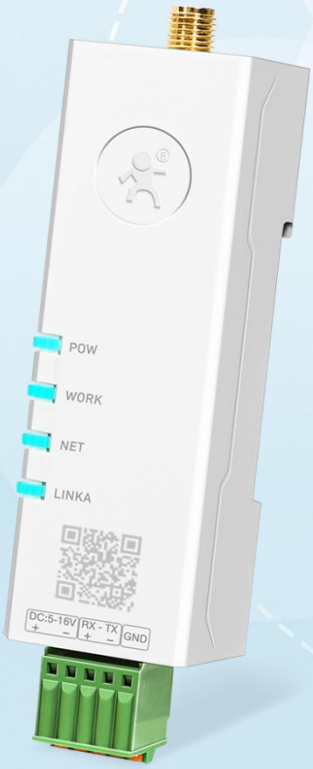
PUSR®
www.pusr.com

“Lipstick” Size 4G Modem

USR-DR154

User Manual



V2.0

Be Honest & Do Best

Your Trustworthy Smart Industrial IoT Partner

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1. Introduction

USR-DR154-E is a LTE CAT 1 communication modem, which supports LTE band, covers the mainstream frequency bands of European operators. It has perfect software function, supports TCP/UDP transparent transmission, HTTPD Client mode MQTT client mode and AT command configuration. In addition, it is simple to configure, has high reliability and built-in hardware watchdog, supports FOTA upgrading.

USR-DR154-E supplies a wide voltage range power through terminal interface, RS485 standard interface, meets the needs of different application scenarios.

1.1. Features

- 4G Cat1 connectivity, low latency, broad coverage, and high network stability;
- Supports multiple work modes: TCP, UDP, HTTP, and MQTT, capable of interfacing with various protocol servers;
- Built-in hardware watchdog to ensure stable operation without crashes;
- Industrial-grade design with a wide operating temperature range: -20 to 75°C;
- Wide voltage supply: 5-24V;
- Modbus gateway: allowing seamless communication between on-site devices and SCADA software;
- Supports both DIN rail and mounting hole installations;
- Utilizes push-in terminals for easy wiring;
- High EMC protection level: Level 2;
- Remote management through the PUSR platform, enabling remote device management.

1.2. Ordering Guide

Model	USR-DR154-E	USR-DR154
Frequency	LTE FDD: B1/3/5/7/8/20/28	LTE FDD: Band1/3/5/8 LTE TDD: Band38/39/40/41
Region	Europe, Southeast Asia, Middle East	China, India
TCP Server	√	/
Modbus Gateway	√	/
SMS	/	√

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1.3. Technical Parameters

USR-DR154-E parameters are as follows:

Power	Power Supply	5-24V DC, 12V/1A is commanded
	Consumption	Average:0.8W, Max:3.5W
Cellular	Frequency Band	B1/3/5/7/8/20/28
	Transmition Rate(Mbps)	10.3 DL/5.1 UL
	Modulation System	UP link: QPSK/16QAM Down link: QPSK/16QAM/64QAM
	Tx Power	23.5±2dBm
	Receive Sensitivity	Band 1 -98.5 10MHz Bandwidth
		Band 3 -98.0 10MHz Bandwidth
		Band 4 -97.5 10MHz Bandwidth
		Band 5 -98.0 10MHz Bandwidth
		Band 7 -97.5 10MHz Bandwidth
		Band 8 -98.0 10MHz Bandwidth
		Band 20 -98.5 10MHz Bandwidth
		Band 28 -98.0 10MHz Bandwidth
	SIM Slot	1*4FF, Nano SIM card
	Antenna Connector	1*SMA Female
Serial Port	Baud Rate	600bps~230400bps
	Data Bits	7,8
	Stop Bit	1,2
	Parity Bit	NONE,EVEN,ODD
Software Features	Protocols	TCP/UDP/HTTP/MQTT/DNS/NTP/FTP/SSL
	Work Mode	TCP Server, TCP client, UDP client, HTTP client, MQTT Client
	Registration Packet	√
	Heartbeat Packet	√
	Modbus Gateway	Modubs RTU to Modbus TCP conversion
	Remote Management	PUSR Cloud(Not available in Europe)
	Configuration	Config Tools, AT command
Environmental Characteristic	Operating Temprature	-25℃~+75℃
	Storage Temprature	-40℃~ +85℃
	Operating Humidity	5%~95%(Non-condensing)
	Weight	<50g
	Dimension	74*24*22mm(L* W* H)
Others	Certificate	CE, NBTC, RoHS*, WEEE*

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1.4. Indicator status description

Table 1. Indicator Status

Name	Description
PWR	Red, on: power on Off: power off
WORK	Green, 1Hz flashing frequency after the system boot up.
NET	Green, On: when it connects to cellular network. Off: when it not connects to cellular network.
LINKA	Green, On: when socketA is in connectivity. Off: when socketA is not in connectivity

1.5. Dimensions

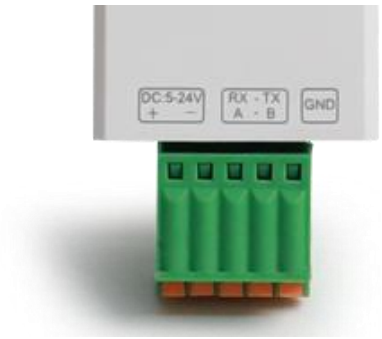
Unit: mm



1.6. Serial port

USR-DR154 series adopts push-type terminal connector, which can realize wiring conveniently and quickly. Terminal wiring definitions are shown below.

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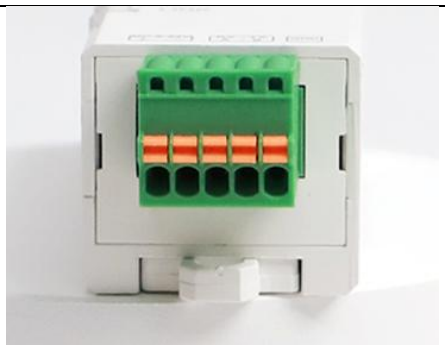


Table 2. Pin description

No.	Pin	Type	Description
1	DC 5-24V +	P	Positive input of the power supply
2	DC 5-24V -	P	Negative input of the power supply
3	RX/A	I/O	Serial signal
4	TX/B	I/O	Serial signal
5	GND	P	The digital ground

2. Get started

2.1. Preparations

2.1.1. Hardware

USB to RS485 converter*1

PC*1

USR-DR154-E*1

4G antenna*1

Power Supply*1

SIM card*1

2.1.2. Configuration software

Configuration software downloading: 插入下载地址

2.1.3. Hardware connection and test

Description:

1.In PC serial parameter setting area, it is necessary to set the serial parameters consistent with the serial device, otherwise they cannot communicate with each other.

2.Working mode selection area, select the work mode of the modem.

3.In the parameter setting area of characteristic functions, set parameters related to modem's featured

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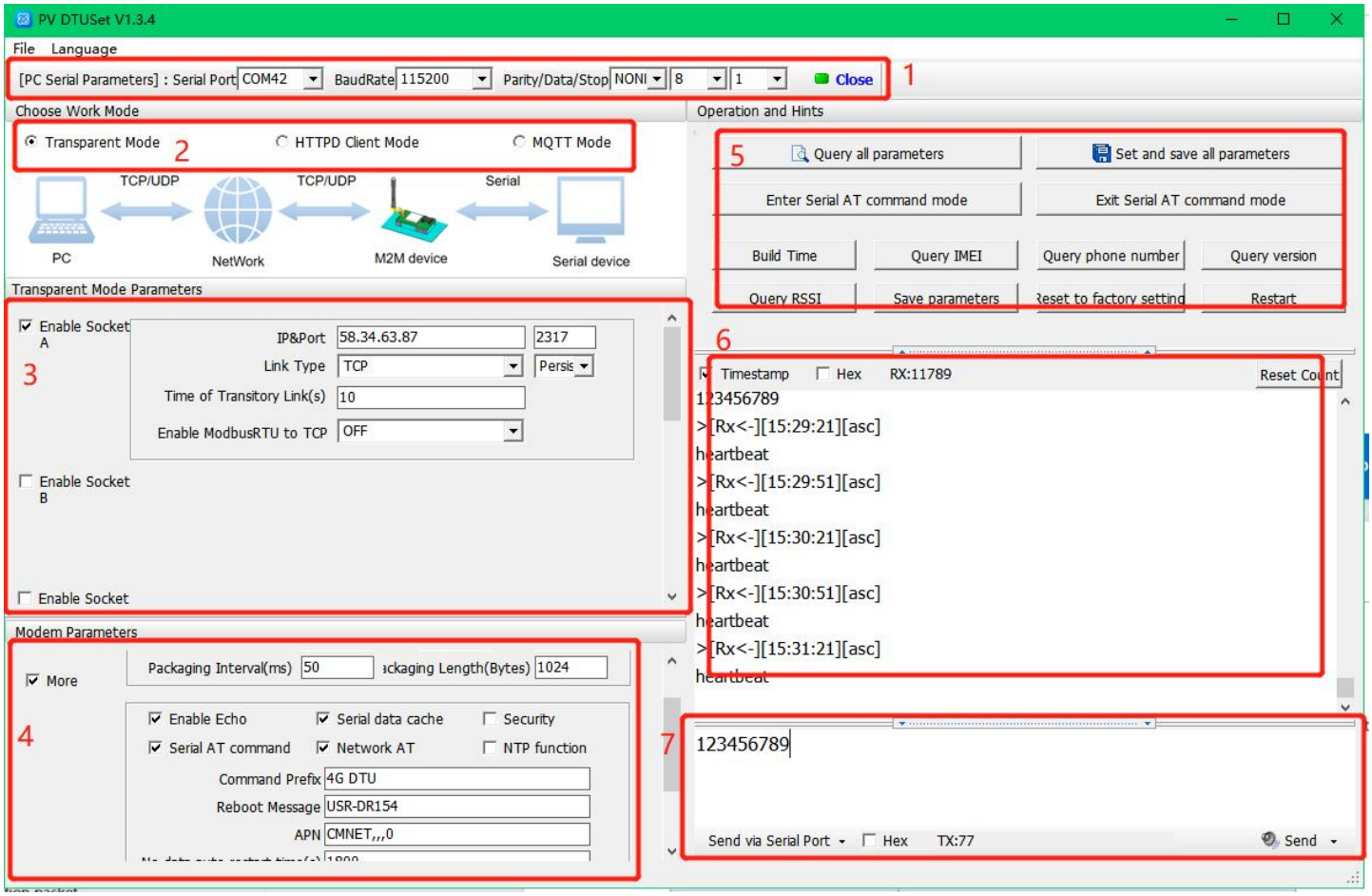
functions.

4.Modem parameter area, setup some basic global parameters.

5.Common command button, click to send the self-input command.

6.Data receiving and display area, displaying the data sent and received.

7.Data sending area, input the data and click Send.



3. Serial port

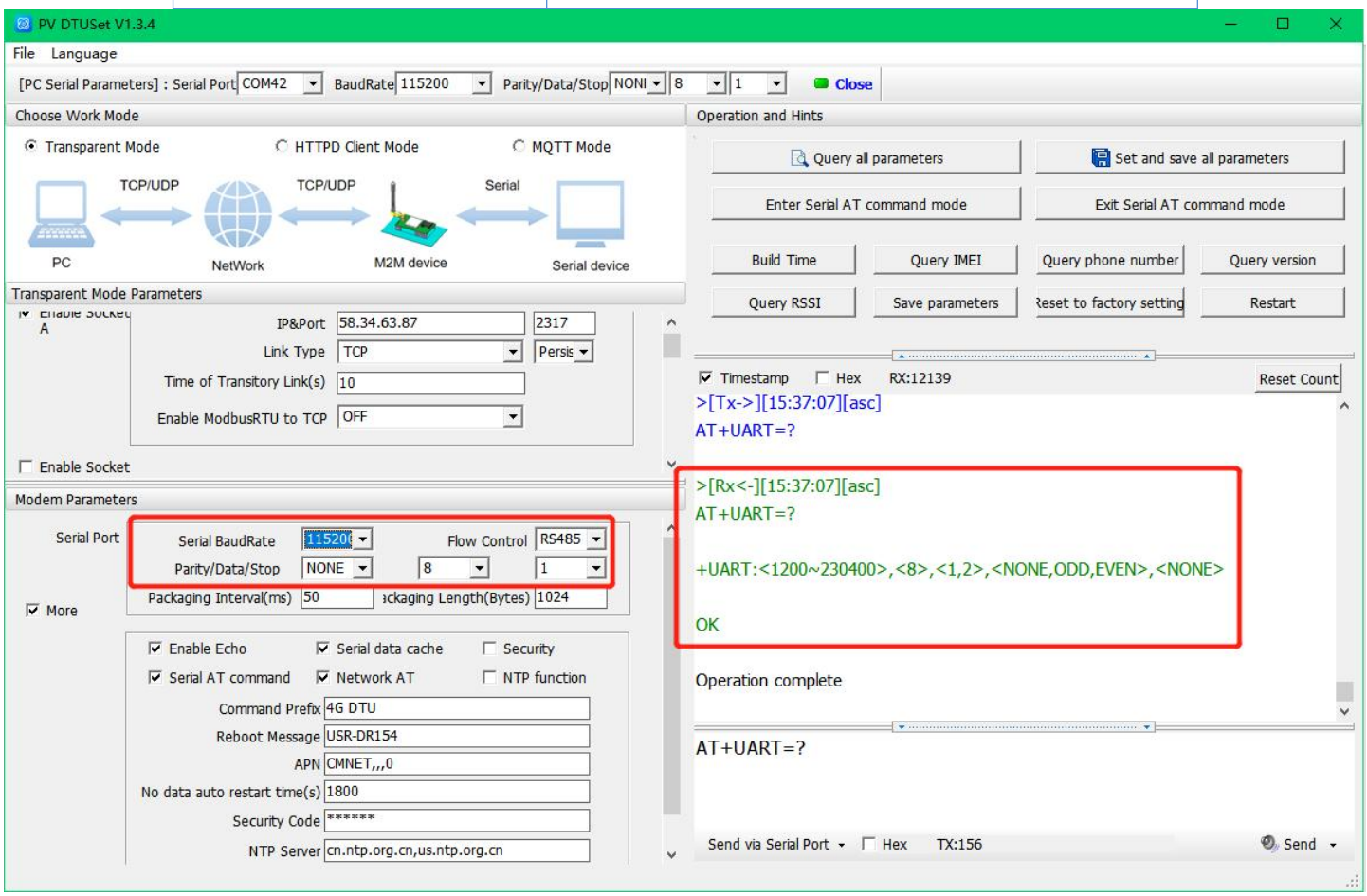
3.1. Basic Parameters

Serial parameters of USR-DR154-E must be consistent with the parameters of the serial device. Serial port parameters include basic parameters and framing parameters.

Item	Parameter
Baud rate	1200~230400bps
Data bit	8
Stop bit	1,2
Check bit	NONE EVEN

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	ODD

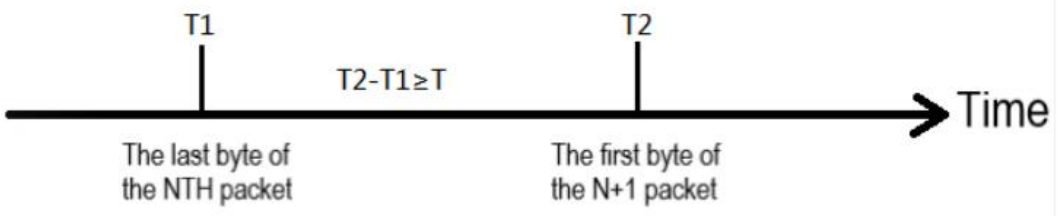


3.2. Frame Forming Mechanism

3.2.1. Time Trigger

When DR154-E receives data from the UART, it continuously checks the interval of two adjacent bytes. If the interval time is greater or equal to a certain "time threshold", then a frame is considered finished, otherwise the data is received until greater or equal to the packet length byte set. This frame is sent to the network as a TCP or UDP packet. The "time threshold" here is the time between packages. The range of settable is 10ms~500ms. Factory default: 50ms.

This parameter can be set by AT command, AT+UARTFT=<time>.

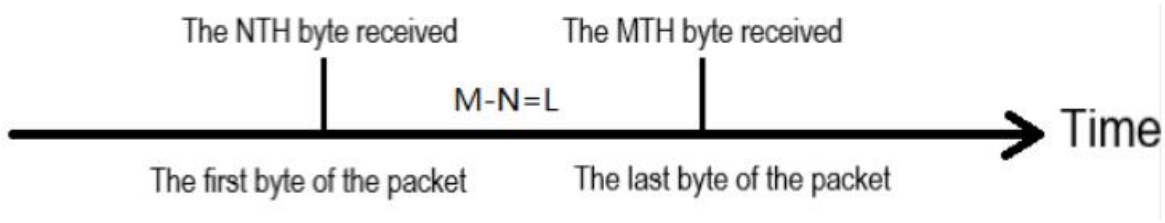


Note: T is the packing interval time.

3.2.2. Length trigger

When DR154-E receives data from the UART, it constantly checks the number of bytes received. If the number of bytes received is equal to a certain "length threshold", a frame is considered to have ended, otherwise the packaging time is waiting for the end. This frame is sent to the network as a TCP or UDP packet. The "length threshold" here is the package length. The settable range is 5~4096. Factory defaults to 1024.

This parameter can be set by AT command, AT+UARTFL=<length>.



Note: L is the packaging length.

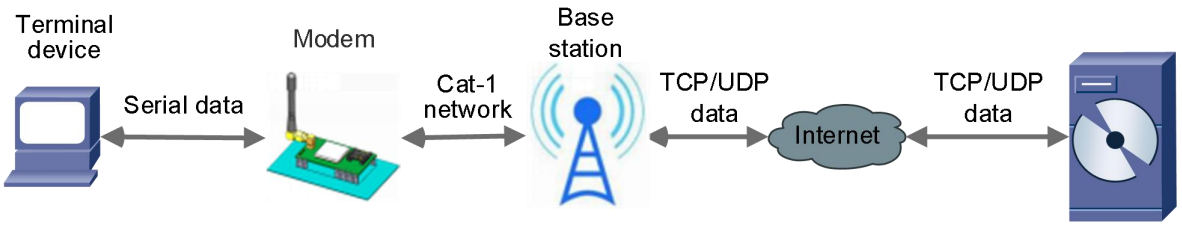
4. Operating Mode

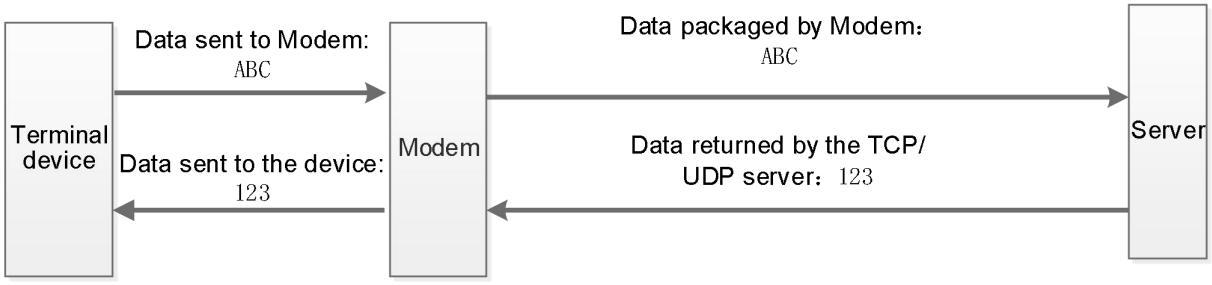
USR-DR154-E has three operating modes: transparent mode, HTTPD Client mode and MQTT mode.

4.1. Transparent Mode

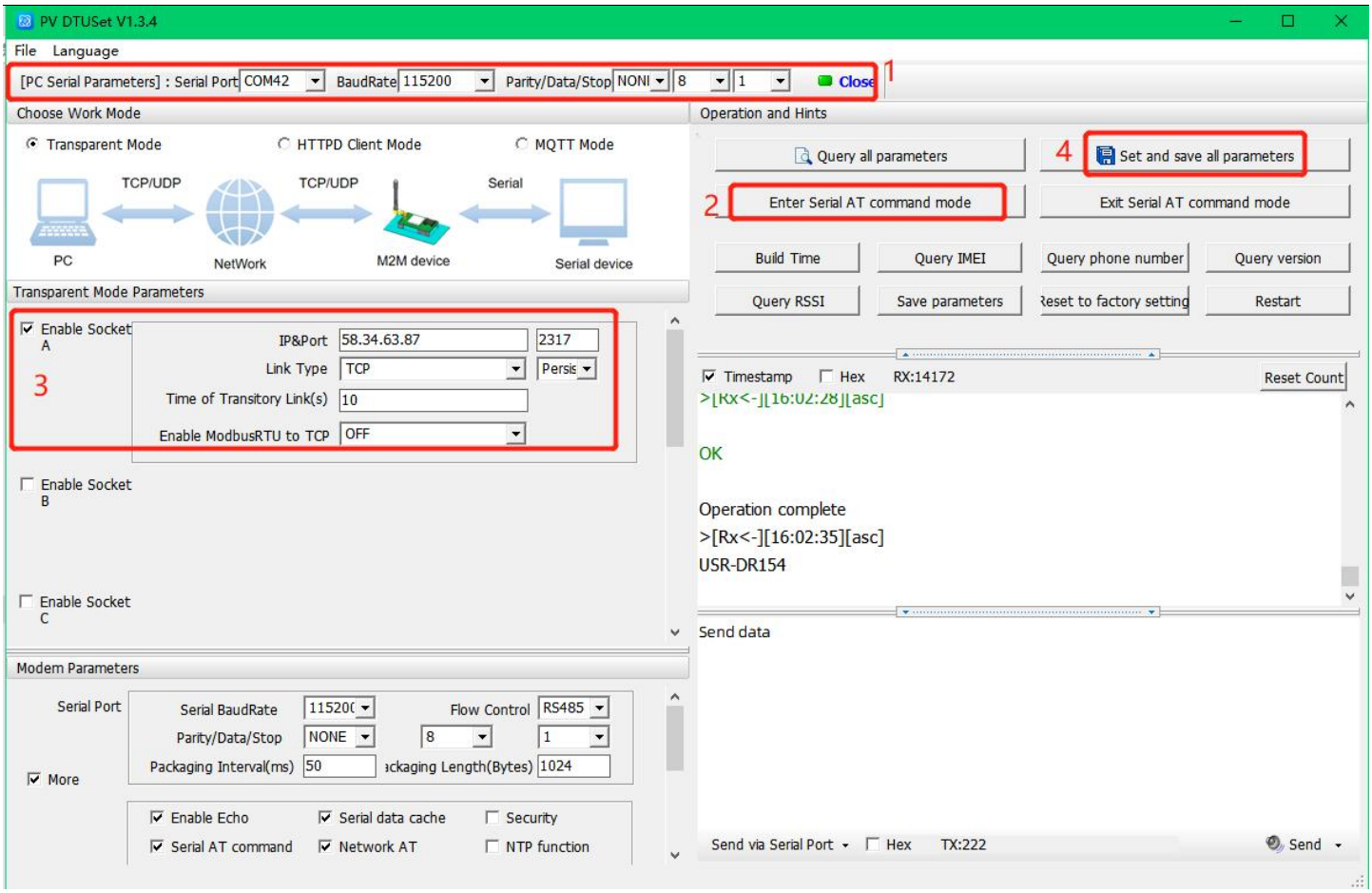
In this mode, users do not need to pay attention to the data conversion process, can realize the bidirectional data transparent transmission between serial devices and network servers.

DR154-E supports 4 socket connections, Socket A, Socket B, socket C and socket D, which are independent with each other. Each socket supports TCP Client and UDP Client. Except TCP/UDP client, socket A supports **TCP server** in additional.





➢Set parameters by the utility:



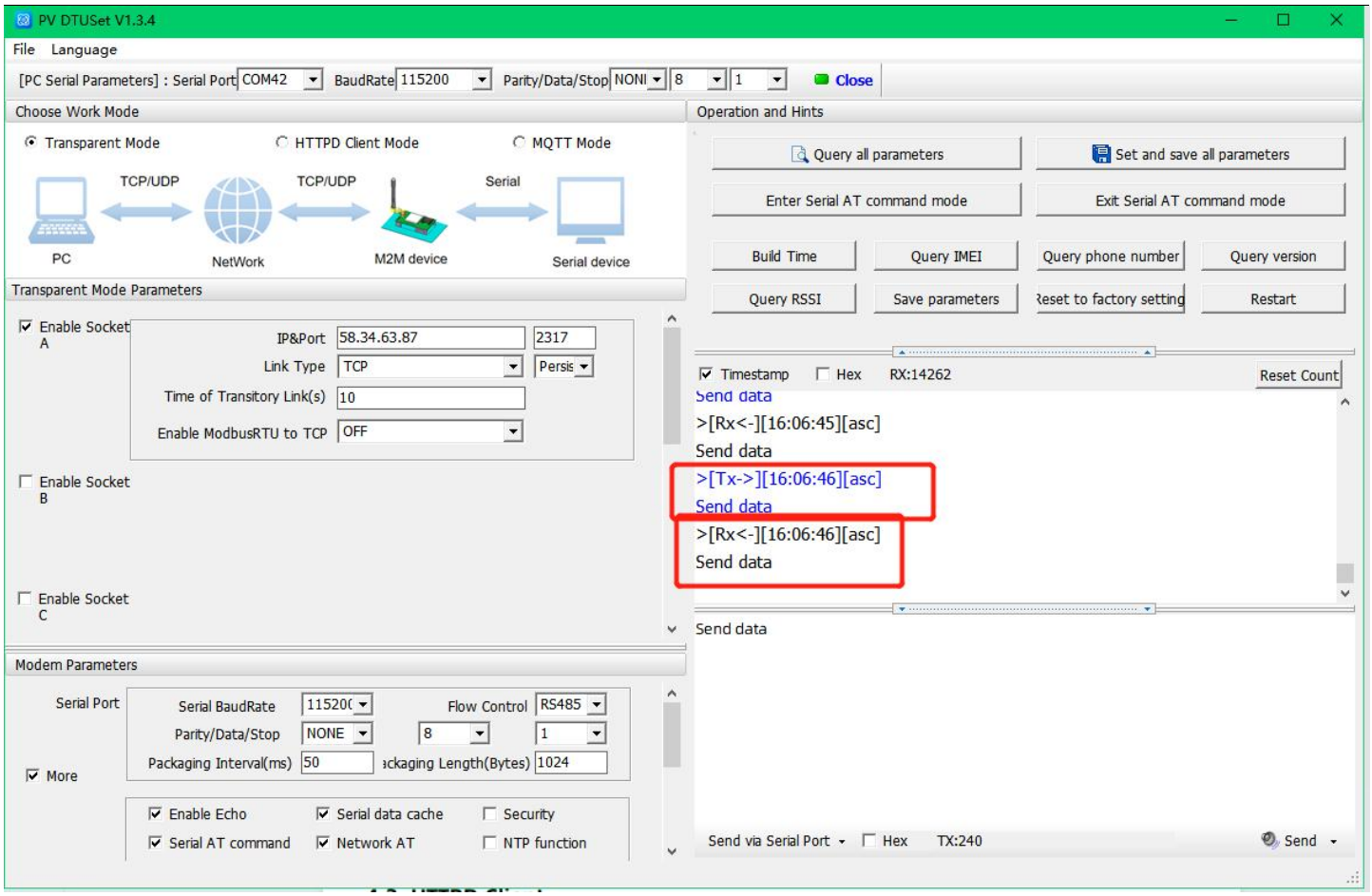
➢Set by AT command:

	Command	Operation
1	+++a	Enter serial AT command mode
2	AT+WKMOD=NET	Set the work mode to Transparent mode
3	AT+SOCKAEN=ON	Enable Socket A
4	AT+SOCKASL=LONG	Set Socket A to persistent link
5	AT+SOCKA=TCP,50.34.63.87,2317	Set the remote IP and port of Socket A working in TCP client
6	AT+SOCKA=TCPS,0.0.0.0,5000	Set Socket A work in TCP server and the local port is 5000
7	AT+S	Save all parameters and restart

➢Test

Connect the serial port of USR-DR154-E to the computer via a RS485 serial to USB cable, send data from the utility, the test server will return the same data to serial port.

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4.2. HTTPD Client

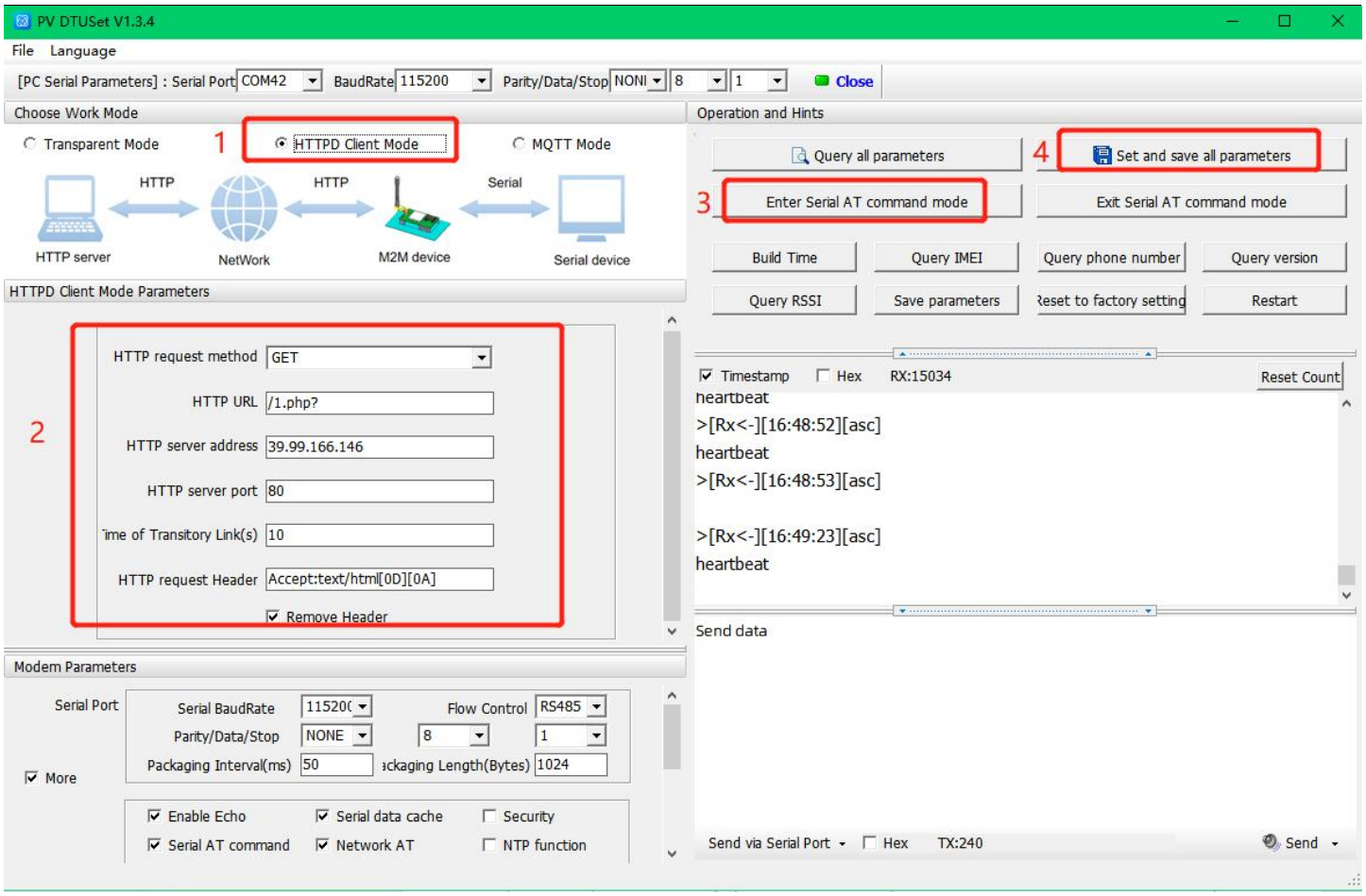
In this mode, user's terminal device can send request data to the specified HTTP server through this modem, then the modem receives data from HTTP server, parses and sends data to the serial device.

User does not need to pay attention to the data conversion process between the serial data and the network data packet, and can achieve the data request from the serial device to the HTTP server through simple parameter settings.

The modem will filter out the received HTTP protocol header data by default, only output user data to the serial port. Users can choose whether to filter by AT command.

➢Set parameters by the utility:

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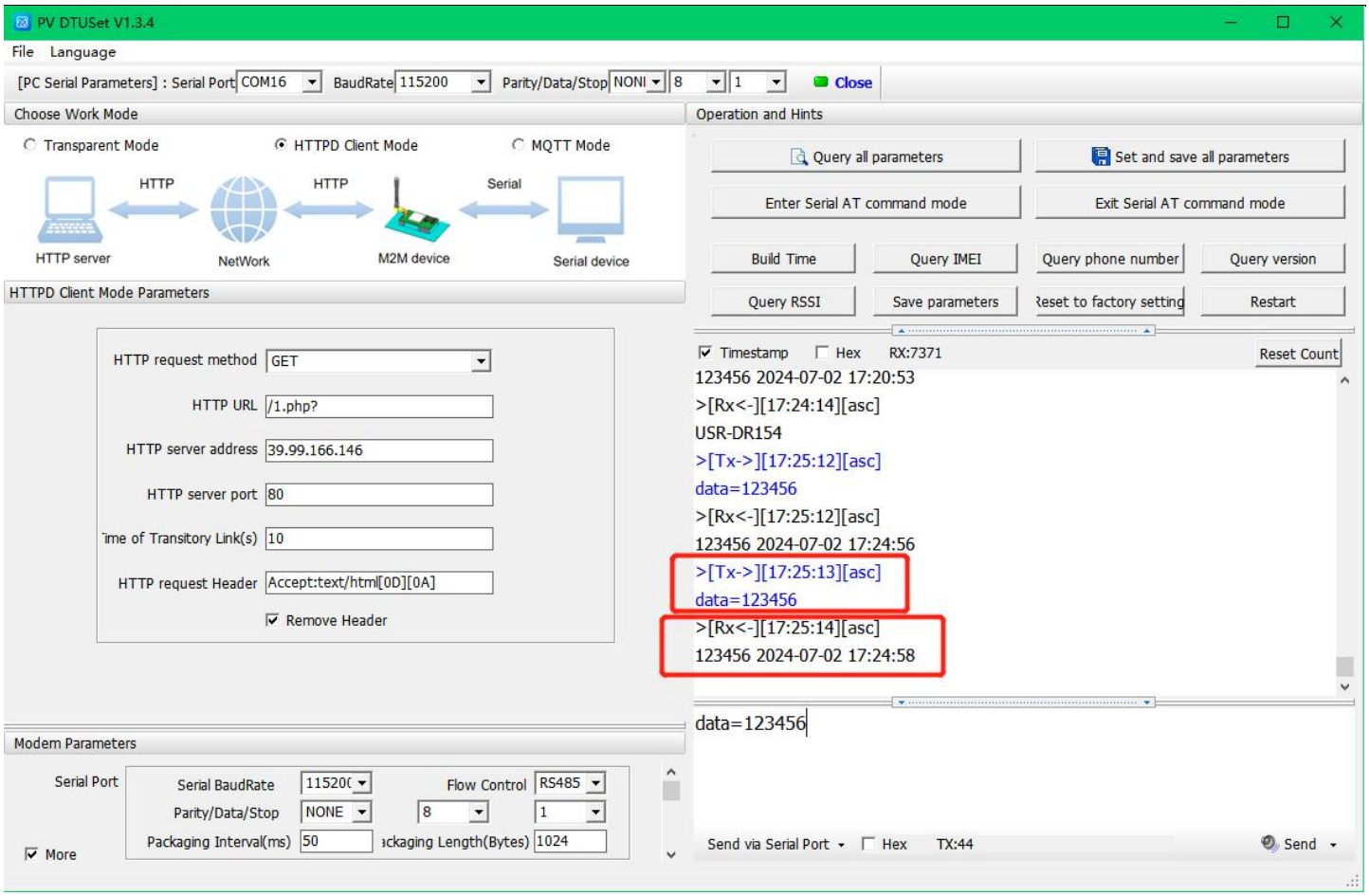
➢Set by AT command:

	Command	Operation
1	+++a	Enter serial AT command mode
2	AT+WKMOD=HTTPD	Set the work mode to HTTPD Client
3	AT+HTPTP=GET	Set the HTTP request type to GET
4	AT+HTPURL=/1.php?	Set the HTTP URL
5	AT+HTPSV=39.99.166.146,80	Set the HTTP server address and port
6	AT+HTPHD=Accept:text/html[0D][0A]	Set the HTTP request header
7	AT+HTPTO=10	Set the time of transitory link
8	AT+HTPPK=ON	Set whether to filter HTTP header
9	AT+S	Save parameters and restart the modem

➢Test

After the NET light is flashing, send the data in the format of "data =". After the data is sent successfully, HTTP server will return the data with time stamp.

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4.3. MQTT Mode

4.3.1. Generic MQTT

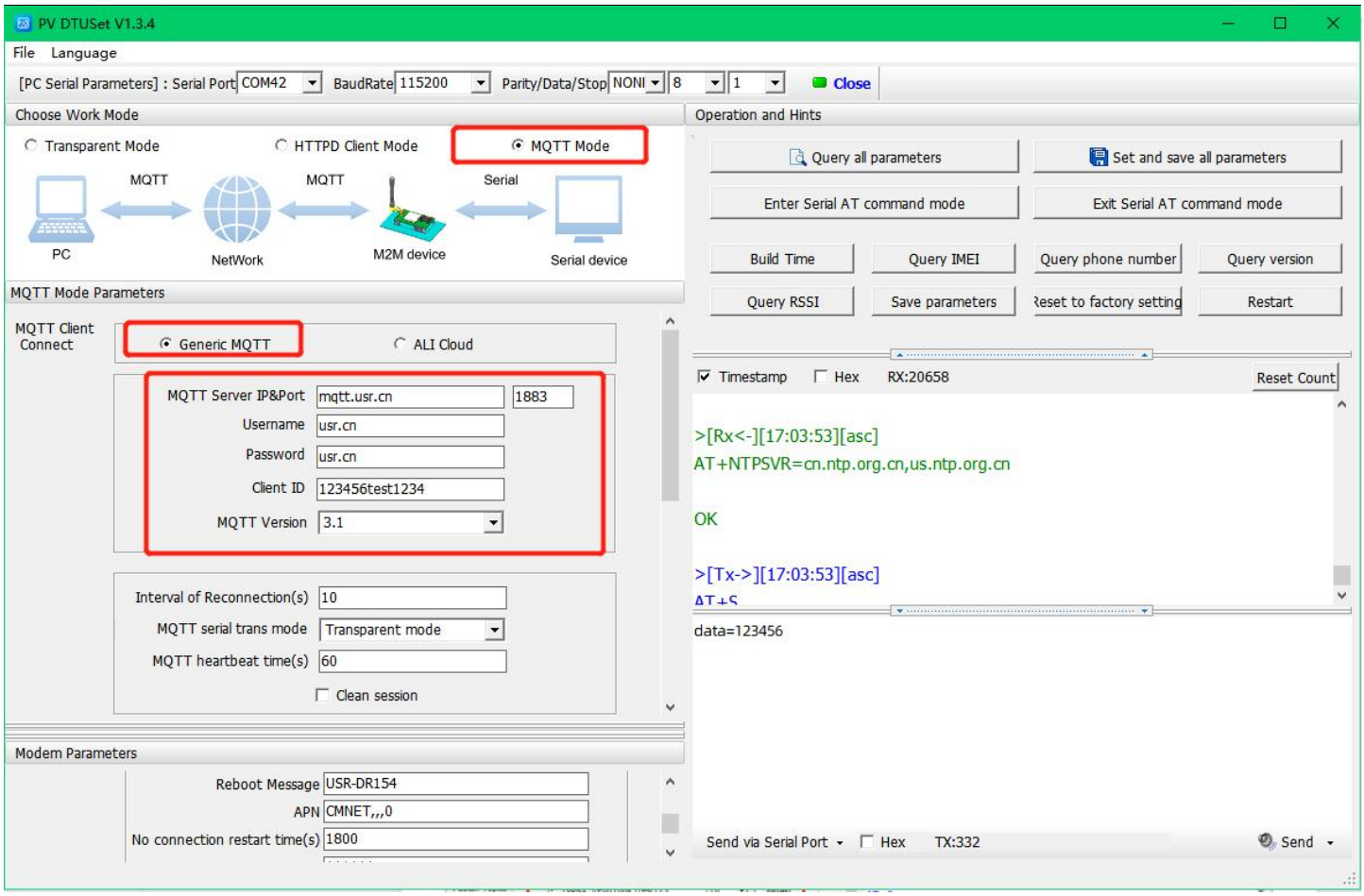
4.3.1.1. Basic parameters

In this mode, USR-DR154 works as an MQTT Client, which can help users quickly access the built private MQTT server or public MQTT IoT cloud platform. Users do not need to pay attention to the data conversion process between serial port data and network data packets, and can realize data transparent transmission between serial port and server only through simple parameter settings.

USR-DR154 supports quick access to general MQTT server and Alibaba Cloud, and supports multi-topic data publishing and data subscription.

Setup software is like below:

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Options	Descriptions	Default
MQTT Mode	Whether to enable MQTT mode	OFF
MQTT Version	V3.1, V3.1.1	V3.1
MQTT Server IP	MQTT server domain name or IP address	mqtt.usr.cn
Port	MQTT server port	1883
Client ID	MQTT client identifier. Not repeatable when connected to the same MQTT server.	123456
Username	Username for MQTT connection authentication	None
Password	Password for MQTT connection authentication	None
Interval of Reconnection	Interval between next reconnection after MQTT disconnection, unit: s.	10
MQTT heartbeat time	MQTT protocol heartbeat time, unit: s. Note: Alibaba Cloud requires that the heartbeat can be set within 30--1200 seconds, and it is recommended to set it to 300 seconds when connecting to Alibaba Cloud.	60
MQTT serial trans mode	Transparent mode, distribution mode	Transparent mode
Clean session	MQTT protocol connection flag, used to control the lifetime of session state.	Disable
Will messages enable	MQTT connection flag, when the network connection is closed, the server must publish the will message, and the	Disable

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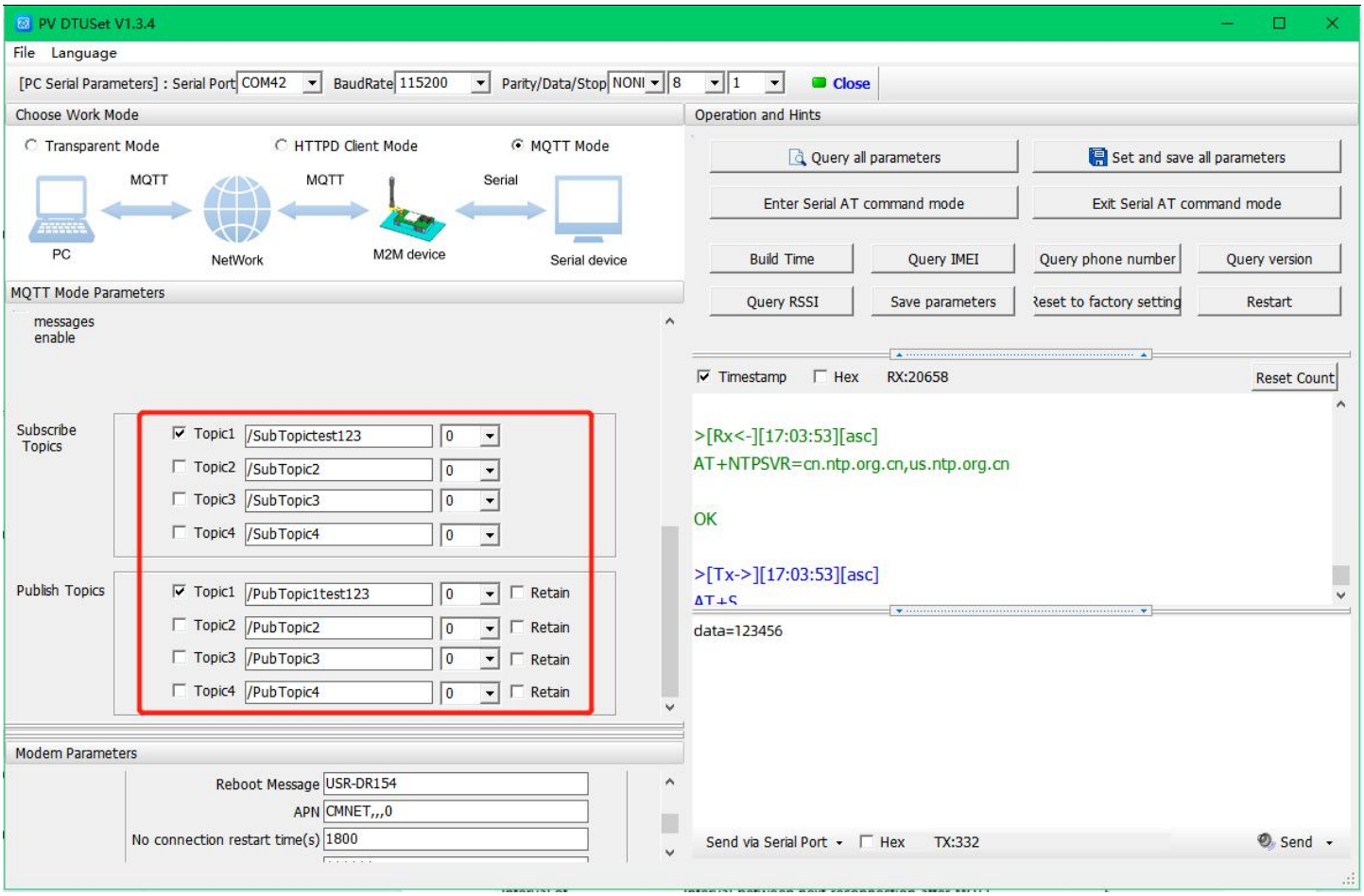
	client subscribing to the will topic will receive the set will.	
Will topic	Will topic	/will
Will payload	Will content	offline
QOS	QOS of the will, can be set: 0: at most once. 1: at least once. 2: Accurate once.	0
Retain	Keep will message	Disable
SSL	Support SSL3.0, TLS1.0, TLS1.1 and TLS1.2 version protocols. Authentication methods can be selected: ➢Do not verify certificate: Only implement data layer transmission decryption, and do not verify the identity of the other party during the handshake process. ➢Verify server certificate: the client will verify the server certificate during the handshake, and the client needs to preset the root certificate of the server. ➢Two-way authentication: The client and the server verify each other's identity, and the server root certificate, client certificate, and client private key need to be preset.	Do not verify certificate

4.3.1.2. Subscribe/Public Topics

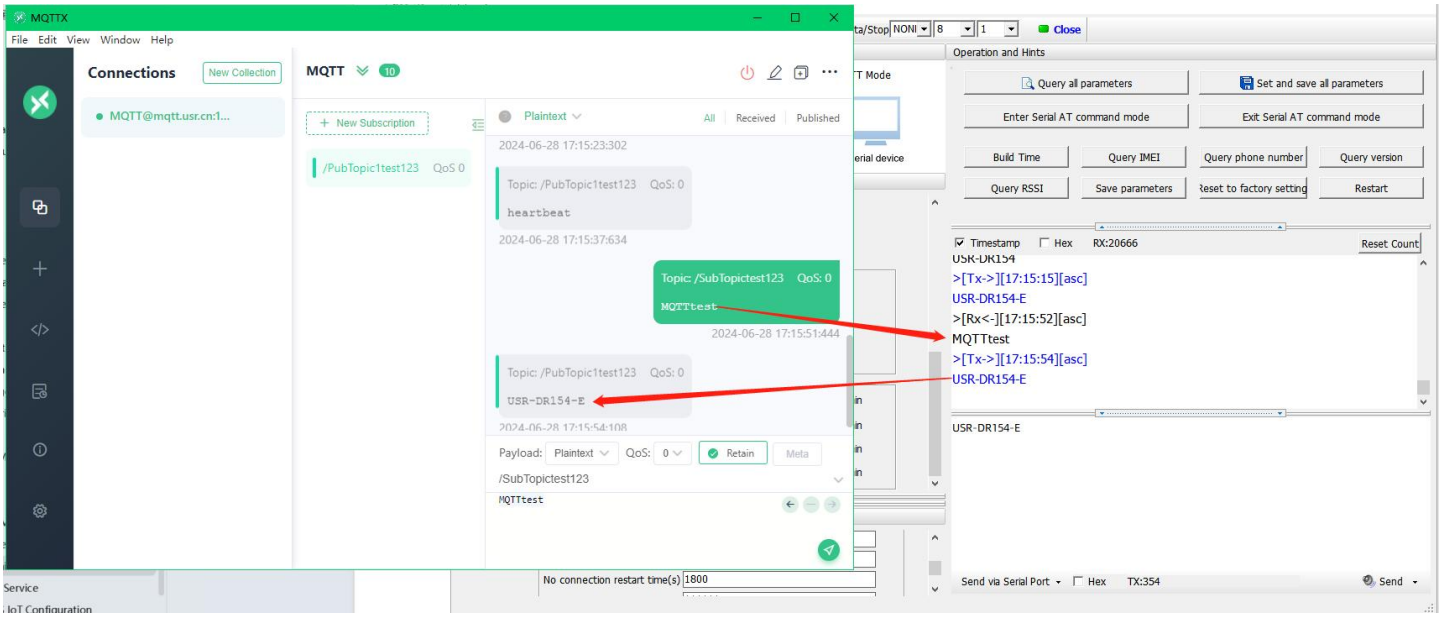
Users can configure the subscribe topics, public topics, topic numbers, QOS, whether to retain will message via the setup software. DR154-E supports two MQTT modes, transparent mode and distribution mode.

In transparent mode, the data received by the serial port is transparently transmitted to the associated topic as the payload of the topic, and up to 4 publish/subscribe topics are supported. Add the identifier of the topic in the distribution mode, and after the module receives the serial port data, it will push it to the associated topic according to the identifier. The identifier defaults to the topic number, and the identifier and payload are separated by commas. The message format is: symbol, <payload>

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4.3.1.3. Communication test

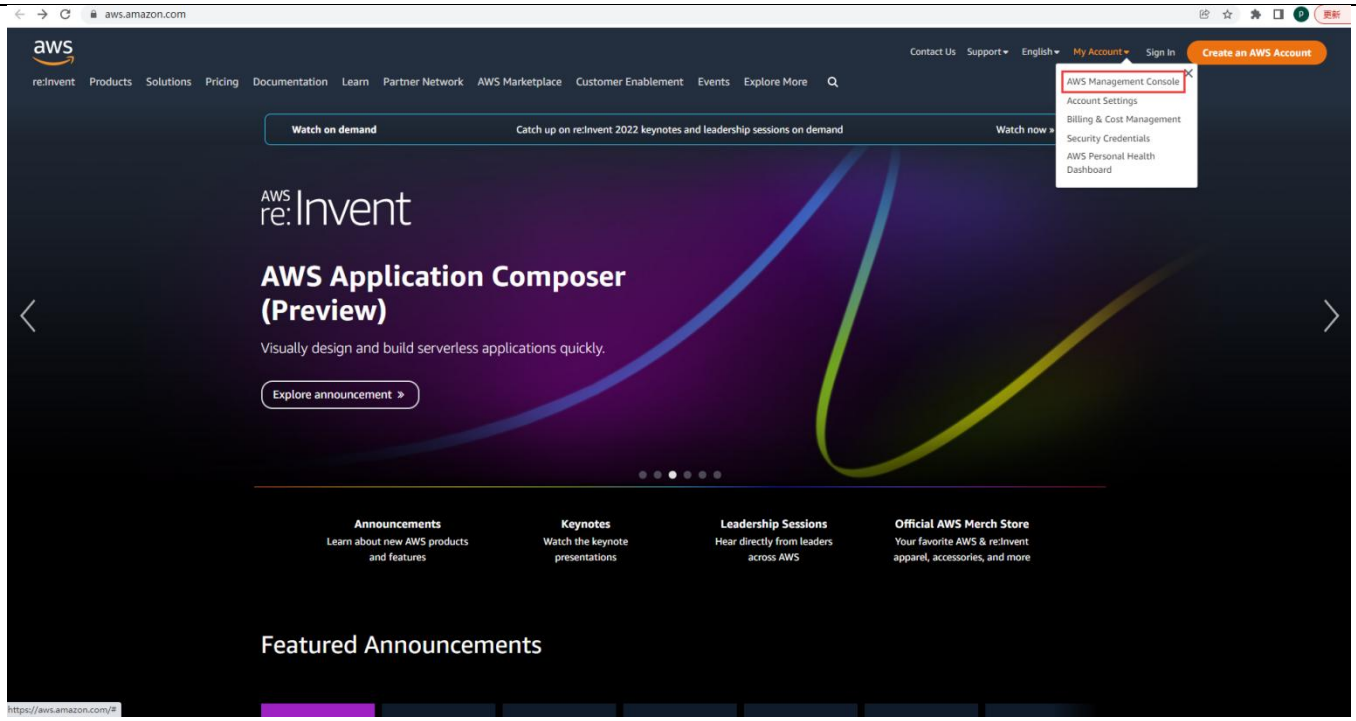


4.3.2. AWS IoT Service

DR154-E supports connecting to AWS IoT platform via MQTT.

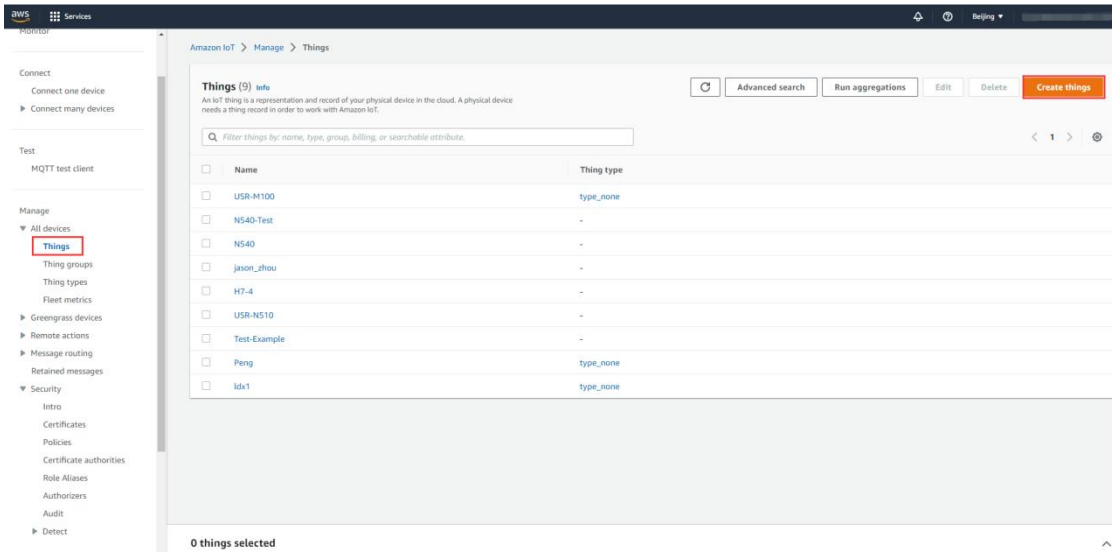
Visit **https://aws.amazon.com/**, log in to the IoT console, choose **AWS Management Console**.

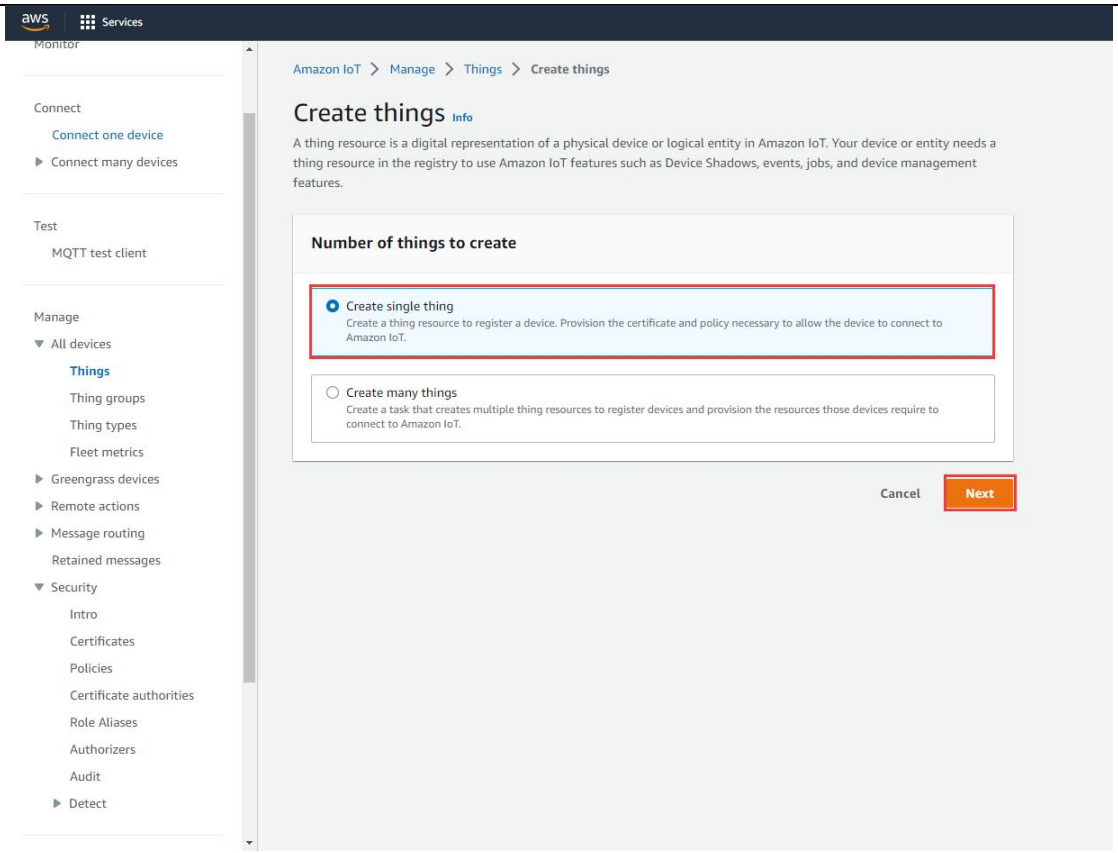
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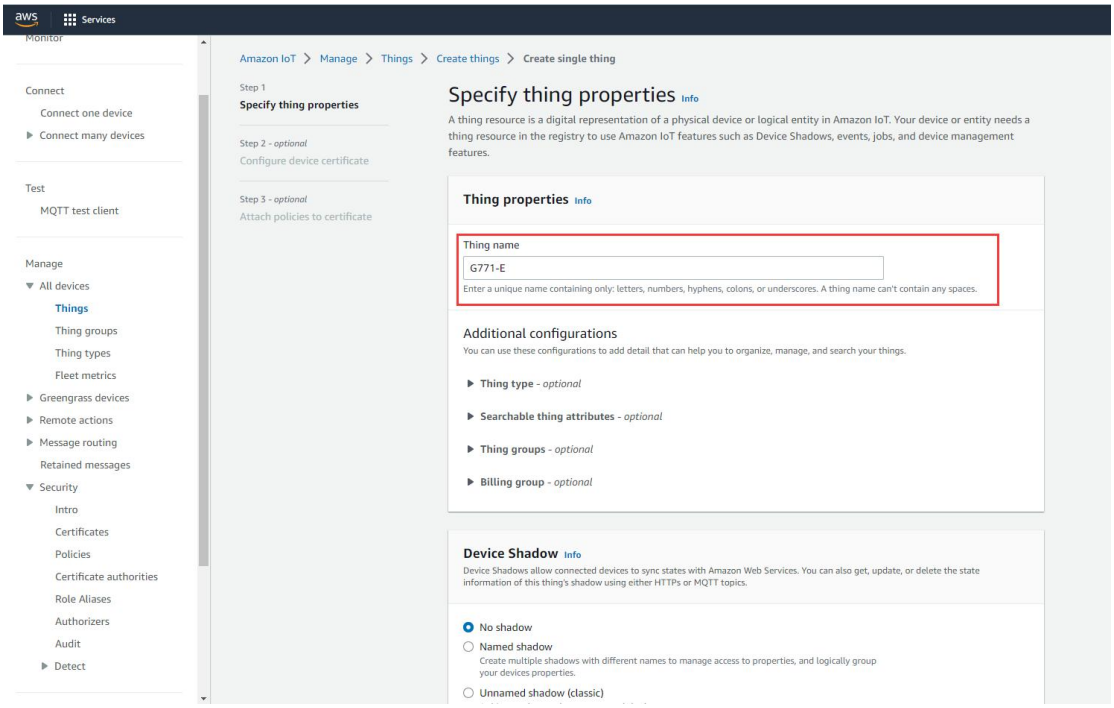
4.3.2.1. AWS IoT Configuration

1. In **Things**, click to **Create things--Create single thing.**

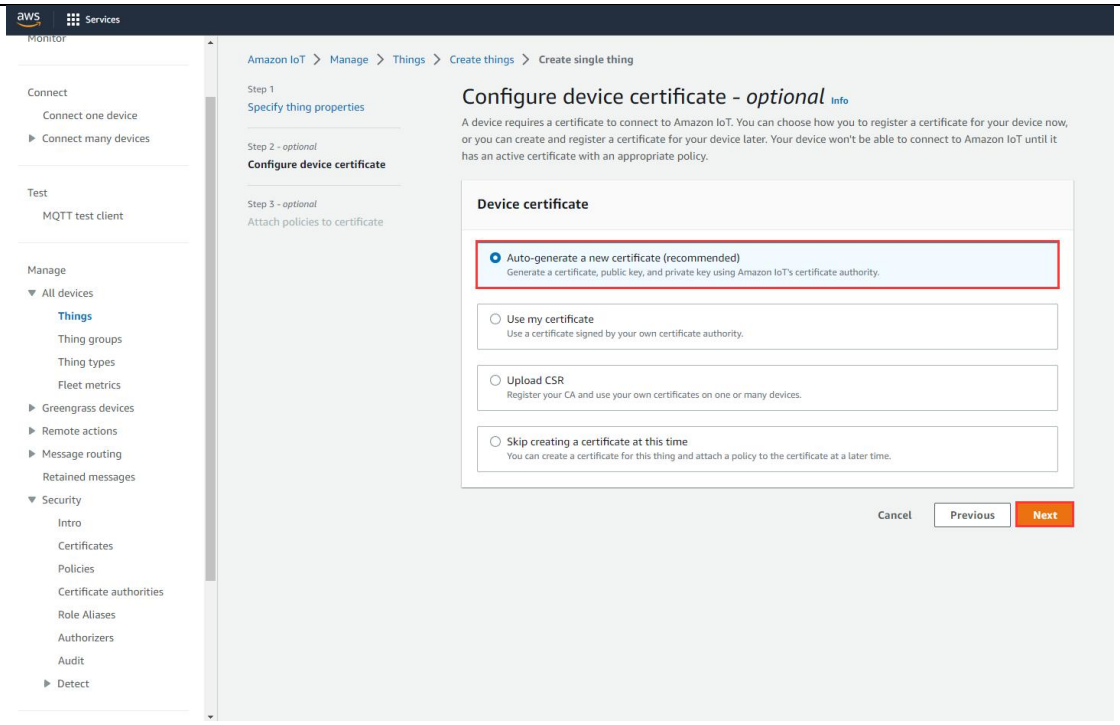




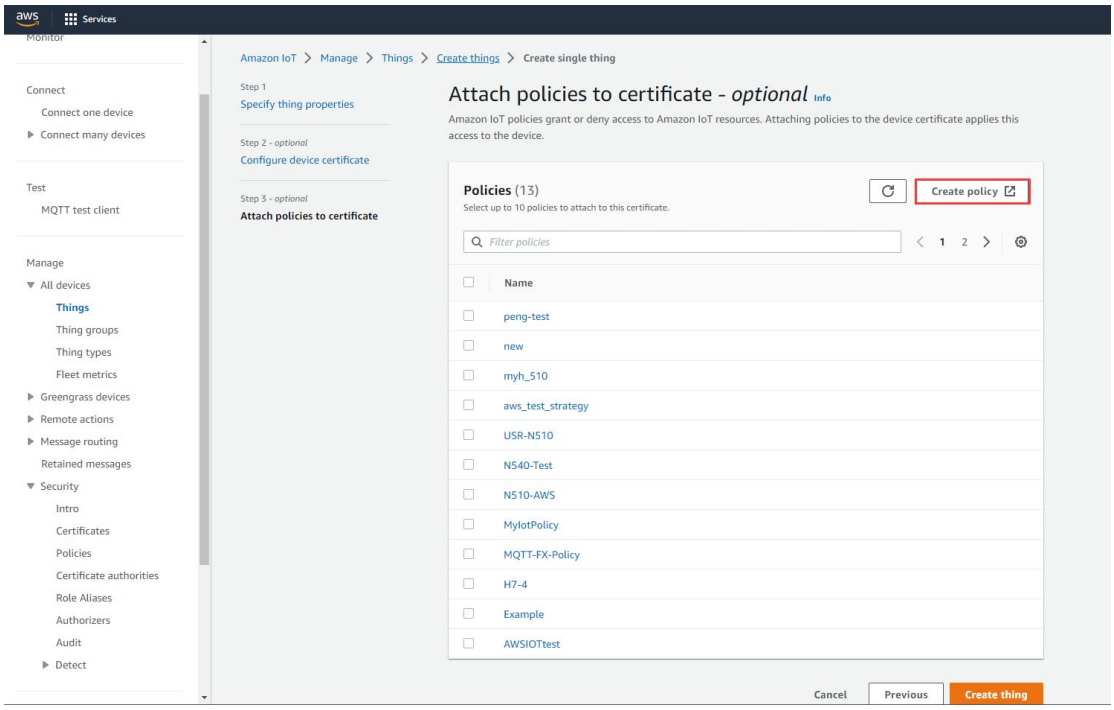
2. Edit the **Thing name**, click **Next.**



3. Choose **Auto-generate a new certificate**. Then click **Next**.

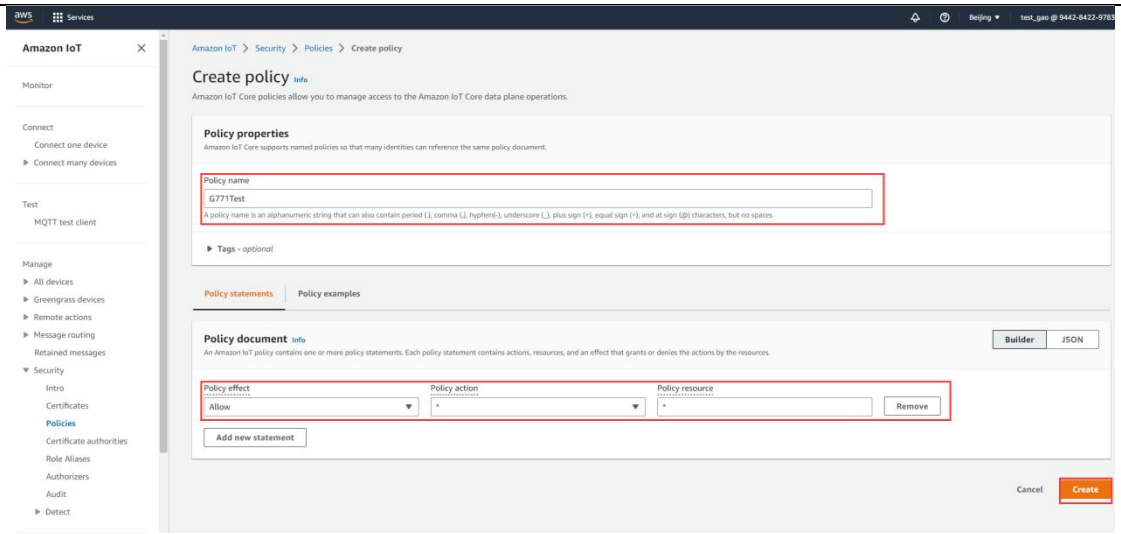


4. **Create Policy**.

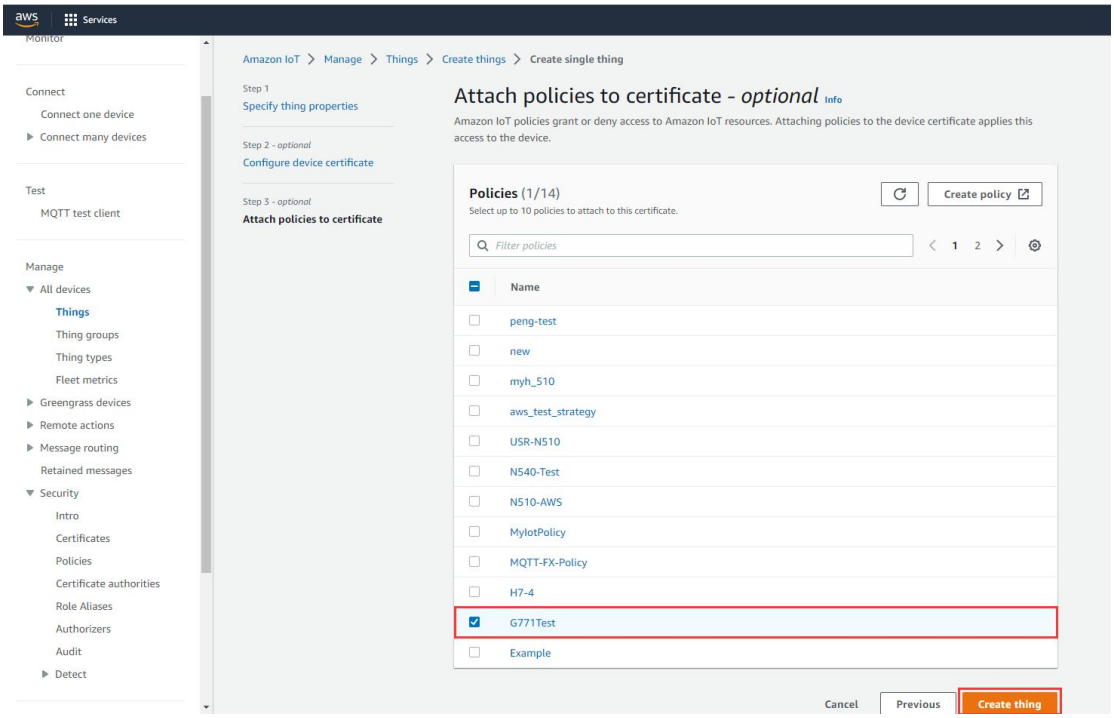


5. Edit the **Policy name**, change the **Policy effect** to **Allow**, the **Policy action** and **Policy resource** to ***.

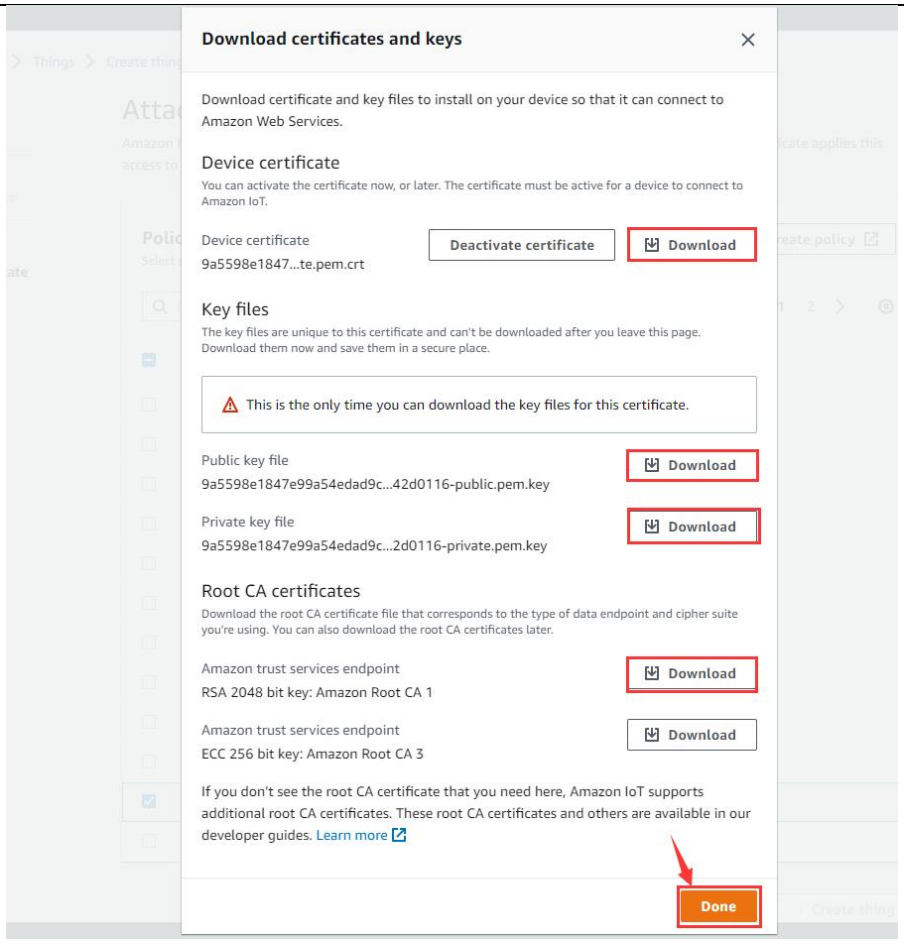
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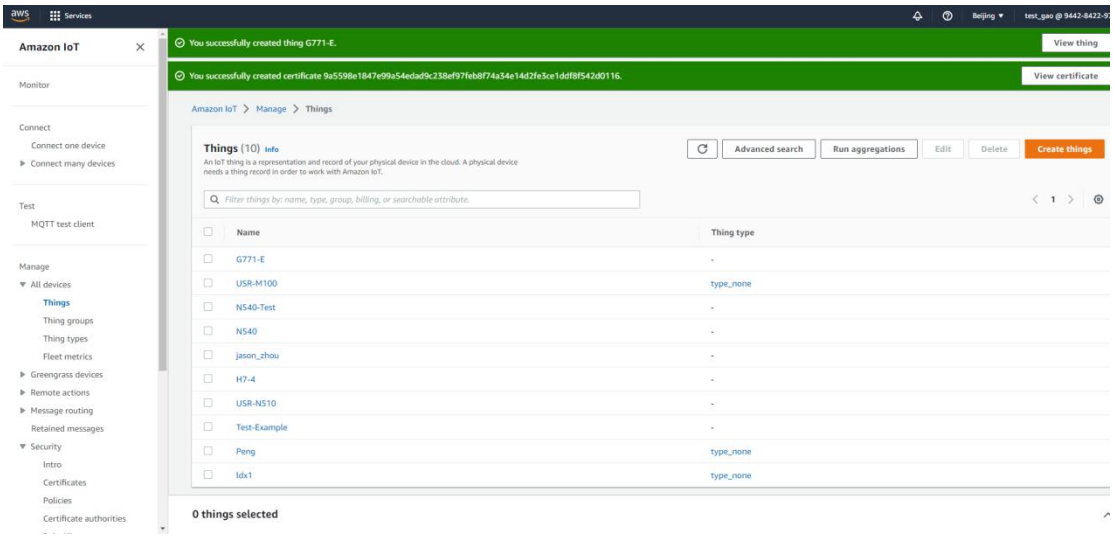
6. After created, return to the previous certificate interface, attach the new created policy to this certificate. Then click **Create thing**.



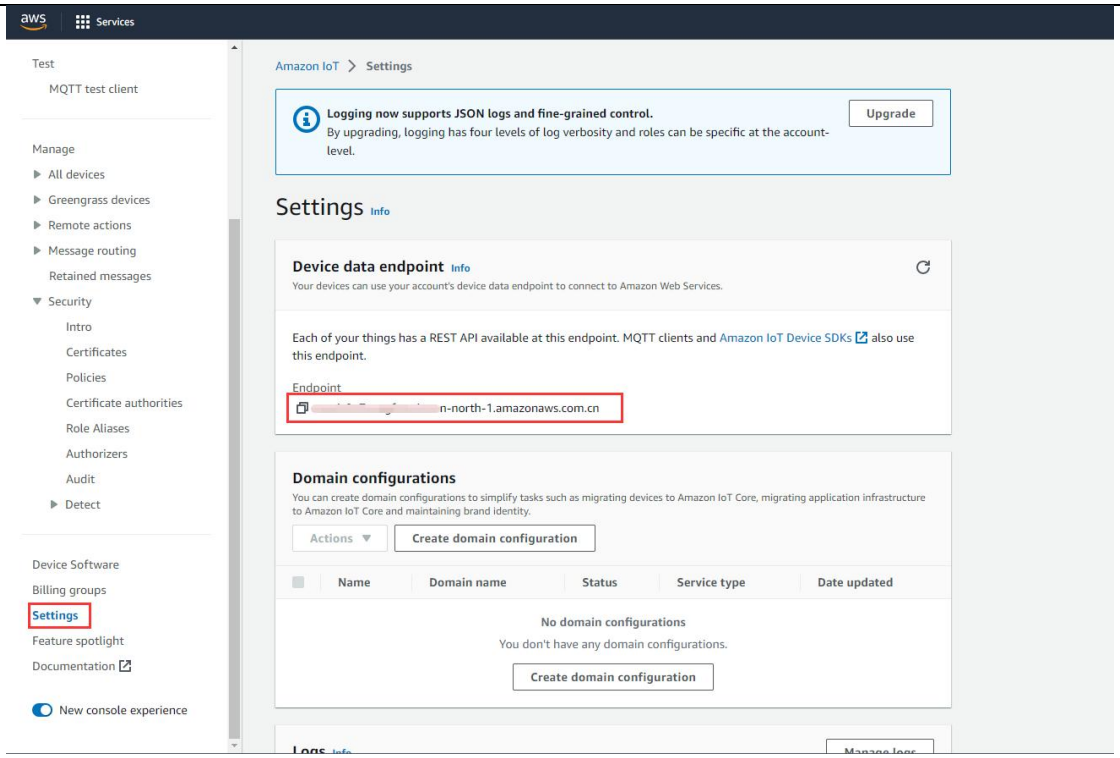
7. Download 4 certificates in below interface. Then click **Done**.



8. Now new thing has been added successfully.



9. In **Settings**, copy the AWS server address that needs to be filled in DR154-E device.

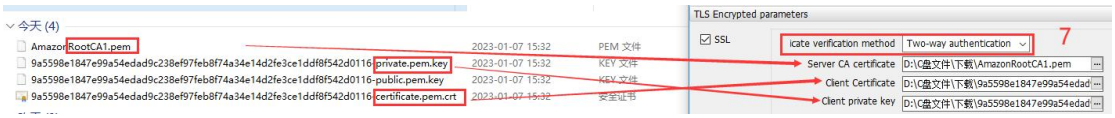


4.3.2.2. DR154-E device configuration

You can use an RS485 to USB adaptor to connect the serial port of DR154-E device to the computer. Then open the CAT1 setup software to configure the MQTT parameters.

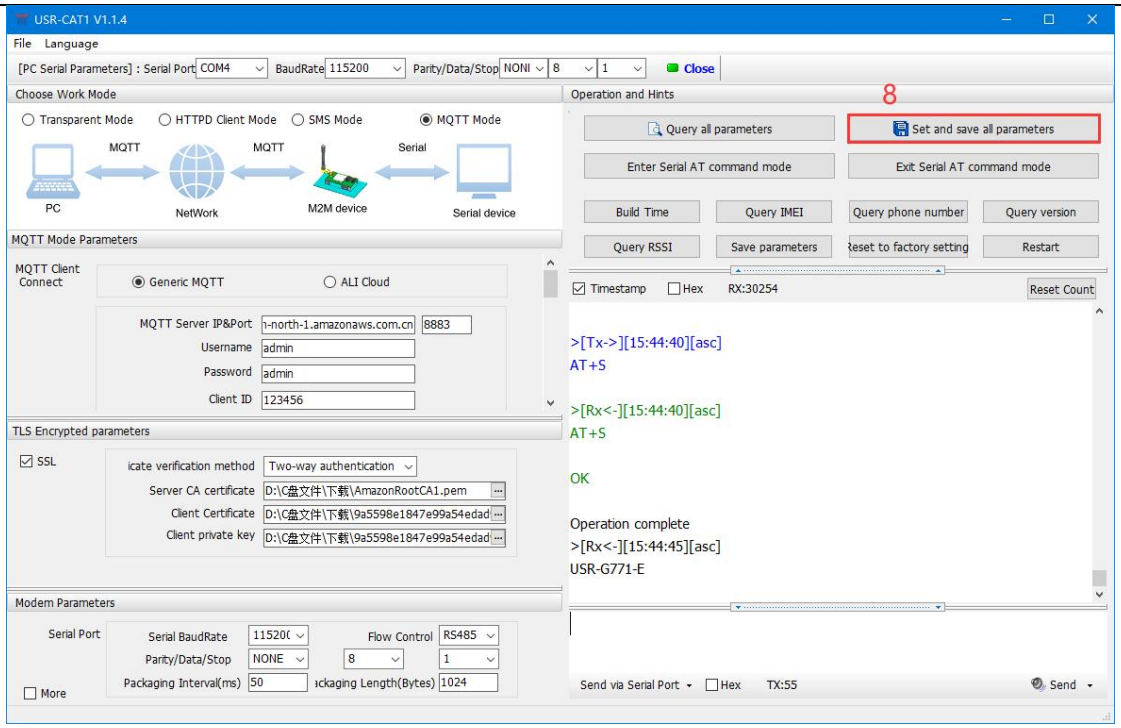
1. Here we choose Generic MQTT mode, the MQTT server IP should be the one that we copied in AWS Cloud, and the MQTT port is 8883. Username and password can be any value. Configure the subscribe and publish topics.

2.Upload the created certificates to DR154-E device. We need to upload the **Server CA certificate**(rootCA.pem), **Client certificate**(certificate.pem.crt) and **Client private key**(private.pem.key).



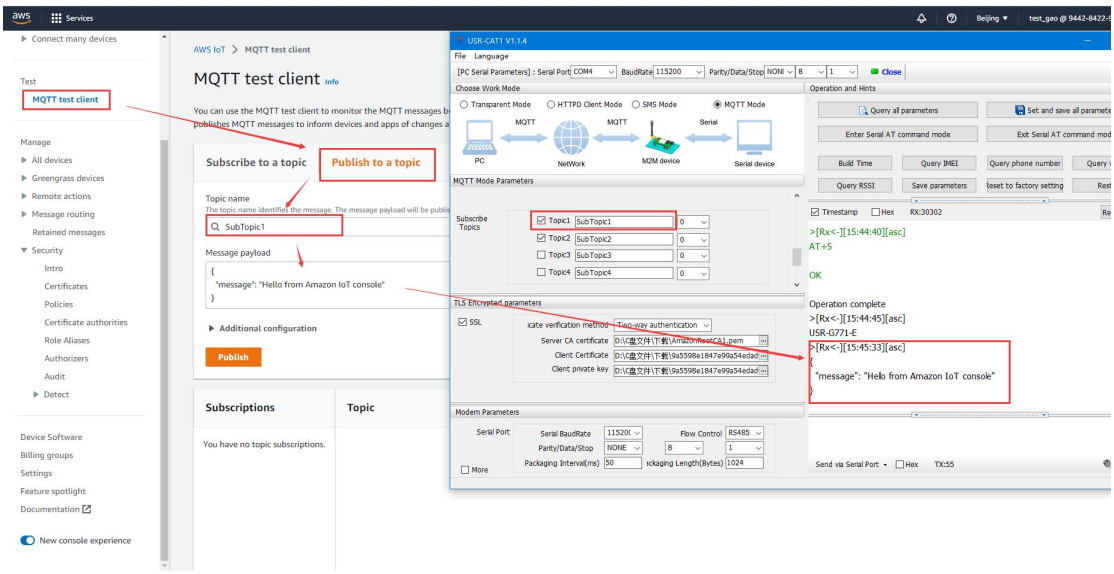
3.After configuring all parameters, click to **Set and save all parameters**. The device will restart automatically.

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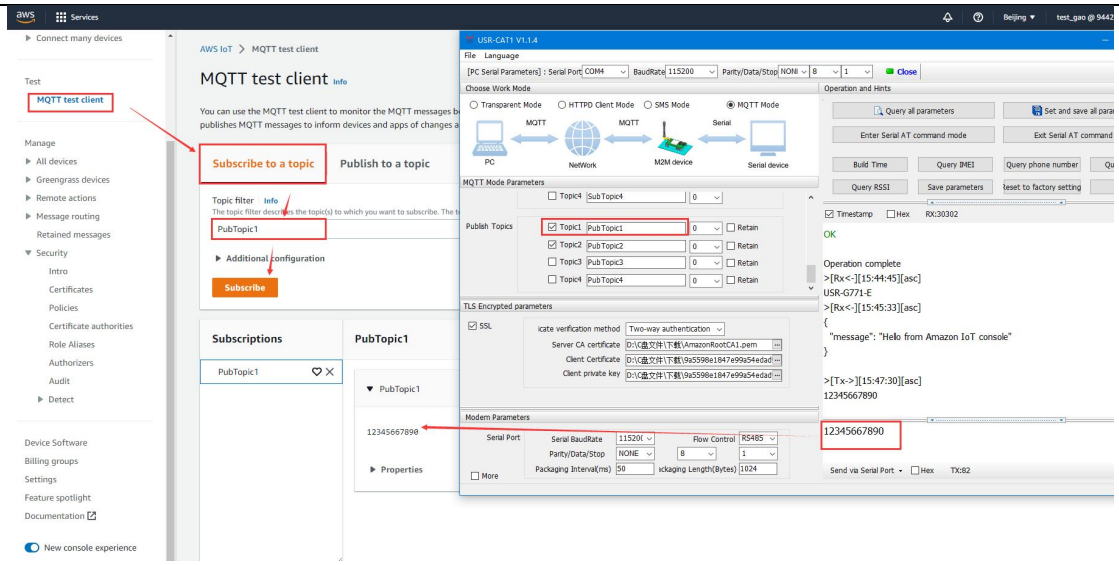


4.3.2.3. Data Transmission Test

In AWS IoT platform, click **MQTT test client**, publish data from AWS to the subscribed topic of DR154 device , we can receive it from the serial port of DR154-E device.



Subscribe the publish topics of DR154-E device in AWS, we can receive the data sent from the serial port of DR154-E device.

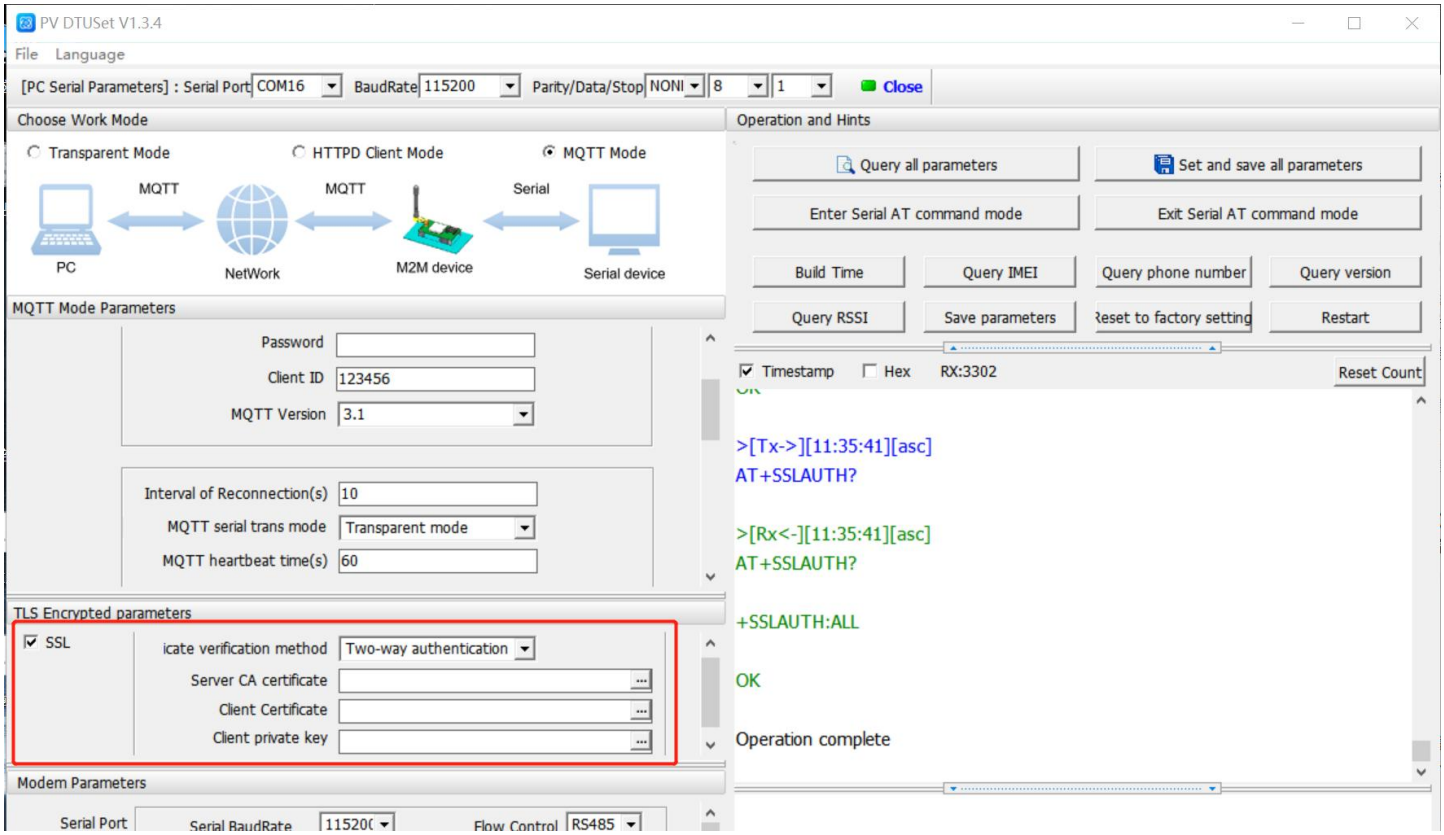


In this way, we can achieve the bi-directional communication between serial device and AWS cloud via DR154-E device.

4.3.3. SSL/TLS encryption

In MQTT mode, the device supports SSL/TLS encryption. If the target server enables SSL certificate verification, you need to configure the SSL encryption parameters. It supports SSL3.0, TLS1.0, TLS1.1, and TLS1.2 versions, and the authentication method can choose not to verify certificate, verify server certificate, and two-way verification authentication.

➢Set parameters by the utility:



➢Set parameters by AT command:

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	Command	Operation
1	+++a	Enter serial AT command mode
2	AT+SSLEN=ON	Enable SSL encryption
3	AT+SSLAUTH=ALL	Enable two-way verification authentication
4	AT+SSLVER=TLS12	Selects TLS1.2 version
5	AT+SSLCRT=0,Content of certificate	CA certificate
6	AT+S	Save all parameters and restart

5. General Function

5.1. Identity packet

In **transparent mode**, user can set the device to send identity package to the server. Identity package is intended to allow the server to identify the data from which device or to use it as a password to obtain authorization for the server's functions.

Identity package can be sent when the modem establishes a connection with the server, or as the prefix of each data packet or both.

Identity package data can be ICCID code, IMEI code, SN, CLOUD or User-defined data.

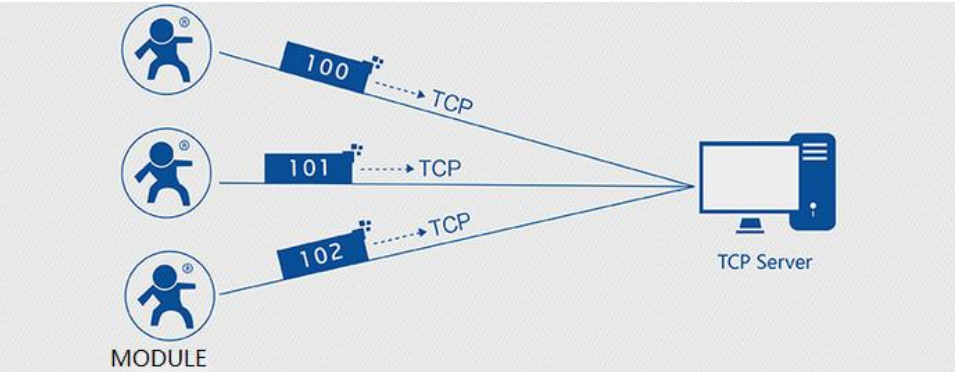
ICCID: Unique SIM identification code, for applications based on SIM card identification.

IMEI: Unique identification code of the Internet modem, which is mainly used in device identification, has nothing to do with SIM card.

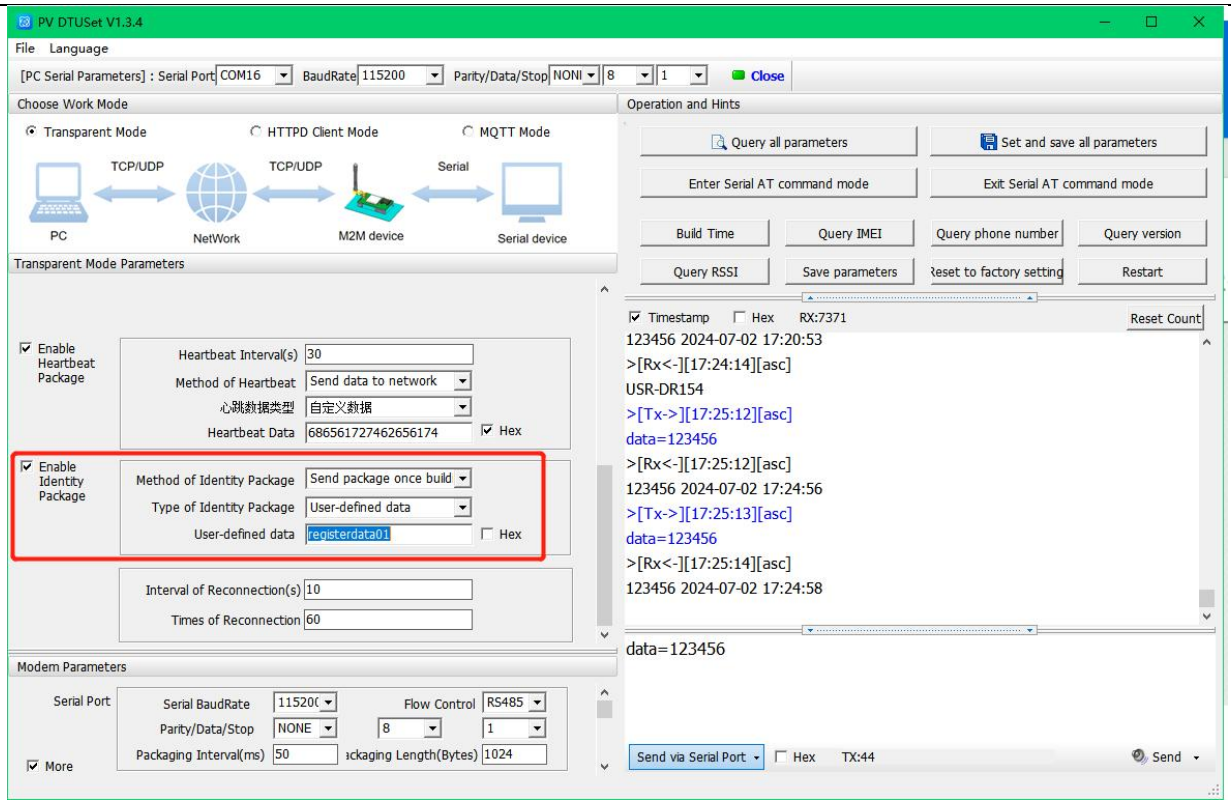
SN: Serial number.

USER: User-defined data.

CLOUD: Set the device ID and password when connecting to USR Cloud, sent when building connection.



➢Set by the utility:



➢Set by AT command:

	Command	Operation
1	+++a	Enter AT command mode
2	AT+WKMOD=NET	Set the work mode to NET
3	AT+REGEN=ON	Enable identity package function
4	AT+REGTP=USER	Set the type to User-defined
5	AT+REGDT=7265676973746572646174613031	Set the User-defined data in HEX.
6	AT+REGSND=LINK	Send the package as the prefix of the data
7	AT+S	Save parameters and restart

5.2. Heartbeat packet

In **transparent mode**, user can send the heartbeat package from the module to the network side or serial port device .

Sending to the network is to ensure the normal connection of the module and let the server know the online status of the module. User can also set the serial heartbeat to a fixed query command instead of sending from server to save the traffic.

Heartbeat package can be ICCID code, IMEI code, SN, LBS or user-defined data.

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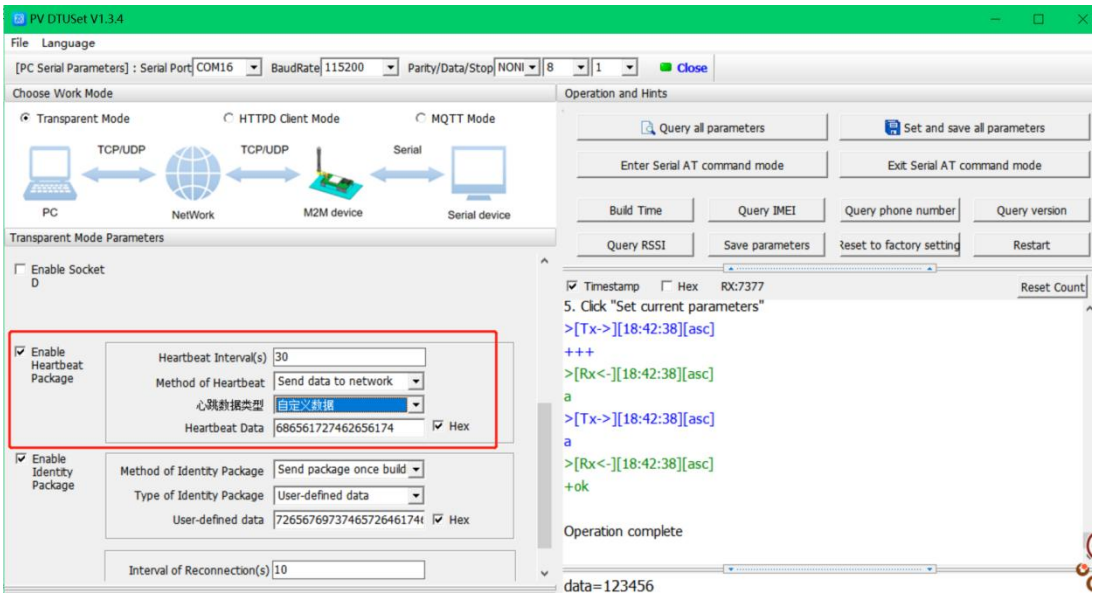
ICCID: Unique SIM identification code, for applications based on SIM card identification.

IMEI: Unique identification code of the Internet modem, which is mainly used in device identification, has nothing to do with SIM card.

SN: Serial number.

USER: User-defined data.

➢Set by the utility:



➢Set by AT command:

	Command	Operation
1	+++a	Enter AT command mode
2	AT+HEARTEN=ON	Enable heartbeat package function
3	AT+HEARTTP=NET	Send the heartbeat package to network side
4	AT+HEARTSORT=USER	Set the type to User-defined
5	AT+HEARTDT=7777772E757372 2E636E	Set the User-defined data in HEX.
6	AT+HEARTTM=30	Set the heartbeat interval

You also need to set the socket parameters. After setting all parameters, save and restart the modem.

Note:

1, Network heartbeat package: In transparent mode, it will only be sent when there is no data sent to network within one heartbeat interval.

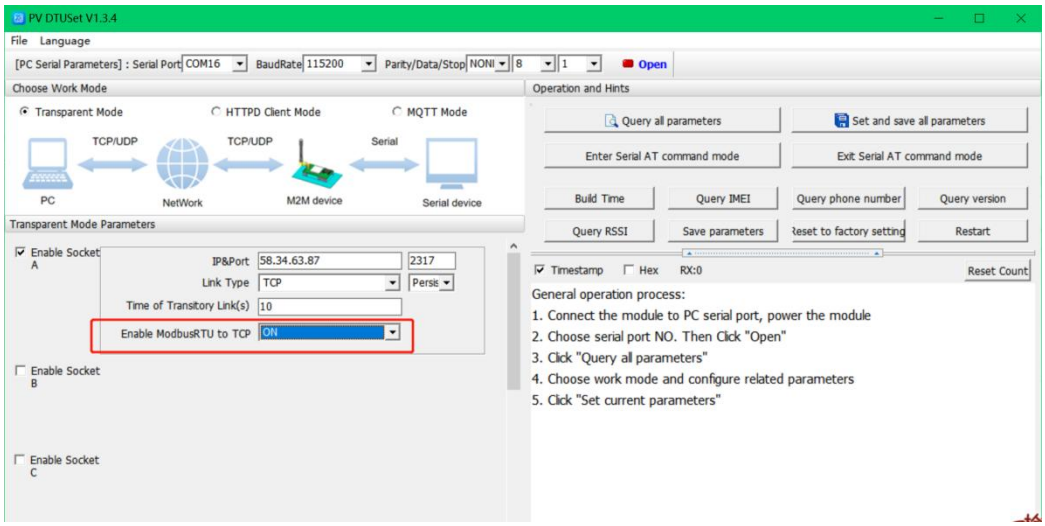
2, Serial heartbeat package: In transparent mode, it will always be sent to serial port according to the set interval.

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5.3. Modbus Gateway

After enabling Modbus Gateway, Modbus RTU/TCP protocol conversion can be realized to connect with the customer's software.

➢Set by the utility:



➢Set by the AT command:

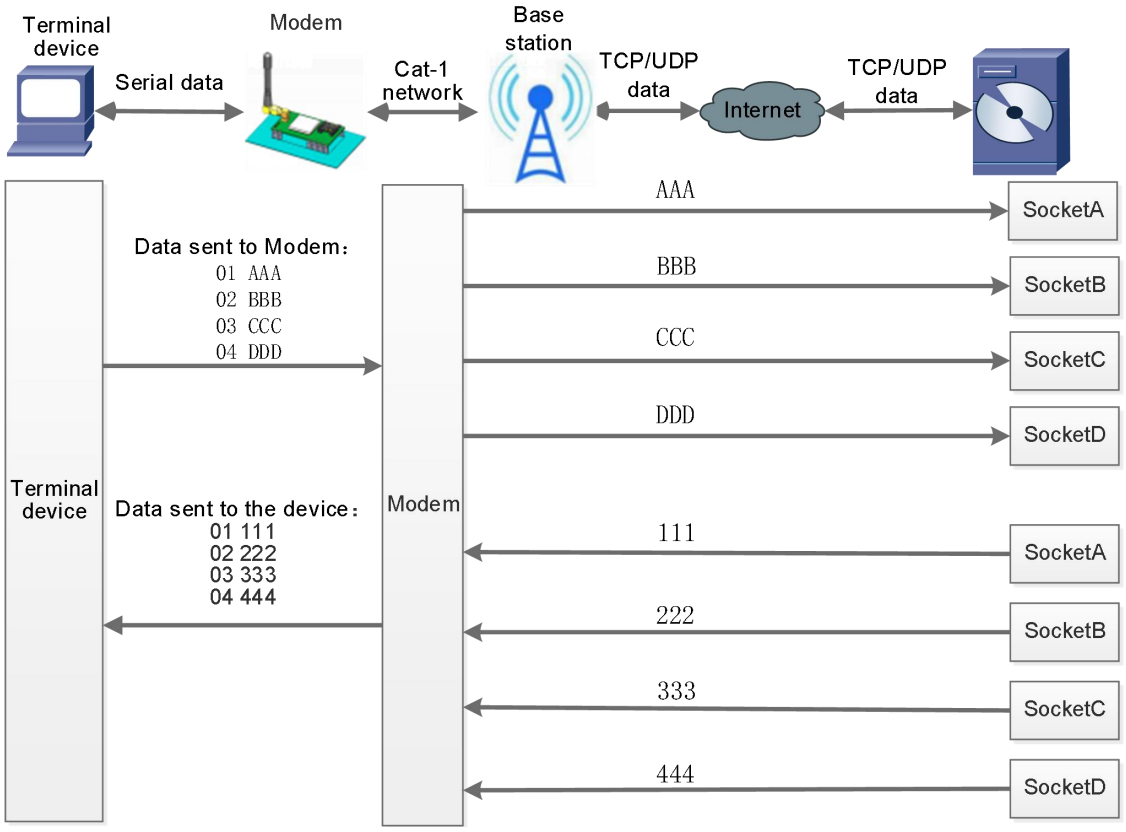
	Command	Operation
1	+++a	Enter serial AT command mode
2	AT+WKMOD=NET	Set the work mode to Transparent mode
3	AT+SOCKAEN=ON	Enable Socket A
4	AT+SOCKASL=LONG	Set Socket A to persistent link
5	AT+SOCKA=TCP,39.99.166.146,2317	Set the remote IP and port of Socket A working in TCP client
6	AT+SOCKA=TCPS,0.0.0.0,5000	Set Socket A work in TCP server and the local port is 5000
7	**AT+MODBUSEN=ON**	**Enable Modbus TCP/RTU protocol conversion**
8	AT+S	Save all parameters and restart

5.4. Socket Distribution Protocol

USR-DR154-E supports socket distribution protocol. When a device is connected to multiple sockets, can send different serial data to different servers via this protocol. Data returned from different server will also be sent to the serial port with the socket distribution protocol.

For detailed protocol, please refer to another document: socket distribution protocol.

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Socket distribution protocol data follows the packaging mechanism, the total length of the real data and socket distribution protocol must be less than the packaging length.

This function is valid in transparent mode, disabled by default, can be set via AT command: **AT+SDPEN**.

5.5. PUSR Cloud

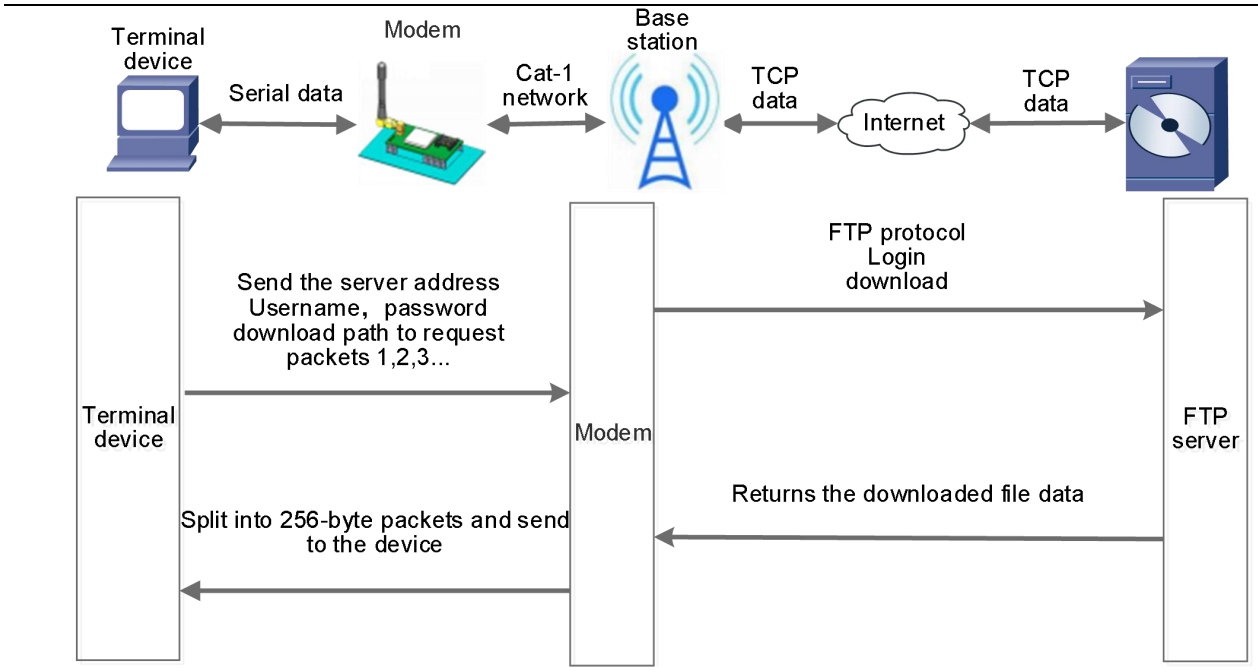
USR Cloud is an open platform for communication between devices and devices, devices and servers (Android, IOS, PC), it can achieve data remote monitoring (Modbus RTU) and transparent transmission. Our USR-DR154-E-E also supports connecting to USR Cloud. For details, please check this link: mp.usriot.com.

5.6. FTP upgrade

DR154-E supports FTP upgrade protocol, user's device can request files on FTP server by special protocol through serial port. The file of the server can be split into small packets with a maximum size of 256 bytes for transmission, which is convenient for customer device to upgrade or download large files remotely.

For details, please refer to "**USR FTP Upgrade protocol**".

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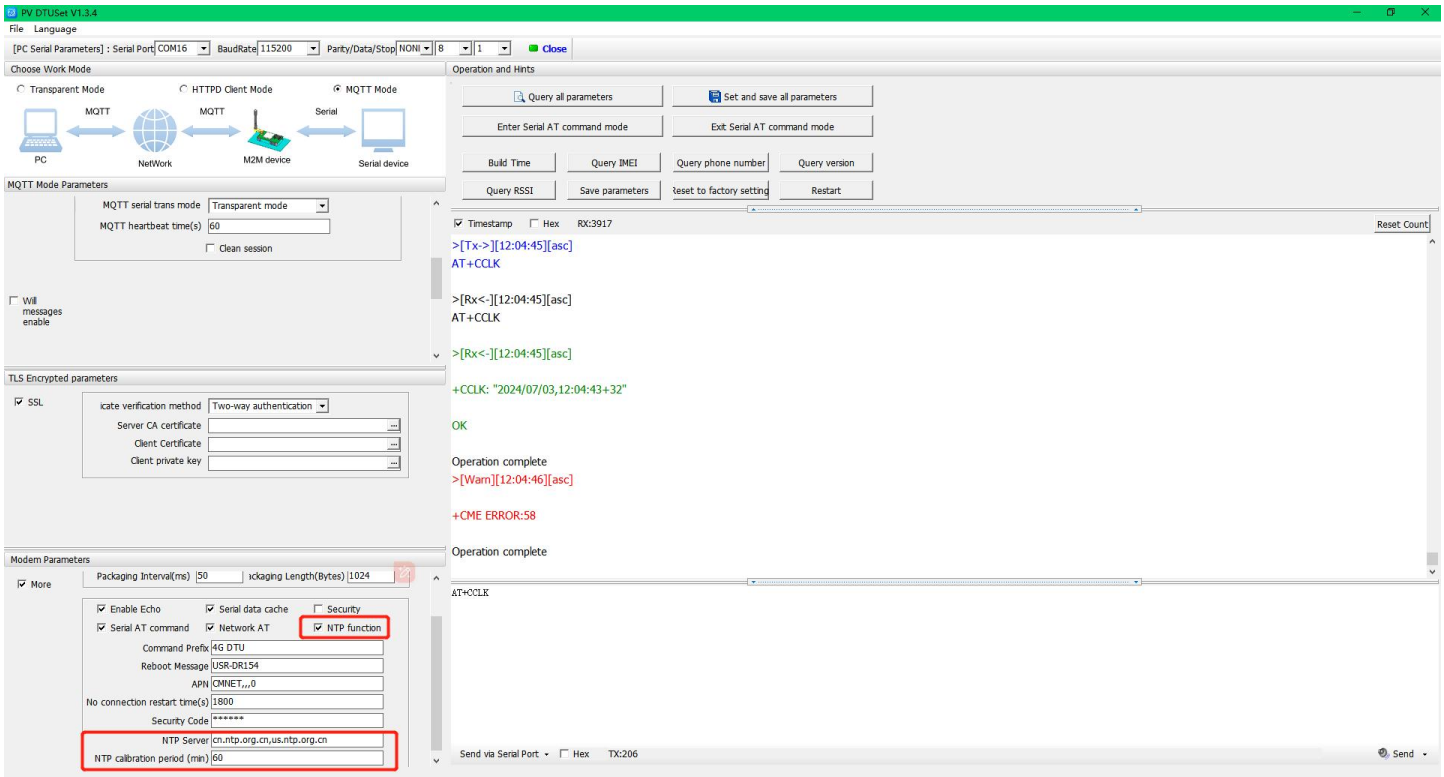


5.7. NTP

USR-DR154-E supports connecting to the NTP server for time synchronization.

This function defaults to be disabled, support connecting to up to 4 NTP servers. User can send "AT+CCLK" or "AT+CCLK?" to query the current time.

➢Set by the utility:



➢Set by AT commands:

	Command	Operation
1	+++a	Enter serial AT command mode
2	AT+NTPEN=ON	Enable NET function
3	AT+NTPSVR=cn.ntp.org.cn,us.ntp.org.cn	Set the NTP server address
4	AT+NTPTM=60	Set the NTP calibration interval
5	AT+S	Save all parameters and restart

5.8. Firmware Upgrade

DR154-E supports upgrading via FOTA or USB. For FOTA upgrading, please contact us for technical support. Please also provide the IMEI and the firmware version of the device after connecting the device to the network.

Here we introduce how to upgrade via USB port:

1.Hardware connection: Connect the USB port (only for upgrading) of DR154-E to the computer.

2.Install the driver(Please contact the technical support).

3.Press the “Reload” button and power on the device at the same time, release it and the device will be in downloading mode. Download port is showing like below:



4.Please contact the sales for upgrading tool (Please contact the technical support). Find “UpgradeDownload.exe” under UPGRADEDOWNLOAD\Bin.

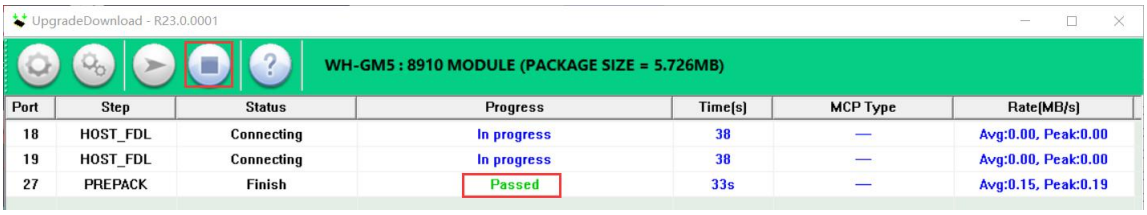
5.Download the firmware.



6.Upgrade successfully. You can directly change to another device to upgrade. After all the devices are upgraded,

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click “Stop”, then close the tool.



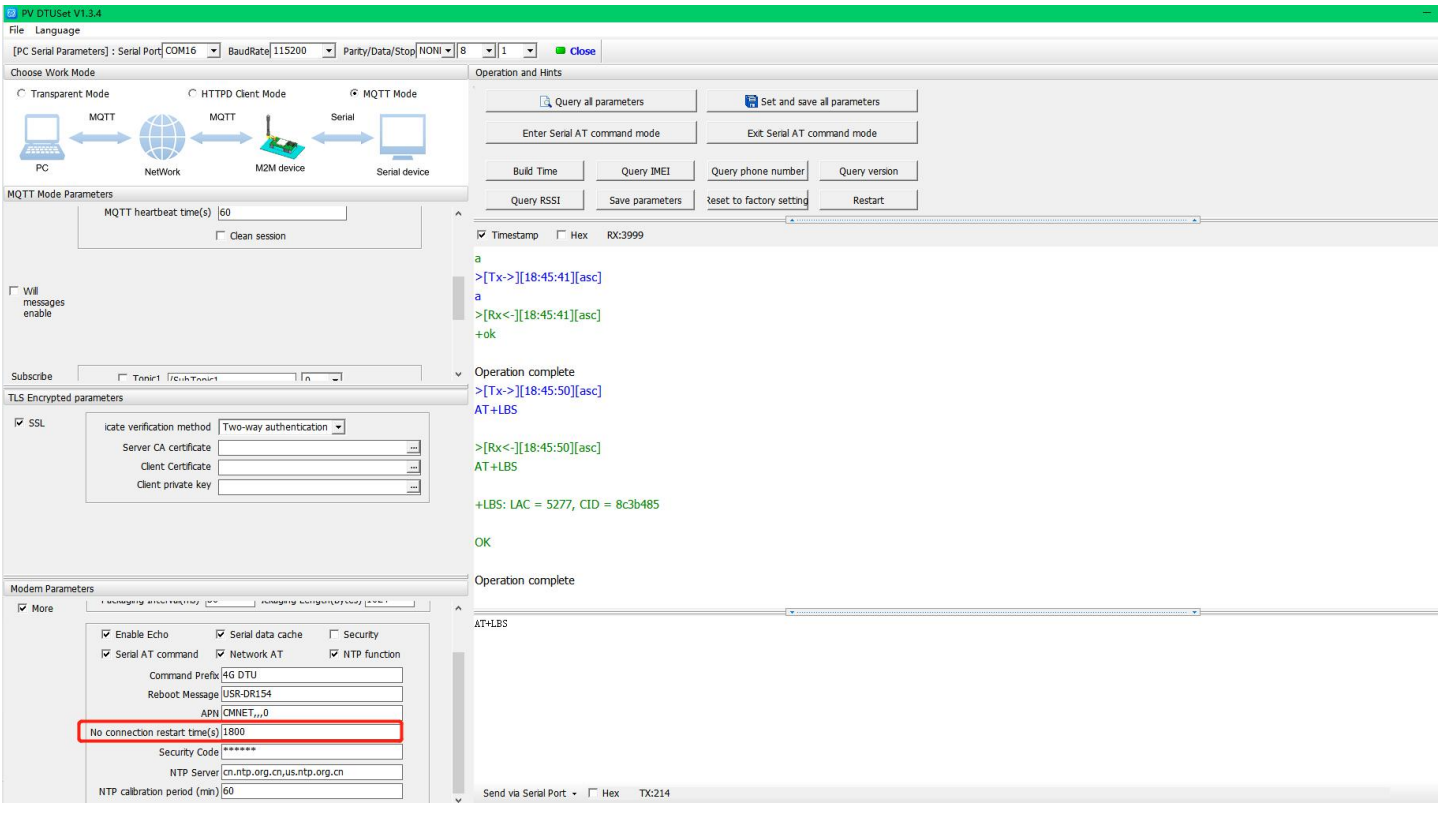
5.9. Restore to Factory Default Settings

1.Hardware reset: After power on, press the “Reload” button in the device for 3~15S to restore the device to factory parameters.

2.Software reset: After enter AT command mode, send “AT+CLEAR” from the serial port to restore the device.

5.10. Timeout Restart

USR-DR502-E supports timeout restart function, defaults to be enabled, 1800s. When there is no data in 30min, the device will restart automatically. You can change it via AT command: AT+**RSTIM**.



6. AT Commands

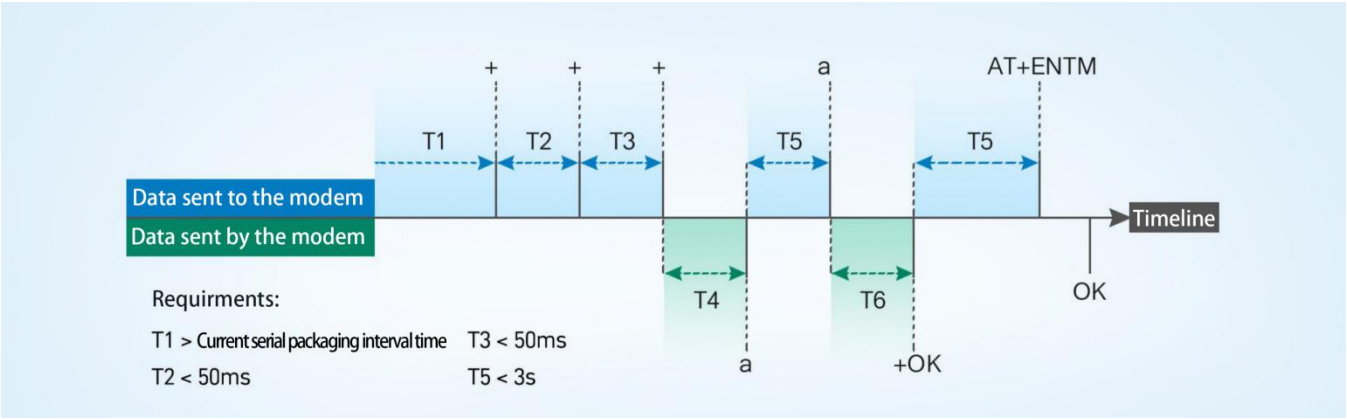
AT command is used for controlling modem, for USR devices in transparent mode normally, you must enter AT command mode at first, then you can send AT commands to configure or query the parameter settings. After setting all parameters, restart the modem to make the settings take effect. Every time the modem restart will work in work mode rather AT command mode.

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Every AT command must add character carriage return <CR> and line feed <LF>. In Hex, <CR> is 0x0D <LF> is 0x0A.

For detailed AT commands, please check the AT commands set.

6.1. AT Command Settings



➢Enter AT command mode:

1.Send “+++” from the serial port, it will be a “a” returned.

2.Do not send any data within a serial port packaging interval before sending "+++".

3.After receiving “a”, send another “a” within 3s.

4.Receiving “+ok” means the device has changed to AT command mode.

5.Then can send AT commands to the device.

➢Exit AT command mode:

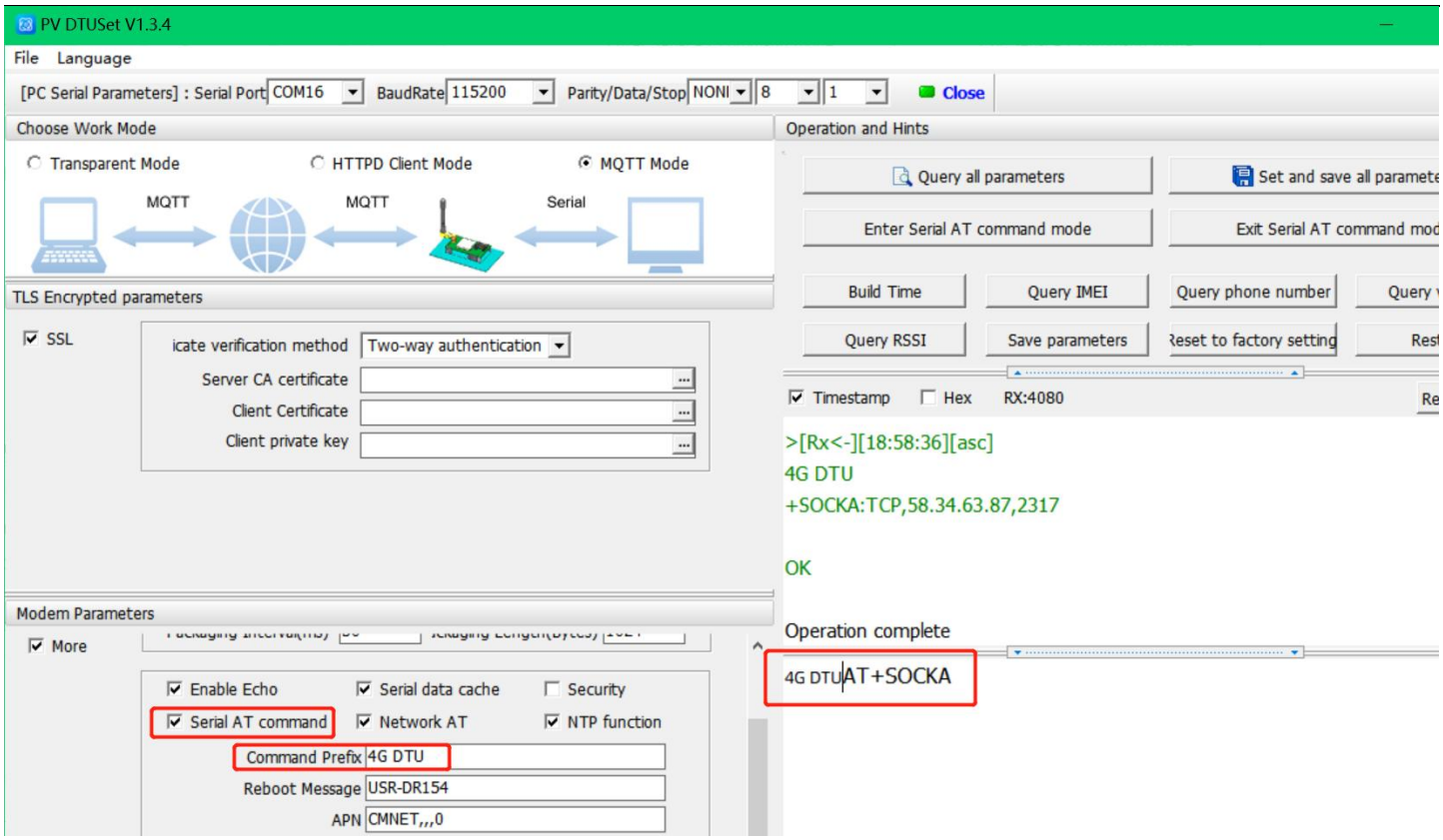
1. Send “AT+ENTM” from the serial port.
2. Receiving “+ok” means the device has exited AT command mode.

6.2. Serial AT Commands

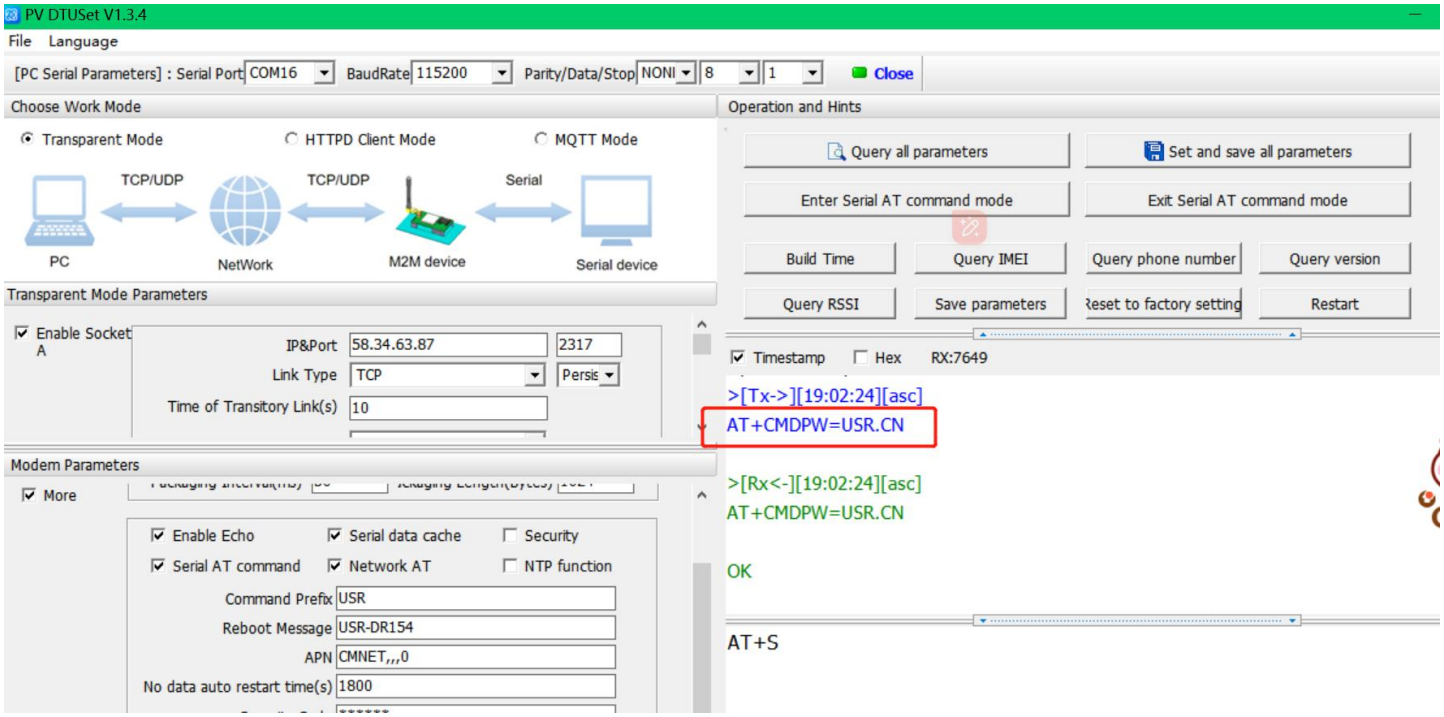
When enable “Serial AT command” function, you can directly send “Command prefix+AT command” in transparent mode without changing to AT command mode. Command prefix defaults to “4G DTU”. The serial AT command is enabled by default.

Example: query socket A status, there is a carriage return and line feed after the AT command.

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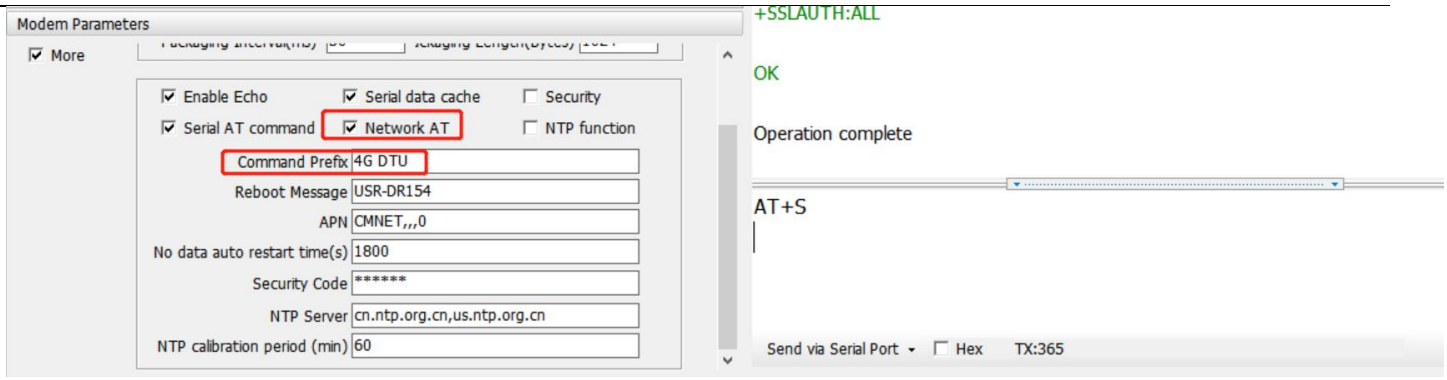
The command prefix can be set by AT+CMDPW,like AT+CMDPW=USR.CN



6.3. Network AT Commands

In transparent mode, you can also send “Command prefix+AT command” from the network side to query or change the modem’s parameter settings. The network AT command is enabled by default, and the default command prefix is 4G DTU.

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Example: query socket A status, there is a carriage return and line feed after the AT command.

7. Contact Us

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