E220-230T30S User Manual

220/236MHz 30dBm New LoRa Wireless Module

Contents

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1. Overview

1.1 Introduction

E220-230T30S is a new generation of Lora wireless serial port module (UART) based on SEMTECH's LLCC68, working at 220.125 ～ 236.125MHz (default 230.125MHz), with TTL level output, compatible with 3.3V and 5V IO port voltage.

Compared with the traditional SX1278 solution, it has a longer transmission distance, faster speed, lower power consumption; it supports functions such as air wake-up, carrier sense, communication keys and sub-package length setting. Ebyte provides customized development services on it. It is a cost-effective solution, which covers the frequency band of 220 ~ 236MHz.

1.2 Features

- LLCC68 LoRa chip has the advantage of low power consumption, fast speed and long distance;
- In ideal condition, communication distance reach up to 10 km ；
- Maximum transmission power of 30dBm, software multi-level adjustable ；
- The communication allows users to set key that cannot be read, greatly improving the user data privacy;
- Supports RSSI for evaluating signal quality, improving communication network, and ranging;
- Support air wake-up, that is, ultra-low power consumption function, suitable for a battery-powered application solutions;
- Supports fixed transmission, radio transmission, channel to monitor;
- Parameters automatically saved when power off, it will work according to previous parameters once powered on.
- Effective watchdog design, once an exception occurs, the module will be in automatic restart, and can continue to work on previous parameter;
- Supports air date rate of 2.4kbps ~ 62.5kbps ；
- Supports 2.3V~5.5V power supply, power supply over 5.0 V can guarantee the best performance ；
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time ；
- Dual antenna (IPEX and stamp hole) optional, good for secondary development and integration.

1.3 Application

- Home security alarm and remote keyless entry ；
- Smart home and industrial sensors ；
- Wireless alarm security system ；
- Building automation solutions ；

- Wireless industrial-grade remote control；
- Health care products；
- Advanced Meter Reading Architecture(AMI)；
- Automotive industry applications.

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）		3.0	5.0	5.5	≥5.0 V ensures output power
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）		220.125	-	236.125	Support ISM band
Power consumption	TX current （mA）		610		Instant power consumption
	RX current （mA）		17		
	Sleep current （μA）		3		Software is shut down@30dBm
Max Tx power （dBm）		29.5	30.0	30.5	
Receiving sensitivity （dBm）		-	-129	-	-124dbm,BW_L=125kHz,SF = 7,LORA™; -129dbm,BW_L=125kHz,SF = 9,LORA™; -121dbm,BW_L=250kHz,SF = 7,LORA™; -129dbm,BW_L=250kHz,SF = 10,LORA™; -117dbm,BW_L=500kHz,SF = 7,LORA™; -127dbm,BW_L=500kHz,SF = 11,LORA™;
Air data rate （bps）		2.4k	2.4k	62.5k	Controlled via user's programming
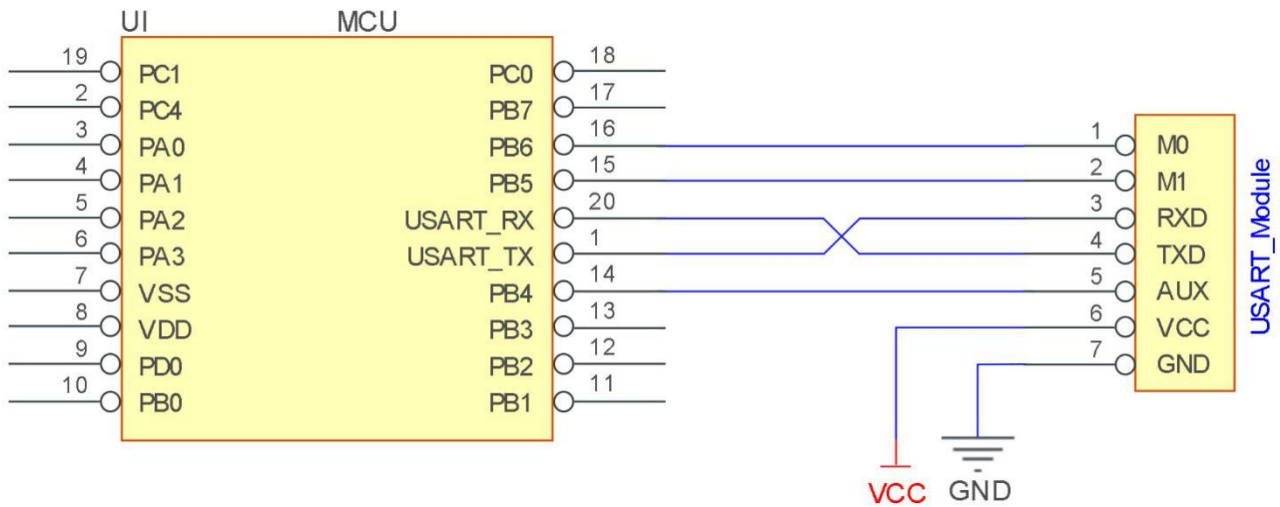
Main parameter	Description	Remark
Distance for reference	10km	Test condition：clear and open area, antenna gain: 5dBi, antenna height: 2.5m, air data rate: 2.4kbps
TX length	200 Byte	Can be configured via command as 32/64/128/240 bytes per packet to transmit
Buffer	400 Byte	
Modulation	LoRa	New generation LoRa modulation technology
Communication interface	UART Serial Port	TTL level
Package	SMD	
Connector	IPEX/stamp hole	Spacing 2.54mm
Size	25*40.5 mm	
Antenna	IPEX/stamp hole	50 ohm impedance

3 Size and pin definition
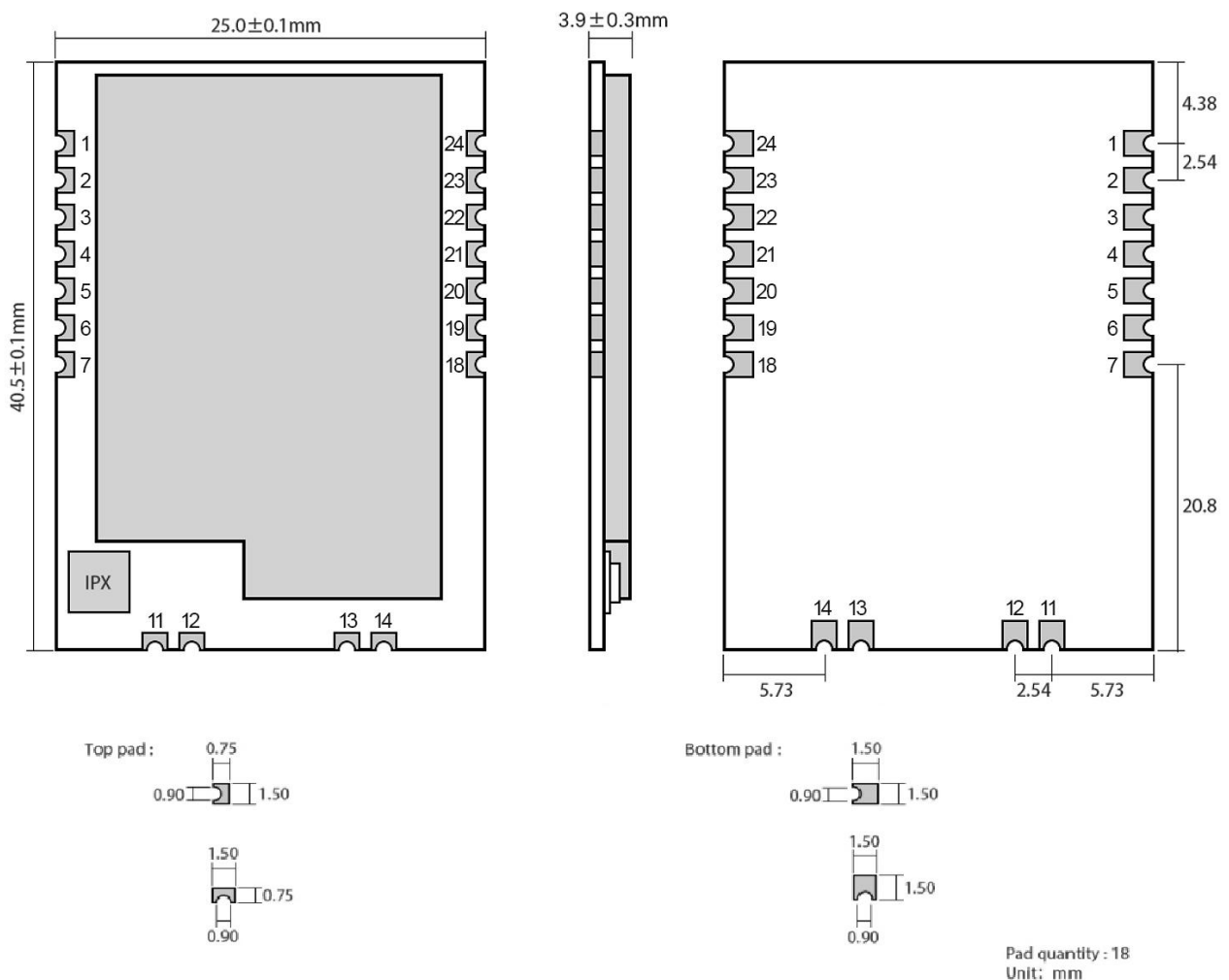
Pin No.	Pin Name	Pin Direction	Pin Function
1	GND	Input	Module ground
2	VCC	Input	Voltage range: 3.0～5.5V DC
3	AUX	Output	Used to indicate the working status of the module; wakes up the external MCU, and outputs low level during power-on self-check initialization; (can be left floating)
4	TXD	Output	TTL UART outputs, connects to external RXD input pin.
5	RXD	Input	TTL UART inputs, connects to external TXD output pin.
6	M1	Input (weak pull-up)	Work with M0 to decide 4 working modes of module (not float, if not used, could be grounded).
7	M0	Input (weak pull-up)	Work with M1 to decide 4 working modes of module (not float, if not used, could be grounded).
11	ANT	Output	Antenna interface (high frequency signal output, 50 ohm impedance)
12	GND		Fixed ground
13	GND		Fixed ground
14	GND		Fixed ground
18	NC	Input/Output	NC pin, this pin needs to be left floating (for subsequent expansion)
19	NC	Input/Output	NC pin, this pin needs to be left floating (for subsequent expansion)
20	NC	Input/Output	NC pin, this pin needs to be left floating (for subsequent expansion)
21	NC	Input	(Users do not need to connect, to be left floating)
22	NC	Input	(Users do not need to connect, to be left floating)
23	GND	Input	Fixed ground
24	NC	Input	(Users do not need to connect, to be left floating)

4. Connect to MCU

No.	Brief description of the connection between the module and the MCU (the above figure uses the STM8L MCU as an example)
1	The UART module is TTL level, please connect with TTL level MCU.
2	For some MCU works at 5VDC, it may need to add 4-10K pull-up resistor for the TXD & AUX pin.

5. Operating mode

There are four operating modes, which are set by M1 and M0, the details are as follows:

Mode(0-3)	M1	M0	Description	Remark
0 Normal mode	0	0	UART and wireless channel are open, transparent transmission is on	-
1 WOR transmitting mode	0	1	Can be defined as WOR transmitter and WOR receiver	Supports wake up over air
2 WOR receiving mode	1	0	Only work as WOR receiver	-
3 Deep sleep mode	1	1	For parameter configuration	-

5.1 Mode switching

No.	Remark

1	• Users can combine M1 and M0 with high and low levels to determine the operating mode. Two GPIOs of the MCU can be used to control mode switching; • After changing M1 and M0: If the module is idle, after 1ms, it can start working according to the new mode; • If the serial port data of the module has not been transmitted through the wireless, the new working mode can be switched after the transmission is completed; • If the module receives the wireless data and transmits the data through the serial port, it needs to finish transmission before switching the new working mode; • Therefore, mode switching can only be valid when AUX output is 1, otherwise it will delay switching.
2	• For example, users continuously inputs a large amount of data and simultaneously performs mode switching. At this time, the switching mode operation is invalid; the module will process all the user data before performing the new mode detection; • Therefore, the general recommendation is to detect the output state of the AUX pin and switch after 2ms when the output is high.
3	• When the module is switched from other modes to sleep mode, if the data has not been processed yet; • The module will process these data (including receiving and sending) before entering sleep mode. This feature can be used for fast sleep, which saves power; for example, the transmitter module works in mode 0, the user transmits the serial port 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 immediately sleeps, the module will automatically transmit the user data through the wireless, and automatically enters sleep within 1ms; • This saves MCU's working time and reduces power consumption.
4	• Similarly, any mode switching can use this feature. After the module processes the current mode event, it will automatically enter the new mode within 1ms; thus eliminating the need for the user to query AUX and achieve the purpose of fast switching; • For example, switching from the transmit mode to the receive mode; the user MCU can also enter sleep before the mode switch, and use the external interrupt function to acquire the AUX change, thereby performing mode switching.
5	• This operation mode is very flexible and efficient, and is designed according to the user's MCU's operation convenience, and can reduce the workload of the entire system as much as possible, improve system efficiency, and reduce power consumption.

5.2 Normal mode（Mode 0）

Type	M0 = 0，M1 = 0
Transmitting	Users can input data through the serial port and the module will start wireless transmission.
Receiving	The module wireless receiving function is turned on, and after receiving the wireless data, it will be output through the serial port TXD pin.

5.3 WOR transmitting mode（Mode 1）

Type	M0 = 1，M1 =0

Transmitting	Wireless data transmitting is enabled
Receiving	Wireless data receiving is enabled

5.4 WOR receiving mode（Mode 2）

Type	M0 = 0，M1 = 1
Transmitting	Wireless transmitting off
Receiving	Wireless receiving on

5.5 Deep sleep mode（Mode 3）
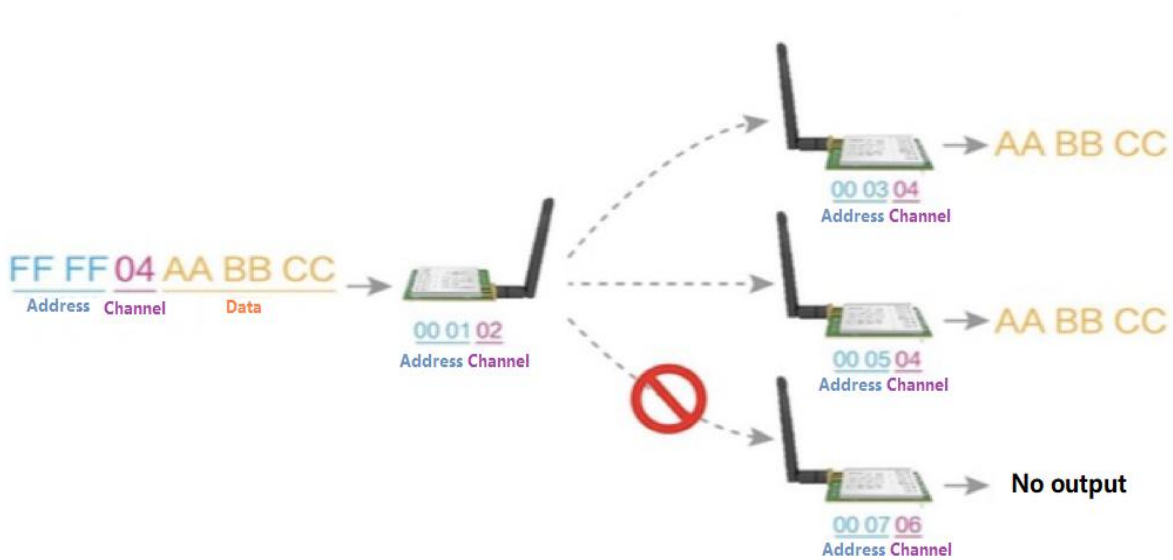
Type	M0 = 1，M1 = 1
Transmitting	Unable to transmit wireless data
Receiving	Unable to receive wireless data
Configuration	Users can access the registers to configure the module's operation state.
Note	When from the sleep mode to other modes, the module will reconfigure the parameters. During the configuration process, AUX will remain low; After configuration, it outputs high level, we suggest that user test rising edge T_BUSY.

6. Function description

6.1 Fixed transmission
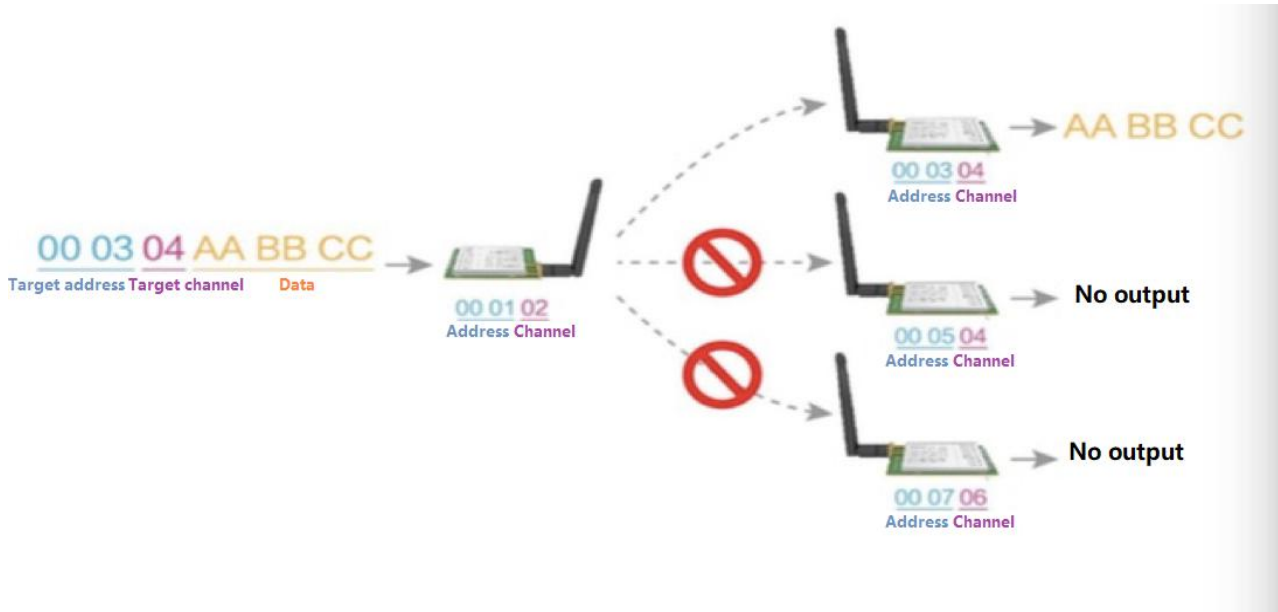
6.2 Broadcasting transmission

6.3 Broadcasting address

● For example: Set the address of module A as 0xFFFF or 0x0000, and the channel as 0x04;

● When module is the transmitter (transparent transmission), all modules under channel 0x04 will receive the data, the purpose of

broadcast is realized.

6.4 Monitor address

● For example: Set the address of module A as 0xFFFF or 0x0000, and the channel as 0x04;

● When module A is the receiver, it can receive the data sent from all modules under channel 0x04, the purpose of monitor is realized.

6.5 Reset
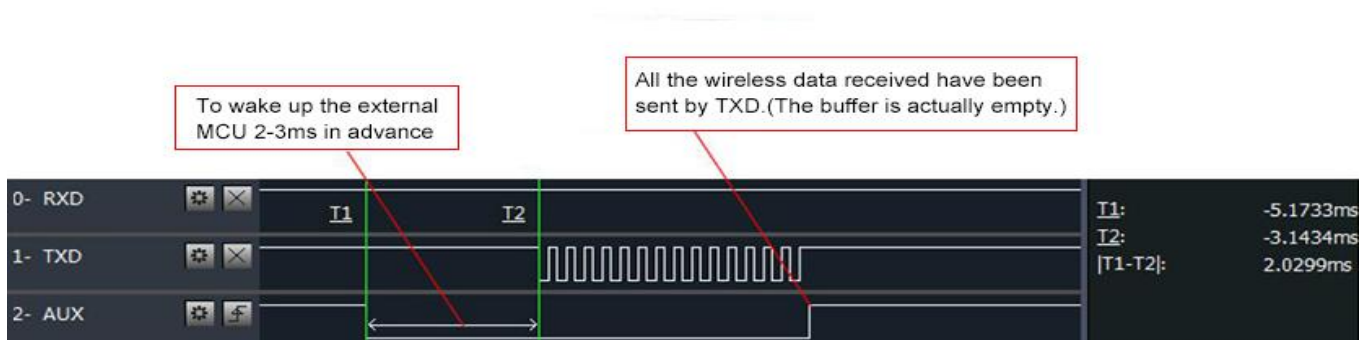
When the module is powered, AUX outputs low level immediately, conducts hardware self-check and sets the operating mode based on user's parameters. During the process, the AUX remains low level. After the process completed, the AUX outputs high level and starts to work as per the operating mode combined by M1 and M0. Therefore, users need to wait the AUX rising edge as the start of module's normal work.

6.6 AUX description

● AUX Pin can be used as indication for wireless send & receive buffer and self-check.

● It can indicate whether there are data that are not sent yet via wireless way, or whether all wireless data has been sent through UART, or whether the module is still in the process of self-check initialization.

6.6.1 Indication of UART output

● To wake up external MCU

Timing Sequence Diagram of AUX when TXD pin transmits

6.6.2 Indication of wireless transmitting
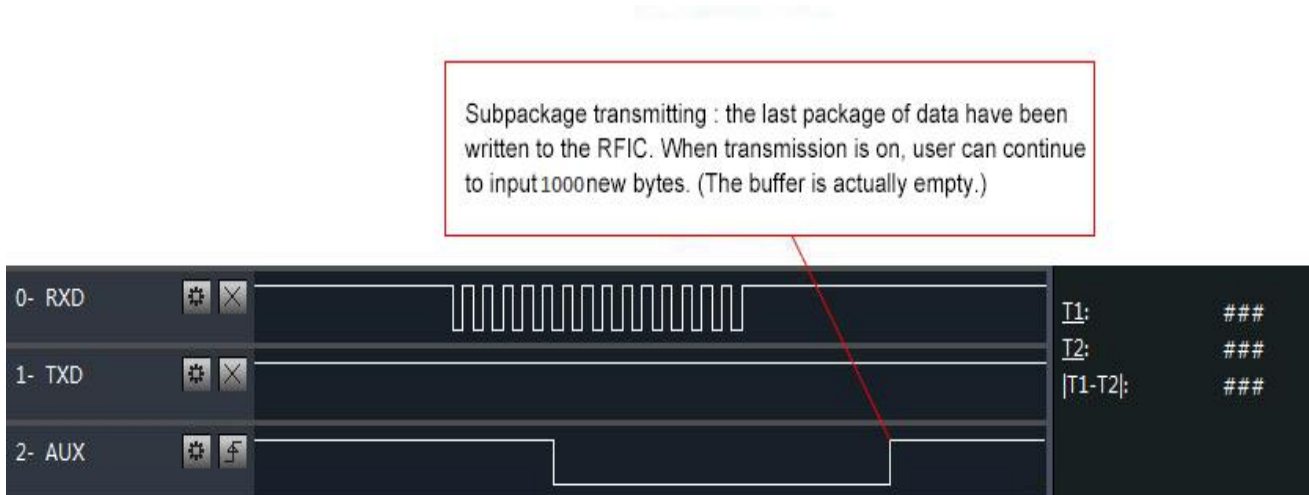
Buffer (empty): the internal 400 bytes data in the buffer are written to the RFIC (Auto sub-packaging);

When AUX=1, the user can input data less than 400 bytes continuously without overflow.

When AUX=0, Buffer (not empty): the internal 400 bytes data in the buffer have not been written to the RFIC completely. If the

user starts to transmit data at this circumstance, it may cause overtime when the module is waiting for the user data, or transmitting wireless sub package.

Notcie: When AUX = 1, it does not mean that all the UART data of the module have been transmitted already, perhaps the last packet of data is still in transmission.

Subpackage transmitting : the last package of data have been written to the RFIC. When transmission is on, user can continue to input 1000 new bytes. (The buffer is actually empty.)

Timing Sequence Diagram of AUX when RXD pin receives

6.6.3 Configuration procedure of module

- Only happened when power-on resetting or exiting sleep mode

The self-check procedure happens when the procedure of power-on reset, instruction reset and exit mode 3.

Normal operation after self-check

Self-checking for hardware and initialization
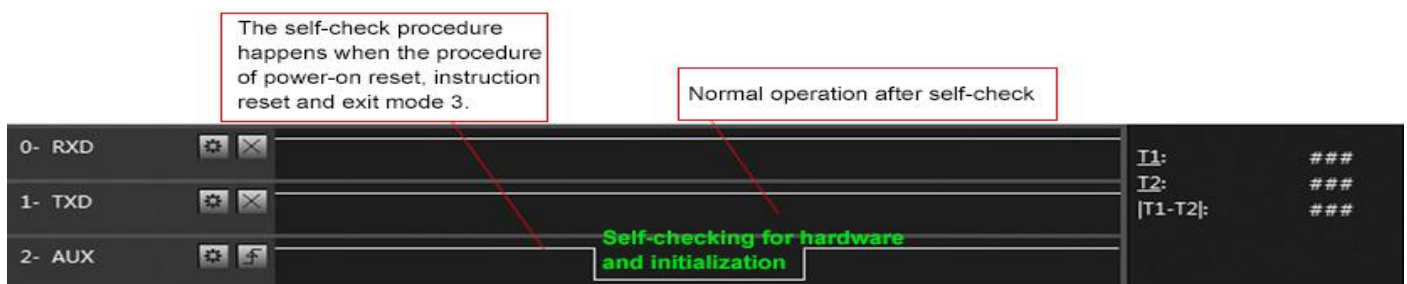
Timing Sequence Diagram of AUX when self-check

6.6.4 Notes for AUX

No.	Description
1	For function 1 & function 2 mentioned above, the priority should be given to the one with low level output, which means if it meets each of any low level output condition, AUX outputs low level, if none of the low level condition is met, AUX outputs high level.
2	When AUX outputs low level, it means the module is busy & cannot conduct operating mode checking. Within 1ms since AUX outputs high level, the mode switch will be completed.
3	After switching to new operating mode, it will not work in the new mode immediately until AUX rising edge lasts for 2ms . If AUX stays on the high level, the operating mode switch can be effected immediately.

4	When the user switches to other operating modes from mode 3 (sleep mode) or it's still in reset process, the module will reset user parameters, during which AUX outputs low level.
5	Due to the characteristics of the LoRa modulation method, the information transmission delay is much longer than that of FSK. For example, at 2.4kbps airspeed, the 100-byte transmission delay is about 1.5 seconds. It is recommended that customers do not transmit large amounts of data at low airspeeds, so as to avoid communication abnormalities caused by data loss due to data accumulation.

7. Register read and write control

7.1 Command format

In configuration mode (mode 3: M1 = 1, M0 = 1), the list of supported commands are as follows (only 9600, 8N1 format is supported when)：

No.	Command format	Description
1	Set register	Command: C0+starting address+length+parameters Response: C1+starting address+length+parameters E.g 1: Channel is 0x09 command starting address length parameter Send: C0 05 01 09 Returen: C1 05 01 09 E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (2.4K). Send: C0 00 04 12 34 00 61 Return: C1 00 04 12 34 00 61
2	Read register	Command: C1+starting address+ length Response: C1+starting address+length+parameters E.g 1：Read channel command starting address length parameter Send: C1 05 01 Returen: C1 05 01 09 E.g 2: Read module address, network address, serial port and air data rate. Send: C1 00 04 Return: C1 00 04 12 34 00 61
3	Set temporary registers	Command: C2+starting address+parameters Response: C1+starting address+length+parameters E.g 1: Channel is 0x09 command starting address length parameter Send: C2 05 01 09 Returen: C1 05 01 09 E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (2.4K). Send: C2 00 04 12 34 00 61 Return: C1 00 04 12 34 00 61
5	Wireless configuration	Command: CF CF + normal command Respond：CF CF + normal respond

		E.g 1: Channel is 0x09 Command head command starting address length parameter Send: CF CF C0 05 01 09 Returen: CF CF C1 05 01 09 E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (2.4K). Send: CF CF C2 00 04 12 34 00 61 Return: CF CF C1 00 04 12 34 00 61
6	Wrong format	Wrong format respond: FF FF FF

7.2 Register description

Address	Read or Write	Name	Description				Remark
00H	Read/Write	ADDH	ADDH（default 0）				High byte and low byte of module address; Note: When the module address is equal to FFFF, it can be used as the broadcast and monitor address, that is: the module will not perform address filtering at this time
01H	Read/Write	ADDL	ADDL（default 0）				
02H	Read/Write	REG0	7	6	5	UART Serial Port Rate（bps）	For the two modules that communicate with each other, the serial port baud rate can be different, and the verification method can also be different; When continuously transmitting large data packets, users need to consider the data congestion caused by the same baud rate, and may even be lost; It is generally recommended that the baud rate of the two communication parties be the same.
			0	0	0	UART Rate is 1200	
			0	0	1	UART Rate is 2400	
			0	1	0	UART Rate is 4800	
			0	1	1	UART Rate is 9600（default）	
			1	0	0	UART Rate is 19200	
			1	0	1	UART Rate is 38400	
			1	1	0	UART Rate is 57600	
			1	1	1	UART Rate is 115200	
			4	3		Serial Parity Bit	The serial port mode of the communication parties can be different;
			0	0		8N1（default）	
			0	1		8O1	
			1	0		8E1	
			1	1		8N1（equal to 00）	
			2	1	0	Air Data Rate（bps）	The air rate of both parties must be the same; The higher the air rate, the smaller the delay and the shorter the transmission distance.
			0	0	0	Air Data Rate 2.4k	
			0	0	1	Air Data Rate 2.4k	
			0	1	0	Air Data Rate 2.4k（default）	
			0	1	1	Air Data Rate 4.8k	
			1	0	0	Air Data Rate 9.6k	
			1	0	1	Air Data Rate 19.2k	
			1	1	0	Air Data Rate 38.4k	

			1	1	1		Air Data Rate 62.5k	
03H	Read/ Write	REG1	7	6		Sub-Packet Setting		The data sent by the user is less than the sub-packet length, and the serial port output of the receiving end appears as an uninterrupted continuous output; The data sent by the user is larger than the packet length, and the serial port of the receiving end will be output in packets.
			0	0		200 bytes（default）		
			0	1		128 bytes		
			1	0		64 bytes		
			1	1		32 bytes		
			5			RSSI Ambient noise enable		Enable command (packet setting, transmit power are default parameters, configuration mode): C0 03 01 20; After enabling, you can send commands C0 C1 C2 C3 in transmission mode or WOR sending mode to read registers; Register 0x00: Current environmental noise RSSI; Register 0x01: RSSI when receiving data last time (The current channel noise is: dBm = - （256 - RSSI）); Command format: C0 C1 C2 C3 + starting address + read length Return: C1 + address + read length + read valid value; for example: Send C0 C1 C2 C3 00 01 Return C1 00 01 RSSI **(address can only start from 00)**
			0			Disable（Default）		
			1			Enable		
			4	3	2	Reserve		
			1	0		Transmitting Power		The relationship between power and current is non-linear, and the power supply has the highest efficiency at maximum power; The current will not decrease in the same proportion as the power decreases.
			0	0		30dBm（default）		
			0	1		27dBm		
			1	0		24dBm		
			1	1		21dBm		
04H	Read/ Write	REG2	Channel Control（CH） 0-63 represents a total of 64 channels					Actual frequency = 220.125 + CH *0.25M
05H	Read/ Write	REG3	7			Enable RSSI Byte		After being enabled, the module receives wireless data and outputs it through the serial port TXD, followed by an RSSI strength byte.
			0			Disable（Default）		
			1			Enable		
			6			Transmission Method		During fixed transmission, the module will recognize the first three bytes of serial data as: address high + address low + channel, and use it as a wireless transmission target.
			0			Transparent transmission mode（default）		
			1			Fixed transmission mode		
			5			Reserve		
			4			LBT Enable		After enabling, monitoring will be conducted before wireless data transmission, which can avoid interference to a certain extent, but may cause data delay; The maximum stay time of LBT is 2 seconds, and it will be issued forcibly when it reaches 2 seconds.
			0			Disable（default）		
			1			Enable		
			3			Reserve		
			2	1	0	WOR Cycle		Only valid for mode 1;
			0	0	0	500ms		Cycle T= (1+WOR)*500ms, the maximum is

			0	0	1	1000ms	4000ms, the minimum is 500ms;
			0	1	0	1500ms	The longer the WOR monitoring interval period, the lower the average power consumption, but the greater the data delay;
			0	1	1	2000ms	
			1	0	0	2500ms	
			1	0	1	3000ms	Both sender and receiver must agree (very important)
			1	1	0	3500ms	
			1	1	1	4000ms	
06H	Write	CRYPT_H	Key high byte（default 0）				Write only, read returns 0; Used for encryption to avoid interception of wireless data in the air by similar modules;
07H	Write	CRYPT_L	Key low byte（default 0）				The module will use these two bytes as a calculation factor to transform and encrypt the air wireless signal.

7.3 Factory default parameter

	Factory default parameters：C0 00 00 62 00 00						
Model No.	Frequency	Address	Channel	Air data rate	Baud rate	Parity format	Power
E220-230T30S	230.125MHz	0x0000	0x17	2.4kbps	9600	8N1	30dbm

8. Configuration instructions on computer

● The following figure shows the E220-230T30S configuration host computer display interface, the user can switch to the command mode through M0,M1, and quickly configure and read the parameters on computer.

- In the configuration on computer, the module address, frequency channel, network ID, and key are all in decimal mode. The range of values of each parameter is:

  Network address: 0-65535

  Frequency channel: 0-64

  Key: 0-65535

9. 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.

10 FAQ

10.1 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 2.5V, the lower the voltage, the lower the transmitting power.
- Due to antenna quality or poor matching between antenna and module.

10.2 Module is easy to damage

- Please check the power supply source, ensure it is in right range, voltage higher than max value will damage the module.
- Please check the stability of power source, the voltage cannot fluctuate too much.
- Please make sure antistatic 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.

10.3   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;

11 Production guidance

11.1 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	max 6 minutes	max 8 minutes

11.2 Reflow soldering curve
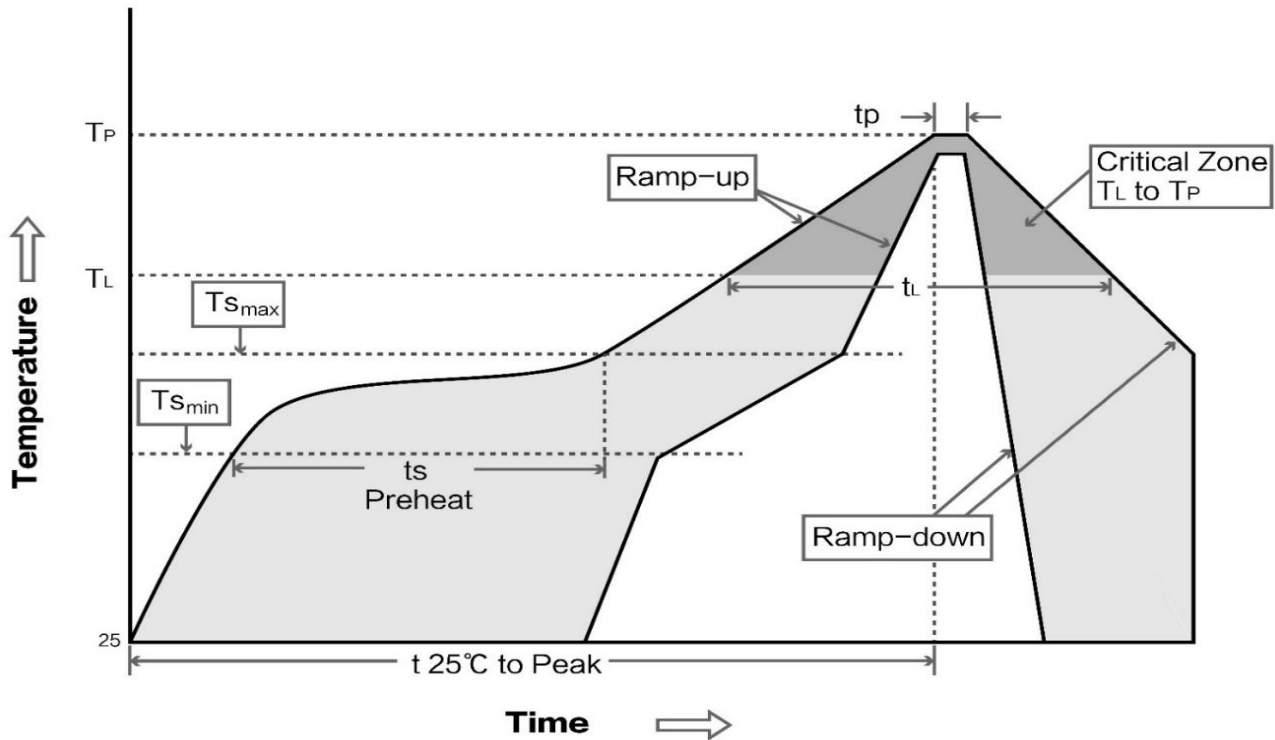
12 E220 series

| Model No.	Core IC	Frequency Hz	Tx power dBm	Distance km	Package	Interface
E220-400T22S	LLCC68	433/470M	22	5	SMD	TTL
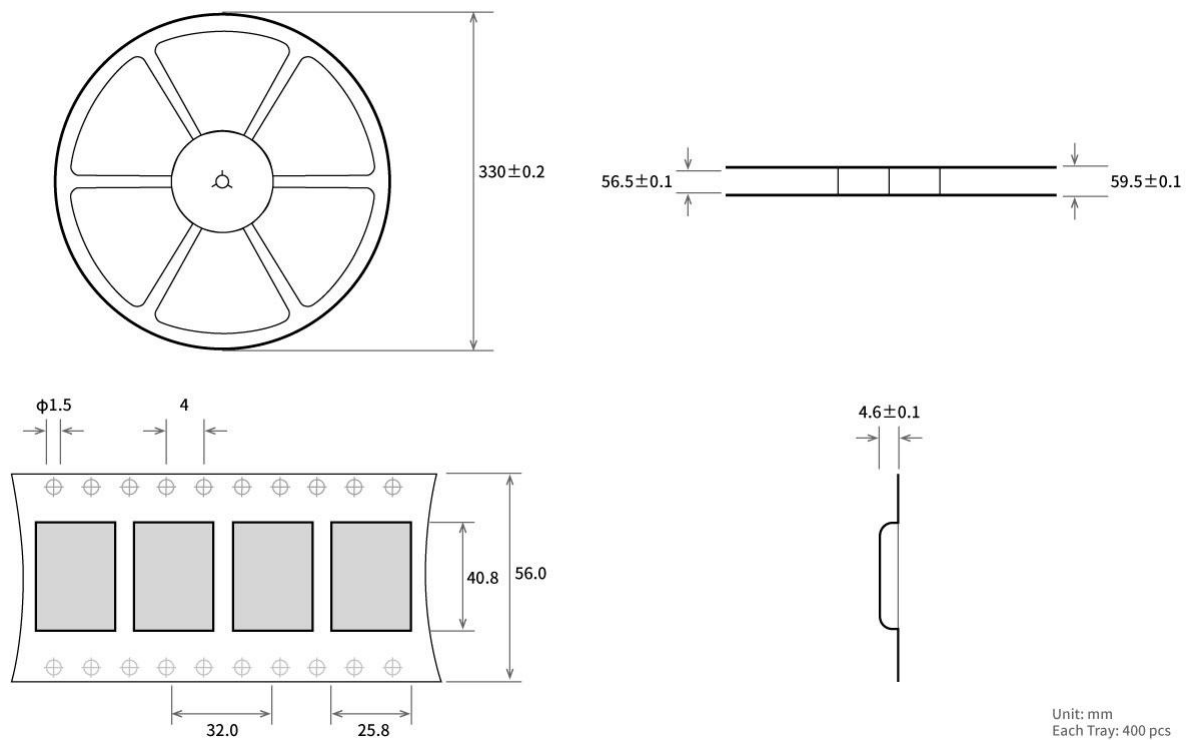
13 Antenna recommendation

The antenna is an important role in the communication process. A good antenna can largely improve the communication system. Therefore, we recommend some antennas for wireless modules with excellent performance and reasonable price.

Model No.	Type	Frequency Hz	Interface	Gain dBi	Height mm	Feeder cm	Features
TX230-JK-11	Rubber Antenna	230M	SMA-J	2.5	110	-	Bendable rubber, omnidirectional antenna
TX230-JK-20	Rubber Antenna	230M	SMA-J	3.0	210	-	Bendable rubber, omnidirectional antenna
TX230-XP-200	Suction	230M	SMA-J	4.0	350	200	Middle suction antenna,low loss

	Antenna						
TX230-XPH-300	Suction Antenna	230M	SMA-J	5.5	745	300	Big suction antenna, high gain

14 Package for batch order

Unit: mm
Each Tray: 400 pcs

Revision history

Version	Date	Description	Issued by
1.0	2020-07-08	Initial version	Ken
1.1	2020-12-10	Bugfix	Linson

About us

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