# E22-400T22S User Manual

SX1262 433/470MHz 160mW SMD Wireless Module



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# 1. Overview

## 1.1 Introduction




E22-400T22S is a wireless serial port module (UART) based on SEMTECH's SX1262 RF chip. It has multiple transmission modes, working in the 410.125MHz~493.125MHz, (default 433.125MHz), LoRa spread spectrum technology, TTL level output, compatible with 3.3V and 5V IC port voltage.

LoRa direct sequence spread spectrum technology will bring longer communication distance, and has the advantages of concentrated power density and strong anti-interference ability. The module has a software FEC forward error correction algorithm, which has high coding efficiency and strong error correction capability. In the case of sudden interference, it can actively correct the interfered data packets, greatly improving reliability and transmission distance. When without FEC, such packets can only be discarded.

The module has data encryption. Data transmitted over the air, with randomness, makes data interception meaningless through strict encryption and decryption algorithms. The module reserves multiple IO interfaces to provide custom development services.It supports packet length setting and also supports different real-time and data packets.

## 1.2 Features

- Communication distance tested is up to 7km；
- Maximum transmission power of 160mW, software multi-level adjustable；
- Support the global license-free ISM 433MHz band；
- Support air date rate of 0.3kbps ~ 62.5kbps；
- Support new generation LoRa technology based on SX1262；
- Compared with SX1276, the power consumption of hardware is reduced by 40%,and the power consumption of software is reduced by 35%;
- Compared with the SX1276, for the same power consumption, the transmission power is increased by 80%;
- Low power consumption for battery supplied applications；
- Support 2.1V~5.5V power supply, power supply over 3.3 V can guarantee the best performance；
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time；
- IPEX and stamp hole optional, good for secondary development and integration.

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## 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.

## 1.4 Function introduction

- **LoRa spread spectrum**: LoRa direct sequence spread spectrum technology will bring longer communication distance; low transmit power density, it is not easy to cause interference to other equipment.
- **High confidentiality**, extremely low probability of interception; strong anti-interference ability, strong suppression of co-channel interference and various noises; excellent anti-multipath fading performance.
- **LBT**: The module has a Listen before talk (LBT) function. When this function is enabled, the module actively monitors the channel environment noise before transmitting. If the noise exceeds the threshold, it will be sent delayed. This feature can greatly improve the communication success rate of the module in harsh environments. This function can be used for network transmission and anti-collision processing.
- **RSSI:** The signal strength indication function. The module supports packet signal strength serial output. Can be used to assess signal quality, improve communication networks, and ranging. The module supports ambient noise signal strength serial output. It can be used to implement LBT functions manually.
- **Wireless configuration**: Remotely configure or read wireless module parameters by sending command packets wirelessly.
- **Networking function**: The module can implement multi-level repeater networking. Multi-level repeater is suitable for ultra long-distance communication. Multiple networks in the same area can run simultaneously.
- **Ultra-low power consumption**: the air wake-up function. It is especially suitable for battery-powered applications: when the module is in WOR state, the configuration module WOR monitors the overall power consumption of the adjustable module. The maximum configurable response delay of the module is 4000ms. The average current of the module in this mode is about 2uA.
- **Fixed-point transmission**: supports address function, the host can transmit data to any address, any channel, to achieve networking, repeater and other application. For example: module A transmits data to module B (address is 0x00 01, channel is 0x80), date is AA BB CC, the communication format is: 00 01 80 AA BB CC, where 00 01 is the module B address and 80 is the module B channel, then module B can receive the AA BB CC (other modules do not receive data).
- **Broadcast monitoring**: Set the module address to 0xFFFF, which can monitor the data transmission of the module on the same channel; the transmitted data can be received by the module of any address on the same channel, thus playing the role of broadcasting and monitoring.

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- **Forward error correction**: The module has FEC forward error correction algorithm, which has high coding efficiency and strong error correction capability. In the case of sudden interference, it can actively correct the interfered data packets, greatly improving reliability and transmission distance. When without FEC, such packets can only be discarded.
- **Deep sleep function**: When the module is in sleep mode, mode 3, the wireless receiver is turned off and the micro-controller is in a sleep state; at this time, the power consumption of the whole device is about 2uA.
- **Watchdog**: The module has a built-in watchdog and performs precise time layout. Once an exception occurs, the module will restart within 1 second and continue to work according to the previous parameter settings.
- **Parameter saving**: After the user sets the parameters, the module parameters will be saved, the power will not be lost, and the module will work according to the set parameters after power-on.
- **Applicable environment**: 433MHz is free frequency band, users can use it directly without application; 433MHz features certain penetration and diffraction ability, suitable for environment with small data volume, long transmission distance and easy to be interfered.

# 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（C°） | -40 | 85 | / |

## 2.2 Operating parameter

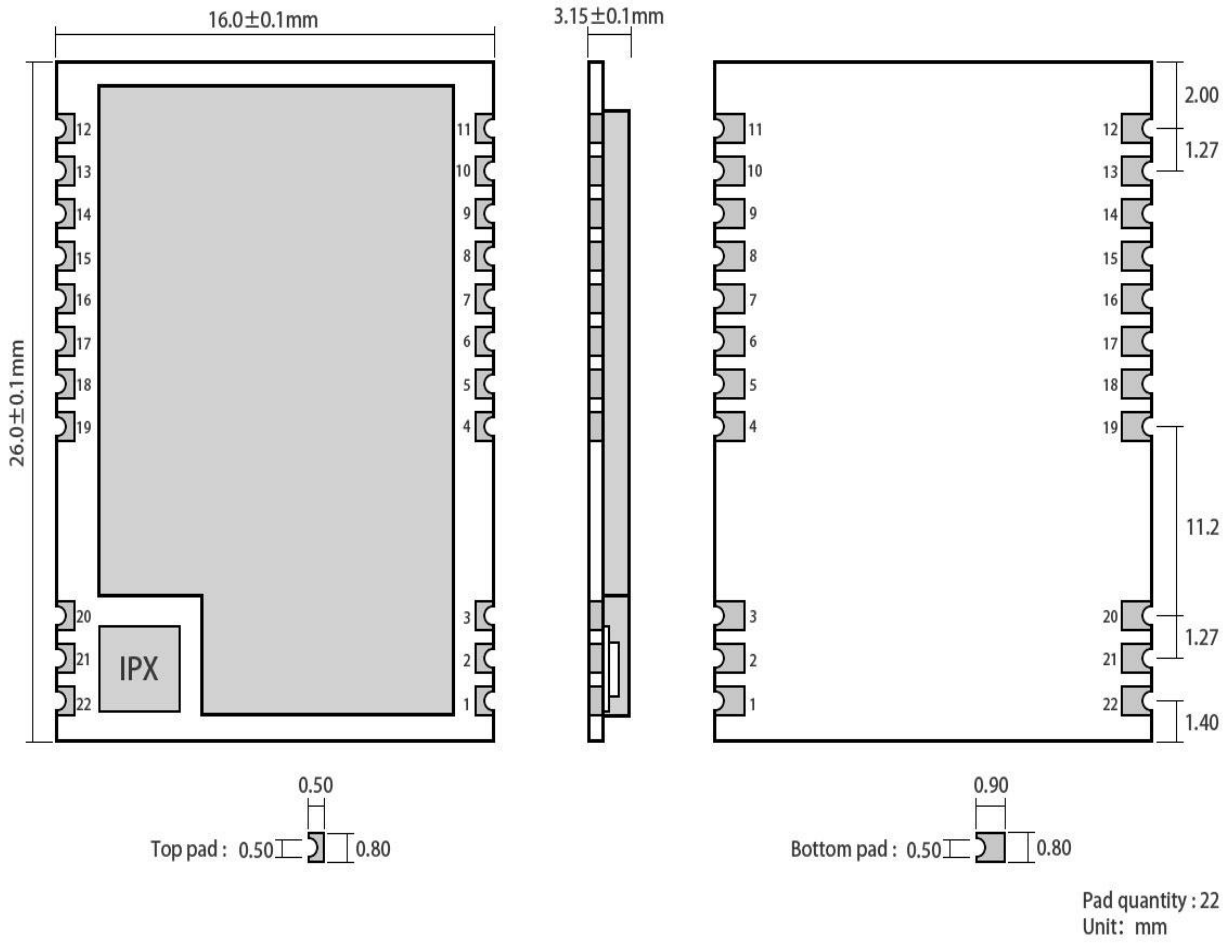
| Main parameter | | Performance | | | Remark |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Operating voltage（V） | | 2.1 | 5.0 | 5.5 | ⩾3.3V ensures output power |
| Communication level（V） | | | 3.3 | | For 5V TTL, It is recommended to add level conversion |
| Operating temperature（C°） | | -40 | - | 85 | Industrial design |
| Operating frequency（MHz） | | 410.125 | - | 493.125 | Support ISM band |
| Power consumption | TX current（mA） | | 133 | | Instant power consumption |
| | RX current（mA） | | 11 | | |
| | Sleep current （μA） | | 469 | | Software is shut down |
| Max Tx power（dBm） | | 21.5 | 22.0 | 22.5 | |
| Receiving sensitivity（dBm） | | -146 | -147 | -148 | Air data rate is 2.4kbps |
| Air data rate（bps） | | 0.3k | 2.4k | 62.5k | Controlled via user’ s programming |

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| Main parameter | Description | Remark |
|---|---|---|
| Distance for reference | 7000m | Test condition :clear and open area, antenna gain: 5dBi, antenna height: 2.5m， air data rate: 2.4kbps |
| TX length | 240 Btye | Can be configured via command as 32/64/128/240 bytes per packet to transmit |
| Buffer | 1000 Btye | |
| Modulation | GFSK | |
| | LoRa | |
| Communication interface | UART | |
| Package | SMD | |
| Connector | 1.27mm | |
| Size | 16 * 26 mm | |
| Antenna | IPEX/stamp hole | 50 ohm impedance |

# 3 Size and pin definition




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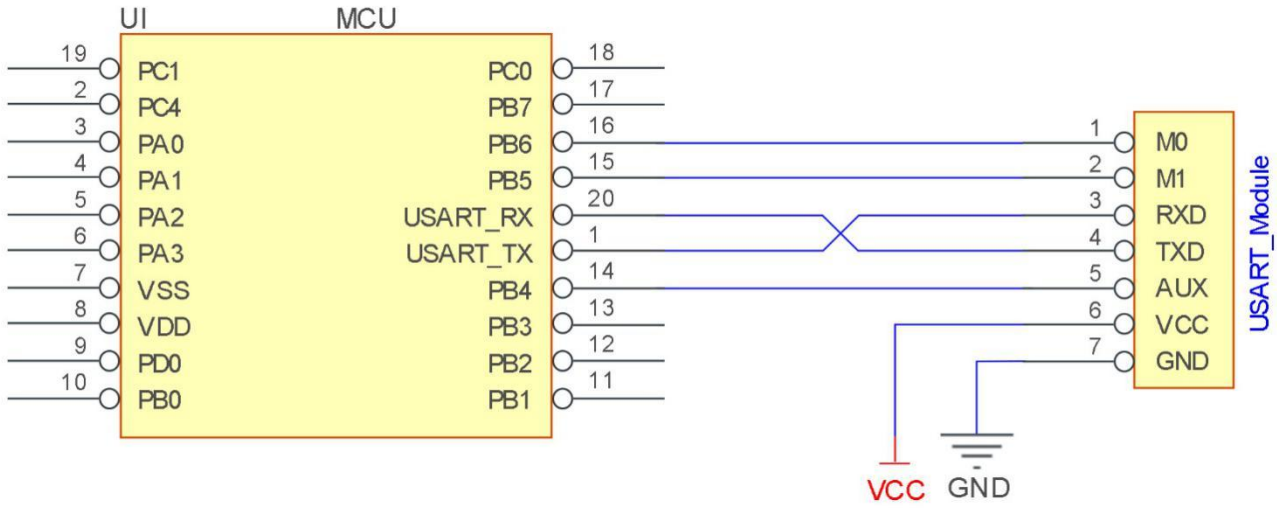
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| No. | Name | Direction | Function |
|---|---|---|---|
| 1 | GND | | Ground |
| 2 | GND | | Ground |
| 3 | GND | | Ground |
| 4 | GND | | Ground |
| 5 | M0 | Input (weak pull-up) | Work with M1 to decide 4 working modes of module (not suspended, if not used, could be grounded). |
| 6 | M1 | Input (weak pull-up) | Work with M0 to decide 4 working modes of module (not suspended, if not used, could be grounded). |
| 7 | RXD | Input | TTL UART inputs, connects to external (MCU, PC) TXD output pin. Can be configured as open-drain or pull-up input. |
| 8 | TXD | Output | TTL UART outputs, connects to external RXD (MCU, PC) input pin. Can be configured as open-drain or push-pull output |
| 9 | AUX | Output | To indicate module ' s working status & wakes up the external MCU. During the procedure of self-check initialization, the pin outputs low level. Can be configured as push-pull output (suspending is allowed). |
| 10 | VCC | | Power supply ：2.3~ 5.2V DC |
| 11 | GND | | Ground |
| 12 | NRST | Input | Module reset pin, low reset |
| 13 | GND | | Ground |
| 14 | NC | | |
| 15 | NC | | |
| 16 | NC | | |
| 17 | NC | | |
| 18 | NC | | |
| 19 | GND | | Ground |
| 20 | GND | | Ground |
| 21 | ANT | | Antenna |
| 22 | GND | | Ground |

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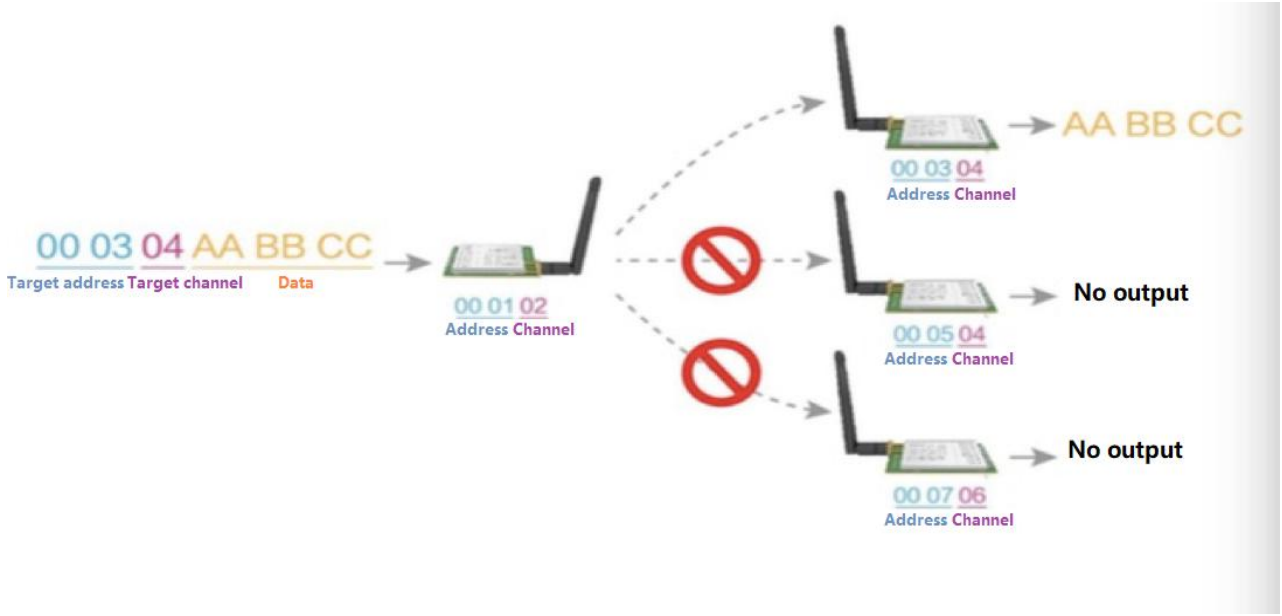
# 4. Connect to MCU




| No. | Description（STM8L MCU） |
|---|---|
| 1 | The UART module is TTL level. |
| 2 | For some MCU works at 5VDC, it may need to add 4-10K pull-up resistor for the TXD & AUX pin. |

# 5 Function description

## 5.1 Fixed transmission




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## 5.2 Broadcasting transmission




## 5.3 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.

## 5.4 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.

## 5.5 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.

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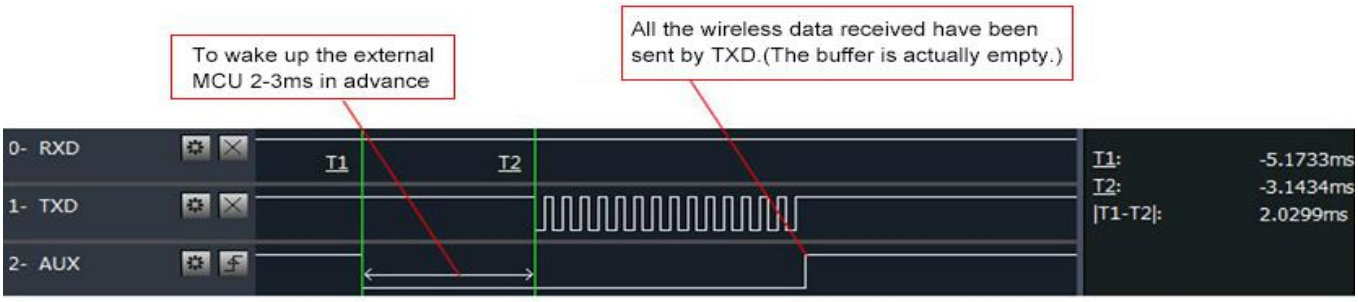
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## 5.6 AUX description

- 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.

### 5.6.1 Indication of UART output

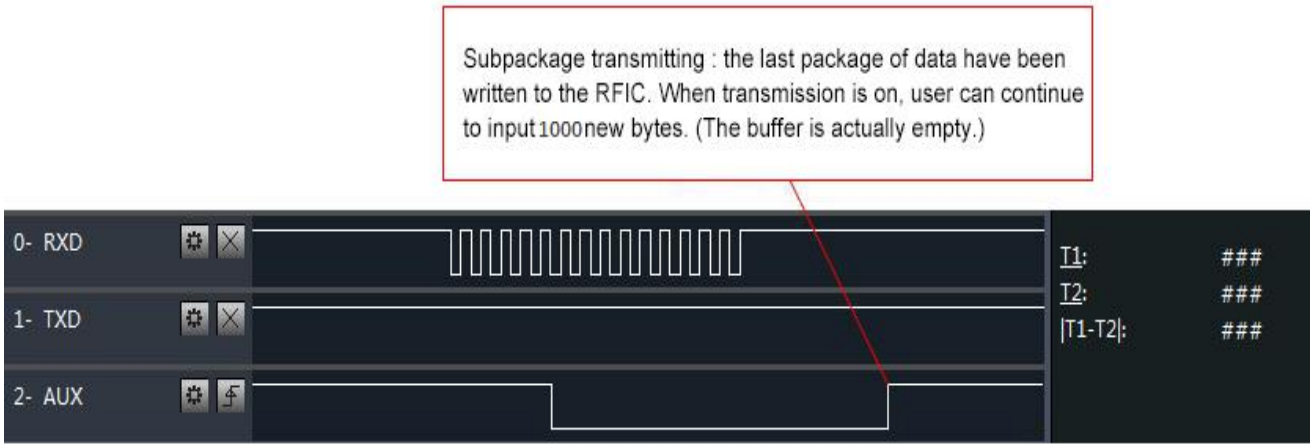
- To wake up external MCU




**Timing Sequence Diagram of AUX when TXD pin transmits**

### 5.6.2 Indication of wireless transmitting

Buffer (empty): the internal 1000 bytes data in the buffer are written to the RFIC (Auto sub-packaging). When AUX=1, the user can input data less than 1000 bytes continuously without overflow. Buffer (not empty): when AUX=0, the internal 1000 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.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.




**Timing Sequence Diagram of AUX when RXD pin receives**

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### 5.6.3 Configuration procedure of module

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




**Timing Sequence Diagram of AUX when self-check**

### 5.6.4 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. |

## 6 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 | Supports configuration over air via special command |
| 1 WOR mode | 0 | 1 | Can be defined as WOR transmitter and WOR receiver | Supports wake up over air |
| 2 Configuration mode | 1 | 0 | Users can access the register through the serial port to control the working state of the module | |
| 3 Deep sleep mode | 1 | 1 | Sleep mode | |

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## 6.1 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;<br>● After changing M1 and M0: If the module is idle, after 1ms, it can start working according to the new mode;<br>● 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;<br>● 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;<br>● 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;<br>● 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;<br>● 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;<br>● 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;<br>● 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. |

## 6.2 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. |

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## 6.3 WOR mode（Mode 1）

| Type | M0 = 1，M1 =0 |
|---|---|
| Transmitting | When defined as a transmitting party, a preamble is automatically added before transmitting. |
| Receiving | It can receive data normally, the receiving function is the same as mode 0. |

## 6.4 Configuration mode（Mode 2）

| Type | M0 = 0，M1 = 1 |
|---|---|
| Transmitting | Wireless transmitting off |
| Receiving | Wireless receiving off |
| Configuration | Users can access the registers to configure the module's operation state. |

## 6.5 Deep sleep mode（Mode 3）

| Type | M0 = 1，M1 = 1 |
|---|---|
| Transmitting | Unable to transmit wireless data |
| Receiving | Unable to receive wireless data |
| 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 AUX. |

# 7 Register read and write control

## 7.1 Command format

In configuration mode (mode 2: M1 = 1, M0 = 0), the list of supported commands are as follows (only 9600, 8N1 format is supported when)：

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| No. | Command format | Description |
|---|---|---|
| 1 | Set register | Command: C0+starting address+length+parameters<br>Response: C1+starting address+length+parameters<br><br>E.g 1: Channel is 0x09<br>command starting address length parameter<br>Send: C0 05 01 09<br>Returen: C1 05 01 09<br><br>E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (1.2K).<br>Send: C0 00 04 12 34 00 61<br>Return: C1 00 04 12 34 00 61 |
| 2 | Read register | Command: C1+starting address+parameters<br>Response: C1+starting address+length+parameters<br><br>E.g 1：Read channel<br>command starting address length parameter<br>Send: C1 05 01<br>Returen: C1 05 01 09<br><br>E.g 2: Read module address, network address, serial port and air data rate.<br>Send: C1 00 04<br>Return: C1 00 04 12 34 00 61 |
| 3 | Set temporary registers | Command: C2+starting address+parameters<br>Response: C1+starting address+length+parameters<br><br>E.g 1: Channel is 0x09<br>command starting address length parameter<br>Send: C2 05 01 09<br>Returen: C1 05 01 09<br><br>E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (1.2K).<br>Send: C2 00 04 12 34 00 61<br>Return: C1 00 04 12 34 00 61 |
| 4 | Wireless configuration | Command: CF CF + normal command<br>Respond：CF CF + normal respond<br><br>E.g 1: Channel is 0x09<br>Command head command starting address length parameter<br>Send: CF CF C0 05 01 09<br>Returen: CF CF C1 05 01 09<br><br>E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (1.2K).<br>Send: CF CF C2 00 04 12 34 00 61<br>Return: CF CF C1 00 04 12 34 00 61 |
| 5 | Wrong format | Wrong format respond: FF FF FF |

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## 7.2 Register description

| Address | Read or write | Name | Description | Remark |
|---|---|---|---|---|
| 00H | Read/Write | ADDH | ADDH（default 0） | ● The module address is high byte and low byte. Note: When the module address is FFFF, it can be used as the broadcast and monitor address, that is the module will not perform address filtering. |
| 01H | Read/Write | ADDL | ADDL（default 0） | |
| 02H | Read/Write | NETID | NETID（default 0） | ● Network address, used to distinguish the network. When communicating with each other, they should be set to the same. |
| 03H | Read/Write | REG0 | 7，6，5 UART: Serial port rate（bps）<br>000: 1200<br>001: 2400<br>010: 4800<br>011: 9600（default）<br>100: 19200<br>101: 38400<br>110: 57600<br>111: 115200<br>---<br>4，3： Serial parity bit<br>00：8N1（default）<br>01：8O1<br>10：8E1<br>11：8N1（equal to 00）<br>---<br>2，1，0，air data rate<br>000: 0.3k<br>001: 1.2k<br>010: 2.4k（default）<br>011: 4.8k<br>100: 9.6k<br>101: 19.2k<br>110: 38.4k<br>111: 62.5k | ● 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.<br>● When transmitting large packets continuously, users need to consider the data blocking caused by the same baud rate, and data may even be lost. It is generally recommended that both parties have the same baud rate.<br>---<br>● Both parties must be the same<br>● The higher the rate, the shorter the distance |
| 04H | Read/Write | REG1 | 7，6： Sub packet setting<br>00: 240 bytes（default）<br>01: 128 bytes<br>10: 64 bytes<br>11: 32 bytes<br>---<br>5 ：RSSI Ambient noise enable<br>1: Enable<br>0: Disable（default）<br>---<br>4，3，2 Reserve<br>---<br>1，0： Transmitting power | ● When the data is smaller than the sub packet length, the serial output of the receiving end is an uninterrupted continuous output.<br>When the data is larger than the sub packet length, the receiving end serial port will output the sub packet.<br>---<br>● When enabled, the C0 C1 C2 C3 command can be sent in the transmitting mode or WOR transmitting mode to read the register.<br>Register 0x00: Current ambient noise rssi<br>Register 0X01: rssi when the data was received last time. |

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| | | | | |
|---|---|---|---|---|
| | | | 00：22dbm（default）<br>01：17dbm<br>10：13dbm<br>11：10dbm | （Current channel noise is:dBm = -（256 - RSSI））<br><br>Command format: C0 C1 C2 C3 + starting address + read length<br>Returns: C1 + address + read length + read valid value<br>E.g: send C0 C1 C2 C3 00 01<br>Return C1 00 01 rssi<br>**（Address can only start from 00）**<br>---<br>● Power and current are nonlinear, and power efficiency is highest at maximum power.<br>● The current does not decrease in proportion to the decrease in power. |
| 05H | Read/Write | REG2 | Channel control（CH）<br>0-83 represents a total of 84 channels | ● Frequency= 410.125 + CH *1M |
| 06H | Read/Write | REG3 | 7 Enable RSSI<br>1：Enable<br>0：Disable（default）<br>---<br>6, Fixed point transmission<br>1：Fixed point transmission mode<br>0：Transparent transmission mode（default）<br>---<br>5 Enable reply<br>1：Enable repeater function<br>0：Disable repeater function<br>---<br>4 LBT enable byte (monitor before transmission)<br>1：Enable<br>0：Disable（default）<br>---<br>3 WOR transceiver control<br>1：WOR transmitter<br>The module receiving and transmitting functions are turned on, and a wake-up code is added when transmitting data. Receiving is turned on.<br>0：WOR receiver（default）<br>The module is unable to transmit data and works in WOR monitoring mode. The monitoring period is as follows (WOR cycle), which can save a lot of power.<br>---<br>2, 1, 0, WOR cycle<br>000：500ms<br>001：1000ms<br>010：1500ms<br>011：2000ms（default）<br>100：2500ms | ● When enabled, the module receives wireless data and it will follow an RSSI strength byte after output via the serial port TXD<br>.---<br>● The module recognizes the first three bytes of the serial data as: address high + address low + channel and takes it as the wireless transmitting target.<br>---<br>● After the reply function is enabled, if the target address is not the module itself, the module will forward it once.<br>● In order to prevent data return-back, it is recommended to use it in conjunction with the fixed point mode. That is: the target address is different from the source address.<br>---<br>● When enabled, wireless data will be monitored before it is transmitted, which can avoid interference to a certain extent, but may cause data delay.<br><br>---<br>● Valid only for mode 1.<br>● After the WOR receiver receives the wireless data and outputs it through the serial port, it will wait for 1000ms before entering the WOR again. Users can input the serial port data and return it via the wireless during this period. Each serial byte will be refreshed for 1000ms. Users must transmit the first byte within 1000ms.<br>---<br>● Valid only for mode 1.<br>● Period T = (1 + WOR) * 500ms, maximum 4000ms, minimum 500ms<br>● The longer the WOR monitoring interval period, the lower the average power consumption, but the greater the data delay<br>● Both the transmitter and the receiver must be the same (very important). |

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| | | | | |
|---|---|---|---|---|
| | | | 101：3000ms<br>110：3500ms<br>111：4000ms | |
| 07H | Write | CRYPT_H | Key high byte (default 0) | ● Write only, read returns 0<br>● Used for user encryption to avoid intercepting airborne wireless data by similar modules.<br>● The module will internally use these two bytes as a calculation factor to transform and encrypt the over-the-air wireless signal. |
| 08H | Write | CRYPT_L | Key low byte (default 0) | |
| 80H~<br>86H | Read only | PID | Product information 7 bytes | ● Product information 7 bytes |

## 7.3 Factory default parameter

| | **Factory default parameters：C0 00 09 00 00 00 62 00 17 03 00 00** | | | | | | |
|---|---|---|---|---|---|---|---|
| Model No. | Frequency | Address | Channel | Air data rate | Baud rate | Parity format | Power |
| E22-400T22S | 433MHz | 0x0000 | 0x17 | 2.4kbps | 9600 | 8N1 | 22dbm |

# 8 Repeater networking mode

| No. | Description |
|---|---|
| 1 | After setting the repeater mode by configuration, switch to the normal mode and the repeater starts working. |
| 2 | In the repeater mode, ADDH, ADDL are no longer used as the module address, but is correspondingly paired with the NETID. If the data of one of the networks is received, it is forwarded to another network. The network ID of the repeater itself is invalid. |
| 3 | In repeater mode, the repeater module cannot transmit and receive data, and cannot perform low-power operation. |
| 4 | The user enters the other mode from mode 3 (sleep mode) or during the reset process, the module resets the user parameters during which the AUX outputs low level. |

Repeater networking rules:

1. Forwarding rules, the repeater can forward data in both directions between two NETIDs.

2. In repeater mode, ADDH\ADDL is no longer used as the module address, and it is used as a NETID forwarding pairing flag.

Figure:

① Primary repeater

“Node 1” NETID is 08.

“Node 2” NETID is 33.

Primary repeater 1 ‘s ’ ADDH\ADDL are 08，33.

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So the signal sent by node 1 (08) can be forwarded to node 2 (33)

At the same time, node 1 and node 2 have the same address, so the data transmitted by node 1 can be received by node 2.

② Secondary repeater

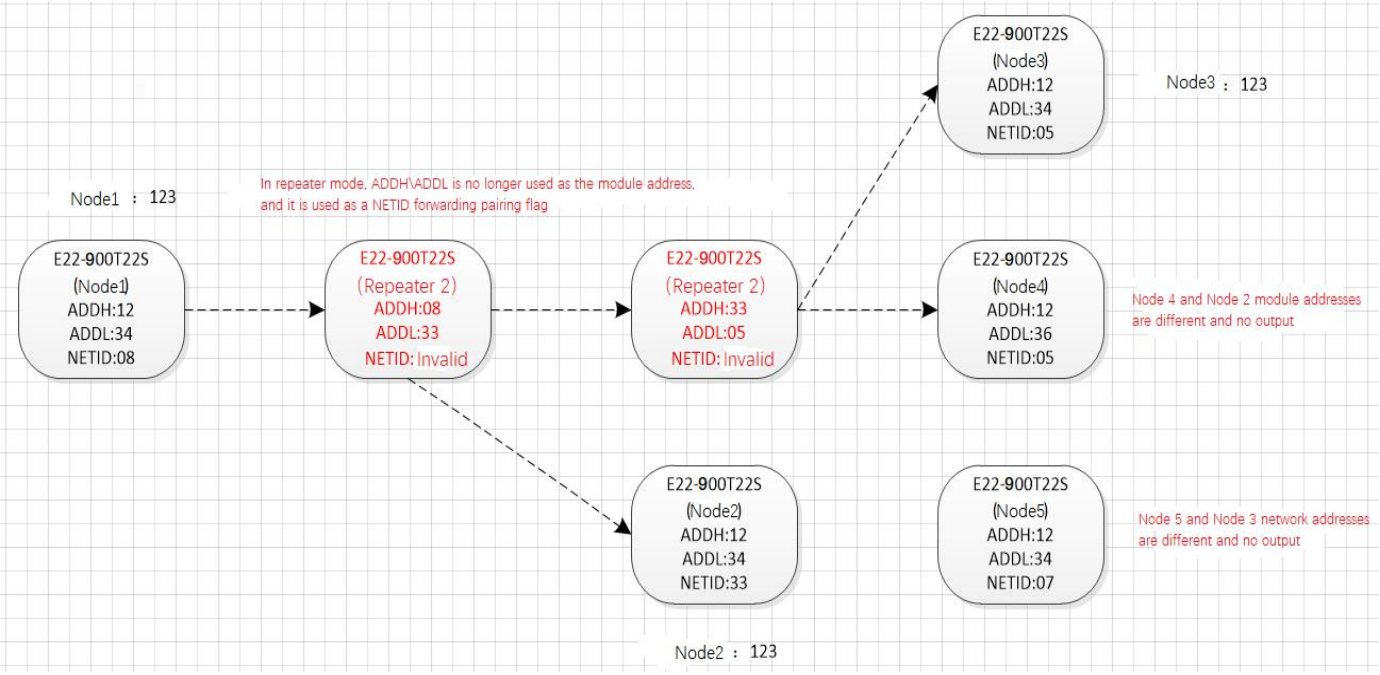
Secondary repeater' s ADDH\ADDL are 33, 05.

Therefore, Repeater 2 can forward the data of Repeater 1 to the network NETID: 05.

Thus node 3 and node 4 can receive node 1 data. Node 4 outputs data normally, and node 3 has a different address than node 1, so no data is output.

③ Two-way repeater

As shown in the figure: the data sent by node 1, the nodes 2, 4 can receive the data sent by node 2, 4, and node 1 can also receive it.




# 9 Configuration instructions on computer

- The following figure shows the E22-400T22S configuration host computer display interface, the user can switch to the command mode through M0M1, and quickly configure and read the parameters on computer.

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- 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: 0-83

  Network ID: 0-255

  Key: 0-65535

- When the user configures the repeater mode using the host computer, special attention must be paid. Since the parameters are in decimal mode in the host computer, the module address and network ID need to be converted into hexadecimal. For example, if the network ID input by the transmitting end A is 02, and the network ID input by the receiving end B is 10, when the repeater end R sets the module address, the hexadecimal value 0X020A is converted into the decimal value 522 as the repeater end R. Module address. That is, the module address value of the repeater terminal R is 522 at this time.

# 10 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. ;

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- 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.

# 11 FAQ

## 11.1 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.

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## 11.2 Module is easy to damage

- Please check the power supply source, ensure it is 2.1V~5.5V, Voltage over 5.5V will cause permanent damage to 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.

## 11.3 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;

# 12 Production guidance

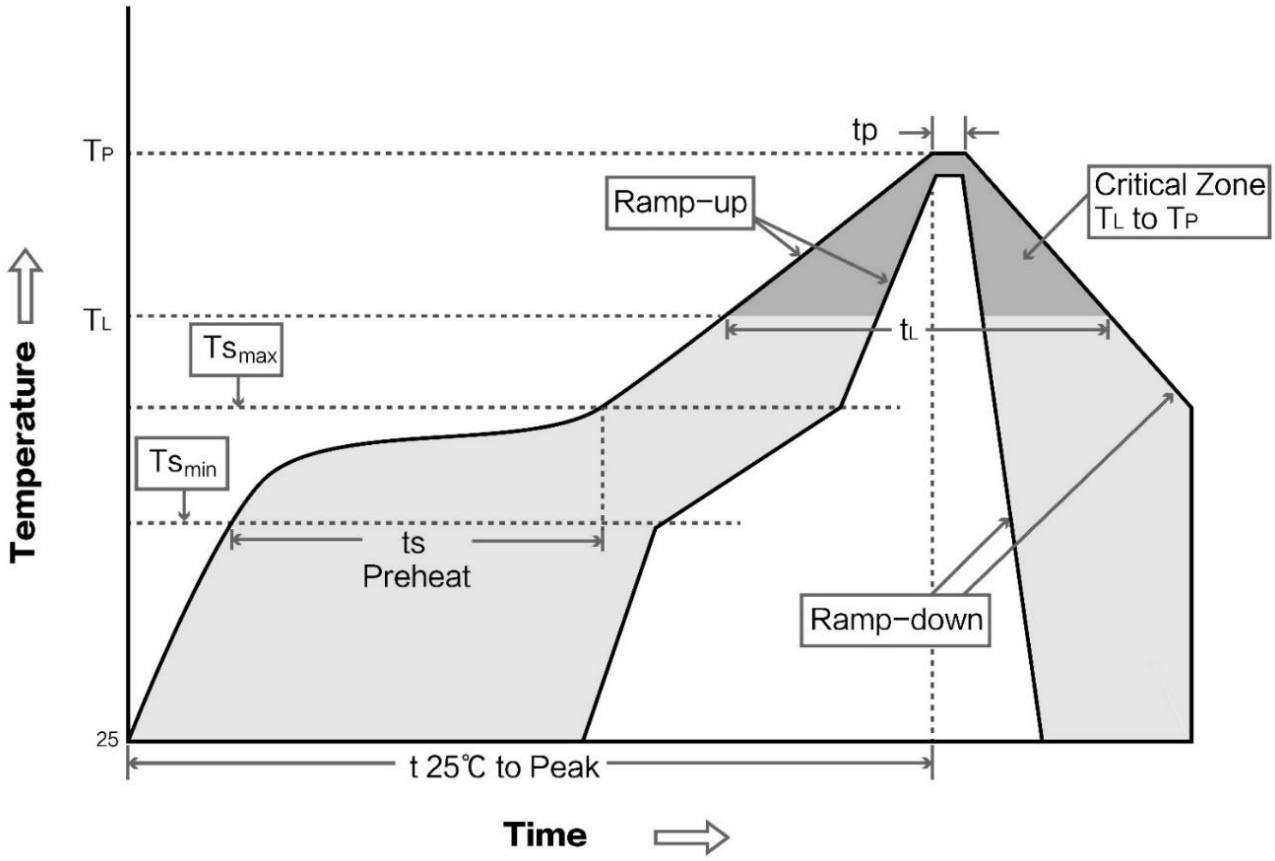
## 12.1 Reflow soldering temperature

| Profile Feature | Curve characteristics | Sn-Pb Assembly | Pb-Free Assembly |
|---|---|---|---|
| Solder Paste | Solder paste | Sn63/Pb37 | Sn96.5/Ag3/Cu0.5 |
| Preheat Temperature min （Tsmin） | Min preheating temp. | 100C° | 150C° |
| Preheat temperature max (Tsmax) | Mx preheating temp. | 150C° | 200C° |
| Preheat Time (Tsmin to Tsmax)(ts) | Preheating time | 60-120 sec | 60-120 sec |
| Average ramp-up rate(Tsmax to Tp) | Average ramp-up rate | 3C°/second max | 3C°/second max |
| Liquidous Temperature (TL) | Liquid phase temp. | 183C° | 217C° |
| Time（tL）Maintained Above（TL） | Time below liquid phase line | 60-90 sec | 30-90 sec |
| Peak temperature（Tp） | Peak temp. | 220-235C° | 230-250C° |
| Aveage ramp-down rate（Tp to Tsmax） | Aveage ramp-down rate | 6C°/second max | 6C°/second max |
| Time 25C° to peak temperature | Time to peak temperature for 25C° | max 6 minutes | max 8 minutes |

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## 12.2 Reflow soldering curve




# 13 E22 series

| Model No. | Core IC | Frequency Hz | Tx power dBm | Distance km | Package | Size mm | Interface |
|---|---|---|---|---|---|---|---|
| E22-900T22S | SX1262 | 868M 915M | 22 | 7 | SMD | 16*26 | UART |
| E22-230T22S | SX1262 | 230M | 22 | 7 | SMD | 16*26 | UART |
| E22-400T22S | SX1262 | 430M 470M | 22 | 7 | SMD | 16*26 | UART |
| E22-400M30S | SX1262 | 433M 470M | 30 | 12 | SMD | 24*38.5 | SPI |
| E22-900M30S | SX1262 | 868M 915M | 30 | 12 | SMD | 24*38.5 | SPI |
| E22-900M22S | SX1262 | 868M 915M | 22 | 6.5 | SMD | 14*20 | SPI |
| E22-400M22S | SX1262 | 433M 470M | 22 | 6.5 | SMD | 14*20 | SPI |
| E22-230T30S | SX1262 | 230M | 30 | 10 | SMD | 40.5*25 | UART |
| E22-400T30S | SX1262 | 430M 470M | 30 | 10 | SMD | 40.5*25 | UART |
| E22-900T30S | SX1262 | 868M 915M | 30 | 10 | SMD | 40.5*25 | UART |

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# 14 Antenna recommendation

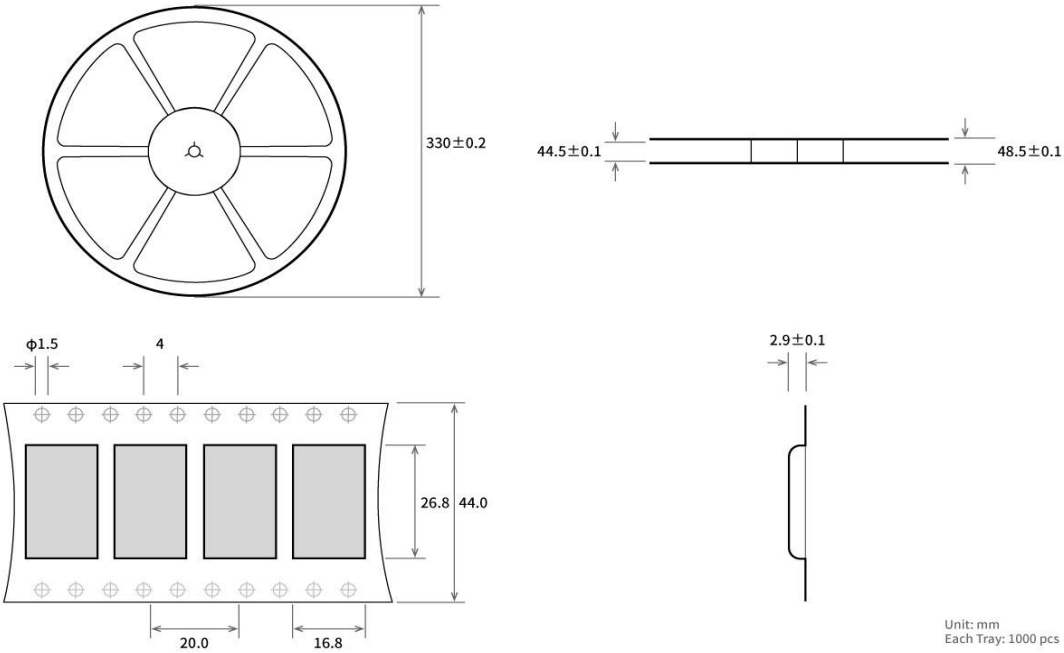
The antenna is an important role in the communication process. A good antenna can largely improve the communication system. Therefore, we recommend some antennas for wireless modules with excellent performance and reasonable price.

| Model No. | Type | Frequency Hz | Interface | Gain dBi | Height | Cable | Function feature |
|---|---|---|---|---|---|---|---|
| TX433-NP-4310 | Flexible pcb antenna | 433M | SMA-J | 2 | 43.8*9.5mm | - | Embedded FPC antenna |
| TX433-JW-5 | Rubber antenna | 433M | SMA-J | 2 | 50mm | - | Flexible &omnidirectional |
| TX433-JWG-7 | Rubber antenna | 433M | SMA-J | 2.5 | 75mm | - | Flexible &omnidirectional |
| TX433-JK-20 | Rubber antenna | 433M | SMA-J | 3 | 210mm | - | Flexible &omnidirectional |
| TX433-JK-11 | Rubber antenna | 433M | SMA-J | 2.5 | 110mm | - | Flexible &omnidirectional |
| TX433-XP-200 | Sucker antenna | 433M | SMA-J | 4 | 19cm | 200cm | Sucker antenna, high gain |
| TX433-XP-100 | Sucker antenna | 433M | SMA-J | 3.5 | 18.5cm | 100cm | Sucker antenna, high gain |
| TX433-XPH-300 | Sucker antenna | 433M | SMA-J | 6 | 96.5cm | 300cm | Car sucker antenna, ultra high gain |
| TX433-JZG-6 | Rubber antenna | 433M | SMA-J | 2.5 | 52mm | - | Short straight &omnidirectional |
| TX433-JZ-5 | Rubber antenna | 433M | SMA-J | 2 | 52mm | - | Short straight &omnidirectional |

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# 15 Package for batch order




# Revision history

| Version | Date | Description | Issued by |
|---|---|---|---|
| 1.00 | 2018-01-08 | Initial version | huaa |
| 1.10 | 2018-04-16 | Content updated | huaa |
| 1.20 | 2018-05-24 | Content updated | Huaa |
| 1.21 | 2018-07-20 | Model name revised | Huaa |
| 1.30 | 2018-10-23 | Model No. split | Huaa |
| 1.40 | 2019-04-01 | Content updated | Huaa |
| 1.50 | 2019-04-03 | Content updated | Huaa |
| 1.60 | 2020-04-15 | | du |
| 1.7 | 2020-04-30 | | du |
| 1.8 | 2020-11-26 | Error correction | Linson |

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