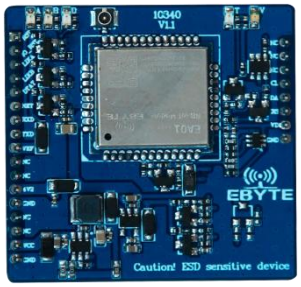
NB-IOT UART Module
EA01-D

Chengdu Ebyte Electronic Technology Co.,Ltd.

Contents

1 Introduction

1.1 Product overview



EA01-D is a NB-IOT data transmission module launched by Ebyte. It is developed to realize the mutual transmission of data between serial port equipment and network server through the network. It supports B3 B5 B8 frequency band. Users can realize the transparent transmission of two-way data from serial port to network server through simple settings. The software has perfect functions and covers most conventional application scenarios. It is widely used in wireless meter reading, bike sharing, intelligent parking, smart city, security, asset tracking, smart appliances, wearable devices, agriculture and environmental monitoring to provide perfect data transmission services.

The module uses 2.0mm pin array to facilitate customer equipment integration, and uses 5V~18V wide voltage power supply or lithium battery power supply. It supports the NB cards of China Mobile, China Unicom and China Telecom. The communication and LED indicators use compatible levels. The default 3.3V level is applicable to 5V level. It has anti-interference capability and can be used in some environments with strong electromagnetic interference, such as some power industries.

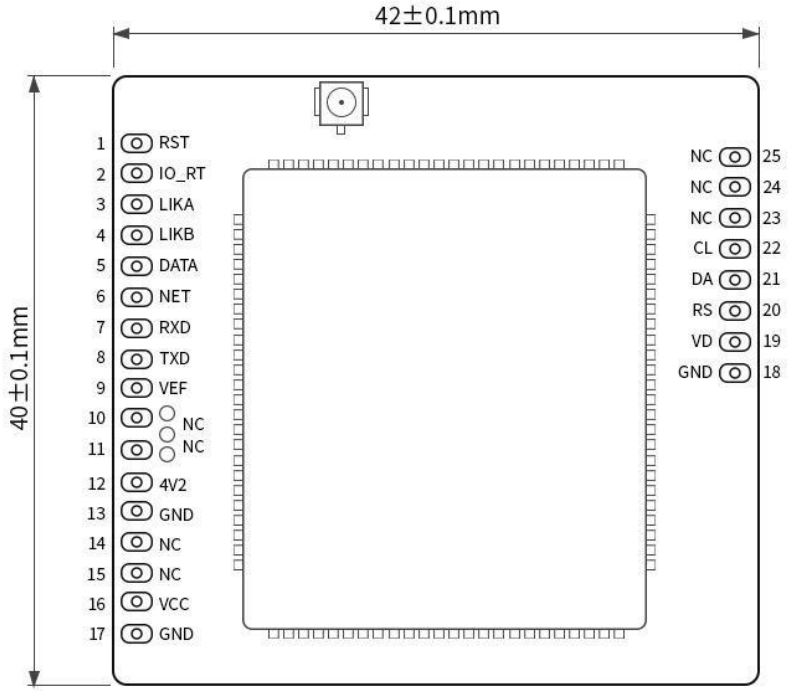
1.2 Features

- Support transparent data transmission and TCP/UDP transparent transmission;, Support heartbeat package and registration package functions;
- TCP, UDP, MQTT, COAP, LwM2M and other protocols;
- Simultaneous sending and receiving of two socket links;
- Modbus RTU/TCP conversion
- SMS in PDU format;
- FOTA remote upgrade;
- Support for Telecom Cloud CTWING, Huawei Cloud OceanConnect, Unicom Cloud, China Mobile onenet cloud platform, Alibaba Cloud and Baidu Cloud;
- Support PSM and eDRX;
- Support NB IoT radio communication protocol 3GPP standard Rel.13 and Rel.14.

1.3 Module system parameter

Parameter	Value	Remarks
Characteristics	Supported frequency band	B3 B5 B8 band The module can automatically search the frequency
	NB Data Properties	Single-tone：25.5kbps（downstream），16.7kbps（upstream）Multi-tone：25.5kbps（downstream），62.5kbps（upstream）
	Network protocol characteristics	Support TCP、UDP、MQTT、COAP、LwM2M protocol
Hardware characteristics	Antenna Options	IPEX
	Baud rate	Max 115200bps，default 9600bps
	Transmitting power	20dBm±2dB
	Current consumption (typical value)	345 mA TX (5V) 30 mA RX (5V)
	Working voltage	DC 5V~18V Lithium battery direct drive：3.6V~4.3V
	Working temperature	Normal operating temperature -30°C to +75°C Extreme operating temperature -40°C to +85°C
	Humidity	RH5%～RH95%
	Size	42×40×9mm

1.4 Pins



1.5 Pin definition

No.	Name	Function
1	RST	Module reset, valid at low level
2	IO_RT	The low level lasts for about 1 second, and the module parameters will be restored to the factory settings and restarted immediately
3	LINKA	The socket 0 link connection status indicator pin corresponds to the left 1 LED on the board. High: The connection between Socket0 and the network server is successful; Low: Socket0 failed to connect to the network server;
4	LINKB	Socket 1 link connection status indicator pin, which corresponds to the on-board left 2 LED. High: The connection between Socket1 and the network server is successful; Low: Socket1 failed to connect to the network server;
5	DATA	The data receiving and transmitting indicator pin, when the network receives data or the serial port receives data, the indicator light flashes, corresponding to the left 3 LED lights on the board.
6	NET	The device network status indicator pin corresponds to the on-board right 1LED. Flashes quickly when the device is attached to the network; The device is successfully attached to the network, flashing slowly;
7	RXD	Data receiving pin, 3.3V by default, compatible with 5V communication level.
8	TXD	Data transmitting pin, 3.3V by default, compatible with 5V communication level.
9	VEF	Drive level power supply pin. If it is necessary to realize serial communication and LED indication is 5V, 5V level should be input at this pin.
10,11,14,15,23,24,25	NC	NC, not used
12	4V2	Lithium battery power supply pin, power supply range: 3.6V~4.3V, typical voltage: 3.8V. It is prohibited to reverse connect this pin or connect it with VCC
16	VCC	Power on.
19	VD	External SIM card power supply pin. If the onboard SIM card holder is used, the pin NC can be used.
20	RS	External SIM card reset pin. If the onboard SIM card holder is used, the pin NC can be used.
21	DA	External SIM card data pin. If the onboard SIM card holder is used, the pin NC can be used.
22	CL	Connect the clock pin of the SIM card externally. If the onboard SIM card holder is used, the pin NC can be used.
13,17,18	GND	Ground

2 Command configuration and function description

2.1 AT Mode and data transmission mode switching

AT command	Respond
ATD*98/r/n	CONNECTI NG OK
+++	OK

1. Power on works in AT command mode by default. Under AT command mode, send ATD * 98/r/n or ATD * 99/r/n to switch to transparent transmission mode;
2. <+++>: In the transparent transmission mode, the last three bytes of user data are "+++", or three bytes "++" are sent after the completion of user data transmission, which will end the transparent transmission mode;

2.2 Device software restart

AT command	Respond
AT+NRB/r/n	REBOOTI NG

After entering the AT command, the device will soft restart and save the AT parameters to flash. When the AT parameters need to be memorized after power failure, the AT command is used to configure the parameters, and then the AT+NRB parameters must be entered before they can be memorized in flash.

2.3 Application of electric saving lock WORKLOCK

AT command	Respond
AT+WORKLOCK =<enable>/r/n	OK

1. Since the NB module has been in deep sleep mode for a long time (chip power down state), in order to ensure that the data interaction fails due to entering deep sleep ahead of time during the application period, entering AT+WORKLOCK=1 plus the working lock can prevent entering deep sleep ahead of time. After the data service interaction is completed, entering AT+WORKLOCK=0 releases the lock module to enter deep sleep.

2. The module supports serial port wake-up. Input AT command to wake up. After the AT command wakes up the module, it will automatically process as a lock. Therefore, you must enter AT+WORKLOCK=0 to release the lock after each wake-up for business interaction.

Note: You must input AT+WORKLOCK=0 to enter deep sleep after power on again.

2.4 Serial port baud rate setting

AT command	Respond
AT+UARTSET =<rate>,<store>/r/n	OK

1. This command is similar to the "AT+NATSPEED" function of the remote system. It is used to set parameters such as the baud rate of the AT serial port. The default value is 9600 baud rate. When the store is 0, the baud rate takes effect dynamically. When the store is 1, the baud rate set is divided by 2400 and saved to flash and automatically restarted to take effect.

2. Parameter Configuration Description

◆<rate>: baud rate. Currently, the highest baud rate is 115200.

◆<store>: Save or not. The default is not to save, that is, switch the baud rate dynamically; If it is set to 1, it will be saved to NV and restarted immediately; If it is set to 0, it means that it takes effect dynamically, and the other party needs to switch the baud rate synchronously.

2.5 Communication protocol type configuration

AT command	Respond
AT+PDUTYPE=<pdu_type>/r/n	OK
AT+PDUTYPE/r/n	type:<pdu_type> OK

1. At present, it supports MQTT, COAP, TCP/UDP and 100 million cloud protocols. At present, the module supports two sockets, allowing TCP/UDP to communicate with one of MQTT, COAP and 100 million cloud at the same time. TCP/UDP always opens socket0, and MQTT, COAP and 100 million cloud open socket1.

2. Parameter Setting Description

◆<pdu_ Type>, 0 means based on TCP or UDP protocol, 1 means based on MQTT protocol, 2 means based on COAP protocol, and 3 means based on 100 million cloud protocol. Note: If power failure is required for saving, input the AT+NRB command to save the parameters in flash, and the automatic restart takes effect.

2.6 TCP/UDP Function configuration of transparent transmission channel

2.6.1 TCP/UDP Address and Port Configuration

AT command	Respond
AT+SOCKADDR =<addr>,<port>,<local_port>,<type> /r/n	OK
AT+SOCKADDR /r/n	address:< addr >,port:< port >,local port: <local_port>,type:<type> OK

1. The socket 0 address supports IP address and domain name, and the maximum byte length supports 50 bytes. The device automatically connects to socket 0 after software restart, hardware reset and normal power on. When the device wakes up in deep sleep, it needs to enter the open and close command AT+SOCKONOFF to connect to socket 0. If the server does not release the link before connection, the terminal needs to successfully disconnect the link and then connect to socket 0.

2. Configuration parameter description
◆<addr>, supports IP address or domain name, and the maximum byte length is 50 bytes.
◆<Port>, the port of the remote server.
◆<local_ Port>, the local port. 0 means that it is freely selected by tcp. The default value is 0.
◆<type>, 0 represents the TCP protocol, and 1 represents the UDP protocol.

Note: If power failure is required for saving, input the AT+NRB command to save the parameters in flash, and the automatic restart takes effect.

1. When the socket connection status changes, it will actively report+XSSTATE:<id>,<state>;

◆<id>indicates the socket id created. Currently, only 0 and 1 are supported. Only 0 can be used for TCP/DUP channels, and 1 is used for COAP, MQTT, and 100 million cloud channels.

◆<state>indicates the connection status of the socket, 1 indicates the connection status, and 0 indicates the disconnection.

If socket 0 is successfully connected, it will actively report+XSSTATE: 0,1. When the server or terminal disconnects socket 0, it will also actively report+XSSTATE: 0,0.

2.6.2 Turn on and turn off TCP/UDP socket0 connection

AT command	Respond
AT+SOCKONOFF=<enable>,<on-off>/r/n	+XSSTATE:< id>,<state> OK

◆<enable>,enable TCP/UDP channel，1 enable(default)，0 disable

◆<on-off>,turn on or turn off socket0，1 turn on, 0 turn off
Notes:To save paramter when power off, enter AT+NRB Command to save paramter to flash, and auto-restart takes effect.

2.7 Heartbeat packet function configuration

2.7.1 Configure TCP/UDP heartbeat content

AT command	Respond
AT+HEARTINFO=<type>,<data>/r/n	OK
AT+HEARTINFO /r/n	<data> OK

◆ <type >,0 format is HEX， 1 format is ASCII (character string).

<data>，heartbeat data content，max length is less than 40，default value is“Ebyte nbiot heart rate data”.

Notes:To save paramter when power off, enter AT+NRB Command to save paramter to flash, and auto-restart takes effect.

2.7.2 Send heartbeat packet command

AT command	Respond
AT+SENDHEART=<send>/r/n	OK

1. Enter AT command AT+SENDHEART=1, then the heartbeat packet can be sent.
2. If pdu_ Type If TCP/UDP is selected, TCP/UDP heartbeat packets will be sent; if MQTT is selected, MQTT heartbeat packets will be sent ("PINGRESP" will be printed on the serial port after successful sending); if Ebyte cloud is selected, Ebyte cloud heartbeat packets will be sent.

2.7.3 Registration Packet Mode Configuration

AT command	Respond
AT+REGMOD=<mode>/r/n	OK
AT+REGMOD/r/n	OK mode: <mode>

<mode>,0 close the registration packet, 1 add IMEI registration packet before each packet of data sent, and 2 means to add custom registration packet before each packet of data sent, 3 means that only one IMEI registration packet is sent when the server is linked for the first time; 4 means that a custom registration packet can only be sent when the server is linked for the first time;

Notes:To save paramter when power off, enter AT+NRB Command to save paramter to flash, and auto-restart takes effect.

2.7.4 Customized registration packet data content configuration

AT command	Respond
AT+REGINFO=<type>,<data>/r/n	OK
AT+REGINFO /r/n	OK < data >

◆ <type>,0 indicates that the registration packet type is HEX format, and 1 indicates that it is ASCII code (string) format.
◆ <data>， The maximum length of the sent registration packet data is less than 40, and the default value is"Ebyte Register packet"。

Notes:To save paramter when power off, enter AT+NRB Command to save paramter to flash, and auto-restart takes effect.

2.8 Modbus RTU/TCP Conversion function

Function description:

After the Modbus RTU/TCP conversion function is enabled, in the receiving state, when the wireless receives the Modbus RTU data format, it will automatically convert to the Modbus TCP data format serial port for printing, and when the wireless receives the Modbus TCP data format, it will automatically convert to the Modbus RTU data format serial port for printing; In the transmission state, when the serial port receives the Modbus RTU data format, it will automatically convert to the Modbus TCP data format for wireless transmission, and when the serial port receives the Modbus TCP data format, it will automatically convert to the Modbus RTU data format for wireless transmission;

2.8.1 Modbus RTU/TCP enable configuration

AT command	Respond
AT+MODBUS=<enable>,<Id> /r/n	OK
AT+MODBUS /r/n	OK enable:< enable>,Id:< Id >

1. Parameter Configuration Description

◆ <enable>,0 indicates that the modbus RTU/TCP conversion function is turned off, and 1 indicates that the modbus RTU/TCP conversion function is turned on.

◆ <Id>,indicates the modbus TCP transaction ID, (0~65535) 2 bytes long,

1. Transaction ID Function Description
◆ In the modbus TCP to modbus RTU status, when Id=0, any received modbus TCP will be converted to the corresponding RTU protocol, otherwise, only the transaction ID matching can be converted.
◆ In the modbus RTU to modbus TCP status, it indicates the modbus TCP transaction ID after conversion
Notes:To save paramter when power off, enter AT+NRB Command to save paramter to flash, and auto-restart takes effect.

2.9 MQTT application configuration

2.9.1 MQTT command set instructions

First, the AT+MQTTMODE command configures the working mode soft reset of MOTT and restarts to take effect; secondly, the AT+PDUTYPE confirms whether the data frame type is mqtt transmission; secondly, the AT+MQTTCONN configures the three elements of connection; thirdly, the AT+MQTTSUBTOP and AT+MQTTPUBTOP commands configure the subject of subscription and publication; finally, ATD * 98 enters the transmission mode for business interaction; after the interaction, enter++to enter the AT command mode, If the low power consumption service is involved, the AT+WORKLOCK=0 command should be input to release the lock and enter the deep sleep mode.

2.9.2 MQTT mode configuration

AT command	Respond
AT+MQTTMODE=<mode>/r/n	OK
AT+MQTTMODE /r/n	OK mode:< mode >

◆<type>,0 means to disable the mqtt function, 1 means to access the Alibaba Cloud platform, 2 means to access the onenet platform and other Internet of Things platforms that support the standard MQTT protocol, and 3 means to access the Baidu Cloud platform.

Notes:To save paramter when power off, enter AT+NRB Command to save paramter to flash, and auto-restart takes effect.

2.9.3 MQTT address and port configuration

AT command	Respond
AT+MQTTADDR=<addr>,<port>/r/n	OK
AT+MQTTADDR /r/n	OK address: <addr>,port: <port>

1. When mqtt mode is 0, entering this command will prompt "mqtt closed"; When the mqtt mode is 1, configure the address and port of the Alibaba Cloud platform; When mqtt mode is 2, configure the address and port of onenet platform or other platforms; When the mqtt mode is 3, configure the address and port of Baidu Cloud Platform;

Note: The domain names of Baidu Cloud, Onenet, and MQTT platforms generally do not change. If the domain names do change, they can also be modified through commands.

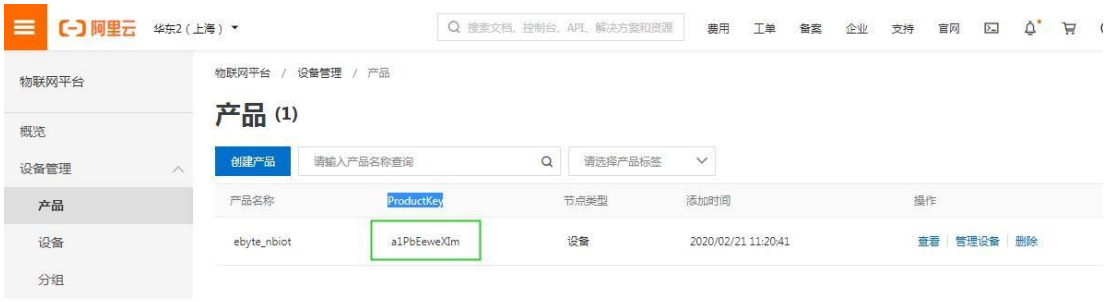
2. Parameter Configuration Description
◆<addr>, representing the IP address or domain name of the server, with a maximum length of 50 bytes.
◆<port>indicates the server port.

2.9.4 MQTT connection three element configuration

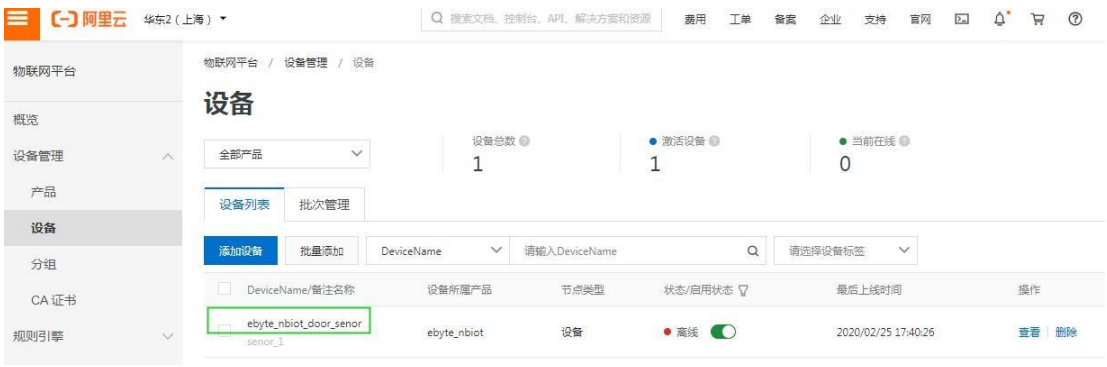
AT command	Respond
AT+MQTTCONN=<value0>,<value1>,<value2>/r/n	OK
AT+MQTTCONN /r/n	OK <value0> <value1> <value2>

1. The length of each of the three elements shall not exceed 40 bytes.
2. Description of three element values of each platform.

◆ Alibaba Cloud platform, value 0 represents the product's ProductKey "a1PbEeweXIm", as shown in the following screenshot



Value1 means device name“ebyte_nbiot_door_senor”as shown below



Value2 is network key（password）.The key is calculated by the mqtt signature tool provided by Alibaba Cloud, and the signature result is entered in value2,

produckkey\deviceName\deviceSecret can be checked as below,

clientIDis460046671104253|securemode=3,signmethod=hmacsha1|，|securemode=3,signmethod=hmacsha1| is fix value，460046671104253 isCIMI number of the card. AT+CIMI to obtain.

◆ Baidu Cloud Platform, value0 refers to the name entered when creating a shadow such as"ebyte_nbiot_xy", value1 is user such as "7nzgctm/ebyte_nbiot_xy"; value2 means the key in the shadow connection configuration.

◆ onenet，value0 is deviceID as shown below

Value1 is product ID，as shown below

Value2 is the authentication information of the device, as shown below

Notes:To save paramter when power off, enter AT+NRB Command to save paramter to flash, and auto-restart takes effect.

2.9.5 MQTT subscription topic configuration

AT command	Respond
AT+MQTTSUBTOP=< topicName>，<qos>/r/n	OK
AT+MQTTSUBTOP /r/n	OK qos:< qos > < topicName>

◆ <topicName>：the string within 200 bytes of the content of the subscription topic.

◆ <qos>：service quality supports qos=0,qos=1,qos=2.

2.9.6 MQTT publish topic configuration

AT command	Respond
AT+MQTTPUBTOP=< topicName>，<qos>/r/n	OK
AT+MQTTPUBTOP /r/n	OK qos:< qos > < topicName>

◆ <topicName>：the string within 200 bytes of the content of the subscription topic.

◆ <qos>：service quality supports qos=0,qos=1,qos=2

2.9.7 MQTT and server keepalive configuration

AT command	Respond
AT+MQTTALIVE=< alive_time >/r/n	OK
AT+MQTTALIVE /r/n	OK keep alive time:< alive_time >

◆<alive_time>： The time to keep the server alive, unit: second, data range: 2 bytes, default: 600 seconds (10 minutes)

Notes:To save paramter when power off, enter AT+NRB Command to save paramter to flash, and auto-restart takes effect.

2.10 COAP function configuration

2.10.1 COAP function instruction

◆ First, the AT+COAPADDR command configures the address and port of the COAP server to simultaneously open the COAP function, and the AT+NRB soft reset restart takes effect;

◆ Secondly, the AT+PDUTYPE command selects the data protocol type as COAP

◆ Next, AT+ADDOPTION, AT+ADDTOKEN, AT+COAPMINUS commands add or delete option or token in the message;

◆ Finally, AT+COAPHEADER command sends the message without load; ATD * 98 enters the transparent transmission mode and inputs the serial port transparent transmission data. At this time, the data sent is the loaded COAP message (the serial port transparent transmission data is the payload of the COAP message).

2.10.2 COAP address parameter configuration

AT command	Respond
AT+COAPADDR=<addr>,<port>,<local_port>,<enable>/r/n	OK
AT+COAPADDR /r/n	OK address: <addr>,port: <port>， local port:< local_port >,enable<enable>

◆<addr>, supports IP address or domain name, and the maximum byte length is 50 bytes

◆<port>, the server port

◆<local_ Port>, local port

◆<enable>, COAP enable, 0 means to turn off COAP function, 1 means to turn on COAP function

Notes:To save paramter when power off, enter AT+NRB Command to save paramter to flash, and auto-restart takes effect.

2.10.3 Command to add Option to message in COAP

AT command	Respond
AT+ADDOPTION=<index>,< type>,< value>/r/n	OK
AT+ADDOPTION /r/n	OK index：<index>，type:<type>， value:<value>

◆<index>, the serial number of option options, ranging from 0 to 7, can be configured with a maximum of 8 options and a storage space of 1024 bytes.
◆<type>, option number, as shown in the figure below:

No.	C	U	N	R	Name	Format	Length	Default
1	x			x	If-Match	opaque	0-8	(none)
3	x	x	-		Uri-Host	string	1-255	(see below)
4				x	ETag	opaque	1-8	(none)
5	x				If-None-Match	empty	0	(none)
7	x	x	-		Uri-Port	uint	0-2	(see below)
8				x	Location-Path	string	0-255	(none)
11	x	x	-	x	Uri-Path	string	0-255	(none)
12					Content-Format	uint	0-2	(none)
14		x	-		Max-Age	uint	0-4	60
15	x	x	-	x	Uri-Query	string	0-255	(none)
17	x				Accept	uint	0-2	(none)
20				x	Location-Query	string	0-255	(none)
35	x	x	-		Proxy-Uri	string	1-1034	(none)
39	x	x	-		Proxy-Scheme	string	1-255	(none)
60			x		Size1	uint	0-4	(none)

For example type=11, means option resource type is Uri-Path.

◆<value>, the specific content of the option. For example, the specific value of the Uri Path path

option is property. If the data type of value is Uint, the data range is 0-4294967295, and the data

length only supports 0-4 bytes

Multiple options can be configured, up to 8 options can be configured. For

example, enter the instructions in sequence as follows:

AT+ADDOPTION=0,3, iot.eclipse.org

AT+ADDOPTION=1,7, 5683

AT+ADDOPTION=2,11,\temperature

AT+ADDOPTION read instruction return index：

0，type：3，value: iot.eclipse.org index：1，

type：7，value: 5683 index：2，type：11，

value: \temperature

2.10.4 Command to add Token to message in COAP

AT command	Respond
AT+ADDTOKEN =<token>/r/n	OK
AT+ADDTOKEN /r/n	OK <token>

◆ <token>，data format is HEX.

For example, parameter is 0x7A5B69EF

AT+ADDTOKEN=7A5B69EF

Read command

AT+ADDTOKEN

AT+ADDTOKEN

7A5B69EF

2.10.5 Command to delete option or token in message

AT command	Respond
AT+COAPMINUS=<token>,<option>/r/n	OK

◆ <token> =1，delete token

◆ <option>=1,delete option

2.10.6 Sending command of COAP message without load

AT command	Respond
AT+COAPHEADER =<type>,<code>/r/n	OK
AT+COAPHEADER /r/n	OK type:<token>,code:<code>

◆ <type>，configure the type of sending message.

Type=0，CON frame: request to be confirmed. If CON request is sent, the other party must

respond.

Type=1，NON frame, the request does not need to be confirmed. If the NON request is sent,

the other party does not have to respond

Type=2，ACK frame, reply message, and response to received CON message.

Type=3，RST frame, reset message. When the message received by the receiver contains an error, the receiver parses the message or no longer cares about the content sent by the sender

The reset message will be sent.

◆ <code>，configure the type of sending

message.

◆ code =1，GET method，to gain some

resource

◆ code =2，POST method，to create some

resource

◆ code =3，PUT method，to update some

resource

◆ code =4，DELETE method，to delete

some resource

For example, if AT+COAPHEADER=0,1 is input, a COAP get message can be sent. The message includes fixed headers, which may have option or token.

2.10.7 COAP data receiving description

◆ The serial port prints the header information of the received COAP data frame: response code:<code>, type:<type>, tid:<tid>, and ends with a carriage return and line feed.
<code>, the function code of the server response< Type>, indicating the type of received message< Tid>indicates the message id (decimal format) of the received message;

◆ If there is a token in the received message, the serial port will print the token:<token>ends with a carriage return and line feed, and<token>is in the form of a HEX string.
◆ If there is an option in the received message, the serial port will print option type:<type>, value:<value>and end with a carriage return and line break.
◆ If there is Payload in the received message, the serial port will print Payload:<Payload>and end with a carriage return and line feed.

Revision history

Version	Date	Description	Issued by
1.0	2017-08-10	Initial version	Linson
1.1	2021-05-26	Content modification	XN
1.2	2022-10-31	Content modification	Hao

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