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E18 V3.2 Software Datasheet
（ZigBee Ad hoc network module ）

1. Module introduction

1.1 ZigBee introduction

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

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

The functions of each type of equipment are as follows:

Coordinator (coordinator) The coordinator is responsible for starting the entire network. It is also the first device on the network. The coordinator selects a channel and a network ID (also called PAN ID, or Personal Area Network ID), and then starts the entire network. The coordinator can also be used to assist in the establishment of bindings between the security layer and the application layer in the network. Note that the role of the coordinator mainly involves network startup and configuration. Once these are all completed, the coordinator works like a router (or disappears and goes away). Due to the distributed nature of the ZigBee network itself, the subsequent operation of the entire network does not depend on the existence of the coordinator.

Router (router) The main function of the router is to allow other devices to join the network, multi-hop routing and assist its own battery-powered son terminal device communication. Usually, the router wants to be always active, so it must use the main power supply. However, when using the tree group network mode, the routing is allowed to operate once in a certain period so that it can be powered by batteries.

End-Device (terminal equipment) The terminal 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 Product feature

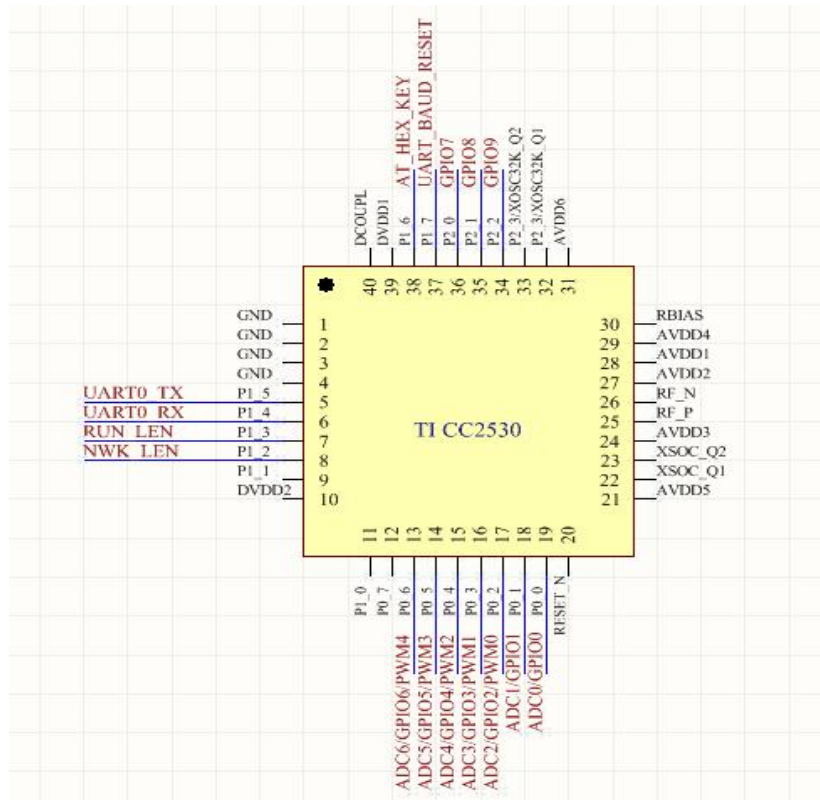| No.	Product feature	Description
1	Role switching	The user can switch the device among the three types of coordinator, router and terminal through serial commands.
2	Automatic networking	Support power-on automatic networking. The coordinator is powered on to automatically form a network, and the terminal and router automatically search for and join the network.
3	Network self-healing function	Lost the network automatic reconnection function. If the intermediate node of the network is lost, other networks will automatically join or maintain the original network. (Isolated nodes automatically join the original network, and non-isolated nodes keep the original network.) If the coordinator is lost, there are non-isolated nodes in the original network, the coordinator can join the network again or the coordinator of the original network PAN_ID set by the same user can join the original network.
4	Ultra low power consumption	In the terminal state, the device can be set to a low power consumption mode, and the sleep time of the device can be changed according to the user's use time. The standby power consumption in the low power consumption mode is less than 2uA. You can receive the message you should receive within the time set by the user during the parent node data storage time.
5	Data retention time setting	When the device is in the state of the coordinator and router, the user can set the data storage time by himself, and use it with the terminal in sleep mode to save the data of the terminal device and send the data to the terminal after the terminal wakes up from sleep.
6	Automatic resend function	Save 3 pieces of data at most, if it exceeds, the first data will be cleared automatically! After the data storage time has passed, the data pile is automatically cleared. In unicast (on-demand) mode, the device automatically

		resends when it fails to send to the next node, and the number of retransmissions for each message is 3 times.
7	Automatic routing	The module supports network routing functions. Routers and coordinators carry network data routing functions, and users can perform multi-hop networking.
8	Support encryption protocol	The module adopts AES 128-bit encryption function, which can change the network encryption and anti-monitoring. Users can change the network key by themselves, and the devices with the same network key can communicate with each other normally.
9	Support serial port configuration	The module has built-in serial port commands, and the user can configure (view) the parameters and functions of the module through the serial port commands.
10	Multi-type data communication	Support whole network broadcast, multicast and on-demand (unicast) functions. Several transmission methods are also supported in broadcast and unicast modes.
11	Multiple working mode selection	Support transparent transmission mode, semi-transparent transmission mode, protocol mode, three working modes, users can switch freely. (New in V2.0)
12	Channel change	Support 16 channel changes (2405~2480MHZ) from 11 to 26, and different channels correspond to different frequency bands.
13	Network PAN_ID change	Any switch of network PAN_ID, users can customize PAN_ID to join the corresponding network or automatically select PAN_ID to join the network. .
14	Serial port baud rate change	The user can set the baud rate by himself, up to 1M, the default number of bits is 8, the stop bit is 1 bit, and there is no parity bit.
15	Short address collection	The user can find the corresponding short address according to the MAC address (unique, fixed) of the module that has joined the network.
16	Gpio control	Local/remote gpio control function, ten gpio for users to choose.
17	Pwm control	Local/remote pwm control, 5 pwm channels for users to choose.
18	Adc control	Local/remote adc reading, 7 adc channels for users to choose.
19	Command format switching	This module supports two command modes: AT command and HEX command. Users can easily configure and switch. The physical location is P1.6.
20	Module reset	The user can reset the module through the serial port command.
21	One key to restore baud rate reset	This module supports one-key recovery of baud rate. Users can use this function if they forget the baud rate. The default baud rate is 115200 and the physical location is P1.7.
22	Reset to factory setting	Users can restore the factory settings of the module through serial commands.

1.3 E18 series

No.	Product Model No.	RF chipset	Frequency（Hz）	Air data rate（bps）	Power（dBm）	Antenna
1	E18-MS1-PCB	CC2530	2.4G	250K	4	PCB
2	E18-MS1- IPX	CC2530	2.4G	250K	4	IPEX
3	E18-MS1PA1-PCB	CC2530	2.4G	250K	20	PCB
4	E18-MS1PA-IPX	CC2530	2.4G	250K	20	IPEX

2. Function introduction

2.1 Pin definition

Pin	Function	Description（The alternate function pin can only be specified as the last modified function）	Input/output
P0_0	GPIO0/ADC0	Function pins GPIO0/ADC0 controlled by user	I/O
P0_1	GPIO1/ADC1	Function pins GPIO1/ADC1controlled by user	I/O
P0_2	GPIO2/ADC2/PWM0	Function pins GPIO2/ADC2/PWM0 controlled by user	I/O
P0_3	GPIO3/ADC3/PWM1	Function pins GPIO3/ADC3/PWM1 controlled by user	I/O
P0_4	GPIO4/ADC4/PWM2	Function pins GPIO4/ADC4/PWM2 controlled by user	I/O
P0_5	GPIO5/ADC5/PWM3	Function pins GPIO5/ADC5/PWM3 controlled by user	I/O
P0_6	GPIO6/ADC6/PWM4	Function pins GPIO6/ADC6/PWM4 controlled by user	I/O

P2_0	GPIO7	Function pin GPIO7 controlled by user	I/O
P2_1	GPIO8	Function pin GPIO8 controlled by user	I/O
P2_2	GPIO9	Function pin GPIO9 controlled by user	I/O
P1_2	NWK_LED	Used to indicate the network access status of the module, low level means the module has joined the network, high level means the module has no network.	O
P1_3	RUN_LED	The indicator light used to indicate the normal operation of the module. A low level indicates that the module is operating normally, and a high level indicates that the module is not operating.	O
P1_6	AT_HEX_KEY	Used to switch between AT command mode and HEX command mode. Low level means HEX command mode, high level means AT command mode (default).	I
P1_7	UART_BAUD_RESET	Used to restore the serial port baud rate, when the user forgets or does not know the baud rate of the module, this button can be used to restore the factory baud rate (115200). (The falling edge is valid)	I
P1_4	UART0_RX	Uart RX pin	I
P1_5	UART0_TX	Uart TX pin	O

2.2 Pin connection description

2.2.1 UART connection

2.2.2 Pin definition

E18-MS1 Series   E18-MD0 Series

E18 ZigBee networking module adopts UART serial communication mode. Users can connect to it through any MCU with UART function for data exchange. The E18 P1_4 and P1_5 pins are the RX and TX pins of the E18 internal serial port respectively. The specific connection method is shown in the figure above.

E18-MS1 series module pin table

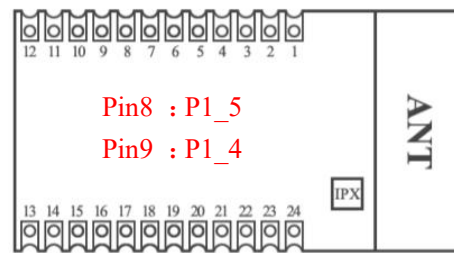| 1	GND	13	P1.2
2	VCC	14	P1.1
3	P2.2	15	P1.0
4	P2.1	16	P0.7
5	P2.0	17	P0.6
6	P1.7	18	P0.5
7	P1.6	19	P0.4
8	NC	20	P0.3
9	NC	21	P0.2
10	P1.5	22	P0.1
11	P1.4	23	P0.0
12	P1.3	24	RESET

E18-MD0 series module pin table

1	GND	13	P1.0
2	VCC	14	P0.7
3	P2.2	15	P0.6
4	P2.1	16	P0.5
5	P2.0	17	P0.4
6	P1.7	18	P0.3
7	P1.6	19	P0.2
8	P1.5	20	P0.1
9	P1.4	21	P0.0
10	P1.3	22	RESET
11	P1.2	23	NC
12	P1.0	24	NC

4. User command set

For the convenience of users, the E18 ZigBee module uses two instruction formats, namely AT instruction format and HEX instruction format. Its format mode is controlled by default P1_6.

When P1_6 = 0, the module enters the HEX instruction mode. In this mode, enter +++ to enter the temporary AT command mode. You can use the AT command to configure, enter AT+EXIT to exit the temporary AT command.

When P1_6 = 1, the module enters the AT command mode. In the AT command, the end of a newline character cannot be used.

Remark：

1 Serial port data format error message

In HEX command mode: F7 FF

In AT command mode: +ERROR<CR><LF>

2 The coordinator device will prompt information when establishing a network:

In HEX command mode: FF FF

In AT command mode: Builded network<CR><LF>

3 The device will be prompted to join the network

In HEX command mode: FF AA

In AT command mode: Joined network<CR><LF>

4 The module device has no network or loses the network will prompt a message

In HEX command mode: FF 00

In AT command mode: No network<CR><LF>

5 <CR> means: 0x0D

6 <LF> means: 0x0A

4.1 HEX command set

4.1.1 Parameter read HEX command set

Command description	Command format	Command example
Read device type	Send:FE 01 01 FF Return:FB dev_type	Send:FE 01 01 FF Return:FB 02
Read network state	Send:FE 01 02 FF Return:FB nwk_state	Send:FE 01 02 FF Return:FB 01
Read PAN_ID	Send:FE 01 03 FF Return:FB pan_id	Send:FE 01 03 FF Return:FB 02 F4
Read network key	Send:FE 01 04 FF Return:FB key	Send:FE 01 04 FF Return:FB 11 13 15 17 19 1B 1D 1F 10 12 14 16 18 1A 1C 1D
Read local network short address	Send:FE 01 05 FF Return:FB ShortAddr	Send:FE 01 05 FF Return:FB F2 EF
Read local MAC address	Send:FE 01 06 FF Return:FB Mac_Addr	Send:FE 01 06 FF Return:FB 89 6C 50 09 00 4B 12 00
Read network short address of father node	Send:FE 01 07 FF Return:FB Coor_shortAddr	Send:FE 01 07 FF Return:FB 00 00
Read MAC address of father node	FE 01 08 FF Return:FB Coor _Mac_Addr	Send:FE 01 08 FF Return:FB 20 39 EA 0A 00 4B 12 00
Read network group number	Send:FE 01 09 FF Return:FB group	Send:FE 01 09 FF Return:FB 01
Read network channel	Send:FE 01 0A FF Return:FB channel	Send:FE 01 0A FF Return:FB 0B
Read tx power	Send:FE 01 0B FF Return:FB txpower	Send:FE 01 0B FF Return:FB 04
Read uart baud rate	Send:FE 01 0C FF Return:FB baud	Send:FE 01 0C FF Return:FB 09
Read sleep state（valid for terminal）	Send:FE 01 0D FF Return:FB sleep_time	Send:FE 01 0D FF Return:FB 05
Read the data retention time of the node (valid for router and coordinator)	Send:FE 01 0E FF Return:FB 1E	Send:FE 01 0E FF Return:FB 1E
Read network join period and times（valid for terminal）	Send:FE 01 0F FF Return:FB join_cycle join_cnt	Send:FE 1 0F FF Return:FB 00 FF

Command description	Command format	Command example
Read all device info	Send:FE 01 FE FF Return:FB all_info	Send:FE 01 FE FF Return:FB 02 01 02 F4 11 13 15 17 19 1B 1D 1F 10 12 14 16 18 1A 1C 1D F2 EF 89 6C 50 09 00 4B 12 00 00 00 20 39 EA 0A 00 4B 12 00 01 0B 04 09 05
Get the short address of any MAC address in the network	Send:FE 09 10 Mac_Addr FF Return:FB shortAddr	Send:FE 09 10 AF 99 E9 0A 00 4B 12 00 FF Return:FB 08 35
Read remote/local GPIO input and output status	Command：FE 04 20 addr gpiox FF Return:FB 20 addr In/Out	FE 04 20 F9 DE 04 FF
Read remote/local GPIO level	Command：FE 04 21 addr gpiox FF Return:FB 21 addr In/Out level	FE 04 21 FF FF 04 FF
Read remote/local PWM status	Command:FE 04 22 addr 22 FF Return:FB 22 addr period duty1 duty2 duty3 duty4 duty5	FE 04 22 FFFF 22 FF
Read remote/local ADC state	Command:FE 04 23 addr pin FF Return:FB 23 addr adc_value	FE 04 23 FF FF 01 FF

4.1.2 Parameter setting HEX command sets

Command description	Command format	Command example
Set device type	Send:FD 02 01 dev_type FF Return:FA 01	Send:FD 02 01 02 FF Return:FA 01
Set PAN_ID	Send:FD 03 03 pan_id FF Return:FA 03	Send:FD 03 03 12 34 FF Return:FA 03
Set network key	Send:FD 11 04 key FF Return:FA 04	Send:FD 11 04 11 13 15 17 19 1B 1D 1F 10 12 14 16 18 1A 1C 1D FF Return:FA 04
Set network group number	Send:FD 02 09 group FF Return:FA 09	Send:FD 02 09 01 FF Return:FA 09
Set communication channel	Send:FD 02 0A channel FF Return:FA 0A	Send:FD 02 0A 0B FF Return:FA 0A
Set tx power	Send:FD 02 0B txpower FF Return:FA 0B	Send:FD 02 0B 04 FF Return:FA 0B
Set uart baud rate	Send:FD 02 0C baud FF Return:FA 0C	Send:FD 02 0C 09 FF Return:FA 0C
Set sleep mode（valid for terminal）	Send:FD 02 0D sleep_time FF Return:FA 0D	Send:FD 02 0D 05 FF Return:FA 0D
Configure the node data retention time （valid for router and coordinator）	Send:FD 02 0E time FF Return:FA 0E	Send:FD 02 0E 07 FF Return:FA 0E
Set network join period and times(valid for terminal)	Send:FD 03 0F join_cycle jion_cnt FF Return:FA 0F	Send:FD 03 0F 00 FF FF Return:FA 0F
Set remote/local GPIO input output state	Command:FD 05 20 addr gpiox In/Out FF Return:FA 20 addr	Send:FD 05 20 FF FF 04 01 FF Return:FA 20 FFFF
Set remote/local GPIO output level （output mode valid）	Command:FD 05 21 addr gpiox level FF Return:FA 21 addr	Send:FD 05 21 FF FF 04 02 FF Return:FA 21 FFFF
Set remote local PWM state	Command:FD 0F 22 addr period duty1 duty2 duty3 duty4 duty5 FF Return:FA 22 addr	Send:FD 0F 22 FFFF FFFF 1FFF 3FFF 5FFF 7FFF 9FFF FF Return:FA 22 FFFF
Device restart	Send:FD 01 12 FF Return:FA 12	Send:FD 01 12 FF Return:FA 12
Recover factory setting	Send:FD 01 13 FF Return:FA 13	Send:FD 01 13 FF Return:FA 13
Off network and restart	Send:FD 01 14 FF Return:FA 14	Send:FD 01 14 FF Return:FA 14
Set all info	Send:FD 2E FE all_info FF Return:FA FE	Send:FD 2E FE 02 01 02 F4 11 13 15 17 19 1B 1D 1F 10 12 14 16 18 1A 1C 1D F2 EF 89 6C 50 09 00 4B 12 00 00

Command description	Command format	Command example
		00 20 39 EA 0A 00 4B 12 00 01 0B 04 09 05 FF
		Return:FA FE

4.2 HEX parameter description

4.2.1 Network type

1、HEX command description

Read device type	Send:FE 01 01 FF	Send:FE 01 01 FF
	Return:FB dev_type	Return:FB 02
Set device type	Send:FD 02 01 dev_type FF	Send:FD 02 01 02 FF
	Return:FA 01	Return:FA 01

dev_type： 00 Coordinator

01 Router

02 Terminal (default)

2、AT command description

AT+DEV

Function：Query/set device type

Format：

Query

Send:AT+DEV= type

Return:+OK<CR><LF>

Set

Send:AT+DEV=?

Return:DEV= type<CR><LF>

Parameter： type

C Coordinator

R Router

E Terminal (default)

For example：AT+DEV=C

Default：DEV=E

4.2.2 Network state

1、HEX command description

Read network state	Send:FE 01 02 FF	Send:FE 01 02 FF
	Return:FB nwk_state	Return:FB 01

nwk_state： 00 No network

01   Network exists

2、AT command description

AT+NWK

Function：check device type

Format：Query

Send:AT+NWK=?

Return:NWK=nwk_state<CR><LF>

Parameter：nwk_state

    0   No network

    1   network exists

For example：AT+NWK=？

4.2.3　Network PAN_ID

1、HEX command description

Read network PAN_ID	Send:FE 01 03 FF	Send:FE 01 03 FF
	Return:FB pan_id	Return:FB 02 F4
Set PAN_ID	Send:FD 03 03 pan_id FF	Send:FD 03 03 12 34 FF
	Return:FA 03	Return:FA 03

pan_id：   0000~FFFE   fixed network PAN_ID

                FFFF   random network PAN_ID

2、AT command description

AT+PANID

Function：**query**/set network PANID

Format：**query**

    Send:AT+PANID=?

    Return:PANID=panid<CR><LF>

  Set

    Send:AT+PANID=mode

    Return:+OK<CR><LF>

Parameter：panid

    0000-FFFE   fixed PANID

    FFFF   random PANID

For example：AT+ PANID=0XA1B2

4.2.4 Network key

1、HEX command description

Read network key	Send:FE 01 04 FF	Send:FE 01 04 FF
	Return:FB key	Return:FB 11 13 15 17 19 1B 1D 1F 10 12 14 16 18 1A 1C 1D
Set network key	Send:FD 11 04 key FF	Send:FD 11 04 11 13 15 17 19 1B 1D 1F 10 12 14 16 18 1A 1C 1D FF
	Return:FA 04	Return:FA 04

key：   16 bit network key

2、AT command description

AT+KEY

Function：**query**/set key

Format：**query**

    Send:AT+KEY=?

    Return:KEY=key<CR><LF>

  set

Send:AT+KEY=key

Return:+OK<CR><LF>

parameter：key

16　Byte network key

For example：AT+ KEY=01030507090B0D0F00020406080A0C0D

Default：KEY=11131517191B1D1F10121416181A1C1D

4.2.5 Network short address
1、HEX command description

Read local network short address	Send:FE 01 05 FF	Send:FE 01 05 FF
	Return:FB ShortAddr	Return:FB F2 EF

ShortAddr：　2 Byte address

2、AT command description
AT+SHORT_ADDR

Function：query local network address

Format：query

Send:AT+SHORT_ADDR =?

Return:SHORT_ADDR=shortaddr<CR><LF>

Paramter：shortaddr

0000-FFFF network short address

For example：AT+SHORT_ADDR=?

4.2.6 MAC address
1、HEX command description

Read local MAC address	Send:FE 01 06 FF	Send:FE 01 06 FF
	Return:FB Mac_Addr	Return:FB 89 6C 50 09 00 4B 12 00

Mac_Addr：　8 Byte address

2、AT command description
AT+MAC_ADDR

Function：query local MAC address

Format：query

Send:AT+MAC_ADDR=?

Return:MAC_ADDR=macaddr<CR><LF>

Parameter：macaddr

8 Byte MAC length address（unique IEEE ID）

For example：AT+MAC_ADDR=?

4.2.7 Network short address of father node
1、HEX command description

Read network short address of father node	Send:FE 01 07 FF	Send:FE 01 07 FF
	Return:FB Coor_shortAddr	Return:FB 00 00

Coor_shortAddr：2 Byte address

2、AT command description
AT+COOR_SHORT_ADDR

Function：Query network short address of father node

Format：**Query**

        Send:AT+COOR_SHORT_ADDR=?

        Return:COOR_SHORT_ADDR= shoraddr <CR><LF>

 Parameter：shoraddrt

        2 Byte device short address

For example：AT+COOR_SHORT_ADDR=?

4.2.8 MAC address of father node

1、HEX command description

Read MAC address of father node	FE 01 08 FF	Send:FE 01 08 FF
	Return:FB Coor _Mac_Addr	Return:FB 20 39 EA 0A 00 4B 12 00

    Coor_Mac_Addr：8 Byte address

2、AT command description
AT+COOR_MAC_ADDR

Function：query MAC address of father node

Format：**query**

        Send:AT+COOR_MAC_ADDR=?

        Return:COOR_MAC_ADDR=macaddr<CR><LF>

Parameter：macaddr

        8 Byte MAC length address（unique IEEE ID）

For example：AT+COOR_MAC_ADDR=?

4.2.9 network group number

1、HEX command description

Read network group number	Send:FE 01 09 FF	Send:FE 01 09 FF
	Return:FB group	Return:FB 01
Set network group number	Send:FD 02 09 group FF	Send:FD 02 09 01 FF
	Return:FA 09	Return:FA 09

    group：   group number range 1~99（default 1）

2、AT command description
AT+GROUP

Function：query/set network group number

Format：**Query**

        Send:AT+GROUP=?

        Return:GROUP=group<CR><LF>

    Set

        Send:AT+GROUP=group

        Return:+OK<CR><LF>

Parameter：group（0~99）

        Local group number

For example：AT+GROUP=group

Default：GROUP=1

4.2.10 Network channel

1、HEX command description

Read communication channel	Send:FE 01 0A FF	Send:FE 01 0A FF
	Return:FB channel	Return:FB 0B
Set communication channel	Send:FD 02 0A channel FF	Send:FD 02 0A 0B FF
	Return:FA 0A	Return:FA 0A

channel： channel range 11~26（default 11）

2、AT command description
AT+CH

Function：query/set wireless channel

Format：Query

> Send:AT+CH=?
>
> Return:CH=ch<CR><LF>

> Set
>
> Send:AT+CH=ch
>
> Return:+OK<CR><LF>

Parameter： ch（11~26）

> Wireless channel

For example： AT+CH=11

Default： CH=11

4.2.11 Tx power

1、HEX command description

Read tx power	Send:FE 01 0B FF	Send:FE 01 0B FF
	Return:FB txpower	Return:FB 04
Set tx power	Send:FD 02 0B txpower FF	Send:FD 02 0B 04 FF
	Return:FA 0B	Return:FA 0B

txpower：

Power parameter txpower table Without PA/with PA

txpower	Power (dBm)	txpower	power (dBm)
00	-3 / 16 / 20	03	2.5 / 20 / 26
01	-1.5 / 17 / 22	04	4.5 / 20 / 27（default）
02	0　/ 19 / 24	05	

2、AT command description
AT+TXPOWER

Function：query/set wireless tx power

Format：Query

> Send:AT+TXPOWER=?
>
> Return:CH=txpower<CR><LF>

> Set
>
> Send:AT+TXPOWER=txpower
>
> Return:+OK<CR><LF>

Parameter：txpower（0~4）

　　　　　　　Transmission power（see details from power table）

Format：AT+TXPOWER=4

Default：TXPOWER=4

4.2.12 UART baud rate
1、HEX command description

Read UART baud rate	Send:FE 01 0C FF	Send:FE 01 0C FF
	Return:FB baud	Return:FB 09
Set UART baud rate	Send:FD 02 0C baud FF	Send:FD 02 0C 09 FF
	Return:FA 0C	Return:FA 0C

baud：

Baud rate table

baud	Baud rate		baud	Baud rate
00	2400		08	76800
01	4800		09	115200（default）
02	9600		0A	128000
03	14400		0B	230400
04	19200		0C	256000
05	38400		0D	460800
06	43000		0E	921600
07	57600		0F	1000000

2、AT command description
AT+UART

Function：**query**/set baud rate

Format：Query

　　　　　　Send:AT+UART=?

　　　　　　Return:UART=baud<CR><LF>

　　　Set

　　　　　　Send:AT+UART=baud

　　　　　　Return:+OK<CR><LF>

Parameter：baud（0~15）

　　　Baud rate（See details from parameter power table）

For example：AT+UART=9

Default：UART=9

4.2.13 Sleep time
1、HEX command description

Read sleep state（valid for terminal）	Send:FE 01 0D FF	Send:FE 01 0D FF
	Return:FB sleep_time	Return:FB 05
Set sleep state（valid for terminal）	Send:FD 02 0D sleep_time FF	Send:FD 02 0D 05 FF
	Return:FA 0D	Return:FA 0D

sleep_time：0　　　sleep state off（default）

Other（1~250） sleep mode on，sleep_time unit S（second）

2、AT command description
AT+SLEEP

Function：Query/set device sleep mode（valid for terminal）

Format：Query

    Send:AT+SLEEP=?

    Return:SLEEP=sleep<CR><LF>

  Set

    Send:AT+SLEEP=sleep

    Return:+OK<CR><LF>

Parameter：sleep

    0 Sleep mode off

    1~250 Sleep mode on,sleep time is **1~60 s, time over 60s will be 60s as default**

For example：AT+SLEEP=0

Default：SLEEP=0

4.2.14 Join network time
1、HEX command description

Read join network sleep period and times（valid for terminal）	Send:FE 01 0F FF Return:FB join_cycle join_cnt	Send:FE 1 0F FF Return:FB 00 FF
Set join network sleep period and times（valid for terminal）	Send:FD 03 0F join_cycle jion_cnt FF Return:FA 0F	Send:FD 03 0F 00 FF FF Return:FA 0F

  join_cycle：

    0 No network join，no device in sleep mode（default）

    1~255 No network join，allow device in sleep mode

      61-255：sleep time（join_cycle-60）*60+60 second，max 196min

      1-60 ：sleep time join_cycle seconds

  join_cnt：

    0：Invalid

    1~254 join_cycle is sleep time，try connect join_cnt times，when exceeding fail to join network.

    255 join_cycle is sleep time，try join network all the time.（default）

2、AT command description
AT+JOINSLEEP

Function：Query/configure device has no network，sleep time（terminal valid ，default 0S）

Fomat：Query

    Send:AT+JOINSLEEP=?

    Return:JOINSLEEP =sleep<CR><LF>

  Set

    Send:AT+ JOINSLEEP =sleep

    Return:+OK<CR><LF>

Parameter：sleep

0　No network join，no device in sleep mode（default）

1~255 No network join，device in sleep for 1s~196min

Parameter calculation：

1~60　device sleep time is 1~60s

61~255 device sleep time is 2min~196min　　　（(sleep -60)*1min+1min）

For example：AT+ JOINSLEEP =0

Default：JOINSLEEP =0

AT+JOINCNT

Function：Query/configure the number of connections (reconnections) when the device has no network;

Join the network JOINCNT times in the JOINSLEEP cycle, and enter the PM3 low power consumption (sleep terminal) or standby mode (terminal) after executing the JOINCNT times, and enter the PM3 low power consumption (sleep terminal) or standby mode (terminal). You can re-enter the network (terminal valid, default 255)

Format：Query

Send:AT+ JOINCNT =?

Return:JOINCNT = joincnt <CR><LF>

Set

Send:AT+ JOINCNT =joincnt

Return:+OK<CR><LF>

Parameter：joincnt

0　Invalid parameter

1~254 no network joins，join joincnt times

255 no network joins, try join it all the time

For example：AT+JOINCNT =255

Default：AT+JOINCNT = 255

4.2.15 Father node storage time

1、HEX command description

Read data storage time of the node（valid for router and coordinator）	Send:FE 01 0E FF	Send:FE 01 0E FF
	Return:FB 1E	Return:FB 1E
Set data storage time of the node（valid for router and coordinator）	Send:FD 02 0E time FF	Send:FD 02 0E 07 FF
	Return:FA 0E	Return:FA 0E

time：　　　　　range 0~120（default 30），unit S(second)

2、AT command description
AT+DATA_TIME

Function：**Query**/set data storage time（valid for router and coordinator）

Format：Query

Send:AT+DATA_TIME=?

Return:DATA_TIME=data_time<CR><LF>

Set

Send:AT+SLEEP=data_time

Return:+OK<CR><LF>

Parameter： data_time

0~120 data storage time，unit:S

For example： AT+DATA_TIME=30

Default： DATA_TIME=30

4.2.16 User gpio parameter

1、HEX command description

Read remote/local GPIO input output state	Command:FE 04 20 addr gpiox FF Return:FB 20 addr In/Out	FE 04 20 F9 DE 04 FF
Read remote/local GPIO level	Command:FE 04 21 addr gpiox FF Return:FB 21 addr In/Out level	FE 04 21 FF FF 04 FF
Set remote/local GPIO input output state	Command:FD 05 20 addr gpiox In/Out FF Return:FA 20 addr	Send:FD 05 20 FF FF 04 01 FF Return:FA 20 FFFF
Set remote/local GPIO output level（output mode valid）	Command:FD 05 21 addr gpiox level FF Return:FA 21 addr	Send:FD 05 21 FF FF 04 02 FF Return:FA 21 FFFF

（1）gpio port

gpiox：

User gpio port table

gpiox	00	01	02	03	04	05	06	07	08	09
GPIO	P0_0	P0_1	P0_2	P0_3	P0_4	P0_5	P0_6	P2_0	P2_1	P2_2

For example ： when gpio parameter is 2 ，pin position is P0_2

When gpio parameter is 8，pin position is P2_1

（2）gpio input ouput state

in/out：   1   input state

0   output state

（3）gpio state value（set input state invalid）

level：   0   low level

1   high level

2   roll over

2、AT command description

AT+RGPIO_PUT

Function：read remote/local GPIO input output mode

Format：set

Send:AT+RGPIO_PUT=addr,gpiox

Return:RGPIO_PUT=addr,input<CR><LF>

Parameter： addr

0000~FFF8 remote short address device

FFFF local device

gpiox   (0~9)

GPIO port number

input

0   output state

1   input state

For example： AT+RGPIO_PUT=1AC0,5

AT+GPIO_PUT

Function：set remote/local GPIO input output mode

Format：set

    Send:AT+GPIO_PUT=addr,gpiox,inout

    Return:+OK<CR><LF>

Parameter： addr

    0000~FFF8 remote short address device

    FFFF local device

  gpiox　(0~9)

    GPIO port number

  input

    0　output state

    1　input state

For example： AT+GPIO_PUT=1AC0,5,0

AT+RGPIO_LEVEL

Function：read remote/local GPIO input output mode

Format：read

    Send:AT+RGPIO_LEVEL=addr,gpiox

    Return:RGPIO_LEVEL=input,level<CR><LF>

Parameter： addr

    0000~FFF8 remote short address device

    FFFF local device

  gpiox　(0~9)

    GPIO port number

  input

    0 output state

    1 input state

  level

    1　high level

    0　low level

For example： AT+RGPIO_LEVEL=1AC0,5

AT+GPIO_LEVEL

Function：set remote/local GPIO input output mode

Format：set

    Send:AT+GPIO_LEVEL=addr,gpiox,level

    Return:+OK<CR><LF>

Parameter： addr

    0000~FFF8 remote short address device

    FFFF local device

  gpiox　(0~9)

    GPIO port number

level

1 high level

0 low level

2 roll over

For example：AT+GPIO_LEVEL=1AC0,5,2

4.2.17 User pwm parameter

1、HEX command description

Read remote/local PWM state	Command:FE 04 22 addr 22 FF	FE 04 22 FFFF 22 FF
	Return:FB 22 addr period duty1 duty2 duty3 duty4 duty5	
Set remote/local PWM state	Command:FD 0F 22 addr period duty1 duty2 duty3 duty4 duty5 FF	Send:FD 0F 22 FFFF FFFF 1FFF 3FFF 5FFF 7FFF 9FFF FF
	Return:FA 22 addr	Return:FA 22 FFFF

（1）pwm port

pwmx：

User pwm port table

pwmx	duty1	duty2	duty3	duty4	duty5
GPIO	P0_2	P0_3	P0_4	P0_5	P0_6

（2）pwm period

period：（0~FFFF）

time （unit 1 = 62.5ns）

（3）pwm duty cycle time

dutyx：（0~FFFF）：

Duty cycle time（unit 1 = 62.5ns）

2、AT command description

AT+RPWM

Function：read remote/local PWM input output mode

Format： **read**

Send:AT+RPWM=addr

Return:RPWM=addr,period,duty1,duty2,duty3,duty4,duty5<CR><LF>

Parameter：addr

0000~FFF8 remote short address device

FFFF local device

period （unit1 = 62.5ns）

0~65535 period

duty1

0 off

other channel 1 Square wave of 50% duty cycle

duty2~ duty5 （0~65535 unit 1 = 62.5ns）

The positive pulse width time corresponding to the number of channels is 0 or greater than the period when the PWM of the channel is turned off.

For example：AT+RPWM=1AC0

AT+PWM

Function：set remote/local PWM input output mode

Format：set

> Send:AT+PWM= addr,period,duty1, duty2,duty3,duty4,duty5

> Return:+OK<CR><LF>

Parameter：addr

> 0000~FFF8 remote short address device

> FFFF local device

period   (unit 1 = 62.5ns)

> 0~65535 period

duty1

> 0   off

> other   channel 1 Square wave of 50% duty cycle

duty2~ duty5 （0~65535 unit 1 = 62.5ns）

The positive pulse width time corresponding to the number of channels is 0 or greater than the period when the PWM of the channel is turned off.

For example：AT+ PWM=1AC0,1000,1,500,500,0,500

4.2.18 User adc parameter
1、HEX command description

Read remote/local ADC state	Command:FE 04 23 addr pin FF	FE 04 23 FF FF 01 FF
	Return:FB 23 addr adc_value	

（1）adc channel

adcx：

<div align="center">User adc channel table</div>

adcx	0	1	2	3	4	5	6
GPIO	P0_0	P0_1	P0_2	P0_3	P0_4	P0_5	P0_6

（2）adc state value

adc_state：   0   ADC on

> 1   ADC off

（3）adc sampling value

adc_value： 0~0X0CE4 （0~3300）   unit mV

2、AT command description
AT+ADC

Function：read remote/local ADC input value

Format：read

> Send:AT+ADC=addr,adcx

> Return:ADC=addr,val<CR><LF>

Parameter：addr

> 0000~FFF8 remote short address device

> FFFF local device

adcx （0~6）

ADC channel

val （0~3300）

The current collected voltage value, in mV (millivolt)

For example：AT+ADC=1AC0,5

4.2.19 Peripheral addr parameter description

（1）Peripheral function address

addr：

FFFF View/Configure local information

0~FFF8 View/configure the information of the network address as addr FFFE, FFFD, FFFC can receive broadcast device viewing/configuration information

  ---FFFE broadcast to all devices in the network

---FFFD broadcast to idle receiving devices (except sleeping devices)

---FFFC broadcast to the coordinator and router

4.2.20 Save network information
1、HEX command description

Read if save network information	Command:FE 01 30 FF	Command:FE 01 30 FF
	Return:FB 00	Return:FB 00
Set if save network information	Command:FD 02 30 netifo FF	Command:FD 02 30 01 FF
	Return:FA 30	Return:FA 30

Netifo   0: Turn off the network information storage, restart the new device to join the   network, and build the network

1: Turn on network information storage, join or restore the original network after restarting.

2、AT command description
AT+NETIFO

Function：Read and set if save network information

Format：query

Send:AT+ NETIFO =?

Return:NETIFO = data<CR><LF>

set

Send:AT+ NETIFO = data

Return:+OK<CR><LF>

Parameter：data

0: Turn off the network information storage, restart the new device to join the network, and build the network

1: Turn on network information storage, join or restore the original network after restarting.

For example：AT+ NETIFO =0

Default：AT+ NETIFO =0

4.2.21 Clear current network information
1、HEX command description

Leave network and restart	Send:FD 01 14 FF	Send:FD 01 14 FF
	Return:FA 14	Return:FA 14

2、AT command description

AT+LEAVE

Function: Clear the current network information and restart.

Format：set

> Send:AT+ LEAVE

> Return:+OK<CR><LF>

For example： AT+LEAVE

4.2.22 Module reset

1、HEX command description

Device reset	Send:FD 01 12 FF	Send:FD 01 12 FF
	Return:FA 12	Return:FA 12

2、AT command description

AT+RESET

Function：device reset

Format：set

> Send:AT+RESET

> Return:+OK<CR><LF>

For example： AT+ RESET

4.2.23 Working mode

1、AT command description

AT+MODE

Function: Query/set working mode

Format：Query

> Send:AT+MODE=?

> Return:MODE= mode <CR><LF>

Set

> Send:AT+MODE=mode

> Return:+OK<CR><LF>

Parameter： mode

> 1 Mode 1 （transparent transmission mode）

> 2 Mode 2 （half transparent transmission mode）

> 3 Mode 3 （protocol mode）

For example： AT+MODE=3

Default： MODE=3

Mode	Node type	Description
Mode 1 （transparent transmission mode）	Router	This type of node is in a transparent transmission mode, which transparently transmits serial port data to non-sleeping devices in the network through broadcast.
	Router	This type of node is in the transparent transmission mode, and the serial port data is transparently transmitted to the coordinator through on-demand.
	End device	(Note: The terminal cannot receive mode 1 transparent data in sleep mode)
Mode 2 （half transparent	Coordinator	The module transmits according to the fixed format and full protocol of data transmission. Can be used for on-demand, broadcast, and multicast communication. For details, please refer to "HEX Data Communication Instructions".

transmission mode)	Router	This type of node is in the transparent transmission mode, and the serial port data is transparently transmitted to the coordinator through on-demand.
	End device	
Mode 3 (protocol mode)	Coordinator	The module transmits according to the fixed format and full protocol of data transmission. Can be used for on-demand, broadcast, and multicast communication. For details, please refer to "HEX Data Communication Instructions".
	Router	
	End device	
Note: Only mode 3 can be selected for GPIO function configuration Any mode can communicate with each other without affecting each other.		

4.2.24 Communication display mode

1、AT command description

AT+RMODE

Function：Query/configure communication display mode, protocol mode and semi-transparent mode coordinator are invalid

Format：query

    Send:AT+RMODE=?

    Return:RMODE=rmode <CR><LF>

  Set

    Send:AT+RMODE= rmode

    Return:+OK<CR><LF>

Parameter： rmode（1 on 0 off ；range：0-7 ）

0bit: Display the mac address of the sender

1bit: Display the short address of the sender

2bit: Display the RSSI value of the shortest path of the message

  For example：AT+RMODE=0

Default：RMODE=0

4.2.25 Exit AT command

1、AT command description

AT+EXIT

Function：**Exit the temporary AT command. (When P1_6 pin is pulled low, it is valid when entering AT command.)**

Format：**set**

    Send:AT+EXIT

    Return:+OK<CR><LF>

For example：AT+EXIT

4.2.26 Query version firmware number

1、AT command description

AT+SOFT_ID

Function：**Query version firmware number**

Format：**Query**

    Send:AT+SOFT_ID=?

    Return:SOFT_ID=soft_id<CR><LF>

Parameter：soft_id

        Software version number

For example：AT+SOFT_ID=?

4.2.27 All information

（1）All information

all_info：

Info indicator	（info length	（info site））	info description
dev_type	（1	Byte（0））	device type
nwk_state	（1	Byte（1））	network state
pan_id	（2	Byte（2~3））	network PAN_ID
key	（16	Byte（4~20））	network key
ShortAddr	（2	Byte（21~22））	network short address
Mac_Addr	（8	Byte（23~30））	MAC address
Coor_shortAddr	（2	Byte（31~32））	network short address of father node
Coor_Mac_Addr	（8	Byte（33~40））	MAC address of father node
group	（1	Byte（41））	network group number
channel	（1	Byte（42））	communication channel
txpower	（1	Byte（43））	tx power
baud	（1	Byte（44））	uart baud rate
sleep_time	（1	Byte（45））	Sleep state

detailed parameter examples：

all_info：

02 01 02 F4 11 13 15 17 19 1B 1D 1F 10 12 14 16 18 1A 1C 1D F2 EF 89 6C 50 09 00 4B 12 00 00 00 20 39 EA 0A 00 4B 12 00 01 0B 04 09 05

- ➢ Device type： 02 （end device）
- ➢ Network state： 01 （existed network）
- ➢ Network PANID： 02 F4 （PAN_ID=0X02F4）
- ➢ Network key： 11 13 15 17 19 1B 1D 1F 10 12 14 16 18 1A 1C 1D
- ➢ Local network short address： F2 EF （Local Short Address=0XF2EF）
- ➢ Local MAC address： 89 6C 50 09 00 4B 12 00
- ➢ Father node short address： 00 00（Father Node Short Address=0X0000）
- ➢ Father node MAC address： 20 39 EA 0A 00 4B 12 00
- ➢ Network group number： 01 （network group number 1）
- ➢ Network channel： 0B （channel 11）
- ➢ TX power： 04 （Tx power 4.5dBm）
- ➢ UART baud rate： 09 （baud rate 115200）
- ➢ Sleep time： 05（sleep state 5 s）

（Note: The retention time of the father node is not listed in all the information, if you need to configure or query, please use the corresponding command separately）

4.3 HEX data communication description

4.3.1 Command format description

（**Remarks: only applicable to all nodes in mode 3 or coordinator in mode 2** ）

Command（COM）1Byte	Data length（LEN）1Byte	Data content（DATA）
FC	LEN	DATA

4.3.2 Detailed parameter description

DATA parameter：

（1）Broadcasting **data**（data to be transmitted）

      Command:01+type+data

    Parameter description：type

        01：Broadcasting mode 1 ——The message is broadcast to all devices in the entire network

        02：Broadcasting mode 2 ——The message is broadcast to only devices that have enabled reception (except sleep mode)

        03：Broadcasting mode 3 ——The message is broadcast to all fully functional devices (routers and coordinators)

For example：FC 05 01 02 31 32 33

Example description: Send HEX data to network broadcast in broadcast mode 2: 0X31 0X32 0X33

（2）**Multicast data**（data to be transmitted）

      Command:02+ group+data

      Parameter description：group

      0~99：The multicast number of the multicast message

For example：FC 05 02 01 31 32 33

Example description：Send HEX data to network group number 1: 0X31 0X32 0X33

（3）**On-demand (unicast) data**（data to be transmitted）

      Command:03+ type +addr+data

     Example description：type （**For the coordinator in mode 2, this parameter is invalid and can be set to any value** ）

      01: Transparent transmission mode (without carrying information)

      02: Short address mode (carrying information is short address)

      03: MAC address mode (carrying information is MAC address)

Parameter description：addr：network short address   valid on-demand (unicast)address 0x0000—0xFFF8 ）

For example：FC 07 03 02 AB CD 31 32 33

Example description: To the device with the network address of 0XABCD to carry the short address on-demand HEX data: 0X31 0X32 0X33

5. User Notice
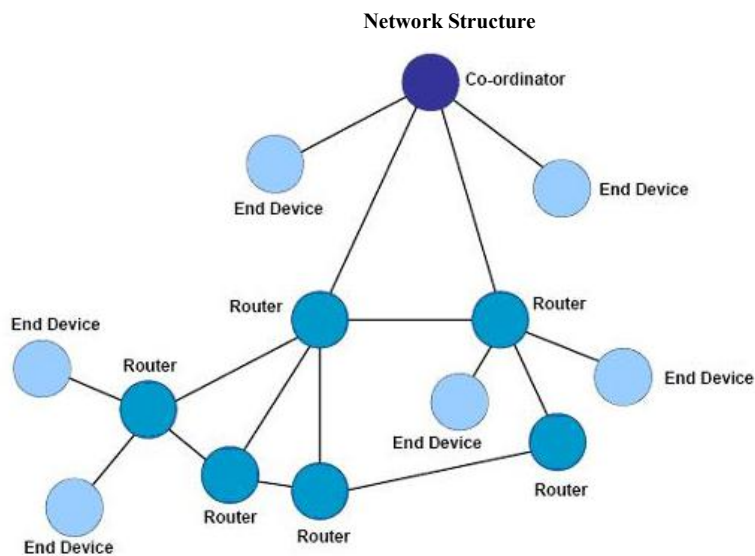
5.1 ZigBee Network roles and precautions

NO	Description
1	This module uses ZigBee network networking, the network is composed of a coordinator plus any other equipment (router and terminal).

2	With self-organization, self-routing, network multi-hop functions. (The default support network depth is 5, the total number of child nodes is 20, and the number of child routing nodes is 6)
3	The parent node device (coordinator and router) can save data for the dormant terminal, and the saving time can be set by the user (default 30 seconds, range 0~120 seconds).
4	Only the terminal device has a sleep function. The sleep time is within 250, which can be set by the user. The default is 0 (sleep mode is off). Note: It is recommended that the sleep time must be less than the parent node data storage time, otherwise it will affect the data reception.
5	The short address ShortAddress communication is used for network communication. Note: The short address is randomly assigned when the device joins the network. The long MacAddress address of the device is uniquely fixed. If you don't know the short address, you can find the ShortAddress in the network through corresponding instructions according to MacAddress, but perform point-to-point communication.
6	The coordinator is unique in the network, and the short address is fixed at 0000.
7	If the on-demand address is FFFF, FFFD, FFFC, there are three broadcast modes respectively.
8	When the network parameter PANID is FFFF, it is automatically assigned. If the device PANID is different, it cannot be networked.
9	You cannot join the network without the network key. The network keys of this module are all turned on, and users cannot obtain correct air data through software capture.
10	All devices in the network have the broadcasting function turned on. Simultaneous broadcasting of multiple devices or higher frequency broadcasting of a single device may cause serious network congestion. Please try to avoid this situation.
11	The module does not need to join the group during multicast, and directly multicast to any group according to the communication method. After multicasting, the local group number will not change due to different multicast numbers.
12	The PWM function and sleep mode in the network cannot be used at the same time. Please turn off the sleep mode before turning on the pwm function.
13	After sleep mode, it can be awakened through the serial port. Remarks: In the sleep state, the first frame of data awakened by the serial port is invalid.
14	In ZigBee network communication, the single-packet data transmission cycle cannot be too fast (generally recommended to be more than 1 second), too fast may cause data loss. (Pay special attention to the fact that there are too many nodes in the network and the broadcast cycle is too fast, which may cause network instability.)
15	The longest allowable byte of a single device communication packet: 70Byte. If it exceeds 70Byte, data communication may fail.

5.2 Network Structure

The network structure of this module is a mesh network structure （MESH）
The network of the MESH network topology structure has powerful functions, and the network can communicate in a "multi-hop" manner; the topology structure can also form an extremely complex network; the network also has self-organization and self-healing functions.

Network Structure

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