E180-Z5812SP User Manual

TLSR8258 2.4GHz ZigBee multifunctional SOC wireless module

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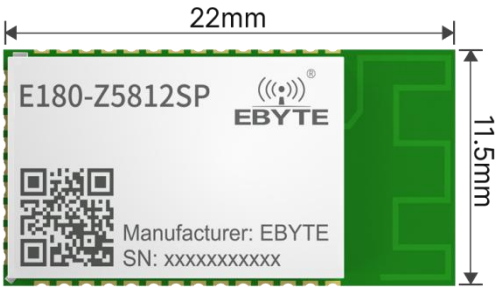
Contents

1. Overview

1.1 Introduction

E180-Z5812SP is a ZigBee module based on TELINK TLSR8258 wireless SoC designed and produced by Ebyte, which is small size, low power consumption, high reliability and works in 2.4GHz frequency band. The chip has a 32-bit high-performance MCU up to 48mhz, with a maximum transmission power of 12dBm and a minimum sleep current of 2uA.



TLSR8258 is a wireless microcontroller with great potential to become the first choice for intelligent furniture, Internet of things transformation and industrial automation in the future. Its network characteristics meet ZigBee 3.0 standard, and provide a complete application integration scheme based on IEEE802.15.4 ISM band. The product has been tested and certified by a series of authoritative RF instruments, combined with many years of market experience and the actual needs of users in the industry, integrates the extremely complex communication protocols of wireless products into the built-in SOC, supports the transparent serial transmission mode, integrates the fast and easy-to-use ad hoc network function, and provides multi-channel configurable ADC, IO, PWM interface, simplify the complex development process of wireless products, make your products quickly put into the market with lower cost.

1.2 Feature

- Centralized network management: ZigBee 3.0 security standard centralized network access mechanism, data is safe and reliable
- Large capacity: 512k flash, 64K ram, network nodes can be expanded to more than 100
- Role switching: user can switch the device between terminal and sleep terminal with comand through serial port
- Support a variety of network topologies: point-to-point, star network, mesh network
- Network self-healing: when the network intermediate node is lost, other networks automatically join or maintain the original network
- Address search: users can find out the corresponding short address according to the MAC address of the node that has joined the network, and can also find the corresponding MAC address of each node in the network according to the short address of the node
- Data security: integrated ZigBee 3.0 security communication standard, the network contains multi-level security keys
- Serial port configuration: the module has built-in serial port command, and users can configure (check) the parameters and functions of the module through the serial port command
- Network PAN_ID change: The network PAN_ID can be switched arbitrarily, and the user can customize the PAN_ID to join the corresponding network or automatically select the PAN_ID to join the network
- GPIO control: local/remote GPIO level control, 2 IO options
- PWM control: local/remote PWM control, 4 PWM channel options
- ADC control: local/remote ADC reading, 3 ADC options (including power supply voltage detection)

- One key to restore the baud rate: if the user forgets or does not know the baud rate, this function can be used to restore the default baud rate to 115200
- Serial port receive wakeup: support the serial port receive wakeup function, when the module receives a frame of less than or equal to 10 bytes of data in the dormant state, it will be awakened. This data is a wake-up frame used to wake up the module and will not be treated as data
- Module reset: the user can reset the module through the serial port command
- Restore factory settings: the user can restore the factory settings of the module through serial command
- Air configuration: the user can use the air configuration command to remotely configure other devices in the network

1.3 Device type introduction

There are four types of logical devices in the ZigBee network: Coordinator, Router, End-Device and Sleep-End-Device. The ZigBee network consists of a coordinator, multiple routers, and multiple End-Devices (End-Device can be divided into sleeping terminals and non-sleeping terminals). This product only supports two device types, End-Device (non-sleeping terminal) and Sleep-End-Device (sleeping terminal), and two types of Coordinator and Router. Use our E180-ZG120A/B products .

1.3.1 Non-sleeping terminal

The main task of the terminal device is to send and receive messages, and other nodes are not allowed to connect with the terminal device. The non-sleeping terminal is always in the working state and can receive and send data at any time.

1.3.2 Sleeping terminal

The sleeping terminal enters a dormant state when there is no data transmission and reception, and the dormant current is as low as about 2uA.

When you need to send wireless data or command, you need to send a wake-up frame through the serial port first. The length needs to be 5 bytes (it is recommended to use the command "FF FF FF FF FF" to wake up). The wake-up time lasts for Uart_holdtime, during which serial data can be processed (Configuration command, effective load), when a frame of serial port data is successfully received, the wake-up timeout counter will be refreshed, and the wake-up duration will go further by Uart_holdtime, otherwise the device will go to sleep again. Uart_holdtime defaults to 1000ms and supports HEX command to change its value.

The sleeping terminal can also be awakened through the pin WAKE. WAKE defaults to high level. Pull down the WAKE pin to wake up the module continuously, and release the WAKE pin to restore the default settings.

When data needs to be received, data is received through periodic wake-up. The longer the wake-up period is set, the greater the receiving delay will be. The wake-up period setting must be less than 30 seconds. If you only need to upload data, you can set the wake-up period greater than 30 seconds to reduce power consumption (the default is 10 seconds), such as battery-powered sensors.

1.4 Application

- Smart home and industrial sensors
- Security system, positioning system
- Wireless remote control, UAV

- Wireless game remote control
- Healthcare products
- Wireless voice, wireless headset
- Advanced Metering Infrastructure (AMI)
- Application in automobile industry
- Building automation solutions
- Application of agricultural greenhouse automation

2. Parameters

2.1 Limit parameter

Parameter	Performance		Remark
	Max	Min	
Power supply (V)	1.9	3.6	Module will be permanently damaged over 3.6V
Blocking power (dBm)	-	10	The damage probability is small in close range use
Working temperature (℃)	-40	+85	Industrial

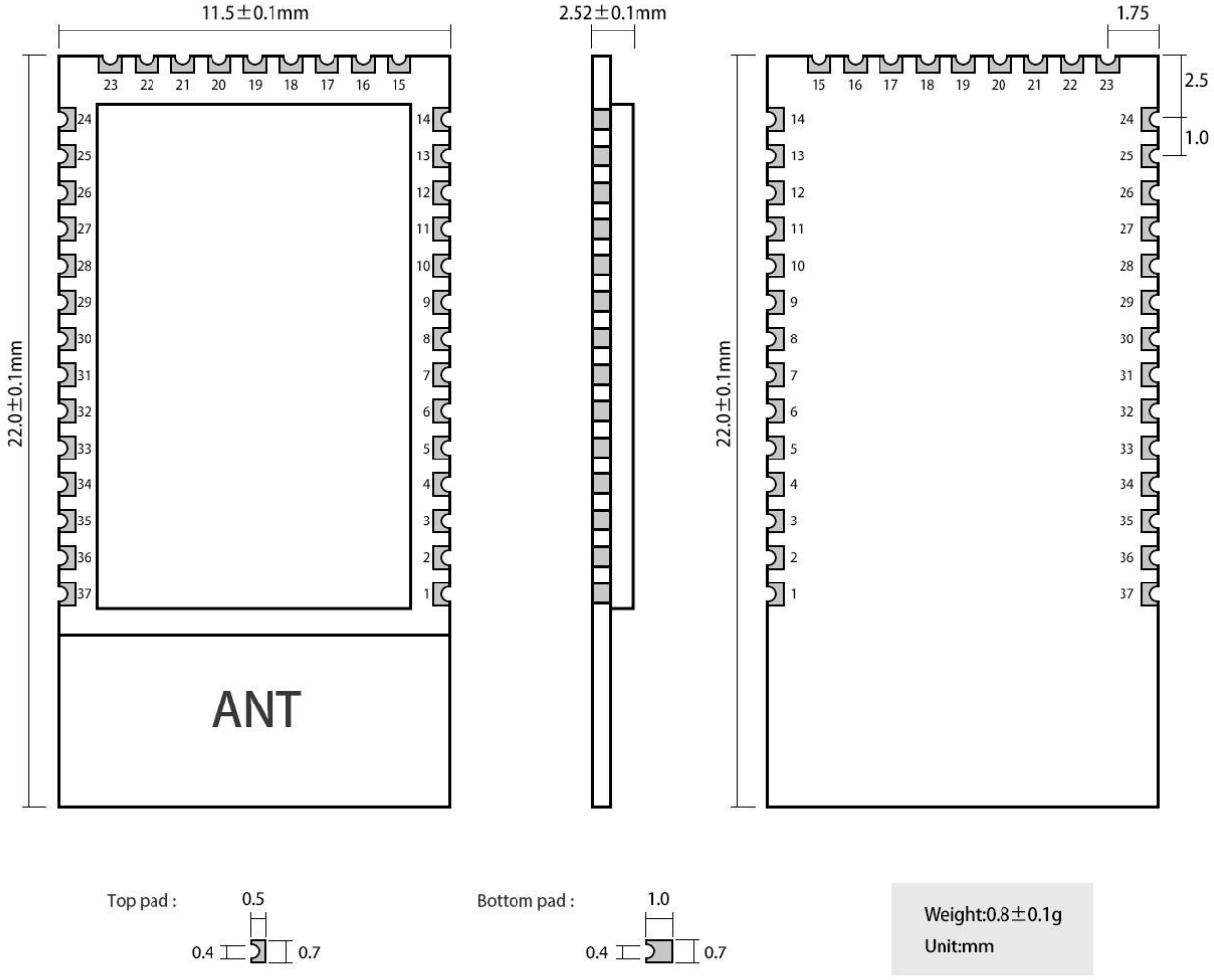
2.2 Working parameter

Parameter		Performance			Remark
		Max	Typ	Mix	
Power supply (V)		1.9	3.3	3.6	≥3.3V can guarantee output power
Communication level (V)			3.3		Risk of damage using 5V TTL
Working temperature (℃)		-40	-	+85	Industrial
Working frequency band (MHz)		2405	-	2480	ISM band
Power consumption	TX current (mA)		24		Max 24mA at 12dbm
	RX current (mA)		9		-
	Sleeping current (μA)		2.5		Periodic sleep current averages 2.5uA
Max output power (dBm)			12		-
Air data rate (bps)			250k		-

Parameter	Description	Remark
Reference range	200m	Between two points (ZigBee network supports multi hop routing function, and can extend therangeby adding routers)
Weight	0.9g	-
Protocol	Zigbee 3.0	-
Package	SMD	-
Interface	1.27mm	Stamp hole
IC	TLSR8258F512ET32	-
FLASH	512KB	-

RAM	64KB	-
Core chip	32 bit MCU	-
Size	11.5*22mm	-
Antenne	PCB	50Ω

3. Dimension and pin definition



No.	Pin	Direction	Description
1	NC	-	Reserved, suspended
2	GND	-	Ground
3	NC	-	Reserved, suspended
4	PD3(WAKE)	Input	The wake pin is mainly used to wake up the sleepingterminal. The default value is high level. When the pin is pulled down, the sleeping terminal device will wake up
5	PD7(TX)	Output	Serial port transmission TX
6	PA0(RX)	Input	Serial port receiving RX

7	NC	-	Reserved, suspended
8	NC	-	Reserved, suspended
9	PD4(MODE)	Input	Working mode switch pin, when pull down time is more than 500ms, switch working mode
10	PA1(BAUD_ R)	Input	UART_ BAUD_ The reset pin is used to reset the baud rate of the device. The default value is high level. In any mode, if the pin is pulled down for more than 1000ms, thedefault baud rate will restore to 115200
11	PB1(ACK)	Output	The ACK pin is used to indicate the status of the last user data transmission. The pin is pulled down before the transmission is started, and it is pulled up after the transmission is down
12	PC0(GPIO0)	Input/Output	GPIO Input/Output 0
13	VCC	-	Power supply
14	GND	-	Ground
15	PB4(GPIO1)	Input/Output	GPIO Input/Output 1
16	NC	-	Reserved, suspended
17	NC	-	Reserved, suspended
18	PB5(AUX)	Output	The aux pin indicates the current working state of the device. When the pin is at low level, it indicates that the device is busy and the high level indicates that the device is idle
19	NC	-	Reserved, suspended
20	NC	-	Reserved, suspended
21	PB6(ADC1)	Input	ADC detection port 1
22	PB7(ADC2)	Input	ADC detection port 2
23	NC	-	Reserved, suspended
24	NC	-	Reserved, suspended
25	NC	-	Reserved, suspended
26	SWS	-	Reserved
27	PC2(PWM0)	Output	PWM output 0
28	PC3(PWM2)	Output	PWM output 2
29	PC4(PWM3)	Output	PWM output 3
30	PC1(LINK)	Output	The link pin indicates the current network status of the module, its high level indicates that it has joined the network
31	NC	-	Reserved, suspended
32	PD2(PWM1)	Output	PWM output 1
33	NC	-	Reserved, suspended
34	NC	-	Reserved, suspended
35	NC	-	Reserved, suspended
36	GND	Input//Output	Ground
37	nRESET	Input	Reset

4. Working mode

4.1 Transmission mode

When the module enters the transmission mode, any data received by the serial port will be sent out wirelessly. The transmission mode is wireless communication between nodes. The communication modes include unicast, protocol unicast, multicast, protocol multicast, broadcast, etc.

4.2 Configuration mode

When the module enters the configuration mode, the data received by the serial port are all configuration commands, which are used to configure and operate the device. In the configuration mode, the data received by the serial port of the module is considered to be HEX commands.

4.3 Mode switching

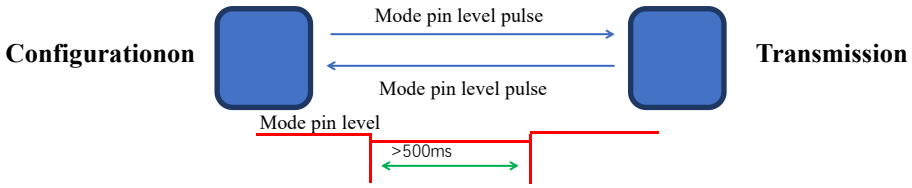
4.3.1 Command switching

The module is in transmission mode by default.

In the transmission mode, when the serial port of the module receives "2A 2D 2E", it will enter the configuration mode. After entering the configuration mode successfully, it will return "7A 7D 7E". In the configuration mode, when the serial port of the module receives "2F 2C 2B", the module exits the configuration mode and enters the transmission mode. After entering the transmission mode successfully, the module returns "7F 7C 7B".

4.3.2 Pin switching

The pin of working mode switching is PD4, which is internally configured with pull-up resistor input mode. The default is high level. In any mode, when PD4 is pulled down for more than 500ms, the module switches working mode, as shown in the figure below:



5. Transmission and receiving mode

5.1 Transmission mode

The data transmission mode of the module includes unicast, protocol unicast, multicast, protocol multicast and broadcast.

5.1.1 Broadcast mode

In broadcast mode, the transmitter sends data received by the serial port to each node in the network, and all devices in the network will receive the data.

5.1.2 Multicast mode

In multicast mode, first set the group number of the devices in the network in the configuration mode (set group, restart valid), the transmitter specifies the target group number in the configuration mode (send the data to specified group), and then the transmitter enters the transmission mode to send the data received by the serial port to the network, and the devices with the same group number in the network will receive the data.

5.1.3 Protocol multicast mode

When the transmitter is in transmission mode, the serial port receives data. The first byte represents the target group number, and the following data represents valid data. There is no need to enter the configuration mode to set the target group number.

5.1.4 Unicast Mode

In unicast mode, the devices in the network communicate point to point through the network address. The transmitter sends the data received to the device with target address. After receiving the data, the device with can return an ACK to the transmitter to indicate that it has received the data (the sleep terminal node has no ACK function).

5.1.5 Protocol unicast mode

In the transmission mode, the transmitter receives data from the serial port. The first two bytes represent the network short address of the target device, and the following data represent valid data. There is no need to enter the configuration mode to configure the network short address of the target device.

Note: when it is configured as broadcast or multicast, it is recommended that the period of periodic transmission should be greater than 2000ms, otherwise it may cause data blocking.

5.2 Output mode of received data

Output mode of received data means that when the module receives the wireless data, the mode of serial port outputs the data.

5.2.1 Transparent output

If the output mode is transparent, the module will output the original data through the serial port after receiving the wireless data.

5.2.2 Data+short address

When the output mode is data + short address, after the module receives the wireless data, the serial port will output the original data+short address of the transmitter.

5.2.3 Data+long address

When the output mode is data+long address, after the module receives the wireless data, the serial port will output the original data+long address of the transmitter.

Note: the terminal device can analysis the long address of the coordinator, router, terminal and other transmitters, but the coordinator and router can not analysis the long address of the terminal transmitters. The coordinator and router here are

module E180-ZG120A/E180-ZG120B.

5.2.4 Data+RSSI

When the output mode is data+RSSI, after the module receives the wireless data, the serial port will output the original data+RSSI value of the received data packet.

5.2.5 Data+short address+RSSI

When the output mode is data+short address+RSSI, after the module receives the wireless data, the serial port will output the original data+short address of the transmitter+RSSI value of the received data packet.

5.2.6 Data+long address+RSSI

When the output mode is data+long address+RSSI, after the module receives the wireless data, the serial port will output the original data+long address of the transmitter+RSSI value of the received data packet.

Note: the terminal device can analysis the long address of the coordinator, router, terminal and other transmitters, but the coordinator and router can not analysis the long address of the terminal transmitters. The coordinator and router here are module E180-ZG120A/E180-ZG120B.

Note: the maximum packet length of the transmitter is 72 bytes.

6. Application function and command configuration

6.1 Pin definition

6.1.1 LINK description

Link pin indicates the current network status of the module. After the device is successfully connected to the network, it is high level. When the device has no network or the parent node is lost, it is low level. External devices can query the network status of the device through the pin level.

6.1.2 WAKE description

WAKE pin is mainly used to wake up the sleeping terminal. The default value is high level. When the external device pulls the pin down, the sleeping terminal device will be continuously awakened. When the external device releases the pin to restore to high level, the terminal device will enter sleeping state. The sleep time is determined by the duration for which the pin is pulled down by the external device. For non-sleeping devices, this pin is invalid.

6.1.3 AUX description

AUX pin indicates the current working state of the module. When the pin is at low level, the device is busy, and at high level, the device is idle. When the device receives data, the module will pull the AUX pin AUX_delaytime time, the serial port starts to output data, which is used to wake up the external control device. AUX_delaytime time is 4ms by default, which can be changed by the serial port command. The user can decide according to the wake-up time of the main chip.

6.1.4 ACK description

ACK pin is used to indicate the status of the data transmission. The pin is low level before the transmission is started, and high level after the transmission is successful. The user can judge whether the data is delivered successfully by the pin status. This pin function can not be used to indicate the broadcast messages transmitted by coordinator. (Only for non sleeping terminals).

6.1.5 UART_BAUD_RESET description

UART_BAUD_RESE pin is used to reset the baud rate of the device. The default value is high level. In any mode, if the pin is pulled down for more than 1000ms, the module's serial port parameters will return to the default 115200 and 8N1.

Pin	Pin No
LINK	PC1
WAKE	PD3
AUX	PB5
ACK	PB1
UART_BAUD_RESET	PA1

6.2 Wireless remote configuration function

The module supports remote configuration function, which is identified by two byte wireless configuration ID (default is A8 8A). The user can modify the remote configuration ID. When the module receives the first two bytes of the wireless air data as the wireless configuration ID, the module judges that the data packet is the remote configuration command and executes the corresponding operation of the command. The data packet will not be output through the serial port. When configuring the sleep terminal remotely, it is necessary to wake it up first..

6.3 Function parameter description

The module provides a wealth of configurable parameters, which can be flexibly used according to the actual application requirements to build different forms of network.

Parameter	Attribute	Range	Description
PANID	Read/Write	0x0000～0xFFFF	PANID is the network identifier of ZigBee network, which is used to determine the identity of its own network. The PANID of all devices in the same network must be the same. When the terminal or router is configured as 0xFFFF, it can join any existing network with the same channel.
Local network address	Read	0x0000～0xFFFF	It is used to distinguish each node in the network. The local network address of each device in the same network must be unique. When the device does not join the network, the network address of the device is 0xFFFF. After joining, the short address of the device is assigned by the coordinator. The local network address of coordinator is fixed as: 0x0000.

Network status	Read	0、2、3	It indicates the network status of the device, including no network, successfully joined the network, with network but no parent node.
Target network address	Read/Write	0x0000～0xFFFF	The communication target address (short address) can be switched at any time through configuration command.
Local MAC address	Read	64 bit MAC	The MAC address assigned by the network, can not be changed by the user (changed when re-accessing the network)
Target MAC address	Read/Write	64 bit MAC	In fixed-point mode, long address is used
Device type	Read/Write	E、S	Non sleeping terminal and sleeping terminal
Channel	Read/Write	CH11～26	Physical channel of ZigBee communication
Transmission mode	Read/Write	0、1、2、3、4、5	Broadcast mode, multicast mode, short address unicast mode, long address unicast mode, protocol unicast mode and protocol multicast mode. For details, please check the corresponding mode introduction
Output mode	Read/Write	0、1、2、3、4、5	Transparent communication, data+short address, data+long address, data+RSSI, data+short address+RSSI, data+long address+RSSI
TX power	Read/Write	-37dbm～7dbm	In the case of high requirements for low power consumption and no requirements for distance, the transmission power can be reduced to save the average power consumption
Remote configuration ID	Read/Write	2 bytes	It is used to judge whether the data received by the wireless is a remote configuration command. The user can change the remote configuration ID according to the need, and the default is A8 8A
Local network group number	Read/Write	1～254	It is used to configure the group number of the device in the network
Target network group number	Read/Write	1～254	It is used to configure the group number of the corresponding target during multicast
Wake up period (sleep time)	Read/Write	0～2010 / second	It is used to configure the wake-up cycle of the terminal sleeping device. The larger the wake-up cycle, the lower the overall power consumption, but the greater the delay of receiving data
Parent node lost reconnectio	Read/Write	1～254 / minute	When the parent node is lost (the coordinator is powered off), the terminal device reconnects to the previous network at regular intervals

n cycle			
Maximum number of reconnections	Read/Write	1～254 times	After the maximum number of reconnections is exceeded, if the reconnection is not successful, the previous network information will be cleared and the new network will be scanned again. The scanning cycle is equal to the reconnection cycle
IO status	Read/Write	High/Low	Access/control module GPIO level status
PWM	Read/Write	1us～340 ms	Access/control module PWM duty cycle and period
ADC value	Read	0～3300 mv	Read the ADC value of the device, you can use channel 0 to read the device power supply voltage value

6.4 HEX command

6.4.1 Command description

Read format of local serial port:

Network parameter reading: FE LEN CMD FF

Peripheral parameter reading: FE LEN CMD CHANNEL FF

FE: Fixed head

LEN: DATA length

CMD: Command ID

CHANNEL: PWM, ADC, GPIO, Channel selection when reading

FF: Command terminator

Read return format: FB CMD DATA

FB: Fixed head

CMD: Command ID

DATA: Paremeter

Local serial port configuration format: FD LEN CMD DATA FF

FD: Fixed head

LEN: DATA length

CMD: Command ID

DATA: Parameter

FF: Command terminator

Configuration return: FA CMD

FA: Fixed head

CMD: Commadn ID

Return when reading /configuration: F7 FF, it means command does not exist or failed to read /configure/format incorrect

Wireless remote reading /configuration format: add remote configuration ID before the command format of local serial port mode. The default value is A8 8A (its value can be modified), for example:

Configuration format is A8 8A FD LEN CMD DATA

Parameter reading format is A8 8A FE LEN CMD (CHANNEL) FF

Network operation format: F5 LEN CMD DATA FF

F5: Fixed head

LEN: DATA length

CMD: Command ID

DATA: Parameter

FF: Command terminator

Configuration return: FC CMD STATUS

FC: Fixed head

CMD: Command ID

STATUS: 00 success

01 fail

6.4.2 Read command set

Command description	ID	Format	Example
Read device type	01	Send: FE 01 01 FF Return: FB 01 dev_type	Send: FE 01 01 FF Return: FB 01 03
Read network status	02	Send: FE 01 02 FF Return: FB 02 nwk_state	Send: FE 01 02 FF Return: FB 02 02
Read network PAN_ID	03	Send: FE 02 03 FF Return: FB 03 pan_id	Send: FE 02 03 FF Return: FB 03 FE 5B
Read local network short address	05	Send: FE 02 05 FF Return: FB 05 Short_Addr	Send: FE 02 05 FF Return: FB 05 F6 FA
Read local MAC address	06	Send: FE 08 06 FF Return: FB 06 Mac_Addr	Send: FE 08 06 FF Return: FB 06 1F 1C 21 FE FF 57 B4 14
Read the short network address of the parent node	07	Send: FE 02 07 FF Return: FB 07 Coor_shortAddr	Send: FE 02 07 FF Return: FB 07 00 00
Read the MAC address of the parent node	08	Send: FE 08 08 FF Return: FB 08 Coor _Mac_Addr	Send: FE 08 08 FF Return: FB 08 0C 46 0C FE FF 9F FD 90
Read network group number	09	Send: FE 01 09 FF Return: FB 09 group	Send: FE 01 09 FF Return: FB 09 01
Read communication channel	0A	Send: FE 01 0A FF Return: FB 0A channel	Send: FE 01 0A FF Return: FB 0A 0B
Read TX power	0B	Send: FE 01 0B FF Return: FB 0B txpower	Send: FE 01 0B FF Return: FB 0B 0A
Read serial port baud rate	0C	Send: FE 01 0C FF Return: FB 0C baud	Send: FE 01 0C FF Return: FB 0C 09
Read sleep time	0D	Send: FE 01 0D FF Return: FB 0D sleep_time	Send: FE 01 0D FF Return: FB 0D 54
Read the target short network address	23	Send:FE 02 23 FF Return: FB 23 Dec_ShortAddr	Send: FE 02 23 FF Return: FB 23 00 00
Read target network group number	24	Send: FE 01 24 FF Return: FB 24 Dec_netid	Send: FE 01 24 FF Return: FB 24 00

Read target long address	25	Send: FE 08 25 FF Return: FB 25 Dec_mac	Send: FE 08 25 FF Return: FB 25 0A 1C 21 FE FF 57 B4 14
Read transmission mode	26	Send: FE 01 26 FF Return: FB 26 send_mode	Send: FE 01 26 FF Return: FB 26 02
Read data output mode	27	Send: FE 01 27 FF Return: FB 27 out_mode	Send: FE 01 27 FF Return: FB 27 00
Read node rejoin cycle	29	Send: FE 01 29 FF Return: FB 29 net_rejoinperiod	Send: FE 01 29 FF Return: FB 29 05
Read the maximum number of reconnection times when lost parent node	30	Send: FE 01 30 FF Return: FB 30 net_rejoincount	Send: FE 01 30 FF Return: FB 30 05
Read remote configuration ID	31	Send: FE 02 31 FF Return: FB 31 header	Send: FE 02 31 FF Return: FB 31 A8 8A
Read all network parameters of the device	FE	Send: FE 2F FE FF Return: FB FE all_info	Send:FE 2F FE FF Return:FB FE 03 02 FE 5B F6 FA 1F 1C 21 FE FF 57 B4 14 00 00 0C 46 0C FE FF 9F FD 90 01 0B 0A 09 54 00 00 00 0A 1C 21 FE FF 57 B4 14 02 00 FF 05 05 A8 8A
Read remote/local GPIO level	20	Command: FE 03 20 GpioId FF Return: FB 20 GpioId In/Out level	Send: FE 03 20 00 FF Return: FB 20 00 01 01
Read remote/local PWM parameters	21	Command: FE 06 21 PWMId FF Return: FB 21 PWMId start/stop Period Period duty duty	Send: FE 06 21 00 FF Return: FB 21 00 01 0A 3E 63 50
Read local/remote ADC status	22	Comand: FE 03 22 adcid FF Return: FB 22 adcid voltage1 voltage2	Send: FE 03 22 00 FF Return: FB 22 00 0C E4
Read firmware version	34	Command: FE 03 34 FF Return: FB 34 FirmwareVersion	Send: FE 03 34 FF Return: FB 34 82 69 01

Read the delay print time of external MCU serial port when AUX wakes up in wireless receiving state	35	Send: FE 01 35 FF Return: FB 35 AUX_delaytime	Send: FE 01 35 FF Return: FB 35 04
Read the hold time of serial port wake-up	36	Send: FE 01 36 FF Return: FB 36 Uart_holdtime	Send: FE 01 36 FF Return: FB 36 64
Read terminal information	37	Send: FE 05 37 FF Return: FB 37 Endpoint_info	Send: FE 05 37 FF Return: FB 37 01 FE B0 05 04

Read trust center connection key	38	Send: FE 10 38 FF Return: FB 10 TrustCentLinkKey	Send: FE 10 38 FF Return: FB 38 5A 69 67 42 65 65 41 6C 6C 69 61 6E 63 65 30 39

6.4.3 Configuration command set

Configure device type	Send:FD 01 01 dev_type FF Return:FA 01	Send:FD 01 01 03 FF Return:FA 01
Configure PAN_ID	Send:FD 02 03 pan_id FF Return:FA 03	Send:FD 02 03 FE 5B FF Return:FA 03
Configure network group number	Send:FD 01 09 group FF Return:FA 09	Send:FD 01 09 01 FF Return:FA 09
Configure communication channel	Send:FD 01 0A channel FF Return:FA 0A	Send:FD 01 0A 0B FF Return:FA 0A
Configure TX power (0-10)	Send:FD 01 0B txpower FF Return:FA 0B	Send:FD 01 0B 0A FF Return:FA 0B
Configure serial port baud rate	Send:FD 01 0C baud FF Return:FA 0C	Send:FD 01 0C 09 FF Return:FA 0C
Configure sleep time (Valid for terminal)	Send:FD 01 0D sleep_time FF Return:FA 0D	Send:FD 01 0D 54 FF Return:FA 0D
Configure target network short address	Send:FD 02 23 dec_addr FF Return:FA 23	Send:FD 02 23 00 00 FF Return:FA 23
Configure target network group number	Send:FD 01 24 netid FF Return:FA 24	Send:FD 01 24 00 FF Return:FA 24
Configure target long address	Send:FD 08 25 dec_mac FF Return:FA 25	Send:FD 08 25 0A 1C 21 FE FF 57 B4 14 FF Return:FA 25
Configure system transmission mode	Send:FD 01 26 mode FF Return:FA 26	Send:FD 01 26 02 FF Return:FA 26
Configure data output mode	Send:FD 01 27 mode FF Return:FA 27	Send:FD 01 27 00 FF Return:FA 26
Configure node rejoin cycle	Send:FD 01 29 time FF Return:FA 29	Send:FD 01 29 05 FF Return:FA 29
Configure max number of rejoin after a node loses its parent node	Send:FD 01 30 time FF Return:FA 30	Send:FD 01 30 05 FF Return:FA 30
Configure wireless remote configuration ID	Send:FD 02 31 header FF Return:FA 31	Send:FD 02 31 A8 8A FF Return:FA 31
Configure all network parameters	Send:FD 1A FE all_info FF Return:FA FE	Send:FD 1A FE 03 FE 5B 01 0B 0A 09 54 00 00 00 0A 1C 21 FE FF 57 B4 14 02 00 FF 05 05 A8 8A FF Return:FA FE
Configure remote/local GPIO	Send: FD 03 20 GpioId In/Out level	Send:FD 03 20 00 01 01 FF

input/output status	FF Return:FA 20	Return:FA 20
Configure remote/local PWM status	Send: FD 06 21 PwmId start/stop Period1 Period2 duty1 duty2 FF Return:FA 21	Send:FD 06 21 00 FF 03 65 02 48 FF Return:FA 21
Device restart	Send:FD 00 12 FF Return:FA 12	Send:FD 00 12 FF Return:FA 12
Restore factory settings	Send:FD 00 13 FF Return:FA 13	Send:FD 00 13 FF Return:FA 13

Configure AUX wake-up external MCU serial port delay printing time in wireless receiving state	Send:FD 01 35 AUX_delaytime FF Return:FA 35	Send:FD 01 35 04 FF Return:FA 35
Configure serial port wake up hold time	Send:FD 01 36 Uart_holdtime FF Return:FA 36	Send:FD 01 36 64 FF Return:FA 36
Configure terminal information	Send:FD 05 37 Endpoint_info FF Return:FA 37	Send:FD 05 37 01 FE B0 05 04 FF Return:FA 37
Configure trust center connection key	Send:FD 10 38 TrustCentLinkKey FF Return:FA 38	Send:FD 10 38 5A 69 67 42 65 65 41 6C 6C 69 61 6E 63 65 30 39 FF Return:FA 38

6.4.4 Network operation command set

Open the network	Send:F5 01 40 01 FF Return:FC 40 00	Send:F5 01 40 01 FF Return:FC 40 00
Leave the network	Send:F5 01 40 02 FF Return:FC 40 00	Send:F5 01 40 02 FF Return:FC 40 00
Creat the network	Send:F5 01 40 03 FF Return:FC 40 00	Send:F5 01 40 03 FF Return:FC 40 00

Open the network: The main coordinator node takes effect, which means that the terminal is allowed to join the network for a period of time. The command configures the "centralized network open time" parameter. This command is invalid for the terminal and dormant terminal, and only valid for the coordinator node (E180-ZG120A / B).

Leave the network: When the coordinator executes this command, the original network will be cleared and a new network will be created. When the terminal node executes this command, the saved network will be cleared, and then restart or join in a new network.

Creat the network: Mainly for the terminal, to execute this command to join a new network, the terminal needs to leave the network first, and then to join a new network.

6.5 HEX parameter description

6.5.1 System transmission mode

Read command format:

Command format	Command example
Send: FE 01 26 FF Return: FB 26 send_mode	Send: FE 01 26 FF Return: FB 26 02

Configuration command format:

Command format	Command example
Send:FD 01 26 mode FF Return:FA 26	Send:FD 01 26 02 FF Return:FA 26

Mode:

0x00 Broadcast (Default)

0x01 Multicast (It needs to configure target group number in configuration mode first)

0x02 Transparent unicast+short address (It needs to configure the target short address in configuration mode first)

0x03 Transparent unicast+long address (It needs to configure the target long address in configuration mode first)

0x04 Protocol unicast+short address (In transmission mode, the first two bytes are the network short address of the target device)

0x05 Protocol multicast (In transmission mode, the first byte is the target network group number)

6.5.2 Receiving data output mode

Read command format:

Command format	Command example
Send: FE 01 27 FF Return: FB 27 out_mode	Send: FE 01 27 FF Return: FB 27 00

Configuration command format:

Command format	Command example
Send:FD 01 27 mode FF Return:FA 27	Send:FD 01 27 00 FF Return:FA 26

Mode:

0x00 Transparent transmission (default)

0x01 Data+short address

0x02 Data+long address

0x03 Data+RSSI

0x04 Data+short address+RSSI

0x05 Data+long address+RSSI

Note: When sleep terminal equipment receives data, it does not support to analyze the long address of source device.

When non sleep terminal device receives data, it can analyze the long address of coordinator, router, terminal and other source equipment, but coordinator and router cannot analyze the long address of source equipment. Here coordinator and router are E180-ZG120A/B devices.

Note: The maximum packet length supported by the transmitter is 72 bytes.

6.5.3 Network node type

Read command format:

Command format	Command example
Send: FE 01 01 FF Return: FB 01 dev_type	Send: FE 01 01 FF Return: FB 01 03

Configuration command format:

Command format	Command example
Send:FD 01 01 dev_type FF Return:FA 01	Send:FD 01 01 03 FF Return:FA 01

Dev_type:

0x03 Terminal (default)

0x04 Sleep terminal

The configuration of the changed node type will take effect after restart. If the node type is configured in normal operation, the device will leave the current network and be in no network state. After restart, it will switch to the changed node type. Sleep terminal supports serial port pin wake-up function, wake-up frame byte length is less than or equal to 5 bytes, it is recommended to use "FF FF FF FF FF" wake-up.

6.5.4 Network status

Read command format:

Command format	Command example
Send: FE 01 02 FF Return: FB 02 nwk_state	Send: FE 01 02 FF Return: FB 02 02

Nwk_state:

0x00 No network

0x02 Has joined the network

0x03 Has network but no parent node

6.5.5 Network PAN_ID

Read command format:

Command format	Command example
Send: FE 02 03 FF Return: FB 03 pan_id	Send: FE 02 03 FF Return: FB 03 FE 5B

Configuration command format:

Command format	Command example
Send:FD 02 03 pan_id FF	Send:FD 02 03 FE 5B FF

Return:FA 03	Return:FA 03

Pan_id:

0x0000～0xFFFE Fixed network PAN_ID

0xFFFF Random PAN_ID

Note: if the coordinator is configured as 0xFFFF, PAN_ID will be randomly selected to creat a network. If the terminal and router are configured as 0xFFFF, any PAN_ID network can be joined. PAN_ID needs to be configured before joining the network.

6.5.6 Network short address

Read command format:

Command format	Command example
Send: FE 02 05 FF Return: FB 05 Short_Addr	Send: FE 02 05 FF Return: FB 05 F6 FA

Short_Addr: 2 Bytes, address randomly assigned by Coordinator

6.5.7 MAC address

Read command format:

Command format	Command example
Send: FE 08 06 FF Return: FB 06 Mac_Addr	Send: FE 08 06 FF Return: FB 06 1F 1C 21 FE FF 57 B4 14

Mac_Addr: 8 Bytes

6.5.8 Network short address of the parent node

Read command format:

Command format	Command example
Send: FE 02 07 FF Return: FB 07 Coor_shortAddr	Send: FE 02 07 FF Return: FB 07 00 00

Coor_shortAddr: 2 Bytes, the short address of the parent node, if it is coordinator, it is 0x0000

6.5.9 Mac address of the parent node

Read command format:

Command format	Command example
Send: FE 08 08 FF Return: FB 08 Coor _Mac_Addr	Send: FE 08 08 FF Return: FB 08 0C 46 0C FE FF 9F FD 90

Coor_Mac_Addr: 8 Bytes, the long address of the parent node

6.5.10 Network group number

Read command format:

Command format	Command example
Send: FE 01 09 FF Return: FB 09 group	Send: FE 01 09 FF Return: FB 09 01

Configuration command format:

Command format	Command example
Send:FD 01 09 group FF Return:FA 09	Send:FD 01 09 01 FF Return:FA 09

Group: Group number range, 0x01-0xFE(Default 1)

6.5.11 Network channel

Read command format:

Command format	Command example
Send: FE 01 0A FF Return: FB 0A channel	Send: FE 01 0A FF Return: FB 0A 0B

Configuration command format:

Command format	Command example
Send:FD 01 0A channel FF Return:FA 0A	Send:FD 01 0A 0B FF Return:FA 0A

Channel: Channel range, 0x0B(11)-0x1A(26) (Defauly 11), 0xFF indicates full channel scan.
Channel parameter needs to be configured before joining network.

6.5.12 TX power

Read command format:

Command format	Command example
Send: FE 01 0B FF Return: FB 0B txpower	Send: FE 01 0B FF Return: FB 0B 0A

Configuration command format:

Command format	Command example
Send:FD 01 0B txpower FF Return:FA 0B	Send:FD 01 0B 0A FF Return:FA 0B

Txpower: Transmitting power level(00), it needs to be configured before joining network.

txpower	**Transmitting power level (dbm)**	**txpower**	**Transmitting power level(dbm)**

00	11.76	06	10.33
01	11.66	07	10.04
02	11.31	08	9.73
03	11.09	09	9.38
04	10.82	0A	9.03
05	10.54		

Note: The actual reference value of transmitting power.

6.5.13 Serial port baud rate

Read command format:

Command format	Command example
Send: FE 01 0C FF Return: FB 0C baud	Send: FE 01 0C FF Return: FB 0C 09

Configuration command format:

Command format	Command example
Send:FD 01 0C baud FF Return:FA 0C	Send:FD 01 0C 09 FF Return:FA 0C

Baud rate parameter (baud) table:

Buad	Baud rate	Buad	Baud rate
01	4800	08	76800
02	9600	09	115200(default)
03	14400	0A	128000
04	19200	0B	230400
05	38400	0C	256000
06	50000	0D	460800
07	57600		

Note: changing the serial port baud rate configuration will take effect only after restarting the device.

6.5.14 Sleep time

Read command format:

Command format	Command example
Send: FE 01 0D FF Return: FB 0D sleep_time	Send: FE 01 0D FF Return: FB 0D 54

Configuration command format(terminal valid):

Command format	Command example
Send:FD 01 0D sleep_time FF Return:FA 0D	Send:FD 01 0D 54 FF Return:FA 0D

When the node is a sleep terminal, its functions are as follows:

Sleep_time: (1～60) Sleep wake cycle is 1～6, unit (second)

(61～255) Sleep wake cycle is 60+(sleep_time-60)*10, unit (second)

Default value is 10, which means 10 seconds.

It represents sleep cycle, data request cycle and heartbeat cycle. When it is less than 30 seconds, the device can receive the data from the parent node. The smaller the period, the smaller the delay of receiving data, the faster the speed of switching the best parent node, and the faster the speed of detecting the lost parent node.

When the node is a sleep terminal, its functions are as follows:

If the node is a terminal, it represents the heartbeat cycle of the terminal and the parent node. The shorter the cycle is, the faster the terminal switches the route to find the best parent node. At the same time, the coordinator detects the network access of the terminal through heartbeat.

Sleep_time:

Value	heartbeat cycle (second)
1	3
10	40
20	80
30	160
40	320
50	640
60	1280

Note: if the node is coordinator and router, this parameter is invalid.

6.5.15 Save time of parent node

Time: the time for the parent node to save the data of its child node is 30 seconds. If the terminal node needs to receive the data from the parent node, the configuration of sleep time cannot be greater than 30 seconds.

Note: this parameter is the parameter of the parent node (router and coordinator), which temporarily saves the data to be sent to the sleep node. The parent node (router and coordinator) is E180-ZG120A/B device.

6.5.16 Node rejoin cycle

Read command format:

Command format	Command example
Send: FE 01 29 FF Return: FB 29 net_rejoinperiod	Send: FE 01 29 FF Return: FB 29 05

Configuration command format:

Command format	Command example
Send:FD 01 29 time FF Return:FA 29	Send:FD 01 29 05 FF Return:FA 29

Rejoin period: (1～254) rejoin cycle range 1～25, unit (minute), defaul 1 minute.

When the node is powered on, it will join the network (if there is no network) or recover the network (if there is network but no parent node) in the cycle of rejoin period. When the node detects the loss of the parent node, it will reconnect in the cycle of rejoin period.

When this parameter is 254, it means that it doesn't reconnect or join network periodically.

6.5.17 The maximum number of attempts to reconnect

Read command format:

Command format	Command example
Send: FE 01 30 FF Return: FB 30 net_rejoincount	Send: FE 01 30 FF Return: FB 30 05

Configuration command format:

Command format	Command example
Send:FD 01 30 time FF Return:FA 30	Send:FD 01 30 05 FF Return:FA 30

Rejoin maxcount: (1～254) range of the maximum number of reconnections, 1～254, default 10.

When the parent node is lost or there is network but no parent node, the maximum number of rejoin attempts will be made after the node is powered on. If the previous network has not been restored, the previous network information will be cleared, the node will periodically scan the new network in the cycle of rejoin period . The power consumption of scanning the new network is higher than restoring the previous network.

When the parameter is 254, it means that it always reconnects without clearing the network information when there is network but no parent node.

6.5.18 Remote configuration ID

Read command format:

Command format	Command example
Send: FE 02 31 FF Return: FB 31 header	Send: FE 02 31 FF Return: FB 31 A8 8A

Configuration command format:

Command format	Command example
Send:FD 02 31 header FF Return:FA 31	Send:FD 02 31 A8 8A FF Return:FA 31

Remote Header: 0x0000 indicates that remote configuration is turned off, 0x0001～0xFFFF indicates that remote configuration is turned off, default 0xA88A(0xA8 0x8A).

6.5.19 User GPIO parameter

Read command format:

Command format	Command example
Send: FE 03 20 GpioId FF Return: FB 20 GpioId In/Out level	Send: FE 03 20 00 FF Return: FB 20 00 01 01

Configuration command format:

Command format	Command example
Send: FD 03 20 GpioId In/Out level FF Return:FA 20	Send:FD 03 20 00 01 01 FF Return:FA 20

GPIO format of peripheral configuration data (3 Byte): GpioId In/Out level。

GPIO ID: Channel ID

Channel ID	GPIO port
00	PC0 port
01	PB4 port

In/Out: Channel output/inpout mode

0 Output

1 Input

Level: The level state of the channel

0 Low level

1 High level

2 Reverse

Note: when it is set to input, level represents the input level value 0 (low level) or 1 (high level), when it is set to output, level represents 0 (low level), 1 (high level), 2 (reverse).

6.5.20 User PWM parameter

Read command format:

Command format	Command example
Send: FE 06 21 PWMId FF Return: FB 21 PWMId start/stop Period Period duty duty	Send: FE 06 21 00 FF Return: FB 21 00 01 0A 3E 63 50

Configuration command format:

Command format	Command example
Send: FD 06 21 PwmId start/stop Period1 Period2 duty1 duty2 FF Return:FA 21	Send:FD 06 21 00 FF 03 65 02 48 FF Return:FA 21

PWM format of peripheral configuration data(6 Byte): PwmId start/stop Period1 Period2 duty1 duty2

PwmId: Channel ID

Channel ID	PWM GPIO port
0x00	PC2 port
0x01	PD2 port
0x02	PC3 port
0x03	PC4 port

start/stop: Start/stop channel PWM output

0xFF means to start PWM in 1mS unit, the parameter range is 0-340, and the maximum period that can be set is 340mS. When the period parameter is less than 2, the period parameter is 2, and the period is 2mS (2*1mS).

0xFE means to start PWM in 0.5uS unit, the parameter range is 0-3400, and the maximum period that can be set is 1700uS (3400*0.5). When the period parameter is less than 2, the period parameter is 2, and the period is 1uS (2*0.5uS).

0x00 means stop PWM.

Period: Cycle time of PWM (the unit of cycle and the maximum cycle are determined according to the start/stop byte)

Period1 indicates the upper 8 bits

Period2 indicates the lower 8 bits

Duty: Duty cycle time of PWM (the unit of cycle and the maximum cycle are determined according to the start/stop byte)

Duty1 indicates the upper 8 bits

Duty2 indicates the lower 8 bits

Note:

1. The value of period must be greater than the value of duty. It is recommended that the difference between period and duty is greater than 2ms. If the period is less than duty, the system will default that period is equal to twice of duty. The duty here represents the high level time.
2. The PWM cycle units of the four channels need to be the same.

6.5.21 User ADC parameter

Read command format:

Command format	Command example
Send: FE 03 22 adcid FF Return: FB 22 adcid voltage1 voltage2	Send: FE 03 22 00 FF Return: FB 22 00 0C E4

Adcformat of peripheral configuration data (3 Byte): adcid voltage1 voltage2

adcid：ADC channel ID

Channel ID	ADC GPIO port
0x00	VDD Power supply voltage detection
0x01	PB6 port
0x02	PB7 port

Voltage: ADC channel voltage value read (unit: mV)

Detectable range 0x0000～0x0E74 (0～3700)

voltage 1 indicates the upper 8 bits

voltage 2 indicates the lower 8 bits

For example, value read: voltage =0x0C voltage =0xE4

Then voltage is: voltage =0x0CE4

No:

1. If the power supply voltage is the highest 3.3V, the detection range of ADC can reach 3.3V.
2. The time interval between two times of reading of ADC voltage of the same device must be greater than 10ms.

6.5.22 Configure all network parameters

Configuration command format:

Command format	Command example
Send:FD 1A FE all_info FF Return:FA FE	Send:FD 1A FE 03 FE 5B 01 0B 0A 09 54 00 00 00 0A 1C 21 FE FF 57 B4 14 02 00 FF 05 05 A8 8A FF Return:FA FE

all_info: FD 1A FE 03 FE 5B 01 0B 0A 09 54 00 00 00 0A 1C 21 FE FF 57 B4 14 02 00 FF 05 05 A8 8A FF

Note type 03; PANID FE 5B; Network group number 01; Channel 0B; TX power 0A; Baudrate 09: Sleep time 54; Target network short address 00 00; Targe network group number 00; Target long address 0A 1C 21 FE FF 57 B4 14; System transmission mode 02; Data output mode 00; Network open time FF(Modules that are not coordinators are not supported); rejoin cycle 05; rejoin times 05; Remote ID A8 8A.

6.5.23 Read all network parameters

Read command format:

Send: FE 2F FE FF Return: FB FE all_info	Send:FE 2F FE FF Return:FB FE 03 02 FE 5B F6 FA 1F 1C 21 FE FF 57 B4 14 00 00 0C 46 0C FE FF 9F FD 90 01 0B 0A 09 54 00 00 00 0A 1C 21 FE FF 57 B4 14 02 00 FF 05 05 A8 8A

all_info: FB FE 03 02 FE 5B F6 FA 1F 1C 21 FE FF 57 B4 14 00 00 0C 46 0C FE FF 9F FD 90 01 0B 0A 09 54 00 00 00 0A 1C 21 FE FF 57 B4 14 02 00 FF 05 05 A8 8A

Note type 03; Network status 02; Network address FE 5B; Loacl network address F6 FA; Local MAC address 1F 1C 21 FE FF 57 B4 14; Network short address of parent node 00 00; MAC address of parent node 0C 46 0C FE FF 9F FD 90; Network group number 01; Channel 0B; TX power 0A; Baudrate 09: Sleep time 54; Target network short address 00 00; Targe network group number 00; Target long address 0A 1C 21 FE FF 57 B4 14; System transmission mode 02; Data output mode 00; Network open time FF(Modules that are not coordinators are not supported); rejoin cycle 05; rejoin times 05; Remote ID A8 8A.

6.5.24 Configure AUX wake-up external MCU serial port delay printing time in wireless receiving state

Read command format:

Command format	Command example

Send: FE 01 35 FF Return: FB 35 AUX_delaytime	Send: FE 01 35 FF Return: FB 35 04

Configuration command format:

Command format	Command example
Send:FD 01 35 AUX_delaytime FF Return:FA 35	Send:FD 01 35 04 FF Return:FA 35

AUX_delaytime: 1～255, unit is mS, default is 4mS. That is, after receiving the data, the module first pulls down the AUX pin to wake up the external MCU, and then outputs the serial port data to the external MCU with a delay of 4ms.

6.5.25 Configure serial wake up hold time

Read command format:

Command format	Command example
Send: FE 01 36 FF Return: FB 36 Uart_holdtime	Send: FE 01 36 FF Return: FB 36 64

Configuration command format:

Command format	Command example
Send:FD 01 36 Uart_holdtime FF Return:FA 36	Send:FD 01 36 64 FF Return:FA 36

Uart_holdtime: 1～255, unit is 10mS, default is 100, That is, after the serial port wakes up, keep 100 * 10ms continuous wake-up, and then go to sleep after 1000ms.

6.5.26 Configure node information

Read command format:

Command format	Command example
Send: FE 05 37 FF Return: FB 37 Endpoint_info	Send: FE 05 37 FF Return: FB 37 01 FE B0 05 04

Configuration command format:

Command format	Command example
Send:FD 05 37 Endpoint_info FF Return:FA 37	Send:FD 05 37 01 FE B0 05 04 FF Return:FA 37

Endpoint_info: The 5-byte data format is: endpoint clusterId_H clusterId_L profileId_H profileId_L

Default is: endpoint 0x01, clusterId 0xfeb0, profileId 0x0504

endpoint	clusterId		profileId	
	clusterId_H	clusterId_L	profileId_H	profileId_L
01	FE	B0	05	04

6.5.27 Configure trust center connection key

Read command format:

Command format	Command example
Send: FE 10 38 FF Return: FB 38 TrustCentLinkKey	Send: FE 10 38 FF Return: FB 38 5A 69 67 42 65 65 41 6C 6C 69 61 6E 63 65 30 39

Configuration command format:

Command format	Command example
Send:FD 10 38 TrustCentLinkKey FF Return:FA 38	Send:FD 10 38 5A 69 67 42 65 65 41 6C 6C 69 61 6E 63 65 30 39 FF Return:FA 38

TrustCentLinkKey: 16 bytes, default is: the default key of ZigBee Alliance, the value is:

0x5A 0x69 0x67 0x42 0x65 0x65 0x41 0x6C

0x6C 0x69 0x61 0x6E 0x63 0x65 0x30 0x39

Device restart takes effect.

Note: only the network access device with the same Linkkey as the Trust Center (Coordinator) can connect to the network of the Trust Center (Coordinator). At the same time, the Trust Center (Coordinator) transmits the network key to the network access device, and the network access device completes the network access process, obtains the network key for normal communication.

6.5.28 Firmware version command description

Read command format:

Command format	Command example
Send: FE 03 34 FF Return: FB 34 FirmwareVersion	Send: FE 03 34 FF Return: FB 34 82 58 00

Firmware_version: 82 58 00

82 58 is Telink’s 8258 chip

00 is firmware version

7.FAQ

7.1 Communication range is too short

- The communication distance will be affected when obstacle exists.
- Data lose rate will be affected by temperature, humidity and co-channel interference.
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground.
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea.
- The signal will be affected when the antenna is near metal object or put in a metal case.
- Power register was set incorrectly, air data rate is set as too high (the higher the air data rate, the shorter the distance).
- When the power supply at room temperature is lower than the recommended low voltage, the lower the voltage is, the lower the transmitting power is.
- Due to antenna quality or poor matching between antenna and module.

7.2 Module is easy to damage

- Please check the power supply and ensure it is within the recommended range. Voltage higher than the peak will lead to a permanent damage to the module.
- Please check the stability of power supply and ensure the voltage not to fluctuate too much.
- Please make sure anti-static measures are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range for some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

7.3 High bit error rate

- There are co-channel signal interference nearby, keep away from interference sources or modify frequency, channel to avoid interference.
- The clock waveform on the SPI is not standard. Check whether there is interference on the SPI line. The SPI bus line should not be too long.
- Unsatisfactory power supply may also cause garbled characters, and ensure the reliability of the power supply.
- If the extension cable or feeder is of poor quality or too long, the bit error rate will be high.

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