF, here represents the manufacturer in the State Grid ID number, such as Wasion is 0020
	MAC Address (6 bytes)	0xE7D4370AFC02, here is the MAC address, to be compatible with Apple IOS APP
Advertising Device Name	Length-Type	0x07 0x09
	Device Name (6Byte ASCII Char)	The last six digits of the communication address of the energy meter are expressed in ASCII format

Note: Bluetooth broadcast transmission is in little-endian mode. For example, the connection interval transmission message sequence is: 0x05 0x12 0x18 0x00 0x50

0x00, where 0x18 0x00 represents MinConnection Interval, which is 1.25ms*24=30ms; 0x50 0x00 represents MaxConnection Interval, which is 1.25ms* 80=100ms.

Broadcast scan response data

Payload #	content	Example
Service UUID Service UUID	Length-Type	0x11 0x07
UUID(LSB)	6E4000001-B5A3-F393-E0A9-E50E24DC4179 (here is an example, see UUID convention for details)	0x7941DC240EE5A9E093F3A3B50100 406E (here is an example, see UUID convention for details) to be compatible with Apple IOS APP

7.6 Bluetooth communication process agreement process
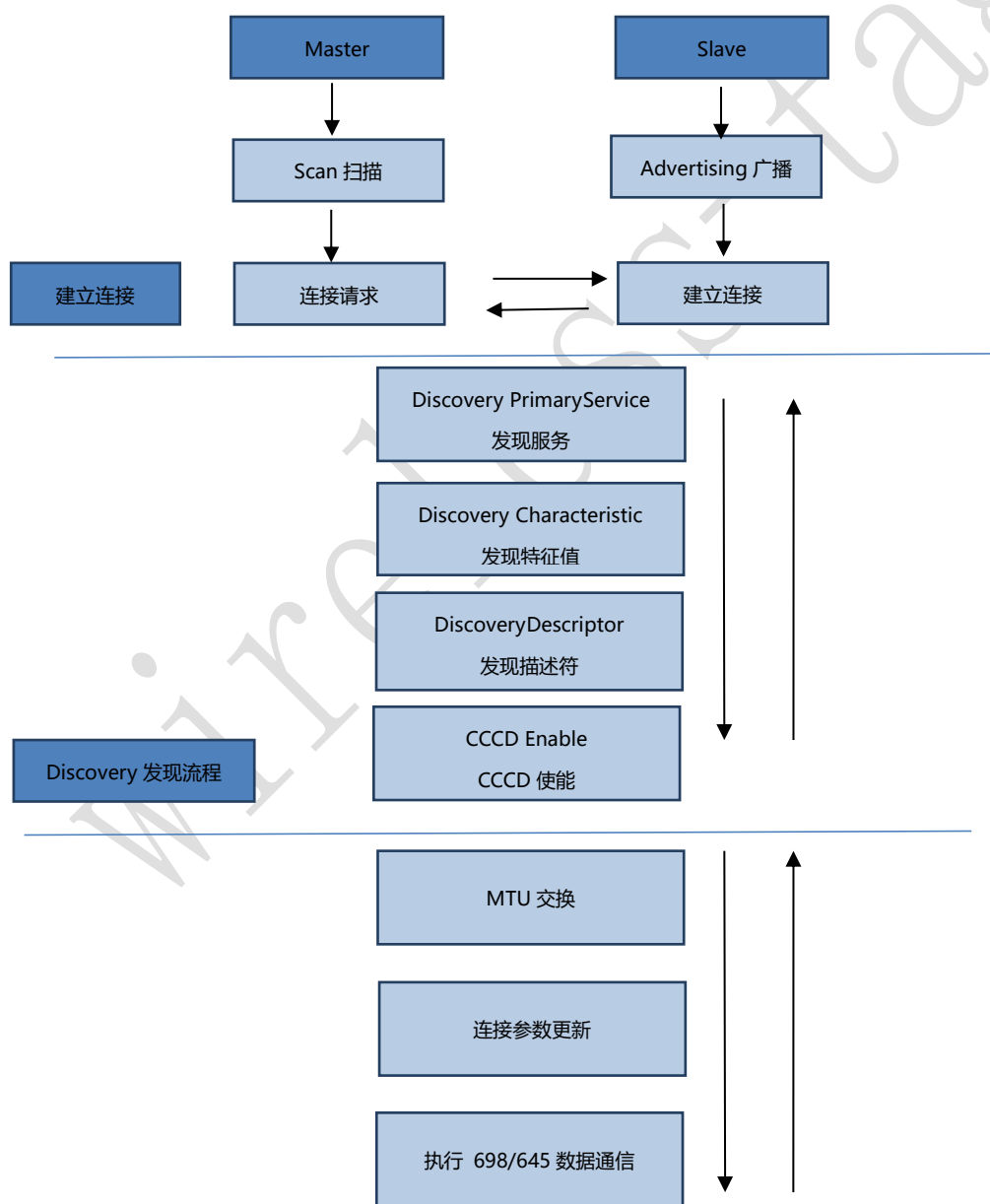
Bluetooth communication process agreement flow chart

7.7 Bluetooth power-on initialization process

a) After the Bluetooth module is powered on, it determines the legality of the three-way slave MAC address. If the address is legal (not full FF), a data connection will be established with the corresponding

slave. If it is illegal (full FF, factory default), it will not be established. connect. When the slave MAC parameters change, the energy meter should reinitiate the connection.

b) The electric energy meter turns on Bluetooth broadcast and waits to be connected by the Bluetooth host . After being connected by the host, if the communication times out or there is no communication within 6 seconds, the electric energy meter should actively disconnect.

7.8 Circuit breaker bluetooth broadcast content

Bluetooth broadcast content of circuit breakers that support automatic pairing function:

Payload #	content	Example (26 bytes)
broadcast data flag	length-type-value	0x02 0x01 0x06
Manufacturer specified data	length-type	0x16 0xFF
	Circuit breaker equipment category code (1byte)	0xC4 (fixed value)
	Manufacturer code (2bytes)	This represents the manufacturer's ID number in the State Grid. The default is 0 xFFFF.
	Circuit breaker automatic pairing check code (2bytes)	0xE212 (generated by algorithm)
	Connection PIN password (16 bytes)	0 xACA748039B980D1DDA0A6A4AF D1B1B55

Note 1. The feature code is in little-endian mode, and the feature code 0xe212 is in the order of 0x12 0xe2 in the broadcast packet.

Note 2. If the PIN code is all FF, it means that the pairing PIN is not enabled, that is, the link layer encryption is not enabled, and it is compatible with some Bluetooth slave devices with low security requirements. When the meter connects to the slave machine, it connects according to the MAC address. If the slave machine does not enable the security PIN, it can still connect.

Federal Communication Commission Statement (FCC, U.S.)

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.

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.

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.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

IMPORTANT NOTES

Co-location warning:

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

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.).

  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.

End product labeling:

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: 2AFOS-WT05511A-S8".

Information that must be placed in the end user manual:

  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.

Integration instructions for host product manufactures according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

FCC Part 15 Subpart C 15.247 & 15.207 & 15.209

2.3 Specific operational use conditions

The module is a BLE Module with BLE 2.4G function.

BLE Specification：

Operation Frequency: 2402~2480MHz

Number of Channel: 40

Modulation: GFSK

Type: PCB Antenna

Gain:0.42dBi

The module can be used for mobile or applications with a maximum 0.42dBi antenna. The host manufacturer installing this module into their product must ensure that the final composit product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operaition. The host manufacturer 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.

2.4 Limited module procedures

Not applicable.

2.5 Trace antenna designs

Not applicable. The module has its own antenna, and doesn＇t need a host＇s printed board microstrip trace antenna etc.

2.6 RF exposure considerations

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and users＇ body; and if RF exposure statement or module layout is changed, then the host product

manufacturer required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization

2.7 Antennas

Antenna Specification are as follows:

Type: PCB Antenna

Gain:0.42dBi

This device is intended only for host manufacturers 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 internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a 'unique' antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer 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.)

2.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating "Contains Transmitter Module FCC ID: 2AFOS-WT05511A-S8" with their finished product.

2.9 Information on test modes and additional testingrequirements

BLE

Operation Frequency: 2402~2480MHz

Number of Channel: 40

Modulation: GFSK

Host manufacturer must perfom test of radiated & conducted emission and spurious emission, etc

according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product. Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.207 & 15.209 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. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.