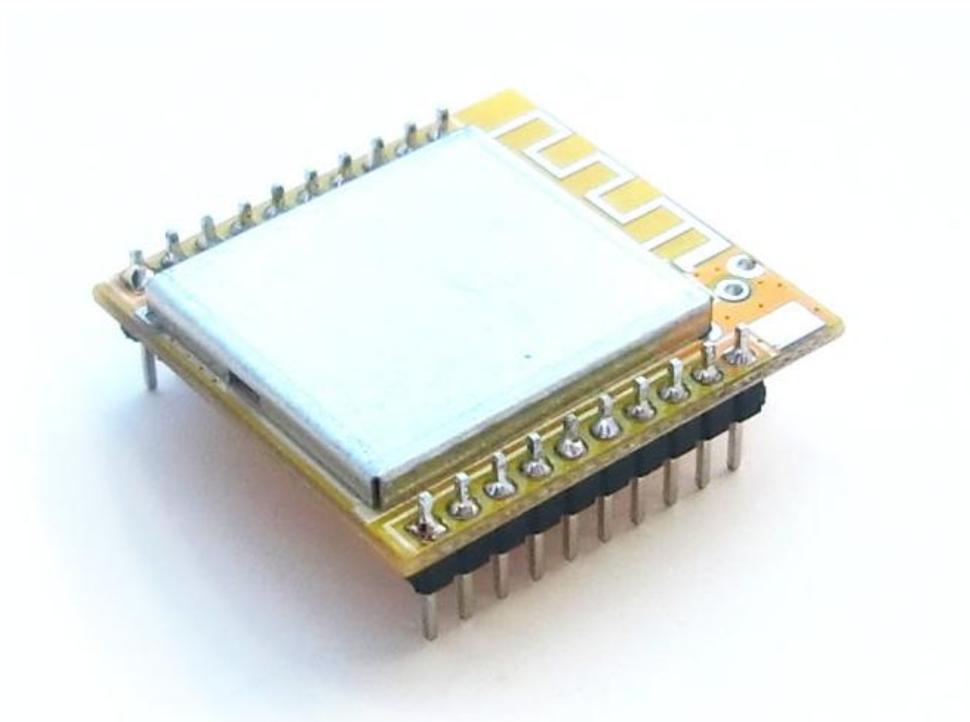


Specification of Micropower ZigBee Wireless Module --WT-5168CK-PA (V1.2) --



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A、 Company Profile

- ✧ Our company is specialized in radio frequency wireless products, technology or project development/production/sales work.
- ✧ Familiar with solutions like Silicon Labs / Amicom / TI / Semtech / Nordic / NXP / STC etc.
- ✧ Provide standard micropower half-duplex serial transparent transmission of radio frequency (RF) wireless data transceiver module.
- ✧ product types include RF front-end / data transmission module / ad hoc networks (Zigbee) / Bluetooth (BLE4.0) / Serial WiFi ◦
- ✧ module communication interfaces include SPI / UART / TTL / RS232 / RS485 / USB / DB9 and other forms ◦
- ✧ Use domestic and foreign common band such as 230/315/408/433/470/490/868/915 / 933MHz / 2.4GHz band
- ✧ According to different programs or different transmit power ,open transmission distance ranges from a few meters to tens of kilometers.
- ✧ Involving industrial automation / agricultural modernization / wireless meter reading / smart home / smart transportation and other areas of IoT ◦
- ✧ Undertake wireless peripheral related product development projects or programs customized to provide OEM service!

B、 Product overview

WT-5168CK-PA is a based on NXP's latest high-performance radio frequency chip design from the zigbee module with high stability, low power consumption, high cost-effective, rich internal resources, 32bit processor with high-performance embedded chip and large-capacity flash, powerful function, user-friendly for customers to do secondary development. It supports multiple network protocols, wide range of usage, develop flexibly, scalably. The module has a small size, simple structure, easy to embed the customer's product

C、 Product feature

- Micro-power transmission, standard 20dB, divides into 3 floors, can control the transmission power by setting software.
- Working band: 2.4G-2.485GHZ, global free applications operating band.
- High noise immunity and low error rate, high-efficiency circulation interleaving error correction coding techniques and frequency hopping mechanism to improve the data burst of anti-interference and noise immunity.
- Supports multiple protocols, 2.4G IEEE802.15.4, JENNet-IP, ZigBee light link, ZigBee Smart Energy and RF4CE protocol.
- Receive sensitivity up to -104dBm, transmission distance far away.
- Module reserve enough I / O digital interfaces and analog to digital conversion interface,

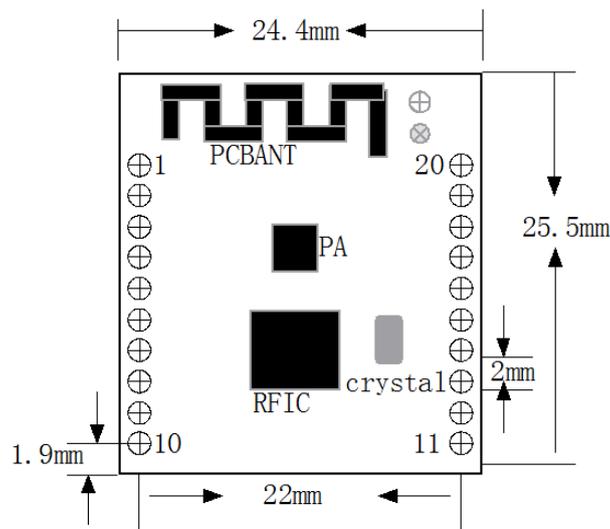
enabling customers to secondary development and extensions.

- Free debugging produce, wide operating voltage range: 3.3V-6V, you can customize 2.0V-3.6V.
- Module of low power consumption, the dormancy current is 0.8Ua.
- Small size, light weight, easy for clients to embed devices.
- Reserved multiple antenna interfaces, including sucker antenna, glue stick antenna, antenna and IPX ceramic antenna connector.
- Automatic network, automatically find the router, automatically form a robust mesh network topology.

D、 Application Area

- ✓ Robust and secure low power wireless applications
- ✓ RF4CE remote control
- ✓ JenNet-IP net work
- ✓ ZigBee SE net work
- ✓ ZigBee optical link network
- ✓ Lighting and home automation
- ✓ Toys and games peripherals
- ✓ Smart energy
- ✓ The energy collection, such as power of light switch

E、 Size and Structure



F、 Pin Definition

Pin Symbol	Pin Name	Pin Description
1	VCC	Power (2.0V-3.6V)
2	TXD	Serial data output pin
3	RXD	Serial data input
4	DO1	Programming control foot/SPIMISO
5	RESTEN	Low level reset the feet
6	DIO18/SPIMISI	I/O digital interface 18
7	DIO4	I/O digital interface 4
8	DIO5	I/O digital interface 5

9	DIO8	I/O digital interface 8
10	GND	Power ground 0V
11	DIO9	I/O digital interface 9
12	DIO10	I/O digital interface 10
13	DIO11	I/O digital interface 11
14	DIO12	I/O digital interface 12
15	DIO13	I/O digital interface 13
16	DIO14	I/O digital interface 14
17	DIO15	I/O digital interface 15
18	DIO16	I/O digital interface 16
19	DIO17	I/O digital interface 17
20	GND	Power ground (0V)

G、Technical Index

Electrical Parameters :

Supply Voltage : 2.0V-3.6V

Emission Current : 130mA @20dBm

Receive Current : 27mA

Dormancy Current : 0.8uA

RF Technology Parameters :

Working Frequency : 2.405GHZ-2.48GHZ

Transmitted Power : 20dBm

Receive Sensitivity : -104dBm

Wireless Transmission Rate : 250kbps

Other Technical Parameters

Sense Rate : 4800bps~115200bps(can be set)

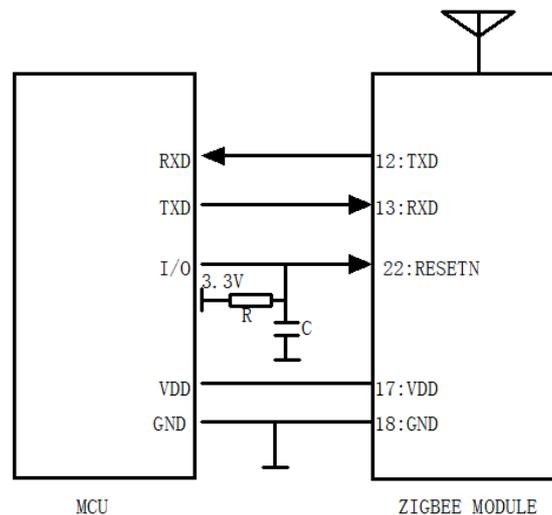
The interface data format : 8E1/8O1/8N 1(choosable)

Working Temperature : -40℃ ~ +80℃ (industrial level)

Working Humidity : 10%~90% relative humidity, without condensation

H、Applicationo Circuit

The simple connection method of module and customers' setting terminal as shown below, attention to the need to connect a total wireless module with customer terminal equipment docking, the module may not work properly. When users' device and module docking, port rate and serial devices needs to remain the same as that of modules. Users can reset module by AT command, or by I / O port reset module. Please note that the user needs to reset the circuit outside of Canada, where $R = 18K$, $C = 470NF$ shown in the following figure.



Equipment and Terminal Module Connection Diagram

I、Antenna Selection

Antenna is an important part of the communication system, its performance has a direct impact on indicators of communication system, and the users must first pay attention to the choice of antenna performance. There are two general areas:

- (1) Antenna Type—wares of antenna cover whether conform to the requirements of the system design ;
- (2) Electrical Performance—Antenna frequency bandwidth, gain, impedance, rated power whether conform to system design requirements, the general requirements of the antenna impedance is 50 ohm, VSWR less than 1.4.

Our company offers a variety of antenna solutions, users choose according to the actual situation in order to achieve the best transmission.

WT-5168CK-PA use PCB on-board antenna ◦

J、Work Pattern

WT-5168CK-PA Wireless module can work in transparent transmission mode, AT command

mode, API mode ◦

(A) Transparent Transmission Mode

Transparent transmission mode is a data module to module the device emitted RXD pin. The receiver outputs the received data to the terminal device from the TXD. TXD output module does not add any protocol packets.

The data that RXD pin of serial port module received will be stored in the buffer and the package won't sent out from the air until when one of the following conditions are met, sent packing conditions are:

Serial data input occurred pause, did not receive follow-up data from the serial port; or:

Serial data received from the air has reached the maximum load of a packet data;

Under the transparent transmission mode, the object module is a module to send data determined by the ATDS 16bit instruction target address.

Note: The module API mode by default, if you modify the transparent mode, the module can be changed via AT commands transparent mode.

First sent to the module: + + + module returns OK, and the module into the AT command mode.

Input: ATAP 0 <CR> module saves transparent transmission mode, this command is executed after the module exits AT command mode, directly into the transparent transmission mode, parameter settings are saved directly to the non-volatile memory modules, the next time the power, module directly work in transparent mode.

(B) API working mode

API working mode is the supplement to transparent transmission mode, API mode add the data frame protocol in the packet communication. For the data is not in conformity with the frame agreement, the module will be ignored

Under the API mode, the transmitter module received data RXD pin has two kinds :

1. Data frames are used for communication ;
2. Command frame similar to the AT command

API work mode, the receiving module from TXD feet output data frame includes:

1. The received RF data frames ;
2. AT command returns the frame under the API mode ;
3. Other information frame ;

(C) AT Command Mode

In AT command mode, you can read through the AT command or parameter of modification module. Module default serial port parameter is 9600bps, 8N1, if AT command does not return, check whether the serial port parameters are correct. In API mode, you can also specify the frame in accordance with the agreement to execute AT commands.

AT commands can be divided into read and modify the parameters of the command module command module parameters, if it is read module parameters AT commands, need no parameters behind the command, after executing the command, the module returns parameter read; If the command is to modify the module parameters, behind the command you need to add parameters, after executing the command, the module returns OK.

For example: speed reading module serial command: ATBD, module returns OK 01, indicates that the module serial rate is 9600bps.

Set the module serial rate command: ATBD 04, the module returns OK; then use the AT command ATWR <CR> to save the modified data. After the next power module, serial rate is run as parameter settings.

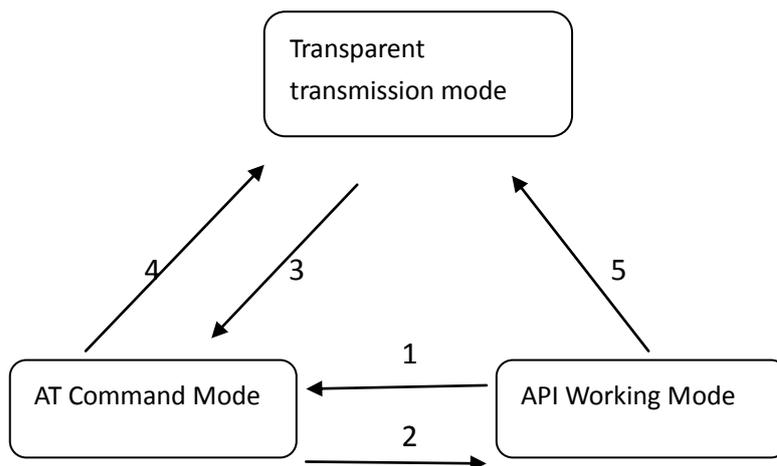
It should be noted that some of the parameters will take effect immediately after setting, but some may have to wait for the next power to take effect after some parameter settings, there is some parameters need to meet to the set of other parameters to take effect, please read the details of each Description AT commands and special attention "Effective conditions" section.

The method of exit the AT command mode:

Enter ATCN command plus a carriage return (0x0d), the module exits AT command mode

K、 Mode Switch

Module works in API mode by default when out of factory.



- A、 Module in API mode, enter: + + + module returns OK, the module enters AT command mode ◦
- B、 Under the ATAP, enter the AT command module API if you set the operating mode, ATCN <CR>, the module exits AT command mode, enter API mode.
- C、 If the module has set in transparent transmission mode (ATAP 0), enter: + + +, the module enters AT command mode.
- D、 In the AT command mode, enter: ATAP 0, module exit AT command mode, and switch to transparent transmission mode. .
- E、 First input: + + +, enter AT command mode, then use the command ATAP 0, the module into the transparent transmission mode, or in API mode, using AT commands.

L、 AT Command List

NO	AT Command	Command Description	Parameter Range	Default Parameters
1	ATAI	Network status, check network status of EndDevice, only valid for EndDevice.	0 : In the net work 1 : Not in the net work	1
2	ATAP	Work pattern, read or set the operation mode of the module ◦	0 : Transparent transmission mode 1 : API work pattern	1
3	ATBD	Serial port baud rate read or set the module serial baud rate.	0:4800 1:9600 2:19200 3:38400 4:57600 5:115200	1
4	ATCN	Out of the AT command mode		
5	ATDS	16bit Destination address set / read the target address of the module, when the target address is set to 0xFFFF to broadcast.	0x00-0xFFFF	0x0001
6	ATCH	The number of channels, read the module channel (the channel is defined by the 802.15.4 protocol)	0x0B-0x1A	
7	ATFR	Restarted immediately hardware reset and restart.		
8	ATHV	Hardware version, read the hardware version of the module	0x00-0xFFFF	
9	ATID	PANID, set /read PANID data ◦	0x00-0xFFFF	0x29AC
10	ATMP	Short address of the parent node, read the parent node 16bit short address	0x00-0xFFFF	
11	ATMT	Module type, read the ZigBee module device type	0:Coordinator 1:Router 2:EndDevice	
12	ATMY	16bit source address, read module 16 bit source address. Can only read address	0x00-0xFFFE	
13	ATND	Search node. Reading the line of nodes in the network address 16, the level of the address 64, the signal strength of the received data, and description strings.	0-20 ↑ ASCII	

14	ATNI	Node description string settings. Set / read the description string module.	0-20 ↑ ASCII	
15	ATNO	Search node option. Whether to display the node information when node searches.	0 : No display 1 : display	0
16	ATNT	Node search time limit set.	0x01-0xFC	0x19
17	ATPI	PAN ID: Read module of the actual work PAN ID.	0x00-0xFFFE	
18	ATPL	Power levels. Set / read module RF transmitter power	0x00-0x03	0x03
19	ATRE	Restore the default settings. The parameters of the module to restore the factory default parameters.		
20	ATRN	Reset the network. After the module next power or hardware reset, the module is set to initialize the network according to the parameters of memory, and re-search network. Note: After renetworking, a short address of the module, the channel numbers may change.	0:Disable 1:Enable	0
21	ATTR	When the air failed to send, retries settings.	3-6 次	3
22	ATSC	Channel search settings. Channel Set / read module to join the network you want to search.	0x01-0xFFFF	0x03
23	ATSH	IEEE 64-bit address high 32bit. Reading module IEEE 64bit address high 32bit.	0x00-0xFFFFFFFF	
24	ATSL	IEEE 64-bit address low 32bit. Reading module IEEE 64bit address low 32bit.	0x00-0xFFFFFFFF	
25	ATSM	Sleep Settings / status query. Set / read module sleep mode. (Only EndDevice valid)	0 : Disable 1:Enable	0
26	ATSP	Time limit for Coordinator, Router to save data for its child node EndDevice or the period for EndDevice to receive data from its parent node regularly. (Valid for Coordinator, Router and EndDevice)	0x01-0xFFFF	0x12C
27	ATST	EndDevice in sleep mode, keep working time after each wake. This data must not exceed the data set by 1/2 SP. (Only EndDevice valid)	0x01-0xFFFF	0x32
28	ATVR	Software version. Read the software version of the module	0x00-0xFF	

29	ATWR	Write parameters. Save the modified parameter to non-volatile memory module. In the new module or restart after power, but also according to the parameters set in the original run.		
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M、AT Command Explanation

1. ATAI

ATAI used to query module End Device net work status. This command is only valid to End Device. If the return value is 0, indicating EndDevice has internet, namely to find the parent node; If the return value is 1, indicating EndDevice has no network, that cannot find the parent node. EndDevice network search takes several hundred milliseconds to a few seconds of time. AI need to use the command repeatedly to view the results in order to determine their status; another parent node is dynamic, means the parent node may different when connect with network.

AT Command	ATAI
Parameter values :	0 : join net work 1 : not join net work
Default values	1

2.ATAP

ATAP, the operating mode used to set or read module. If you set the parameter to 0, indicating that the module will go into transparent mode after exit AT command mode, and if the parameter is set to 1, it indicates that the module will go into the API mode after exit AT command mode. After exiting AT command mode, effective immediately

AT Command	ATAP
Parameter Values :	0 : transparent transmission mode 1 : API work pattern
Default Values	1
Entry-into-force conditions :	Take effect immediately after exit the AT command mode

Set the operating mode Example:

From the module serial input: + + +, the module enters AT command mode;

Set the operating mode with ATAP Command: Enter ATAP 0 (CR) or ATAP 1 (CR);

I hope next time the power is set operating mode: enter ATWR (CR); module to save setting

parameters;

Enter ATCN (CR) to exit AT command mode, the module into working mode setting operation.

3. ATBD

ATBD command is used to set or read module serial port baud rate, effective range parameters for 0-7, respectively corresponding to different baud rates in the following table. Modules air data transfer rate (fixed at 250kbps) is not affected by this parameter affects. Recommends that users do not choose too small a serial port baud rate, otherwise it may cause overflow serial data communications. AT commands only change the module serial port baud rate; not supply the command of changing serial port baud rate in API mode.

AT Command	ATBD
Parameter Values :	0 : 1200 1 : 2400 2 : 4800 3 : 9600 4 : 19200 5 : 38400 6: 57600 7 : 115200
Default Values	3
Entry-into-force conditions :	Use ATWR command to save, electric effect on the next time

Modify module serial port baud rate, for example:

From the module serial input: + + +, the module enters AT command mode;

ATBD command set with the hope of serial port baud rate, enter ATBD 7 (CR);

With ATWR command to save the parameter settings, enter ATWR (CR);

Input module hardware reset command: ATFR (CR), module hardware reset, run by setting the baud rate.

4.ATCN

ATCN is out of the command the AT command mode.

AT Command	ATCN
Parameter values :	NO
Default Values	NO

Entry-into-force conditions :	Effective immediately °
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5. ATDS

ATDS is used to set or read the destination address of the module 16-bit, 16-bit address, also known as short address. Only in transparent mode, this setting will work. When the 16-bit destination address is 0xFFFF, and the module works in transparent mode, the module will send air data by broadcasting.

AT Command	ATDS
Parameter values :	0x00-0xFFFF
Default Values	0x0001
Entry-into-force conditions :	Effective immediately

Modify transmitter module 16bit destination address, for example:

From the module serial input: + + +, then the module into AT command mode;

ATDS set with the desired destination address to send data, such as ATDS 4D2C (CR);

If you want the module after the next power, still desired target address to send the data, then use ATWR command to save the parameter settings, enter ATWR (CR);

Enter ATCN (CR), exit AT command mode.

6. ATCH

ATCH command is used to read the operating channel wireless module. Network channels to choose from a total of 16 (0x0B-0x1A), all modules in the same network must be working on the same channel, and different network modules set on different channels also avoid their mutual interference. Module in accordance with 802.15.4 standard, Center frequency = 2405 + (CH - 11d) * 5 MHz (d = decimal).

AT Command	ATCH
Parameter Values :	0x0B-0x1A
Default Values	0x19

Read module wireless channel, for example:

From the module serial input: + + +, the module enters AT command mode;

Read module with ATCH command channel: eg: ATCH (CR), the module response;

Enter ATCN (CR) to exit AT command mode.

7. ATFR

ATFR command is used to restart the module, when the module receives FR command, the module will not return "OK" and the direct simulation off and immediately restart.

AT Command	ATFR
Parameter values :	NO
Default Values	NO
Entry-into-force conditions :	Effective immediately

Example for module restart:

From the module serial input: + + +, the module enters AT command mode;

With ATFR command enables the module restarts, enter ATFR (CR). Module is immediately restarted.

8. ATHV

ATHV : Hardware version for reading module

AT Command	ATHV
Parameter values :	0x00-0xFFFF
Default Values	No

9. ATID

ATID command is used to set or read PAN ID (Personal Area Network) settings of module. Only in the same PAN ID of the module, the module can communicate with each other.

To let the PAN ID take effect, you must set the PAN ID to be used while RN command, the module is set to reset network when start next time and then these two settings are written to non-volatile memory of module. This way, next time when the module is powered on, it's a new PAN ID will take effect.

AT Command	ATID
Parameter Values :	0x00-0xFFFF
Default Values	0x29AC
Entry-into-force conditions :	RN=1 use the WR save settings, module take effect when power on next time

All modules in a network PAN ID must be the same, if you want to specify its PANID for a module, which can be set a value to the PAN ID 0x00-0xFFFE, if the module PAN ID is set to 0xFFFF, then will have different results depending on different module types. If the Coordinator of PAN ID is set to 0xFFFF, then, Coordinator will randomly selected a value from 0x00-0xFFFE for its PAN ID

when start, and if it is the Router or EndDevice the PAN ID is set to 0xFFFF, then the Router or EndDevice will search around the ZigBee network PAN ID when power on, and try to add to the ZigBee network after PAN ID set to this value, when surrounded by multiple ZigBee networks, it will select the best RSSI value network to join.

When the PAN ID is set to 0xFFFF, the actual PAN ID value after module join the net work can be read by APTI command. When the specified value of the PAN ID (0x00-0xFFFE) for the module, PAN ID value read by command ATPI will be the same as that by ATID.

Modify PAN ID of module, for example:

From the module serial input: + + +, the module enters AT command mode;

ATID command set with the desired PAN ID, such as: ATID 24C1 (CR);

Reset the network settings using the ATRN command module next time, that is ATRN 1 (CR);

Save the parameter settings into memory: ATWR (CR);

Restart modules: ATFR (CR).

10.ATMP

ATMP is the father node 16bit address of reading modules

ATCommand	ATMP
Parameter values :	0x00-0xFFFD
Default values	No

11. ATMT

ATMT is reading the zigbee module type , the module has confirmed the type when out of factory, the user can't change.

AT Command	ATMT
Parameters values :	0 : Coordinator 1: Router 2: End Device
Default values	No

12. ATMY

ATMY command is used to read module own 16-bit (source) address. 16-bit source address of the module when the module is added to a ZigBee network given by the ZigBee network, 16-bit if the module (source) address is 0xFFFE it means it has not joined a ZigBee network, if it's 16-bit (source) address is less than 0xFFFE, it indicates that it has joined a ZigBee network ◦

AT Command	ATMY
Parameters values :	0x00-0xFFFFE
Default values	No

13. ATND

ATND command is used to search other nodes information within the network, the information including the node address of 16 bit, 64 bit address high 32 bit, 64 bit low 32 bit address, node data received signal strength and node description string .

When ND commands with no arguments, it is used to search for the information of all online nodes within the search network.

When ND command with parameters, the parameters description string for a node, this time it is used to the search online node information that exactly match the describing string node within the net work.

AT Command	ATND
Parameters values :	0-20 pcs ASCII
Default values	No

Search node information, for example:

From the module serial input: + + +, the module enters AT command mode;

Search the specified node by ATND command, such as search sensor nodes, enter ATND sensor (CR);

Enter ATCN (CR), exit AT command mode.

14. ATNI

ATNI command is used to read or set the module description string. Description string module must be ASCII characters can be displayed, and that a string cannot start with a space , module description string must be less than or equal to 20 characters, when more than 20, then take the first 20 characters of valid values .

AT Command	ATNI
Parameter values :	0-20 ASCII
Default values	No
Entry-into-force conditions :	Effective immediately

Set the module description string : Example:

From the module serial input: + + +, enter AT command mode;

Set the desired module by ATNI command strings, such as input: ATNI sensor1 (CR);

After all if you want to change by a string that describes , use ATWR command to save the information to memory, such as TWR (CR);

Enter ATCN (CR), exit AT command mode.

15. ATNO

ATNO command is used to read or set the search node option. When the module is executed ATND command to search for the node, according to the value of ATNO command to determine whether to display their information. When ATNO parameter is 0, the module does not display their information; When ATNO parameter is 1, the module displays their information.

AT Command	ATNO
Parameter values :	0 : No display 1 : display
Default values	0
Entry-into-force conditions :	Effective immediately

Modify the module search node options, for example:

From serial input: + + +, the module enters AT command mode;

Set the desired options by ATNO: Enter ATNO 0 (CR) or ATNO 1 (CR);

If you want the module is still in force when power on next time, the use ATWR command writes to non-volatile memory, which ATWR <CR>;

Enter "ATCN <CR>" command to exit AT command mode. ,

16. ATNT

ATNT command is used to set the time to read or search the network node limit, the unit is 100mS. When the module search for network nodes with ATND command, it will wait for a maximum time set by ATNT command, after this time, the other nodes in the network returns will be ignored.

AT Command	ATNT
Parameter values :	0x01-0xFC(*100ms)
Default values	0x19

Entry-into-force :	Effective immediately
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Modify module network node search time limit, for example:

From the module serial input: + + +, the module enters AT command mode;

ATNT command set with the desired time value, such as ATNT 2A <CR>;

If you want to set the module when the power is still in force next time, use ATWR command writes to memory preservation. That ATWR (CR);

Enter ATCN (CR), exit AT command mode.

17. ATPI

ATPI command is used to read the actual PAN ID of working module. Only when the module's PAN ID setting value is 0xFFFF, the PAN ID after joined the net work may differ from that read by "ATID" command. For this point, please read "ATID" command section.

AT Command	ATPI
Parameter values :	0x00-0xFFFF
Default values	NO

18. ATPL

ATPL command is used to set or read the power lever sent by air data of module. parameter 0-3 progressively increases, the parameter is 0, the transmit power is minimized, and the parameter is 3, the transmit power Max.

When setting parameter is not 3:00, the effect will affect the communication module, the user try not to change this parameter

AT Command	ATPL
Parameter values :	0:min power 3:max power
Default value	3
Entry-into-force conditions :	Use ATWR command to save settings, module take effect when power on next time

Modify module transmit power parameters, for example:

From the module serial input: + + +, the module enters AT command mode;

ATPL command set with the desired power level, as ATPL 3 (CR);

With ATWR command to set the power level to save memory, namely: ATWR (CR);

Enter ATFR (CR), the module immediately restart.

19. ATRE

ATRE command is used to restore the factory default settings for the module. When the module receives RE command, will immediately restore all parameters can be set to the factory default settings, and writes these parameters are non-volatile memory, and then the module restarts.

Executing this command will cause the loss of network modules, and may cause PAN ID, 16bit address of the module etc. changes.

AT Command	ATRE
Parameter value :	NO
Default values	NO
Entry-into-force conditions :	Effective immediately

Command to restore the factory parameters, for example:

From the module serial input: + + +, the module enters AT command mode;

Restore the factory configuration parameters with ATRE command, that ATRE (CR).

20. ATRN

ATRN command is used to read or set whether to reset the network module next start, if you set the next time you start to reset the network, the module when the next time you start the search again and seeking to join the ZigBee network. This means that if the module has joined a ZigBee network, it will first lose the network after it restarts, it's PAN ID, channel, 16-bit source address, etc. are likely to change.

AT Command	ATRN
Parameter values :	0 : Disable 1: Enable
Default values	0
Entry-into-force conditions :	Use ATWR command to save settings, modules will take effect when power on next time

Set the module reorganization Network power on next time, Example: From the module serial input: + + +, the module enters AT command mode; Reset the network settings on the next power-use ATRN command, that ATRN 1 (CR); With ATWR (CR) command the parameters written to the memory; Enter ATFR (CR), the module exits AT command mode, and immediately re-networking.

21. ATRR

ATRR command is used to set or read the resending times in the air after sending data retransmission failures.

AT Command	ATRR
Parameter values :	3-6
Default values	3
Entry-into-force conditions :	Effective immediately

Modify the number of retransmissions Example:

From the module serial input: + + +, the module enters AT command mode;

Set the desired retransmission times with ATRR, such as: ATRR 4 <CR>;

If you want the module is still in force when power on next time, then use ATWR command written to non-volatile memory, which ATWR <CR>;

Enter "ATCN <CR>" command to exit AT command mode.

22. ATSC

ATSC command is used to set or read the information channels that module need to search for. The module will choose information channels according to the value set by ATSC command. Parameter set by ATSC is two bytes, if one of the two bytes is a binary 1, to show (table corresponding to each channel at the reference) at the position corresponding to the channel search; If the set containing two binary values 1 or more, then take the form of "or" to search for a channel, for Coordinator, will select one work from multiple channels set; for Router and EndDevice will search multiple channel and tried to join the network, until it joined up network.

To let the parameter take effect, you must set the search channel at the same time to use the ATRN command to reset. The module will reset the net work when start next time, then these two settings is written to non-volatile memory, in this way, the next time the module is powered on, it will select a new channel in the work according to the set value.

AT Command	ATSS			
Parameter range :	0x00-0xFFFF			
Parameter values :	Bit0 :0x0B Bit1 :0x0C Bit2 :0x0D Bit3 :0x0E	Bit4 :0x0F Bit5 :0x10 Bit6 :0x11 Bit7 :0x12	Bit8 : 0x13 Bit9 : 0x14 Bit10 :0x15 Bit11 :0x16	Bit12 :0x17 Bit13 :0x18 Bit14 :0x19 Bit15 :0x1A
Default values	0x03			
Entry-into-force conditions :	RN=1,use ATWR to save settings and the module will take effect when power on next time			

Modify the module search channel Example: From serial input: + + +, the module enters AT

command mode; ATSC command set the desired value, such as ATSC 2 <CR>; (0x0C channel) Reset the network settings next time you start using the ATRN command, that ATRN 1 <CR>; ATWR the write command to the non-volatile memory, i.e. ATWR <CR>; Enter "ATFR <CR>" command, the module immediately restart.

23. ATSH

ATSH command is used to set or read the high 32-bit of module's IEEE 64-bit address.

Note: 64bit address of each module factory is provided by the chip manufacturer module used; chip manufacturers ensured the global uniqueness of 64 bit addresses. In a ZigBee network, 64-bit address of each module must be unique; otherwise it will cause traffic chaos, therefore, not recommended for users of 64-bit address to be changed. The high 32-bit and low 32-bit of 64-bit address are set to 0xFFFFFFFF, can set 64-bit address (IEEE 64-bit address or 64-bit ID) to restore settings to factory defaults.

To enable the 64-bit address to take effect, you must set the 64-bit address to be used while RN command, the module is set to reset the network start next time, and then these two settings are written to non-volatile module lost to memory, so that the next time the module is powered on, it's the new 64-bit address to take effect.

AT Command	ATSH
Parameter values :	0-0xFFFFFFFF
Default values	No
Entry-into-force conditions :	RN=1 , Use ATWR command to save the settings, the module will take effect when power on next time

24. ATSL

ATSL command is used to set or read the low 32-bit module of IEEE 64-bit addresses.

AT Command	ATSH
Parameter values :	0-0xFFFFFFFF
Default values	No
Entry-into-force conditions :	RN=1 , Use ATWR command to save the settings, the module will take effect when power on next time

25. ATSM

ATSM command is used to set or read module's sleep mode, this setting is only valid for EndDevice, when argument is 0, not allowed the module sleep while parameters is 1, allowing the module sleep after joining the network. When the module is in no ZigBee network status, because

the module need to constantly look for ZigBee network to join, it does not go to sleep. EndDevice into hibernation there are three preconditions, first, EndDevice has been added to the ZigBee network; Second, SM parameter is set to 1, that is dormant allowed; third, sleep control pin allows the module to sleep, that pin is 9 high lever signal , when these three conditions are met, EndDevice before entering hibernation.

AT Command	ATSM
Parameter values :	0 : Disable 1: Enable
Default values	0
Entry-in force conditions :	Effective immediately

Modify module sleep mode, for example:

From the module serial input: + + +, the module enters AT command mode;

Set sleep mode with ATSM commands, such as ATSM 1 <CR>;

If you want the power to set the next time the module is still in force, the use ATWR command writes to non-volatile memory, which ATWR <CR>;

Enter "ATCN <CR>" command to exit AT command mode.

26. ATSP

ATSP command is used to set or read the lime limit of module Coordinator, Route for its child nodes End Device save data, it is also used to set or read End Device regularly to its parent node data acquisition cycle. The command Coordinator, Router and End Device are valid, but the sleep cycle value End Device should set its parent node Coordinator or Router) of equal value because End Device during hibernation, the air is not receiving data, the parent node for End Device save all sent End Device data, then save the data to determine the length of time depending on the value ATSP command. End Device take every waking from its parent node data, if more than save time, End Device not to take the data, the data will be cleared its parent node, so ATSP value End Device set by its parent node should be equal.

AT Command	ATSP
Parameter values :	0x01-0xFFFF(*10ms)
Default values	0x12C
Entry-into-force conditions :	Use ATWR command to save settings, modules will take effect when power on next time.

Modify module SP value Example:

From the module serial input: + + +, the module enters AT command mode;

ATSP command set with the desired value, such as ATSP 1F4 <CR>;

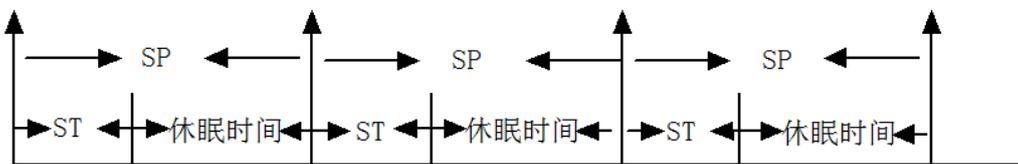
With ATWR command to save the settings, namely ATWR <CR>, module power take effect the next

time;

By "ATFR <CR>" command to restart the module.

27. ATST

ATST command is used to set or read module End Device after hibernation wake, keep working time. ATST value must not exceed by a half of ATSP value, otherwise there will be confusion sleep time period. This command is valid only for End Device. In sleep mode ,End Device, when regular wake-up time (ATSP command set) arrives, the module automatically wake up and keep a working time (ATST command set), go to sleep again after working time and won't wake up again until the next time comes, periodically operations like this. Then the module actual sleep time (SP * 10-ST), is 10 milliseconds. As shown



below:

休眠时间 means : sleep time

AT Command	ATST
Parameter values :	0x01-0xFFFF(*1ms)
Default	0x32
Entry-into-force :	Effective immediately

Modify the module's working time after wake up, for example: From the module serial input: +++, the module enters AT command mode; ATST command set the desired working time values, such as ATST 64 <CR>; If you want the module's settings remain in effect when power on next time, then need to write to nonvolatile RAM by ATWR command, namely ATWR <CR>; Enter "ATCN <CR>" command to exit AT command mode.

28. ATVr

ATVR read software version of the module.

AT command	ATVF
Parameter values :	0x00-0xFF
Default values	N/A

29. ATWR

ATWR command enable all the current settings can be written into non-volatile memory. When modules power on, it reads the parameters from the non-volatile memory, and some of the parameters in the settings, if not written to non-volatile memory, then will not effective when power on next time. Therefore, with ATWR command writes to non-volatile memory, these settings can be still valid even the module power off or power on next time. Note: The entry into force conditions of each parameter may be different, even if it is written to non-volatile memory, it does not necessarily take effect when power on next time, please read the entry into force conditions part of each command description.

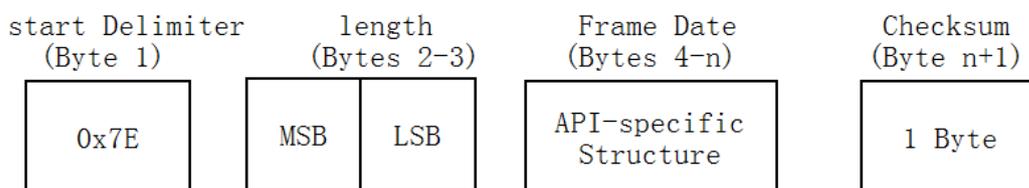
AT Command	ATWR
Parameter values :	No
Default Values	No

N、API working mode

When the module is operating in transparent mode, the module packed all the data received from RXD and transmitted by radio frequency chip. After the target module receives the data, all the received data output from the TXD, the module does not add any protocol information to data. Transparent mode has the following limitations: 1 or only send a broadcast, or only send data to a specific module, when you need to send data to different modules, it is not easy to achieve; 2 When receiving data from several other modules into the air, and cannot determine who is the source module, you cannot determine which of these data originally came from which module. As a complement to transparent mode, API mode (Application Programming Interface) will not have these limitations of transparent mode. API mode requires serial data communication explain according to specific protocol, the module will ignore the data do not conform to the agreement.

API frame structure

API module using ATAP command to select, when ATAP parameter is 0, is the transparent transmission mode, when ATAP is 1, is the API mode. API mode (ATAP = 1) in the API mode, serial data frame format as shown



below:

Each frame of serial data is made up by the four fields, namely Start Delimiter, Length, Frame Data and Checksum.

Start Delimiter

Start Delimiter is the header logo, header fixed API mode is 0x7E.

Length

Length is the valid data length is the length Frame Data field, MSB = high byte, LSB = low byte.

Frame Data

Frame Data valid data field.

Checksum

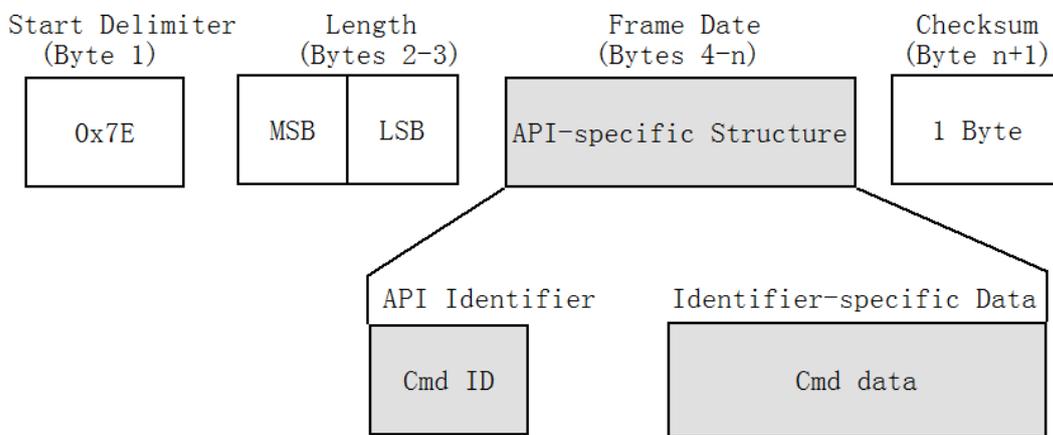
Checksum is checksum, which is used to verify the correctness of the data frame.

The checksum is calculated as follows: do not include a header and a length (1-3 bytes), including the contents of "Frame Data" fields are added one by one, and only one byte sum is reserved and, and then subtracted this sum by 0xFF.

Check: does not include header and length (1-3 bytes), "Frame Data" field-by adding and keep only one byte sum and plus the value of Checksum, if the result of sum is equal to 0xFF, it means checksum is correct.

(A) The definition of frame structure :

The definition of serial frame structure and "Frame Data" field under the API modes are as follows:

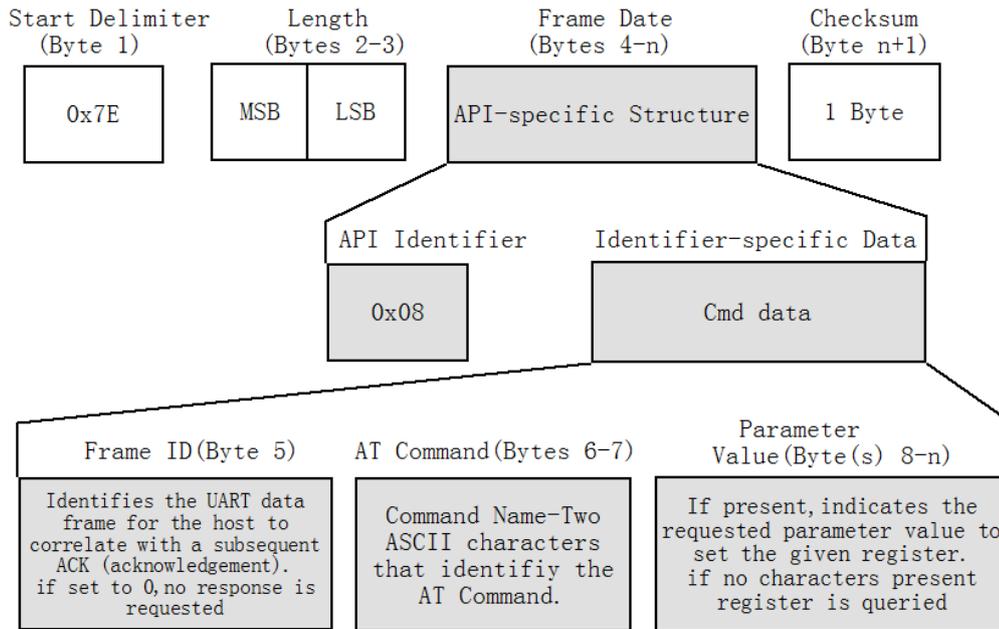


"CmdID" field (API-identifier) is used to indicate what the command code API commands to perform the data frame. The following sections describe several different API commands, note that, for the field which is composed of more than one byte (such as "Length" field), the high byte is in the front.

(B) (In API Modes) Local AT Command

In API mode, you can also execute AT commands, such as reading parameter module with an AT command or setting a parameter using an AT commands, and execute AT command in AT command mode, as in the API mode, after setting an argument with the AT command, the argument whether immediately or take effect when you restart the next time and so on, different depending on each different AT commands. However reading parameters by AT command will immediately return parameter results.

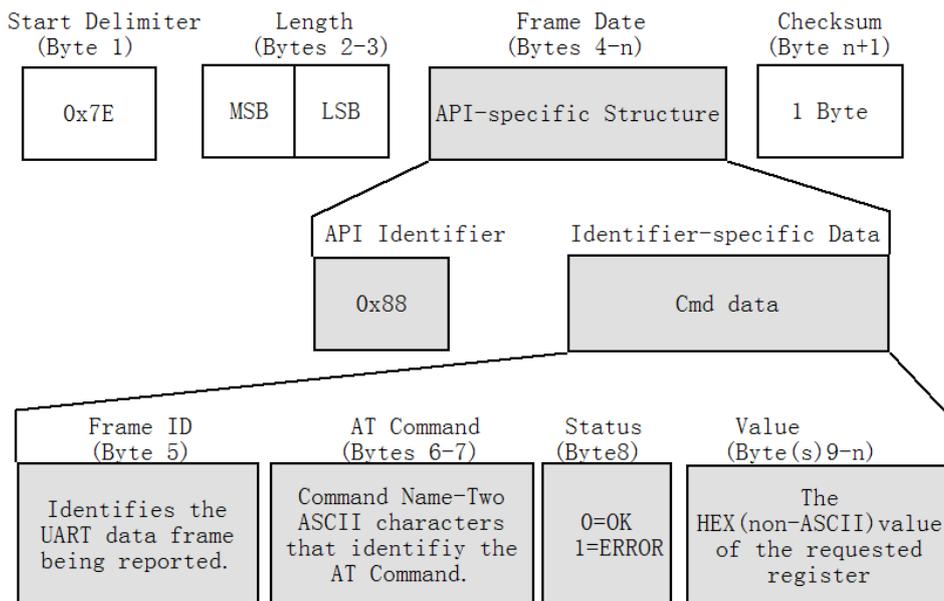
(API mode) command codes for local AT command request: 0x08, frame structure as shown



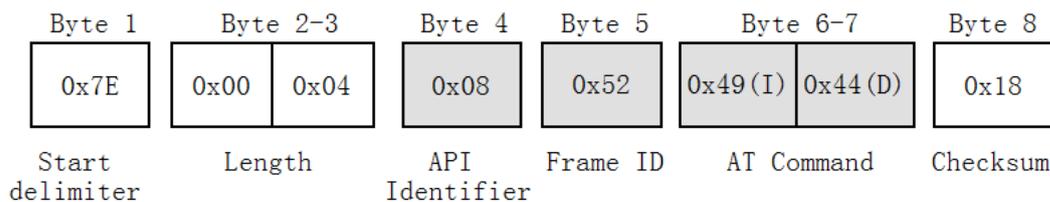
below:

(API mode) local AT command returns the command code is: 0x88, frame structure as shown

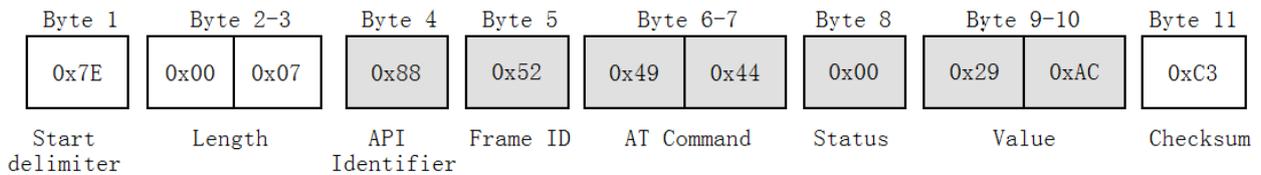
below:



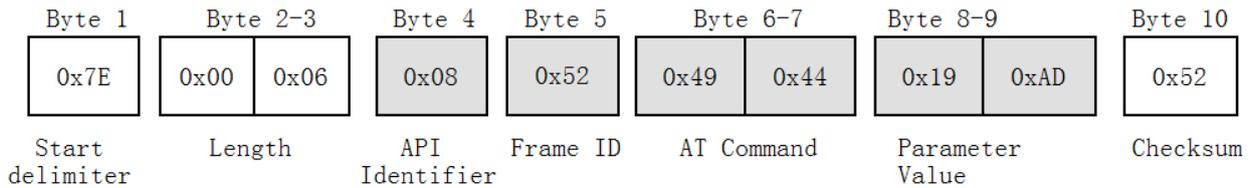
For example: in PAN API mode using ATID command to read module's PAN (Personal Area Network) ID, read the data frame of ID command, pictures as shown below:



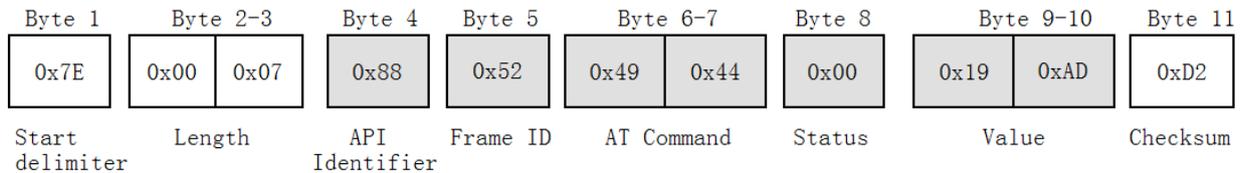
Read ID command's returning data frame structure as shown below:



In API mode, use ATID command to set the module's PAN ID is: 0x19AD set the ID command requests data frame as shown below:

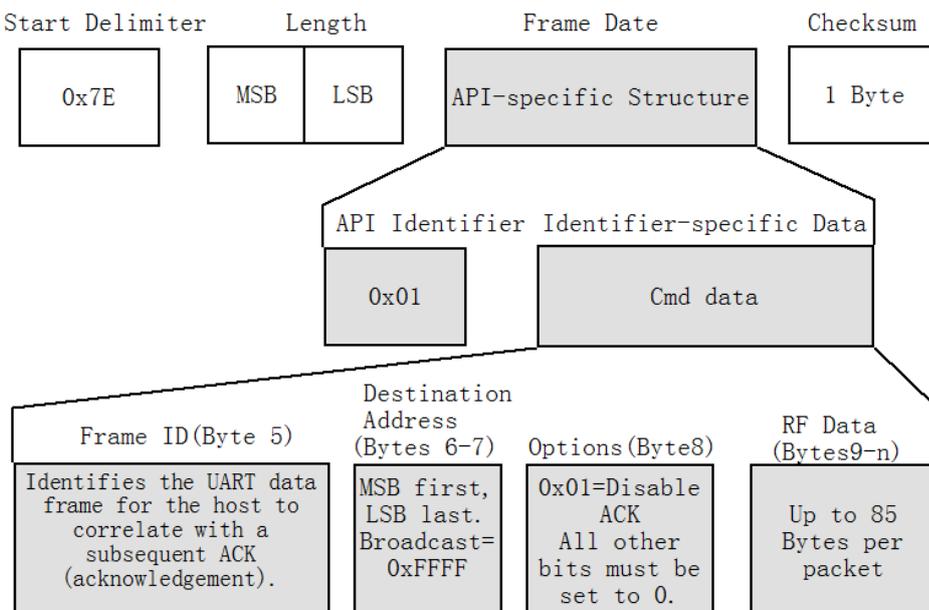


Set ID command's returning data frame as shown below:



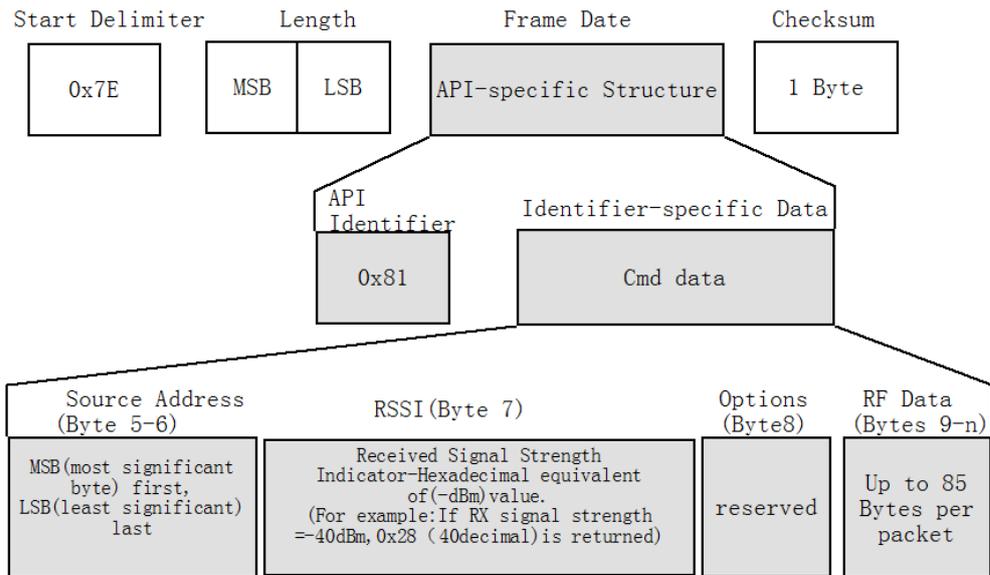
(C)the receive and send of 16bit address in API mode

After the module receives the command code 0x01 data transmission request frame, will send the contents of the "RF Data" field to the 16-bit destination address appointed by "Destination Address". In API mode, the command code send data according to the 16bit address is 0x01, frame structure as shown below:



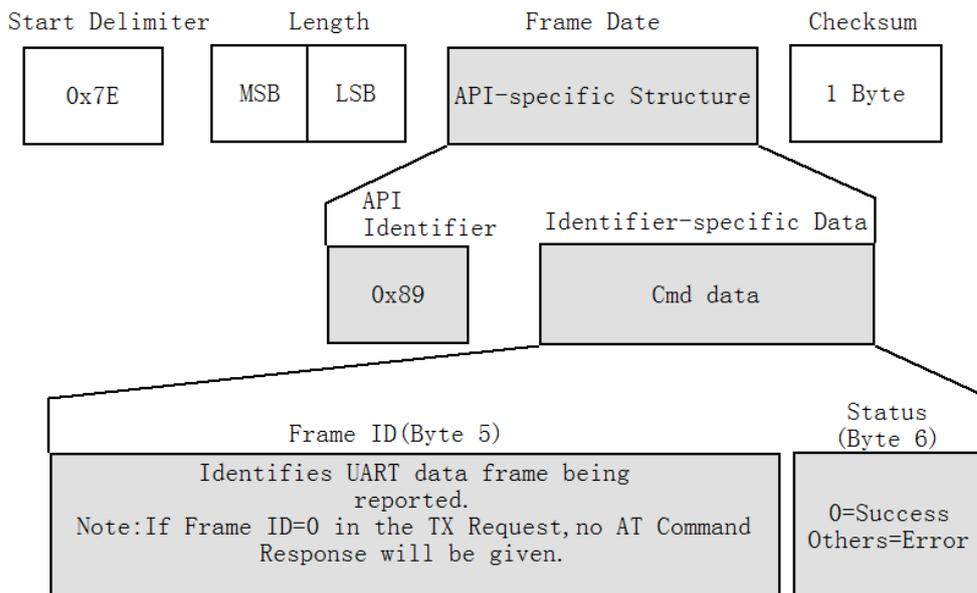
When the module receives the data, will output data from serial after demodulation in accordance with the format of the following data frame. In API mode, the command code for

16bit address to receive data is: 0x81, frame structure as shown below:



Data's sending status under API mode

After a module completes the API data structure (command code is 0x01) sending, if not prohibited ACK, regardless of whether the transmission is successful, the module will return a transmit status frame. In API mode, data transmission status command code: 0x89, frame structure as shown



below:

O、 Problem Solution

(A)How to send the radio?

When a module sends broadcast data, all other modules (channel must be the same) within the same PAN ID network will receive the broadcast data.

Broadcast in transparent mode

In transparent mode, the 16bit Dest Address is set to 0xFFFF, setting command is ATDS, so, in transparent mode, all data input from the module serial, will be sending by broadcasting ways. Broadcast API mode

In API mode, simply 16bit destination address is set to 0xFFFF, so, in the API mode, the data will be sent by broadcasting.

(B) How to send data to a specific module in transparent mode?

When a module is in transparent mode, apart from sending a broadcast data, you can also send data to a specific module, the method is:

Continuous input from the serial port "+ + +" and pause switch to AT command mode;

Set Transparent mode by ATAP command, that is ATAP 0 <CR>;

Use ATDS command to set the desired short address, such as ATDS 1A93 <CR>;

Write to non-volatile memory by ATWR command, that is ATWR <CR>;

Enter "ATCN <CR>" Exit AT Command Mode command.

(C) How do I know if a module has been added to the network?

You can by reading a module's short address (Short Address or 16bit Address, AT command ATMY) to determine whether this module has been added to the network, if it's short address is 0xFFFFE then it did not join the network, if it is a short address less than 0xFFFFE.

Note that it has joined a ZigBee network. Note that, Coordinator is always in the network, and a module if you joined a ZigBee network, it will always in the net unless you use it to re-initialize the network ATRN command. It's in the network even restart after power failure, it normally does not change the short address either.

(D) How to change the module's serial port baud rate?

We can use AT command ATBD to change module's serial port baud rate, its parameters ranges from 0 to 7. If we change the baud rate to 38400bps (corresponding parameters is 5), for example:

Continuous input "+ + +", and wait for the module returns "OK";

Enter "ATBD 5 <CR>" command, the module returns "OK", which is the serial port baud rate is set to 38400;

Enter "ATWR <CR>" command, the module returns "OK", which is to save the settings so that

the module's serial port baud rate will be 38400 bps when power on next time;

Enter "ATFR <CR>" command, this way, the module restarts after a restart, the module will work under 38400bps.

(E) How to make the module in transparent mode when power on?

Default working module in API mode, you can use the ATAP command allowed to work in transparent transmission mode.

From serial input: + + +, the module enters AT command mode;

Enter ATAP 0, module exit AT command mode, and immediately enters the transparent transmission mode.

(F)The sleep and sleep control of End Device

There are three preconditions for End Device into hibernation, first, End Device has been added to the ZigBee network; Second, SM parameter is set to 1, that is dormant allowed; third, sleep control pin allows the module to sleep, that pin 9 high level, when these three conditions are met, End Device begin enter hibernation.

When the module into hibernation, it will not receive air data nor receiving serial data, its length and sleep cycles SP set sleep time is related to the default of the sleep cycle is 0x12C, units of 10mS, therefore, End Device will wake up per 3000mS, after waking up, it will go to its parent node to extract other nodes' data in their own air. It should be noted that, even End Device not hibernate, End Device also press cycle time to extract the air data sent by other nodes from its parent node.

To wake up the module from time to time, send serial data to the module is not feasible, because when you send serial data to the module, the module is entirely possible in hibernation, therefore, reliable way to awaken dormant control module via pin to wake it up, just need to End Device pin 9 can be set low level, as long as it stays low level, End Device will continue in operation without dormancy. Module pin 9 and the test board is connected to Switch 4 feet, so when End Device inserted in the test board, when Switch 4 is OFF allow hibernation, when Switch 4 is ON allowed to enter dormancy.

Also important to note is that when the module is powered, it needs always to work in a network environment to save power, when ZigBee is in no network status, due to the module need to constantly look for ZigBee network to join; it does not enter the sleep state, which also means no save power.

(G)The module's net load by air data transmission

The module's air data transmission depends on the current operating status factors, the system can allocate resources to other modules, but at least not less than 80 bytes, if the module is a non-air data transmission encryption mode, its net load is greater than 80 characters section (Note: air data encryption mode data transmission module for custom needs).

P、ZIGBEE profile

(1) ZigBee introduction

The ZigBee Alliance is a high growth non-profit organization, members including internationally renowned semiconductor manufacturers, technology providers, technology integrators and end-users. Alliance developed based on IEEE802.15.4, with high reliability, high cost, low-power network application specifications.

The main objective of the ZigBee Alliance is by adding wireless networking capabilities, to provide consumers with a more flexible and easier to use electronic products. ZigBee technology can be integrated into all kinds of electronic products, applications across a range of global civil, commercial, public utility and industrial markets. Union members can make use of this standardized ZigBee wireless network platform, designed a simple, reliable, cheap and a variety of products to save power.

ZigBee Alliance focuses on the development of network, security and application software layers; product provided coordination and interoperability test specifications; worldwide adoption of ZigBee brand and gain market attention, development of management technology.

(2) ZigBee module category

Our offer zigbee modules can be divided coordinator (coordinator), router (router) and the terminal (end device) according to the functions, the structure and interface definitions of the three are the same, just different in procedures and functions. You can distinguish by AT commands, or our software provides distinction or discrimination by the product label.

(3) ZigBee network

A ZigBee network has one and only one coordinator, the coordinator is used for the formation of the network, only a few seconds after power on the network, the coordinator starts, the coordinator is the first node of the network, then the router can be connected with the coordinator and added to the network at the same time, and the router adding to the network also allows other routers connect to the network by connecting themselves to join the network. Any two nodes can be point to point communication, at the same time; any node in the network can broadcast to other nodes.

A module can join the network within its communication range depends on whether a node has joined the network, if the distance of nearest node longer than the module's communication node (see module specifications), then the node will be off-grid and cannot communicate with any node in the network.

ZigBee network is set up on the module automatically after power on, users do not need to manipulate. On the order of power module does not seem particularly important, but only after power on the coordinator, ZigBee network began to form, once a router is added to the network, even if the coordinator off, the network can still work, but for data encrypted transmission module, when it joins the network, the coordinator must be online.

The coordinator needs to search for the most appropriate channel when power on and form network, and if the router needs to join the network also need to search for channels, looking for network and connection, etc. These processes require ranging from a few seconds to tens of seconds. To Coordination and routers, once the module joins the network, it will keep record its

network status to non-volatile memory, including its PAN ID, channel, 16-bit address, etc., unless re-initialize its network, this module will always be in network state. All modules in a network will have the same PAN ID and channel.

(4) The module's 64-bit and 16-bit address

64 bit address , also called IEEE address 、 64-bit ID or Serial Number , Each module's 64 bit address out of factory is provided by the module's chip manufacturers, chip manufacturers ensured global uniqueness of the 64 bit addresses. The 16-bit address of the module, also known as short address or 16-bit ID, obtained after the module is added to the ZigBee network. Before the module is added to a ZigBee network, its 16-bit address is 0xFFFFE, this 16-bit address is meaningless. Once the module is added to the ZigBee network, it will get a less than 0xFFFFE the 16bit address, in this network, the 16-bit address is unique, unless you reset the network, otherwise the 16-bit address will always belong to this module, even after re-power the module after power failure, it's the 16-bit address will not change generally.

The 16-bit address of Coordinator is fixed in the network, and its 16-bit address is always 0x0000.

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