Chengdu Ebyte Electronic Technology Co.,Ltd.

# E180-ZG120A/B V1.0 User Manual
# (ZigBee3.0 Ad Hoc Network Module)

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# 1. Module introduction

## 1.1 Introduction to ZigBee

ZigBee technology is a short-range, low-complexity, low-power, low-speed, low-cost two-way wireless communication technology.

There are three logical device types in the ZigBee network: Coordinator (coordinator), Router (router) and End-Device (terminal device). A ZigBee network consists of a Coordinator, multiple Routers and multiple End_Devices.

The functions of each type of equipment are as follows:

(1) Coordinator (coordinator)

The coordinator is responsible for starting the entire network. It is also the first device of the network. The coordinator selects a channel and a network ID (also called PAN ID, Personal Area Network ID), and then starts the entire network.

The coordinator can also be used to assist in establishing bindings between the security layer and the application layer in the network.

Note that the role of the coordinator primarily involves the startup and configuration of the network. Once this is all done, the coordinator works like a router (or goes away). Due to the distributed characteristics of the ZigBee network itself, the subsequent operation of the entire network does not depend on the existence of the coordinator.

(2) Router (router)

The main functions of the router are: to allow other devices to join the network, multi-hop routing and to assist in communication with its own battery-powered son terminal device.

Usually, a router is expected to be active all the time, so it must be powered by mains power. But when using the network mode of the tree group, the routing is allowed to operate once at a certain period of time, so that it can be powered by the battery.

(3) End-Device (terminal equipment)

The end device has no specific responsibility for maintaining the network structure, it can sleep or wake up, so it can be a battery powered device.

## 1.2 Features

| Serial number | Features | Feature description |
|---|---|---|
| 1 | Centralized network management | The centralized network access mechanism of ZIGBEE 3.0 security standard makes the data safe and reliable; |
| 2 | Interoperability | It conforms to zigbee 3.0 standard network mechanism and is compatible with ZCL network protocol. |
| 3 | high-capacity | 256K flash, 32K RAM, and the maximum number of network nodes can be expanded to 80; |
| 4 | Role switching | The user can make the device switch freely among the four types of coordinator, router, terminal and sleeping terminal through the serial port instruction; |
| 5 | Support multiple network topologies | Point to point, star network, MESH network; |

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| | | |
|---|---|---|
| 6 | Network self-healing | If the intermediate node of the network is lost, a new mesh topology will be automatically formed, and the lost node will be automatically recovered after restart; |
| 7 | Automatic routing | The module supports network routing function; |
| 8 | Open and close networking | The coordinator controls the opening or closing of the network. During the period of opening the network, devices that meet the ZigBee3.0 standard can join the network. After closing the network, any device cannot join. If the coordinator is not closed after opening the network, it will be automatically closed 180 seconds later. |
| 9 | One button screening | The node does not need to set PANID and channel, but only needs to trigger the networking within the window time when the coordinator opens the network. |
| 10 | Automatic channel and PANID | The coordinator automatically creates a network in the optimal channel and automatically allocates PANID to avoid duplication with other coordinators. |
| 11 | Get MAC address automatically | The coordinator can obtain the node MAC address and short address at the moment when the node is connected to the network, without further processing on the device side. |
| 12 | Address Search | The user can find the corresponding short address according to the MAC address (unique, fixed) of the network node that has joined, and can also find the corresponding long address of each node in the network according to the short address of the node; |
| 13 | data security | Integrated with ZIGBEE 3.0 security communication standard, the network contains multi-level security keys; |
| 14 | Serial port configuration | The module has built-in serial port instructions, through which the user can configure (view) the parameters and functions of the module; |
| 15 | PWM control | Local/remote PWM control, three PWM channels for user selection; |
| 16 | One click restore baud rate | If you forget or do not know the baud rate, you can use this function to restore the default baud rate to 115,200bps; |
| 17 | Serial port receiving wake-up | Support the serial port receiving wake-up function. When the module is in the sleep state, when it receives an arbitrary byte of data, it will be wakened. This data is a wake-up frame for the wake-up module and will not be treated as data; |
| 18 | Module reset | The user can reset the module through the serial port command; |
| 19 | Air configuration | Users can remotely configure other devices in the network using air configuration instructions. |
| 20 | Multiple command formats | The user can configure and control the module using the hexadecimal format command and AT command to realize networking, setting transparent transmission, light control and other operations. |

# 1.3 Support product family

| Number | Product number | RF chip | Frequency (Hz) | Airspeed (bps) | Power (dBm) | Antenna form |
|---|---|---|---|---|---|---|
| 1 | E180-ZG120A/B | EFR32MG1B232F256GM32 | 2.4G | 250K | 20 | PCB |

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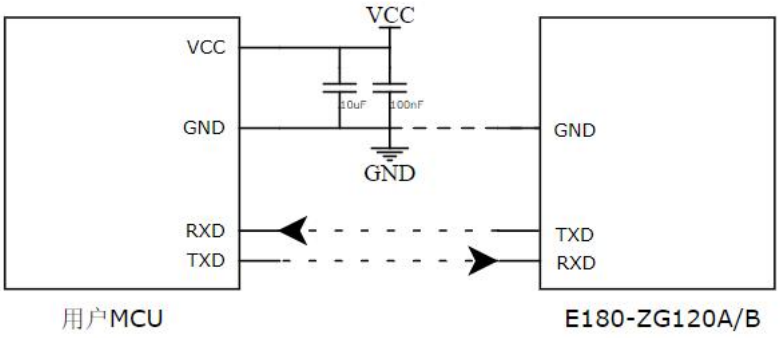
# 2. Introduction to Functions and Command Structure

## 2.1 Function pin table

Refer to the hardware description document E180-ZG120series_User Manual_CN_v1.0 for pin packaging.

## 2.2 Pin connection instructions

### 2.2.1 Serial port connection instructions






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### 2.2.2 Pin Location Description

The E180-ZG120A/B networking module adopts UART serial communication mode. Users can connect to it through any MCU with UART function for data exchange. For the specific pin positions, please refer to the user manual "E180-ZG120series_User Manual_CN_v1.0", and the specific connection method is as shown in the figure above.

# 3. Module firmware function

The E180-ZG120A/B module supports the ZigBee 3.0 protocol, conforms to the ZCL (ZigBee cluster library) standard specification, and can interoperate with other manufacturers' ZigBee-based smart products.

The module uses UART interface for control, supports HEX command configuration and communication, AT command configuration, data transparent transmission three modes; supports "one-key networking" function, that is, networking control is realized through IO port external buttons or level signals; The module can be configured as coordinator, routing node, common terminal node, and sleep terminal node four types of ZigBee node types; support 3 sets of PWM signal output in line with ZCL standard specification control.

## 3.1 Three serial port modes

### 3.1.1 HEX instruction mode

The HEX command format is a fixed mode of "frame header + frame length + frame load", the command frame length is variable, the command input is not affected by command sticky packets, and the input command has a timeout protection mechanism, which effectively solves the problem of command packet breakage. Each input command has corresponding command feedback to confirm whether the module works normally and whether the command is executed correctly. The HEX command mode is full-duplex mode, and the corresponding HEX command is output in real time through the UART_TX port when the module status changes or data is received.

For the format and analysis of HEX, please refer to the document "Ebyte ZigBee3.0 Module HEX Command Standard Specification". This document focuses on the characteristics of E180-ZG120 in HEX command mode.

**HEX instruction format：**

| frame header (1 byte) | frame length (1 byte) | **Frame payload (variable length 3~255 bytes)** | | | |
|---|---|---|---|---|---|
| | | Command type (1 byte) | command code (1 byte) | command data (variable length 0~252 bytes) | XOR check (1 byte) |

**Frame header:** fixed byte 0x55 in hexadecimal

**Frame length:** 1 byte length, the value range is 3~255 (0x03~0xFF in hexadecimal)

**Frame load:** The frame load contains the command type, command code, command data and XOR check, and the length is determined by the frame length.

**Command type:** According to the mode and working mechanism of the command, it is classified.

**Command code:** The code corresponding to the command, the length is 1 byte, and each command has a unique

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command code.

**Command data:** The additional parameters of the command execution, the minimum is 0 bytes, and the maximum is 252 bytes.

**XOR checksum:** XOR8 checksum of the entire command payload (command type, command code, command data).

**Three types of HEX instructions**

input the command:

The command input to the module by the host computer can be used to configure the module or send it wirelessly. The command type of the input command is less than 0x0F.

Feedback command:

After the module receives and executes the command from the upper computer, it feeds back the execution result to the upper computer. The command type and command code of the feedback command are the same as the input command.

Asynchronous command:

The command actively sent to the host computer during the operation of the module, which corresponds to the asynchronous event in the ZigBee application. The command type of the asynchronous command is greater than 0x80.

**Input command (including feedback command)**

- Local configuration command, command type 0x00, used for local settings of the module.
- Network management command, command type 0x01, used to manage other modules at the network layer during networking.
- ZCL sends the command, the command type is 0x02, which is used by the module to control other modules or third-party devices, in line with the ZCL specification.

**asynchronous command：**

- System notification command, command type 0x80, module status change notification.
- The network management return command, the command type is 0x81, other modules or devices receive the gateway management command return message.
- ZCL receives the command, the command type is 0x82, the module receives the ZCL layer message or return message from other modules or devices.
- Send confirmation, command type 0x8F, used to diagnose whether the sending of network management commands and ZCL sending commands is abnormal.

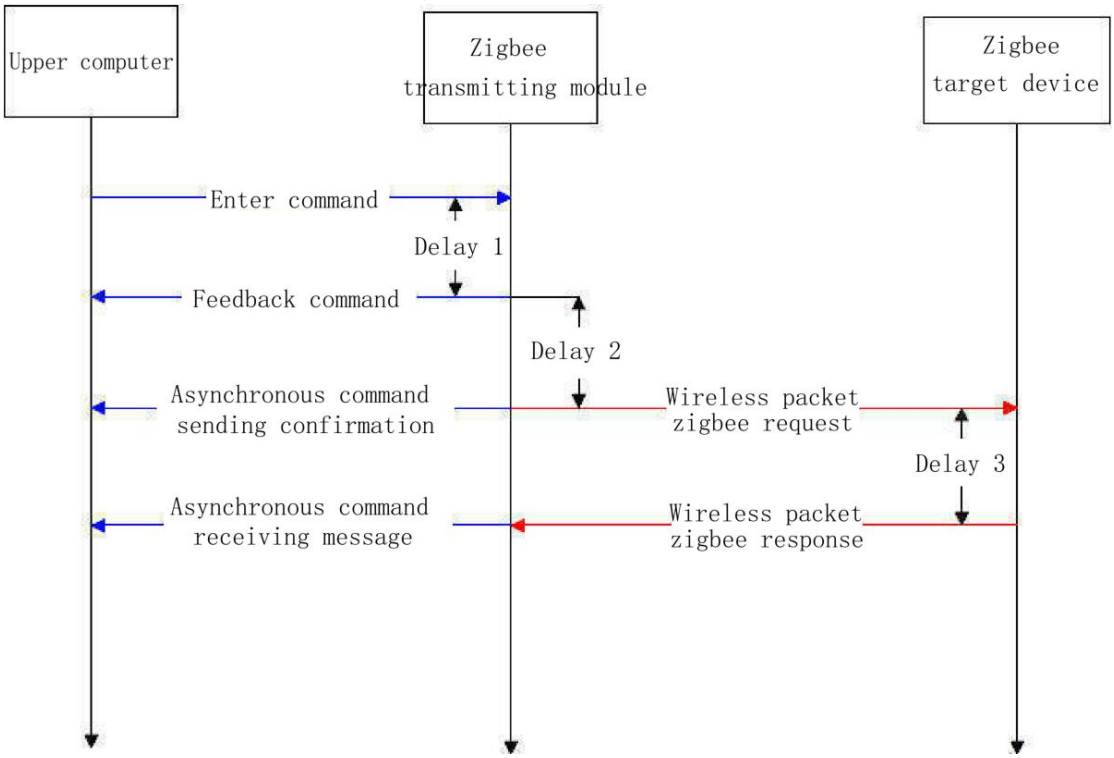
**Regarding the correct use of "Send Confirmation":**

(host computer) input network management commands and ZCL sending commands to the module and receive the corresponding feedback commands. The commands are not immediately converted into wireless signals and sent out, but are sent to the module at a rate of 250kbps after avoiding other devices in the same network. The signal is transmitted in the air, and the "Send Confirmation" command is the result of the wireless signal transmission. There are only two states for sending confirmation on the E180ZG120 module: 0x00 = sending successfully, 0x66 = sending failed. The final correctness of the network management command is judged according to the corresponding network management return command received; the final correctness of the ZCL

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sending command is also judged according to the corresponding ZCL receiving command received. Sending acknowledgment can be used to end the wait for the return message early, and other modules or devices that can be used to diagnose abnormalities, and it can be used to waste limited network resources on meaningless device nodes.




When the E180ZG120 module sends network management commands and ZCL sending commands in broadcast mode, due to the influence of broadcast flooding, the sending confirmation will be triggered 1 second after the feedback command. Therefore, when using this module for broadcast or multicast, it is recommended that the sending interval be greater than 1 second.

**HEX command directory supported by E180ZG120**

| command name | command type | command code |
|---|---|---|
| local configuration class | | |
| Query the current status of the module | 0x00 | 0x00 |
| Start distribution network | 0x00 | 0x02 |
| Stop distribution network | 0x00 | 0x03 |
| reset/factory reset | 0x00 | 0x04 |
| Set the native node type | 0x00 | 0x05 |
| View local add group | 0x00 | 0x09 |
| Add the machine to the group | 0x00 | 0x0A |
| This machine withdraws from the group | 0x00 | 0x0B |
| Set and query the current transmit power | 0x00 | 0x0D |
| read local properties | 0x00 | 0x10 |
| set local properties | 0x00 | 0x11 |
| auto bind target | 0x00 | 0x14 |

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| | | |
|---|---|---|
| Enter AT command mode | 0x00 | 0x16 |
| Read the network access node address table | 0x00 | 0x22 |
| System notification class | | |
| mod start | 0x80 | 0x00 |
| network status change | 0x80 | 0x01 |
| Turn on and off network notifications | 0x80 | 0x02 |
| Detect node access to the network | 0x80 | 0x03 |
| Node short address notification | 0x80 | 0x04 |
| Node Off-Grid Notification | 0x80 | 0x06 |
| Automatically bind target result notification | 0x80 | 0x10 |
| ZDO network management command / network management return | | |
| Query node short address/return | 0x01/0x81 | 0x00 |
| Query node MAC address/return | 0x01/0x81 | 0x01 |
| Query node port information/return | 0x01/0x81 | 0x04 |
| Query the number of node ports/return | 0x01/0x81 | 0x05 |
| Set node constant connection binding/return | 0x01/0x81 | 0x21 |
| Unbind/return the node's constant connection | 0x01/0x81 | 0x22 |
| View node constant connection binding/return | 0x01/0x81 | 0x33 |
| delete node/return | 0x01/0x81 | 0x34 |
| ZCL commands and ZCL returns | | |
| read device properties/return | 0x02/0x82 | 0x00 |
| Modify device properties/return | 0x02/0x82 | 0x01 |
| Query attribute reporting rules/return | 0x02/0x82 | 0x02 |
| Modify attribute reporting rules/return | 0x02/0x82 | 0x03 |
| View All Properties/Return | 0x02/0x82 | 0x04 |
| View all status with extended fields/return | 0x02/0x82 | 0x05 |
| Receive attribute active report | 0x82 | 0x0A |
| Default return frame | 0x82 | 0x0B |
| send control commands | 0x02 | 0x0F |
| received control command | 0x82 | 0x0F |

### 3.1.2 AT command mode

The AT command is in ASCII string format, which is convenient for manual direct input and mnemonic. The AT command adopts the format of "AT+command code", and the command code is a fixed string. For the detailed analysis of the AT command, please refer to "Ebyte ZigBee 3.0 Module AT Command Standard Specification". There are three input forms of AT commands: execution type, query type, and setting type.

**Execution:**

The format of the executive command is the direct format of "AT+command code". The execution

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command ends with the last byte of the command code, and does not continue with any bytes, including the carriage return symbol. Otherwise, the input is invalid. Such as "AT+JOIN", "AT+LEAVE". Executing the command input effectively returns "OK\r\n", that is, a "OK" with a carriage return is received. If the input command ends incorrectly, the module returns "INVALID\r\n".

**query:**

The format of the query command is "AT+command code?", that is, it ends with ASCII "?" (hexadecimal 0x3F). The query command is used to query the current value of a certain parameter of the module, and print the query value through the serial port in ASCII format.

**Setup:**

The format of the set command is the format of "AT+command code=value", that is, after the command code ends, it needs to follow the ASCII "=", and the "=" followed by the numerical value. Values are entered in decimal or hexadecimal according to different commands, and are expressed in the format of %d or %x. If you enter multiple parameters, you need to separate them with ",". For details, please refer to "Ebyte ZigBee 3.0 Module AT Command Standard Specification".

**AT command directory：**

| Command function | command code | implement | Inquire | set up |
|---|---|---|---|---|
| Exit AT mode to HEX mode | AT+EXIT | Y | N | N |
| Network or create a new network | AT+JOIN | Y | N | N |
| stop networking | AT+STOP | Y | N | N |
| Module reset | AT+RESET | Y | N | N |
| leave the network | AT+LEAVE | Y | N | N |
| Enter transparent transmission mode | AT+SEND | Y | N | N |
| auto bind target | AT+FIND | Y | N | N |
| Read device information | AT+INFO | Y | N | N |
| Set or read device type | AT+DEVTYPE | N | Y | Y |
| Set or read baud rate | AT+BAUD | N | Y | Y |
| Set or read target address | AT+DSTADDR | N | Y | Y |
| Set or read target port | AT+DSTEP | N | Y | Y |
| switch on | AT+TURNON | Y | Y | Y |
| open switch | AT+TURNOFF | Y | Y | Y |
| Invert switch | AT+TOGGLE | Y | Y | Y |
| Brightness increased | AT+LEVELUP | Y | Y | Y |
| brightness down to | AT+LEVELDOWN | Y | Y | Y |
| set brightness | AT+LEVELSET | Y | Y | Y |
| mark target | AT+IDENTIFY | Y | Y | Y |
| unbind | AT+UNBIND | Y | Y | Y |

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### 3.1.3 Data transparent transmission mode

In data transparent transmission mode, any data input to the serial port will be sent out through wireless signals. The module that receives the transparent transmission data directly prints the data frame in transparent transmission mode or AT command mode, such as the receiving end in HEX command mode. Then output the frame data in ZCL command format.

**ZCL format for data transparent transmission：**

Data transparent transmission conforms to the ZCL specification, and the specification is as follows

- port=1
- Profile = 0x0104
- cluster=0xFC08
- manufacture code=0x2000
- Command Type: Special Command
- Command direction: Server to Client
- Command ID: 0x00

Note: When the coordinator or other nodes are in HEX mode to send data to the E180ZG120 module in transparent transmission mode, they also need to follow the ZCL specification, even if the cluster with cluster=0xFC08 is used, Manufacture Code=0x2000, and the command direction is changed to Client to Server. Command ID is 0x00.

**Target settings for data transparent transmission**

The target of data transparent transmission is to set the local attribute DstAddr and local attribute DstEP of the module, which are located in port 1 of the module, cluster=0xFC08. The attribute IDs are 0x0001 and 0x0002, respectively, and the data types are UINT16 and UINT8, respectively.

DstAddr is the short address for transparent transmission, and DstEP is the target port for transparent transmission. Transparent transmission has four modes: on-demand transmission, broadcast transmission, multicast transmission, and binding transmission. When DstEP is set to other values, it is used to reserve ZigBee modules with multiple serial ports for transparent transmission.

| Transparent mode | DstAddr | DstEP |
|---|---|---|
| On-demand (to the main serial port) | The other party's short address | 1 |
| On-demand (to serial port 2)<br>Note: Reserve dual serial port function | The other party's short address | 2 |
| broadcast | 0xFFFF | 0xFF |
| multicast | 16bit group address | 0 |
| bind send | 0xFFFE | 0xFE |

**Binding transparent transmission target settings**

In the binding transparent transmission mode, the module can find the transparent transmission target through the MAC address to cope with the change of the transparent transmission target short address. There are 3

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ways to set the binding：

a) The coordinator assigns the transparent transmission target to the module through the HEX command "Set node constant connection binding (command code 0x21)". If the module knows the MAC address of the other party, it can also send this command to itself in the HEX command mode.

b) Both modules are in the HEX command mode, sending the local configuration command "Auto bind target (command code 0x14)". The target module of the transparent transmission sends the command first, and waits for about 1~3 seconds for the LINK indicator to flash, and then the source module of the transparent transmission sends the command.

c) In the AT command mode, the two modes are bound to each other using the "AT+FIND" command, and the operation mode is the same as the local configuration command "Automatic binding target (command code 0x14)".

d) In any mode, input a key signal (falling edge 20ms~ 200ms) on the PD13 pins of two modules that need to be bound to each other, the operation method is the same as the local configuration command "Auto binding target (command code 0x14)".

**Feedback of data transparent transmission**

When the E180ZG120 module sends data in the transparent transmission mode, there will be a result feedback, and the feedback information is less than or equal to 4 bytes. In order to distinguish the feedback information from the received transparent transmission data, it is recommended that the transparent transmission data be greater than or equal to 5 bytes. The feedback information is as follows

"OK": send successfully

"FAIL": Failed to send

"ERRO": Sending error, such as sending buffer is full, the module is not networked, the module is offline

"OFF": the module is offline, this phenomenon will occur on terminal nodes and dormant terminals

"NET": The module is back online, this phenomenon will occur on terminal nodes and dormant terminals

## 3.1.4 Switching between the three modes

**The mutual conversion of the three modes is shown in the table**

| | | target mode | | |
|---|---|---|---|---|
| | | HEX command | AT command | Transparent mode |
| current mode | HEX command | | Configuration command "Enter AT Command Mode" | Configuration command "set local properties" Property 0x0003 is set to "1" |
| | AT command | "AT+EXIT" | | "AT+SEND" |
| | Transparent | Send 3 characters | Send 3 characters "+AT" | |

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| | | | | |
|---|---|---|---|---|
| | mode | "+++" | | |

Example:

HEX command mode Switch to AT command mode:

| instructions | answer |
|---|---|
| 55 03 00 16 16 | 55 04 00 16 00 16 |
| Description: None | |

AT command mode Switch HEX command mode:

| instructions | answer |
|---|---|
| AT+EXIT | OK |
| Description: Answer here ends with \r\n,\r\n (carriage return and line feed) | |

HEX command mode switch transparent transmission mode:

| instructions | answer |
|---|---|
| 55 07 00 11 00 03 00 01 13 | 55 04 00 11 00 11 |
| Description: None | |

Transparent transmission mode switches HEX command mode:

| instructions | answer |
|---|---|
| +++ | 55 0D 80 00 00 10 E9 CE D6 FE FF 14 43 0C 3B |
| Description: E9 CE D6 FE FF 14 43 0C 3B is the MAC address. | |

AT command mode switch transparent transmission mode:

| instructions | answer |
|---|---|
| AT+SEND | SEND_MODE |
| Description: Answer here ends with \r\n,\r\n (carriage return and line feed) | |

Transparent transmission mode switches to AT command mode:

| instructions | answer |
|---|---|
| +AT | AT_MODE |
| Description: Answer here ends with \r\n,\r\n (carriage return and line feed) | |

**Restore Factory**

After factory reset, the module is in HEX command mode.

**mode after reset**

Reset in any non-HEX command mode. If the module is connected to the network, the default is data transparent transmission mode. If the module is not connected to the network, the default is AT command mode.

# 3.2 Wake up from the serial port of a sleeping node

After the module is configured in sleep mode, if you need to send serial port commands to it, you need to

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send a wake-up frame first. The serial port RX pin of the dormant terminal wakes up from the sleep state after receiving any signal (mainly the falling edge signal). The serial port RX can run normally within 0.5ms~ 200ms after the wake-up signal, and the host computer needs to write to the serial port within this time. command or transparently transmit data. At present, there are the following 3 ways to realize serial wake-up in low power mode.

### 3.2.1 delay method

Send a serial port command to the sleep node, first send a single byte of 0x00, and then send a HEX command or AT command or a transparent message within 1ms~200ms.

### 3.2.2 continuous click

This method is suitable for manually operating the upper computer to send HEX commands or AT commands to the dormant node. First operate the host computer to send a command to the module, this command is used to wake up the module, but the command is not received completely and the module receives an error command. It then needs to issue a second command to the sleep module within 200 milliseconds. This method is not suitable for transparent data transmission, because there is no error detection for transparent data transmission, which will cause wrong data packets to be sent out.

### 3.2.3 insertion method

This method is suitable for HEX command mode, AT command mode, and data transparent transmission mode. Insert several bytes of 0x00 before the command or data to wake up the serial port. The number of 0x00 inserted is determined by the serial port baud rate, and the accumulated baud rate is 0.5ms. Because the RX starts to take effect 0.5ms after the module wakes up, if it is in AT mode or transparent transmission mode, neither more nor less 0x00 can be inserted.

| baud rate | Insert 0x00 bytes |
|---|---|
| 230400 | 12 |
| 115200 | 6 |
| 57600 | 3 |
| 38400 | 2 |
| 19200 | 1 |
| 9600 | 1 |

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# 3.3 ZCL Standard Specification for Modules

The E180-ZG120A/B module has 4 APS layer ports. Port 1 is for transparent transmission control, and ports 2, 3, and 4 are for PWM output control. The specifications are as follows.

## 3.3.1 E180-ZG120A/B ZCL Specification Function Allocation Table

| port number | Profile | Device ID | in cluster) | out cluster |
|---|---|---|---|---|
| 1 | 0x0104<br>HA protocol | 0x0050<br>gateway device | 0x0000: BASIC<br>0x0003: IDENTIFY<br>0x0004: GROUP<br>0x0007: ONOFF SWITCH<br>0xFC08: EBYTE_TRANS | 0x0003: IDENTIFY<br>0x0006: ONOFF<br>0x0008: LEVEL |
| 2 | 0x0104<br>HA protocol | 0x0101<br>Dimmable light | 0x0003: IDENTIFY<br>0x0004: GROUP<br>0x0005: SCENE<br>0x0006: ONOFF<br>0x0008: LEVEL | none |
| 3 | 0x0104<br>HA protocol | 0x0101<br>Dimmable light | 0x0003: IDENTIFY<br>0x0004: GROUP<br>0x0005: SCENE<br>0x0006: ONOFF<br>0x0008: LEVEL | none |
| 4 | 0x0104<br>HA protocol | 0x0101<br>Dimmable light | 0x0003: IDENTIFY<br>0x0004: GROUP<br>0x0005: SCENE<br>0x0006: ONOFF<br>0x0008: LEVEL | none |

## 3.3.2 ZCL specification of Ebyte transparent transmission protocol

Ebyte ZigBee module transparent transmission protocol completely follows the ZCL specification, and uses a custom cluster ID and a custom manufacturer code (Manufacture Code) to enrich the ZCL standard specification library. The module can be connected to the ZigBee network of other manufacturers, in addition to completing the data transparent transmission function, it can also realize the functions of light control and switch control.

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**cluster specification：**

cluster ID = 0xFC08，Manufacture Code=0x2000

**property sheet：**

| AttrID | Direction | Descriptor | Name | Type of Data | Operation |
|---|---|---|---|---|---|
| 0x0000 | Server | Baud | baud rate | uint32 | read only |
| 0x0001 | Server | targetAddr | Default destination short address | uint16 | read and write |
| 0x0002 | Server | targetEP | Default destination port | uint8 | read and write |
| 0x0003 | Server | sendMode | Transparent mode | bool | read and write |
| 0x0004 | Server | LP Level | low power mode | enum8 | read only + report |
| 0x0005 | Server | target IEEE | Destination MAC address display | EUI64 | read only |

**ZCL control command (Special Command) table：**

| cmdID | direction | Descriptor | name | parameter |
|---|---|---|---|---|
| 0x00 | C->S | UartSend | Transparent data transmission | uint8 data[]: Transparent data transmission |
| 0x00 | S->C | UartNotify | Transparent data notification | uint8 data[]: Transparent data transmission |
| 0x01 | C->S | SetDstAddr | Set default target | uint16 dstAddr: target short address<br>uint8 endpoint: destination port |
| 0x01 | S->C | SetDstAddrRsp | set default target return | uint8 status: ZCL status |
| 0x02 | C->S | SetBaud | set baud rate | uint32 baud: Set the new baud rate, restart to take effect |
| 0x02 | S->C | SetBaudRsp | set baud rate return | uint8 status: ZCL status |
| 0x03 | C->S | SetLP_Level | Set low power mode | uint8 LP_level: Low power level |
| 0x03 | S->C | SetLP_LevelRsp | Set low power return | uint8 status: ZCL status |
| 0x04 | C->S | Reset | Module restart | uint8 extAddr[8]: The MAC address of the module |

- The transparent transmission module sends transparent transmission using "transparent data notification", and the gateway or coordinator sends data to the transparent transmission module using "transparent data sending".
- The baud rate only supports 6 modes: 9600, 19200, 38400, 57600, 115200, 230400.
- The value of low power mode is 0~3, corresponding to 0 = 1 second wake up, 1 = 3 second wake up, 2 = 5 second wake up, 3 = 1 minute wake up.

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# 3.4 Function buttons, status indicators and PWM output

The E180ZG120 module has 2 groups of button input IO ports, 1 group of LED flashing indication IO ports, and 3 groups of PWM output IO ports.

## 3.4.1 pin assignment

Network function key –> PD_13
Baud rate reset key –> PB_11
Status Indicator -> PF_7 (E180-ZG120A)
Port 0 PWM -> PF2 (E180-ZG120A)
Port 1 PWM -> PF3 (E180-ZG120A)
Port 2 PWM -> PF4 (E180-ZG120A)
Status Indicator -> PF_3 (E180-ZG120B)
Port 0 PWM -> PB_14 E180-ZG120B)
Port 1 PWM -> PB_15 (E180-ZG120B)
Port 2 PWM -> PB_13 (E180-ZG120B)
UART_RX -> PA_1
UART_TX -> PA_0

## 3.4.2 Network function key function introduction

**One key network function：**

Modules that have been configured as routing nodes, terminal nodes and dormant terminal nodes can be added to a coordinator with a network open by pressing the network function key briefly (less than 1 second) and then releasing it when it is not connected to the network or leaves the network.

If the module is configured as a coordinator, short press the network function key when the coordinator has not established a network to directly create a new network, short press the key for the coordinator of an existing network to start the distribution network, and short press the key for the coordinator of an existing network to close the network.

**Automatic binding function：**

Two nodes that have been connected to the network, press this key in succession (3 seconds interval, the status indicator of the module to be pressed first flashes), and automatically bind the data transparent transmission; if you need to bind the control light or switch, you can first Let the light or switch enter the Identify state, and then short press the button on the module. After the binding is successful, the module can control the light or switch through AT commands, and receive the status attribute report of the light and switch. When binding lights or switches, you can set multiple lights or switches to enter the Identify state at one time, and the module can bind multiple lights or switches at the same time with one keystroke. The coordinator does not support the automatic binding function.

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**Off-grid and factory reset：**

For a module that has been connected to the network, press and hold this key for 5 seconds, and when the status indicator is on, release the key to exit the current network. When the module has been disconnected from the network, press and hold this key for 5 seconds. When the status indicator is always on, the factory settings will be restored. (Off network modules cannot be restored to factory by any command, but can be restored to factory by pressing this key)

### 3.4.3 Status indicator: (It is recommended that this pin be connected to a low level to drive the LED)

This pin is usually high level, when the following events occur, it will output a continuously changing high and low level.

**Node access status：**

The module is configured as routing, terminal node, and dormant terminal node. After the first successful network access, this pin outputs a low level of 166ms 3 times, and the interval between the two low levels is 166ms.

**The coordinator created the network successfully:**

The coordinator successfully created the network for the first time, the pin outputs a low level of 166ms 3 times, and the interval between the two low levels is 166ms.

**Network open status:**

When the coordinator starts to distribute the network, or the network of the routing node is opened by the coordinator, this pin outputs a low level of 500ms, and outputs a low level again every 500ms, until the network is closed (including manual closing and automatic closing).

**Identify tag status:**

When the router or terminal node is marked by Identify, this pin outputs a low level for 500ms until the end of the Identify mark. This function can be used to visually detect where the module with a certain MAC address or short address is located.

Precautions:

The network open state and Identify flag state of the routing node, the output signal of this pin is the same, so in actual operation, the two operations should be avoided at the same time.

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# 4.Application configuration example

## 4.1 Example 1: Coordinator HEX command to control network access nodes

Example introduction:

The E180ZG120 module is set up as a coordinator and creates a network. Another E180ZG120 module (normal terminal node + transparent transmission mode) is added to this coordinator, and completes device identification, data transparent transmission control and PWM control.

### 4.1.1 E180-ZG120A/B coordinator to create network

At this stage, after the E180-ZG120A/B module is restored to the factory mode, it is set as the coordinator, and a new network is started and created.

**Step 1: Check whether the module is currently networked**

Send the configuration command "Query the current status of the module (type 0x00, code 0x00)":
55 03 00 00 00
Received the feedback of "Query the current status of the module":
55 2A 00 00 00 02 6E 93 50 FE FF 14 2E 84 0F 7E CC D8 2B FB FD FE 7F BF DF 6F 37 57 AE 5C 01 D4 35 FA D4 D3 9A 23 47 A2 3F 2D 30 27
Parse serial port feedback:
Network Status: Networked
Device Type: Normal Endpoint
MAC address: 6E 93 50 FE FF 14 2E 84
Channel: 0x0F = 15 channels
PANID: 0xCC7E

**Step 2: Restore the module to the factory**

Send the configuration command "reset/restore to factory (type 0x00, code 0x04)":
55 07 00 04 02 7E CC 0F BB
Parse the send command
Reset mode: 0x02 – factory reset, that is, all parameters saved in FLASH need to be erased
PANID: 0xCC7E
Channel: 0x0F - 15 channels
Receive "reset/factory reset" feedback command:
55 04 00 04 00 04
Wait 2 seconds, the module restarts.
Received asynchronous command system notification "device started (type 0x80, code 0x00)":
55 0D 80 00 00 00 6E 93 50 FE FF 14 2E 84 92


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Parse asynchronous feedback:

Reset Mode: 0x00 - Watchdog soft reset on E180ZG120

Version: 0x00

MAC address: 6E 93 50 FE FF 14 2E 84

**Step 3: Set the device type to coordinator and restart**

Send the configuration command "set node type (type 0x00, code 0x05)":

55 04 00 05 00 05

Parse the send command

Node Type: 0x00 - Coordinator

Received a "set node type" feedback command:

55 04 00 05 00 05

Send the configuration command "reset/restore to factory (type 0x00, code 0x04)":

55 07 00 04 00 FF FF 00 04

Parse the send command

Reset mode: 0x00 - direct reset

PANID: 0xFFFF – reset directly without exiting the network

Channel: 0xFF - reset directly without exiting the network

Receive the feedback command of "reset/factory reset":

55 04 00 04 00 04

After waiting for 1 second, the asynchronous command system notification "device started (type 0x80, code 0x00)" is received:

55 0D 80 00 00 00 6E 93 50 FE FF 14 2E 84 92

☆. Receiving "device startup notification" indicates that the coordinator is successfully set up.

**Step 4: Coordinator distribution network**

Send the configuration command "Start distribution network (type 0x00, code 0x02)":

55 03 00 02 02

Receive the feedback command of "Start distribution network":

55 04 00 02 00 02

Parse the feedback command:

Status: 0x00 - Success

Wait for the coordinator module to create a new network (2 seconds this time)

Received asynchronous command system notification "Network state change (type 0x80, code 0x01)":

55 29 80 01 01 6E 93 50 FE FF 14 2E 84 14 BB B3 00 00 76 8E 17 47 E7 A7 27 27 E9 AB DE D6 A7 AD D3 8C A0 FC A5 3E 7A C5 CC 2B E6

Parse asynchronous commands:

Network Status - 0x01 Networked

MAC address: 6E 93 50 FE FF 14 2E 84

Channels: 0x14 – 20 channels

PANID: 0xB3BB

Short address: 0x0000 – Coordinator address

Extended PANID: 76 8E 17 47 E7 A7 27 27

Network key: E9 AB DE D6 A7 AD D3 8C A0 FC A5 3E 7A C5 CC 2B

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Continue to receive asynchronous command system notification "Turn on and off network notifications (type 0x80, code 0x02)"

55 04 80 02 B4 36

Parse asynchronous commands:

Allowed access time: 0xB4 -180 seconds, if the command is received again and the open time becomes 0, it means the network is closed.

### 4.1.2 Joining of new nodes to the network and identification and configuration of new nodes

In this stage, an E180ZG120 module set to the common terminal node + transparent transmission mode is added to the coordinator network, and the network access module uses a keyed network. After entering the network, complete the identification of the network access module.

**Step 1: Redistribution of coordinator**

Send the configuration command "Start distribution network (type 0x00, code 0x02)":

55 03 00 02 02

Received the feedback command of "Start distribution network"

55 04 00 02 00 02

Then received the asynchronous command system notification "Turn on and off network notifications (type 0x80, code 0x02)"

55 04 80 02 B3 31

**Step 2: Set up coordinator and start distribution network**

☆.Another E180ZG120 module (common terminal node+transparent transmission mode) needs to join the coordinator by briefly pressing the network function key within 180 seconds after the coordinator allows access to the network. The following are the serial port command operations of the coordinator.

Received the asynchronous command system notification "detection node is connected to the network (type: 0x80, code 0x03)":

55 10 80 03 C1 5E CA FE FF 5F 32 50 C5 B9 00 00 00 96

Parse asynchronous commands:

MAC address: C1 5E CA FE FF 5F 32 50

Short address: 0xB9C5

Parent node short address: 0x0000

Immediately after receiving the asynchronous command system notification "node short address notification (type 0x80, code 0x04)":

55 0E 80 04 C1 5E CA FE FF 5F 32 50 C5 B9 02 93

Parse asynchronous commands

MAC address: C1 5E CA FE FF 5F 32 50

Short address: 0xB9C5

Node Type: 0x02 - Normal Terminal Node

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### Step 3: Check the number of ports on the network access node

☆.This step queries the number of application layer ports of the network access node.

Send the network management command "query node port number (type 0x01, code 0x05)"

55 05 01 05 C5 B9 78

Parse the send command:

Destination address: 0xB9C5

Received "Query Node Port Number" feedback

55 05 01 05 00 02 06

Parse the feedback command:

Execution Status: 0x00 - Success

Command number: 0x02, the command number is assigned by the system of the module

Received asynchronous command "Send confirmation of network management command"

55 07 8F 01 C5 B9 02 00 F0

Parse send confirmation:

Destination address: 0xB9C5

Command number: 0x02

Send result: 0x00 - send successfully

Received asynchronous command "Query node port number response (type 0x81, code 0x05)"

55 0C 81 05 C5 B9 02 00 04 01 02 03 04 FA

Parse asynchronous response commands

The other party's short address: 0xB9C5

Command number: 0x02

Execution result: 0x00

Port number: 0x04

Port list: 0x01, 0x02, 0x03, 0x04

### Step 4: View the details of port 1

Send the network management command "query node port information (type 0x01, code 0x04)":

55 06 01 04 C5 B9 01 78

Parse the send command:

Target short address: 0xB9C5

Query port: 0x01

Received feedback on "Query Node Port Information"

55 05 01 04 00 03 06

Parse the feedback command:

Execution Status: 0x00 - Success

Command number: 0x03

Received asynchronous command "Query node port information response (type 0x81, code 0x04)"

55 21 81 04 C5 B9 03 00 01 04 01 50 00 00 05 00 00 03 00 04 00 07 00 08 FC 04 03 00 06 00 08 00 08 FC A2

Parse asynchronous response commands:

The other party's short address: 0xB9C5

Command number: 0x03

Execution result: 0x00

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Port number: 0x01
Port outline: 0x0104
Device ID: 0x0050 (gateway control device)
Device version: 0x00
Enter the number of clusters: 0x05
Input cluster list: 0x0000, 0x0003, 0x0004, 0x0007, 0xFC08
Number of output clusters: 0x04
Output cluster list: 0x0003, 0x0006, 0x0008, 0xFC08
☆.The inversion of the response command and the sending acknowledgment here is because the Silicon Labs system enables APS ACK when sending the command, which makes the command transmission more reliable, which is a normal phenomenon.
Received asynchronous command "Send confirmation of network management command"
55 07 8F 01 C5 B9 03 00 F1
Parse send confirmation:
Destination address: 0xB9C5
Command number: 0x03
Send result: 0x00 - send successfully

**Step 5: View the detailed information of port 2, the operation methods of port 3 and port 4 are the same**

Send the network management command "query node port information (type 0x01, code 0x04)" to query port 2:
55 06 01 04 C5 B9 02 7B
Received feedback on this command, the command number is 0x04:
55 05 01 04 00 04 01
Received asynchronous command "Query node port information response (type 0x81, code 0x04)"
55 19 81 04 C5 B9 04 00 02 04 01 01 01 00 05 03 00 04 00 05 00 06 00 08 00 00 F3
Parse the asynchronous response command for port 2:
The other party's short address: 0xB9C5
Command number: 0x04
Execution result: 0x00
Port number: 0x02
Port outline: 0x0104
Device ID: 0x0101 (dimmable lighting device)
Device version: 0x00
Enter the number of clusters: 0x05
Input cluster list: 0x0003, 0x0004, 0x0005, 0x0006, 0x0008
Number of output clusters: 0x00
☆.By querying the ZCL specification, port 2 is a lighting device, supporting grouping, scene control, switch control, and brightness adjustment
Received asynchronous command "Send confirmation of network management command"
55 07 8F 01 C5 B9 03 00 F1

☆.Use the same method as querying port 2 to query port 3 and port 4 to obtain their function information.

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**Suggested use of sending confirmation:**

On Silicon-based ZigBee modules or devices, there are situations where responding to commands and sending confirmation commands are reversed. It is recommended that the host only processes the response command when processing information, and sending the confirmation command can be used as the judgment basis for waiting for the timeout of the response command to end; it can also be used as the blocking condition for querying a single node, and no response command is received when querying a node. or sending confirmation of either command, no subsequent commands shall be sent to the target.

### Step 6: Set the binding of the attribute report of the network access node

☆*.Port 1 has input cluster 0xFC08, and port 2, port 3, and port 4 have input cluster 0x0006 and 0x0008. Use the network management command "set node constant connection binding" to bind it to the serial port control port (port 1) of the coordinator.*

*Send the network management command "Set node constant connection binding (type 0x01, code 0x21)":*

*55 19 01 21 C5 B9 01 C1 5E CA FE FF 5F 32 50 08 FC 01 6E 93 50 FE FF 14 2E 84 D3*

*Parse the send command*

*Target short address: 0xB9C5*

*Source virtual SN: 01 C1 5E CA FE FF 5F 32 50, the virtual SN of port 1 of the network access node*

*Cluster ID: 0xFC08, Ebyte serial port transparent transmission function cluster*

*Target virtual SN: 01 6E 93 50 FE FF 14 2E 84, the coordinator's serial port virtual SN*

*received feedback on the order*

*55 05 01 21 00 08 28*

*Received asynchronous command "set node ALWAYS binding response (type 0x01, code 0x21)":*

*55 07 81 21 C5 B9 08 00 D4*

*Parse asynchronous response commands*

*The other party's short address: 0xB9C5*

*Command number: 0x08*

*Execution result: 0x00 - binding succeeded*

*Received asynchronous command "Send Acknowledge"：*

55 7 8F 01 C5 B9 08 00 FA

☆.When setting up the binding, it also happened that the response command and the sending acknowledgment were reversed. According to this format, continue to bind the cluster 0x0006 and cluster 0x0008 of port 2, port 3, and port 4 of the inbound node.

## 4.1.3 Control access nodes

### Step 1: Receive the attribute report of the network access node

☆.The attribute report of the node can be used as a heartbeat packet

Received the ZCL asynchronous command "property active reporting (type 0x82, code 0x0A)":

55 13 82 0A 00 C5 B9 01 07 01 08 FC 00 20 DF 01 04 00 30 00 CD

Parse the received asynchronous command:

Receive port: 0 - the module's default port (port 1) to receive the message

Receive mode: 0 - On-demand mode, can't judge whether the signal strength is valid or not

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Source short address: 0xB9C5

Source port: 0x01

Frame number: 0x07

Command direction: 0x01 – Server To Client

Cluster ID: 0xFC08

Manufacturer code: 0x2000

Signal Strength: 0xDF = -33dbm

Total number of reported attributes: 0x01

Report attribute ID: 0x0004 Low power consumption level of the network access module

Attribute data type: 0x30 = enum8

Data value: 0x00

Received the ZCL asynchronous command "attribute active report (type 0x82, code 0x0A)" from other ports:

55 13 82 0A 00 C5 B9 02 16 01 06 00 00 00 D9 01 00 00 10 01 2E

55 13 82 0A 00 C5 B9 02 17 01 08 00 00 00 DA 01 00 00 20 FF EC

55 13 82 0A 00 C5 B9 03 18 01 06 00 00 00 DA 01 00 00 10 01 22

55 13 82 0A 00 C5 B9 03 19 01 08 00 00 00 DA 01 00 00 20 FF E3

55 13 82 0A 00 C5 B9 04 1A 01 06 00 00 00 DA 01 00 00 10 01 27

55 13 82 0A 00 C5 B9 04 1B 01 08 00 00 00 DA 01 00 00 20 FF E6

Parse the first asynchronous command received:

Receive port: 0 – port 1

Receive Mode: 0 - On Demand Mode

Source short address: 0xB9C5

Source port: 0x02

Frame number: 0x16

Command direction: 0x01 – Server To Client

Cluster ID: 0x0006

Manufacturer code: 0x0000

Signal strength: 0xD9 = -39dbm

Total number of reported attributes: 0x01

Report attribute ID: 0x0000 PWM output switch status

Attribute data type: 0x10 = bool

Data value: 0x01 PWM output on

Parse the second asynchronous command received:

Receive port: 0 – port 1

Receive Mode: 0 - On Demand Mode

Source short address: 0xB9C5

Source port: 0x02

Frame number: 0x17

Command direction: 0x01 – Server To Client

Cluster ID: 0x0008

Manufacturer code: 0x0000

Signal Strength: 0xDA = -38dbm

Total number of reported attributes: 0x01

Report attribute ID: 0x0000 PWM output brightness

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Attribute data type: 0x20 = uint8

Data value: 0xFF PWM output duty cycle is 255/255, i.e. 100%.

### Step 2: Read the properties of the incoming node

☆.The port 1 of the network access node supports cluster ID=0x0000, and there are attributes related to the node's identity information under this cluster.

Send ZCL command "Read Device Properties (Type 0x02, Code 0x00)"

55 1F 02 00 00 C5 B9 01 A1 00 00 00 00 00 00 08 00 00 01 00 02 00 03 00 04 00 05 00 06 00 07 00 D6

Parse the send command:

Outgoing port: 0 – default port (port 1)

Send Mode: 0 – normal send, no encryption

Target short address: 0xB9C5

Destination port: 0x01

Frame number: 0xA1

Command direction: 0x00 – Client To Server

Cluster ID: 0x0000

Manufacturer code: 0x0000

Response mode: 0x00 - use Default Response, do not enable APS Ack

Total number of properties read: 0x08

List of property IDs: 0x0000, 0x0001, 0x0002, 0x0003, 0x0004, 0x0005, 0x0006, 0x0007

Received command feedback:

55 05 02 00 00 A1 A3

Received send confirmation of ZCL command (type 0x8F, code 0x02):

55 0A 8F 02 00 C5 B9 01 A1 00 00 51

Parse send confirmation:

Outgoing port: 0 – default port (port 1)

Send Mode: 0 – normal send, no encryption

Target short address: 0xB9C5

Destination port: 0x01

Frame number: 0xA1

Command direction: 0x00 – Client To Server

Send result: 0x00 - send successfully

Received ZCL asynchronous command "Read Device Properties Response (Type 0x82, Code 0x00)"

55 4F 82 00 00 C5 B9 01 A1 01 00 00 00 00 D6 08 00 0000200801 0000201002 0000200003 0000200004 0000420545 42 59 54 4505 0000420B 46 57 37 34 32 31 2D 30 2D 31 3006 00004208 32 30 32 32 30 39 31 3607 00003000 8E

Parse ZCL async commands: attribute ID underlined, red ZCL status, green attribute data type, blue attribute data value

Receive port: 0 – port 1

Receive Mode: 0 - On Demand Mode

Source short address: 0xB9C5

Source port: 0x01

Frame number: 0xA1

Command direction: 0x01 – Server To Client

Cluster ID: 0x0000

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Manufacturer code: 0x0000

Signal strength: 0xD6 = -42dbm

Number of properties read: 0x08

Read the list of properties:

Attribute 0x0000 (ZigBee version) is valid, data type uint8, value 0x08

Attribute 0x0001 (software version) is valid, data type uint8, value 0x10

Attribute 0x0002 (protocol version) is valid, data type uint8, value 0x00

Attribute 0x0003 (hardware version) is valid, data type uint8, value 0x00

Attribute 0x0004 (vendor name) is valid, data type string, value is 5 bytes "EBYTE"

The attribute 0x0005 (product model) is valid, the data type is string, and the value is 11 bytes "FW7421-0-10"

Attribute 0x0006 (compile date) is valid, data type string, value 8 bytes "20220916"

Attribute 0x0007 (power mode) is valid, data type enum8, value 0x00

☆. Use the read attribute command to read the identity information of the connected device, as well as the current baud rate, PWM switch status, PWM brightness (duty cycle) and other device status parameters.

**Step 3: Transparent data transmission of the receiving node**

Received ZCL asynchronous command "Control command (type 0x82, code 0x0F)":

55 19 82 0F 00 C5 B9 01 0E 01 08 FC 00 20 DB 00 31 32 33 34 35 36 37 38 39 30 F1

Parse ZCL asynchronous commands:

Receive port: 0 – port 1

Receive Mode: 0 - On Demand Mode

Source short address: 0xB9C5

Source port: 0x01

Frame number: 0x0E

Command direction: 0x01 – Server To Client

Cluster ID: 0xFC08

Manufacturer code: 0x2000

Signal Strength: 0xDB = -37dbm

Command ID: 0x00 - transparently transmit received data

Command parameters: 31 32 33 34 35 36 37 38 39 30 – The network access node transparently transmits the ASCII string "1234567890"

**Step 4: Send serial port transparent data to the network access node**

Send ZCL command "Control Command (Type 0x02, Code 0x0F)":

55 19 02 0F 00 C5 B9 01 8C 00 08 FC 00 20 00 00 31 32 33 34 35 36 37 38 39 30 29

Parse the send command:

Outgoing port: 0 – default port (port 1)

Send Mode: 0 – normal send, no encryption

Target short address: 0xB9C5

Destination port: 0x01

Frame number: 0x8C

Command direction: 0x00 – Client To Server

Cluster ID: 0xFC08

Manufacturer code: 0x2000

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Response mode: 0x00 - use Default Response, do not enable APS Ack
Command ID: 0x00 - Transparent transmission
Command parameters: 31 32 33 34 35 36 37 38 39 30 – The network access node prints out the ASCII string "1234567890"
Receive feedback command:
55 05 02 0F 00 8C 81
Received send confirmation of ZCL command (type 0x8F, code 0x02):
55 0A 8F 02 00 C5 B9 01 8C 00 00 7C
Received ZCL asynchronous command "Default return frame (type 0x82, code 0x0B)"
55 10 82 0B 00 C5 B9 01 8C 01 08 FC 00 20 D5 00 00 78
Parsing ZCL asynchronous commands
Receive port: 0 – port 1
Receive Mode: 0 - On Demand Mode
Source short address: 0xB9C5
Source port: 0x01
Frame number: 0x8C
Command direction: 0x01 – Server To Client
Cluster ID: 0xFC08
Manufacturer code: 0x2000
Signal strength: 0xD5 = -43dbm
Command ID: 0x00
ZCL Status: 0x00 - Operation successful

**Step 5: Control the PWM on/off on the module (control the port 2 of the other party)**

Send ZCL command "Control Command (Type 0x02, Code 0x0F)":
55 0F 02 0F 00 C5 B9 02 45 00 06 00 00 00 00 02 32
Parse control commands:
Outgoing port: 0 – default port (port 1)
Send Mode: 0 – normal send, no encryption
Target short address: 0xB9C5
Destination port: 0x02
Frame number: 0x45
Command direction: 0x00 – Client To Server
Cluster ID: 0x0006
Manufacturer code: 0x0000
Response mode: 0x00 - use Default Response, do not enable APS Ack
Command ID: 0x02 - switch toggle
Command parameters: none
Receive feedback command:
55 05 02 0F 00 45 48
Received send confirmation of ZCL command (type 0x8F, code 0x02):
55 0A 8F 02 00 C5 B9 02 45 00 00 B6
Received ZCL asynchronous command "Default return frame (type 0x82, code 0x0B)"
55 10 82 0B 00 C5 B9 02 45 01 06 00 00 00 DA 02 00 6D

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☆. Observe that the PWM output of the target node goes out

Received the ZCL asynchronous command "property active reporting (type 0x82, code 0x0A)":

55 13 82 0A 00 C5 B9 02 0D 01 06 00 00 00 DA 01 00 00 10 00 37

55 13 82 0A 00 C5 B9 02 0E 01 08 00 00 00 DA 01 00 00 20 FF F5

☆.Turn on and off the light on the PWM output port of the target node, and the attribute corresponding to the PWM will also be reported to the coordination.

## 4.2 Example 2: Terminal node AT command configuration and data transparent transmission

Example introduction:

The E180ZG120 module is configured as a dormant terminal node, uses AT commands to access the network, and completes the demo of transparent data transmission.

### 4.2.1 The module is configured in AT command mode to access the network

**Step 1: Configure AT Command Mode**

Send the local configuration command "Enter AT command mode (type 0x00, code 0x16)"

55 03 00 16 16

Receive feedback command:

55 04 00 16 00 16

**Step 2: Query the current status of the module**

Enter the AT command "AT+INFO?"

Module output:

"NO NET\r\n"

"TYPE=Coordinate\r\n "

"MAC=0x50325FFFFECA5EC1\r\n "

The module is not connected to the network

**Set the mod to sleep the terminal**

Enter the AT command "AT+DEVTYPE?"

Module output:

"DEVTYPE=COORDINATOR\r\n"

Enter the AT command "AT+DEVTYPE=3"

Module output:

"OK\r\n"

Enter the AT command "AT+RESET"

Module output:

"OK\r\n"

wait 1 second

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Module output:

"BOOT=0\r\n"

"VERSION=0\r\n"

"AT_MODE\r\n"

**Step 3: Module access to the network**

☆.Operation when the coordinator opens to allow access to the network

Enter the AT command "AT+JOIN", and enter " \0\0\0\0\0\0AT+JOIN" in the sleep terminal

Module output:

"OK\r\n"

wait a few seconds

Module output:

"NET:JOIN\r\n"

☆.The module is successfully connected to the network

Enter the AT command "AT+INFO?", and enter "\0\0\0\0\0\0AT+INFO?" in the sleep terminal

Module output:

" TYPE=SleepyEndDevice\r\n

MAC=0x50325FFFFECA5EC1\r\n

PANID=0xB3BB\r\n

CHANNEL=20\r\n

ADDR=0x3F48\r\n"

## 4.2.2 Data transparent transmission

**Step 1: Set the transparent transmission target**

☆.Set the serial port of the coordinator as the transparent transmission target

Input AT command "AT+DSTADDR=0000", input "\0\0\0\0\0\0 AT+DSTADDR=0000" in sleep terminal

Module output:

"OK\r\n"

Input AT command "AT+DSTEP=1", input "\0\0\0\0\0\0 AT+DSTEP=1" in sleep terminal

module output：

"OK\r\n"

**Step 2: Switch to transparent transmission mode**

*Method 1: Enter the AT command "AT+SEND", and enter "\0\0\0\0\0\0 AT+SEND " in the sleep terminal*

*Module output:*

*"SEND_MODE\r\n"*

*Method 2: Enter the AT command "AT+RESET", enter "\0\0\0\0\0\0 AT+RESET" in the sleep terminal, or reset the module*

*Module output:*

*"OK\r\n"*

*Wait 1~2 seconds*

*Module output:*

*"BOOT=0\r\n*

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*VERSION=0\r\n*

*SEND_MODE\r\n"*

*Wait for 1~2 seconds, the dormant terminal connects to the parent node*

module output:（Note that there is no carriage return at the end）

"NET"

**The third step: data transparent transmission**

Enter the transparent data "HelloWorld", and enter " \0\0\0\0\0\0HelloWorld " in the sleep terminal

Module output: (note that there is no carriage return at the end)

"OK"

The coordinator side receives the ZCL asynchronous command:

55 19 82 0F 00 48 3F 01 0B 01 08 FC 00 20 DB 00 48 65 6C 6C 6F 57 6F 72 6C 64 FE

**Step 4: Data transparent transmission and reception**

☆.The coordinator refers to the operation of sending data to the transparent transmission module by referring to "Sending serial port transparent data to the network access node"

The coordinator sends the ZCL command:

55 19 02 0F 00 48 3F 01 8C 00 08 FC 00 20 00 00 31 32 33 34 35 36 37 38 39 30 22

The transparent transmission module receives:

Module output:

"1234567890"

**Step 5: Automatically bind the transparent transmission target**

☆.Join another node (routing node)

Enter the AT command "At+FIND", the sleep node input "\0\0\0\0\0\0AT+FIND", the route is 3 seconds earlier than the sleep node to enter the command

Module output:

"OK\r\n"

wait a few seconds

Module output:

"FIND:ADDR=0x7436 EP=1 cluster=0xFC08\r\n

FIND:ADDR=0x7436 EP=1 cluster=0xFC08\r\n

RSP:0x7436-1 IDENT:SUCCESS\r\n

RSP:0x7436-1 IDENT:SUCCESS\r\n"

☆.The above printing information appears, the binding is successful.

☆.Operations on the Routing Node Side

Enter the AT command "At+FIND"

Routing node output:

"OK\r\n"

Wait about 1~3 seconds

routing node output:

"FIND:MISS\r\n"

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☆.The routing node is the party to be found. After printing "FIND:MISS", it enters the Identify state and waits for other nodes to bind.

### 4.2.3 AT command light

**Step 1: Set the binding control light**

☆.First, send a binding command to the dormant terminal on the coordinator to bind the PWM port of the controlled node (routing node).

The coordinator sends the network management command "Set node constant connection binding (type 0x01, code 0x21)", and the dormant node inserts 6 0x00s:

55 19 01 21 48 3F 01 C1 5E CA FE FF 5F 32 50 06 00 02 CB 5E CA FE FF 5F 32 50

Parse the send command:

Target short address: 0x3F48

Source virtual SN: 01 C1 5E CA FE FF 5F 32 50, the virtual SN of port 1 of the transparent transmission module

Cluster ID: 0x0006, switch control cluster

Target virtual SN: 02 CB 5E CA FE FF 5F 32 50, port 2 of routing node controls PWM

Feedback received:

55 05 01 21 00 04 24

Asynchronous command binding response received (type 0x81, code 0x21)

55 07 81 21 48 3F 04 00 D3

Receive confirmation of delivery

55 07 8F 01 48 3F 04 00 FD

☆.According to the above method, the control coordinator binds the transparent transmission port (port 1) of the dormant terminal to the port 2, port 3 and port 4 of the routing node respectively with cluster ID=0x0006 and cluster ID=0x0008.

☆.Then test whether the sleep terminal is bound to the PWM output of the routing node.

Enter the AT command "AT+IDENTIFY?"

module output：

"(0)TRANS:SN=[01.CB.5E.CA.FE.FF.5F.32.50] \r\n

(1)ONOFF:SN=[02.CB.5E.CA.FE.FF.5F.32.50] \r\n

(2)LEVEL:SN=[02.CB.5E.CA.FE.FF.5F.32.50] \r\n

(3)ONOFF:SN=[03.CB.5E.CA.FE.FF.5F.32.50] \r\n

(4)LEVEL:SN=[03.CB.5E.CA.FE.FF.5F.32.50] \r\n

(5)ONOFF:SN=[04.CB.5E.CA.FE.FF.5F.32.50] \r\n

(6)LEVEL:SN=[04.CB.5E.CA.FE.FF.5F.32.50] \r\n

OK\r\n"

☆.The mod prints a menu of controllable devices

Enter the AT command "AT+IDENTIFY=1"

Module output:

"OK\r\n"

Wait 10~100ms

module output：

"RSP:0x7436-2 IDENT:SUCCESS\r\n"

☆.Observation phenomenon: The PWM output LED corresponding to port 2 of the routing node

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flashes at a frequency of 1 second

### Step 2: AT command control light on and off

Input AT command "AT+TURNOFF?", input "\0\0\0\0\0\0AT+TURNOFF?" for sleep node

module output：

"(0)ONOFF:SN=[02.CB.5E.CA.FE.FF.5F.32.50]\r\n

(1)ONOFF:SN=[03.CB.5E.CA.FE.FF.5F.32.50] \r\n

(2)ONOFF:SN=[04.CB.5E.CA.FE.FF.5F.32.50] \r\n

OK\r\n "

Enter the AT command "AT+TURNOFF=0"

Module output:

"OK\r\n"

Wait 10~100ms

module output：

"RSP:0x7436-2 ONOFF:SUCCESS\r\n"

☆.Observation phenomenon: The PWM output LED corresponding to port 2 of the routing node is off

Enter the AT command "AT+TURNOFF", and enter "\0\0\0\0\0\0AT+TURNOFF" for the sleep node

module output：

OK

Wait 10~100ms

The module outputs continuously every 10~100 milliseconds：

"RSP:0x7436-2 ONOFF:SUCCESS\r\n"

"RSP:0x7436-3 ONOFF:SUCCESS\r\n "

"RSP:0x7436-4 ONOFF:SUCCESS\r\n "

☆.Observation phenomenon: All PWM output LEDs of the routing node are off.

### Step 3: AT command to control the brightness of the light

Enter the AT command "AT+LEVELSET?", enter "\0\0\0\0\0\0AT+LEVELSET?" in the sleep terminal

Module output:

"(0)LEVEL:SN=[02.CB.5E.CA.FE.FF.5F.32.50] \r\n

(1) LEVEL:SN=[03.CB.5E.CA.FE.FF.5F.32.50] \r\n

(2) LEVEL:SN=[04.CB.5E.CA.FE.FF.5F.32.50] \r\n

OK\r\n"

Enter the AT command "AT+LEVELSET=1,2", and enter "\0\0\0\0\0\0AT+LEVELSET=1,2" in the sleep terminal

Module output:

"OK\r\n"

Wait 10~100ms

module output：

"RSP:0x7436-4 LEVEL:SUCCESS\r\n"

☆.Observation phenomenon: The brightness of the PWM output LED corresponding to port 2 of the routing node becomes very dim

### Step 4: Set up the control light with two-way binding

☆.This function requires the controlled light to enter the Identify mode first, and then the module that initiates the



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control uses the AT+FIND function to bind the target light. After the setting is successful, when using the AT command to control the light (PWM), you can receive the report message of the current state of the PWM of the controlled end.

The routing node sends the AT command "AT+PWMIDENT=0,30"

routing node module output：

"OK\r\n"

☆.Observe that the PWM0 pin of the routing node outputs a PWM signal that changes with a period of 1 second.

Dormant terminal sends AT command "\0\0\0\0\0\0AT+FIND"

Sleep terminal module output:

"OK\r\n"

Wait 100ms~1s

Sleep terminal module output：

FIND:ADDR=0x7436 EP=2 cluster=0x0006

FIND:ADDR=0x7436 EP=2 cluster=0x0008

☆.This state indicates that the dormant terminal and the controlled light have achieved two-way binding, and the controlled light can report to the dormant terminal the attribute "OnOff (switch state)" under cluster ID=0x0006 and the attribute "currentLevel (current brightness) under cluster ID=0x0008. )".

Sleeping terminal receives the following message every 5 minutes

module output：

" RPT:0x7436-2 ONOFF=1\r\n"

" RPT:0x7436-2 LEVEL=255\r\n"

☆.When the dormant terminal receives the message reported by the routing node, the first can be used as the status heartbeat packet of the controlled end, and the second can be used to monitor whether the controlled end is effectively controlled.

The dormant terminal sends the AT command " \0\0\0\0\0\0AT+LEVELSET=0,0", which sets the port 2PWM to 0% output

Module output:

"OK\r\n"

Wait 10~100ms

The module outputs continuously every 10~100 milliseconds：

"RSP:0x7436-2 LEVEL:SUCCESS\r\n "

"RPT:0x7436-2 LEVEL=125\r\n "

"RPT:0x7436-2 ONOFF=0\r\n "

"RPT:0x7436-2 LEVEL=0\r\n "

☆.The AT command of the dormant terminal sets the port 2 of the routing node corresponding to PWM to turn off the light, and the state corresponding to port 2 is reported to the dormant terminal.

## 4.3 Example 3: Host computer software configuration networking and transparent transmission

Example introduction:



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Two E180ZG120A/B modules, configured as coordinator and terminal node respectively, and then transparently transmit data to each other.

## 4.3.1Host computer software configuration coordinator

**Step 1: Set the serial port and module type**

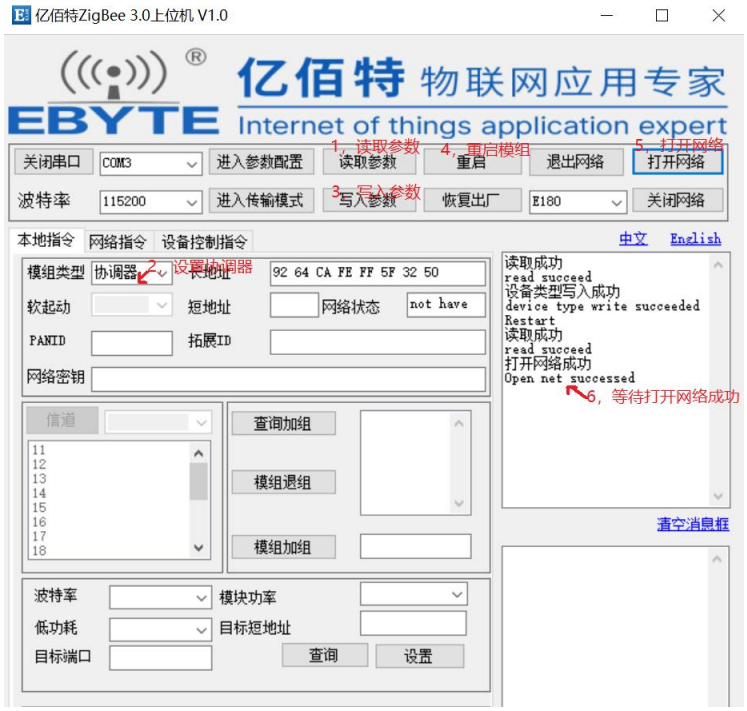



1. Select the serial port corresponding to the E180 module
2. Select the hardware model as E180
3. Set the initial baud rate to 115200
4. Open the serial port

**Step 2：Set up coordinator and start distribution network**



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1, read parameters

2. Select the coordinator mode

3. Write the configuration parameters

4. Reset the module

5, Start distribution network

6, wait for the network to open successfully

**Step 3：The third step, the coordinator starts successfully**




1. Wait for the network to be successfully opened before reading the parameters



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2. The short address of the acquired module is 0x0000, which is the coordinator
3. The obtained PANID is 0x577D, and the extended PANID is 98 59 D0 A0 40 E2 CF F7, both of which are randomly created by the coordinator
4. Obtain the current network key, which can parse the data packet in a protocol analysis tool (such as ubiqua)
5. The channel created by the coordinator is 19 channels and the frequency is 2445MHz

## 4.3.2 The host computer software configures the terminal node

**Step 1: Set up serial ports and modules, and set up network access nodes**




*1. Select the module corresponding to the serial port*

*2. Set the module to E180*

*3. Set the default baud rate to 115200*

*4. Read parameters, modules that are not connected to the network can only get the module type (default coordinator) and MAC address*

*5. Set the module type to terminal node*

*6. Write configuration parameters*

*7. Reset the module*

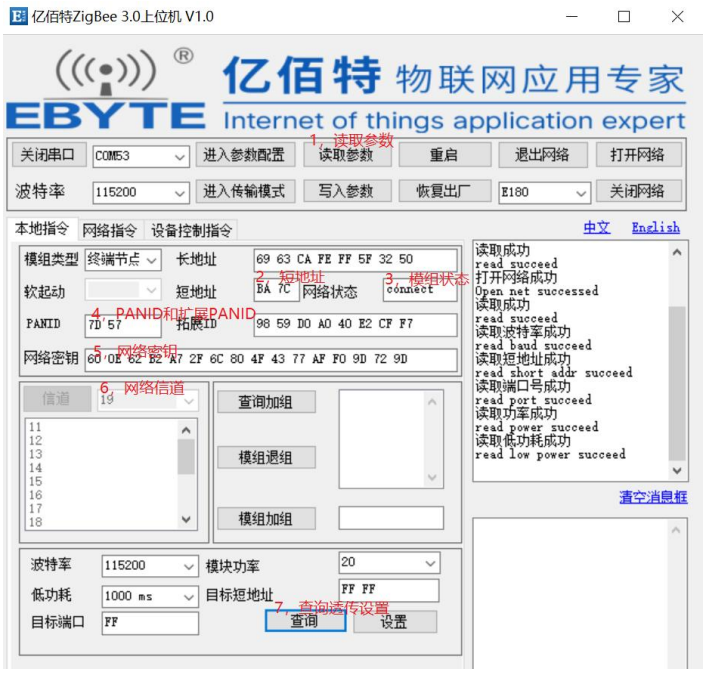
*8. Execute "Start distribution network" to enable the terminal node to join the coordinator. The coordinator must first enter the distribution network state.*

*9. Wait for the module to connect to the network successfully*

**Step 2: The terminal node is successfully connected to the network, and the module parameters are queried.**



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1. Read the module parameters after successful network access
2. The short address of the module is 0x7CBA (little endian mode)
3. The module status is connect, indicating that it has connected to the network
4. The PANID is 0x575D, which is the same as the coordinator. The extended PANID is also the same as the coordinator
5. The network key and the coordinator are the same
6. The network channel and coordinator are the same
7. Query the transparent transmission settings. The baud rate of the module is 115200, the power is 20dbm, the low power consumption is 1000ms wake-up time, and the target short address and target port are broadcast addresses.

## 4.3.3 Data communication between coordinator and end nodes

**Step 1: The coordinator views the terminal node information that has entered the network**

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1. Obtain the MAC address and short address of the network access module
2. The MAC address and short address of the network access node are displayed in the coordinator. Note that the E180 module does not support power-off saving, and the host computer needs to record it after each reading.
3. Set the target short address, and currently fill in the short address of the network access node.
4. Target port 01, manufacturer code 0x2000, cluster ID=0xFC08, the format conforms to the ZCL standard structure, fill in the format of the little endian mode, pay attention to the command direction and select "C2S".
5. Set the instruction type to "read"
6. Read the 4 attributes on the target node, 0x0000, 0x0001, 0x0002, 0x0003, and fill them in the array format in little endian mode. Then click "Send"
7. Four attributes are read, corresponding to the four parameters of "Baud Rate", "Destination Address", "Destination Port" and "Command Mode" of the network access node, which are consistent with the transparent transmission setting parameters of the network access node module.

**Step 2: The coordinator transmits data to the network access node**

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1. Fill in the destination address
2. Select the command direction as C2S
3. Fill in 0x20000 for the manufacturer code and 0xFC08 for the cluster ID, all in little endian mode
4. Select "Control" for the instruction type
5. Fill in 0x01 for the target port, and select "Default" for the answer mode
6. Fill in 0x00 for the command ID
7. Enter the data to be sent in hexadecimal array format, and then click "Send"
8. The message box area displays data packets starting with 55 10 82 0B 00 BA 7C 01, which is the message returned by the target terminal node

In the software window of the terminal node, the data sent by the coordinator is received, and the message area is output

```
ZCL received：55 17 82 0F 00 00 00 01 0E 00 08 FC 00 20 E8 00 31 32 33 34 35 36 37 38 B6
```

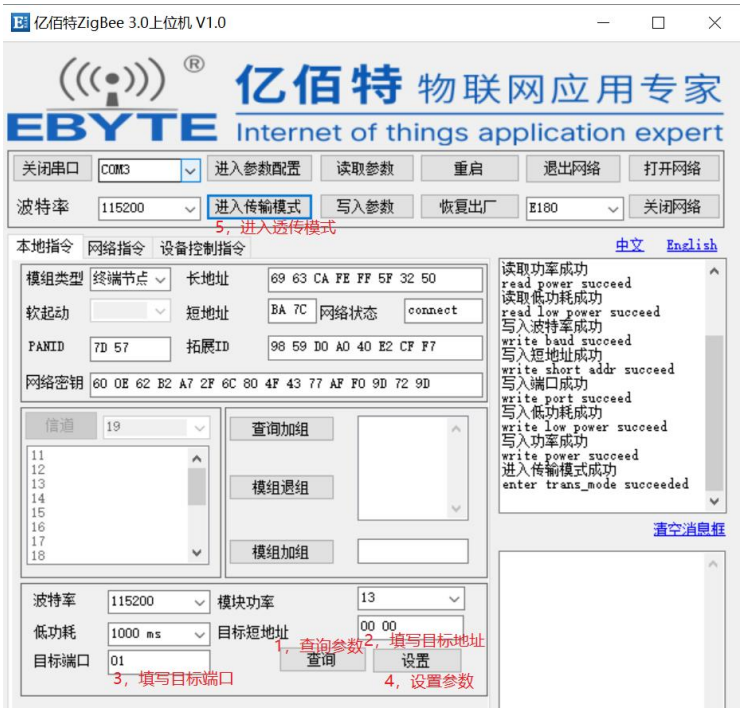


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# 4.3.4 The host computer sets data transparent transmission

**The first step, the terminal node sets the transparent transmission mode**




*1. Parameter data current data transparent transmission related parameters*

*2. Modify the transparent transmission target address to 0x0000*

*3. Modify the target port to 0x01*

*4. Setting parameters*

*5. Enter transparent transmission mode*



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**The second step is to switch to the serial port assistant after the software configuration of the host computer is completed, and reset the terminal node by hardware**




*1. Enter the data to be sent in the input window of the serial port assistant, and send*

*2. Receive "OK"*

**Step 3: The coordinator receives transparent data**




The message receiving window of the coordinator host computer, receiving the message ZCL received: 55 19 82 0F 00 BA 7C 01 08 01 08 FC 00 20 EA 00 48 65 6C 6C 6F 57 6F 72 6C 64 7D

The hexadecimal data "48 65 6C 6C 6F 57 6F 72 6C 64" is "HelloWorld" sent by the terminal node

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# 5. User notice

## 5.1 ZigBee network roles and considerations

| number | description |
|---|---|
| 1 | This module adopts ZigBee network networking and only realizes the functions of coordinator and router. |
| 2 | The Zigbee network is a Mesh structure, which is not affected by the network depth. The more routing nodes are connected, the more sub-nodes are supported. (The total number of terminal child nodes is 32, and the maximum number of networking is 80) |
| 3 | The coordinator can save data for 7 seconds for dormant terminals. |
| 4 | Broadcast performance: The maximum broadcast within 5 seconds does not exceed 100 packets, which actually depends on the broadcast receiving capability of the access device. |
| 5 | The coordinator is unique in the network, and the short address is fixed at 0000. |
| 6 | If the on-demand address is FFFF, FFFD, and FFFC, it corresponds to three broadcast modes respectively. If multicast transmission is required, the target port is set to 0, and the target short address is set to the group ID. |
| 7 | When the network parameter PANID is FFFF, the PANID is automatically generated. If you need to manually set the PANID, you need to ensure that there is no coordinator and router with the PANID in the space, including the router that joined the coordinator last time. |
| 8 | All devices in the network have the broadcast function turned on. Simultaneous broadcasting by multiple devices or higher-frequency broadcasting by a single device may cause serious network congestion. Please try to avoid this situation. |
| 9 | All wireless commands will generate a sending confirmation, and the return time of the sending confirmation will be different for different sending targets, and even out of order. After sending a wireless command to a specific target, it is recommended to wait for an acknowledgment before sending the next command to that target. But sending commands to multiple different targets does not need to wait for a confirmation to send the command to the next target. For example, when there are routing nodes and sleeping nodes in the sending target, the routing node returns faster than the sleeping node. |
| 10 | In ZigBee network communication, the single-packet data transmission cycle cannot be too fast (generally recommended to be more than 1 second, or wait for the device to send confirmation or asynchronous return). Too fast may cause data loss. (Special attention, too many nodes in the network, too fast broadcast cycle may cause network instability.) |
| 11 | According to the node network access notification and device information notification, it is determined whether the network access node is the first time access to the network or the network is restored. A device with a first-time access record can be counted as a legitimate device. When deleting a node, if the node just shuts down or is offline, it can be considered that the device is illegal, and the next time it receives any information from the device (including the network access notification is not the first time to access the network), immediately send a delete command |

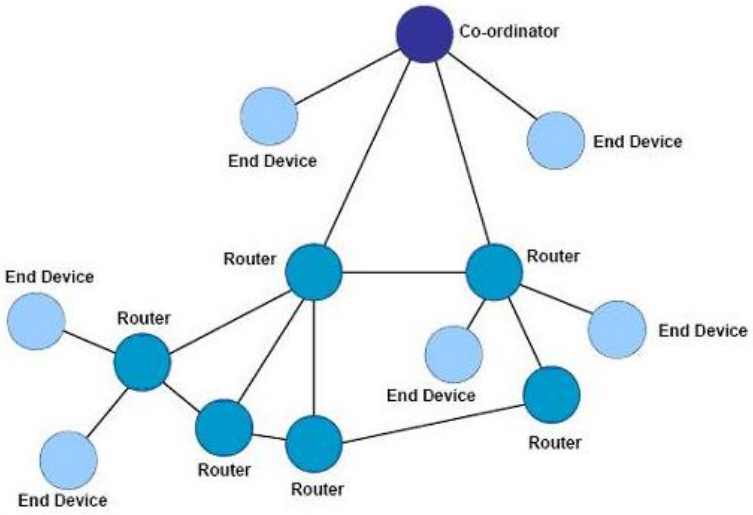
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# 5.2 network structure

| The network structure of this module is a mesh network structure (MESH) |
| --- |
| The network of MESH mesh network topology has powerful functions, and the network can communicate through "multi-level hop"; this topology can also form a very complex network; the network also has self-organization and self-healing functions; |

**Network structure diagram**






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**★Ebyte has reached in-depth cooperation with many well-known enterprises.**

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EBYTE is a company specializing in providing wireless data transmission solutions and products

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◆Has nearly 100 employees, tens of thousands of customers, and has sold millions of products;
◆Business covers more than 30 countries and regions around the world;
◆Passed ISO 9001 quality management system and ISO 14001 environmental system certification;
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