

WS8475

LoRa Uart Module

Data Sheet

- Support 850-930MHz frequency band.
- Support transparent transmission, fixed-point transmission, broadcast transmission, channel monitoring and other functions.
- Support deep sleep, in which the power consumption of the whole machine is less than 2UA;
- Support multi-level data transmission rate of 2.4k ~ 62.5kbps
- Supports multiple levels of baud rate from 1200 bps to 256000 bps.
- The maximum supported packet length is 246 bytes.
- Support random encryption of data in the air
- Support LBT function
- Support relay function
- Support packet RSSI and channel detection RSSI
- Support 1K data cache.
- The module supports 81 channels.
- Support 3.0 ~ 5.5V power supply, and power supply greater than 3.5V can ensure the best performance.
- Industrial standard design, supporting long-term use at -40 ~ +85°C
- Dual antennas are optional (IPEX/ stamp hole) for integration.

Document information		
product model	WS8475	
Product overview	Uart Module	
Document type	Data sheet	
Document number		
Document version	V3.0	2025.06.18

Document version update				
serial number	version number	Revised content	Revision date	Reviser
one	v1.0	Initial version	2024.12.17	SQ
2	v2.0	Adjust RF-related configuration parameters	2025.02.12	SQ
three	v2.1	Modify parameter description	2025.03.26	SQ
four	v2.2	Modify the default parameter description and send the data sequence diagram.	2025.04.19	SQ
five	v3.0	Add AT command configuration and modify hardware parameters.	2025.06.18	SQ/LP



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1 Product overview

1.1 Product introduction

WS8475 is a UART wireless LoRa data transmission module designed and produced by Chengdu Silent Communication Technology Co., Ltd. and supporting multiple frequency bands. It is designed with high-performance MCU+Transceiver. The module supports low power consumption, and the user's single packet length is 246 bytes. Support fixed-point transmission, transparent transmission, broadcast transmission, WOR transceiver and other functions.

WS8475 supports random encryption, and every time the same data is sent, different data is captured in the air. Supporting Lora spread spectrum technology, Lora direct sequence spread spectrum technology has the advantages of longer communication distance, strong anti-interference ability and strong confidentiality.

1.2 Characteristic function

Characteristic function
The measured communication distance is 5km.
It supports advanced LoRa modulation mode and has the advantage of long-distance anti-interference.
Support license-free ISM 433MHz frequency band, support 470MHz meter reading frequency band.
Support transparent transmission, fixed-point transmission, broadcast transmission, channel monitoring, low-power reception and other functions.
Support deep sleep. In this mode, the power consumption of the whole machine is about $< 2\mu A$;
Support multi-level data transmission rate of 2.4 k ~ 62.5kbps.
Support 1200 ~ 25600bps serial baud rate.
The length of supported subpackages is 246 bytes.
Support random encryption of air data to ensure that the same user data is different encrypted data after being captured in the air for many times.
Support LBT function
Wide voltage working range: 3.0V~5.5V to support various battery application scenarios.
Industrial standard design, supporting long-term use at -40 ~ +85°C
Dual antennas are optional (IPEX/ stamp hole) for integration.

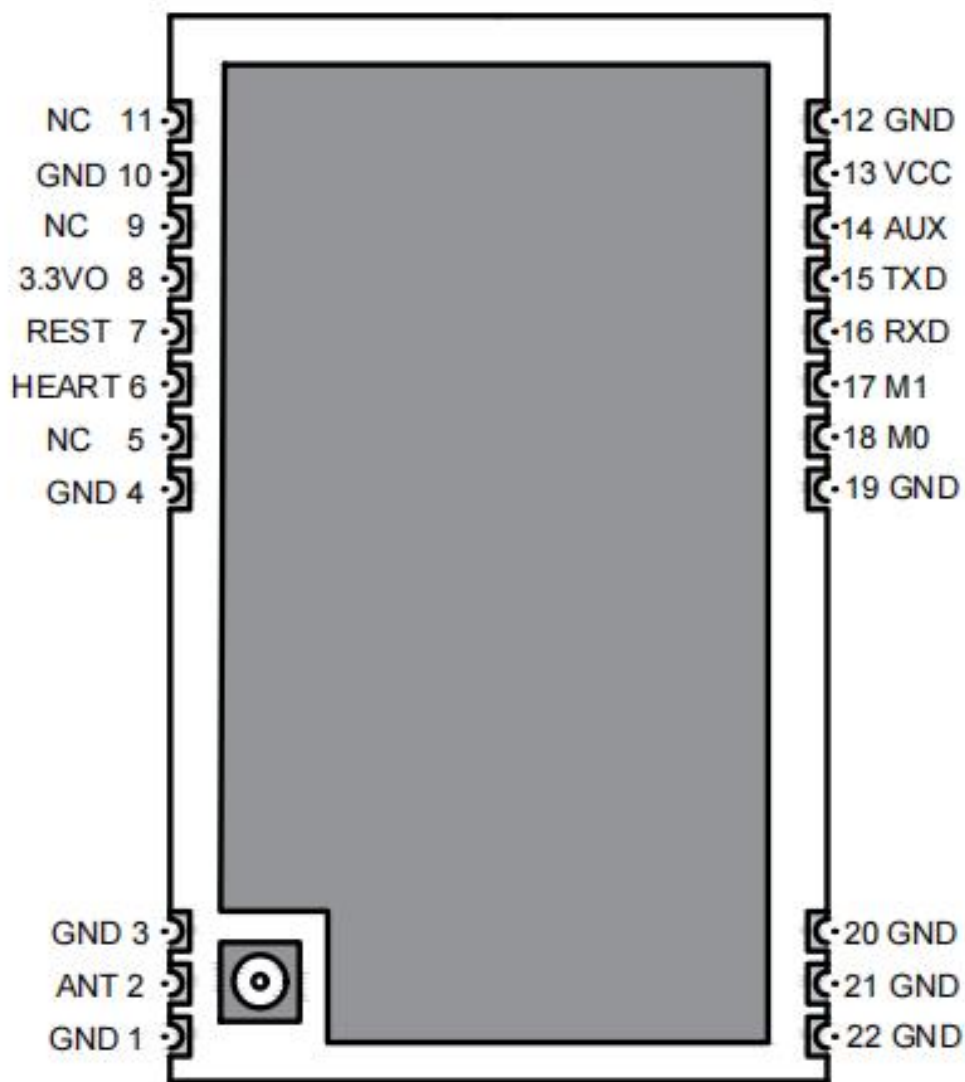
1.3 Application scenario

Application scenario
Street lamp control
environmental monitoring
Intelligent parking lot sensor
Smart agriculture sensor
Industrial sensor, remote controller
Smart home

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Wireless alarm safety system
Building automation solution
Health care products
Advanced meter reading architecture (AMI)

2 Pin definition



Pin name	Pin direction	Pin usage
GND	-	Power supply reference ground
M0	I	Mode 0 pin (internal 1M Ω weak pull-up), and the combination of M0 and M1 determines the working mode of the module.
M1	I	Mode 1 pin (internal 1M Ω weak pull-up), M0 and M1 together determine the working mode of the module.



RXD	I	UART data input, connected to external TXD output pin
TXD	O	UART data output, connected to external RXD input pin
AUX	O	Module mode status pin
VCC	I	Power supply, the range of 3.0V~5.5V is greater than 3.5V to ensure full power output.
3.3VO	-	Modular system 3.3V power supply, users don't need to pay attention, no network connection, NC processing.
REST	I	Module reset pin, active at low level, with internal reset circuit, users do not need external reset circuit, NC processing or connecting MCU controller pin.
HEART	O	Module heartbeat pin, which outputs a square wave with a period of 1s and a logic level of 3.3V Users can NC process or connect LED or MCU input pin. Note that this pin may affect sleep and receive current if it is connected to equipment.
ANT	I/O	Radio frequency interface, stamp hole
NC	-	No connection required

3 hardware design

- The supporting voltage range of the module is 3.0-5.5V, and the module performance can be satisfied when it is greater than 3.5V, and the power supply for the module needs to meet the transient load capacity of $\geq 300\text{mA}$;
- It is suggested to add $22\mu\text{F}+0.1\mu\text{F}$ capacitor near the power input port outside the WS8475 module;
- When the serial port is connected to an external device or MCU, it is suggested that TXD and RXD should reserve a 4.7k pull-up resistor to a 3.3V power supply without welding.
- Reset the existing circuit inside the REST pin, which can be reset at low level. It is suggested to reserve an MCU pin for control.

4 function declaration

4.1 Pattern description

The module mode is controlled by the module mode pins (M0, M1), and there are four modes in total: 0~3. M0 or M1 is 0, which means pulling low; A value of M0 or M1 is 1, which means pulling high.

model	M1	M0	model	remarks
0	0	0	Transmission mode	In this mode, RF works normally, and supports transparent transmission, broadcasting, monitoring, fixed point and other functions. Among them, transparent transmission and fixed-point functions are determined by

				transmission mode parameters; The receiver is in the same mode.
one	0	one	WOR transmission mode	The receiver is in WOR receiving mode or transmission mode; In this mode, the transmission power consumption increases.
2	one	0	WOR receiving mode	In this mode, the module periodically sleeps and wakes up to reduce power consumption, and the sleep and wake-up period is determined by WOR parameters, which is used in conjunction with WOR transmission.
three	one	one	Hibernation, configuration mode	The module enters the sleep mode, in which the module current is less than 2uA, and parameter configuration is supported.

4.1.1 Transmission mode (mode 0)

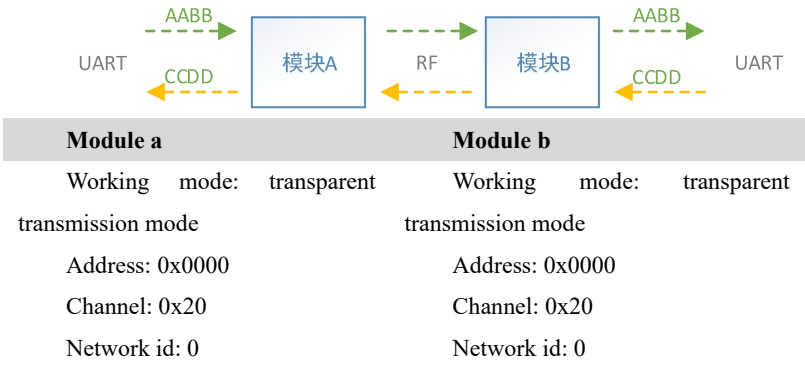
The transmission mode, namely mode 0, is realized when M0 and M1 are pulled low at the same time.

In the transmission mode, the module can be configured as transparent transmission function, fixed-point transmission function and broadcast transmission function.

(Note: In the following example, if the parameters are not specified, the wireless address, wireless channel, wireless airspeed, encryption method and key parameters must be consistent.)

4.1.1.1 Transparent transmission function

Example of scenario:



Module A receives data through serial port: AA BB, and then sends it to module B through radio frequency; after receiving data, module B outputs data through serial port: AABB; After receiving serial port data: CC DD, module B sends data to module A through radio frequency, and module A outputs data CC DD through serial port after receiving data. It is up to the user to send and receive data on both sides.

In transparent transmission mode, modules communicating with each other must have the same address and channel (except address 0xFFFF, which is broadcast and monitoring address).

Note: In the transparent transmission function, the data received by serial port is directly transmitted by radio frequency, without any format conversion and data packaging.



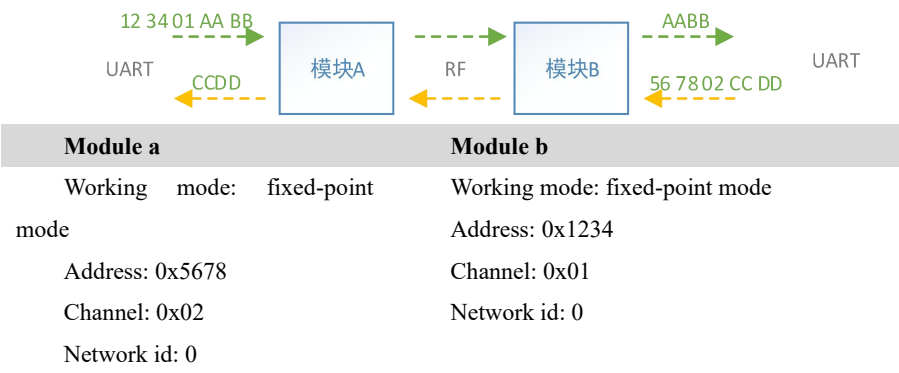
4.1.1.2 Broadcasting and monitoring functions

Broadcast function: When the module address of the sender is 0xFFFF(65535), the data sent by the sender can be received by the module at any address (provided that the airspeed, channel and network ID of the sender and receiver are the same or 255).

Listening function: When the address of the receiver module is 0xFFFF(65535), the receiver can receive the data sent by the sender module at any address (provided that the airspeed, channel and network ID of the transmitter and receiver are the same or 255).

4.1.1.3 Fixed point transmission function

Example of scenario:



Module A receives data through serial port: 123401aaabb, where 0x1234 is the address of the target module and 0x01 is the channel of the target module. The data are all in hexadecimal, and the data is sent to module B through radio frequency. After receiving the data, module B outputs the data through serial port: aabb; Module B receives data through serial port: 56 78 02 CC DD, where 0x5678 is the address of the target module and 0x01 is the channel of the target module. The data are all in hexadecimal, and the data is sent to module A through radio frequency. After receiving the data, module A outputs the data through serial port: CC DD.

Transmission format: high byte of destination address+low byte of destination address+destination channel+transmission data.

Note: 1) The data is sent in hexadecimal. In the fixed-point transmission function, the module needs to add the address and channel of the target module before sending the data.

2) In fixed-point mode, the transmission address and channel will also be included in the packet length calculation.

4.1.1.4 Relay transmission function

Example of scenario:



Relay Enable: No.	Relay Enable: Yes	Relay Enable: Yes	Relay Enable: Yes	Relay Enable: No.
Address: 0x1234	Address: any	Address: any	Address: any	Address: 0x1234
Network id: 0x00	Network id: 0x01	Network id: 0x02	Network id: 0x03	Network id: 0x04

With this parameter configuration, modules A and B can communicate with each other and forward through relays 1, 2 and 3. Attention should be paid to the following parameter requirements when using this relay:

- The network ID in the relay network must be set in sequence, and the sequence step is 1.
- The relay in the relay network needs to be configured to be relay enabled.
- The communication modules (modules A and B) in the relay network can be in transparent transmission mode.
- All modules in the relay network need to be in the same channel and at the same airspeed.
- Modules A and B can be composed of multiple modules with different addresses, but the addresses of modules that need to communicate must be the same or meet the broadcasting conditions (address is 0xffff).

4.1.1.5 AT configuration function

In the transmission mode, you can use the AT command to configure, and send the ASCII character "++" to enter the AT configuration. After entering the AT configuration, the module will respond "\r\n+OK\r\n", which means that the module has entered the AT configuration. When you send a configuration command or a query command, you can receive the response of the configuration query command. After the module enters AT configuration, it will receive the correct configuration command within 20S, and the countdown will be refreshed for 20S. If the configuration command is not received after 20S, the module will exit the configuration, and at the same time, the module serial port will output "\r\n+EXIT\r\n", which means that it has exited the configuration and returned to the RF data transmission function before AT configuration.

Note: In the transmission mode, the configuration needs to wait for the RF to be idle before sending the AT configuration command (the AUX status can be detected as high before sending the command to enter the AT configuration), otherwise the response of the command to enter the AT configuration may be delayed.

4.1.2 WOR mode (modes 1 and 2)

WOR modes are modes 1 and 2. When M0 is pulled low and M1 is pulled high, it is mode 1, that is, WOR transmission mode; When M0 is pulled high and M1 is pulled low, it is mode 2, that is, WOR receiving mode.

In WOR mode, the WOR parameters need to be set at the sender and the receiver. The longer the WOR period, the longer the sending time of the sender, the higher the power consumption, the higher the delay of the receiver and the lower the power consumption.

4.1.3 Configuration, Sleep Mode (Mode 3)

Configuration and sleep mode, namely mode 3, is realized when M0 and M1 are pulled high at the same time. When configuring, the default baud rate is 9600bps, with no check and 1 stop bit. When the serial port receives the configuration command, it will wake up the mcu to analyze the execution command and continue to sleep after the execution is completed.

4.1.3.1 sleep mode

In this mode, the module will enter low power consumption, and the average current of the module is lower than 2uA. When sleeping, the corresponding functional pin levels of the module are shown in the following table:

serial number	pin	Pin state at sleep	Output and input modes
one	M0	up level	Pull up input
2	M1	up level	Pull up input
three	AUX	up level	Pull up input
four	UART_RX	up level	Pull up input
five	UART_TX	up level	Push-pull output

4.1.3.2 Parameter configuration

4.1.3.2.1 Configuration, configuration in sleep mode

Parameter configuration function is supported in configuration and sleep modes. During parameter configuration, the fixed serial communication parameter is baud rate of 9600bps, and there is no verification. For configuration commands, refer to the chapter of Parameter Configuration. ConfigurATion uses hexadecimal to send configuration commands, and at instruction configuration is also supported.

4.1.3.2.2 Configuration in transmission mode

Configuration is also supported in transmission mode (only AT command is supported, and the baud rate of configuration is determined by the baud rate of configuration). You need to send "+++"to enter AT command configuration mode. For detailed instructions, please refer to the chapter of AT Command Configuration.

4.2 Module status indication

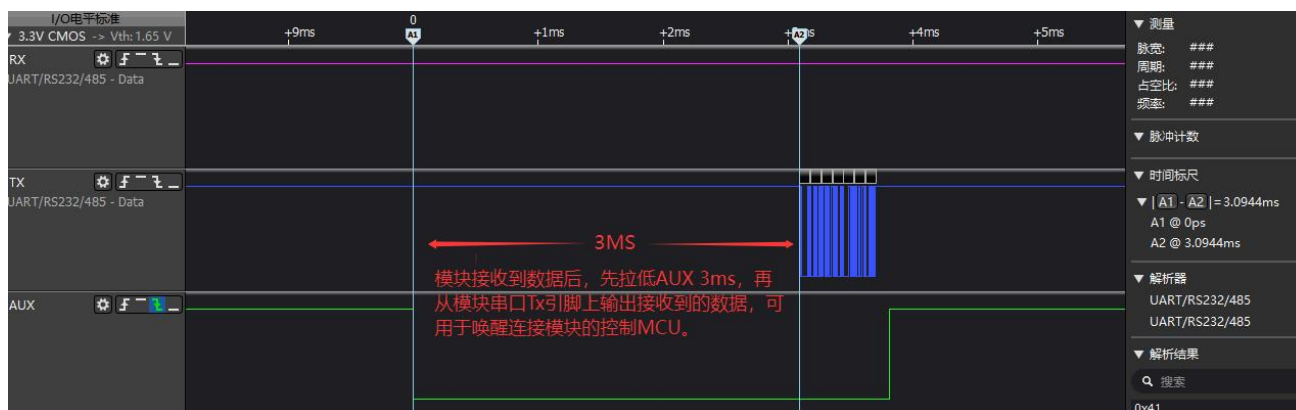
The module status is indicated by the AUX pin. When AUX is low, it represents the busy status of the module. The busy status of the module has the following situations:

- The serial port is sending and receiving data or the serial port buffer is not empty.
- Radio frequency is sending data.
- Module is initializing or software resetting.
- The module is entering other modes from sleep mode.

Therefore, when operating the module, it is best to judge the AUX state first, and then operate the module when the AUX pin level is high.

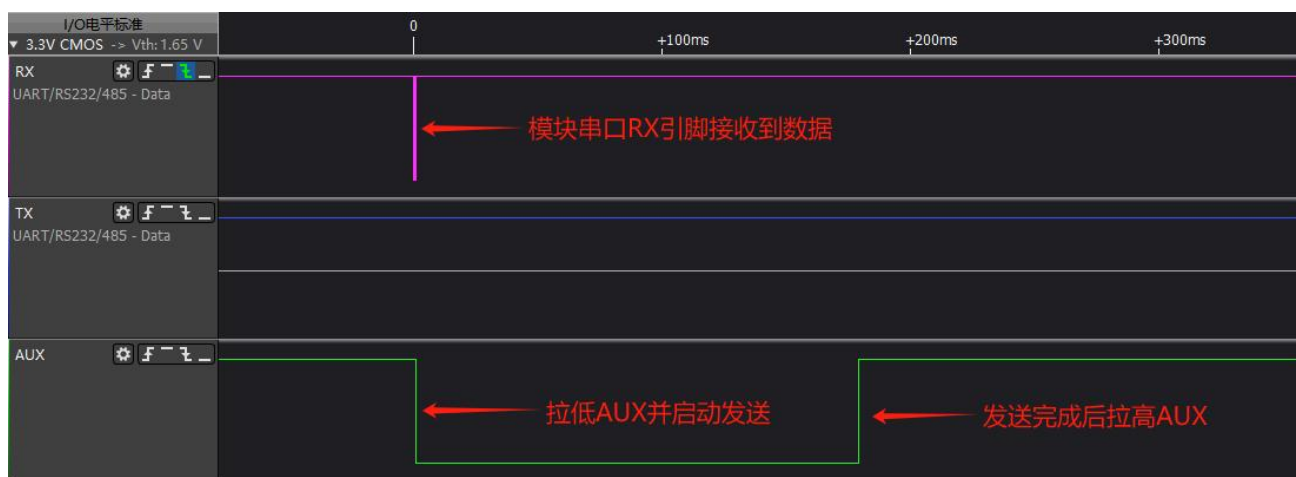
4.2.1 Receiving data AUX status indication

After receiving the data, the module pulls down the AUX pin for 3ms, and then outputs the data from the TXD pin of the serial port. This function can be used to wake up the user MCU and receive data.



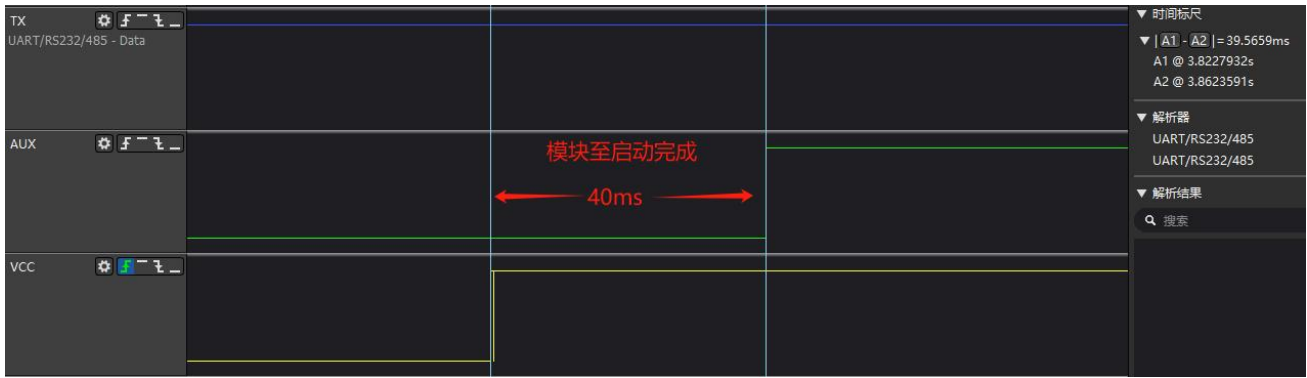
4.2.2 Send data AUX status indication

When sending data, the module receives the data through the serial port, and then pulls AUX down until the data reception is completed or the maximum subcontracting length is reached, and then starts RF transmission, and then pulls AUX up after RF transmission is completed.



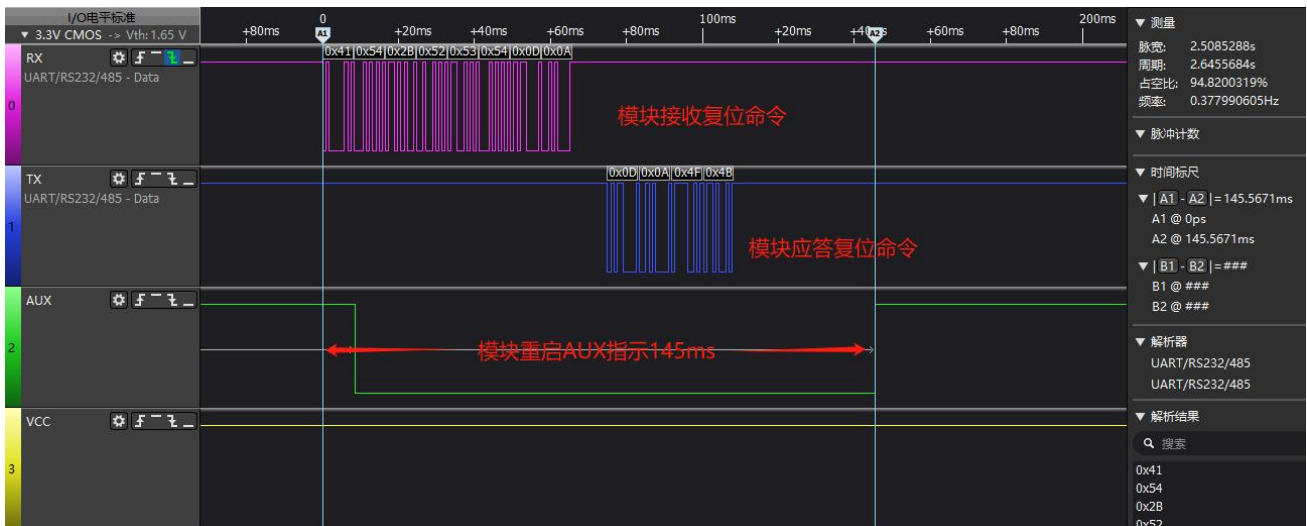
4.2.3 Power-on AUX status indication

The power-on timing of the module is shown in the figure. When the module is fully powered on, VCC becomes high, and the module starts to initialize, while AUX remains low until the module initialization is completed. The time from the stable power supply to the completion of module initialization is about 40 ms.



4.2.4 AT command resets AUX status indication.

After receiving the AT+RST reset command, the module pulls AUX low and responds to the reset command. After the response is completed, restart will be started until the restart initialization is completed in about 145 ms (at 1200 bps baud rate, it is about 40ms at 145ms(1200bps baud rate).



4.3 Restore factory settings

Restoring the factory settings of the module means that all parameters are restored to the factory default parameters. Restoring the factory parameters is realized by command. In configuration and sleep mode, data 0xC5 0xC5 0xC5 is sent to the module, and the module starts to reset the parameters and restart after receiving it. You can also use AT command AT+RESTORE to restore factory settings in transmission mode.

4.4 Factory default parameters

Factory default parameters: 00 00 00 00 30 40 00 14 BF 07 D0A0A1 A2 A3A4A5AA7 A9 AA AB AC AD AE AF.

Baud rate	Check Digit	airspeed	Default channel	address	LBT	RSSI	Transmit power
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115200bps	No parity	2.4kbps	twenty	0	disability	disability	12.3dBm
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5 Parameter configuration

Configuration needs to be in mode 3 (configuration and sleep mode), with baud rate fixed at 9600bps and 8 data bits, without verification, and the configuration command is sent in hexadecimal.

5.1 Register configuration

5.1.1 Brief introduction of configuration instruction

The supported instruction formats are as follows (all commands are sent in hexadecimal, and must be sent continuously, and frames cannot be broken):

serial number	instruction format	explain	remarks
one	C0+ operating parameters	Configuration parameter command (power-off saving) C0+27 bytes working parameters For example: Send the command c000000000 30 40000 14bf07d0a1a2a3a4a5a6a7 A8 A9 AA AB AC AD AE AF. Module response c000000000 30 40000 14bf07d0a1a2a3a4a5a6a7 A8 A9 AA AB AC AD AE AF	
2	C1 C1 C1	Read module parameter command For example: Send command C1 C1 C1 Module response C1 00 00 00 30 40 00 14bf07d0	The key is unreadable.
three	C2+ operating parameters	Configure temporary parameter command (power off without saving) C2+27 bytes working parameters. For example: Send command C2 00 00 00 00 30 40 00 14 BF 07 d0A0A1 A2 A3A4A5AA7 A8 A9 AA AB AC AD AE AF. Module response C2 00 00 00 00 30 40 00 14 BF 07 d0A0A1 A2 A3A4A5AA7 A8 A9 AA AB AC AD AE AF	
four	C3 C3 C3	Read module model and version command For example: Send command C3 C3 C3 Module response C3 57 53 38 34 37 35 44 48 53 20 56 33 2e30 2e32 (ASCII) Corresponding string: ws 8475 v3.0.2.	
five	C4 C4 C4	Reset module command For example:	

		Send command C4 C4 C4 module response C4 C4 C4.
six	C5 C5 C5	Recovery module parameters are factory-set parameters. For example: Send command C5 C5 C5 module response C5 C5 C5.

5.1.2 Configuration register description

There are 27 configuration registers in total, corresponding to 27 bytes (1 byte per register); The configuration command is 1 byte and the configuration parameters are 28 bytes in total.

register	Bit bit	Parameter name	explain			remarks
0	7~0	Command 0xC0 or 0xC2	The configuration command is fixed to 0xC0 (power failure to save) or 0xC2 (power failure not to save).			
one	7~0	High 8 bits of module address	The module address parameter has 8 high bits, and the default value is 0x00.			
2	7~0	Low 8 bits of module address	The module address parameter has 8 lower bits, and the default value is 0x00.			
three	7~0	reserve	The default value is 0x00, just write 0 when configuring.			
four	7~0	Network ID	0~255, the default is 0, and the sender and receiver must be the same.			
five	7~6	Serial parity bit	bit7	bit6	Corresponding parity bit value	
			0	0	No check (8N1, default)	
			0	one	Odd check (8O1)	
			one	0	Even check (8E1)	
			one	one	No check (8N1)	
	5~3	Serial baud rate	bit5	bit4	bit3	Corresponding baud rate value
			0	0	0	Baud rate 1200bps
			0	0	one	Baud rate 4800bps
			0	one	0	Baud rate 9600bps (configured baud rate)
			0	one	one	Baud rate 19200bps
			one	0	0	Baud rate 38400bps
			one	0	one	Baud rate 57600bps
			one	one	0	Baud rate 115200bps (default communication baud rate)
			one	one	one	Baud rate 256000bps
	2~1	Serial stop bit	bit2	bit1	Bit value corresponding to stop bit	
			0	0	1 bit (default)	
			0	one	1.5 bit	
			one	0	2 bits	

			one	one	1 bit			
	0	reserve						
six	7~5	Wireless air rate	bit7	bit6	bit5	Corresponding wireless air rate		
			0	0	0	The air speed is 2.4kbps.		
			0	0	one	The air speed is 2.4kbps.		
			0	one	0	The air rate is 2.4kbps (default).		
			0	one	one	The air speed is 4.8kbps.		
			one	0	0	The air speed is 9.6kbps.		
			one	0	one	The air speed is 19.2kbps.		
			one	one	0	The air speed is 38.4kbps.		
			one	one	one	The air speed is 62.5kbps.		
	4~3	Wireless transmission power	bit4	bit3	Corresponding power value			
			0	0				
			0	one	12.3 dBm			
			one	0	11 dBm			
			one	one	10dBm			
	2	Packet RSSI Output enable	bit2	Packet RSSI output enable bit				Complemen ent output Follow the received data output
			0	Turn off the packet RSSI function (default)				
			one	Turn on the packet RSSI function.				
	one	Real-time channel RSSI read enable	bit1	Real-time channel RSSI read enable bit				After opening, it can be read by AT command .
			0	Turn off the real-time channel RSSI reading function (default)				
			one	Turn on the real-time channel RSSI reading function (it can be read in transparent transmission mode after being enabled).				
	0	reserve						
seven	7~5	WOR Wireless wake-up time	bit7	bit6	bit5	WOR wireless wake-up time value		
			0	0	0	250ms (default)		
			0	0	one	500ms		
			0	one	0	750ms		
			0	one	one	1000ms		
			one	0	0	1250ms		
			one	0	one	1500ms		
			one	one	0	1750ms		
			one	one	one	2000ms		
	four	LBT enable	bit4	LBT function enable bit				When the detected
			0	Turn off LBT (default)				

			one	Turn on lbt (after lbt is enabled, the module will start sending according to the current environmental noise, and the environmental noise will continue to be higher than the threshold for 2s, and the module will send after 2s timeout).	environmental noise is lower than the threshold, the transmission is started.
	three	Preamble detection enabled (WOR receive mode)	bit3	Preamble enable bit in WOR receiving mode	Aux pin pulled low for 5ms was detected.
			0	Turn off the preamble detection function in WOR receiving mode.	
			one	Turn on the preamble detection function in WOR receiving mode.	
	2	Relay enable	bit2	Relay is potential.	
			0	Turn off trunking (default)	
			one	Turn on the relay	
	one	Echo of AT instruction	bit1	Echo of AT instruction is energy bit.	
			0	Turn off echo (default)	
			one	Turn on echo	
	0	Fixed-point mode enable	bit7	Fixed-point mode enable bit	
			0	Turn off fixed-point mode and transparent transmission mode (default)	
			one	Turn on fixed-point mode	
eight	7~0	Module channel	0~80, a total of 81, the default channel 20 (corresponding to the frequency of 869.75M), Operating frequency: 849.75+ channel value (MHz)		
nine	7~0	LBT threshold value	Default 0xBF(-65), complement value		
10-11	16~0	LBT timeout	The default value is 0x07D0(2000), in ms bits.		
12-27	-	encryption key	Default: A0A1 A2 A3A4A5AA7 A8 A9 AA AB AC AD AE AF		16 bytes

Because the generated parameters are composed of bits, it is suggested to use the generated parameters of upper computer WSXT_Setting for verification.

5.2 AT instruction configuration

The transmission mode is entered by sending the character "++", which is three characters in total, without carriage return and line feed, which is different from other instructions; At the same time, after entering with this command, the module response is also different from the configuration instruction, and the module will respond "\r\n+OK\r\n". If you don't receive a valid AT command within 20s, you will automatically exit the AT configuration mode and output "\r\n+exit\r\n"; If a valid AT command is received within 20s, the countdown to exit AT configuration mode will be refreshed. The configured baud rate in transmission mode is

consistent with the baud rate of transmission data (determined by the configured serial port parameters).

Configuration mode can be configured without sending "+". In configuration mode, baud rate bits 9600bps and 8N1 are fixed.

Symbol description

symbol	explain
<CR>	Enter, hexadecimal 0x0D
<LF>	Line feed, hexadecimal 0x0A

5.2.1 AT instruction list

instruction	describe	Effective mode	remarks
AT	test instruction	--	
ATE	Set/query command echo switch	be effective immediately	
AT+RST	system reset	be effective immediately	
AT+RESTORE	Restore factory settings	be effective immediately	The software resets and exits configuration.
AT+GMR	Query module information	--	
AT+UART	Set/query serial port parameters	Restart takes effect Or withdraw from the allocation to take effect	
AT+CHAN	Set/query wireless channel range	Restart takes effect	
AT+RATE	Set/query wireless airspeed	Restart takes effect	
AT+PWR	Set/query wireless transmission power	Restart takes effect	
AT+PKTRSSI	Set/query packet RSSI enable	be effective immediately	
AT+RSSI	Set/Query Real-time RSSI Enable	be effective immediately	

AT+WOR	Set/query WOR wake-up period	be effective immediately
AT+LBT	Set/query LBT function	be effective immediately
AT+LPWRPREAM	Set/query the enabling of preamble detection in WOR receiving mode.	be effective immediately
AT+RELAY	Set/query relay function enabled.	be effective immediately
AT+TRANSMOD	Set/query transmission mode control (transparent transmission and fixed-point transmission)	be effective immediately
AT+KEY	Set the communication transmission key (write only)	be effective immediately
AT+NETID	Set/query network ID	be effective immediately
AT+ADDR	Set/query module address	be effective immediately
AT+SCAN	Scan the current RSSI of the query module channel.	--
AT+EXIT	Exit configuration module	be effective immediately

5.2.2 Detailed explanation of at instruction

5.2.2.1 Test instruction AT

Instruction description	Test instruction, used for handshake test.
execution instruction	AT<CR><LF>
respond	<CR><LF>OK<CR><LF>

description of parameter	without
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5.2.2.2 Echo control instruction ATE

Instruction description	Used to turn command echo on or off.
execution instruction	ATE[<value>]<CR><LF>
respond	<CR><LF>OK<CR><LF>
description of parameter	● <value> ➤ 0: Turn off echo ➤ 1. Open echo
example	ATE1<CR><LF> open echo

5.2.2.3 Reset instruction AT+RST

Instruction description	This command restarts the device. If the AT configuration is sent in transparent mode, the configuration mode will be exited.
execution instruction	AT+RST<CR><LF>
respond	<CR><LF>OK<CR><LF>
description of parameter	without

5.2.2.4 Restore factory setting instruction AT+RESTORE

Instruction description	This command will reset the device once, and if the command is sent by AT configuration in transparent mode, it will exit the configuration mode.	
execution instruction	AT+RESTORE<CR><LF>	
respond	<CR><LF>OK<CR><LF>	
description of parameter	without	

5.2.2.5 View version information instruction AT+GMR

Instruction description	Used to query the equipment model and version number.	
execution instruction	AT+GMR? <CR><LF>	
respond	<CR><LF>+GMR: <module name>,<version><CR><LF> <CR><LF>OK<CR><LF>	
description of parameter	● < module name >: product model. ● < version >: product version	

5.2.2.6 Serial port operation instruction AT+UART

Instruction description	Used to query and set serial port parameters.	
execution instruction	query	deploy
instruction	AT+UART? <CR><LF>	AT+UART=<baud>,<parity>,<stop><CR><LF>

respond	<code><CR><LF>+UART=<baud>,<parity>,<stop></code> <code><CR><LF><CR><LF>OK<CR><LF></code>	<code><CR><LF>OK<CR><LF></code>
description of parameter	● <code>< baud ></code>: baud rate of serial port. ➤ 0: 1200bps ➤ 1: 4800bps ➤ 2: 9600bps ➤ 3: 19200bps ➤ 4: 38400bps ➤ 5: 57600bps ➤ 6: 115200 bps (default) ➤ 7: 256000bps	
	● <code>< parity ></code>: parity bit ➤ 0: No verification. ➤ 1: Odd check ➤ 2: Even check ➤ 3: No verification	
	● <code>< stop ></code>: stop bit ➤ 0: 1 bit ➤ 1: 1.5 bit ➤ 2: 2 bit ➤ 3: 1 bit	
	Note: The data bit width is 8 bits when there is no check, and 9 bits when there is check.	
example	<code>AT+UART=6,0,0<CR><LF></code>	

5.2.2.7 Channel operation instruction AT+CHAN

Instruction description	Used to query and set the working channel.	
execution	query	deploy

instruction	AT+CHAN? <CR><LF>	AT+CHAN=<ch><CR><LF>
respond	<CR><LF>+CHAN=<ch><CR><LF> <CR><LF>OK<CR><LF>	<CR><LF>OK<CR><LF>
description of parameter	● < ch >: wireless channel ➤ 0~80 (default value is 20) Note: the channel interval is 1M, the initial channel is 849.75M, and the default channel 20 corresponds to the frequency point of $849.75+1 * 20 = 869.75\text{M}$	
example	AT+CHAN=20<CR><LF>	

5.2.2.8 Wireless airspeed operation command AT+RATE

Instruction description	Used to query and set the wireless airspeed.	
execution	query	deploy
instruction	AT+RATE? <CR><LF>	AT+RATE=<level><CR><LF>
respond	<CR><LF>+RATE =<level><CR><LF> <CR><LF>OK<CR><LF>	<CR><LF>OK<CR><LF>
description of parameter	● < level >: airspeed (baud rate in the air) ➤ 0: airspeed 2.4kbps ➤ 1: airspeed 2.4kbps ➤ 2: airspeed 2.4kbps (default) ➤ 3: airspeed 4.8kbps ➤ 4: airspeed 9.6kbps ➤ 5: the airspeed is 19.2kbps ➤ 6: airspeed 38.4kbps ➤ 7: airspeed 62.5kbps Note: The higher the airspeed, the smaller the transmission delay and the shorter the transmission distance.	
example	AT+RATE=2<CR><LF>	

5.2.2.9 Wireless transmit power operation instruction AT+PWR

Instruction description	Set and query the wireless transmission power, with a total of four levels.	
execution	query	deploy
instruction	AT+PWR? <CR><LF>	AT+PWR=<pwr><CR><LF>
respond	<CR><LF>+PWR=<pwr><CR><LF> <CR><LF>OK<CR><LF>	<CR><LF>OK<CR><LF>
description of parameter	● <pwr>: wireless transmission power	
example	AT+PWR=0<CR><LF>	

5.2.2.10 Packet RSSI operation instruction AT+PKTRSSI

Instruction description	It is used to query and set the RSSI enable of data packets, and receive data frames with radio frequency for output.	
execution	query	deploy
instruction	AT+PKTRSSI? <CR><LF>	AT+PKTRSSI=<en><CR><LF>
respond	<CR><LF>+PKTRSSI=<en><CR><LF> <CR><LF>OK<CR><LF>	<CR><LF>OK<CR><LF>
description of parameter	● <en>: packet RSSI enabled. ➤ 0, turn off packet RSSI (default) ➤ 1. Turn on RSSI of data packet.	
parameter	Note: After the RSSI of the data packet is turned on, every time the module receives a packet of RF data, it will add a byte of the signal strength of the received data packet at the end of the data and output it in the form of complement.	
example	AT+PKTRSSI=1<CR><LF>	

5.2.2.11 Real-time RSSI operation instruction AT+RSSI

(1) Setting environmental noise enabling and disabling in configuration mode

Instruction description	Used to query and set the reading enable of real-time RSSI value of the current channel.	
execution	query	deploy
instruction	AT+RSSI? <CR><LF>	AT+RSSI=<en><CR><LF>
respond	<CR><LF>+RSSI=<en><CR><LF> <CR><LF>OK<CR><LF>	
description of parameter	● < en >: real-time RSSI enabled. ➤ 0, turn off real-time RSSI (default) ➤ 1. Turn on real-time RSSI.	
parameter	Description: After the real-time RSSI is turned on, AT+RSSI command is supported to read the real-time RSSI value of the current channel in transmission mode.	
example	AT+RSSI=1<CR><LF>	

(2) reading the real-time RSSI value in transmission mode

Instruction description	Used to query the current real-time RSSI value (in transmission mode)	
execution	query	
instruction	AT+RSSI? <CR><LF>	
respond	<CR><LF>+RSSI=<val><CR><LF><CR><LF>OK<CR><LF>	
description of parameter	● < val >: real-time RSSI value. ➤ 0~-128dBm: the real-time RSSI value of the current channel.	
parameter	Note: Real-time RSSI can only be read in transmission mode after it is turned on.	
example	AT+RSSI=-60<CR><LF>	

5.2.2.12 WOR cycle configuration instruction AT+WOR

Instruction description	Setting and querying wireless communication address
--------------------------------	---

execution	query	deploy
instruction	AT+WOR? <CR><LF>	AT+WOR=<val><CR><LF>
respond	<CR><LF>+WOR=<val><CR><LF> <CR><LF>OK<CR><LF>	<CR><LF>OK<CR><LF>
description of parameter	● < val >: WOR cycle setting ➤ 0: 250 ms (default) ➤ 1: 500ms ➤ 2: 750ms ➤ 3: 1000ms ➤ 4: 1250ms ➤ 5: 1500ms ➤ 6: 1750ms ➤ 7: 2000ms	
example	AT+WOR=1<CR><LF>	

5.2.2.13 LBT operation instruction AT+LBT

Instruction description	Used to query and set LBT parameters.	
execution	query	deploy
instruction	AT+LBT? <CR><LF>	AT+LBT=<en>,<thresh>,<timeout><CR><LF>
respond	<CR><LF>+LBT=<en>,<thresh>,<timeout> <CR><LF><CR><LF>OK<CR><LF>	<CR><LF>OK<CR><LF>
description of parameter	● < en >: LBT enabled ➤ 0: turn off LBT (default) ➤ 1: turn on LBT ● < threshold >: threshold value of lbt detection signal strength (RSSI) ➤ 0 ~128: RSSI threshold (default -65)	

	● < timeout >: timeout. ➤ 0~5000: timeout value in milliseconds (default is 2000).
	Description: 1. The last two parameters can be ignored when the RSSI value is turned off. 2. The RSSI threshold is related to the antenna. The higher the antenna gain, the higher the threshold should be set.
example	AT+LBT=1,-70,2000<CR><LF>

5.2.2.14 Preamble detection enable operation instruction AT+LPWRPREAM

Instruction description	Used to query and set the enabling of preamble detection indication (indicated by AUX).	
execution	query	deploy
instruction	AT+LPWRPREAM? <CR><LF>	AT+LPWRPREAM=<en><CR><LF>
respond	<CR><LF>+LPWRPREAM=<en><CR><LF> <CR><LF>OK<CR><LF>	<CR><LF>OK<CR><LF>
description of parameter	● < en >: preamble detection is enabled (effective in WOR receiving mode). ➤ 0, enabling preamble detection is turned off (default) ➤ 1. Enable preamble detection. Note: After enabling preamble detection, in WOR receiving mode, if the preamble is detected, the AUX pin will be pulled low for 5 ms..	
example	AT+LPWRPREAM=1<CR><LF>	

5.2.2.15 Relay enable operation instruction AT+RELAY

Instruction description	Used to query and set the relay function enabling.	
execution	query	deploy
instruction	AT+RELAY? <CR><LF>	AT+RELAY=<en><CR><LF>
respond	<CR><LF>+RELAY=<en><CR><LF> <CR><LF>OK<CR><LF>	<CR><LF>OK<CR><LF>

description of parameter	● < en >: relay enabled ➤ 0, turn off relay enabling (default) ➤ 1. Turn on relay enabling.
	Note: After the relay is enabled, this module is only used for forwarding radio frequency data.
example	AT+RELAY=1<CR><LF>

5.2.2.16 Transmission mode operation instruction AT+TRANSMOD

Instruction description	Used to query and set the relay function enabling.	
execution	query	deploy
instruction	AT+TRANSMOD? <CR><LF>	AT+TRANSMOD=<val><CR><LF>
respond	<CR><LF>+TRANSMOD=<val><CR><LF> <CR><LF>OK<CR><LF>	<CR><LF>OK<CR><LF>
description of parameter	● < val >: transmission mode ➤ 0, transparent transmission mode (default) ➤ 1, fixed-point mode	
	Description: See the chapter on fixed-point mode for details.	
example	AT+TRANSMOD=1<CR><LF>	

5.2.2.17 Wireless key operation instruction AT+KEY

Instruction description	Used to set the wireless key	
execution	deploy	
instruction	AT+KEY=<key_str><CR><LF>	
respond	<CR><LF>OK<CR><LF>	
description of parameter	● < key_str >: hexadecimal string of the set key. ➤ Hexadecimal string key of 16 bytes (default: A0A1A2A 3A 4A 5A 6A 7A 8A9 AAAbacadaeaf)	
	Description: A 16-byte hexadecimal string with 32 characters in total. No spaces are allowed in the string.	

example	AT+KEY=A0A1A2A3A4A5A6A7A8A9AAABACADAEAF<CR><LF>
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5.2.2.18 Network ID configuration instruction AT+NETID

Instruction description	Setting and querying wireless network ID	
execution	query	deploy
instruction	AT+NETID? <CR><LF>	AT+NETID=<id><CR><LF>
respond	<CR><LF>+ADDR=<id><CR><LF> <CR><LF>OK<CR><LF>	
description of parameter	● < ID >: network id value. ➤ 0 ~ 255: 0 (default) Description: 1. Network ID must be the same to send and receive data normally (except ID=255). 2. When set to 255, data with any network ID can be received, and the sent data can also be received by modules with any network ID.	
example	AT+NETID=0<CR><LF>	

5.2.2.19 Wireless communication address configuration instruction AT+ADDR

Instruction description	Setting and querying wireless communication address	
execution	query	deploy
instruction	AT+ADDR? <CR><LF>	AT+LOG=<val><CR><LF>
respond	<CR><LF>+ADDR=<val><CR><LF> <CR><LF>OK<CR><LF>	
description of	● < val >: module address setting ➤ 0 ~ 65535: 0 (default)	



parameter	Description: 1. The addresses of the sender and receiver must be the same, except for address 0x65535. 2. When the address is 65535, the module can receive data of any address, and can also receive data sent by the module of any address.
example	AT+ADDR=1<CR><LF>

5.2.2.20 Channel current RSSI scanning configuration instruction AT+SCAN

Instruction description	Inquire about RSSI instructions of current multiple channels
execution	query
instruction	AT+SCAN=<ch1>,<chn><CR><LF>
respond	<CR><LF>+SCAN=<ch1,val1>,<ch2,val2>,...<chn,valn>,<CR><LF> <CR><LF>OK<CR><LF>
description of parameter	● < ch1 >: initial channel ➤ 0~96
	● < chn >: end channel ➤ 0~96
	● < val 1 >: RSSI value. ➤ 0~-128
	Description: 1. The ending channel value cannot be greater than the starting channel value.
example	AT+SCAN=5,10<CR><LF> \r\n+SCAN:5,-78,6,-78,7,-78,8,-78,9,-78,10,-77\r\n\r\nOK\r\n

5.2.2.21 Exit configuration mode instruction AT+EXIT

Instruction description	This instruction is used to manually exit configuration mode (configuration is valid only in transmission mode).
execution	AT+EXIT<CR><LF>

instruction	
respond	<CR><LF>OK<CR><LF>
example	AT+EXIT<CR><LF>

6 Electrical and other parameters

6.1 Limit parameter

parameter	symbol	minimum value	maximum	unit
Power supply voltage	VCC	-0.3	5.5	V
Interface voltage	VIN	-0.3	3.6	V
Radio frequency input power	RFIN	-	+10	dBm
Storage temperature	TSTG	-40	125	°C

6.2 working parameter

parameter	symbol	minimum value	typical value	maximum	unit
Power supply voltage	VCC	3.0	five	5.5	V
Communication level	VIN	-0.3	3.3	3.6	V
Working temperature	TOP	-40	-	eighty-five	°C

6.3 Radio frequency performance parameters

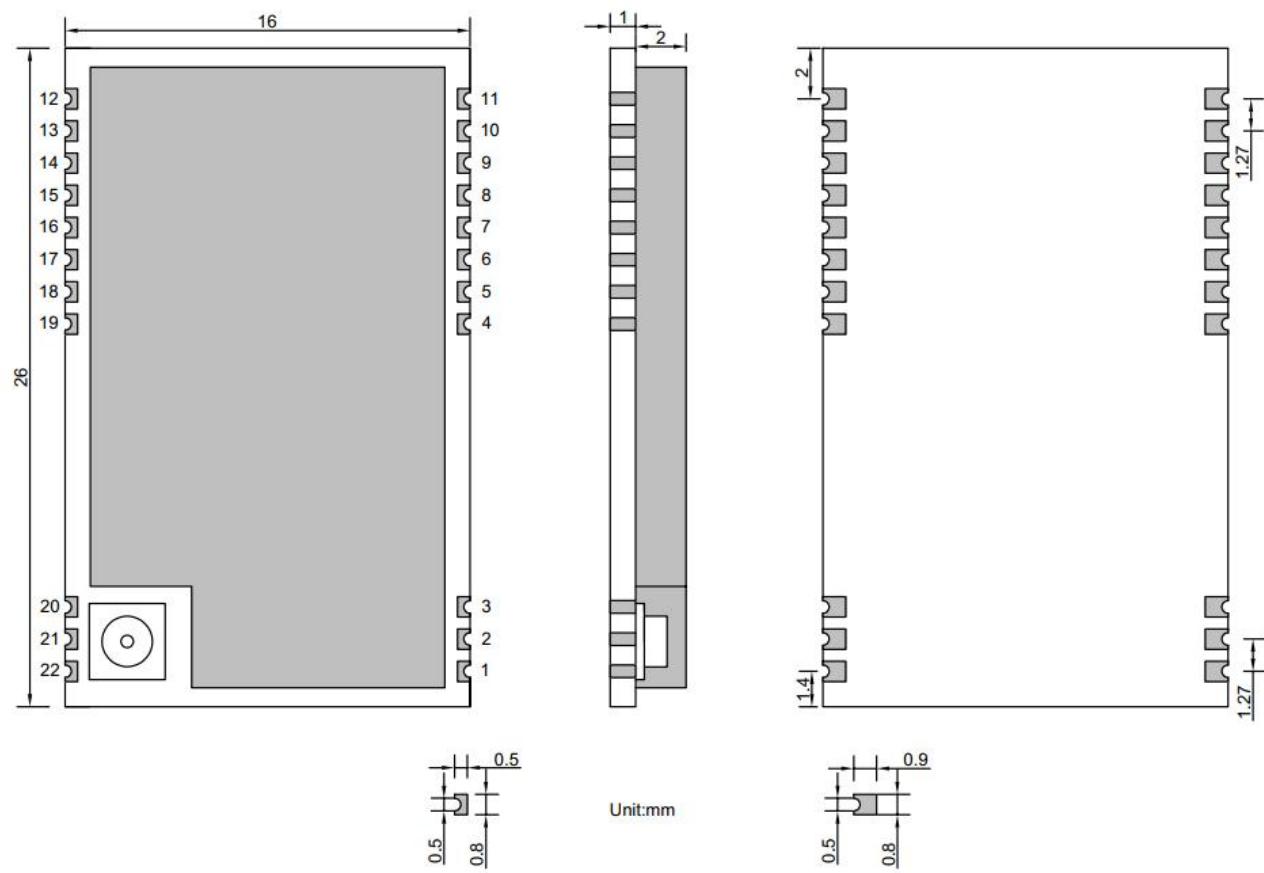
parameter	minimum value	typical value	maximum	unit	remarks
Working frequency band	849.75	-	929.75	MHz	
Air velocity	2.4	2.4	62.5	kbps	

Transmit power	11	11.5	12.3	dBm	2.4kbps@GFSK
receiving sensitivity	-	-124	-	dBm	
emission current	100	110	120	mA	
Receiving current	8.5	nine	9.5	mA	
Dormant current	1.5	2	2.5	uA	

6.4 Package size

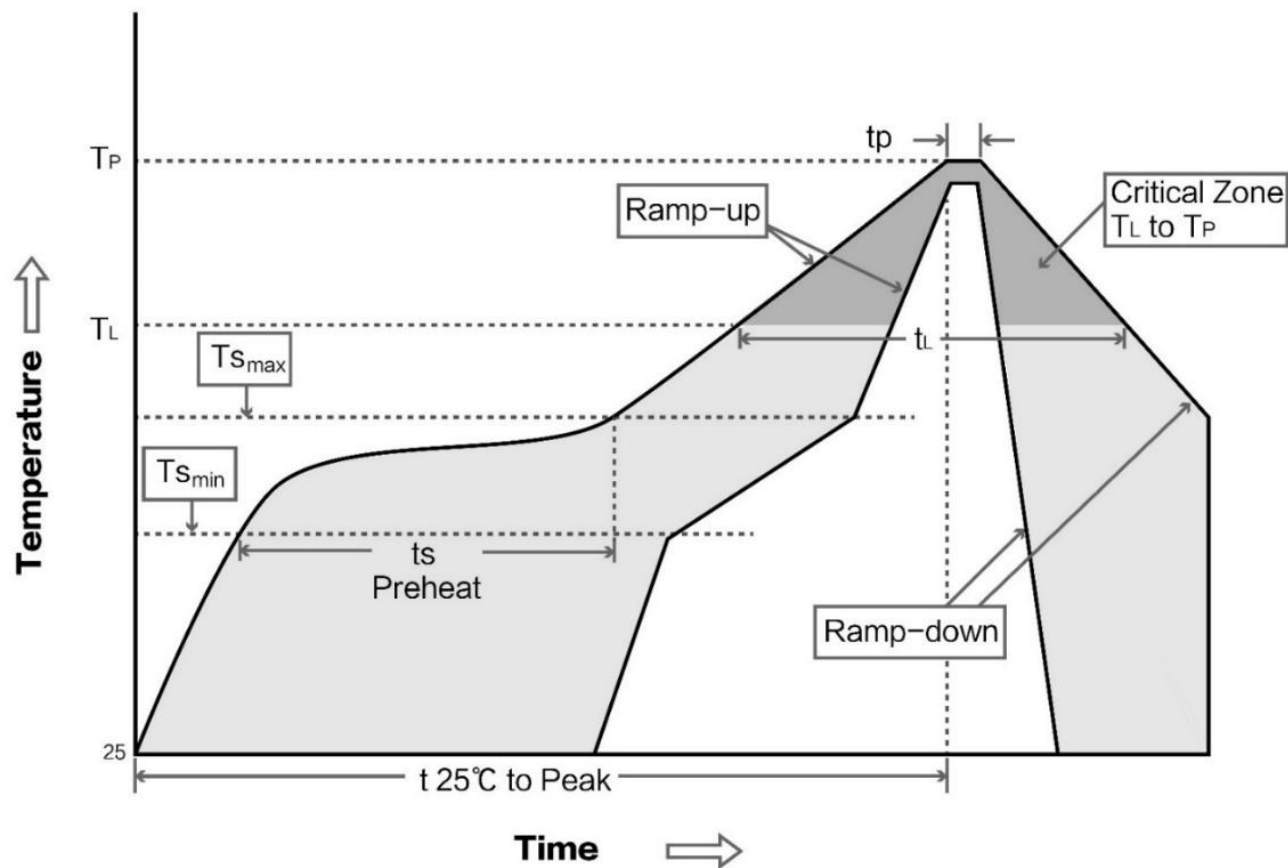
parameter	describe
communication interface	UART
Radio frequency interface	U.LF connector/stamp hole
package	Patch type
Interface mode	Stamp holes with 1.27mm spacing
outline dimension	16*26*3mm (including shield)
weight	-

7 Package size



8 Production guidance

8.1 Reflow welding curve



8.2 Reflow soldering temperature and time

Curve characteristics	Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
tin cream	Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Minimum preheating temperature	Preheat Temperature min ($T_{S_{min}}$)	100°C	150°C
Maximum preheating temperature	Preheat temperature max ($T_{S_{max}}$)	150°C	200°C
preheating time	Preheat Time ($T_{S_{min}}$ to $T_{S_{max}}$)(t_s)	60-120 sec	60-120 sec
Average rising	Average ramp-up rate($T_{S_{max}}$ to	3°C/second max	3°C/second max

rate	TP)		
Liquid temperature	Liquidous Temperature (TL)	183°C	217°C
Time above liquidus	Time (tL) Maintained Above (TL)	60-90 sec	30-90 sec
Peak temperature	Peak temperature (Tp)	220-235°C	230-250°C
Average decline rate	Aveage ramp-down rate (Tp to Tsmax)	6°C/second max	6°C/second max
Time from 25°C to peak temperature	Time 25°C to peak temperature	6 minutes max	8 minutes max

9 Contact information

contacts	mobile phone	mailbox
Manager Chen	15000319232	chenliang@silent-smart.com
Tel: 028-64823553		
Address: Room 303-7, Floor 3, Unit 4, Building 12, No.38 Jinke South Road, Jinniu High-tech Industrial Park, Chengdu		

KDB 996369 D03 statements

2.2 List of applicable FCC rules:

The module complies with FCC Part 15.247.

FCC ID: 2BB8U-WS8475 on User manual and on the external of the packaging.

2.3 Summarize the specific operational use conditions

The module has been certified for Potable applications. This transmitter must not beco-located or operating in conjunction with any other antenna or transmitter

2.4 Limited module procedures

The module is not a limited module.

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

This equipment complies with FCC's RF radiation exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must not be collocated or operating in conjunction with any other antenna or transmitter.

2.7 Antennas

The EUT use a permanently attached antenna which is unique.

2.8 Label and compliance information

The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2BB8U-WS8475

2.9 Information on test modes and additional testing requirements

When testing host product, the host manufacture should follow FCC KDB Publication 996369 D04 Module Integration Guide for testing the host products. The host manufacturer may operate their product during the measurements. In setting up the configurations, if the pairing and call box options for testing does not work, then the host product manufacturer should coordinate with the module manufacturer for access to test mode software.

The module has been certified for Potable applications. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter

2.10 Additional testing, Part 15 Subpart B disclaimer

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

2.11 Note EMI Considerations

host manufacture is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties

2.12 How to make changes

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in evaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device (including unintentional radiators) as a composite. The host manufacturer must fix any failure a host, host manufacturer have to consult with module manufacturer for the installation method in end system. According to the KDB 996369 D02 Q&A Q12, that a host manufacture only needs to do anevaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device(including unintentional radiators) as a composite. The host manufacturer must fix any failure

FCC Caution.

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