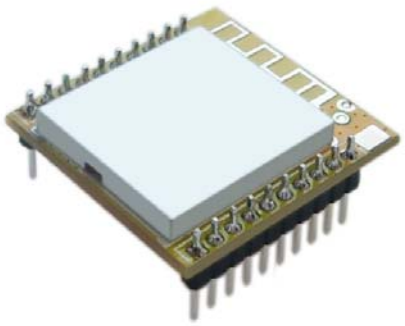
DZM5168M
2.4-GHz Low Energy Zigbee Module V1.02

Features:

- Frequency Range: 2405~2480MHz
- UART Data Interface
- Sensitivity: -104dBm
- Output Power: 20dBm
- High efficient coding & Frequency hopping
- High anti-interferences
- Two working modes
- AT command support
- Supply voltage: 2.0~3.6V



Applications

- Lighting & Home automation
- Toys and gaming peripherals
- Sports and leisure equipment
- Consumer Electronics
- Smart Energy
- Remote Control
- Sensor Data Logger System

DESCRIPTION

DZM5168M is a type of low energy Zigbee module based on RFIC JN5168 from NXP Semiconductors, that provides a fully integrated solution for applications using the IEEE802.15.4 standard in the 2.4 - 2.5GHz ISM frequency band [1], including Zigbee PRO, ZigBee Smart Energy, ZigBee LightLink, RF4CE and JenNet-IP. DZM5168M module integrates PA circuit to overcome the disadvantage of short distance of JN5168.

The module utilizes the own application protocol and can work two different modes: Transparent mode and API mode, which can be switched flexibly through AT commands which also can be used to change the default parameters for higher efficient networking for different applications. The DZM5168M module integrates PCB antenna so users don’t need to consider RF circuit design which will shorten the development time.

PIN FUNCTIONS

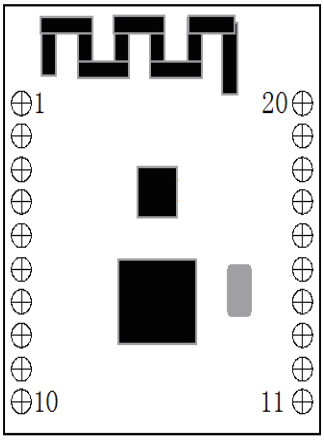


Figure 1: DZM5168M Pin Layout

PIN	Name	Function	Description
1	VCC	Power	+2.0~3.6V
2	TXD	Digital I/O	UART interface; TX pin
3	RXD	Digital I/O	UART interface; RX pin
4	DIO1	Digital I/O	Programming pin / SIMISO
5	RESETN	Input	Reset pin, low effective
6	DIO18	Digital I/O	Reserved
7	DIO4	Digital I/O	Reserved
8	DIO5	Digital I/O	Reserved
9	DIO8	Digital I/O	Sleep pin only for EndDevice; high effective
10	GND	Ground	Ground (0V)
11	DIO9	Digital I/O	Reserved
12	DIO10	Digital I/O	Reserved
13	DIO11	Digital I/O	Reserved
14	DIO12	Digital I/O	Reserved
15	DIO13	Digital I/O	Reserved
16	DIO14	Digital I/O	Reserved
17	DIO15	Digital I/O	Reserved
18	DIO16	Digital I/O	Reserved
19	DIO17	Digital I/O	Reserved
20	GND	Ground	Ground (0V)

Table 1: DZM5168M Pin Functions

SPECIFICATIONS

Symbol	Parameter (condition)	Min.	Typ.	Max.	Units
VCC	Supply Voltage	2.0	3.3	3.6	V
Temp	Operating temperature range	-40	25	80	°C
Freq	Frequency range	2.405		2.48	GHz
I_{DD_R}	RX current in data transmission mode		27		mA
RF_{RATE}	RF data rate		250		kbps
I_{DD_T}	TX current in data transmission mode		130		mA
I_{DD_S}	Current in sleep mode for end device		0.8		uA
Pout	Max. output power			20	dBm
Sen.	Receiver sensitivity			-104	dBm
D_L	Light of sight distance		200		meter

Table 2: DZM5168M Electrical Specifications

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min.	Max.	Units
VCC	Supply Voltage	-0.3	6	V
VI	Input voltage	-0.3	VCC+0.3	V
VO	Output voltage	-0.3	VCC+0.3	V
T_{ST}	Storage temperature	-55	125	°C

Table 3: DZM5168M Maximum Ratings

WORKING MECHNISM

DZM5168MM communicates with the host through five pins. The UART data format of DZM5168MM must be the same as the host. User can reset the module through AT command or I/O port. Please note that the external reset circuit should be consisted of a 18K resistor and a 470nF capacitor (seeing the connection diagram below). DZM5168MM module works in two different modes: Transparent mode and API mode which can be switched between them freely by AT command.

Baud rate	Data bit	Stop bit	Parity check
9.6 kbps	8 bits	1 bit	No

Table 4: DZM5168M Default UART Data Format

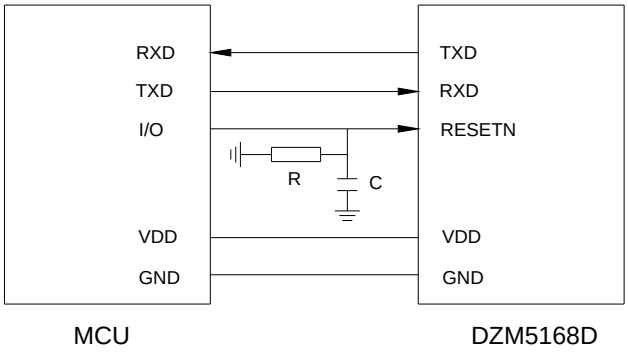


Figure 2: DZM5168M Connection Diagram

- **TRANSPARENT MODE**

In this mode DZM5168M receives data from the host through RXD pin and transfers the data through TXD pin to the host with no protocol utilized in the data package. The data received by RXD pin will be stored in the buffer of the module and will be transmit when one of the two conditions is met:

1. The time interval between two continuous bytes exceeds the max. value 30ms.
2. The size of data package exceeds

In transparent mode the targeted receive module is chosen by the 16-bit object address specified by AT command ATDS. By default DZM5168M works in API mode which can be switched to transparent mode by AT command.

Firstly the host needs to send '+++' to the module. If DZM5168M respond with OK, the module enters into configuration mode now. By executing AT command: ATAP 0<CR><LF>, the module will be switched to transparent mode. The host then sends AT command: ATCN to quit configuration mode. After be resetting, DZM5168M will work in transparent mode.

The modules in transparent mode are easy to use because of no protocol concerned but there are some disadvantages for this mode.

1. The data only can be broadcasted or only can be sent to the specified module. It will be difficult to realize when sending data to different modules.
2. When receiving data from multiple modules, it is hard for DZM5168M to recognize the source module so it can not judge which module is the first one to send the data.

In order to overcome such shortcomings, API MODE is introduced, which is discussed in the next section.

- **API MODE**

This mode is a complimentary of transparent mode. The data will be encapsulated with frame protocol. In this mode the AT command also can be executed with specified frame protocol. Any data which is not compliant with frame protocol will be omitted. There are two types of data obtained through RXD pin:

1. Data Frame
2. Command Frame

The data transferred to the host by TXD pin include three types:

1. Data Frame
2. Command Response Frame
3. Other Information Frame

The host also can enable DZM5168M module enter into configuration mode by sending AT command '+++'. If the module responds with OK, it works in configuration mode now. If the module is in transparent mode, users can let the module enter into configuration mode and execute AT command: ATAP 1 <CR><LF> to switch the module to API mode.

1). API Frame Structure

Each frame is consisted of four sections: Start Delimiter, Length, Frame Data and Checksum.

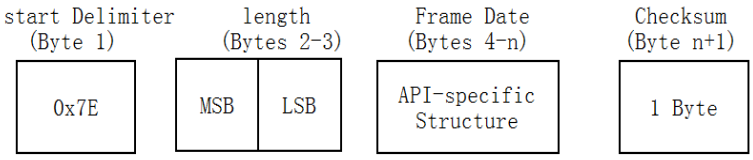


Table 5: Frame Structure in API Mode

Start Delimiter.: It is the start mark of frame, which is fixed as 0x7E.

Length: It is the effective length of frame data

Frame Data.: Effective frame data

Checksum: It is calculated by adding each byte of Frame data and them using 0xFFFF to subtract one byte of the sum. The Start Delimiter and Length data are not calculated.

2). Frame Data Structure

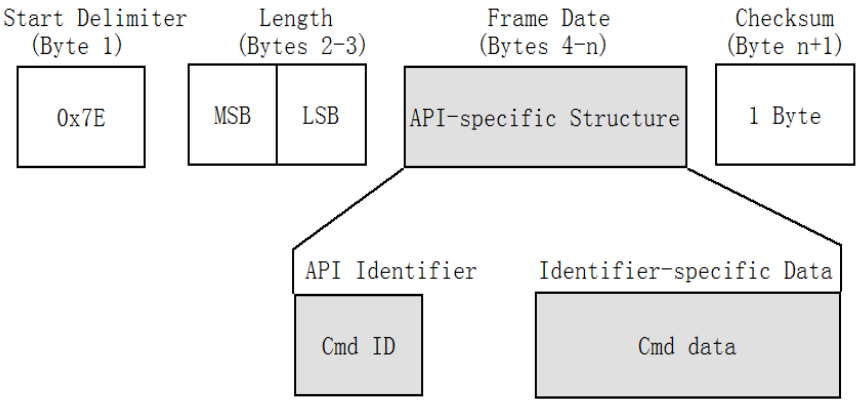


Table 6: Frame Data Structure

In Frame Data Section cmdID (API Identifier) is used to identify which API command should be executed. In the following sections a few API commands will be introduced.

3). Local AT command in API mode

The AT command also can be executed in API mode, which is the same as in configuration mode. The cmdID for AT command in the data structure is 0x08.

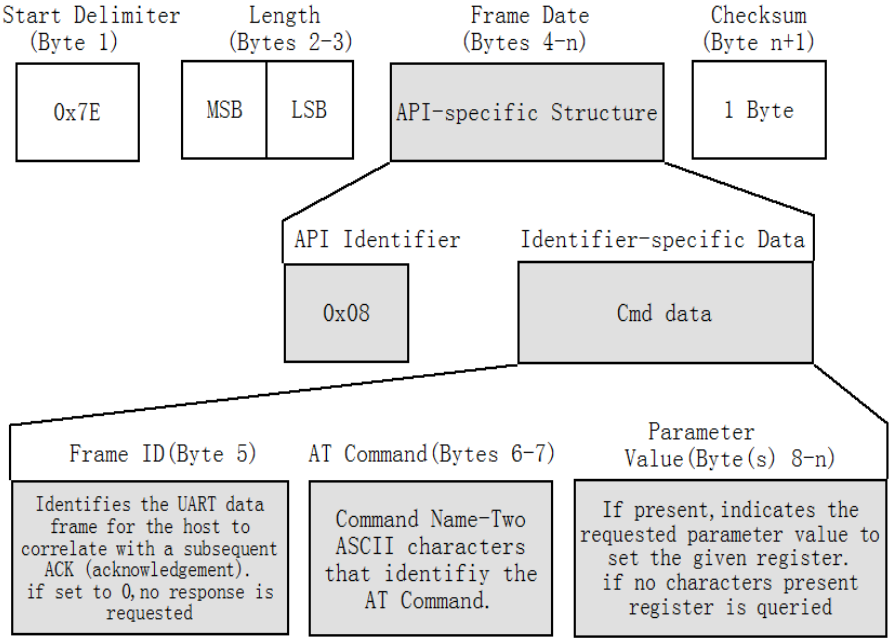


Table 7: CmdID for AT Command

If using AT command to read parameters, the module will return parameters immediately. The cmdID for returned frame is 0x88

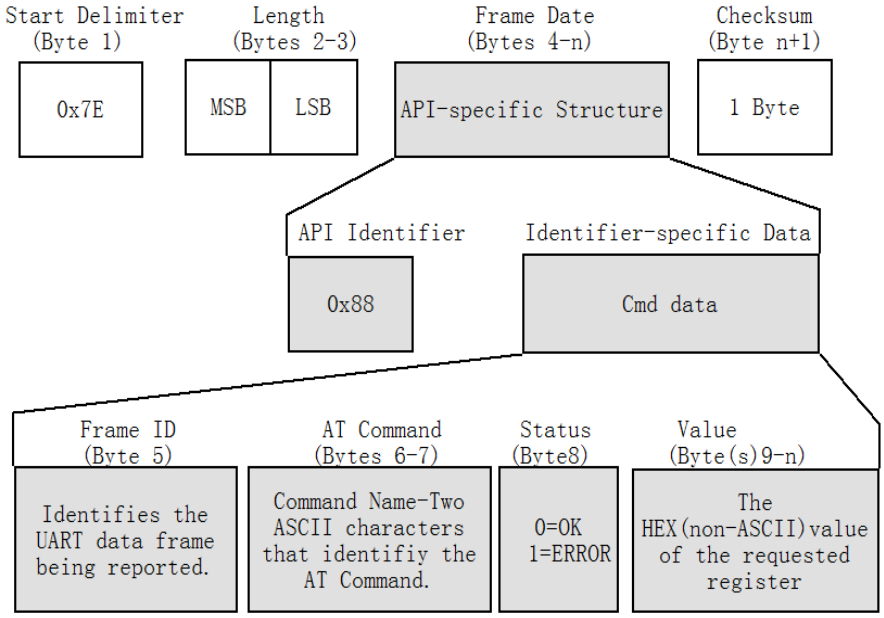


Table 8: CmdID for Returned Frame with Inquiried Parameters

We can use an example to demonstrate the use of AT command in API mode. Here ATID is used to read the PAN ID of DZM5168M module.

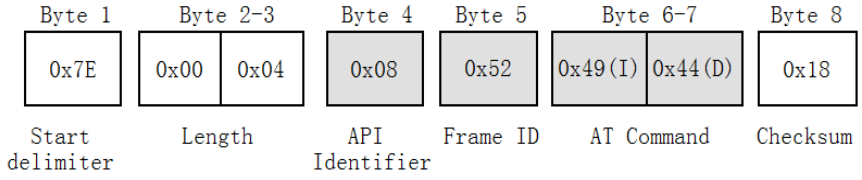


Table 9: Frame Structure for ATID Command to Read Parameters

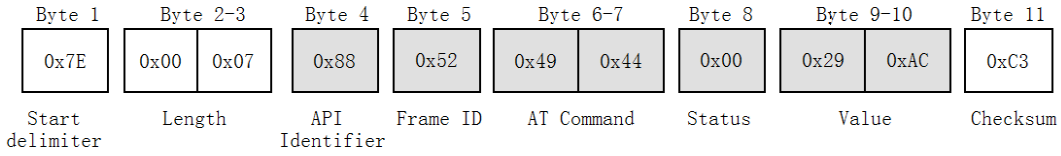


Table 10: Frame Structure for Returned Parameters

If we set the PAN ID of module to 0x19AD by command ATID, the data frame is showed as below:

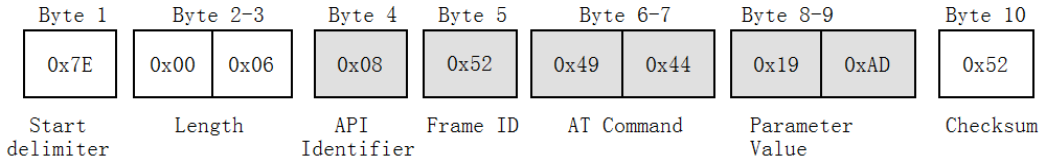


Table 11: Frame Structure for ATID Command to Set Parameters

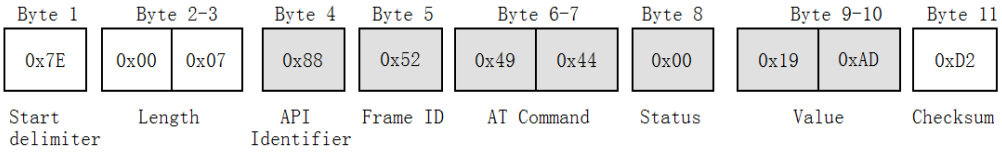


Table 12: Frame Structure for Returned New Parameters

4). Data Transmission in API Mode

The cmdID for data transmission is 0x01. When the module detects the cmdID value, it will send the data in the frame to the targeted module specified by Destination Address.

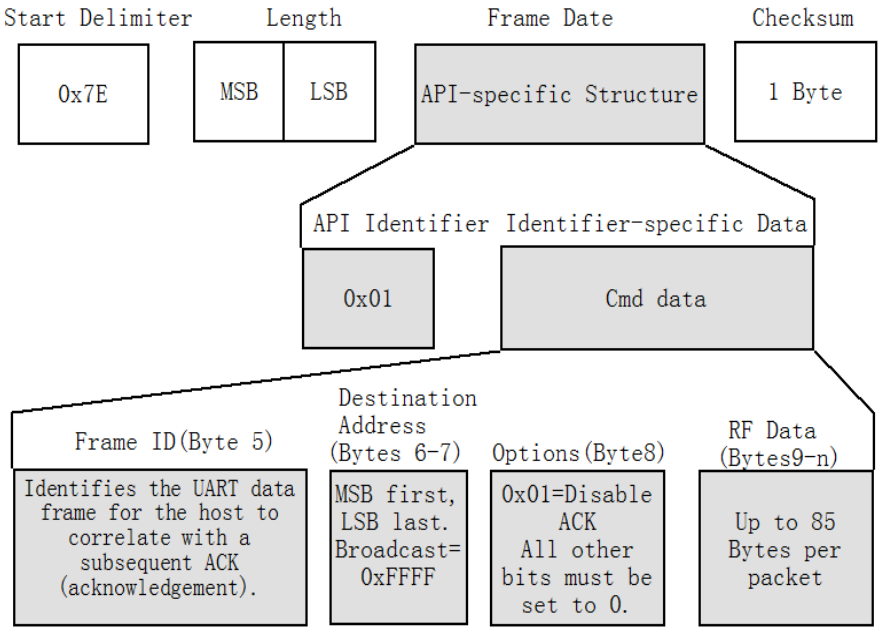


Table 13: Frame Structure for Data Transmission in TX Module

When the data frame is sent, the module will send back a transmission status frame to the host no matter the transmission is successful or not if the ACK function is not forbidden.

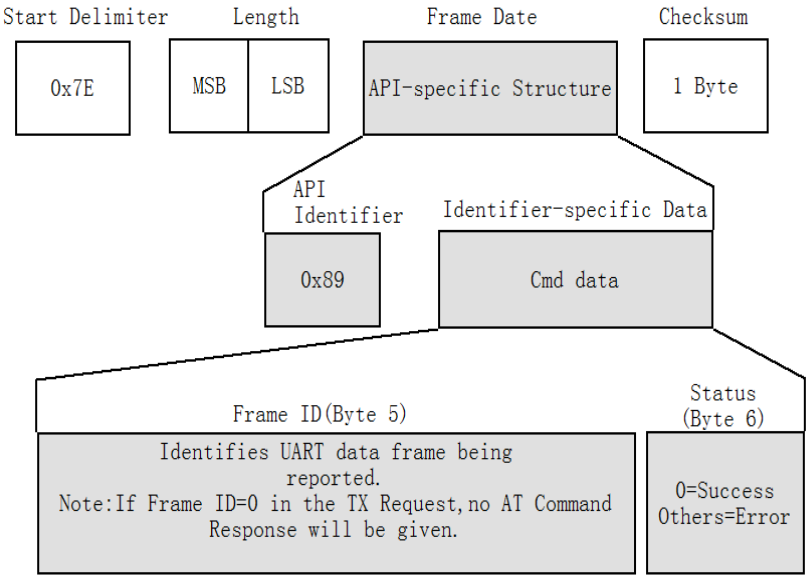


Table 14: Response Frame after Data Transmission in TX Module

When the target module receives the data frame from the source module, it will transfer the data to the host through UART interface with the frame structure as below. The cmdID for received data frame is 0x81.

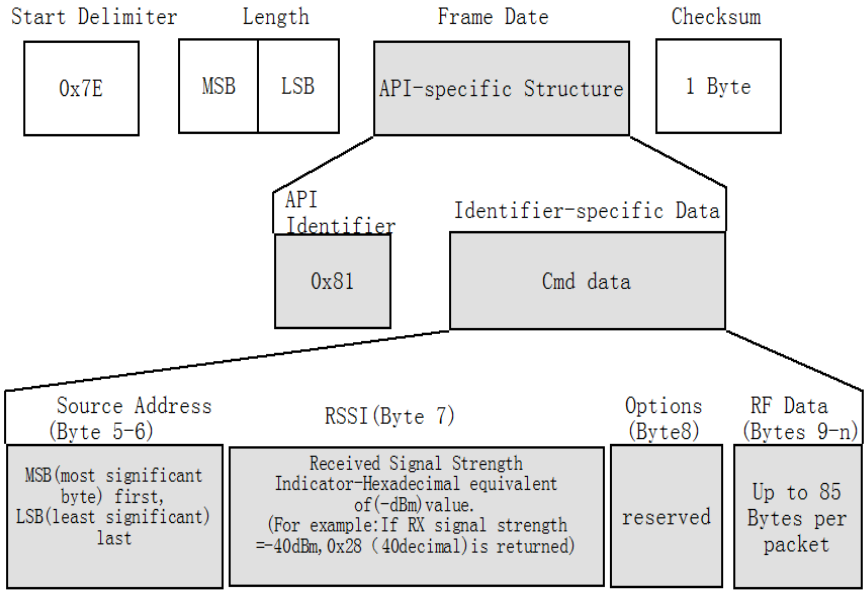


Table 15: Received Data Frame in RX Module

- **AT COMMAND**

DZM5168M module provides rich AT commands with which users can change the default parameters or inquiry network status. Users can switch to configuration mode from any of two working modes by inputting '+++'.

Num	Command	Description	Parameters	Default
1	ATAI	Inquiry network status, only for EndDevice	0: in network 1: no network	1
2	ATAP	R/S working mode	0: Transparent 1: API mode	1
3	ATBD	UART data rate	0: 4.8k bps 1: 9.6k bps 2: 19.2k bps 3: 38.4k bps 4: 57.6k bps 5: 115.2k bps	1
4	ATCN	Quit configuration mode		
5	ATDS	16-bit targeted module address, 0xFFFF means broadcasting	0x0000~0xFFFF	0x0001
6	ATCH	Channel number, defined by 802.15.4 protocol	0x0B~0x1A	0x19
7	ATFR	Reset command		
8	ATHV	Hardware version	0x0000~0xFFFF	
9	ATID	PANID information	0x0000~0xFFFF	0x29AC
10	ATMP	Read the 16-bit short address of father node	0x0000~0xFFFF	
11	ATMT	Device type	0: Coordinator 1: Router 2: EndDevice	
12	ATMY	Read 16-bit source address	0x0000~0xFFFF	
13	ATND	Search node information: 16-bit address of online node, 64bit address, RSSI and description string	0~20 ASCII	
14	ATNI	R/S module description string	0~20 ASCII	
15	ATNO	Select if showing own information in searching	0: not display 1: display	0
16	ATNT	Set limitation time for searching nodes	0x01~0xFC	0x19
17	ATPI	Read actual PANID	0x0000~0xFFFE	
18	ATPL	R/W output power	0x00~0x03	0x03
19	ATRE	Restore the factory settings		
20	ATRN	Reset network	0: disable 1: enable	0
21	ATRR	Set repeat times for RF transmission failure	3~6	3

22	ATSC	R/S the searching channel	0x0001~0xFFFE	0x0003
23	ATSH	Read the high 32-bit of IEEE 64-bit address	0x00000000~ 0xFFFFFFFF	
24	ATSL	Read the low 32-bit of IEEE 64-bit address	0x00000000~ 0xFFFFFFFF	
25	ATSM	R/S sleep mode, only for EndDevice	0: disable 1: enable	0
26	ATSP	The limitation time for Coordinator or Router to keep data for EndDevice or the period for EndDevice to obtain data from Coordinator or Router.	0x0001~0xFFFF	0x12C
27	ATST	The working time of EndDevice after it is waken up. The value (ms) must not exceed half of the value set by ASTP command. Only effective for EndDevice.	0x0001~0xFFFF	0x32
28	ATVR	Software version	0x00~0xFF	
29	ATWR	Save the revised parameters to memory. The module will work on new parameters after being reset.		
30	ATJN	Forbid joining network. Only effective for Coordinator or Router.	0: forbid 1: allow	1

Table 16: DZM5168M AT Command Set

1. ATAI

This command is used to inquiry the network status of EndDevice If the returned value is 0, it means the EndDevice is in the network. In other words it has the father node. The searching time for EndDevice to join the network is from several hundreds of milliseconds to several seconds so it might need to use this command for a few times in order to get the status. Furthermore the father node might be different for each time of the EndDevice to join the network.

2. ATAP

It is used to read or set the working mode of modules. If the parameter following the command is 0 (ATAP 0), the module will enter into transparent mode after quitting configuration mode. Similarly the module will enter into API mode if the parameter is 1.

3. ATBD

This command is used to read or set the UART data rate. Lower data rate is not recommended in case the buffer is overflowed. This command is only effective in configuration mode so it is not applicable in API mode. The command comes into effective after the module is reset.

4. ATCN

It is used to quit configuration mode.

5. ATDS

It is used to read or set 16-bit of targeted module. This command is only available in transparent mode. When the targeted address is 0xFFFF in transparent mode, the module will broadcast the data. If users hope that DZM5168M module still can send the data to the same targeted address after next power-on, users can use command ATWR to save the parameter.

6. ATCH

ATCH command is used to read the present wireless channel number. There are 16 channels available. The modules in the same network must work in the same channel. The channel number is compliant to protocol 802.15.4. The center frequency=2045+(CH-11D)*5 MHz. Among which d refers to decimal.

7. ATFR

It is used to reset the module. When DZM568 receives this command, it will be reset at once without response.

8. ATHV

The command is for reading hardware version of module

9. ATID

ATID is used to read or set PAN (Personal Area Network) ID. The modules only can communicate when their IDs are the same. Users need to execute ATRN command (ATRN 1) and ATWR command if new PAN ID is set. When DZM5168M is powered on next time, the network will be reset and the new PAN ID then comes into effect.

The PAN ID can be set to any value among 0x0000~0xFFFE. If the PAN ID is set to 0xFFFF, different type of modules will have different reaction.

- For Coordinator, it will choose one value among 0x0000~0xFFFE randomly as its PAN ID when it is powered on.
- For Router or EndDevice, they will search the PAN ID of ZigBee network and change their PAN ID to the same and try to join this network after the modules being powered on. If there are more than one ZigBee network, it will choose to join the one with best RSSI.

When the PAN ID of modules are set to 0xFFFF, the actual PAN ID of DZM5168M after joining a network can be read out by ATPI command. If the PAN ID is specified to any one among 0x0000 ~ 0xFFFF, the values read out by commands ATPI and ATID are the same.

10. ATMP

ATMP is used to read the 16-bit address of father node.

11. ATMT

This command is used in inquiry the type of modules. There are three types of modules for DZM5168M: Coordinator, Router and EndDevice. The module type is fixed in factory so users can not change it.

12. ATMY

ATMY is used to read its own 16-bit address of DZM5168M module (source address). The source address is distributed by the network when the module joins in a ZigBee network. If the source address is 0xFFFE, it means the module has not joined any network. If the address is smaller than 0xFFFE, it means the module is in a network now.

13. ATND

It is used to search the information of other nodes in the same network. The information includes 16-bit address, 64-bit address, RSSI and node description string. If the ATND is used without parameter, it will return the information of all nodes in the network. If the ATND is followed with node description string of a node, it will only return the information of this node.

14. ATNI

ATNI is used to read or set description string of a node. The string must be displayable ASCII and it can not start with space character. The length should be not longer than 20 ASCII.

15. ATNO

It is a searching-related command which is used to read or set the option of showing the information of the node itself. When its parameter is 0, it means it will not display its own information in the searched result. Users can use ATWR to store this parameter into the memory to make it still effective when restart.

16. ATNT

It is also a searching-related command and is used to read or set the search time with the unit of 100ms. When ATND is used to search the information of other nodes, the processing time will only last for the parameter set here. The information of other nodes which have not been found in this period will be omitted. Users can use ATWR to store this parameter into the memory.

17. ATPI

It is used to read the actual PAN ID. It is different from ATID only when the PAN ID of the module is set to 0xFFFF. Please check command ATID for more details.

18. ATPL

It is used to read or set the output power of module. The value of the parameter is 0~3, which 3 means the highest output power and 0 refers to the lowest output power.

19. ATRE

This command is used to restore the factory settings of the module. The execution of this command will result in the loss of network and might affect other information such as PAN ID, 16-bit address, etc.

20. ATRN

ATRN is used to read or set if the module resets the network connection at next power-on. If the parameter is 1, DZM5168M will research the network and apply for joining it when it is powered on next time. It means the information including PAN ID, channel, 16-bit source address might be changed after restart.

21. ATRR

It is to set or read the repeat times of air transmission when it fails. Users can use ATWR to store this parameter into the memory.

22. ATSC

ATSC is used to set or read the channel which will be used for searching. The parameter is a 16-bit value. Each bit is corresponding to one channel. If the bit value is 1, it means this corresponding channel will be searched. If it is 0, this channel will be omitted.

Bit	Channel	Bit	Channel	Bit	Channel	Bit	Channel
Bit0	0x0B	Bit4	0x0F	Bit8	0x13	Bit12	0x17
Bit1	0x0C	Bit5	0x10	Bit9	0x14	Bit13	0x18
Bit2	0x0D	Bit6	0x11	Bit10	0x15	Bit14	0x19
Bit3	0x0E	Bit7	0x12	Bit11	0x16	Bit15	0x1A

Table 17: Bit vs Corresponding Channel Number

For example, if the parameter is 0x0008, the corresponding binary is 0000000000001000b so the bit3 is set to 1 and corresponding channel 0x0E will be chosen. If there are more than one bit are set to , the Coordinator will choose one as working channel but for Router or EndDevice, they will search the multiple channels till they join in one of them.

Users need to execute command ATRN to make the new parameter of command ATSC come into effect at next power-on of modules and use command ATWR to save the parameter into the memory.

23. ATSH

ATSH is used to read or set the high 32-bit address of IEEE 64-bit address. The 64-bit address of each module is assigned by the RFIC supplier NXP Semiconductor and it is unique on the earth in order to avoid the disorder of Zigbee network. Therefore it is not recommended for users to change it. To set the 64-bit address with 0xFFFFFFFF can restore the address to the factory default setting. The new address comes into effect at the next power-on after executing ATRN and ATWR.

24. ATSL

ATSL is used to read or set the low 32-bit address of IEEE 64-bit address. Please refer to ATSH for detailed use.

25. ATSM

This command is only available for EndDevice. It is used to read or set the sleep mode of EndDevice. The parameter value 1 enables the sleep function. When the EndDevice joins the network, it keeps searching the network so it will not enter into sleep mode till it joins in a network. EndDevice only can enter into sleep mode when all of the three conditions below are met.

- EndDevice has joined the network
- Sleep mode is enabled
- The sleep control pin 9 is logic high

26. ATSP

This command is used to read or set the time T_K of keeping data for EndDevice by its father nodes (Coordinator or Router). It is also the time for the EndDevice to read data from its father nodes periodically. If the EndDevice is not able to read data from the father nodes in this period, the data kept in Coordinator or Router will be cleared away. Therefore this parameter of EndDevice must be the same as Coordinator or Router.

27. ATST

ATST is used to read or set the working time T_W (or wake-up time) after being activated from sleep mode. The time T_W should not exceed 1/2 of T_K in case of disorder. When one period of T_K comes, the module will work for T_K and then enters into sleep mode till the next T_K.

28. ATVR

This command is used to read the software version of module.

29. ATWR

It's a write command which is used to save the parameters changed by other commands into nonvolatile memory and make the new parameters available when module is powered on again.

When the module is powered on, it will read the parameters from the nonvolatile memory. For the changed parameters, if they are not written into memory, the new parameters will get lost when the module restarts next time. Please note even though some parameters are saved into the memory, they only can come into effect at restart next time when some conditions are met. For example the parameter of commands ATID only comes into effect after restarting of the module after the commands ATRN and ATWR.

30. ATJN

This command is used to allow the Coordinator or Router joining in the network or not. If the value of parameter is 0, it allows the Coordinator launching networking or allows Router joining the network. If the value is 1, it forbids the Coordinator launching networking or forbids Router joining network or as the father node of EndDevice.

MECHANICAL DATA

Unit:mm

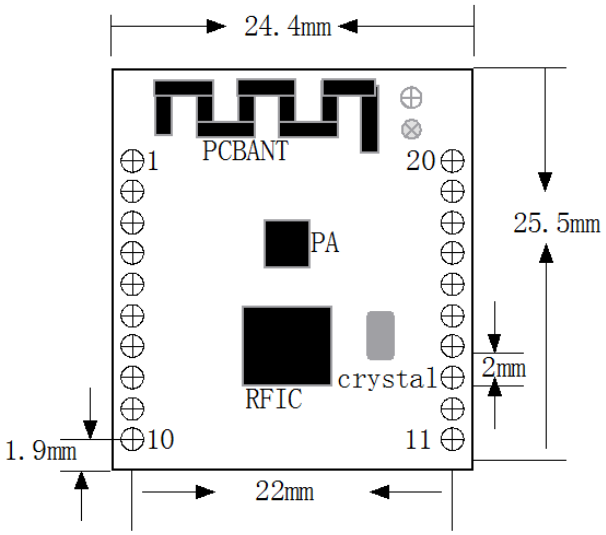


Figure 3: DZM5168M Mechanical Dimension

ORDERIN INFORMATION

There are three types of modules: Coordinator, Router and EndDevice. For one network, only one Coordinator is allowed but there can be multiple Routers and EndDevice. Router can be acted as relay node and terminate node. As to EndDevice it only acts as terminate node and doesn't have routing function. Just for this reason the EndDevice has sleep function because it doesn't have children nodes. If the applications don't need to consider power consumption, Coordinator and Routers are enough for networking. For low energy consumption projects which the terminate nodes have no children nodes and only need to communicate with its father nodes, EndDevice can be used together with Coordinator to establish a Star Network. Certainly Coordinator, Router and EndDevice can be used in the same network for more complicated applications.

Part Type	Description
DZM5168M-C1	20dBm Zigbee Coordinator module, DIP package
DZM5168M-R1	20dBm Zigbee Router module, DIP package
DZM5168M-E1	20dBm Zigbee EndDevice module, DIP package

Table 18: DZM5168M Selection Guide

Dorji Applied Technologies
A division of ***Dorji Industrial Group Co., Ltd***

Add.: Xinchenhuayuan 2, Dalangnanlu, Longhua, Baoan district, Shenzhen, China 518109
Tel: 0086-755-28156122
Fax.: 0086-755-28156133
Email: sales@dorji.com
Web: http://www.dorji.com