

# WS8806

## ZigBee3.0 Module

### Instruction Manual

- Support coordinator, router and end node role switch;
- A11 protocol for oilfield applications;
- Support multiple network extension, tree, star and mesh network
- Support zigbee3.0 protocol
- Support ultra-low power consumption
- Support for a variety of secure encryption
- Support long UART packet transmission, up to 1K.

**Document information****Model** WS8806**Overview** ZigBee3.0 Module**Type of documentation** Software Instruction Manual**Document number****Document version** V 1.4

2023.7.10

**Document version update**

| No. | Version | Revised content                                                          | Revised date | Revised |
|-----|---------|--------------------------------------------------------------------------|--------------|---------|
| 1   | v1.0    | The initial version                                                      | 2022.94.1    | XBS     |
| 2   | v1.1    | Add the SE DE CI PI instruction                                          | 2022.104.1   | XBS     |
| 3   | v1.3    | increase SRVN                                                            | 2023.2.17    | XBS     |
| 4   | v1.4    | Add AP=0 (transparent mode) E0=0 (distributed)<br>ZS=0 NW JV instruction | 2023.7.10    | XBS     |

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## 1. API Frame Format Introduction

API frame format:

|            |              |            |          |
|------------|--------------|------------|----------|
| Frame head | Frame length | Frame data | Checksum |
|------------|--------------|------------|----------|

|      |     |     |           |               |
|------|-----|-----|-----------|---------------|
| B1   | B2  | B3  | B4-----Bn | B(n+1)        |
| 0x7E | MSB | LSB | data      | data checksum |

Frame data

cmd\_id      cmd\_data

Checksum = 0 xff - The bottom 8 bits of the sum of the validation segment data.

## 2 API Frames

| API frame name                  | API frame ID |
|---------------------------------|--------------|
| AT command                      | 0x08/0x09    |
| AT command response frame       | 0x88         |
| Module state frame              | 0x8A         |
| Data transfer frame             | 0x10         |
| Data transfer extension frames  | 0x11         |
| Data transfer status frame      | 0x8B         |
| Data receive frame              | 0x90         |
| Data receives an extended frame | 0x91         |

### 2.1 AT command frame

Frame category: 0x08 / 0x09

It is mainly used to configure and read the parameters of the module.

| Frame domain |                       | Byte domain | Example    | Description                                                                                                   |
|--------------|-----------------------|-------------|------------|---------------------------------------------------------------------------------------------------------------|
| Frame head   |                       | 0           | 0x7E       | The byte length of the frame data field.                                                                      |
| Frame length |                       | 1(MSB)      | 0x00       |                                                                                                               |
|              |                       | 2(LSB)      | 0x04       |                                                                                                               |
| Frame data   | Frame category        | 3           | 0x09(0x08) | The 0x09 command needs to execute the AC command to take effect, and the 0x8 command takes effect immediately |
|              | frame number          | 4           | 0x01       | UART data number of the frame to be it from the response frame.                                               |
|              | AT instruct           | 5           | 0x49 (I)   | Command name, composed of two ASCLL characters.                                                               |
|              |                       | 6           | 0x44 (D)   |                                                                                                               |
|              | Parameters (optional) |             |            | Parameters of the instruction, perform parameter configuration if present, and                                |

|                                 |   |      |                                                        |
|---------------------------------|---|------|--------------------------------------------------------|
| parameter query if not present. |   |      |                                                        |
| Verification                    | 7 | 0x68 | 0 xff-Frame data segments summed and (low eight bits). |

The 0x08 command takes effect immediately; the 0x09 command will not take effect immediately, and it will take effect after executing the AC command.

## 2.2 AT command response frame

Frame category: 0x88

The response of AT instruction, the status information of feedback instruction, if it is the response of configuration instruction or no parameter instruction, the parameter field is empty; if it is read with parameter instruction, the parameter field is the parameter value.

| Frame domain     | Byte domain                           | example | description                                            |                                                                                                                |
|------------------|---------------------------------------|---------|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Frame head       | 0                                     | 0x7E    |                                                        |                                                                                                                |
| Frame length     | 1(MSB)                                | 0x00    | The byte length of the frame data field.               |                                                                                                                |
|                  | 2(LSB)                                | 0x0D    |                                                        |                                                                                                                |
| Frame data       | Frame category                        | 3       | 0x88                                                   |                                                                                                                |
|                  | frame number                          | 4       | 0x01                                                   | Serserial data number of the frame to be it from the response frame.                                           |
|                  | AT instruct                           | 5       | 0x49 (I)                                               | Command name, composed of two ASCLL characters.                                                                |
|                  |                                       | 6       | 0x44 (D)                                               |                                                                                                                |
|                  | The instruction responds to the state | 7       | 0x00                                                   | 0= normal, 1= error, 2= invalid instruction, 3= invalid parameter.                                             |
|                  |                                       |         |                                                        |                                                                                                                |
|                  | Parameters (optional)                 | 8       | 0x00                                                   | If the instruction has a parameter this segment is a parameter value, if there is no this segment it is empty. |
|                  |                                       | 9       | 0x00                                                   |                                                                                                                |
|                  |                                       | 10      | 0x00                                                   |                                                                                                                |
|                  |                                       | 11      | 0x00                                                   |                                                                                                                |
|                  |                                       | 12      | 0x00                                                   |                                                                                                                |
|                  |                                       | 13      | 0x00                                                   |                                                                                                                |
|                  |                                       | 14      | 0xA3                                                   |                                                                                                                |
|                  |                                       | 15      | 0x53                                                   | This example is the extended ID of the ZigBee network.                                                         |
| Verificatio<br>n | 16                                    | 0xF3    | 0 xff-Frame data segments summed and (low eight bits). |                                                                                                                |

## 2.3 Module state frame

Frame category: 0x8A

Reporting of the module status information.

| Frame domain | Byte domain | Example | Description                              |
|--------------|-------------|---------|------------------------------------------|
| Frame head   | 0           | 0x7E    |                                          |
| Frame length | 1(MSB)      | 0x00    | The byte length of the frame data field. |
|              | 2(LSB)      | 0x02    |                                          |

|              |                |   |      |                                                                                                                                                                   |
|--------------|----------------|---|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frame data   | Frame category | 3 | 0x8A |                                                                                                                                                                   |
|              | Module state   | 4 | 0x00 | 0= Power start or restart of module,<br>2= routing nodes or terminal nodes join the network,<br>3= network disconnection,<br>6= Coordinator to build the network. |
| Verification |                | 5 | 0x75 | 0 xff-Frame data segments summed and (low eight bits).                                                                                                            |

## 2.4 Data transfer frame

Frame category: 0x10

The API frame sends data, carrying the data to other network devices with the specified target address.

If the short network address of the target device is unknown, the target network short address = 0 xFFFE is set, and the target address uses the 64-bit MAC address for data transmission, 0x000000000000FFFF means broadcast transmission, all devices in the network can receive data, 0x0000000000000000 means sending data to the coordinator, and other values are MAC addresses to unicast other non-coordinator nodes. If the target MAC address is not in the device's address table, the ZigBee network addresses the MAC address to the address table, and then sends the data. If a target address is already available in the MAC address table, the direct data is sent.

If the network address of the target device is known, data is sent with a 16-bit network address. Short network address =0x0000 indicates unicast to the coordinator, short network address =0xFFFF indicates broadcast transmission, and other addresses directly unicast other nodes outside the coordinator in the network.

| Frame domain |                                           | Byte domain | Example | Description                                                                                                                                                                                                                                     |
|--------------|-------------------------------------------|-------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frame head   |                                           | 0           | 0x7E    |                                                                                                                                                                                                                                                 |
| Frame length |                                           | 1(MSB)      | 0x00    | The byte length of the frame data field.                                                                                                                                                                                                        |
|              |                                           | 2(LSB)      | 0x17    |                                                                                                                                                                                                                                                 |
| Frame data   | Frame category                            | 3           | 0x10    |                                                                                                                                                                                                                                                 |
|              | frame number                              | 4           | 0x01    | Serserial data number of the frame to be it from the response frame.                                                                                                                                                                            |
|              | Target address, module 64-bit MAC address | 5(MSB)      | 0x0C    | Set the 64-bit MAC address of the target device,<br>0x0000000000000000= indicates that the target address is the coordinator<br>0x000000000000FFFF= indicates that the target address is a broadcast<br>Other values are the unicast addresses. |
|              |                                           | 6           | 0x43    |                                                                                                                                                                                                                                                 |
|              |                                           | 7           | 0x14    |                                                                                                                                                                                                                                                 |
|              |                                           | 8           | 0xFF    |                                                                                                                                                                                                                                                 |
|              |                                           | 9           | 0xFE    |                                                                                                                                                                                                                                                 |
|              |                                           | 10          | 0x09    |                                                                                                                                                                                                                                                 |
|              |                                           | 11          | 0xE3    |                                                                                                                                                                                                                                                 |
|              |                                           | 12(LSB)     | 0x83    |                                                                                                                                                                                                                                                 |
|              | Target address, 16-bit short              | 13(MSB)     | 0xFF    | Set the short network address of the target node,                                                                                                                                                                                               |
|              |                                           | 14(LSB)     | 0xFE    |                                                                                                                                                                                                                                                 |



|              |                              |    |      |                                                                                                                                                                            |
|--------------|------------------------------|----|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              | network short address        |    |      | 0 xFFFE = network short address is unknown, 0xFFFF= broadcast.                                                                                                             |
|              | broadcasting Radius (Radius) | 15 | 0x00 | The broadcast radius of broadcast data, that is, the maximum number of retweets, set to 0 means the maximum radius is 12 forwarding. Generally, the maximum radius is set. |
|              | Send options (Options)       | 16 | 0x00 | 0x01= Turn off the ACK function, 0x20= APS encryption enabled (EE = 1), maximum data load length reduced by 4 bytes.                                                       |
|              | Data payload (Payload)       | 17 | 0x01 | The payload to which the RF data sends.                                                                                                                                    |
|              |                              | 18 | 0x02 |                                                                                                                                                                            |
|              |                              | 19 | 0x03 |                                                                                                                                                                            |
|              |                              | 20 | 0x04 |                                                                                                                                                                            |
|              |                              | 21 | 0x05 |                                                                                                                                                                            |
|              |                              | 22 | 0x06 |                                                                                                                                                                            |
|              |                              | 23 | 0x07 |                                                                                                                                                                            |
|              |                              | 24 | 0x08 |                                                                                                                                                                            |
|              |                              | 25 | 0x09 |                                                                                                                                                                            |
| Verification |                              | 26 | 0xF5 | 0 xff-Frame data segments summed and (low eight bits).                                                                                                                     |

## 2.5 Data transfer extension frame

Frame category: 0x11

The API frames send the data, carrying the target address to wirelessly send the data to other specified network devices, allowing the configuration of Source endpoints, Destination endpoints, Cluster ID, Profile ID and other parameters.

If the short network address of the target device is unknown, the target network short address = 0 xFFFE is set, and the target address uses the 64-bit MAC address for data transmission, 0x000000000000FFFF means broadcast transmission, all devices in the network can receive data, 0x0000000000000000 means sending data to the coordinator, and other values are MAC addresses to unicast other non-coordinator nodes. If the target MAC address is not in the device's address table, the ZigBee network addresses the MAC address to the address table, and then sends the data. If a target address is already available in the MAC address table, the direct data is sent.

If the network address of the target device is known, data is sent with a 16-bit network address. Short network address =0x0000 indicates unicast to the coordinator, short network address =0xFFFF indicates broadcast transmission, and other addresses directly unicast other nodes outside the coordinator in the network.

| Frame domain |                 | Byte domain | Example | Description                                                          |
|--------------|-----------------|-------------|---------|----------------------------------------------------------------------|
| Frame head   |                 | 0           | 0x7E    |                                                                      |
| Frame length |                 | 1(MSB)      | 0x00    | The byte length of the frame data field.                             |
|              |                 | 2(LSB)      | 0x17    |                                                                      |
| Frame data   | Frame category  | 3           | 0x11    |                                                                      |
|              | frame number    | 4           | 0x01    | Serserial data number of the frame to be it from the response frame. |
|              | Target address, | 5(MSB)      | 0x0C    | Set the 64-bit MAC address of the target device,                     |

|             |                 |         |         |      |                                                      |
|-------------|-----------------|---------|---------|------|------------------------------------------------------|
|             | module          | 64-bit  | 6       | 0x43 | 0x0000000000000000= indicates that the target        |
|             | MAC address     |         | 7       | 0x14 | address is the coordinator                           |
|             |                 |         | 8       | 0xFF | 0x000000000000FFFF= indicates that the target        |
|             |                 |         | 9       | 0xFE | address is a broadcast                               |
|             |                 |         | 10      | 0x09 | Other values are the unicast addresses.              |
|             |                 |         | 11      | 0xE3 |                                                      |
|             |                 |         | 12(LSB) | 0x83 |                                                      |
|             | Target address, | 13(MSB) | 0xFF    |      | Set the short network address of the target node,    |
|             | 16-bit short    | 14(LSB) | 0xFE    |      | 0 xFFFE = network short address is unknown,          |
|             | network short   |         |         |      | 0xFFFF= broadcast.                                   |
|             | address         |         |         |      |                                                      |
|             | Source of the   | 15      | 0xE8    |      | Data transferSource endpoints                        |
|             | Endpoint        |         |         |      |                                                      |
|             | target Endpoint | 16      | 0xE8    |      | Data transferDestination endpoints                   |
|             | Cluster ID      | 17(MSB) | 0x00    |      | The Cluster ID of the data transfer                  |
|             |                 | 18(LSB) | 0x11    |      |                                                      |
|             | Profile ID      | 19(MSB) | 0xC1    |      | The Profile ID of the data transfer                  |
|             |                 | 20(LSB) | 0x05    |      |                                                      |
|             | broadcasting    | 21      | 0x00    |      | The broadcast radius of broadcast data, that is, the |
|             | Radius (Radius) |         |         |      | maximum number of retweets, set to 0 means the       |
|             |                 |         |         |      | maximum radius is 12 forwarding. Generally, the      |
|             |                 |         |         |      | maximum radius is set.                               |
|             | Send options    | 22      | 0x00    |      | 0x01= Turn off the ACK function,                     |
|             | (Options)       |         |         |      | 0x20= APS encryption enabled (EE = 1),               |
|             |                 |         |         |      | maximum data load length reduced by 4 bytes.         |
|             | Data payload    | 23      | 0x01    |      | The payload to which the RF data sends.              |
|             | (Payload)       | 24      | 0x02    |      |                                                      |
|             |                 | 25      | 0x03    |      |                                                      |
| Verificatio |                 | 26      | 0x74    |      | 0 xff-Frame data segments summed and (low eight      |
| n           |                 |         |         |      | bits).                                               |

## 2.6 Data transfer status frame

Frame category: 0x8B

0x11 frame and 0x10 frame data transmission status feedback frames, used to indicate the data transmission status, including sending success, invalid target address, ACK failure, sending data is too long, etc.

| Frame domain |          | Byte domain | Example | Description                                 |
|--------------|----------|-------------|---------|---------------------------------------------|
| Frame head   |          | 0           | 0x7E    |                                             |
| Frame length |          | 1(MSB)      | 0x00    | The byte length of the frame data field.    |
|              |          | 2(LSB)      | 0x07    |                                             |
| Frame data   | Frame    | 3           | 0x8B    |                                             |
|              | category |             |         |                                             |
|              | frame    | 4           | 0x01    | Serserial data number of the frame to be it |

| number                                             |    |      | from the response frame.                                                                                                          |
|----------------------------------------------------|----|------|-----------------------------------------------------------------------------------------------------------------------------------|
| Target address, 16-bit short network short address | 5  | 0x00 | Short network address for the data sending                                                                                        |
|                                                    | 6  | 0x00 |                                                                                                                                   |
| The number of retransmission                       | 7  | 0x00 | Number of retransmission times with the ACK retransmission mechanism turned on                                                    |
| transmit status                                    | 8  | 0x00 | 0x00= Send it successfully<br>0 x 01 = ACK failed<br>0x15= Invalid endpoint<br>0x22= no network<br>0x74= sending data is too long |
| Discover the state                                 | 9  | 0x00 | 0x00= No action found<br>0x01= Address found                                                                                      |
| Vverification                                      | 10 | 0x73 | 0 xff-Frame data segments summed and (low eight bits).                                                                            |

## 2.7 Data Receiving Frame

Frame category: 0x90

When wirelessly receiving a 0x10 send frame, the serial ports output the frame format

| Frame domain                              | Byte domain             | example | description                                                                                                                      |  |
|-------------------------------------------|-------------------------|---------|----------------------------------------------------------------------------------------------------------------------------------|--|
| Frame head                                | 0                       | 0x7E    |                                                                                                                                  |  |
| Frame length                              | 1(MSB)                  | 0x00    | The byte length of the frame data field.                                                                                         |  |
|                                           | 2(LSB)                  | 0x15    |                                                                                                                                  |  |
| Frame data                                | Frame category          | 3       | 0x90                                                                                                                             |  |
| Source address, module 64-bit MAC address | 4(MSB)                  | 0x04    | The 64-bit MAC address of the data sending device, if is 0xFFFFFFFFFFFFFFFF means you don't know the sending device MAC address. |  |
|                                           | 5                       | 0xCD    |                                                                                                                                  |  |
|                                           | 6                       | 0x15    |                                                                                                                                  |  |
|                                           | 7                       | 0xFF    |                                                                                                                                  |  |
|                                           | 8                       | 0xFE    |                                                                                                                                  |  |
|                                           | 9                       | 0x56    |                                                                                                                                  |  |
|                                           | 10                      | 0x7D    |                                                                                                                                  |  |
| a 16-bit, network short                   | 11(LSB)                 | 0xA9    |                                                                                                                                  |  |
|                                           | Source address, 12(MSB) | 0x00    | The 16-bit network short address of the data-sending device.                                                                     |  |
|                                           | 13(LSB)                 | 0x00    |                                                                                                                                  |  |

| address                          |    |      |                                                                                                                                     |  |
|----------------------------------|----|------|-------------------------------------------------------------------------------------------------------------------------------------|--|
| Data receiving options (Options) | 14 | 0x01 | 0 x 01 = ACK data frame,<br>0x02= broadcast frame,<br>0 x 20 = APS encrypted frame,<br>0x40= Data frame is from the terminal device |  |
| Receive data payload (Payload)   | 15 | 0x01 | The payload received by the RF data.                                                                                                |  |
|                                  | 16 | 0x02 |                                                                                                                                     |  |
|                                  | 17 | 0x03 |                                                                                                                                     |  |
|                                  | 18 | 0x04 |                                                                                                                                     |  |
|                                  | 19 | 0x05 |                                                                                                                                     |  |
|                                  | 20 | 0x06 |                                                                                                                                     |  |
|                                  | 21 | 0x07 |                                                                                                                                     |  |
|                                  | 22 | 0x08 |                                                                                                                                     |  |
|                                  | 23 | 0x09 |                                                                                                                                     |  |
| Verification                     | 24 | 0xE2 | 0 xff-Frame data segments summed and (low eight bits).                                                                              |  |

## 2.8 Data receiving extended frames

Frame category: 0x91

When wirelessly receiving 0x11 send frame, serial port output frame format

| Frame domain |                                               | Byte domain | Example | Description                                                                                                         |
|--------------|-----------------------------------------------|-------------|---------|---------------------------------------------------------------------------------------------------------------------|
| Frame head   |                                               | 0           | 0x7E    |                                                                                                                     |
| Frame length |                                               | 1(MSB)      | 0x00    | The byte length of the frame data field.                                                                            |
|              |                                               | 2(LSB)      | 0x15    |                                                                                                                     |
| Frame data   | Frame category                                | 3           | 0x91    |                                                                                                                     |
|              | Source address, module 64-bit MAC address     | 4(MSB)      | 0x04    | The 64-bit MAC address of the data sending device, if is 0xFFFFFFFFFFFFFFFF means you don't know the sending device |
|              |                                               | 5           | 0xCD    |                                                                                                                     |
|              |                                               | 6           | 0x15    |                                                                                                                     |
|              |                                               | 7           | 0xFF    |                                                                                                                     |
|              |                                               | 8           | 0xFE    |                                                                                                                     |
|              |                                               | 9           | 0x56    |                                                                                                                     |
|              |                                               | 10          | 0x7D    |                                                                                                                     |
|              |                                               | 11(LSB)     | 0xA9    |                                                                                                                     |
|              | Source address, 16-bit, network short address | 12(MSB)     | 0x00    | The 16-bit network short address of the data-sending device.                                                        |
|              |                                               | 13(LSB)     | 0x 00   |                                                                                                                     |
|              | Source of the Endpoint                        | 14          | 0xE8    | Receive data framesSource endpoints                                                                                 |

|              |    |      |                                                        |
|--------------|----|------|--------------------------------------------------------|
| target       | 15 | 0xE8 | Receive data framesDestination endpoints               |
| Endpoint     |    |      |                                                        |
| Cluster ID   | 16 | 0x00 | Cluster ID                                             |
|              | 17 | 0x11 |                                                        |
| Profile ID   | 18 | 0xC1 | Profile ID                                             |
|              | 19 | 0x05 |                                                        |
| Data         | 20 | 0x01 | 0 x 01 = ACK data frame,                               |
| receiving    |    |      | 0x02= broadcast frame,                                 |
| options      |    |      | 0 x 20 = APS encrypted frame,                          |
| (Options)    |    |      | 0x40= Data frame is from the terminal device           |
| Receive data | 21 | 0x01 | The payload received by the RF data.                   |
| payload      | 22 | 0x02 |                                                        |
| (Payload)    | 23 | 0x03 |                                                        |
| Verification | 24 | 0x61 | 0 xff-Frame data segments summed and (low eight bits). |

### 3 AT command details

| Command name                   | ASCII     | Command overview                                                       | Read / write |
|--------------------------------|-----------|------------------------------------------------------------------------|--------------|
| ID (Extended PANID)            | 0x49 0x44 | ZigBee Network with a 64-bit extension of PANID                        | Read / write |
| SC (Scan Channels)             | 0x53 0x43 | ZigBee Network to scan the channel                                     | Read / write |
| CE (C oordinator Enable )      | 0x43 0x45 | The Coordinator node role enables                                      | Read / write |
| EE (Encryption Enable)         | 0x45 0x45 | ZigBee Network encryption is enabled                                   | Read / write |
| E O (Encryption Options)       | 0x45 0x4F | ZigBee Network encryption options                                      | Read         |
| KY (Link Key)                  | 0x4B 0x59 | ZigBee Network connection secret key                                   | Write        |
| SM (Sleep Mode)                | 0x53 0x4D | Sleep pattern                                                          | Read / write |
| SP (Cyclic Sleep Period)       | 0x53 0x50 | Sleep time for periodic sleep                                          | Read / write |
| ST (Cyclic Sleep Wake Time)    | 0x53 0x54 | Serial port data or RF data wake up duration is received after wake up | Read / write |
| SN (Number of Sleep Periods)   | 0x53 0x4E | Prolonged sleep time, sleep time is equal to the SN * SP               | Read / write |
| SO (Sleep Options)             | 0x53 0x4F | Sleep option configuration to enable the SN and SP command functions   | Read / write |
| OP (Operating Extended PAN ID) | 0x4F 0x50 | The 64-bit extension PANID where the current network is running        | Read         |
| OI (Operating 16-bit PAN ID)   | 0x4F 0x49 | The 16-bit extension PANID where the current                           | Read         |

|                                    |           |                                                                                        |              |
|------------------------------------|-----------|----------------------------------------------------------------------------------------|--------------|
|                                    |           | network is running                                                                     |              |
| CH (Operating Channel)             | 0x43 0x48 | The ZigBee channel where the current network runs                                      | Read         |
| NC (Number of Remaining Children)  | 0x4E 0x43 | Coordinator and router child node table remaining space                                | Read         |
| AI (Association Indication)        | 0x41 0x49 | Network connection status indication                                                   | Read         |
| SH (Serial Number High)            | 0x53 0x48 | The 64-bit MAC address of the module is a 32-bit high one                              | Read         |
| SL (Serial Number Low)             | 0x53 0x4C | The 64-bit MAC address of the module                                                   | Read         |
| MY (16-bit Network Address)        | 0x4D 0x59 | The 16-bit network short address after joining the network                             | Read         |
| MP (16-bit Parent Network Address) | 0x4D 0x50 | The parent node 16-bit network short address of the child node                         | Read         |
| PL (TX Power Level)                | 0x50 0x4C | transmitting power                                                                     | Read / write |
| BD (UART Baud Rate)                | 0x42 0x44 | Serial port port rate                                                                  | Read / write |
| SE (Source Endpoint)               | 0x53 0x45 | Source endpoint of the application-layer data transfer                                 | Read / write |
| DE (Destination Endpoint)          | 0x44 0x45 | Target endpoint for the application-layer data transfer                                | Read / write |
| CI (Cluster ID)                    | 0x43 0x49 | Cluster ID for the application-layer data transfer                                     | Read / write |
| PI (Profile ID)                    | 0x50 0x49 | The Profile ID for the application-layer data transfer                                 | Read / write |
| ZS (Zigbee Stack Profile)          | 0x5A 0x53 | Zigbee stack configuration                                                             | Read / write |
| NW (Network Watchdog Timeout)      | 0x4E 0x57 | Detect if there is a coordinator in the network                                        | Read / write |
| JV (Coordinator Join Verification) | 0x4A 0x56 | During the network access process, verify whether the target network has a coordinator | Read / write |
| AO (API Options )                  | 0x41 0x4F | The API option configuration                                                           | Read / write |
| VN (Version Number)                | 0x56 0x4E | Read the version number                                                                | Read         |
| NR (Network Reset)                 | 0x4E 0x52 | ZigBee Network reset                                                                   | Write        |
| SR (system reset)                  | 0x53 0x52 | System reset restart                                                                   | Write        |
| AC (Apply Changes)                 | 0x41 0x43 | Parameter application takes effect                                                     | Write        |
| WR (Write)                         | 0x57 0x52 | Parameter writes to the flash                                                          | Write        |
| AP (API Enable)                    | 0x41 0x50 | Switch between API mode and transparent transmission mode                              | Read / write |

### 3.1 ID (Extended PANID)

#### Command Overview:

Configure / read the 64-bit extended PAN ID of the ZigBee network. Coordinator node, when configured as 0, randomly generate 64 bit \_ PAN \_ ID to establish the network, non-0 value will specify the 64 bit \_ PAN \_ ID of the network, change the 64 bit \_ PANI \_ ID value will leave the network to create a new network. Terminal / routing node, any network is added when 64 bit \_ PAN \_ ID is configured to 0, non-0 value joins the network designated 64 bit \_ PAN \_ ID, and changing the 64 bit \_ PAN \_ ID value will leave the network to rejoin the network.

Parameter range: 0-0xFFFFFFFFFFFFFFFE

Default: 0

Example: 7E 00 0C 08 01 49 44 00 00 00 00 B2 B3 F4 F8 18

### 3.2 II (Initial 16-bit PAN ID)

#### Command Overview:

Configure / read the 16-bit PAN ID of the ZigBee network. For the coordinator node, the 16 bit \_ PAN \_ ID is randomly generated to build the network, and the non-0xFFFF value specifies the 16 bit \_ PAN \_ ID of the network. The ID value of changing the 16 bit \_ PANI \_ ID will leave the network to create a new network. Terminal / routing node, join any network when 16 bit \_ PAN \_ ID is configured as 0xFFFF, non-0xFFFF value will join the network designated 16 bit \_ PAN \_ ID, change the 16 bit \_ PAN \_ ID value will leave the network to rejoin the network.

Parameter range: 0-0xFFFF

Default value: 0xFFFF

Example: 7E 00 06 08 01 49 49 FF FF 66

### 3.3 SC (Scan Channels)

#### Command Overview:

Configure the channel scanning for the ZigBee network

| bit | channel   | frequency<br>(MHz) |
|-----|-----------|--------------------|
| 0   | 11 (0x0B) | 2405               |
| 1   | 12 (0x0C) | 2410               |
| 2   | 13 (0x0D) | 2415               |
| 3   | 14 (0x0E) | 2420               |
| 4   | 15 (0x0F) | 2425               |
| 5   | 16 (0x10) | 2430               |
| 6   | 17 (0x11) | 2435               |
| 7   | 18 (0x12) | 2440               |
| 8   | 19 (0x13) | 2445               |
| 9   | 20 (0x14) | 2450               |
| 10  | 21 (0x15) | 2455               |

|    |    |        |      |
|----|----|--------|------|
| 11 | 22 | (0x16) | 2460 |
| 12 | 23 | (0x17) | 2465 |
| 13 | 24 | (0x18) | 2470 |
| 14 | 25 | (0x19) | 2475 |
| 15 | 26 | (0x1A) | 2480 |

Parameter range: 0-0xFFFF

Default: 0 x 7 FFF for scan 11 to 25 channels.

Example: 7E 00 06 08 01 53 43 00 40 20, configured to scan the 17 channel.

### 3.4 CE (Coordinator Enable)

Command Overview:

Coordinator device type enables to build a ZigBee network where the SM parameter must be 0 (i. e. sleep off).

Parameter range:

0 -1

0, Indicates that the closing coordinator is enabled, and the node role is to join the network.

1, the coordinator enables, and the node role establishes the network.

Default: 0

Example: 7E 00 05 08 01 43 45 01 6D

### 3.5 EE (Encryption Enable)

Command Overview:

Configure whether the ZigBee network is on encrypted

Parameter range:

0 -1

1, Open the ZigBee network encryption enabled.

1, and turn off the ZigBee network encryption.

Default: 1



Example: 7E 00 05 08 01 45 45 01 6B

### 3.6 EO (Encryption Options)

Command Overview:

ZigBee network encryption option configuration,

| bit | option                                                                  |
|-----|-------------------------------------------------------------------------|
| 0   | reserve                                                                 |
| 1   | 1=ZigBee3.0 Centralized Trust Center<br>0=ZigBee3.0 Distributed network |
| 2   | reserve                                                                 |

Parameter range:

0 -0x07, currently supports the configuration of EO=0x00 and EO=0x02

Default value: 0x02

Example: 7E 00 05 08 01 45 4F 02 60

### 3.7 KY (Link Key)

Command Overview:

ZigBee The pre-configured connection key is used during network establishment or joining. This parameter can only be configured but not read. If the secret key is configured to 0, the default connection key of ZigBee Alliance will be used.

Parameter range:

0 - 0xFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF E

Default: 0

Example: 7E 00 05 08 01 4B 59 01 51, that is, the secret key is configured as 0x00000000000000000000000000000001

### 3.8 SM (Sleep Mode)

Command Overview:

Configure the sleep mode of the node, if SM> 0, the device node type runs in terminal mode (CE parameter must be equal to 0), if SM=0, CE=0, the device node does not sleep by default in routing mode, SM=0, CE=1, the device node runs in coordinator mode.

Parameter range:

0 -5

0, Indicates shutdown dormancy.

2, Non-sleeping end-node.

5, Periodic sleep, foot wake up, sleep terminal.

Default: 0

Example: 7E 00 05 08 01 53 4D 05 51

### 3.9 SP (Cyclic Sleep Period)

Command Overview:

Set the cycle sleep time of the node, you can set the sleep time for up to 28 seconds, but you can use the SN instruction to extend the sleep time to more than 28 seconds.

Parameter range (in 10ms):

0x20 -0xAF0 (32x 10ms-2800x 10ms)

Default: 0x12C (300x 10ms)

Example: 7E 00 06 08 01 53 50 01 2C 26

### 3.10 ST (Cyclic Sleep Wake Time)

Command Overview:

Dormancy terminal nodes periodically wake up and sleep. When the serial port data is received during wake up, the ST parameter is to configure the duration of wake up at this time. For example, the ST parameter is 500ms, and when the node wakes up, it will continuously wake up for 500ms and then sleep.

Parameter range (in ms):

1 - 0xFFFF (x 1 ms)

Default: 0x1F4 (500ms)

Example: 7E 00 06 08 01 53 54 01 F4 5A

### 3.11 SN (Number of Sleep Periods)

Command Overview:

The extended instruction to extend the dormancy time of dormant terminals can be used to extend the dormancy time with SN instruction when the dormancy time is longer than 28 seconds

Parameter range:

1 - 0xFFFF

Default: 1

Example: 7E 00 05 08 01 53 4E 01 54

### 3.12 SO (Sleep Options)

Command Overview:

The sleep option configuration is to enable the ST and SN instruction function.

| bit | option                                                                                                                                                                                                                                                    |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | reserve                                                                                                                                                                                                                                                   |
| 1   | reserve                                                                                                                                                                                                                                                   |
| 2   | Enable the extended sleep time SN command function, the sleep time is SN*SP, but if the sleep time is longer than 30 seconds, the data sent by the parent node cannot be received, and the parent node buffers the child node for a maximum of 30 seconds |

Parameter range:

0 -0x07

Default: 0x04

Example: 7E 00 05 08 01 53 4F 04 50

### 3.13 OP (Operating Extended PAN ID)

Command Overview:

When the node network is online, the 64-bit extension PANID of the current network running is read.

Parameter range:

1-0xFFFFFFFFFFFFFFFE (read-only)

Windows default:N/A

Example:N/A

### 3.14 OI (Operating 16-bit PAN ID)

Command Overview:

When the node network is online, the 16-bit PANID of the current network operation is read.

Parameter range:

0-0xFFFF (read-only)

Windows default:N/A

Example:N/A

### 3.15 CH (Operating Channel)

Command Overview:

When the node network is online, read the current network running ZigBee channel.

Parameter range:

0x0B-0x1A, 11 channels to 26 channels (read-only).

Windows default:N/A

Example:N/A

### 3.16 NC (Number of Remaining Children)

Command Overview:

The instruction coordinator and router are valid and read how many terminal nodes can be added to its child table.

Parameter range:

0-0x14 (20 children, 60 children for special application)

Windows default:N/A

Example:N/A

### 3.17 AI (Association Indication)

Command Overview:

Read the current network status of the node.

Parameter range:

0 xFF indicates that the current network is disconnected

0x00 means that the network is online

Windows default:N/A

Example:N/A

### 3.18 SH (Serial Number High)

Command Overview:

The MAC address of the read module is 32-bit higher.

Parameter range:

0-0xFFFFFFFF

Windows default:N/A

Example:N/A

### 3.19 SL (Serial Number Low)

Command Overview:

The MAC address of the read module is 32 bits lower.

Parameter range:

0-0xFFFFFFFF

Windows default:N/A

Example:N/A

### 3.20 MY (16-bit Network Address)

Command Overview:

After reading the current node network is online, the 16-bit ZigBee network short address.

Parameter range:

0-0xFFFF (read-only)

Windows default:N/A

Example:N/A

### 3.21 MP (16-bit Parent Network Address)

Command Overview:

After the terminal node is online, the 16-bit ZigBee network short address of its parent node is read.

Parameter range:

0-0xFFFF (read-only)

Windows default:N/A

Example:N/A

### 3.22 PL(TX Power Level)

Command Overview:

Configure and read the transmit power of the module.

| Parameter | Power (dBm) | Parameter | Power (dBm) |
|-----------|-------------|-----------|-------------|
| 0         | 0 dBm       | 11        | 11 dBm      |
| 1         | 1 dBm       | 12        | 12 dBm      |
| 2         | 2 dBm       | 13        | 13 dBm      |
| 3         | 3 dBm       | 14        | 14 dBm      |
| 4         | 4 dBm       | 15        | 15 dBm      |
| 5         | 5 dBm       | 16        | 16 dBm      |
| 6         | 6 dBm       | 17        | 17 dBm      |
| 7         | 7 dBm       | 18        | 18 dBm      |
| 8         | 8 dBm       | 19        | 19 dBm      |
| 9         | 9 dBm       | 20        | 20 dBm      |
| 10        | 10 dBm      |           |             |

Parameter range:

0-0x14

Default value: 0x14

Example: 7E 00 05 08 01 50 4C 14 46

### 3.23 BD (UART Baud Rate)

Command Overview:

Configure and read the serial port port rate of the module.

| Parameter | Baud rate (bit/s) |
|-----------|-------------------|
| 2         | 4800              |
| 3         | 9600              |
| 4         | 19200             |
| 5         | 38400             |
| 6         | 57600             |
| 7         | 115200            |
| 8         | 230400            |
| 9         | 460800            |

Parameter range:

0x02-0x09

Default value: 0x03

Example: 7E 00 05 08 01 42 44 07 69

### 3.24 SE (Source Endpoint)

Command Overview:

Configure and read the source endpoints of the application layer data transmission, when using 0x10 frames of data transmission

Parameter range:

0x01-0xFE

Default value: 0 xE 8

Example: 7E 00 05 08 01 53 45 E8 76

### 3.25 DE (Destination Endpoint)

Command Overview:

Configure and read the target endpoints for application layer data transmission, using 0x10 frames for data transmission

Parameter range:

0x01-0xFE

Default value: 0 xE 8

Example: 7E 00 05 08 01 44 45 E8 85

### 3.26 CI (Cluster ID)

Command Overview:

Configure and read the cluster ID of application layer data transmission with 0x10 frames

Parameter range:

0x0000-0xFFFF

Default value: 0x0011

Example: 7E 00 06 08 01 43 49 00 11 59

### 3.27 PI (Profile ID)

Command Overview:

Configure and read the Profile ID for application layer data transmission, and this Profile ID is used for 0x10 frame data transmission

Parameter range:

0x0000-0xFFFF

Default value: 0 xC 105

Example: 7E 00 06 08 01 50 49 C1 05 97

### 3.28 ZS (Zigbee Stack Profile)

Command overview:

Configure and read the zigbee stack configuration, this parameter configures the same devices to communicate with each other

Parameter range:

| Parameter | Description                                                                            |
|-----------|----------------------------------------------------------------------------------------|
| 0         | A private network that does not allow third-party devices to join.                     |
| 1         | reserve                                                                                |
| 2         | ZigBee 3.0 standard network allows third-party devices to communicate with each other. |

Default: 0x02

Example: 7E 00 05 08 01 5A 53 02 47

### 3.29 NW (Network Watchdog Timeout)

Command overview:

Configure and read the network watchdog timeout parameter, which is used by the routing node to detect whether the coordinator in the network is online. If the NW setting > 0, the routing node starts to monitor the communication with the coordinator (similar to the heartbeat between the coordinator), if 3 NW time periods cannot communicate with the coordinator, the route will automatically leave the network and request to join again. This instruction mainly meets the functional requirements that need to replace the coordinator in the network.

Parameter range:

0x0000-0x64FF(x 1 minute)

Default: 0(disabled)

Example: 7E 00 05 08 01 4E 57 05 4C

### 3.30 JV (Coordinator Join Verification)

Command overview:

After enabling this command, the routing node will verify whether there is a coordinator in the target network during the process of joining the network, which is mainly used for distributed networks (EO=0) and unencrypted networks (EE=0), because these two forms of networks Even if there is no coordinator, other devices can join normally. For a centralized network with EO=2, the coordinator must exist before joining the network. This command is invalid for an EO=2 network. This command is used together with NW in distributed network (EO=0) and unencrypted network (EE=0), if the coordinator in the network fails to replace the new coordinator (new coordinator and old coordinator The server network parameters remain the same).

Parameter range:

0x00-0x01

| Parameter | Description                                   |
|-----------|-----------------------------------------------|
| 0         | Disable the coordinator verification function |
| 1         | Enable coordinator authentication function    |

Default: 0x00

Example: 7E 00 05 08 01 4A 56 00 56

### 3.31 AO (API option)

Command Overview:

The API configuration options.

| bit | option                                                                                                                 |
|-----|------------------------------------------------------------------------------------------------------------------------|
| 0   | 0= Invalid data received is output in a 0x90-frame format<br>1= Invalid data received is output in a 0x91-frame format |
| 1   | reserve                                                                                                                |
| 2   | reserve                                                                                                                |

Parameter range: 0-0 xff

Default value: 0x01

Example: 7E 00 05 08 01 41 4F 01 65

### 3.32 NR (Network Reset)

Command Overview:

Reset the ZigBee network of the module, that is, clear the current ZigBee network information of the module. The module will send a live frame to the network, and the network data stored in the flash will be cleared locally. Then the network joins the network or establishes the network with a new device.

NR = 0, representing the ZigBee network clearing the current modulus.

NR = 1, broadcast network reset command to the network, all devices in the network perform the clear network reset operation.

Parameter range (written only):

0-1

Windows default:N/A

Example: 7E 00 05 08 01 4E 52 00 56, ZigBee network reset of the current module



### 3.33 SR (System Reset)

Command Overview:

Module system reset, that is, the software restart

Parameter range: N / A

Windows default:N/A

Example: 7E 00 04 08 01 53 52 51

### 3.34 AC (Apply Changes)

Command Overview:

Parameter effective instruction, all the parameters will not take effect immediately after configuration, need AC instruction to take effective.

Parameter range: N / A

Windows default:N/A

Example: 7E 00 04 08 01 41 43 72

### 3.35 WR (Write)

Command Overview:

Write the parameters to flash operation, after some instructions configuration, if you need to drop the power memory, execute WR instructions to write the parameters to flash.

Parameter range: N / A

Windows default:N/A

Example: 7E 00 04 08 01 57 52 4D

### 3.36 VN (Version Number)

Command Overview:

Read the software (SV) version number and the hardware (HV) version number of the module.

Parameter range: N / A

Windows default:N/A

Example: 7E 00 04 08 01 56 4E 52

7E 12 3F 01 56 4E 53 56 3A 76 30 31 20 48 56 3A 76 30 30 4A

53 56 3A 76 30 31 20 48 56 3A 76 30 30

S V : v 0 1      H V : v 0 0

### 3.37 AP (API Enable)

Command Overview:

Switch between API mode and transparent transmission mode

Parameter range:

| Parameter | Description                                             |
|-----------|---------------------------------------------------------|
| 0         | Disable API mode, work in transparent transmission mode |
| 1         | API mode enabled                                        |

Default: 0x01 (API mode)

Example: 7E 00 05 08 01 41 50 00 65 (switch API mode to transparent transmission mode)

## 4 Transparent transfer mode

In the transparent transmission mode, the data communication is transmitted in a transparent manner. The target address needs to be specified before the data is sent, and the unicast and broadcast are realized through the target address. The unicast includes MAC address unicast and network short address unicast.

### 4.1 The target address of transparent transmission

The target address is 64 bits in length, 0x0000000000000000 means unicast to the coordinator, 0x000000000000FFFF means broadcasting, 0x0000000000001234 (the lower two bits are not FFFF, and the upper six bits are all 00) means network short address unicast, 0x84B4DB00FE73770C (= the MAC address of the module) means MAC address unicast

### 4.2 Commands in transparent transmission mode

(1) +++ enter command mode

```
enter          return
+++           OK\r\n
```

(2) ATDH configures and reads the upper 4 bits of the target address

Read

```
enter          return
ATDH\r\n       *****\r\n
```

Write

```
enter          return
ATDH*****\r\n OK\r\n
```

The parameter \*\*\*\*\* indicates the high 4-bit value of the target address in HEX form.

Example: ATDH84B4DB00\r\n

### (3) ATDL configuration and read the lower 4 bits of the target address

Read

```

enter                      return
ATDL\r\n                  *****\r\n
enter                      return
ATDL*****\r\n            OK\r\n
  
```

写

The parameter \*\*\*\*\* indicates the low 4-bit value of the target address in HEX form.

Example: ATDLFE73770C\r\n

### (4) ATAP Switch from transparent mode to API mode

```

enter                      return
ATAP0\r\n                  OK\r\n
  
```

Exit transparent transmission mode and switch to API mode

### (5) ATCN Exit command mode in transparent transmission mode

```

enter                      return
ATCN\r\n                  OK\r\n
  
```

### (6) Command example

Enter the command mode to configure the target address to realize 16-bit network short address unicast:

+++ Enter command mode

ATDH00000000\r\n Configure the upper 4 bits of the target address

ATDL0000B85A\r\n Configure the lower 4 bits of the target address

ATCN\r\n Exit command mode

Note: 0xB85A represents the 16-bit network short address of the target device

Enter the command mode to configure the target address to realize MAC address unicast:

+++ Enter command mode

ATDH84B4DB00\r\n Configure the upper 4 bits of the target address

ATDLFE73770C\r\n Configure the lower 4 bits of the target address

ATCN\r\n Exit command mode

Note: 0x84B4DB00FE73770C is the 64-bit MAC address of the target device

Enter the command mode to configure the target address and implement broadcasting:

+++ Enter command mode

ATDH00000000\r\n Configure the upper 4 bits of the target address

ATDL0000FFFF\r\n Configure the lower 4 bits of the target address

ATCN\r\n Exit command mode

Enter command configuration mode and exit transparent transmission mode:

+++ Enter command mode

ATAP1\r\n Exit transparent transmission mode and enter API mode

## 5 Contact information

| Contact                                                                                                | Cell        | Email                 |
|--------------------------------------------------------------------------------------------------------|-------------|-----------------------|
| Manager Chen                                                                                           | 15000319232 | chenliang@silentsmart |
| Tel.: 028-64823553                                                                                     |             |                       |
| Address: 3-307, Floor 3, Building 12, No.38, South Jinke Road, Jinniu Hi-tech Industrial Park, Chengdu |             |                       |

## FCC WARNING

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

15.105 Information to the user.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination.

The firmware setting is not accessible by the end user.

The final end product must be labelled in a visible area with the following: "Contains Transmitter Module "FCC ID: 2BB8U-WS8806"

## **Requirement per KDB996369 D03**

### **2.2 List of applicable FCC rules**

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section

2.10 below concerning the need to notify host manufacturers that further testing is required.<sup>3</sup>

**Explanation:** This module meets the requirements of FCC part 15C (15.247). It specifically identified AC Power Line Conducted Emission, Radiated Spurious emissions, Band edge and RF Conducted Spurious Emissions, Conducted Peak Output Power, Bandwidth, Power Spectral Density, Antenna Requirement.

### **2.3 Summarize the specific operational use conditions**

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

**Explanation: The product antenna uses an irreplaceable antenna with a gain of -2dBi**

### **2.4 Single Modular**

If a modular transmitter is approved as a "Single Modular," then the module manufacturer is responsible for approving the host environment that the Single Modular is used with. The manufacturer of a Single Modular must describe, both in the filing and in the installation instructions, the alternative means that the Single Modular manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A Single Modular manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited

module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This Single Modular procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited

module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module. **Explanation:** The module is a single module.

## 2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna); b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered); c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout; d) Appropriate parts by manufacturer and specifications; e) Test procedures for design verification; and f) Production test procedures for ensuring compliance. The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

## 2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions

(mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).



**Explanation:** The module complies with FCC radiofrequency radiation exposure limits for uncontrolled environments. The device is installed and operated with a distance of more than 20 cm between the radiator and your body." This module follows FCC statement design,

FCC ID : 2BB8U-WS8806

## 2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type" ).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product.

The module manufacturers shall provide a list of acceptable unique connectors.

**Explanation:** The product antenna uses an irreplaceable antenna with a gain of -2dBi

## **2.8 Label and compliance information**

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

**Explanation:** The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2BB8U-WS8806

## **2.9 Information on test modes and additional testing requirements**

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

**Explanation:** Chengdu Silent Smart Technology Co., Ltd. can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

## **2.10 Additional testing, Part 15 Subpart B disclaimer**

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product

as being Part 15

Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

**Explanation:** The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.