E49-900T20S User Manuel

868MHz/915MHz SMD Wireless Module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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CONTENTS

DISCLAIMER 3

1. OVERVIEW 4

1.1 INTRODUCTION 4
1.2 FEATURES 4

2. SPECIFICATION AND PARAMETER 5

2.1 LIMIT PARAMETER 5
2.2 OPERATING PARAMETER 5

3. SIZE AND PIN DEFINITION 6

4. RECOMMENDED WIRING DIAGRAM 7

5. FUNCTION DESCRIPTION 8

5.1 MODULE RESET 8
5.2 AUX DETAILED EXPLANATION 8
5.2.1 Wireless receiving indication 8
5.2.2 Wireless transmission indication 8
5.2.3 Reset and exit sleep mode 9
5.2.4 AUX Precautions 9
5.2.5 Detailed explanation of fixed-point mode 9
5.2.6 Broadcast transmission 10
5.2.7 Broadcast address 10
5.2.8 Monitor Address 11

6. OPERATING MODE 11

6.1 MODE SWITCHING 11
6.2 TRANSMISSION MODE（MODE0） 12
6.3 RSSI MODE（MODE1） 12
6.4 SETTING MODE（MODE2） 13
6.5 SLEEP MODE（MODE3） 13
6.6 FAST COMMUNICATION TEST 13

7. COMMAND FORMAT 14

7.1 DEFAULT PARAMETERS 15

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7.2 READING OPERATING PARAMETER 15
7.3 READING VERSION NUMBER READING 15
7.4 PARAMETER SETTING INSTRUCTION 15

8. HARDWARE DESIGN 18

9.1 COMMUNICATION RANGE IS TOO SHORT 19
9.2 MODULE IS EASY TO DAMAGE 19
9.3 BER(BIT ERROR RATE) IS HIGH 19

10. WELDING OPERATION GUIDANCE 20

10.1 REFLOW SOLDERING TEMPERATURE 20
10.2 REFLOW SOLDERING CURVE 20

11. RELATED MODEL 21

12. ANTENNA GUIDE 21

13 BATCH PACKAGING 22

REVISION HISTORY 22

ABOUT US 22

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1. Overview

1.1 Introduction



E49-900T20S is an ultra-high cost-effective wireless module launched by Chengdu Ebyte. It has 4 operating modes. Each transmission mode has its own characteristics and can be applied to various application scenarios. E49-900T20S can perfectly support industrial-grade applications, and undergoes rigorous testing at the factory to ensure its industrial reliability and batch consistency.

The E49-900T20S supports a maximum transmission power of 20dBm. Users can set a lower output power to save power consumption. The module works at 850-930MHz, with TTL level output, and is compatible with 3.3V. The module has data encryption function. The data transmitted by the module in the air is random. Through strict encryption and decryption algorithms, the data interception is meaningless, the probability of interference is reduced, and the reliability and transmission efficiency are improved. Besides, it is a low-cost wireless serial transceiver module.

1.2 Features

- The measured communication distance can reach 2.5km;
- Maximum transmit power is 100mW, software can be adjusted in multiple stages;
- The global license-free ISM 868MHz/915MHz;
- Data transmission rate :1.2Kbps～200Kbps;
- Low power consumption mode, suitable for battery application;
- Advanced ultra-narrowed GFSK modulation;
- 2.3V~5.5V power supply;
- Industrial-grade standard design, support long-term use of -40 ~ 85°C;
- Support stamp hole and IPEX interface, users can choose to use according to their needs.

1.3 Application Scenario

- Wearable devices;
- Security system, Positioning system;
- Wireless remote control, unmanned drone;
- Health care product;
- Wireless voice, wireless headphones;
- Automobile industry application.

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2. Specification and parameter

2.1 Limit parameter

Main parameter	Performance		Remark
	Min.	Max.	
Power supply（V）	0	5.5	Voltage over 5.5V will cause permanent damage to module
Blocking power（dBm）	-	10	Chances of burn is slim when modules are used in short distance
Operating temperature（℃）	-40	85	

2.2 Operating parameter

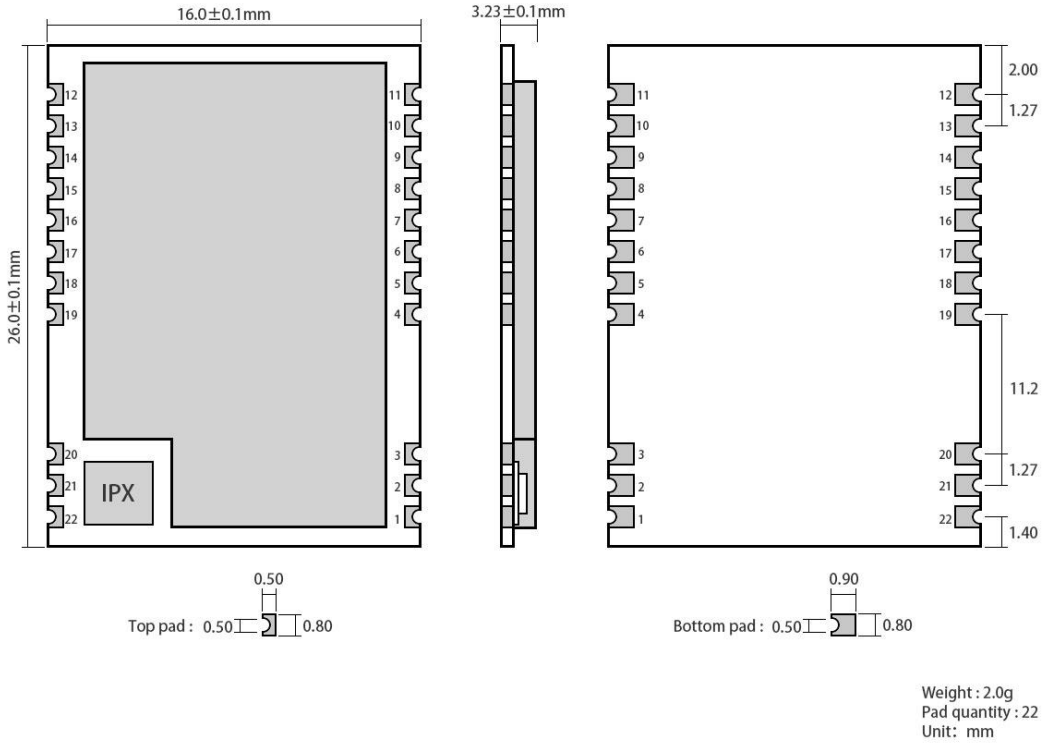
Main parameter		Performance			Remark
		Min.	Typ.	Max.	
Operating voltage（V）		2.3	5	5.5	Over 5.5V will permanently damage module
Communication level（V）			3.3		For 5V TTL, it may be at risk of burning down
Operating temperature（℃）		-40	-	85	Industrial design
Operating frequency（MHz）		850	868	930	Support ISM band
Power consumption	TX current（mA）		97.9		Instant power consumption
	RX current（mA）		12.04		
	Sleep current（μA）		1.3		Software is shut down
Max Tx power（dBm）		-	-	20.0	
Receiving sensitivity（dBm）		-114	-115	-116	Air data rate is1.2kbps
Air data rate（bps）		1.2k	2.4k	200k	Controlled via user’s programming

Main parameter	Description	Remark
Distance for reference	2500m	Test condition：clear and open area, antenna gain: 5dBi,antenna height:2.5m， air data rate:1.2kbps
FIFO	54 Byte	Maximum capacity of single transmission, auto-sub-packing when exceeding
Cache capacity	500 Byte	
Modulation	GFSK	
Communication interface	UART serial port	
Package	SMD	
Connector	1.27mm	
Size	26*16mm	
Antenna	IPEX/Stamp hole	50 ohm impedance

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3. Size and pin definition



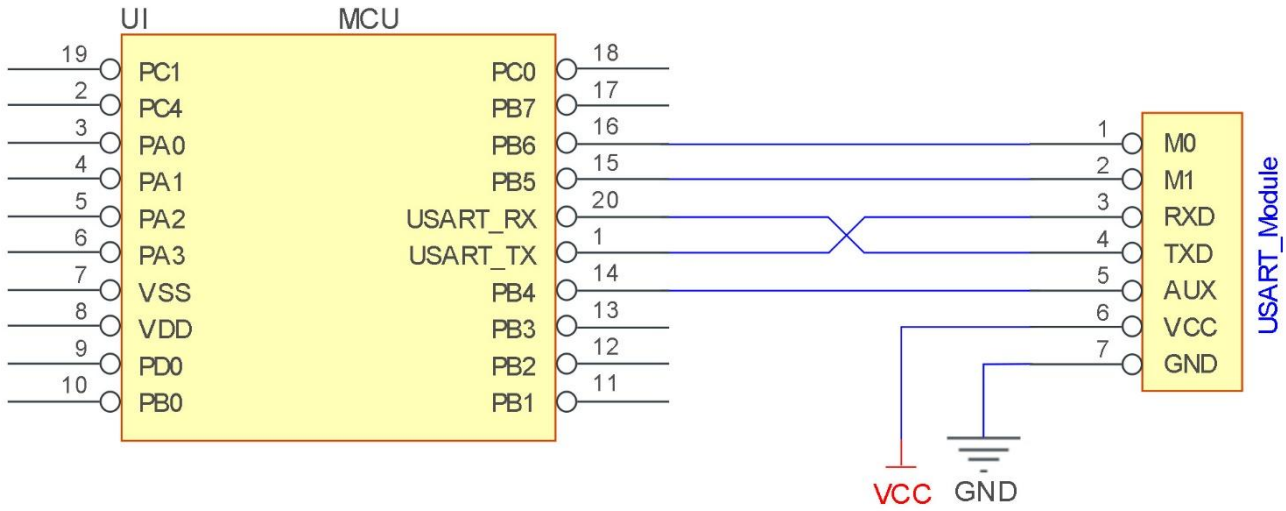
No.	Name	Direction	Function
1	GND		Module ground wire
2	GND		Module ground wire
3	GND		Module ground wire
4	GND		Module ground wire
5	M0	Input(pull up when it's weak)	Cooperate with M1 to determine 4 operating modes of the module(can be lifted floating, the module contains pull-up resistor)
6	M1	Input(pull up when it's weak)	Cooperate with M0 to determine 4 operating modes of the module(can be lifted floating, the module contains pull-up resistor)
7	RXD	Input	TTL serial input, connect to external TXD output pin;
8	TXD	Output	TTL serial input, connect to external RXD output pin;
9	AUX	Output	Used to indicate the working status of the module; the user wakes up the external MCU and outputs a low level during the power-on self-test initialization
10	VCC		Module power supply positive reference, voltage range: 2.6V ~ 5.5V DC
11	GND		Module ground wire
12	NC		
13	GND		Module ground wire
14	NC		
15	NC		

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16	NC		
17	NC		
18	NC		
19	GND		Module ground wire
20	GND		Module ground wire
21	ANT		antenna
22	GND		Module ground wire

4. Recommended wiring diagram



No.	Brief introduction of connection between the module and the single-chip microcomputer (the above picture uses STM8L single-chip microcomputer as an example)
1	The wireless serial port module is TTL level, please connect with MCU with TTL level.
2	Some 5V microcontrollers may require 4 ~ 10K pull-up resistors on the TXD and AUX pins of the module.

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5. Function description

5.1 Module reset

After the module is powered on, AUX will immediately output a low level and perform a hardware self-test and set the operating mode according to user parameters. In this process, AUX is kept at a low level, outputs a high level after completion, and starts to work normally according to the working mode composed of M1 and M0. Therefore, users need to wait for the rising edge of AUX as the starting point for the normal operation of the module.

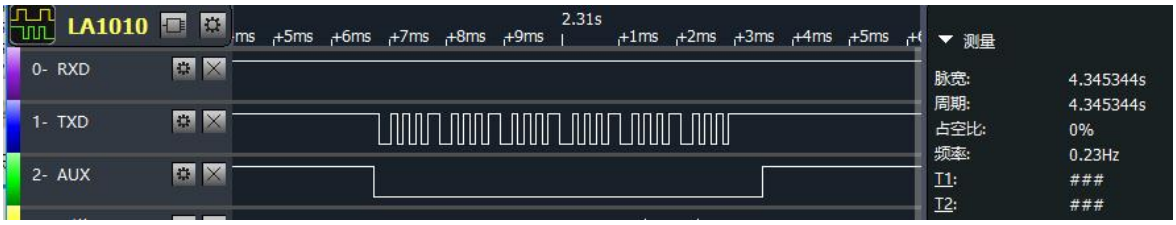
5.2 AUX detailed explanation

AUX is used for wireless sending and receiving buffer indication and self-inspection indication.

It indicates whether the data of the module that has not been transmitted through the wireless, or whether it has received wireless data that has not been transmitted through the serial port, or the module is in the process of initial self-test.

5.2.1 Wireless receiving indication

After receiving the valid wireless data, the module will immediately pull AUX low and start the serial port to output data and then pull up AUX after the data output is completed.

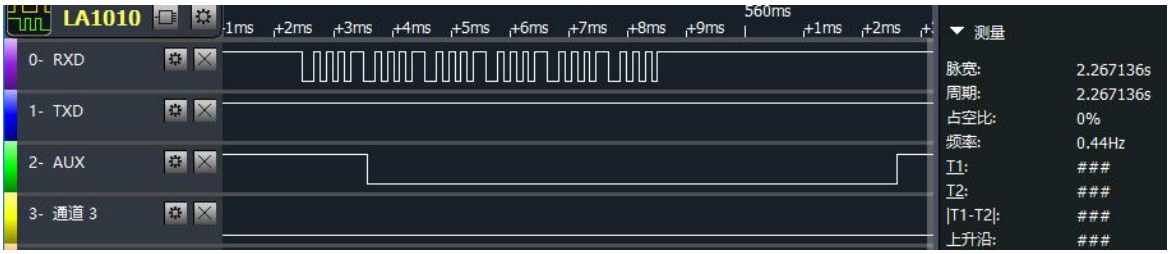


5.2.2 Wireless transmission indication

After receiving the serial port data, the module will immediately pull down AUX and start sending data wirelessly and after all the data is sent, pull up AUX.

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5.2.3 Reset and exit sleep mode

Only when resetting and exiting sleep mode



Timing Sequence Diagram of AUX when self-check

5.2.4 AUX Precautions

The function 1 and function 2 mentioned above have low output priority, that is, if any output low condition is met, AUX outputs a low level; when all low level conditions are not met, AUX outputs a high level.

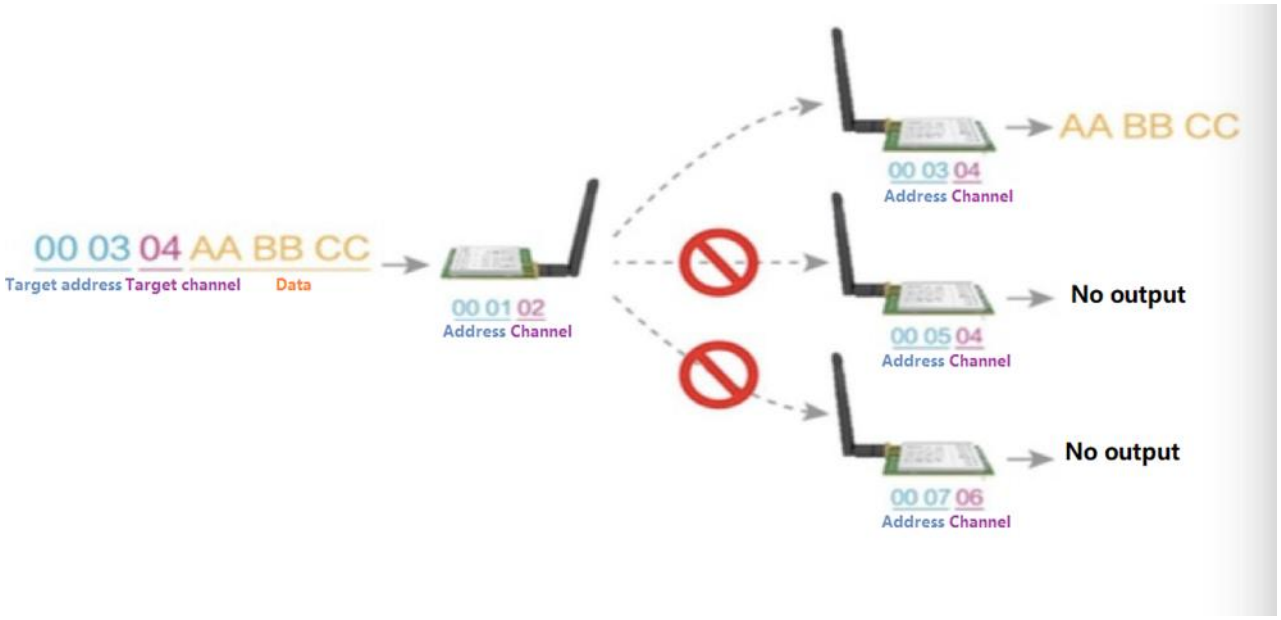
When the AUX output is low, it indicates that the module is busy, and the operating mode detection will not be performed; when the AUX output is high, the mode switching will be completed.

When the user enters other modes from mode 3 (sleep mode) or during the reset process, the module will reset the user parameters, during which AUX outputs low level.

5.2.5 Detailed explanation of fixed-point mode

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5.2.6 Broadcast transmission



5.2.7 Broadcast address

Example:

- Set the address of module A to 0xFFFF and the channel to 0x04
- When module A is used for transmission (same mode, transparent transmission mode), all receiving module under the 0x04 channel can receive data to achieve the purpose of broadcasting.

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5.2.8 Monitor Address

- Example: Set the address of module A to 0xFFFF and the channel to 0x04.When module A is used as a receiver, it can receive all the data under the 0x04 channel to achieve the purpose of monitoring.

6. Operating mode

The module has four operating modes, which are set by pins M0 and M1; details are shown in the table below.

Mode（0-3）	M1	M0	Mode introduction	Remark
0 Transmission mode	0	0	The serial port opens and wireless on, the module performs data transmission according to the set transmission mode	The transmission method of the sender and receiver must be consistent
1 RSSI mode	0	1	Wireless off and the serial port opens, the module outputs RSSI signal strength value at 100ms timing	Relative intensity values only
2 Setting mode	1	0	Wireless off, can receive serial port command, refer Command List, fixed baud rate 9600，8N1	Parameter configuration
3 Sleep mode	1	1	The module goes to sleep standby mode, and the serial port and wireless are turned off.	Ultra-lower power sleep

6.1 Mode switching

- Users can combine M0 and M1 with high and low levels to determine the operating mode of the module. Users can use the MCU’s 2 GPIOs to control the node switching; after changing M0,M1: the module is idle and after 1ms, it can start working according to the new operating mode; if the module has not transmitted serial port data via wireless, then entering the new operating mode after the transmission completed; if the module receives the wireless data and sends out the data through the serial port, it needs to finish sending before entering the new operating mode; if the module; so the mode switching can only be effective when AUX outputs 1, otherwise the switch will be delayed.
- For example: In mode 0, the user continuously inputs a large amount of data and switches the mode at the same time. The mode switching operation is invalid at this time; the module will process all the user data before performing the new mode detection; so the general recommendation is: Detect the AUX pin output status, wait for 2ms after the AUX output goes high before switching.
- When the module is switched from other modes to sleep mode, if any data has not been processed, the module will enter the sleep mode after processing the data(including receiving and sending). This feature can be used for fast sleep mode to save power consumption; for example: the transmitter module works in mode0, the user initiates serial data "12345",and then does not have to wait for the AUX pin to be idle (high level),and can directly switch to sleep mode, And the user's main MCU will immediately sleep, the module will automatically

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send all user data through wireless, and automatically enter sleep within 1ms; thus saving the MCU's working time and reducing power consumption.

- Similarly, any mode switch can use this feature. After processing the current mode event, the module will automatically enter the new mode within 1ms; thereby eliminating the user's query of AUX and achieving the goal of fast switching ,For example, switching from the transmission mode to the setting mode; the user MCU can also go to sleep mode in advance before the mode switching, and use the external interrupt function to obtain the AUX change to perform the mode switching.
- This operation mode is very flexible and efficient. It is designed in accordance with the convenience of the user MCU, and can reduce the workload of the entire system as much as possible, improve system efficiency and reduce power consumption.

6.2 Transmission mode（Mode0）

Type	When M0 = 0，M1 = 0，module working in module0
transmission	The module receives user data from the serial port, the maximum length of the wireless data packet transmitted by the module is 54 bytes, when the amount of user input data reaches 54 bytes, the module will start wireless transmission. At this time, the user can continue to enter the data that needs to be transmitted. When the user needs to transmit less than 54 bytes, the module waits for about 20ms. If there is no user data to continue to input, the data is considered to be terminated. At this time, the module sends all data via wireless. When the module receives the first user data, AUX outputs low level. When the module puts all data into the RF chip and starts transmitting, AUX outputs high level. At this point, it indicates that the last packet of wireless data has been transmitted, and the user can continue to enter data. Data packets sent through mode 0 can only be received by the receiving module in mode 0.
receiving	The module is on the wireless receiving function all the time and can receive data packets from mode 0. After receiving the data packet and the module AUX outputs a low level, it starts sending wireless data through the serial port TXD pin. After all wireless data is output through the serial port, the module outputs AUX high level.

6.3 RSSI Mode（Mode1）

Type	When M1= 0，M1 = 0，module working in module1
transmission	No wireless transmission is allowed, the received serial data will be discarded.

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receiving	Can not receive air wireless data, only scan the signal strength of the current channel, and output a strength value (relative value) through the serial port every 100ms. Numerical calculation method: signal strength =-(256 (decimal)-data (decimal)) dBm If the hexadecimal value output by the serial port is 0x91, the actual signal strength is:-(256 (decimal)-145 (decimal)) =-111dBm

6.4 Setting Mode（Mode2）

Type	When M0 = 0，M1 = 1, module working in module1
transmission	No wireless transmission is allowed, the received serial data will be discarded.
receiving	Unable to receive wireless data
configuration	Can be used for module parameter setting, use serial port 9600, 8N1, set module working parameters according to specific instruction format
	When entering from the setting mode to other modes, the module will reconfigure the parameters. During the configuration, AUX remains low level; It outputs a high level after finished, so it is recommended that the user detect the rising edge of AUX.

6.5 Sleep Mode（Mode3）

Type	When M0 = 1，M1 = 1，module working in module3
transmission	Unable to transmit wireless data
receiving	Unable to receive wireless data
others	When the module is in the ultra-low power state, all other functions of are turned off, and the sleep mode can only be exited through the state switch of M1M0.

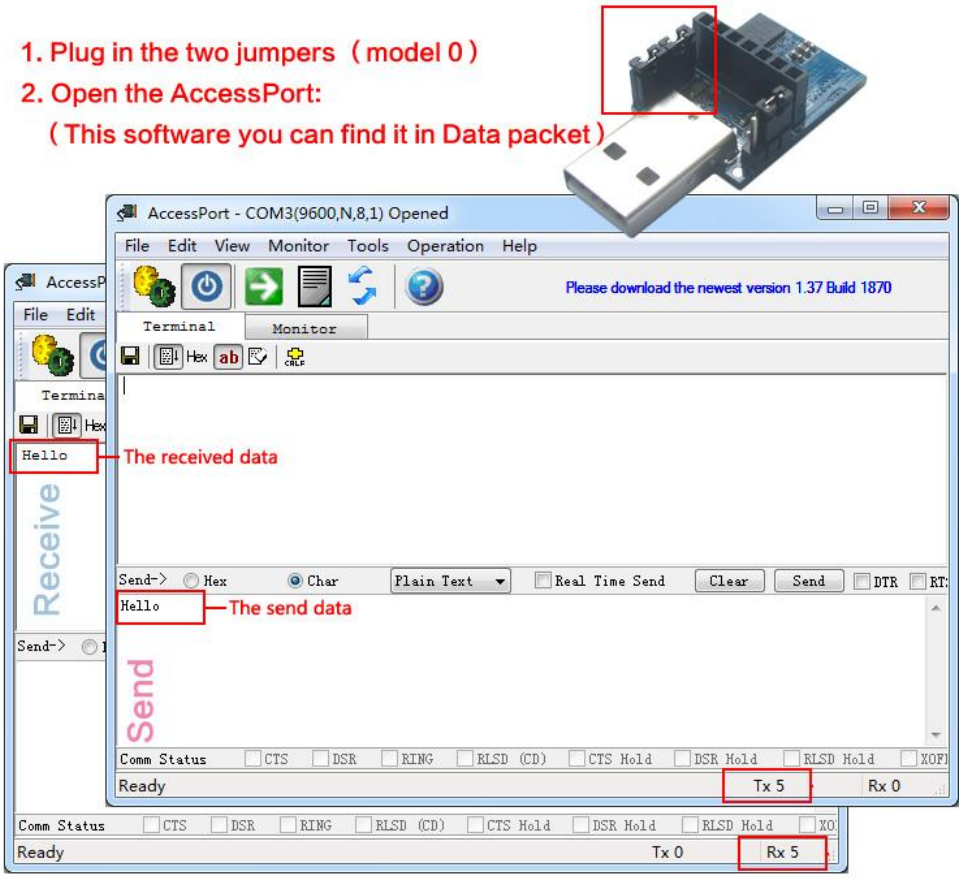
6.6 Fast communication test

Step	Specific operation
1	Connect E49-900T20S module to the E49-TBL test board, and then plug into the USB test board (E15-USB-T2), plug into the computer to ensure that the driver has been installed correctly; Plug in the mode selection jumper cap on the USB test board (M1 = 0, M0 = 0),

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2	Select 5V (the module supports 2.6 ~ 5.5V).
3	Run the "Serial Debug Assistant" software and select the correct serial port number and observe the sending window and the corresponding receiving window.



7. Command format

Command mode (Mode 2: M0 = 0, M 1 = 1), the list of supported commands is as follows (when set, only 9600, 8N1 format is supported):

No.	Instruction format	Detailed description
1	C0+operating parameter	Send C0 + 5 byte working parameters in hexadecimal format, a total of 6 bytes and must be sent continuously (save when power off)
2	C1+C1+C1	Send three C1s in hexadecimal format. The module returns the saved parameters and must be sent continuously.

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3	C2+operating parameter	Send C2 + 5 bytes working parameter in hexadecimal format, a total of 6 bytes and must be sent continuously(do not save when power off)
4	C3+C3+C3	Send three C3s in hexadecimal format. The module returns version information and must be sent continuously.

7.1 Default parameters

Model	Factory default parameter value：C0 00 00 19 2E 00					
Module type	Frequency	Address	Channel	Air rate	Baud rate	Transmitting power
E49-900T20S	868MHz	0x0000	0x2E	2.4kbps	9600	20

7.2 Reading operating parameter

Instruction format	Detailed description
C1+C1+C1	In the setting mode (M0 = 0, M1 = 1), issue a command to the module serial port (HEX format): C1 C1 C1, The module will return the current configuration parameters, such as: C0 00 00 18 20 00

7.3 Reading version number reading

Instruction format	Detailed description
C3+C3+C3	In the setting mode (M0 = 0, M1 = 1), issue a command to the module serial port (HEX format): C3 C3 C3, The module will return the current configuration parameters, such as: C3 49 xx yy; 49 here represents the module model (E49 series), xx is the version number, and yy refers to other features of the module (users can ignore).

7.4 Parameter setting instruction

No.	Item	Description	Remark

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0	HEAD	Fix 0xC0 or 0xC2, it means this frame data is control command	● Must be 0xC0 or 0xC2 C0: Save the parameters when power-down C2: Do not save the parameters when power-down
1	ADDH	High address byte of module （the default 00H）	00H-FFH
2	ADDL	Low address byte of module （the default 00H）	00H-FFH
3	SPED	Rate parameters, including serial rate and air rate 7, 6: Serial parity bit 00: 8N1 (default) 01: 8O1 10: 8E1 11: 8N1 ---------- 5，4，3 TTL serial speed (bps) 000: Serial baud rate is 1200 001: The serial port baud rate is 2400 010: The serial port baud rate is 4800 011: Serial baud rate is 9600 (default) 100: The serial port baud rate is 19200 101: Serial baud rate is 38400 110: Serial baud rate is 57600 111: Serial baud rate is 115200 ---------- 2，1，0 Wireless air rate (bps) 000: The air rate is 1.2k 001: The air speed is 2.4k (default) 010: The air speed is 4.8k 011: The air speed is 9.6k 100: The air speed is 19.2k 101: The air speed is 50k 110: The air speed is 100k 111: 200k air speed	----------UART baud rate can be different between communication parties The UART baud rate has nothing to do with wireless transmission parameters & won’t affect the wireless transmit / receive features. ● ---------- ---------- ● The lower the air data rate, the longer the transmitting distance, better anti-interference performance and longer transmitting time ● The air data rate must keep the same for both communication parties.
4	CHAN	7,，6，5，4，3，2，1，0 Communication channel	----------

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		Communication frequency（850M + CHAN * 0.5M） (Default 0x24: 868M)	● 00H-A0H, ● correspond to 850~930 MHz.
5	OPTION	7; Fixed transmission enabling bit（similar to MODBUS） 0: Transparent transmission mode 1: Fixed transmission mode ---------- 6, 5, 4, 3, 2 Reserved bit, write 0 ---------- 1, 0 Transmission power (approximation) 00: 20 dBm (default) 01: 17 dBm 10: 14 dBm 11: 10 dBm	● In fixed transmission mode, the first three bytes of each user's data frame can be used as high/low address and channel. The module changes its address and channel when transmit. And it will revert to original setting after complete the process. ---------- ---------- The external power must make sure the ability of current output more than 100mA and ensure the power supply ripple within 100mV. Low power transmission is not recommended due to its low power supply efficiency.。

For example: The meaning of No.3 "SPED" byte:

The binary bit of the byte	7	6	5	4	3	2	1	0
Configures by user	0	0	0	1	1	0	0	1
Meaning	UART parity bit 8N1		UART baud rate is 9600			Air data rate is 2.4k		
Corresponding hexadecimal	1				9			

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8. Hardware design

- It is recommended to use a DC stabilized power supply. The power supply ripple factor is as small as possible, and the module needs to be reliably grounded.;
- Please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure it is within the recommended voltage otherwise when it exceeds the maximum value the module will be permanently damaged;
- Please check the stability of the power supply, the voltage can not be fluctuated frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, so the whole machine is beneficial for long-term stable operation.;
- The module should be as far away as possible from the power supply, transformers, high-frequency wiring and other parts with large electromagnetic interference.;
- High-frequency digital routing, high-frequency analog routing, and power routing must be avoided under the module. If it is necessary to pass through the module, assume that the module is soldered to the Top Layer, and the copper is spread on the Top Layer of the module contact part(well grounded), it must be close to the digital part of the module and routed in the Bottom Layer;
- Assuming the module is soldered or placed over the Top Layer, it is wrong to randomly route over the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees;
- It is assumed that there are devices with large electromagnetic interference around the module that will greatly affect the performance. It is recommended to keep them away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done;
- Assume that there are traces with large electromagnetic interference (high-frequency digital, high-frequency analog, power traces) around the module that will greatly affect the performance of the module. It is recommended to stay away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done.
- If the communication line uses a 5V level, a 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage);
- Try to stay away from some physical layers such as TTL protocol at 2.4GHz , for example: USB3.0;
- The mounting structure of antenna has a great influence on the performance of the module. It is necessary to ensure that the antenna is exposed, preferably vertically upward. When the module is mounted inside the case, use a good antenna extension cable to extend the antenna to the outside;
- The antenna must not be installed inside the metal case, which will cause the transmission distance to be greatly weakened.

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9. FAQ

9.1 Communication range is too short

- The communication distance will be affected when obstacle exists.
- Data lose rate will be affected by temperature, humidity and co-channel interference.
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground.
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea.
- The signal will be affected when the antenna is near metal object or put in a metal case.
- Power register was set incorrectly, air data rate is set as too high (the higher the air data rate, the shorter the distance).
- The power supply low voltage under room temperature is lower than recommended value, the lower the voltage, the lower the transmitting power.
- Due to antenna quality or poor matching between antenna and module.

9.2 Module is easy to damage

- Please check the power supply to ensure that it is between the recommended power supply voltage. If the maximum value is exceeded, the module will be permanently damaged.
- Please check the stability of power source, the voltage cannot fluctuate too much.
- Please make sure anti-static measure are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range, some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

9.3 BER(Bit Error Rate) is high

- There are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;
- Poor power supply may cause messy code. Make sure that the power supply is reliable.
- The extension line and feeder quality are poor or too long, so the bit error rate is high;

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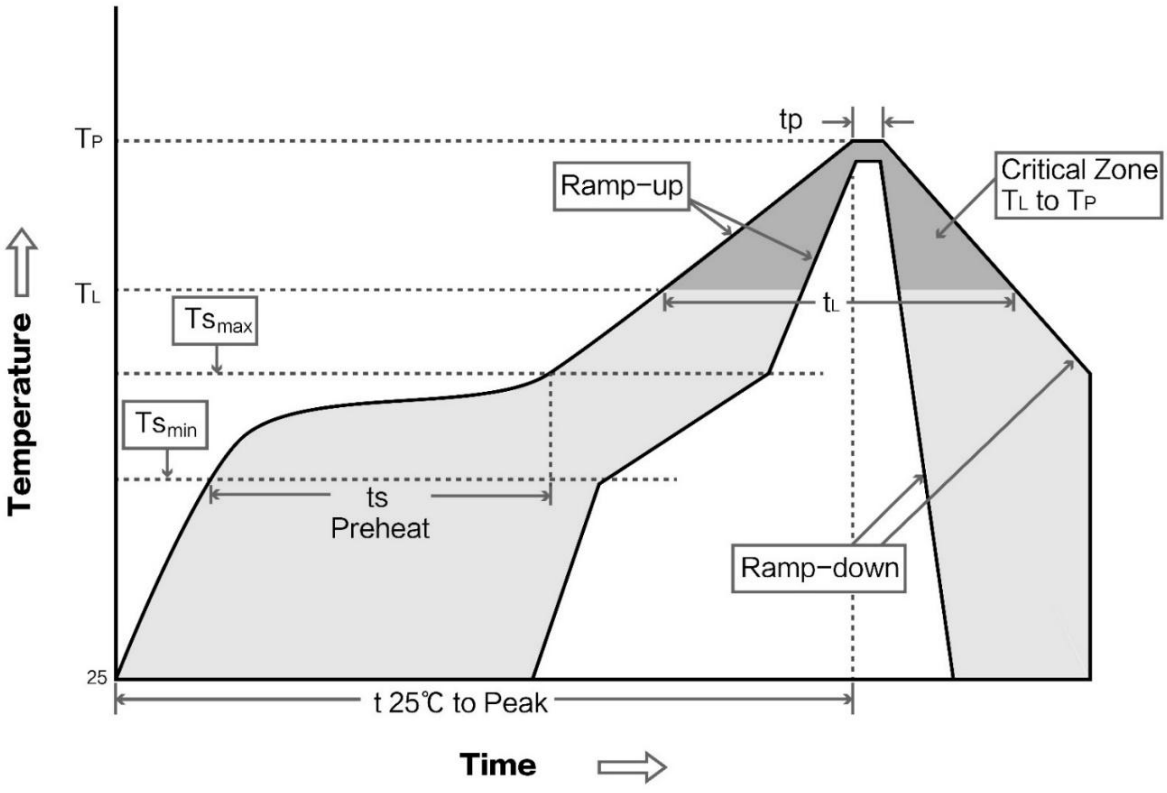
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10. Welding operation guidance

10.1 Reflow Soldering 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

10.2 Reflow Soldering Curve



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11. Related Model

Model	Chip	Frequency Hz	Transmit power dBm	Test distance km	Air rate bps	Packaging	Size mm	Antenna
E49-400T20S	-	433	20	1	1.2k~200k	SMD	26 * 16	IPEX/stamp hole

12. Antenna Guide

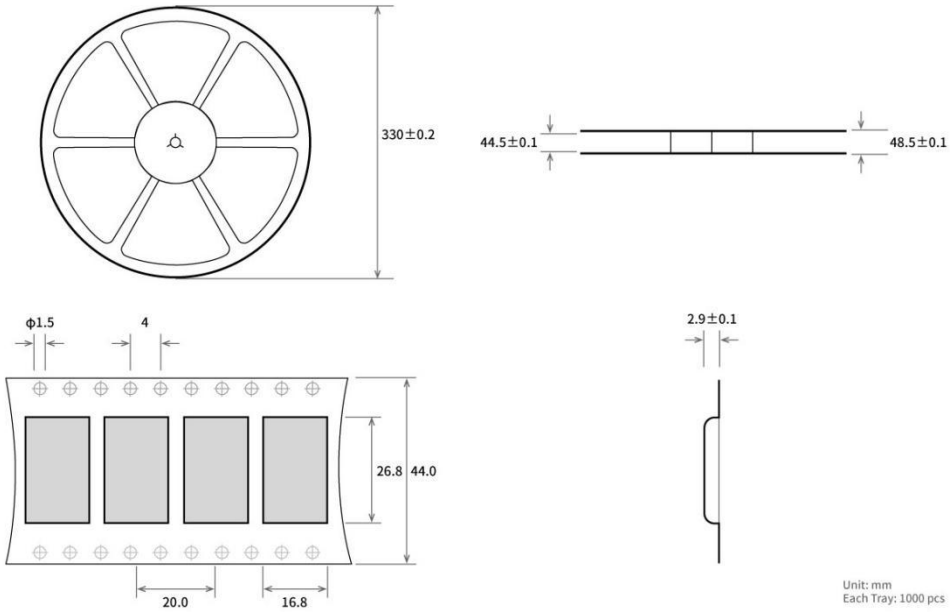
Antennas play an important role in the communication process, and often inferior antennas will have a great impact on the communication system. Therefore, our company recommends some antennas as antennas with excellent performance and reasonable price to match our wireless modules.

Product number	type	frequency Hz	interface	gain dBi	high m m	feeder c m	Features
TX 868 -JZ-5	Plastic Antenna	868M _	SMA-J	2.0 _	52	-	Ultra-short straight, omnidirectional antenna
TX 868 -JK-20	Plastic Antenna	868M _	SMA-J	3.0 _	210	-	Bendable Plastic, omnidirectional antenna
TX 868 -XP L -100	Suction cup antenna	868M _	SMA-J	3.5	290	100	Small suction cup antenna, high cost performance
TX 915 -JZ-5	Plastic Antenna	915M _	SMA-J	2.0	5 2	-	Ultra-short straight, omnidirectional antenna
T X915-JK-11	Plastic Antenna	915M _	SMA-J	2.5	110	-	Bendable Plastic, omnidirectional antenna
T X915-JK-20	Plastic Antenna	915M _	SMA-J	3.0 _	210	-	Bendable Plastic, omnidirectional antenna
TX 915 -XP L -100	Suction cup antenna	915M _	SMA-J	3.5	290	100	Small suction cup antenna, high cost performance

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13 Batch packaging



Revision history

Version	Date	Description	Issued by
V1.0	2021-6-10	Format adjustment	Linson
V1.3	2023-11-13	Content revision	Bin
V1.4	2024-3-8	Content revision	Lau
V1.5	2026-3-18	Content revision	Hao

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