



# **E70-433T14S User Manuel**

**CC1310 433MHz SMD Wireless Module**



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# 1.Overview

## 1.1 Introduction

E70-433T14S wireless transceiver modules, operating at 425~450.5MHz (Default: 433MHz), is based on originally imported CC1310 from TI, with TTL level output, 3.3V IO port voltage,24MHz industrial high-precision low-temperature drift crystal vibration; Ensure its industrial ability and stability.

The module features FEC (Forward Error Correction) algorithm, which ensure its high coding efficiency & good correction performance. In the case of sudden interference, it can correct the interfered data packets proactively, so that the reliability & transmission range are improved correspondingly. But without FEC, those data packets can only be dropped.

Factory has built-in low power multifunctional wireless serial program, users can also according to the need for secondary development.



## 1.2 Features

- Communication distance tested is up to 1.5km
- Maximum transmission power of 25mW, software multi-level adjustable;
- Support the global license-free ISM 433MHz band;
- Support air data rate of 2.5kbps~168kbps;
- Low power consumption for battery supplied applications;
- Can achieve up to 115200bps continuous frame unlimited-packet length transmission
- Support 2.2V~3.8V 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 access point, stamp hole is optional, facilitate user secondary development, facilitate integration.
- Receiving current is only half that of similar products, which supports ultra-low power consumption in the air wake mode

## 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 |      | Remarks   |
|----------------------------|-------------|------|---|
|                            | Min.        | Max. |   |
| Power supply (V)           | 0           | 3.8  | Voltage over 3.8V 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   | -   |

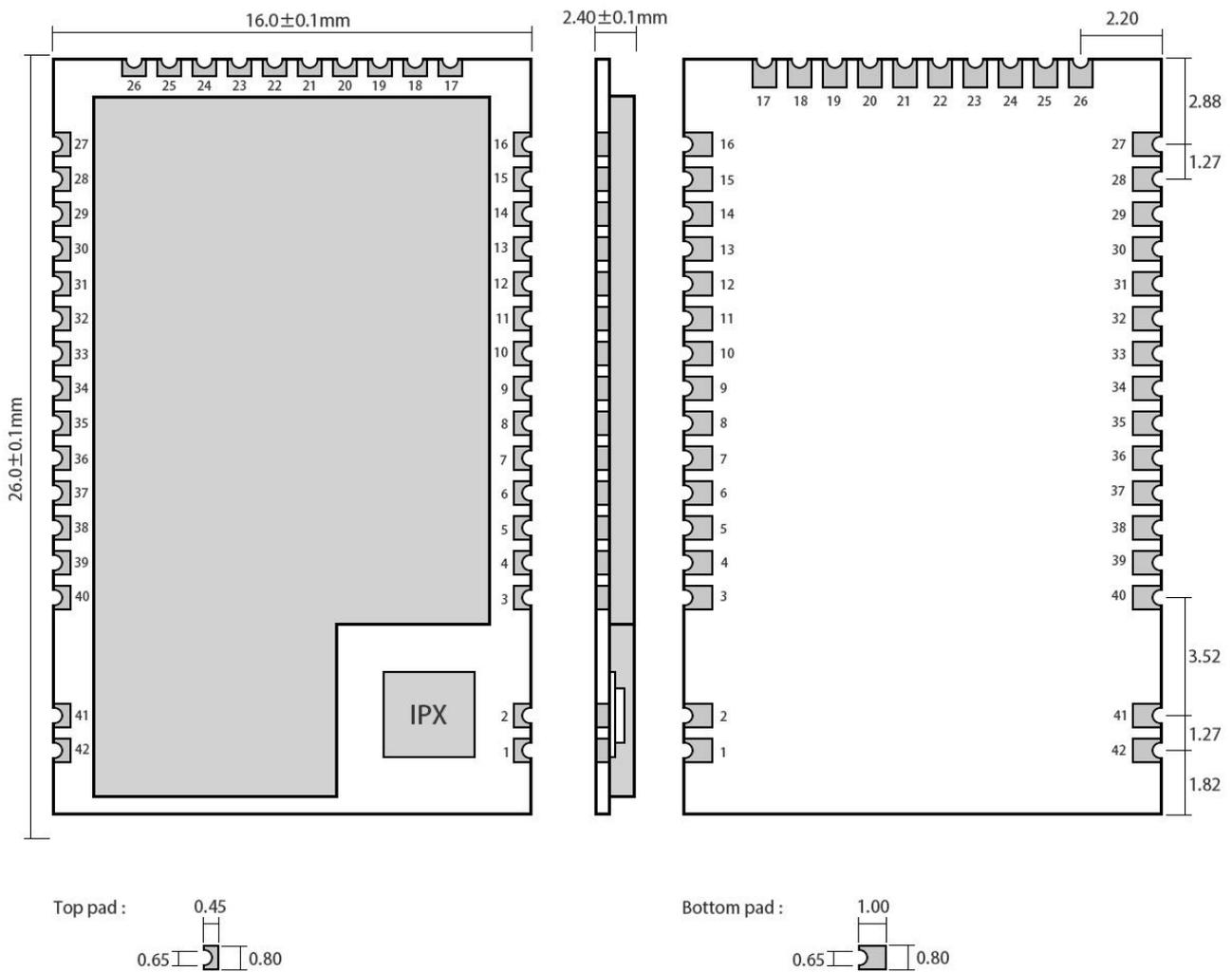
### 2.2 Operating parameter

| Main parameter              |                           | Performance |      |       | Remark  |
|-----------------------------|---------------------------|-------------|------|-------|---|
|                             |                           | Min         | Typ. | Max.  |   |
| Operating voltage (V)       |                           | 2.2         | 3.3  | 3.8   | ≥3.3 V ensures output power                   |
| Communication level (V)     |                           | -           | 3.3  | -     | For 5V TTL, it may be at risk of burning down |
| Operating temperature (°C)  |                           | -40         | -    | 85    | Industrial design                             |
| Operating frequency (MHz)   |                           | 425         | -    | 450.5 | Support ISM band                              |
| Power consumption           | Transmitting current [mA] | -           | 27   | -     | Instant power consumption                     |
|                             | Receiving current [mA]    | -           | 8    | -     | -   |
|                             | Turn-off current [μA]     | -           | 1    | -     | Software is shut down                         |
| Max Tx power (dBm)          |                           | 13.6        | 14.0 | 15.3  | -   |
| Receiving sensitivity (dBm) |                           | -109        | -110 | -111  | Air data rate is 5kbps                        |
| Air data rate (bps)         |                           | 2.5k        | 2.5k | 168k  | Controlled via user's programming             |

| Main parameter         | Description | Remark  |
|------------------------|-------------|---|
| Distance for reference | 1500m       | Test condition : clear and open area, antenna gain: 5dBi, |

|                         |                                 |  |
|-------------------------|---------------------------------|--|
|                         |                                 | antenna height: 2.5m, air data rate: 2.5kbps |
| TX length               | Transmission mode specification | See transmission mode for details            |
| Buffer                  | 2048Byte                        | A single packet may not exceed 128 bytes     |
| Modulation              | GFSK                            | -  |
| Communication interface | UART                            | -  |
| Package                 | SMD                             | -  |
| Connector               | 1.27mm                          | -  |
| Size                    | 16*26mm                         | -  |
| Antenna                 | IPX/Stamp hole                  | 50 ohm impedance                             |

### 3. Dimension/Pin definition



Pad quantity : 42  
Unit: mm

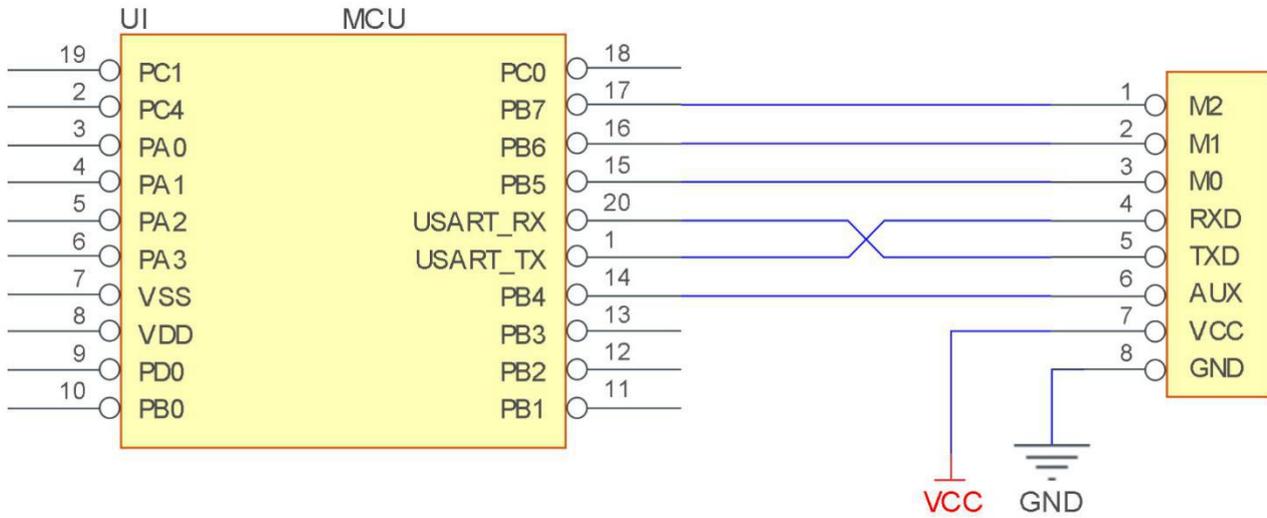
| No. | Pin item | Pin direction | Application   |
|-----|----------|---------------|---|
| 1   | GND      | Ground        | Ground electrode  |
| 2   | ANT      |               | Antenna (50Ω characteristic impedance)  |
| 3   | NC       | Reserved pin  | Reserved, to be floated   |
| 4   | NC       | Reserved pin  | Reserved, to be floated   |
| 5   | NC       | Reserved pin  | Reserved, to be floated   |
| 6   | LNA_EN   | Output        | Internal MCU controlled LNA pin, valid in high level, connect to pin 44   |
| 7   | PA_EN    | Output        | Internal MCU controlled PA pin, valid in high level, connect to pin 45  |
| 8   | NC       | Reserved pin  | Reserved, to be floated   |
| 9   | NC       | Reserved pin  | Reserved, to be floated   |
| 10  | NC       | Reserved pin  | Reserved, to be floated   |
| 11  | NC       | Reserved pin  | Reserved, to be floated   |
| 12  | NC       | Reserved pin  | Reserved, to be floated   |
| 13  | NC       | Reserved pin  | Reserved, to be floated   |
| 14  | NC       | Reserved pin  | Reserved, to be floated   |
| 5   | M2       | Input         | M2, M1, M0 jointly decide the 8 working modes;<br>An external 1k protective resistor shall be connected in series when in use.  |
| 16  | GND      | Ground        | Ground electrode  |
| 17  | M1       | Input         | M2, M1, M0 jointly decide the 8 working modes;<br>An external 1k protective resistor shall be connected in series and a 1M pull-up resistor shall be added when in use. (Cannot be floated, it can be grounded when not used)                               |
| 18  | M0       | Input         | M2, M1, M0 jointly decide the 8 working modes;<br>An external 1k protective resistor shall be connected in series and a 1M pull-up resistor shall be added when in use. (Cannot be floated, it can be grounded when not used)                               |
| 19  | RXD      | Input         | TTL serial port input connecting to external TXD pin. It can be configured as open-drain or high pull input, please refer to Parameter setting. An external 1k protective resistor shall be connected in series when in use                                 |
| 20  | TXD      | Output        | TTL serial port output connecting to external RXD input pin. It can be configured as open-drain or push-pull input, please refer to Parameter setting. An external 1k protective resistor shall be connected in series when in use.                         |
| 21  | TMSC     | Input         | JTAG TMSC   |
| 22  | TCKC     | Input         | JTAG TCKC   |
| 23  | NC       | Reserved pin  | Reserved, to be floated   |
| 24  | NC       | Reserved pin  | Reserved, to be floated   |
| 25  | AUX      | Output        | It is used to indicate the operation status of module, for user to wake up the external MCU, the module outputs low level during self-checking and initialization at power on, it can be configured as open-drain output or pull-up output, please refer to |

|    |       |              |   |
|----|-------|--------------|---|
|    |       |              | parameter setting par. An external 1k protective resistor shall be connected in series while using (can be floated) |
| 26 | VCC   |              | voltage: 2.1V ~ 3.8V DC   |
| 27 | GND   | Ground       | Ground electrode  |
| 28 | NC    | Reserved pin | Reserved, to be floated   |
| 29 | NC    | Reserved pin | Reserved, to be floated   |
| 30 | NC    | Reserved pin | Reserved, to be floated   |
| 31 | NC    | Reserved pin | Reserved, to be floated   |
| 32 | RESET | Input        | Reset pin   |
| 33 | NC    | Reserved pin | Reserved, to be floated   |
| 34 | NC    | Reserved pin | Reserved, to be floated   |
| 35 | NC    | Reserved pin | Reserved, to be floated   |
| 36 | NC    | Reserved pin | Reserved, to be floated   |
| 37 | NC    | Reserved pin | Reserved, to be floated   |
| 38 | NC    | Reserved pin | Reserved, to be floated   |
| 39 | NC    | Reserved pin | Reserved, to be floated   |
| 40 | NC    | Reserved pin | Reserved, to be floated   |
| 41 | GND   | Ground       | Ground electrode  |
| 42 | GND   | Ground       | Ground electrode  |

- This product can achieve Pin compatibility, Pin to Pin replacement
- The single-chip microcomputer control PA LNA truth value table is as follows:

|              | PA_EN | LNA_EN |
|--------------|-------|--------|
| Transmitting | 1     | 0      |
| Receiving    | 0     | 1      |
| Sleeping     | 0     | 0      |

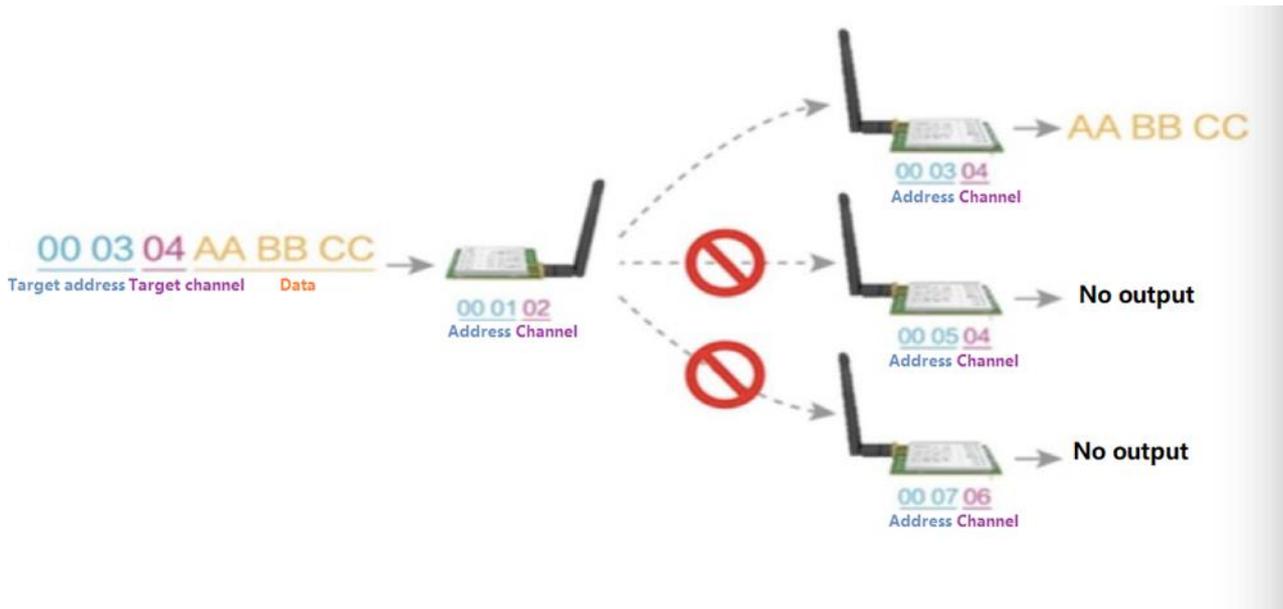
## 4 Connect to MCU



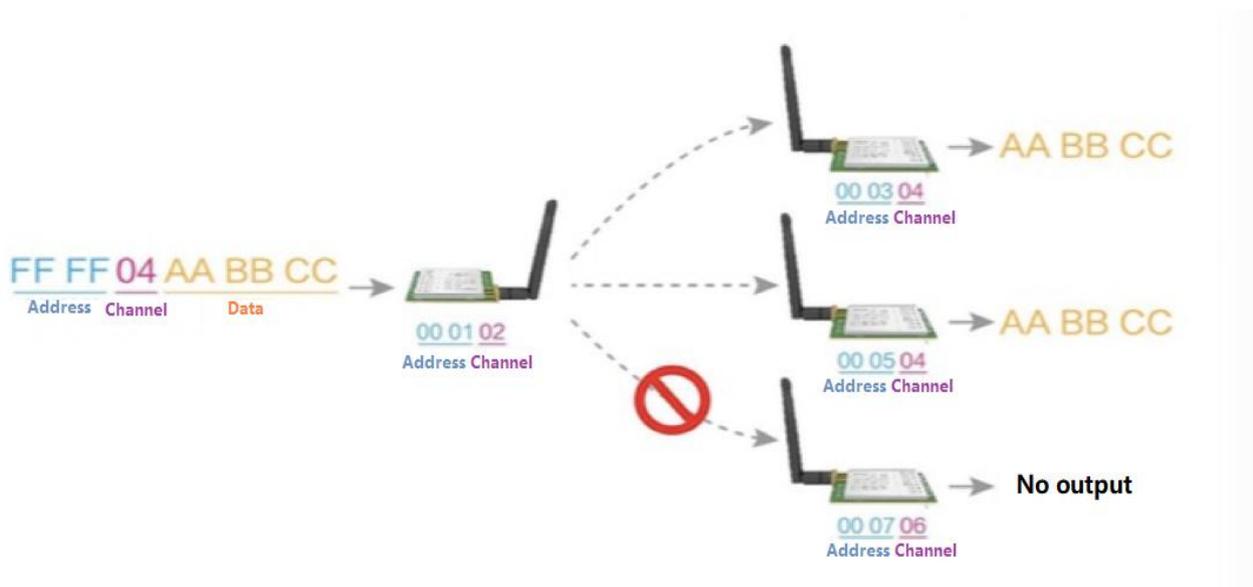
| No. | Description (STM8L MCU)  |
|-----|--|
| 1   | The UART module is TTL level., please collect with MCU.                                      |
| 2   | For some MCU works at 5VDC, it may need to add 4-10K pull-up resistor for the TXD & AUX pin. |

## 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

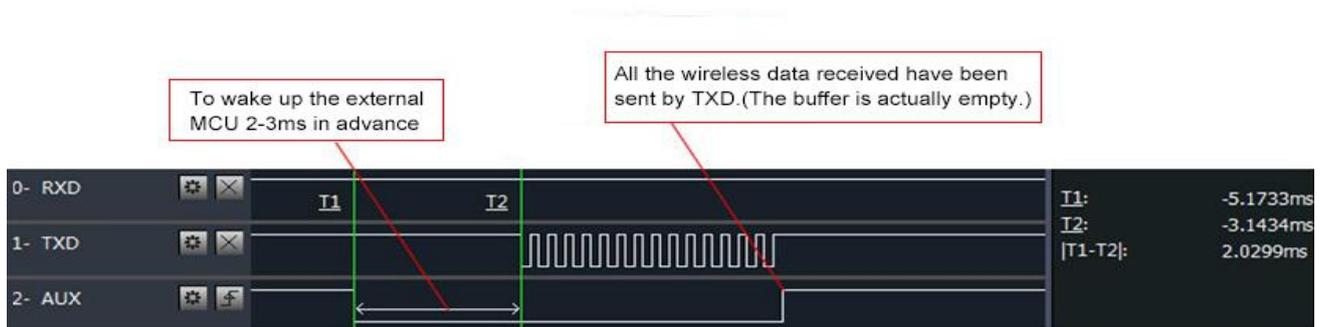
- When the module is powered, AUX outputs low level immediately, conducts hardware self-check and sets the operating mode based on user's parameters. During the process, the AUX remains low level. After the process completed, the AUX outputs high level and starts to work as per the operating mode combined 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

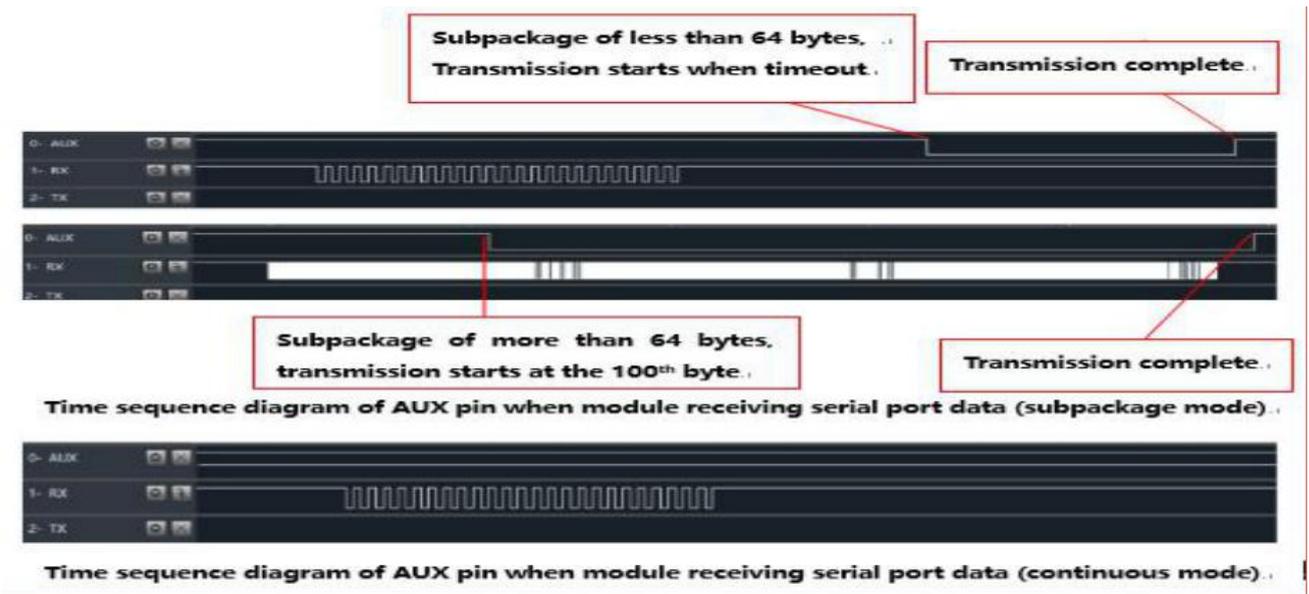
- To wake up external MCU



Timing Sequence Diagram of AUX when TXD pin transmits

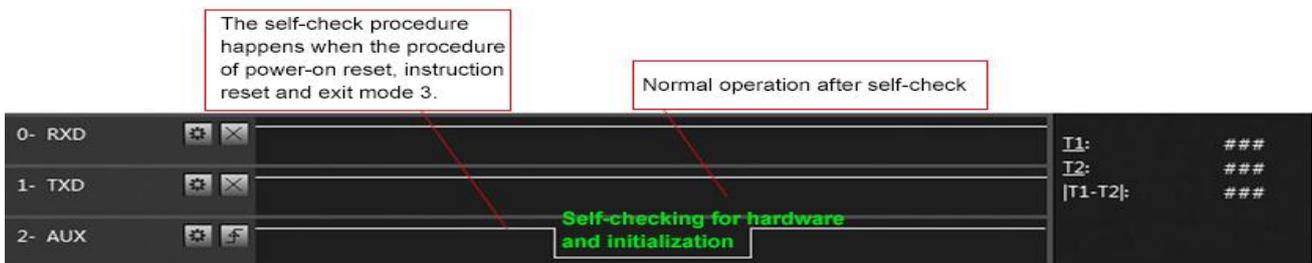
### 5.6.2 Indication of wireless transmitting

- Buffer (empty): the internal 1024 bytes data in the buffer are written to the RFIC (Auto sub-packaging).
- When AUX=1, the user can input data less than 1024 bytes continuously without overflow. Buffer (not empty): when AUX=0, the internal 1024 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.



### 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

## 6. Operating Mode

The table below shows the status of corresponding modes:

| Mode (0-7) | M2 | M1 | M0 | Mode introduction | Remark |
|------------|----|----|----|-------------------|--------|
|------------|----|----|----|-------------------|--------|

|  |   |   |   |   |  |
|--|---|---|---|---|--|
| 0 RSSI mode                              | 0 | 0 | 0 | UART opens. Wireless closes and transmission is unavailable.                                  | Module outputs RSSI value each 100ms through UART  |
| 1 Continuous mode                        | 0 | 0 | 1 | UART opens. Wireless closes and continuous transparent transmission is available.             | Air data rate can be adjusted automatically according to baud rate. The baud rate must be same on both receiver and transmitter. It is applicable for high speed continuous data transmission. |
| 2 Sub-package mode                       | 0 | 1 | 0 | UART opens. Wireless closes and sub-package transparent transmission is available.            | Air data rate and baud rate can be adjusted separately. It is applicable for data packet transmission.   |
| 3 Configuration mode                     | 0 | 1 | 1 | UART opens. Wireless closes and parameter can be configured.                                  | Baud rate is fixed as 9600 8N1.  |
| 4 WOR mode                               | 1 | 0 | 0 | UART opens. Wireless closes and sub package transparent transmission is available.            | Receiving is not available under this mode. Preamble code will be added proactively before transmission to wake up the receiver under mode 6.  |
| 5 Configuration mode<br>(Same as Mode 3) | 1 | 0 | 1 | -   | -  |
| 6 Power saving mode                      | 1 | 1 | 0 | UART closes. Wireless works at WOR power saving mode. Multiple time grades can be configured. | Transmission is not available under this mode. It can be woken up by transmitter under mode 4 to achieve low power consumption receiving.  |
| 7 Sleep mode                             | 1 | 1 | 1 | UART closes, wireless transmitting is available and sleep mode is on.                         | It can be woken up by any falling edge of M2, M1, M0.  |

## 6.1 Mode Switch

- The user can decide the operating mode by the combination of M0, M1 and M2. The two GPIOs of MCU can be used to switch mode. After modifying M0, M1 or M2, it will start to work in new mode 1ms later if the module is free. If there are any serial data that are yet to finish wireless transmitting, it will start to work in new mode after the UART transmitting finished. After the module receives the wireless data & transmits the data through serial port, it will start to work in new mode after the transmitting finished. Therefore, the mode-switch is only valid when AUX outputs 1, otherwise it will delay.
- For example, in mode 2 or mode 4, if the user inputs massive data consecutively and switches operating mode at the same time, the mode-switch operation is invalid. New mode checking can only be started after all the user's data process completed. It is recommended to check AUX pin out status and wait 2ms after AUX outputs high level before switching the mode.

- If the module switches from other modes to stand-by mode, it will work in stand-by mode only after all the remained data process completed. The feature can be used to save power consumption. For example, when the transmitter works in mode 0, after the external MCU transmits data “12345”, it can switch to sleep mode immediately without waiting the rising edge of the AUX pin, also the user’s main MCU will go dormancy immediately. Then the module will transmit all the data through wireless transmission & go dormancy 1ms later automatically, which reduces MCU working time & save power.
- Likewise, this feature can be used in any mode-switch. The module will start to work in new mode within 1ms after completing present mode task, which enables the user to omit the procedure of AUX inquiry and switch mode swiftly. For example, when switching from transmitting mode to receiving mode, the user MCU can go dormancy before mode-switch, using external interrupt function to get AUX change so that the mode-switch can be realized.
- This operation is very flexible and efficient. It is totally designed on the basis of the user MCU’s convenience, at the same time the work load and power consumption of the whole system has been reduced and the efficiency of whole system is largely improved.

## 6.2 RSSI Mode (Mode 0)

| Status                    | M0=1 M1=0 M2=0   |
|---------------------------|--|
| Transmitting              | Wireless data transmission is not available  |
| Receiving                 | Wireless data receiving is not available   |
| Baud rate & air data rate | Current baud rate  |
| Advantage                 | RSSI value of one byte output every 100ms can indicate the noise value of current environment. |
| Disadvantage              | Data transmission and receiving are not available  |
| Applications              | For monitoring environmental noise   |
| Note                      | -  |

## 6.3 Continuous Mode (Mode 1)

| Status                    | M0=1 M1=0 M2=0   |
|---------------------------|--|
| Transmitting              | Wireless data transmission is available.   |
| Receiving                 | Wireless data receiving is available.  |
| Baud rate & air data rate | Module will calculate the minimum air data rate according to the configured baud rate. Since the modules with different air data rate cannot communicate, the serial port parameters must be the same on both receiver and transmitter.  |
| Advantage                 | The data output on the receiver is continuous, it meets the requirements for MODBUS continuous transmission and low latency.   |
| Disadvantage              | The baud rates on both receiver and transmitter must be same. The module will raise its air data when the baud rate is raised, thus the receiving sensitivity will be lowered and operation range will be shorter.   |
| Applications              | Applicable for those applications not requiring distance but continuous data and response time.  |
| Note                      | 1. The “wireless air data rate” in the configuration commands is invalid (SPED.210 bits) and software will calculate automatically.<br>2. 0000 and FFFF are the broadcast addresses, which can be used to monitor and broadcast.<br>3. The addresses and baud rates must be same on both receiver and transmitter.<br>4. In continuous mode, both transmitter and receiver must be same model. For example, E70 (868T14S) and E70 (868T30S) cannot communicate in continuous mode. |

## 6.4 Sub-package Mode (Mode 2)

| Status                    | M0=0 M1=1 M2=0   |
|---------------------------|--|
| Transmitting              | Wireless data transmission is available.   |
| Receiving                 | Wireless data receiving is available.  |
| Baud rate & air data rate | Under this mode, the baud rate and air data rate are independent, both receiver and transmitter can have different baud rate but same air data rate.   |
| Advantage                 | Very low air data rate can be configured for longer distance, the data continuousness between output data depends on the data packet length.   |
| Disadvantage              | Since the air data rate is low and the receiver needs to wait for the data packet length or timeout byte numbers, it may cause some delay, which depends on the actual value as set.   |
| Applications              | Applicable for those applications requiring distance and continuous data while not requiring transmission speed.   |
| Note                      | 1. Air data rate and baud rate are not relative; the values are valid.<br>2. 0000 and FFFF are the broadcast addresses, which can be used to monitor and broadcast.<br>3. The addresses and air data rates must be same, but baud rates can be different on both receiver and transmitter.<br>4. The size of individual data packet depends on the subpackage size CHAN [7:5] (excluding address and channel for directional transmission) |

## 6.5 Configuration Mode (Mode 3)

| Status       | M0=1 M1=1 M2=0   |
|--------------|--|
| Transmitting | Transmission not available, serial data received will be discarded.  |
| Receiving    | Receiving is not available.  |
| Configuring  | Parameter configuration can be made in configuration mode with specific instruction format and UART 9600, 8N1.   |
| Note         | When entering other modes from configuration mode, the module will reconfigure parameters, AUX keeps low level during configuration;<br>After configuration completed, it outputs high level, so users are recommended to check the AUX rising edge. |

## 6.6 Wake-up Mode (Mode 4)

| Status                    | M0=0 M1=0 M2=1   |
|---------------------------|--|
| Transmitting              | Transmission is available.   |
| Receiving                 | Receiving is not available.  |
| Baud rate & air data rate | Under this mode, the baud rate and air data rate are independent, both receiver and transmitter can have different baud rate but same air data rate. |
| Advantage                 | It can wake up the receiver under mode 6; wake up code will be added automatically before transmitting, the code number depends on the wake up time. |
| Disadvantage              | The transmission time is long, only applicable to wake up the receiver, not applicable for common data transmission.                                 |
| Applications              | For waking up the receiver under WOR mode.   |
| Note                      | Under wake up mode, the single data packet length is 84 bytes (excluding the address and channel for directional transmission).                      |

## 6.7 Configuration Mode (Mode 5)

| Status        | M0=1 M1=0 M2=1   |
|---------------|--|
| Transmitting  | Transmission is not available. Serial data received are considered as configuration command.                   |
| Receiving     | Receiving is not available.  |
| Configuration | Parameter configuration can be made in configuration mode with specific instruction format and UART 9600, 8N1. |

|      |  |
|------|--|
| Note | When entering other modes from configuration mode, the module will reconfigure parameters, AUX keeps low level during configuration;<br>After configuration completed, it outputs high level, so users are recommended to check the AUX rising edge. |
|------|--|

## 6.8 Power Saving Mode (Mode 6)

| Status                    | M0=0 M1=1 M2=1   |
|---------------------------|--|
| Transmitting              | Transmission is not available.   |
| Receiving                 | Receiving is available.  |
| Baud rate & air data rate | Under this mode, the baud rate and air data rate are independent, both receiver and transmitter can have different baud rate but same air data rate.   |
| Advantage                 | The module works under WOR status, it wakes up periodically and monitors the wireless data packets, when data packet monitored, the module enters receiving mode and receives complete data packets, and outputs the data through serial port, and then enters WOR status again, which can save power consumption significantly. |
| Disadvantage              | Transmission is not available under this mode, the module must be switched to other mode for data transmission.  |
| Applications              | Applicable for those devices which have requirement on power consumption and need to receive data.   |
| Note                      | It can only receive the data sent from the transmitter under mode 4.   |

## 6.9 Sleep Mode (Mode 7)

| Status       | M0=1 M1=1 M2=1  |
|--------------|---|
| Transmitting | Transmitting is not available.  |
| Receiving    | Receiving is not available.   |
| Others       | Other functions of the module are closed, only can quit sleep mode by switching the M0, M1 and M2 status. |

## 7. Instruction Format

In configuration mode ( Mode 3 : M0=1, M1=1, M2=0 ) , it supports instructions below.

**(Only support 9600 and 8N1 format when setting)**

| 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.<br>( 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.  |

## 7.1 Default Parameter

| Default parameter values : C0 00 00 18 44 1C |           |         |         |               |           |        |                    |
|--|-----------|---------|---------|---------------|-----------|--------|--------------------|
| Model  | Frequency | Address | Channel | Air data rate | Baud rate | Parity | Transmitting power |
| E70 (433T14S)                                | 433MHz    | 0x0000  | 0x04    | 2.5K          | 9600      | 8N1    | 25mW               |

## 7.2 Reading Operating Parameters

| Instruction format | Description   |
|--------------------|---|
| C1+C1+C1           | In configuration mode ( M0=1, M1=1, M2=0 ),<br>User gives the module instruction (HEX format): C1 C1 C1,<br>Module returns the present configuration parameters.<br>For example, C0 00 00 18 4E 1C. |

## 7.3 Reading Version Number

| Instruction format | Description  |
|--------------------|--|
| C3+C3+C3           | In configuration mode ( M0=1, M1=1, M2=0 ),<br>User gives the module instruction (HEX format): C3 C3 C3,<br>Module returns its present version number, for example C3 0071 XX1 XX2 XX3 XX4 XX5.<br>70 here means the module model (E70 series); xx1 is the version number and XX2 XX3 XX4 XX5 refers to the other module features. |

## 7.4 Reset Instruction

| Instruction format | Description  |
|--------------------|--|
| C4+C4+C4           | In configuration mode ( M0=1, M1=1, M2=0 ),<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 completed, the AUX outputs high level, then the module starts to work regularly when the working mode can be switched or be given another instruction. |

## 7.5 Parameter Setting Instruction

| No. | Item | Description   |         |                   | Notes   |  |
|-----|------|---|---------|-------------------|---|--|
| 0   | HEAD | Fix 0xC0 or 0xC2, it means this frame data is control command |         |                   | <ul style="list-style-type: none"> <li>● Must be 0xC0 or 0xC2</li> <li>● C0: Save the parameters when power-down</li> <li>● C2: Do not save the parameters when power-down</li> </ul> |  |
| 1   | ADDH | High address byte of module (the default 00H)                 |         |                   | ● 00H-FFH   |  |
| 2   | ADDL | Low address byte of module (the default 00H)                  |         |                   | ● 00H-FFH   |  |
| 3   | SPED | 7   | 6       | UART parity bit   | ● UART mode can be different between communication parties  |  |
|     |      | 0   | 0       | 8N1 (Default )    |   |  |
|     |      | 0   | 1       | 8O1               |   |  |
|     |      | 1   | 0       | 8E1               |   |  |
|     |      | 1   | 1       | 8N1 (equal to 00) |   |  |
|     |      | 5   | 4       | 3                 | TTL UART baud rate (bps)  | <ul style="list-style-type: none"> <li>● UART baud rate can be different between communication parties</li> <li>● The UART baud rate has nothing to do with wireless transmission parameters &amp; won't affect the wireless transmit / receive features.</li> </ul>     |
|     |      | 0   | 0       | 0                 | 1200bps   |  |
|     |      | 0   | 0       | 1                 | 2400bps   |  |
|     |      | 0   | 1       | 0                 | 4800bps   |  |
|     |      | 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)   | <ul style="list-style-type: none"> <li>● The lower the air data rate, the longer the transmitting distance, better anti-interference performance and longer transmitting time</li> <li>● The air data rate must keep the same for both communication parties.</li> </ul> |
|     |      | 0   | 0       | 0                 | 2.5kbps   |  |
|     |      | 0   | 0       | 1                 | 5kbps   |  |
|     |      | 0   | 1       | 0                 | 12kbps (Default)  |  |
|     |      | 0   | 1       | 1                 | 28kbps  |  |
|     |      | 1   | 0       | 0                 | 64kbps  |  |
| 1   | 0    | 1   | 168kbps |                   |   |  |
| 1   | 1    | 0   | 168kbps |                   |   |  |
| 1   | 1    | 1   | 168kbps |                   |   |  |
| 4   | CHAN | 7   | 6       | 5                 | Packet length (only for sub-package mode)   | ● Under continuous transmitting mode (M0=1 M1=0 M2=0), this parameter is invalid   |
|     |      | 0   | 0       | 0                 | 16 bytes  |  |
|     |      | 0   | 0       | 1                 | 32 bytes  |  |
|     |      | 0   | 1       | 0                 | 64 bytes (Default)  |  |
|     |      | 0   | 1       | 1                 | 128 bytes   |  |
|     |      | 1   | 0       | 0                 | 256 bytes   |  |
|     |      | 1   | 0       | 1                 | 512 bytes   |  |
|     |      | 1   | 1       | 0                 | 1024 bytes  |  |
|     |      | 1   | 1       | 1                 | 2048 bytes  |  |
|     |      | Communication Channel   |         |                   |   |  |

|   |        |   |   |                        |  |  |  |   |   |
|---|--------|---|---|------------------------|--|--|--|---|---|
|   |        | 00H~1FH, 425~450.5MHz, (Default) 04H (433M) |   |                        |  |  |  |   |   |
| 5   | OPTION | 7   | Fixed transmission (similar to MODBUS)                    |                        | <ul style="list-style-type: none"> <li>When it is 1, the first three bytes of each user data frame can be used as high/low address and channel. The module changes its address and channel when transmitting. And it will revert to original setting after the process is completed.</li> <li>It is transparent transmission under continuous mode.</li> </ul> |  |  |   |   |
|   |        | 0   | Transparent transmission mode (Default)                   |                        |  |  |  |   |   |
|   |        | 1   | Fixed transmission mode                                   |                        |  |  |  |   |   |
|   |        | 6   | 5   | 4                      | wireless wake-up time  | <ul style="list-style-type: none"> <li>This parameter is only valid for mode 4, 6.</li> <li>For mode 6, the wake-up time will affect the WOR cycle of the module, and affect the power consumption.</li> <li>For mode 4, the wake-up time decides the number of wake-up code before transmission so as to ensure the wake up the module in mode 6.</li> <li>Generally, mode 4 and 6 shall be used jointly and the wake-up time on both modules shall be the same.</li> </ul> |  |   |   |
|   |        | 0   | 0   | 0                      | 500ms  |  |  |   |   |
|   |        | 0   | 0   | 1                      | 1000ms(Default)  |  |  |   |   |
|   |        | 0   | 1   | 0                      | 1500ms   |  |  |   |   |
|   |        | 0   | 1   | 1                      | 2000ms   |  |  |   |   |
|   |        | 1   | 0   | 0                      | 2500ms   |  |  |   |   |
|   |        | 1   | 0   | 1                      | 3000ms   |  |  |   |   |
|   |        | 1   | 1   | 0                      | 3500ms   |  |  |   |   |
|   |        | 1   | 1   | 1                      | 4000ms   |  |  |   |   |
|   |        | 3   | FEC switch  |                        |  |  | <ul style="list-style-type: none"> <li>After turn off FEC, the actual data transmission rate increases while anti-interference ability decreases. Also, the transmission distance is relatively short.</li> <li>Both communication parties must keep on the same pages about turn-on or turn-off FEC.</li> </ul> |   |   |
|   |        | 0   | Turn off FEC  |                        |  |  |  |   |   |
|   |        | 1   | Turn on FEC (Default))                                    |                        |  |  |  |   |   |
|   |        | 2   | IO drive mode   |                        |  | <ul style="list-style-type: none"> <li>This bit is used to the 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.</li> </ul>   |  |   |   |
|   |        | 0   | TXD and AUX push-pull outputs, RXD pull-up inputs         |                        |  |  |  |   |   |
|   |        | 1   | TXD、AUX open-collector outputs, RXD open-collector inputs |                        |  | <ul style="list-style-type: none"> <li>The external power must ensure that the ability of current output is more than 80mA and the power supply ripple is within 100mV.</li> <li>Low power transmission is not recommended due to its low power supply efficiency.</li> </ul>  |  |   |   |
| 1   | 0      | transmission power (approximation)          |   |                        |  |  |  |   |   |
| 0   | 0      | 14dBm (Default)                             |   |                        |  |  |  |   |   |
| 0   | 1      | 10dBm                                       |   |                        |  |  |  |   |   |
| 1   | 0      | 7dBm  |   |                        |  |  |  |   |   |
| 1   | 1      | 4dBm  |   |                        |  |  |  |   |   |
| <b>For example: The meaning of No.3 "SPED" byte :</b> |        |   |   |                        |  |  |  |   |   |
| The binary bit of the byte                            |        | 7   | 6   | 5                      | 4  | 3  | 2  | 1 | 0 |
| The specific value (configured by user)               |        | 0   | 0   | 0                      | 1  | 1  | 0  | 1 | 0 |
| Meaning   |        | UART parity bit 8N1                         |   | UART baud rate is 9600 | Air data rate is 2.4k  |  |  |   |   |
| Corresponding hexadecimal                             |        | 1   |   | A                      |  |  |  |   |   |

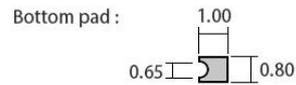
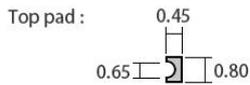
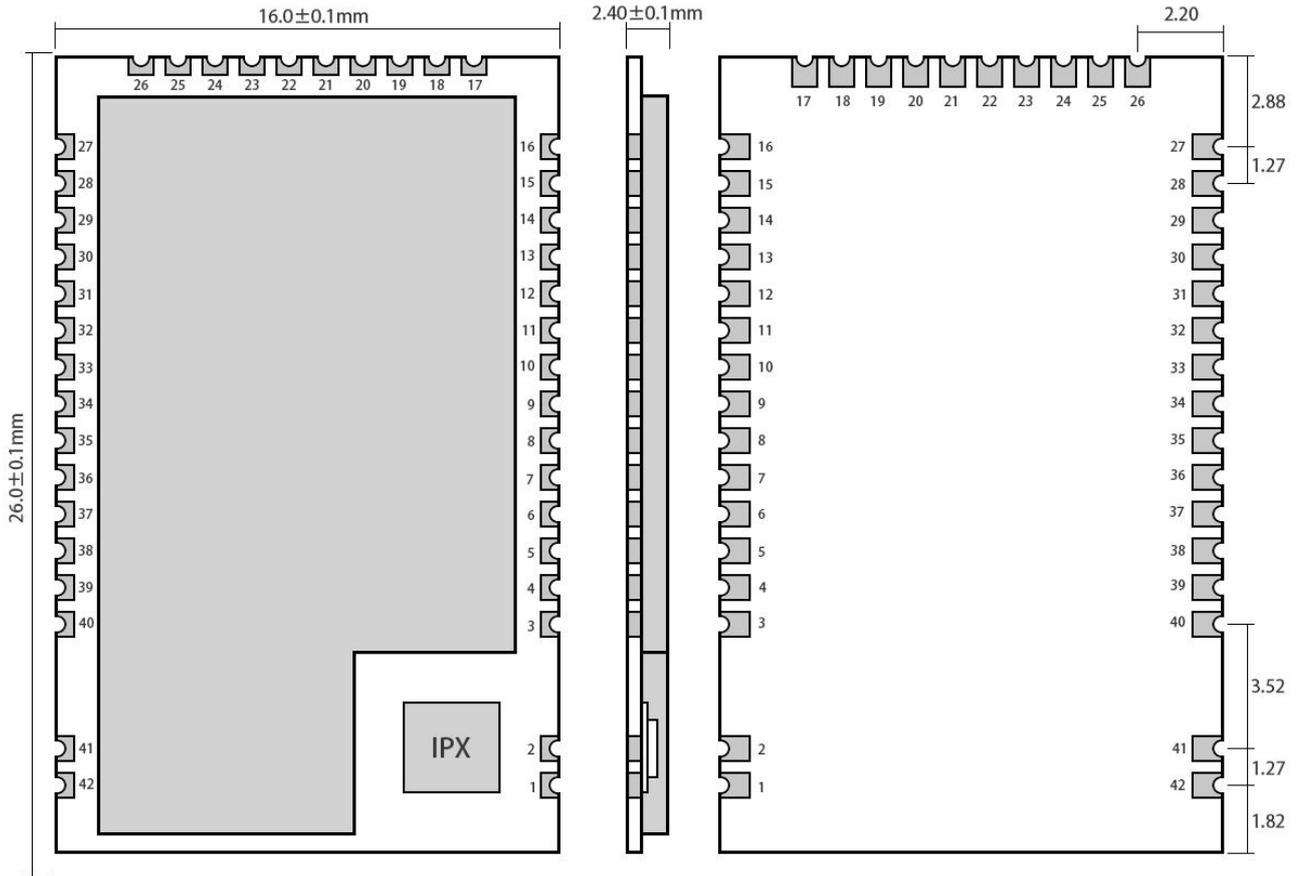
## 8.Parameter Setting

When the module is in Mode 3 (M0=1 M1=1 M2=0) or Mode 5 (M0=1 M1=0 M2=1), the parameter can be set by instruction or software in PC. Please visit [www.cdebyte.com](http://www.cdebyte.com) to download the software.



## 9.Secondary Development

- E70 series have built-in CC1310 SoC chip. Users can conduct the development according to pin description below. Meanwhile, Ebyte can develop the customized software for customers. Please contact us for more details.

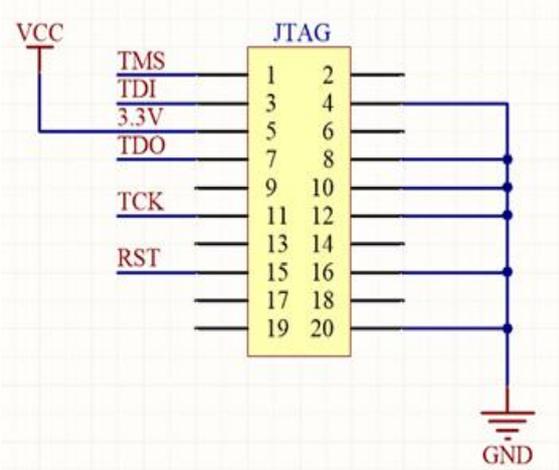


Pad quantity : 42  
Unit: mm

| Pin No.            | Pin item | Pin direction    | Pin application                              |
|--------------------|----------|------------------|--|
| 1、16、27、<br>41、 42 | GND      | Reference ground | Ground electrode                             |
| 2                  | ANT      | -                | Antenna (50Ω characteristic impedance)       |
| 3                  | X32K_Q1  | Input/Output     | Connect to 32.768K quartz crystal with pin 4 |
| 4                  | X32K_Q2  | Input/Output     | Connect to 32.768K quartz crystal with pin 3 |
| 5                  | DIO_1    | Input/Output     | MCU GPIO                                     |
| 6                  | DIO_2    | Input/Output     | MCU GPIO                                     |
| 7                  | DIO_3    | Input/Output     | MCU GPIO                                     |
| 8                  | DIO_4    | Input/Output     | MCU GPIO                                     |

|    |        |              |  |
|----|--------|--------------|--|
| 9  | DIO_5  | Input/Output | MCU GPIO   |
| 10 | DIO_6  | Input/Output | MCU GPIO   |
| 11 | DIO_7  | Input/Output | MCU GPIO   |
| 12 | DIO_8  | Input/Output | MCU GPIO   |
| 13 | DIO_9  | Input/Output | MCU GPIO   |
| 14 | DIO_10 | Input/Output | MCU GPIO   |
| 15 | DIO_11 | Input/Output | MCU GPIO   |
| 17 | DIO_12 | Input/Output | MCU GPIO   |
| 18 | DIO_13 | Input/Output | MCU GPIO   |
| 19 | DIO_14 | Input/Output | MCU GPIO   |
| 20 | DIO_15 | Input/Output | MCU GPIO   |
| 21 | TMSC   | Input        | JTAG TMSC  |
| 22 | TCKC   | Input        | JTAG TCKC  |
| 23 | DIO_16 | Input/Output | MCU GPIO   |
| 24 | DIO_17 | Input/Output | MCU GPIO   |
| 25 | DIO_18 | Input/Output | MCU GPIO   |
| 26 | VCC    | -            | Positive power reference, voltage range : 2.2V ~ 3.8V DC |
| 28 | DIO_19 | Input/Output | MCU GPIO   |
| 29 | DIO_20 | Input/Output | MCU GPIO   |
| 30 | DIO_21 | Input/Output | MCU GPIO   |
| 31 | DIO_22 | Input/Output | MCU GPIO   |
| 32 | RESET  | Input        | Reset pin  |
| 33 | DIO_23 | Input/Output | MCU GPIO   |
| 34 | DIO_24 | Input/Output | MCU GPIO   |
| 35 | DIO_25 | Input/Output | MCU GPIO   |
| 36 | DIO_26 | Input/Output | MCU GPIO   |
| 37 | DIO_27 | Input/Output | MCU GPIO   |
| 38 | DIO_28 | Input/Output | MCU GPIO   |
| 39 | DIO_29 | Input/Output | MCU GPIO   |
| 40 | DIO_30 | Input/Output | MCU GPIO   |

## 9.1 Download Program

| Key word      | Notes   |
|---------------|---|
| Input program | <p>The module is SOC with GPIO port. For program downloading, please use the special downloader of CC series: JTAG (or the original CC1310 board from TI), any other serial port or ISP, ICP are unavailable to download. Below is the connection diagram of JTAG ( XDS100 ) . See more details in TI official document. ( TDI and TDO pin can be unconnected )</p>  <p style="text-align: center;">Connection diagram of JTAG downloader</p> |

## 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. ;
- 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.

### 11.2 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.

## 11.3 BER(Bit Error Rate) is high

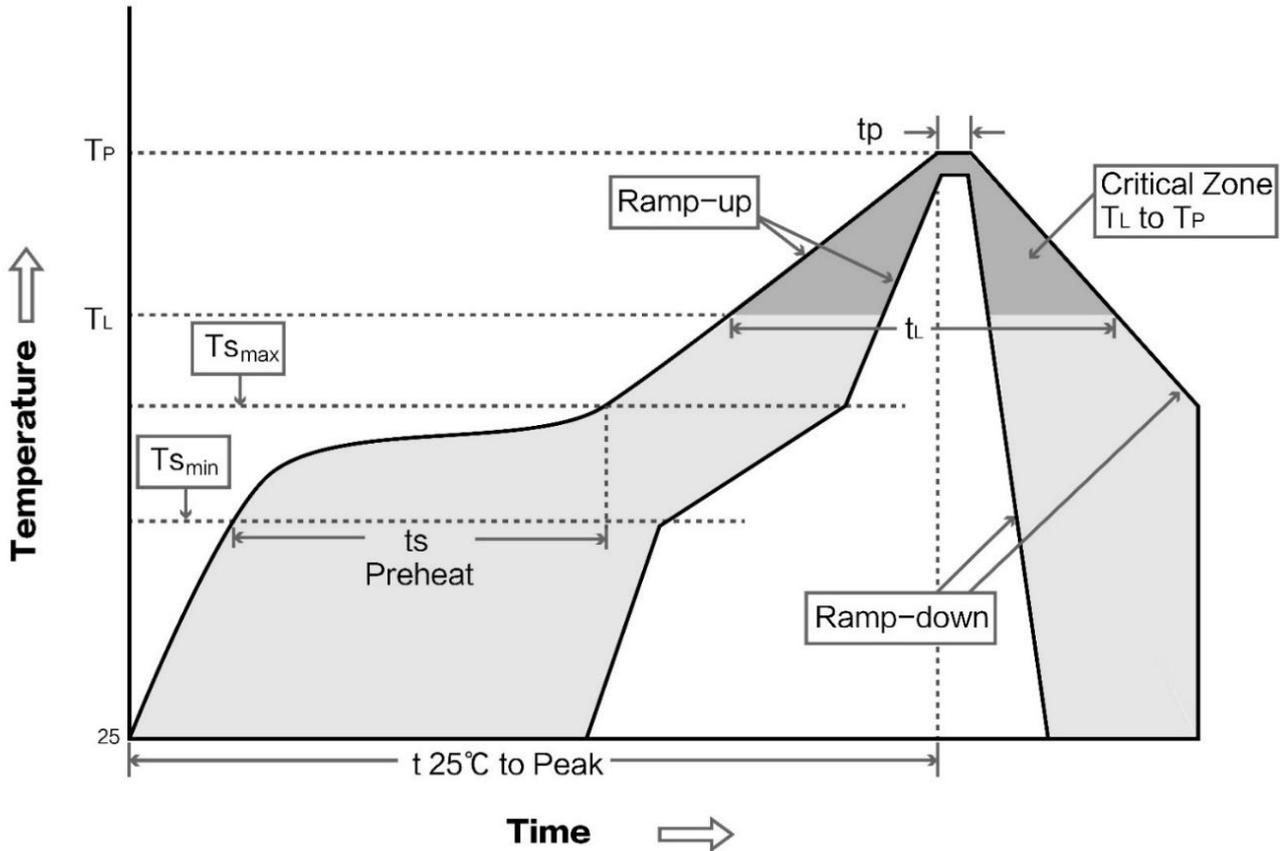
- There are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;
- Poor power supply may cause messy code. Make sure that the power supply is reliable.
- The extension line and feeder quality are poor or too long, so the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

## 12.Production guidance

### 12.1 Reflow soldering temperature

| Profile Feature  | Sn-Pb Assembly | Pb-Free Assembly |
|--|----------------|------------------|
| Solder Paste   | Sn63/Pb37      | Sn96.5/Ag3/Cu0.5 |
| Preheat Temperature min (T <sub>min</sub> )                  | 100°C          | 150°C            |
| Preheat temperature max (T <sub>max</sub> )                  | 150°C          | 200°C            |
| Preheat Time (T <sub>min</sub> to T <sub>max</sub> )(ts)     | 60-120 sec     | 60-120 sec       |
| Average ramp-up rate(T <sub>max</sub> to T <sub>p</sub> )    | 3°C/second max | 3°C/second max   |
| Liquidous Temperature (TL)                                   | 183°C          | 217°C            |
| Time (tL) Maintained Above (TL)                              | 60-90 sec      | 30-90 sec        |
| Peak temperature (T <sub>p</sub> )                           | 220-235°C      | 230-250°C        |
| Average ramp-down rate (T <sub>p</sub> to T <sub>max</sub> ) | 6°C/second max | 6°C/second max   |
| Time 25°C to peak temperature                                | 6 minutes max  | 8 minutes max    |

## 12.2 Reflow soldering curve



## 13. E70 series

| Model No.                    | Core IC | Frequency Hz | Tx power dBm | Distance km | Data Rate | Package | Size mm   | Interface       |
|------------------------------|---------|--------------|--------------|-------------|-----------|---------|-----------|-----------------|
| <a href="#">E70-433NW30S</a> | -       | 433M         | 30           | 6.5         | 2.5k~168k | DIP     | 24 * 38.5 | IPEX/Stamp hole |
| <a href="#">E70-433NW14S</a> | -       | 433M         | 14           | 2.5         | 2.5k~168k | DIP     | 16 * 26   | IPEX/Stamp hole |
| <a href="#">E70-915T14S2</a> | CC1310  | 915M         | 14           | 1.5         | 2.5k~168k | DIP     | 14 * 20   | IPEX/Stamp hole |
| <a href="#">E70-433T14S2</a> | CC1310  | 433M         | 14           | 1.5         | 2.5k~168k | DIP     | 14 * 20   | IPEX/Stamp hole |
| <a href="#">E70-915T14S</a>  | CC1310  | 915M         | 14           | 1.5         | 2.5k~168k | DIP     | 16 * 26   | IPEX/Stamp hole |
| <a href="#">E70-868T14S</a>  | CC1310  | 868M         | 14           | 1.5         | 2.5k~168k | DIP     | 16 * 26   | IPEX/Stamp hole |
| <a href="#">E70-915T30S</a>  | CC1310  | 915M         | 30           | 6           | 2.5k~168k | DIP     | 24 * 38.5 | IPEX/Stamp hole |
| <a href="#">E70-868T30S</a>  | CC1310  | 868M         | 30           | 6           | 2.5k~168k | DIP     | 24 * 38.5 | IPEX/Stamp hole |
| <a href="#">E70-433T30S</a>  | CC1310  | 433M         | 30           | 6           | 2.5k~168k | DIP     | 24 * 38.5 | IPEX/Stamp hole |
| <a href="#">E70-433T14S</a>  | CC1310  | 433M         | 14           | 1.5         | 2.5k~168k | DIP     | 16 * 26   | IPEX/Stamp hole |
| <a href="#">E70-868T14S2</a> | CC1310  | 868M         | 14           | 1.5         | 2.5k~168k | DIP     | 14 * 20   | IPEX/Stamp hole |

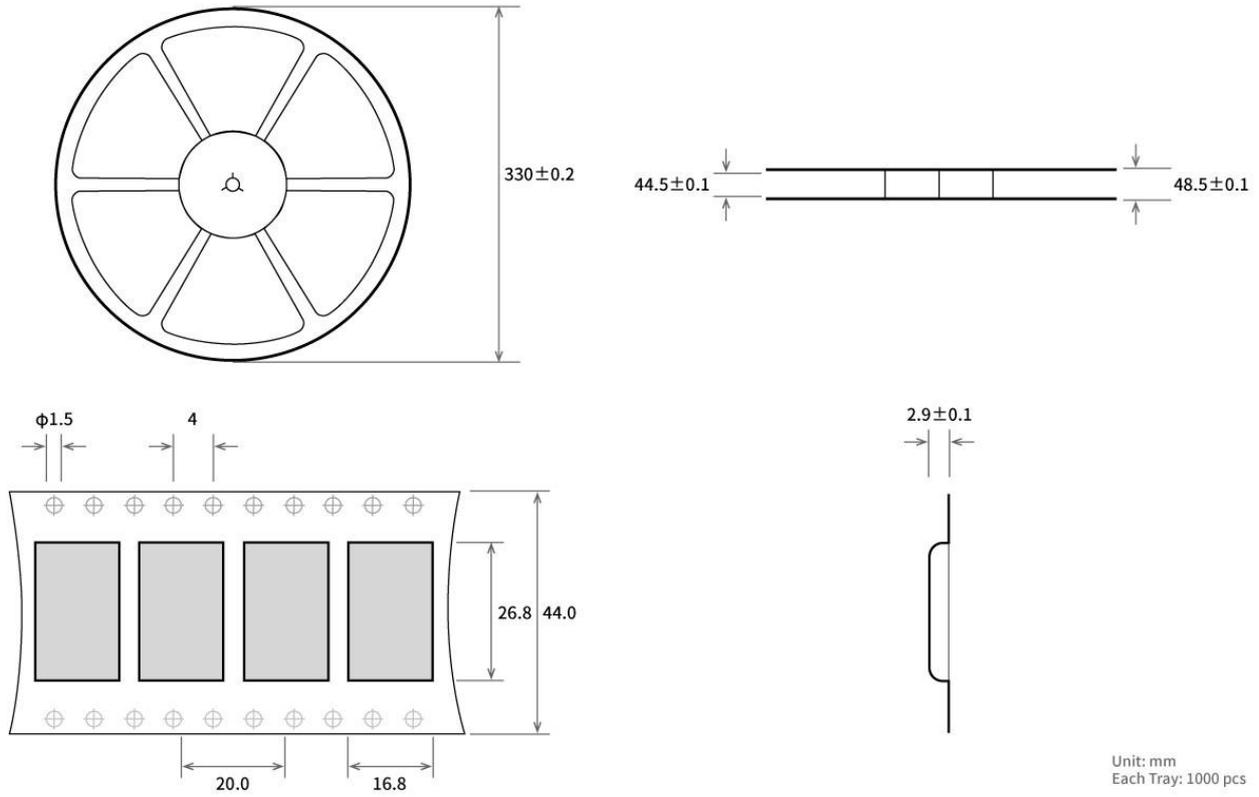
## 14. Antenna Guidance

### 14.1 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 | Soft PCB antenna | 433M         | SMA-J     | 2        | 43.8*9.5mm | -     | Built-in flexibility,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 | Sucker antenna, High gain              |
| TX433-XP-100  | Sucker antenna   | 433M         | SMA-J     | 3.5      | 18.5cm     | 100cm | Sucker antenna, High gain              |
| TX433-XP-300  | Sucker antenna   | 433M         | SMA-J     | 6        | 96.5cm     | 300cm | Car carrying 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       |
| TX490-XP-100  | Sucker antenna   | 490M         | SMA-J     | 50       | 12cm       | 100cm | Sucker antenna, High gain              |
| TX490-JZ-5    | Rubber antenna   | 490M         | SMA-J     | 50       | 50mm       | -     | Short straight & omnidirectional       |

## 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 updating  | huaa      |
| 1.20    | 2018-05-24 | content updating  | Huaa      |
| 1.21    | 2018-07-20 | name change       | Huaa      |
| 1.30    | 2018-10-29 | module separating | Huaa      |
| 1.4     | 2019-12-06 |                   | Ren       |

## About us

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