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E18 V1.2 Datasheet
(ZigBee Ad Hoc Module)

1. Module introduction ZigBee

1.1 ZigBee introduction ZigBee

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

There are three types of logical devices in the ZigBee network: Coordinator, Router, and End-Device. The ZigBee network consists of a Coordinator and multiple routers and End-Devices.

These devices own the following functions:

（1）Coordinator

As the first device in the network, the coordinator is responsible for starting the entire network. . The coordinator selects a channel and a network ID (also known as the PAN ID, the Personal Area Network ID), and then starts the entire network.

Coordinators can also be used to help establish bindings between security layer and application layer in the network.

Note that the role of the coordinator mainly involves the network startup and configuration. Once these are done, the coordinator works like a router (or disappears /go away). Due to the distribution characteristics of the ZigBee network itself, the operation of the entire network is not dependent on the existence of the coordinator.

（2）Router

The main functions of the router: to allow other devices to join the network, multi-hop routing and to assist communication of its own battery-powered son node end-devices.

Typically, the router is expected to remain active, so it must use the main power supply. However, when using the tree group network mode, it allows the routing operate once at an interval of a certain cycle, so battery can be used for power supply.

（3）End-Device

The end-device does not have a specific responsibility for maintaining the network structure, it can sleep or wake up, so it can be a battery-powered device.

1.2 Feature ZigBee

No.	Feature	Description
1	Role switch	Users can switch freely between the coordinator, router and end device via UART command.
2	Automatic networking	Support power-on automatic networking. The coordinator automatically sets up the network, the end device and the router automatically searches and joins the network.
3	Network self-healing	Automatically reconnect when losing network. When intermediate node in network is lost, other networks automatically join or maintain the original network. (Isolated nodes automatically join the original network, non-isolated nodes maintain the original network.) When the coordinator is lost and non-isolated nodes exist in the original network, the coordinator can join the network again or coordinator of the original network PAN_ID set by the same user join the original network.

4	Ultra low power consumption	The device can be set as low power mode in the end state. Sleep time of the device can be changed according to the user's using time. The standby power consumption in the low power mode is less than 2uA. In the father node data storage time, all messages can be received within the time set by users.
5	Configuration for data storage time	When device is in the coordinator and router state, the user can set their own data storage time, and work with end device in sleep mode to save data for the end device, and sent data to the end device when it wakes up. Data saved is up to 3 data packets, if exceeded, it will automatically clear the first data! After the data is saved, the data heap is automatically cleared.
6	Automatic retransmission	In unicast mode, the device will automatically retransmit when failed to send to next node, and the number of retransmission per message is three.
7	Automatic routing	The module supports network routing. Router and coordinator have network data routing function, users can conduct multi-hopping networking.
8	Support encryption protocol	The module uses AES 128 bit encryption function, can change the network encryption and prevent monitoring. Users can change the network key by themselves. Only devices with the same network key can start normal networking communication.
9	Support UART configuration	Module has built-in UART commands, the user can configure (view) the parameters and functions of module via UART command .
10	Communication for various types of data	Support broadcasting, multicasting and unicasting in the entire network. In the broadcast and unicast mode, it also supports several transmission methods, please refer to <E18 v1.2 communication protocol> for the details.
11	Change channel	It supports change of 16 channels ranging from 11 to 26 (2405~2480MHZ) , different channels have different frequency.
12	Change network PAN_ID	Free switch of network PAN_ID. Users can define PAN_ID to join the corresponding network by themselves or automatically select PAN-ID to join the network.
13	Change UART baud rate	Users can set baud rate by themselves which can be as high as 1M, it is 8 bits by default without parity bit.
14	Search short address	Users can find out corresponding short address according to the (unique and fixed) MAC address of module that already joined network.
16	Gpio control	Local/remote gpio control function，there are 10 gpio for users to select.
17	Pwm control	Local/remote pwm control function ，there are 5 pwm channels for users to select.
18	Adc control	Read local/remote adc，there are 7 adc channels for users to select.
19	Command format switch	The module supports AT command and HEX command for users' easy configuration and switch. The physical location is P1.6.
20	Module restore	Users can restore the module via UART commands.
21	Onekey recovery of baud rate	The module supports onekey recovery of baud rate when users forget the baud rate. The baud rate is 115200(default), physical location is P1.7.
22	Recover factory setting	Users recover the factory setting via UART commands.
Notes：see more in <E18 v1.2 communication protocol>		

1.3 Compatible products ZigBee

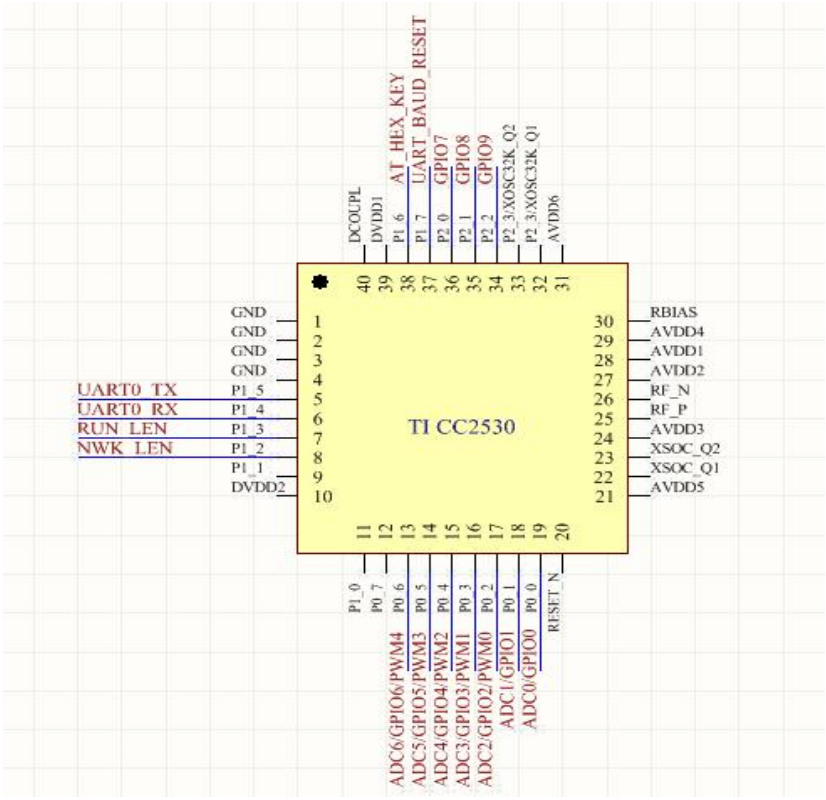
No.	Model	RF IC	Frequency (Hz)	Air data rate (bps)	Power (dBm)	Antenna type
1	E18-MD0-PCB	CC2530	2.4G	250K	4	PCB
2	E18-MD0-IPX	CC2530	2.4G	250K	4	IPEX
3	E18-MS1-PCB	CC2530	2.4G	250K	4	PCB
4	E18-MS1- IPX	CC2530	2.4G	250K	4	IPEX
5	E18-MS1PA1-PCB	CC2530	2.4G	250K	20	PCB
6	E18-MS1PA-IPX	CC2530	2.4G	250K	20	IPEX
★ E18 modules are compatible with each other with different power when software debugging is completed ★						

1.4 Basic communication usage Zigbee

No.	Using mode	Description
1	Broadcast	When joining the network, the user can broadcast according to the commands in the whole network (which can be divided into three broadcast modes) 1, Broadcast Mode 1 - The message is broadcasted to all devices in the entire network. 2, broadcast mode 2 - the message is broadcasted only to receiving devices (except sleep mode). 3, broadcast mode 3 - the message is broadcasted to all full-functional devices (router and coordinator).
2	Multicast	When joining the network, the user can multicast all the devices (not in sleep) in the entire network .
3	Unicast	When joining the network, the user can independently communicate with the devices in the network in a short address mode according to the commands (which can be divided into three broadcast modes) 1, transparent transmission mode - (no carrying information) 2, short address mode - (carry information for the short address) 3, MAC address mode - (carry information for the MAC address)
Notes：see more in <E18 v1.2 communication protocol>		

2. Function description ZigBee

2.1 Pin diagram ZigBee



Peripheral function pin table

Pin No.	Function indication	Description (reuse function pin can only be defined as the function rectified for the last time)	Input/Output
P0_0	GPIO0/ADC0	User controlled function pin GPIO0/ADC0	I/O
P0_1	GPIO1/ADC1	User controlled function pin GPIO1/ADC1	I/O
P0_2	GPIO2/ADC2/PWM0	User controlled function pin GPIO2/ADC2/PWM0	I/O
P0_3	GPIO3/ADC3/PWM1	User controlled function pin GPIO3/ADC3/PWM1	I/O
P0_4	GPIO4/ADC4/PWM2	User controlled function pin GPIO4/ADC4/PWM2	I/O
P0_5	GPIO5/ADC5/PWM3	User controlled function pin GPIO5/ADC5/PWM3	I/O

P0_6	GPIO6/ADC6/PWM4	User controlled function pin GPIO6/ADC6/PWM4	I/O
P2_0	GPIO7	User controlled function pin GPIO7	I/O
P2_1	GPIO8	User controlled function pin GPIO8	I/O
P2_2	GPIO9	User controlled function pin GPIO9	I/O
P1_2	NWK_LED	To indicate module network joining state, low level means that module joins network, high level means no network.	O
P1_3	RUN_LED	To indicate module works normally, low level means that module works normally, high level means module does not work.	O
P1_6	AT_HEX_KEY	To switch AT command and HEX command, low level means HEX command mode, high level means AT command mode (default) .	I
P1_7	UART_BAUD_RESET	To reset baud rate, when users forget or do not know the baud rate use this button to restore factory setting (115200) (valid for falling edge) .	I
P1_4	UART0_RX	UART RX pin	I
P1_5	UART0_TX	UART TX pin	O

3.Quick start ZigBee

The ZigBee ad hoc network module is easy to use. In order to allow users to be quickly familiar with modules, this section will guide users to achieve configuration and communication in various modes via a simple configuration.

The user can pull down the P1.6 pin and conduct the HEX instruction set. In order to facilitate observation of the host computer , the experiment will use HEX command format, AT command users do not test in this test. (AT command can not be used for the configuration of host computer.)

In addition, the user can use the external microcontroller (MCU) instead of test board directly to connect with module for UART command communication to achieve secondary development.

3.1 Network construction and communication ZigBee

No.	Notes
1	【Construct network】： ①.Connect Zigbee ad hoc module via USB to UART converter. ②.Open host computer software “Zigbee_Setting_V1.1”, select Com port and set baud rate as 115200(default), then open port;

③.Click read parameter to read corresponding module parameter.

④.Select node type as coordinator, write in parameter. Wait the coordinator to start constructing network and users can check module parameter.

Set network parameter：（when PAN ID is FFFF, it is automatic PAN ID）

Read parameter when network is constructed：

⑤.Select another module, set it as the router or end device following the same steps (module is set as end device when leave factory (default),no need to set again, in this experiment it is end device)。

<table>
<tr><td></td><td> 
</td></tr>
<tr><td>2</td><td>【Communication test】：
①.Click “fixed networking” of the coordinator and end device of the host computer. Corresponding info. is available to be viewed.
Coordinator：
 

End device：</td></tr>
</table>

②. For users' convenience to observe, in this experiment it is HEX transmitting mode.
If the device address is unknown, please input corresponding mac address and click get network address. The short address of coordinator is 0.

③.Input random content in these 3 modes, click start.
Transparent transmission：
From coordinator to end device：

From end device to coordinator：

Network address：

From coordinator to end device：

From end device to coordinator:

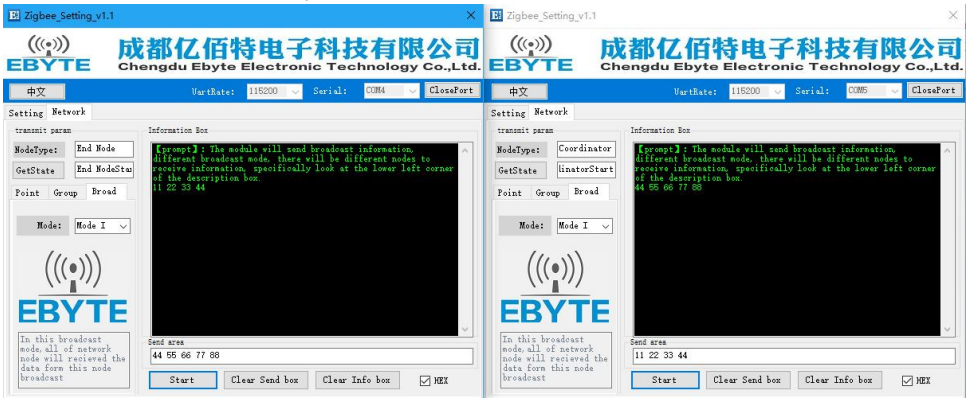
MAC address：

From coordinator to end device：

From end device to coordinator：

Multicast：

Broadcast ：（ broadcast only conduct Mode 1, the entire network conduct broadcast mode experiment, other modes test by themselves ）



Data function transmission needs to reflect its own characteristics in the case of multi-node network, the users can test by themselves !

4. User instruction ZigBee

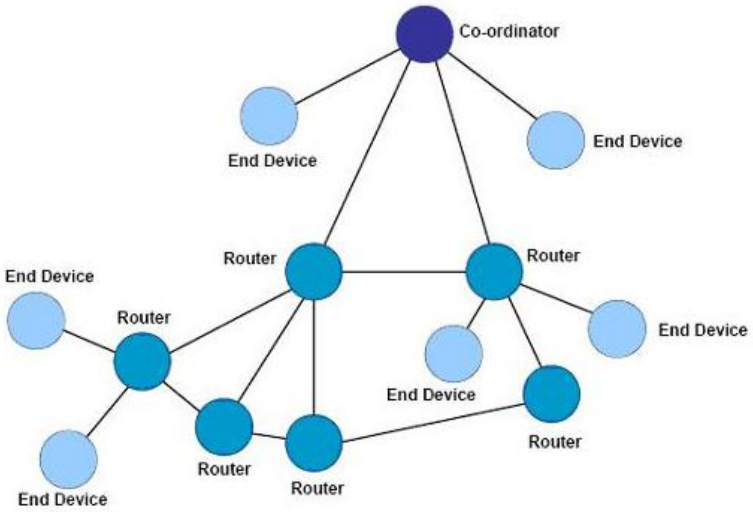
4.1 networking role and notice ZigBee

No.	Description
1	Module uses Zigbee ad hoc networking, consisting of one coordinator and random other devices(routers and end-devices)
2	It has self-organization, self-routing and network multi-hopping function (By default the network depth is 5, there are 20 son nodes and 6 son router nodes in total).
3	The father node device (coordinator and router) can save data for the end-devices in sleep. The save time can be set by the user (by default it is 30 seconds, ranging from 0 to 120 seconds).
4	Only the end device has the sleep function, sleeping within 120S, the user can set by themselves, the default 0 (with sleep mode off). Note: The recommended sleep time must be less than the data storage time of father node , otherwise it will affect the data reception.
5	In network communication Short Address communication is used. Note: The short address is randomly distributed when the device joins the network, the long address of MacAddress is the only fixed one, if the short address is unknown, the network Short Address can be found via corresponding commands according to the MacAddress , and point to point communication is conducted.
6	Coordinator is unique in the network, the short address is 0000.
7	If unicast address is FFFF，FFFD，FFFC，then it corresponds to three broadcast mode.
8	When PANID is FFFF, it means automatic distribution. Networking can not be realized if PANID is different.
9	When network keys are not the same the network can not be joined. The module network key of the module remains open, the user can not get the correct air data via software packet capture .
10	All devices in the network have opened broadcast function. Multiple devices broadcasting at the same time or a single device broadcasting at a higher frequency will lead to a serious network congestion. Please try to avoid this situation.
11	When multicasting module does not need to join the group,but be directly multicasted to any group according to communication usage guidance. After the multicast, the local group number will not change due to different multicast number.
12	PWM function and sleep mode can not be used at the same time in network, please turn off the sleep mode before turn on PWM function .
13	After sleep mode, it can be waked up via the serial port(UART). Note: In the sleep state, the first frame of data waked up via UART is invalid.
Notes：see more in <E18 v1.2 communication protocol>	

4.2 Network structure ZigBee

The network structure of module is MESH network
MESH network topology network has a powerful function, the network can communicate via "multi-level hopping"; the topology can also form a very complex network; network also has self-organization, self-healing function.

Network structure diagram



5. About us ZigBee

Chengdu Ebyte Electronic Technology Co., Ltd., a high-tech company focusing on application of Internet of Things, owns a number of independently researched and developed products and obtains unanimous approvals from customers. With a powerful R&D team, perfect after-sales system, our company provides perfect solutions and technical assistance, shortens R&D period, reduces R&D cost and provides a strong platform for brand new ideas about product R&D.

Our products have been widely applied in various fields, such as consumer electronics, industrial control, healthcare, security alarm, field acquisition, smart home, expressway, property management, water and electricity meter reading, power monitoring, etc.

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