# E30-433T20S3 User Manual

## SI4438 433MHz 100mW SMD Wireless Module

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## CONTENTS

# 1. Overview

## 1.1 Introduction


E30-433T20S3 is a UART module based on Silicon Labs' SI4438. It features half-duplex with transparent transmission, SMD packing, TTL level output, WOR and 433MHz working frequency. This product has been mass-produced and can be used in a wide range of environments and industries.

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 function of data compression decreases the transmission time & probability of being interfered, while improving the reliability & transmission efficiency.

E30-433T20S3 series strictly stick to the design rules home and abroad of FCC, CE, CCC and meet the related RF certifications and export standards.

## 1.2 Features

- Communication distance tested is up to 2.5km
- Maximum transmission power of 100mW, software multi-level adjustable;
- Support the global license-free ISM 433MHz band;
- Support air date rate of 1kbps ~ 25kbps Mbps;
- Low power consumption for battery supplied applications;
- Support 2.3V~5.2V power supply, power supply over 3.3V 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

## 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;
- Intelligent agriculture &oil field solution;
- Health care products;
- Advanced Meter Reading Architecture(AMI);
- Automotive industry applications.

## 1.4 Function introduction

# 2. Specification and parameter

## 2.1 Limit parameter

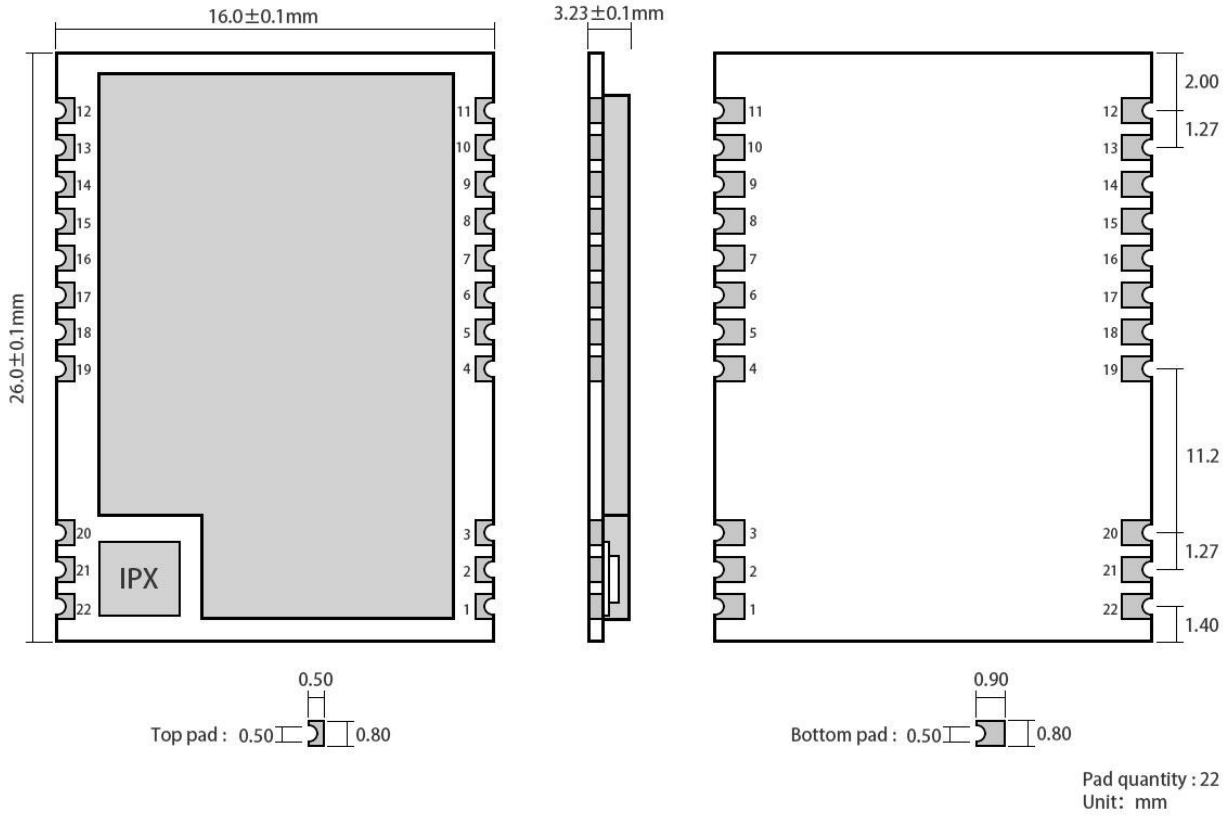
| Main parameter | Performance | | Remark |
|---|---|---|---|
| | Min. | Max. | |
| Power supply（V） | 0 | 5.2 | Voltage over 5.2V will cause permanent damage to module |
| Blocking power（dBm） | - | 10 | Chances of burn is slim when modules are used in short distance |
| Operating temperature（℃） | -40 | 85 | / |

## 2.2 Operating parameter

| Main parameter | | Performance | | | Remark |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Operating voltage（V） | | 2.3 | 5.0 | 5.2 | ≥5.0V 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） | | 425 | - | 450.5 | Support ISM band |
| Power consumption | TX current（mA） | | 88 | | Instant power consumption |
| | RX current（mA） | | 16 | | |
| | Sleep current （μA） | | 4 | | Software is shut down |
| Max Tx power（dBm） | | 19.3 | 20.0 | 20.6 | |
| Receiving sensitivity（dBm） | | -113 | -114 | -115 | Air data rate is 1.0 kbps |
| Air data rate（bps） | | 1k | 5k | 25k | 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: 2.4kbps |
| TX length | 58 Byte | The maximum capacity of a single package |
| Buffer | 512 Byte | |
| Modulation | GFSK | |
| Communication interface | TTL | |
| Package | SMD | |
| Connector | 1.27mm | |
| Size | 16 * 26 mm | |
| Antenna | IPEX/stamp hole | 50 ohm impedance |

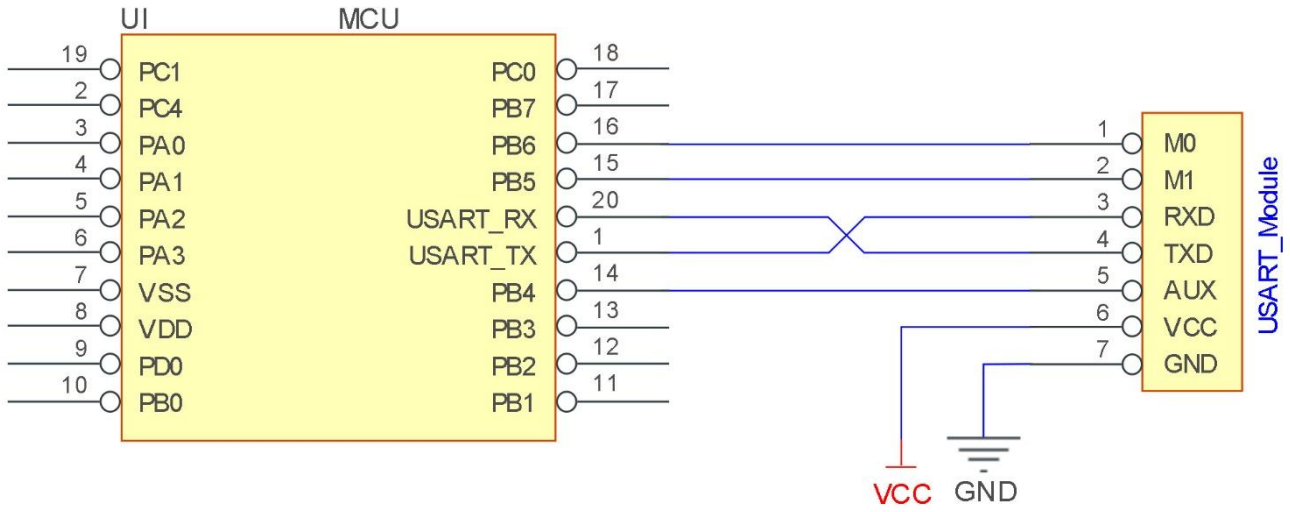
# 3. Size and pin definition




| 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 | NC | | |
| 13 | GND | | Ground |
| 14 | NC | | |
| 15 | NC | | |
| 16 | NC1 | | |
| 17 | NC2 | | |
| 18 | NC3 | | |
| 19 | GND | | Ground |
| 20 | GND | | Ground |
| 21 | ANT | | Antenna |
| 22 | GND | | Ground |

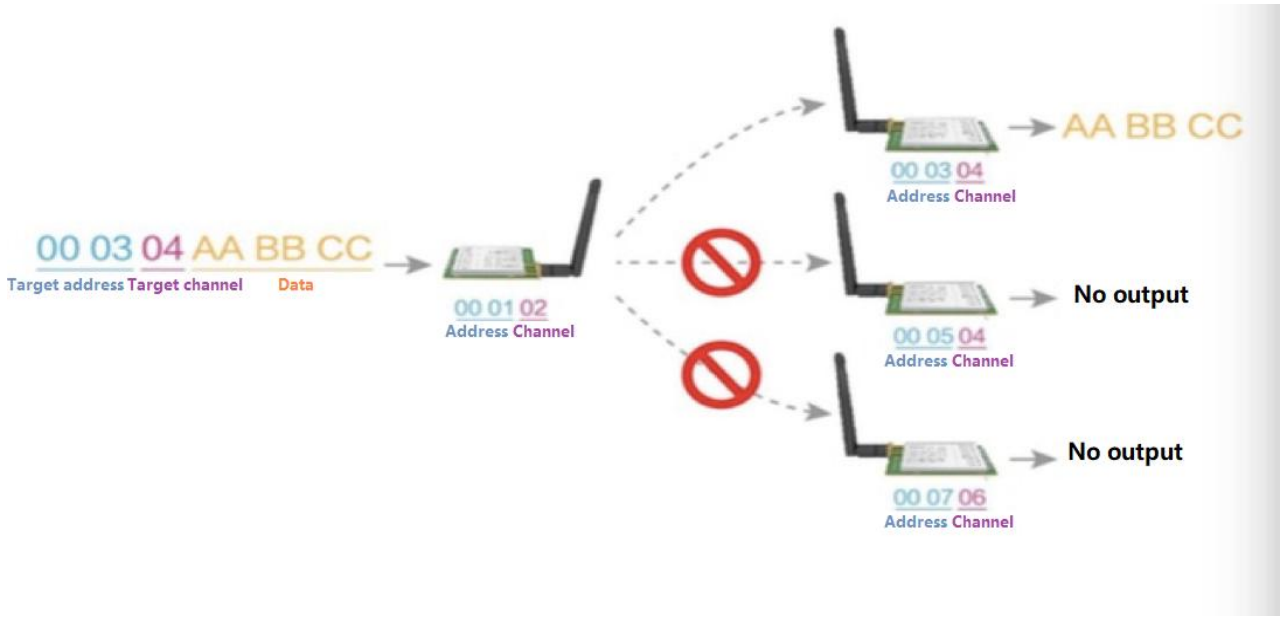
# 4. Connect to MCU



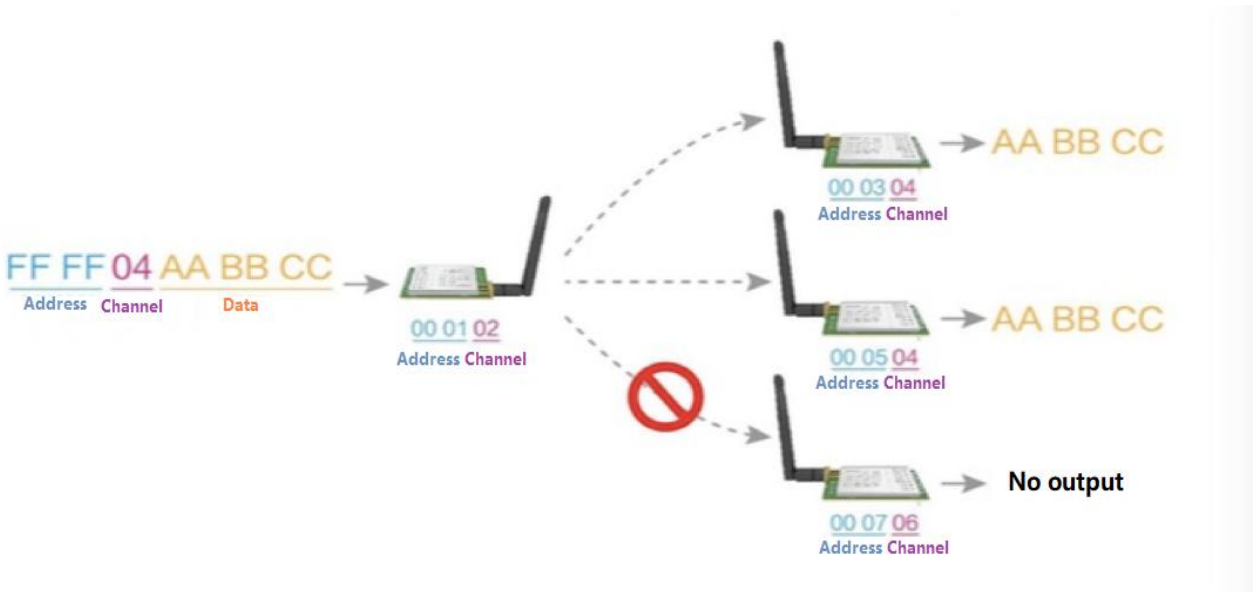

| No. | Description（STM8L MCU） |
|---|---|
| 1 | The UART module is TTL level. |
| 2 | For some MCU works at 5VDC, it may need to add 4-10K pull-up resistor for the TXD & AUX pin. |

# 5. Function description

## 5.1 Fixed transmission



## 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

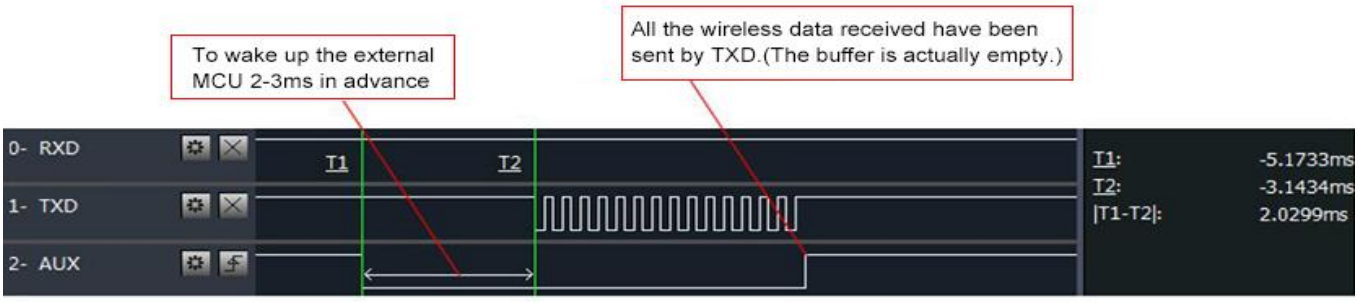
When the module is powered, AUX outputs low level immediately, conducts hardware self-check and sets the operating mode based on user's parameters. During the process, the AUX remains low level. After the process completed, the AUX outputs high level and starts to work as per the operating mode combined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

## 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

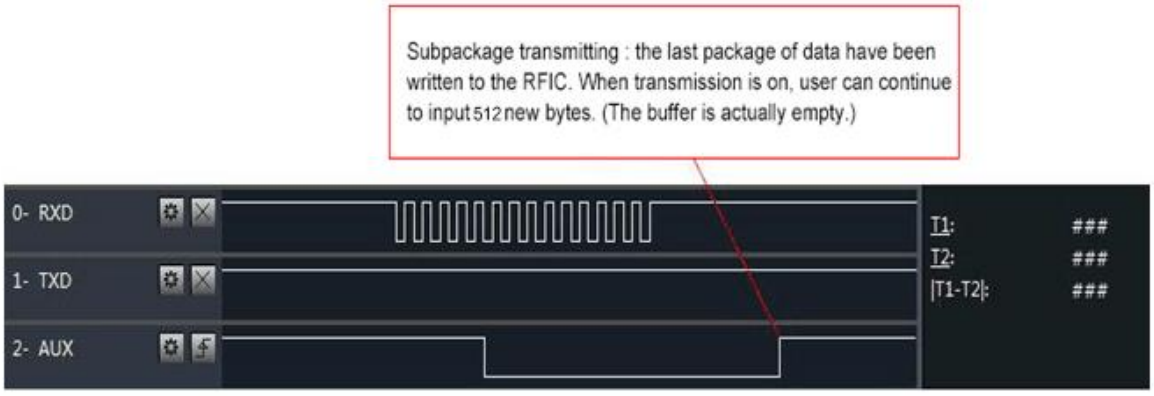
- To wake up external MCU




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

### 5.6.2 Indication of wireless transmitting

Buffer (empty): the internal 512 bytes data in the buffer are written to the RFIC (Auto sub-packaging). When AUX=1, the user can input data less than 512 bytes continuously without overflow. Buffer (not empty): when AUX=0, the internal 512 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**

### 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 | The receiver must work in mode 0 or mode 1 |
| 1 Wake-up | 0 | 1 | UART and wireless channel are open. The difference between normal mode and wake-up mode is that it will add preamble code automatically before data packet transmission so that it can awaken the receiver works in mode 2 | The receiver can work in mode 0, mode 1 or mode 2 |
| 2 Power-saving Mode | 1 | 0 | Users can access the register through the serial port to control the working state of the module | 1. The transmitter must work in mode 1<br>2. Transmitting is not allowed in this mode |
| 3 sleep mode | 1 | 1 | Parameter setting | More in working parameter |

## 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 | The module can receive the user data via serial port, and transmit wireless data package of 58 bytes. When the data inputted by user is up to 58 byte, the module will start wireless transmission. During which the user can input data continuously for transmission.<br>When the required transmission bytes are less than 58 bytes, the module will wait 3-byte time and treat it as data termination unless continuous data inputted by user. Then the module will transmit all the data through wireless channel.<br>When the module receives the first data packet from user, the AUX outputs low level.<br>After all the data are transmitted into RF chip and transmission start , AUX outputs high level.<br>At this time, it means that the last wireless data package transmission is started, which enables the user to input another 512 bytes continuously. The data package transmitted from the module working in mode 0 can only be received by the |

| | |
|---|---|
| | module working in mode 0 or 1. |
| Receiving | The wireless receiving function of the module is on, the data packet transmitted from the module working in mode 0 & mode 1 can be received.<br>After the data packet is received, the AUX outputs low level, 5ms later the module starts to transmit wireless data through serial port TXD pin.<br>After all the wireless data have been transmitted via serial port, the AUX outputs high level. |

## 6.3 Wake up mode（Mode 1）

| Type | M0 = 1，M1 =0 |
|---|---|
| Transmitting | The condition of data packet transmission & AUX function is the same as mode 0. The only difference is that the module will add preamble code before each data packet automatically. The preamble code length depends on the wake-up time set in the user parameters. The purpose of the preamble code is waking up the receiving module works in mode 2. Therefore, the data package transmitted from mode 1 can be received by mode 0, mode1 and mode 2. |
| Receiving | The same as that in mode 0. |

## 6.4 Power-saving mode（Mode 2）

| Type | M0 = 0，M1 = 1 |
|---|---|
| Transmitting | UART is closed, the module cannot receive any serial port data from outside MCU.<br>Hence the function of wireless transmission is not available for the module working in this mode.。 |
| Receiving | In mode 2, it is required the data transmitter works in mode 1.<br>The wireless module monitors the preamble code at regular time.<br>Once it gets the preamble code, it will remain as receiving status and waiting for the completion of receiving the entire valid data package.<br>Then the AUX outputs low level, 5ms later the serial port is open to transmit received wireless data through TXD. Finally, AUX outputs high level after process completed.<br>The wireless module stays in “power-saving – monitoring” working status (polling).<br>By setting different wake-up time, the module will have different receiving response delay (2s in maximum) and average power consumption (30uA in minimum). |

## 6.5 Deep sleep mode（Mode 3）

| Type | M0 = 1，M1 = 1 |
|---|---|
| Transmitting | Unable to transmit wireless data |
| Receiving | Unable to receive wireless data |
| Parameter setting | This mode can be used for parameter setting. It uses serial port 9600 & 8N1 to set module working parameters through specific instruction format. (please refer to parameters setting for details) |
| Note | When the mode changes from sleep mode to others, the module will reset its parameters, during which the AUX keeps low level and then outputs high level after reset completed. User is recommended to check the AUX rising edge. |

# 7. Register read and write control

## 7.1 Command format

In sleep mode (mode 3: M0 = 0, M1 = 1), the list of supported commands are as follows (only 9600, 8N1 format is supported when):

| No. | Instruction format | Illustration |
|---|---|---|
| 1 | C0+ working parameters | C0 + 5 bytes working parameters are sent in hexadecimal format. 6 bytes in total and must be sent in succession. ( Save the parameters when power-down ) |
| 2 | C1+C1+C1 | Three C1 are sent in hexadecimal format. The module returns the saved parameters and must be sent in succession. |
| 3 | C2+working parameters | C2 + 5 bytes working parameters are sent in hexadecimal format. 6 bytes in total and must be sent in succession. ( Do not save the parameters when power-down ) |
| 4 | C3+C3+C3 | Three C3 are sent in hexadecimal format. The module returns the version information and they must be sent in succession. |
| 5 | C4+C4+C4 | Three C4 are sent in hexadecimal format. The module will reset one time and they must be sent in succession. |

## 7.2 Factory default parameter

| | Factory default parameters：C0 00 00 18 50 44 | | | | | | |
|---|---|---|---|---|---|---|---|
| Model No. | Frequency | Address | Channel | Air data rate | Baud rate | Parity format | Power |
| E30-433T20S3 | 433MHz | 0x0000 | 0x50 | 1kbps | 9600 | 8N1 | 100mW |

## 7.3 Reading Operating Parameters

| Instruction format | Description |
|---|---|
| C1+C1+C1 | In sleep mode（M0=1，M1=1），<br>User gives the module instruction (HEX format): C1 C1 C1,<br>Module returns the present configuration parameters.<br>For example, C0 00 00 1A 17 44. |

## 7.4 Reading Version Number

| Instruction format | Description |
|---|---|

| | |
|---|---|
| C3+C3+C3 | In sleep mode（M0=1，M1=1），<br>User gives the module instruction (HEX format): C3 C3 C3,<br>Module returns its present version number, for example C3 30 xx yy;<br>The second byte represents the frequency,if it is 30,means 433MHz;if it is 50,means 170MHz; if it is 35,means 490MHz;if it is 54,means 780MHz;if it is 53,means 868MHz;if it is 36,means 915MHz;xx is the version number and yy refers to the other module features. |

## 7.5 Reset Instruction

| Instruction format | Description |
|---|---|
| C4+C4+C4 | In sleep mode（M0=1，M1=1），<br>User gives the module instruction (HEX format): C4 C4 C4, the module resets for one time. During the reset process, the module will conduct self-check, AUX outputs low level. After reset completing, the AUX outputs<br>high level, then the module starts to work regularly which the working mode can be switched or be given another instruction. |

## 7.6 Parameter Setting Instruction

| 0 | Item | Description | | | | Remark |
|---|---|---|---|---|---|---|
| 0 | HEAD | Fix 0xC0 or 0xC2, it means this frame data is control command | | | | Must be 0xC0 or 0xC2<br>C0: Save the parameters when power-down<br>C2: Do not save the parameters when power-down |
| 1 | ADDH | High address byte of module<br>（the default 00H） | | | | 00H-FFH |
| 2 | ADDL | Low address byte of module<br>（the default 00H） | | | | 00H-FFH |
| 3 | SPED | 7 | 6 | UART parity bit | | ● UART mode can be different between communication parties |
| | | 0 | 0 | 8N1（default） | | |
| | | 0 | 1 | 8O1 | | |
| | | 1 | 0 | 8 E1 | | |
| | | 1 | 1 | 8N1（equal to 0000） | | |
| | | 5 | 4 | 3 | TTL UART baud rate（bps） | ● UART mode can be different between communication parties<br>● The UART baud rate has nothing to do with wireless transmission parameters &won't affect the wireless transmit /receive features. |
| | | 0 | 0 | 0 | 1200bps | |
| | | 0 | 0 | 1 | 2400pbs | |
| | | 0 | 1 | 0 | 4800pbs | |
| | | 0 | 1 | 1 | 9600bps（default） | |
| | | 1 | 0 | 0 | 19200bps | |
| | | 1 | 0 | 1 | 38400bps | |
| | | 1 | 1 | 0 | 57600bps | |
| | | 1 | 1 | 1 | 115200bps | |
| | | 2 | 1 | 0 | Air data rate（bps） | ● The lower the air data rate, the longer |

<table>
<tr><td rowspan="9"></td><td rowspan="9"></td><td>0</td><td>0</td><td>0</td><td>1k bps</td><td rowspan="9">the transmitting distance, better anti-interference performance and longer transmitting time<br>● The air data rate must keep the same for both communication parties.</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>2kbps</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>5kbps（Default）</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>8kbps</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>10kbps</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>15kbps</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>20kbps</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>25kbps</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">CHAN</td><td colspan="4">Communication channel</td><td rowspan="2">00H-FFH， for 425 ~ 450.5MHz</td></tr>
<tr><td colspan="4">4 ~0， Communication frequency（425M + CHAN * 0.1M）, default 50H（433M）</td></tr>
<tr><td rowspan="19">5</td><td rowspan="19">OPTION</td><td>7</td><td colspan="4">Fixed transmission（similar to MODBUS）</td><td rowspan="3">● In fixed transmission mode, the first three bytes of each user's data frame can be used as high/low address and channel.<br>● The module changes its address and channel when transmit. And it will revert to original setting after complete the process.</td></tr>
<tr><td>0</td><td colspan="4">Transparent transmission mode</td></tr>
<tr><td>1</td><td colspan="4">Fixed transmission mode</td></tr>
<tr><td>6</td><td colspan="4">IO drive mode（the default 1）</td><td rowspan="3">● This bit is used to the module internal pull-up resistor. It also increases the level’s adaptability in case of open drain. But in some cases, it may need external pull-up resistor.</td></tr>
<tr><td>1</td><td colspan="4">TXD、AUX push-pull outputs, RXD pull-up inputs</td></tr>
<tr><td>0</td><td colspan="4">TXD、AUX open-collector outputs, RXD open-collector inputs</td></tr>
<tr><td>5</td><td>4</td><td>3</td><td>wireless wake-up time</td><td rowspan="11">● The transmit & receive module work in mode 0, whose delay time is invalid & can<br>be arbitrary value.<br>● The transmitter works in mode 1 can transmit the preamble code of the corresponding time continuously.<br>● When the receiver works in mode 2, the time means the monitor interval time(wireless wake-up). Only the data from transmitter that works in mode 1 can be received.</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>250ms（default）</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>500ms</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>750ms</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1000ms</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1250ms</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1500ms</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1750ms</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>2000ms</td></tr>
<tr><td>2</td><td colspan="4">FEC switch</td><td rowspan="3">● After turn off FEC, the actual data transmission rate increases while anti-interference ability decreases. Also the transmission distance is</td></tr>
<tr><td>0</td><td colspan="4">Turn off FEC</td></tr>
<tr><td>1</td><td colspan="4">Turn on FEC（Default）</td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>relatively short.<br>● Both communication parties must keep on the same pages about turn-on or turn-off FEC.</td></tr>
<tr><td></td><td></td><td>1</td><td>0</td><td>transmission power (approximation)</td><td rowspan="5">● The external power must make sure the ability of current output more than 250 mA and ensure the power supply ripple within 100mV.<br>● Low power transmission is not recommended due to its low power supply efficiency.</td></tr>
<tr><td></td><td></td><td>0</td><td>0</td><td>20dBm（Default）</td></tr>
<tr><td></td><td></td><td>0</td><td>1</td><td>17dBm</td></tr>
<tr><td></td><td></td><td>1</td><td>0</td><td>14dBm</td></tr>
<tr><td></td><td></td><td>1</td><td>1</td><td>10dBm</td></tr>
</table>

<table>
<tr><td colspan="9">For example: The meaning of No.3 "SPED" byte</td></tr>
<tr><td>The binary bit of the byte</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>The specific value<br>( configured by user)</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>Meaning</td><td colspan="2">UART parity bit<br>8N1</td><td colspan="3">UART baud rate is 9600</td><td colspan="3">Air data rate is 2.4k</td></tr>
<tr><td>Corresponding hexadecimal</td><td colspan="3">1</td><td colspan="5">A</td></tr>
</table>

# 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.

# 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 2.5V, 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 source, ensure it is 2.0V~3.6V, voltage higher than 3.6V 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.

## 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;

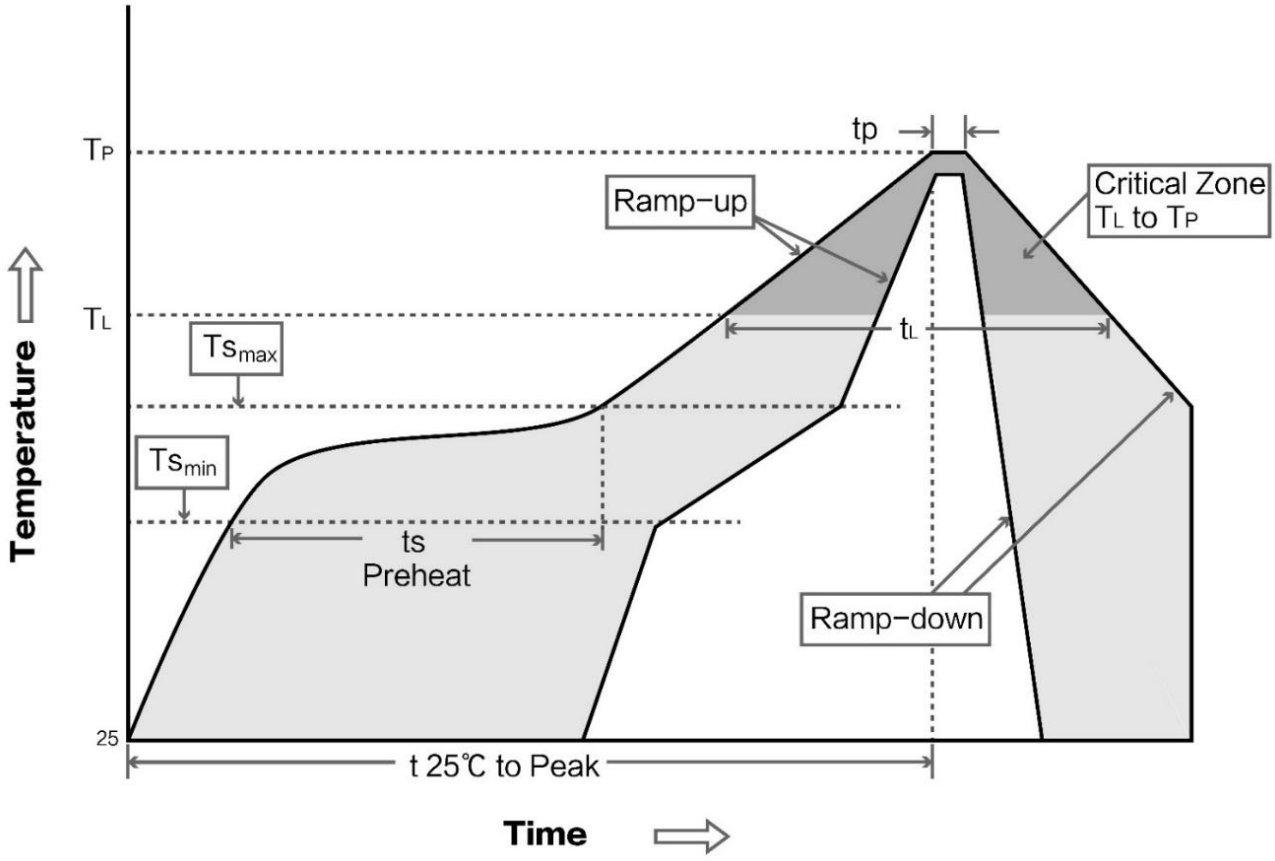
- Poor power supply may cause messy code. Make sure that the power supply is reliable.
- The extension line and feeder quality are poor or too long, so the bit error rate is high;

# 10. Production guidance

## 10.1 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. | 100℃ | 150℃ |
| Preheat temperature max (Tsmax) | Mx preheating temp. | 150℃ | 200℃ |
| 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 | 3℃/second max | 3℃/second max |
| Liquidous Temperature (TL) | Liquid phase temp. | 183℃ | 217℃ |
| Time（tL）Maintained Above（TL） | Time below liquid phase line | 60-90 sec | 30-90 sec |
| Peak temperature（Tp） | Peak temp. | 220-235℃ | 230-250℃ |
| Aveage ramp-down rate（Tp to Tsmax） | Aveage ramp-down rate | 6℃/second max | 6℃/second max |
| Time 25℃ to peak temperature | Time to peak temperature for 25℃ | max 6 minutes | max 8 minutes |

## 10.2 Reflow soldering curve



# 11. E30 series

| Model No. | Core IC | Frequency Hz | Tx power dBm | Distance km | Package | Size mm | Antenna |
|---|---|---|---|---|---|---|---|
| E30-433T20S3 | SI4438 | 433M | 20 | 2.5 | SMD | 16 * 26 | IPEX/Stamp hole |
| E30-780T20S | SI4463 | 780M | 20 | 2.5 | SMD | 17 * 30 | IPEX/Stamp hole/Spring antenna |
| E30-868T20D | SI4463 | 868M | 20 | 2.5 | DIP | 21 * 36 | SMA-K |
| E30-868T20S | SI4463 | 868M | 20 | 2.5 | SMD | 17 * 30 | IPEX/Stamp hole/Spring antenna |
| E30-170T27D | SI4463 | 170M | 27 | 5 | DIP | 24 * 43 | SMA-K |
| E30-170T20D | SI4463 | 170M | 20 | 2 | DIP | 21 * 36 | SMA-K |
| E30-915T20S | SI4463 | 915M | 20 | 2.5 | SMD | 17 * 30 | IPEX/Stamp hole/Spring antenna |
| E30-915T20D | SI4463 | 915M | 20 | 2.5 | DIP | 21 * 36 | SMA-K |
| E30-490T20S | SI4438 | 490M | 20 | 2.5 | SMD | 17 * 30 | IPEX/Stamp hole/Spring antenna |
| E30-490T20D | SI4438 | 490M | 20 | 2.5 | DIP | 21 * 36 | SMA-K |
| E30-433T20S | SI4438 | 433M | 20 | 2 | SMD | 17 * 30 | IPEX/Stamp hole/Spring antenna |
| E30-433T20D | SI4438 | 433M | 20 | 2 | SMD | 21 * 36 | SMA-K |

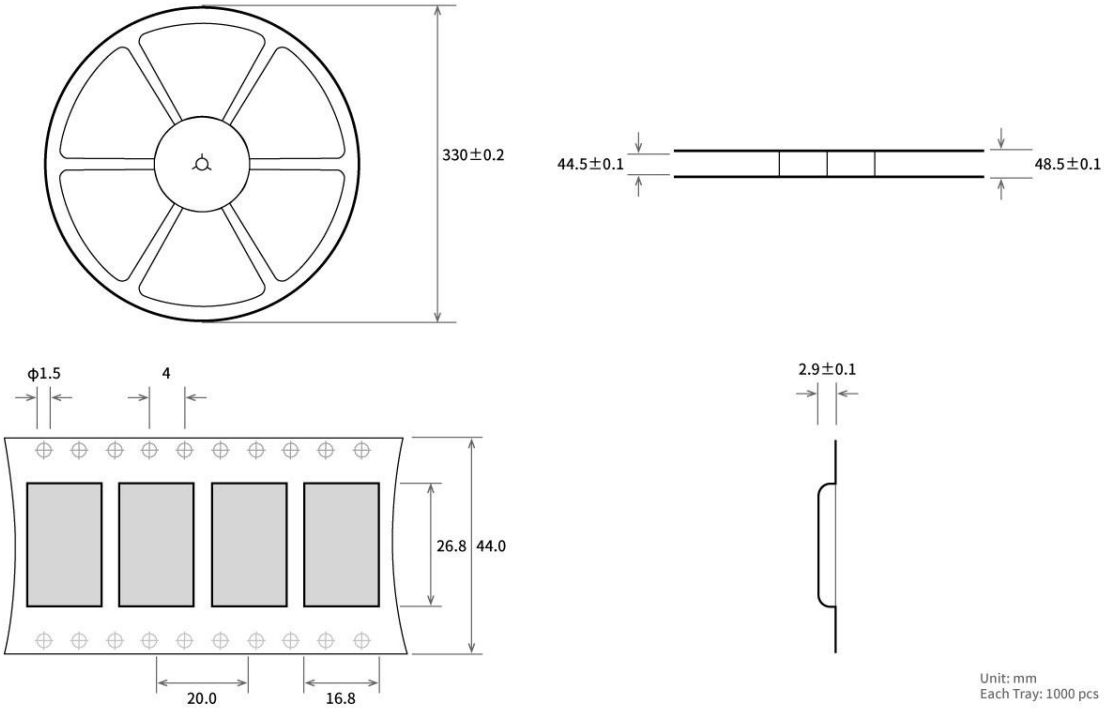
# 12. Antenna recommendation

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 | - | Flexible, FPC soft 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 | Flexible &omnidirectional |
| 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 | Sucker antenna, 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 |

# 13. Package for batch order




# 14.Revision history

| Version | Date | Description | Issued by |
|---|---|---|---|
| 1.00 | 2017-11-17 | Initial version | huaa |
| 1.20 | 2018-01-29 | Content updated | huaa |
| 1.30 | 2018-10-17 | Model No. split | huaa |
| 1.40 | 2020-03-05 | | Ren |
| 1.50 | 2020-7-9 | | Li |
| 1.60 | 2022-08-12 | Error correction | Bin |

# 15.About us

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