

WH-LTE-7S1-E User Manual

Document version: V1.0.0



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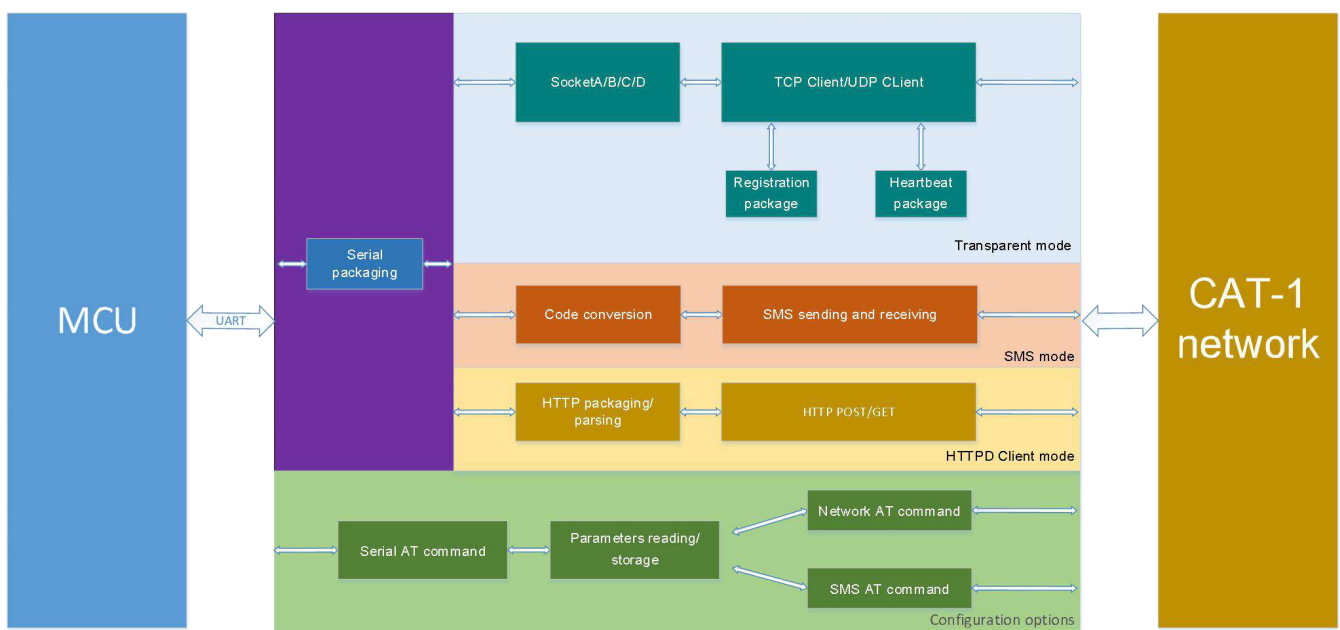
1. Introduction

1.1. Overview

WH-LTE-7S1-E is a LTE CAT 1 communication module, which supports LTE and GSM, supports TCP/UDP transparent transmission, SMS transmission and configuration, and also supports HTTP protocol. At the same time, it supports AT command mode to realize full command operation, meets the needs of different application scenarios.

WH-LTE-7S1-E covers the mainstream frequency bands of European operators. This model is fully PIN compatible with CAT 4 7S5 series and using a double inline package design, convenient for customers to switch and install.

1.2. Features



- Equipped with CAT-1 network, 10Mbps download rate, 5Mbps upload rate, meeting 80% of the data transmission application scenarios
- Low latency in milliseconds
- Multiple modes, supports LTE CAT 1 and GPRS
- Wide coverage, high stability based on existing 4G network
- Supports TCP/UDP, HTTPD and SMS transparent transmission
- Each socket supports buffering 20 packets of serial port data, each packet is up to 4K
- Supports parameter configuration via network, serial and SMS AT command
- Supports base station geolocation and NTP function
- Support 5~16V wide voltage or 3.4~4.2V supply
- Double inline package design
- Support FTP upgrade.

2. Get Started

2.1. Specification

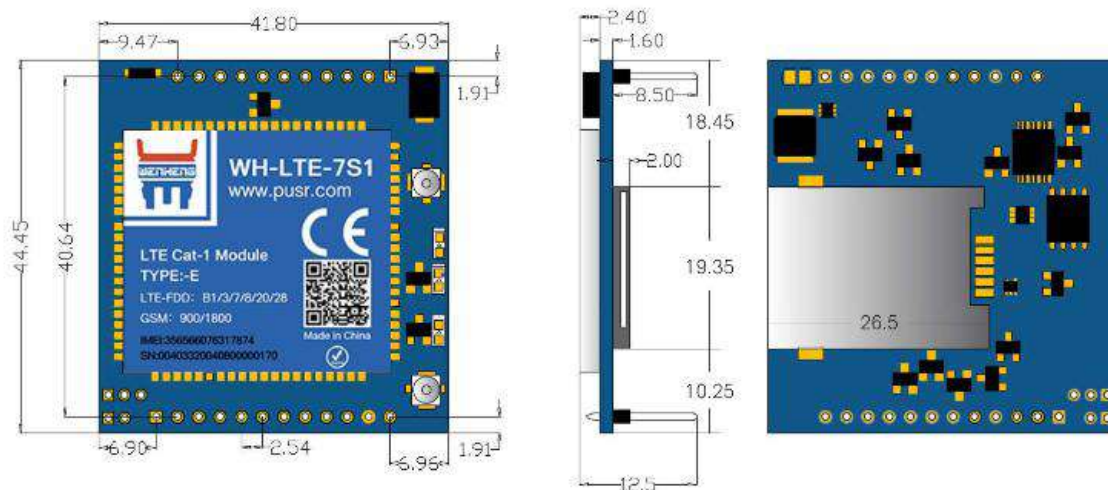
Parameters		Description
Basic Parameters	WH-LTE-7S1-E	Supports B1/B3/B7/B8/B20
	Encapsulation	DIP 23pin
	Power	3.4V~4.2V / 5~16V (Not coexisting)
	Indicators	WORK, NET, LINKA, LINKB, DATA
	SIM/USIM	3V/1.8V SIM slot, 2FF
	USB interface	USB 2.0 High speed
	UART interface	AT commands and data transmission, TTL-3.0V
	RF	IPEX
Environmental	Dimensions(mm)	44.4mm×41.8mm×12.5mm
	Weight(g)	15g
Temperature	Operating temperature	-30°C~ +75°C
	Expansion temperature	-40°C~ +85°C
	Storage temperature	-40°C~ +90°C
Humidity	Operating humidity	5%~95% (non-condensing)
Transmission speed	LTE FDD Rel.13	10MbpsDL/5Mbps UL
	GPRS	85.6KbpsDL/85.6Kbps UL(multi-slot class 12)
Bands	LTE FDD	B1/B3/B7/B8/B20
	GSM	900/1800MHz
TX Power	FDD:B1/3/7/8/20/28	23dBm±2dB
	GSM:900MHz	33dBm±2dB
	GSM:1800MHz	30dBm±2dB
Rx Sensitivity	GSM:900MHz	-109.5dBm
	GSM:1800MHz	-108dBm
	FDD:B1/3/20	-98dBm
	FDD:B7	-97.5dBm
	FDD:B8/B28	-98.5dBm
Software	Operating mode	TCP/UDP/HTTPD/SMS transparent transmission
	Configuration command	AT+command
	Network protocol	TCP/UDP/DNS/FTP/HTTP
	Socket number	4
	User configuration	Serial/Network/SMS AT command
Features	Socket distribution protocol	Support
	FOTA self upgrade	Support

	Security	Support
	Base station geolocation	Support
	FTP upgrade	Support
	NTP	Support

2.2. Hardware

2.2.1. Dimensions

单位:mm 误差+/-0.2mm



2.2.2. Indicator

There are five indicators on WH-LTE-7S1-E, WORK, NET, LINKA, LINKB and DATA .

Indicator	Function	Status
WORK	Working status indicator	Flashes when the module is working normally.
NET	Network status indicator	Flashes when connecting to network. 4G flashes 4 times, 2G flashes 2 times.
LINKA	Socket A connection status indicator	Output high level when connection is established.
LINKB	Socket B connection status indicator	Output high level when connection is established.
DATA	Data transmission indicator	Output high level when data is sent from serial port or network.

Note: All the indicator lights are on at a high level, the module comes with three indicators.

2.2.3. Connecting Hardware

For detailed pin definition and hardware design instructions, please refer to the hardware manual:

<https://www.pusr.com/products/LTE-Cat-1-module.html>

In this manual, I test with our evaluation board WH-7SX-EVK.

3. Utility Configuration

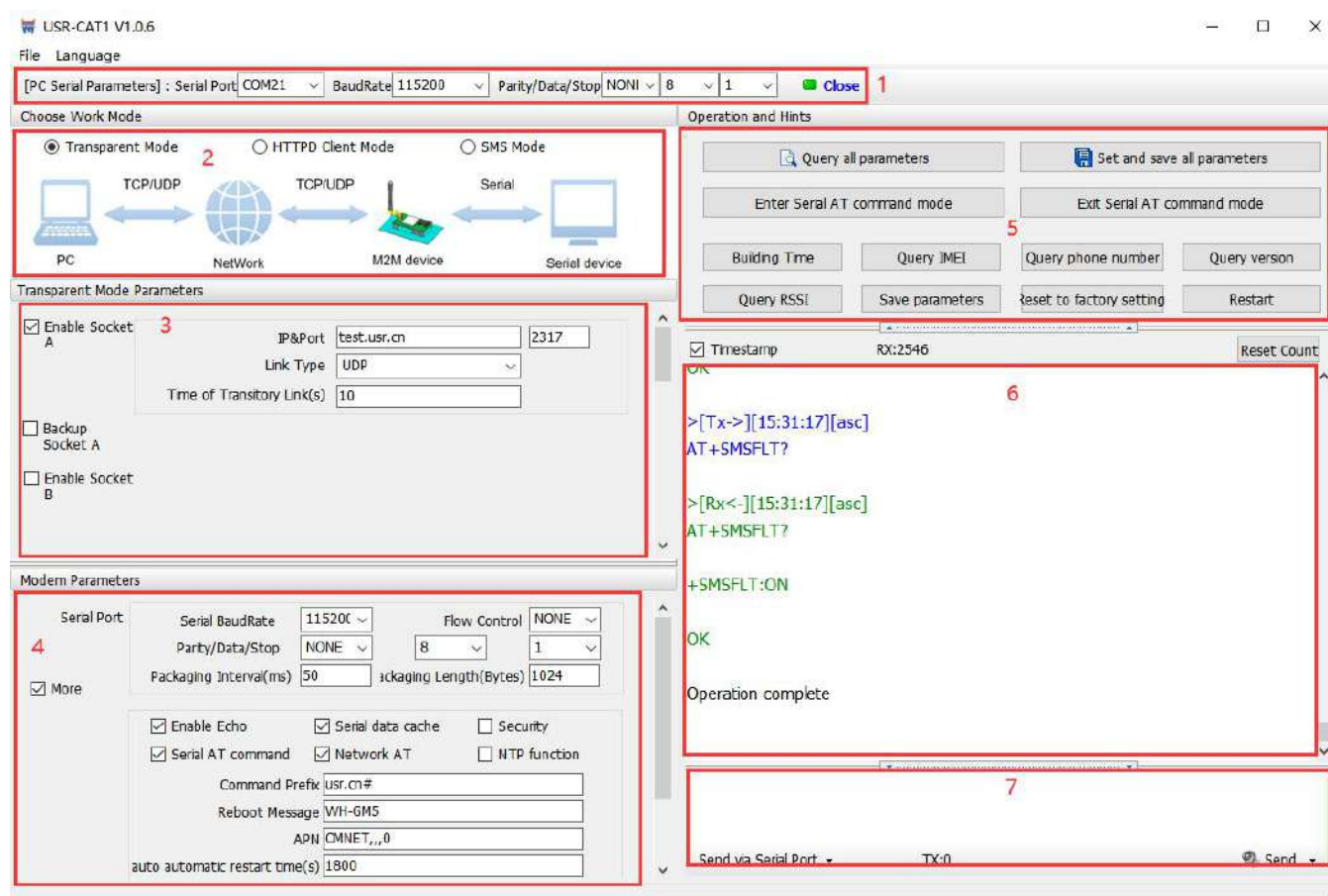
3.1. Download the Utility

Please download the utility in this link:

<https://www.pusr.com/products/LTE-Cat-1-module.html>

3.2. Starting the Configuration Utility

WH-LTE-7S1-E utility is shown as following:

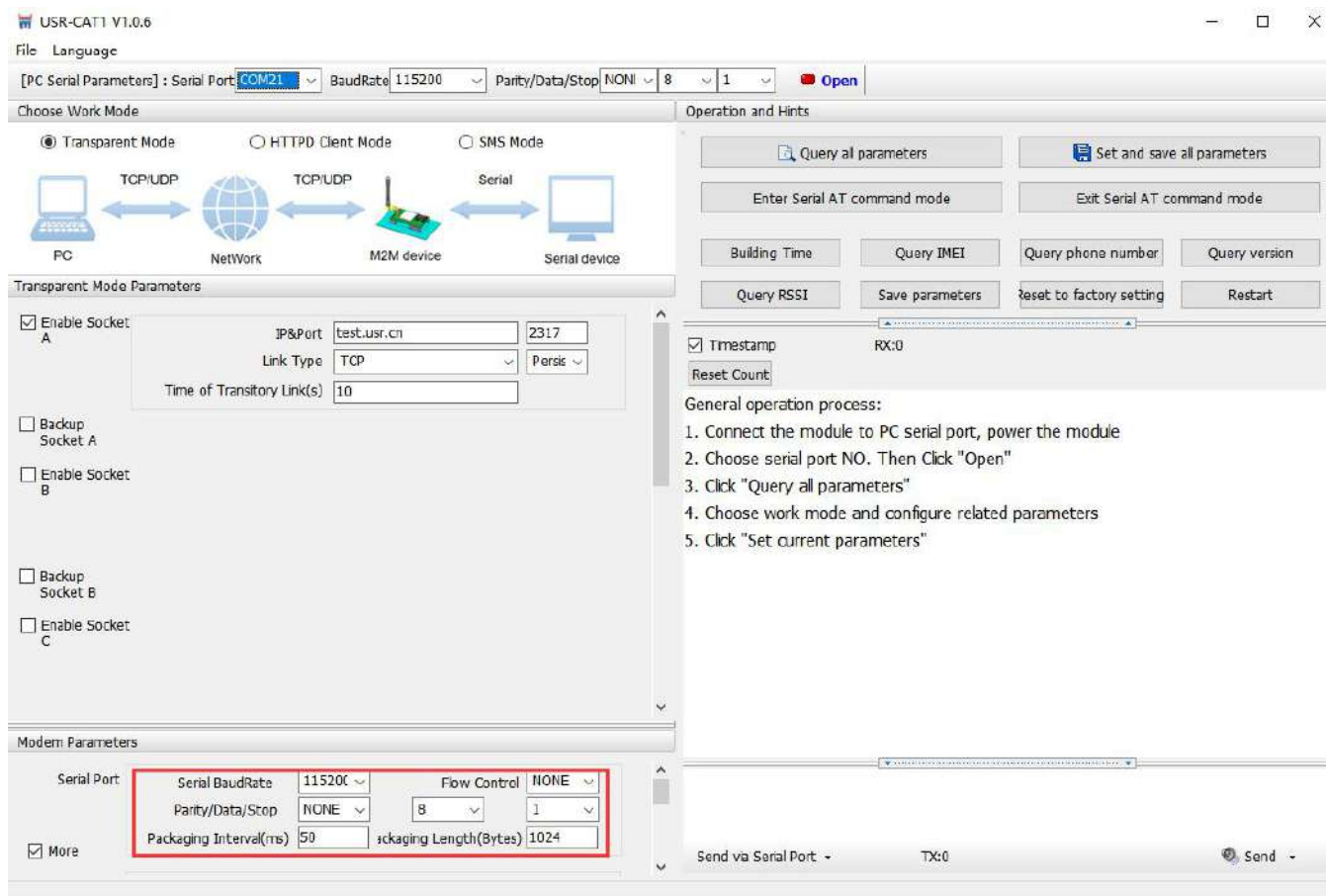


Description:

1. In PC serial parameter setting area, it is necessary to set the serial parameters consistent with the serial module, otherwise they cannot communicate with each other.
2. Working mode selection area, select the work mode of the module.
3. In the parameter setting area of characteristic functions, set parameters related to module's featured 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.

4. Serial Port

4.1. Basic Parameters



Serial parameters of WH-LTE-7S1-E must be consistent with the parameters of the serial device. Serial port parameters include basic parameters and framing parameters.

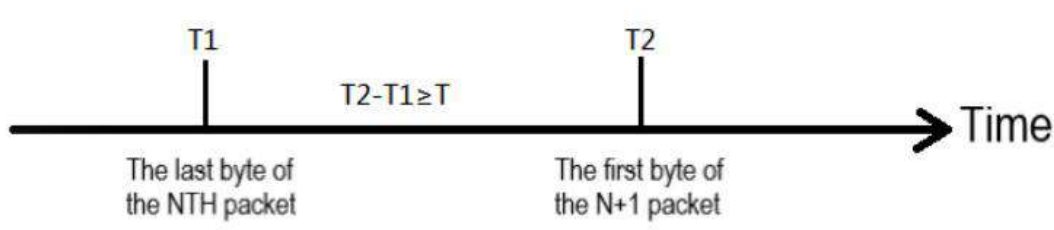
Item	Parameter
Baud rate	1200~921600bps
Data bit	8
Stop bit	1,2
Check bit	NONE EVEN ODD

4.2. Frame Forming Mechanism

4.2.1. Time Trigger

When 7S1-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>.

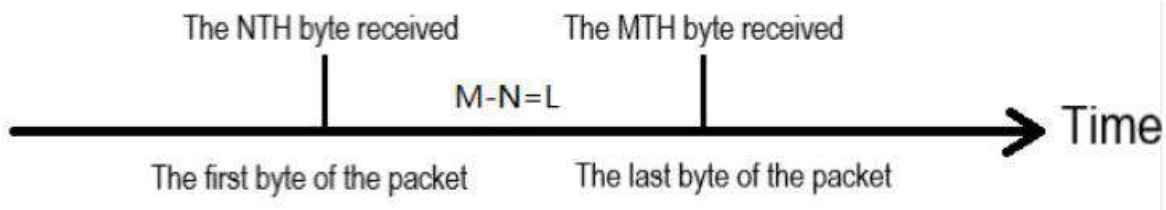


Note: T is the packing interval time.

4.2.2. Length trigger

When 7S1-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>.

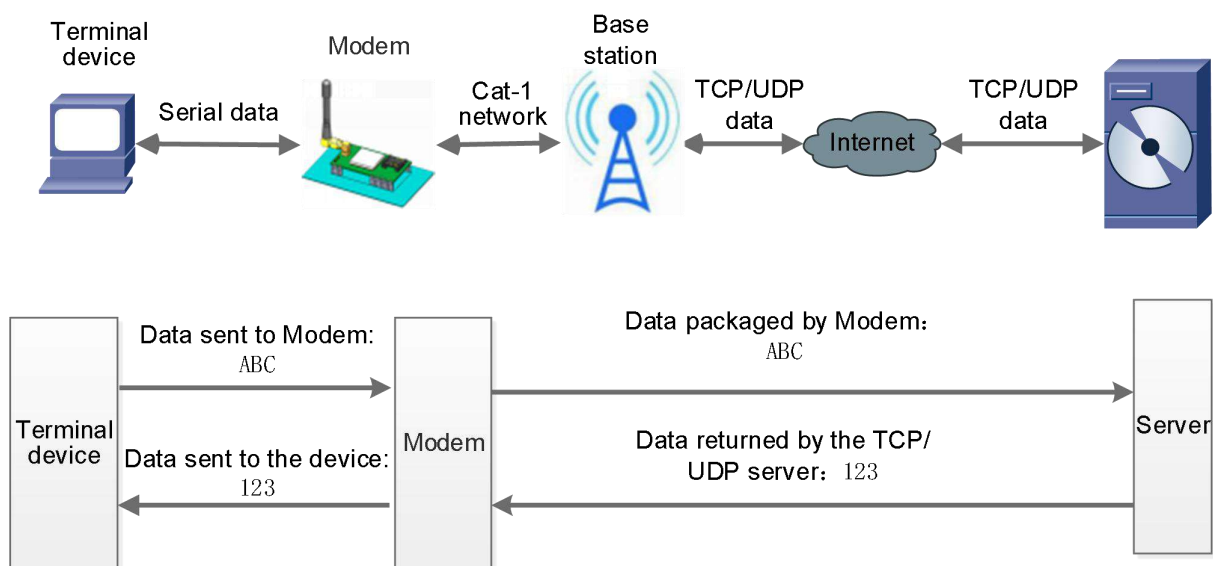


Note: L is the packaging length.

5. Selecting an Operating Mode

WH-LTE-7S1-E has three operating modes: transparent mode, HTTPD Client mode and SMS mode.

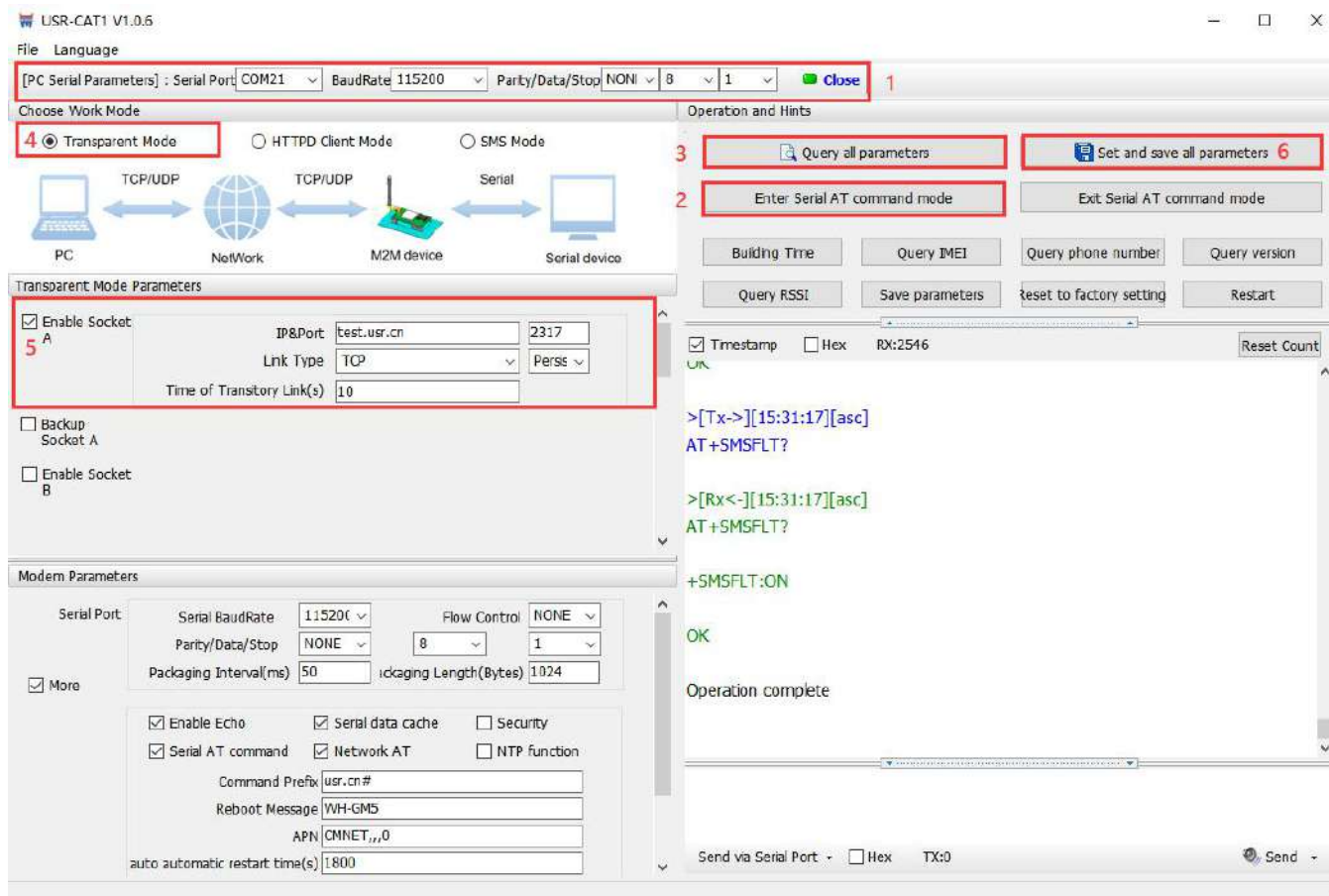
5.1. Transparent Mode



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.

7S1-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.

- 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;test.usr.cn,2317	Set the remote IP and port of Socket A
6	AT+S	Save all parameters and restart

➤ Test

Connect the serial port of WH-LTE-7S1-E to the computer via a serial to USB cable, send data from the utility, the test server will return the same data to serial port.

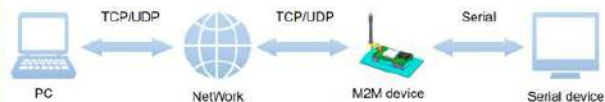
USR-CAT1 V1.0.6

File Language

[PC Serial Parameters] : Serial Port COM21 BaudRate 115200 Parity/Data/Stop NDN 8 1 Close

Choose Work Mode

☒ Transparent Mode
 ☐ HTTPD Client Mode
 ☐ SMS Mode



Transparent Mode Parameters

☒ Enable Socket A
 IP&Port: test.usr.cn 2317
 Link Type: TCP Persist
 Time of Transitory Link(s): 10

☐ Backup Socket A
☐ Enable Socket B
☐ Backup Socket B
☐ Enable Socket C

Modem Parameters

☒ Enable CPU ☒ Serial data cache ☐ Security
☒ Serial AT command ☒ Network AT ☐ NTP function

Command Prefix: usr.cn#
 Reboot Message: WH-GMS
 APN: CMNET,,0
 auto automatic restart time(s): 1800

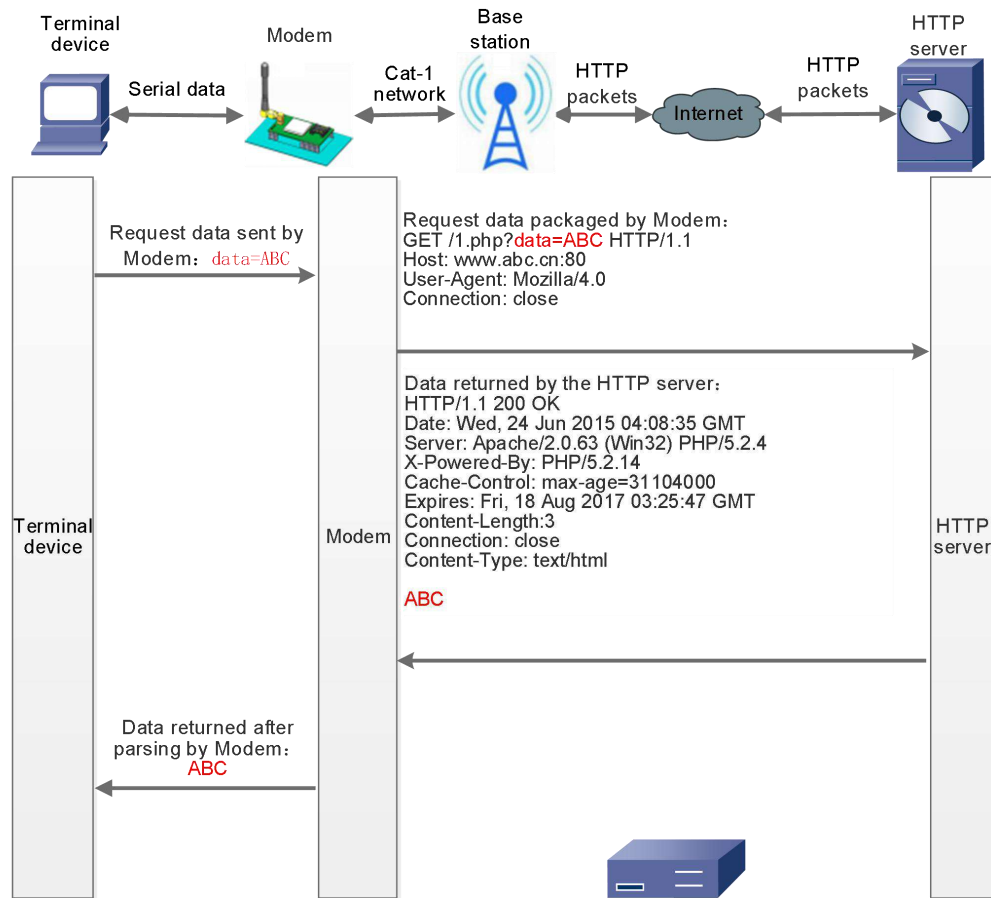
Operation and Hints

Query all parameters Set and save all parameters
 Enter Serial AT command mode Exit Serial AT command mode
 Building Time Query IMEI Query phone number Query version
 Query RSSI Save parameters Reset to factory setting Restart

☒ Timestamp RX:2562
 Reset Count
 18:28:48
 AT+ENTM
 >[Rx<-][18:28:48][asc]
 AT+ENTM
 OK
 Operation complete
 >[Tx->][18:28:52][asc] ← Send
 12345678
 >[Rx<-][18:28:53][asc] ← Receive
 12345678
 12345678

Send via Serial Port TX:8 Send

5.2. HTTPD Client Mode

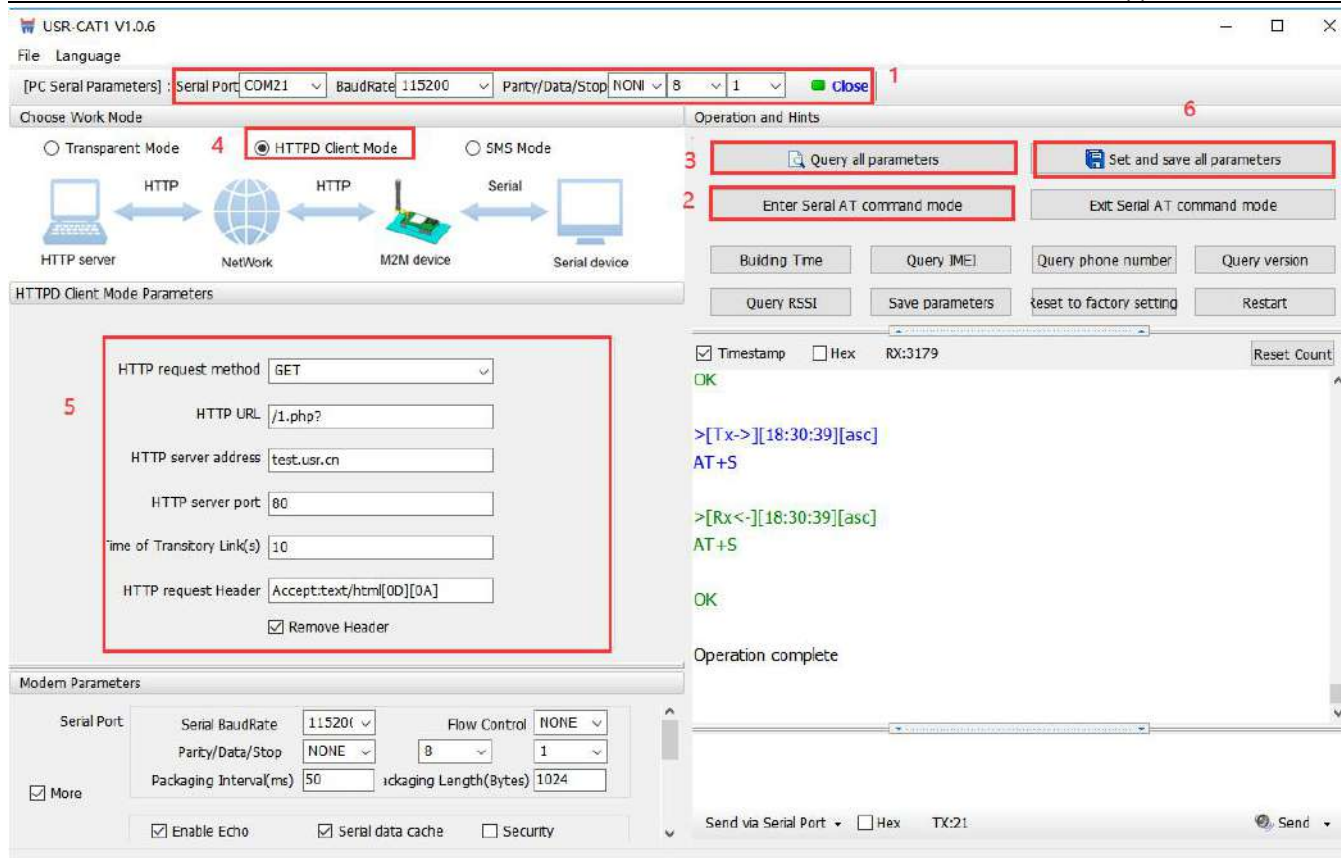


In this mode, user's terminal device can send request data to the specified HTTP server through this module, then the module receives data from HTTP server, parses and sends data to the serial device.

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 module 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:

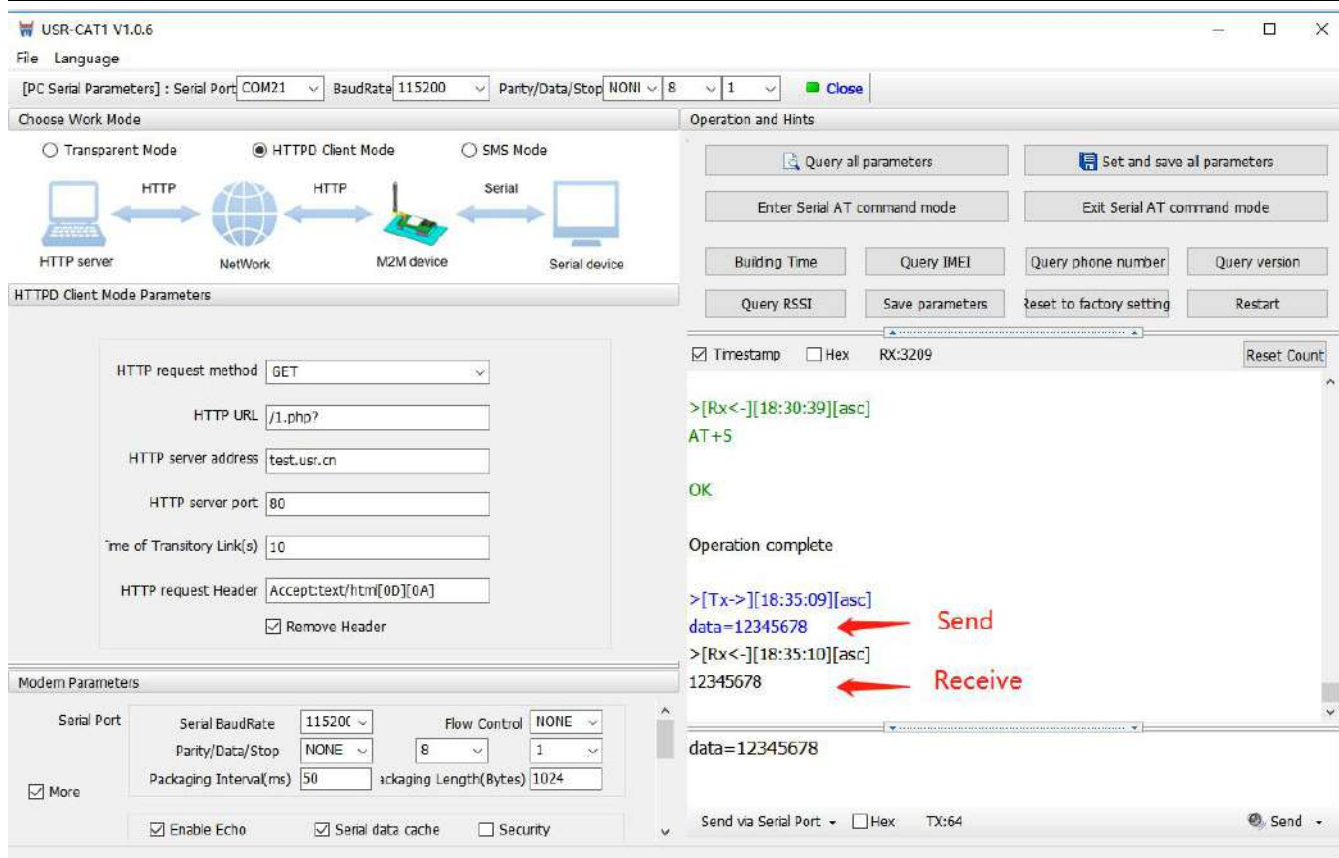


➤ Set by AT command:

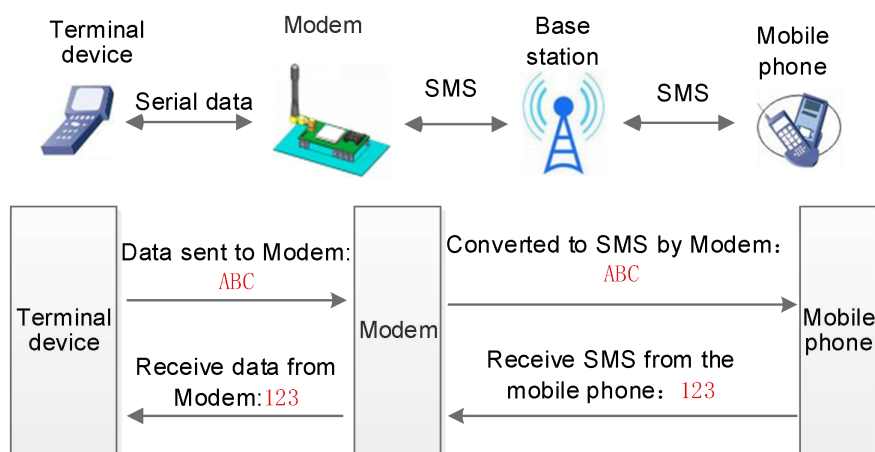
	Command	Operation
1	+++a	Enter serial AT command mode
2	AT+WKMOD=HTTPD	Set the work mode to HTTPD Client
3	AT+HTPTP=GET	Set the HTTP request type to GET
4	AT+HTPURL=/1.php?	Set the HTTP URL
5	AT+HTPSV=test.usr.cn,80	Set the HTTP server address and port
6	AT+HTPHD=Accept:text/html[0D][0A]	Set the HTTP 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 module

➤ Test

After the NET light is on, send the data in the format of "data = ". After the data is sent successfully, server will return the data.



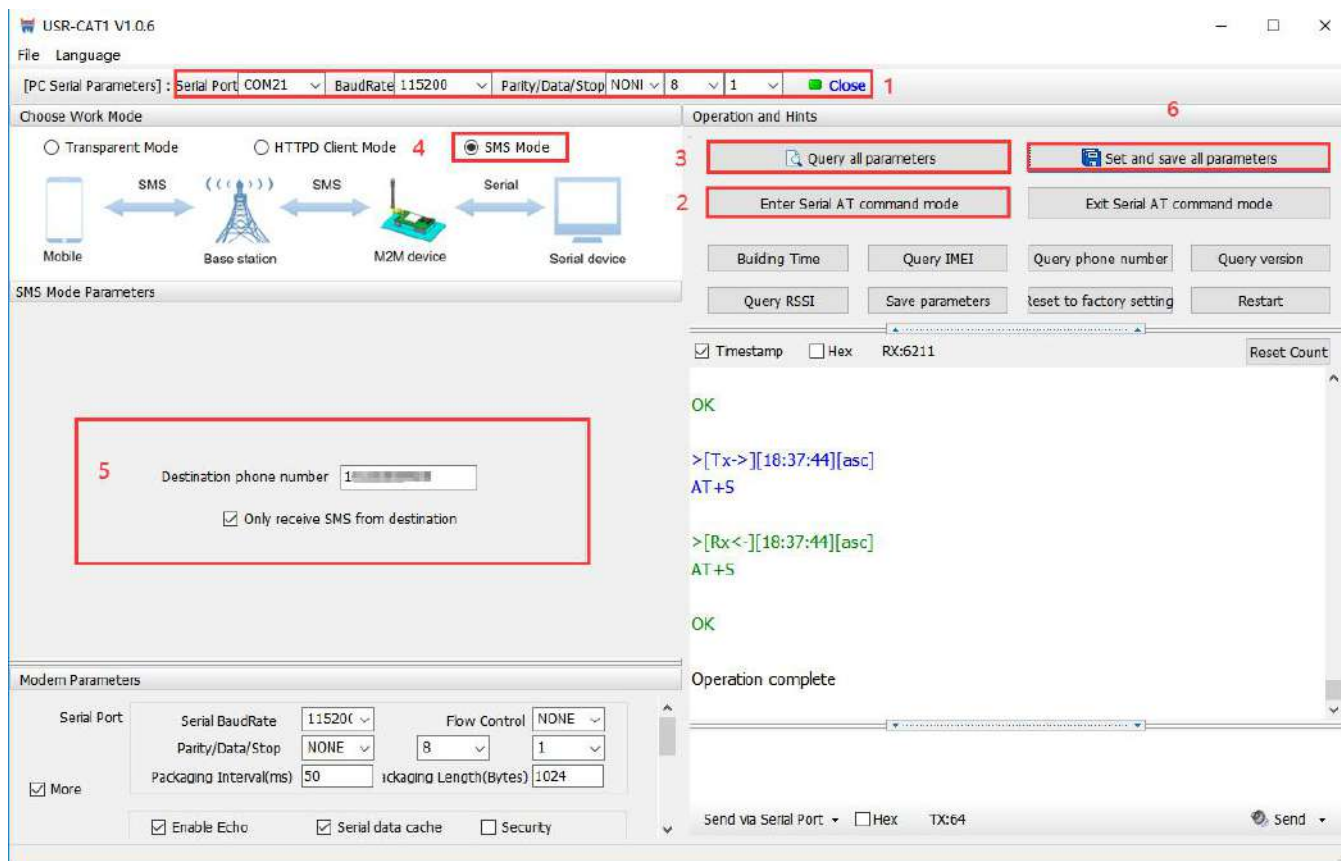
5.3. SMS Mode



In this mode, user's serial device can send SMS to the specified mobile phone and receive SMS from any mobile phone. User can decide whether to transmit the data of the specified mobile phone to the serial device through settings.

Users can send and receive SMS to check the serial device status remotely via 7S1-E.

➤ Set by the utility:



➤ Set by AT command:

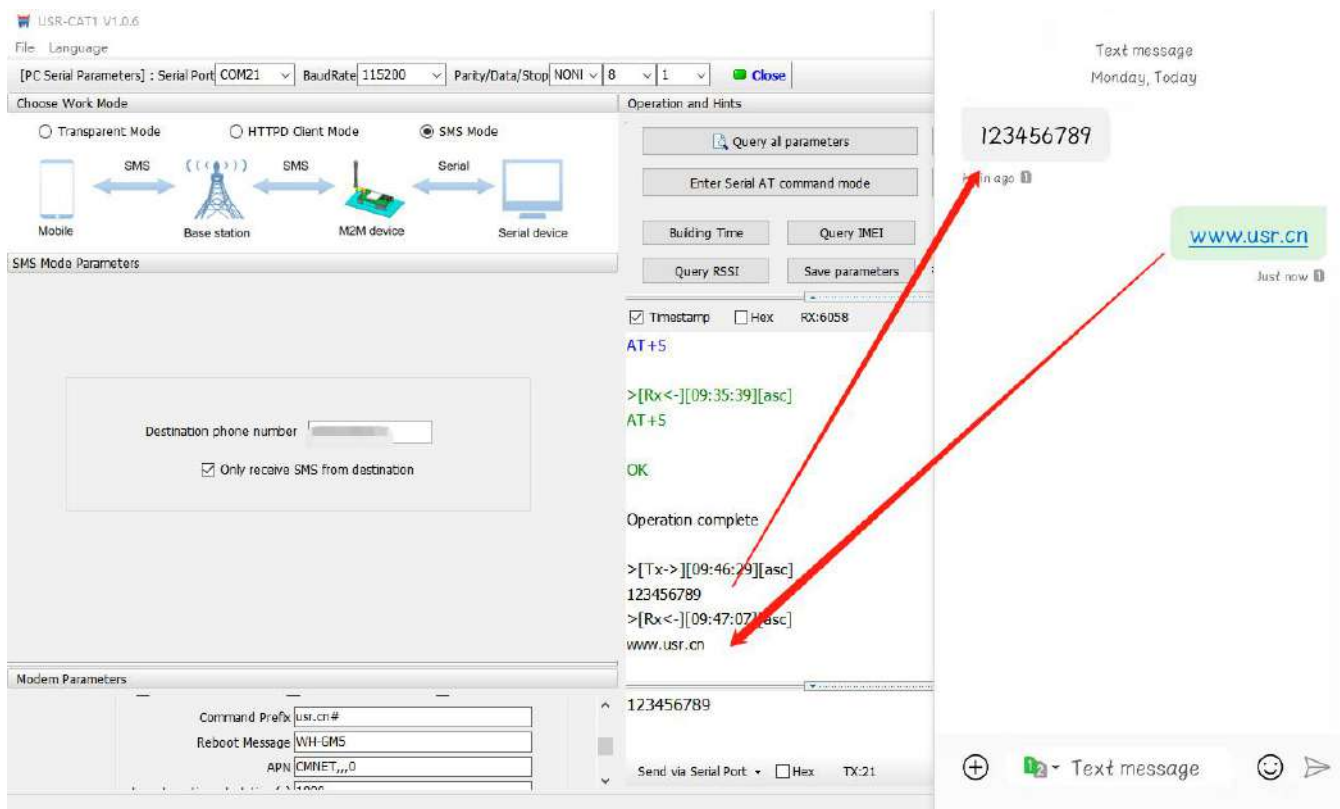
	Command	Operation
1	+++a	Enter serial AT command mode
2	AT+WKMOD=SMS	Set the work mode to SMS
3	AT+DSTNUM=10086	Set the destination phone number
6	AT+S	Save the parameters and restart

Note:

1. You need to add the international number before the destination phone number.
2. When only receive SMS from source number is enabled, other phone numbers can still query or set parameters.

➤ Test

When the NET light is on, we can send and receive data in both directions via SMS with destination phone number.



The screenshot displays the USR-CAT1 V1.0.6 software interface. The top menu bar includes 'File' and 'Language'. Below it, the '[PC Serial Parameters]' section shows 'Serial Port' set to 'COM21', 'BaudRate' at '115200', and 'Parity/Data/Stop' as 'NONE/8/1'. A 'Close' button is present.

The 'Choose Work Mode' section has three radio buttons: 'Transparent Mode', 'HTTPD Client Mode', and 'SMS Mode' (which is selected). Below these is a diagram showing the communication flow: Mobile ↔ Base station ↔ M2M device ↔ Serial device.

The 'SMS Mode Parameters' section contains a 'Destination phone number' input field and a checked checkbox for 'Only receive SMS from destination'.

The 'Modem Parameters' section at the bottom includes fields for 'Command Prefix' (set to 'USR,CT#'), 'Reboot Message' (set to 'WH-GMS'), and 'APN' (set to 'CMNET,').

The 'Operation and Hints' panel on the right contains several buttons: 'Query all parameters', 'Enter Serial AT command mode', 'Building Time', 'Query IMEI', 'Query RSSI', and 'Save parameters'. Below these buttons, a log window shows the following text:

```

[✓] Timestamp [ ] Hex RX:6058
AT+5
>[Rx<-][09:35:39][asc]
AT+5
OK
Operation complete
>[Tx->][09:46:29][asc]
123456789
>[Rx<-][09:47:07][asc]
www.usr.cn

```

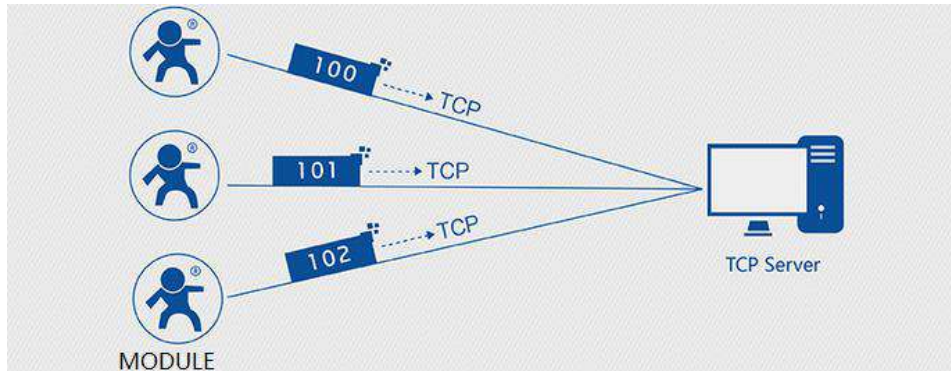
Two red arrows point from the log window to a text message preview on the right. The first arrow points from the phone number '123456789' in the log to the same number in the message preview. The second arrow points from the website 'www.usr.cn' in the log to the same website in the message preview.

The text message preview shows the message content: '123456789' and 'www.usr.cn'. It also includes a timestamp 'Monday, Today' and a status 'Just now'.

At the bottom right, there is a 'Text message' input field with a 'Send' button (represented by a paper plane icon).

6. General Function

6.1. Identity Package



In **transparent mode**, user can set the module 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 module 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.

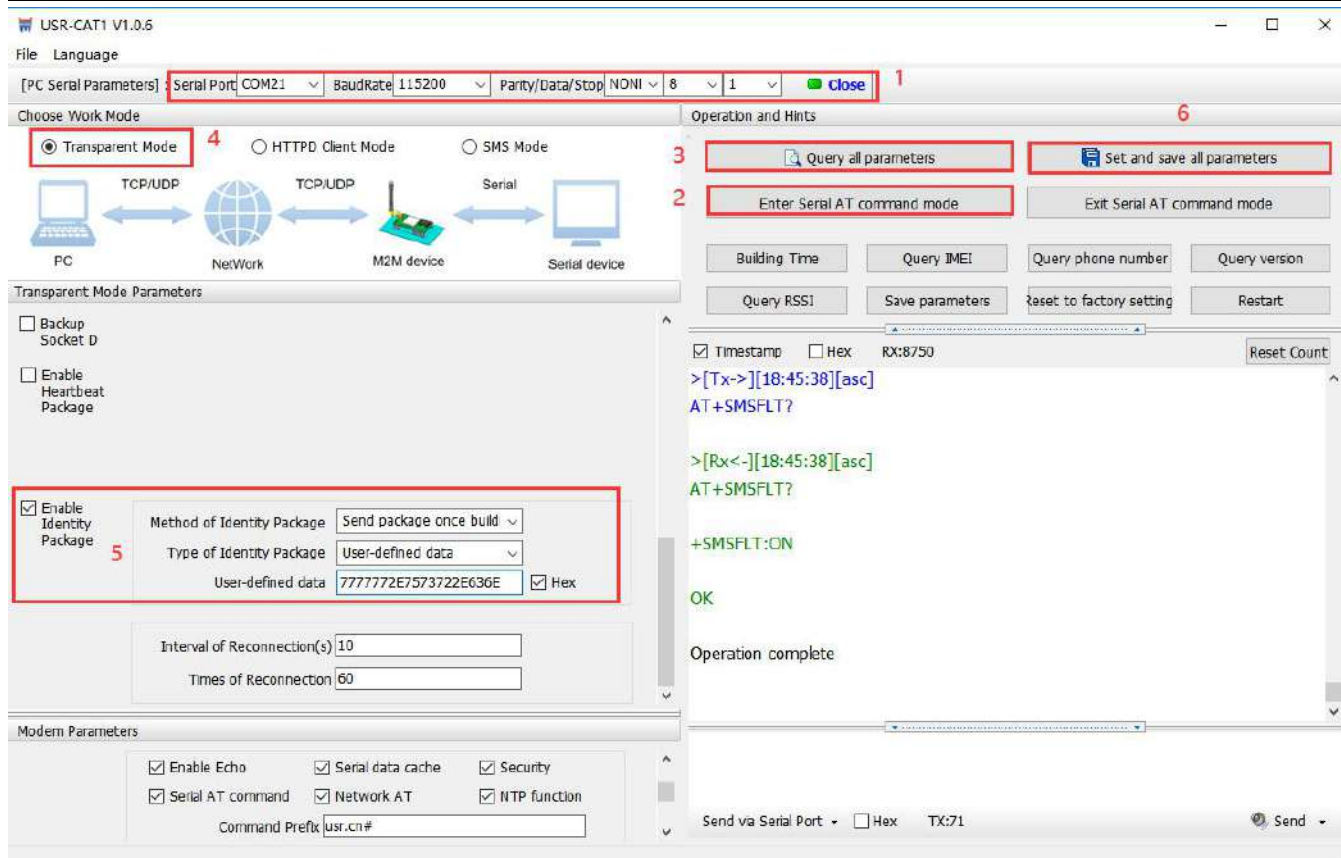
IMEI: Unique identification code of the Internet module, which is mainly used in device identification, has nothing to do with SIM card.

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=7777772E7573722E636E	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

6.2. Heartbeat Package

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.

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

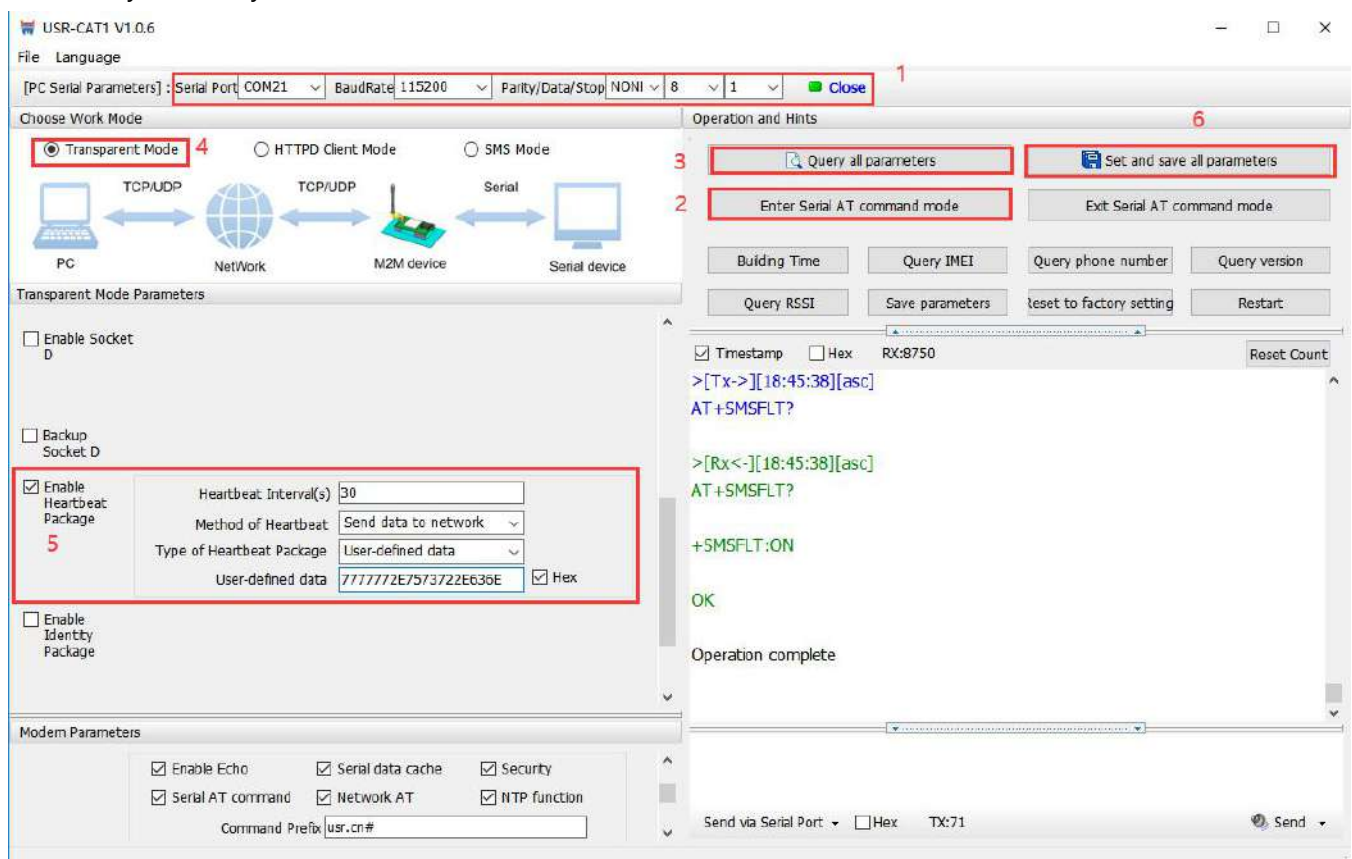
IMEI: Unique identification code of the Internet module, which is mainly used in device identification, has nothing to do with SIM card.

SN: Serial number.

USER: User-defined data.

LBS: Current latitude, longitude of the device and time.

➤ 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=7777772E7573722E636E	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 module.

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.

6.3. Socket Distribution Protocol

WH-LTE-7S1-E supports socket distribution protocol. When a module 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 the document "[Socket distribution protocol](#)".

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**.

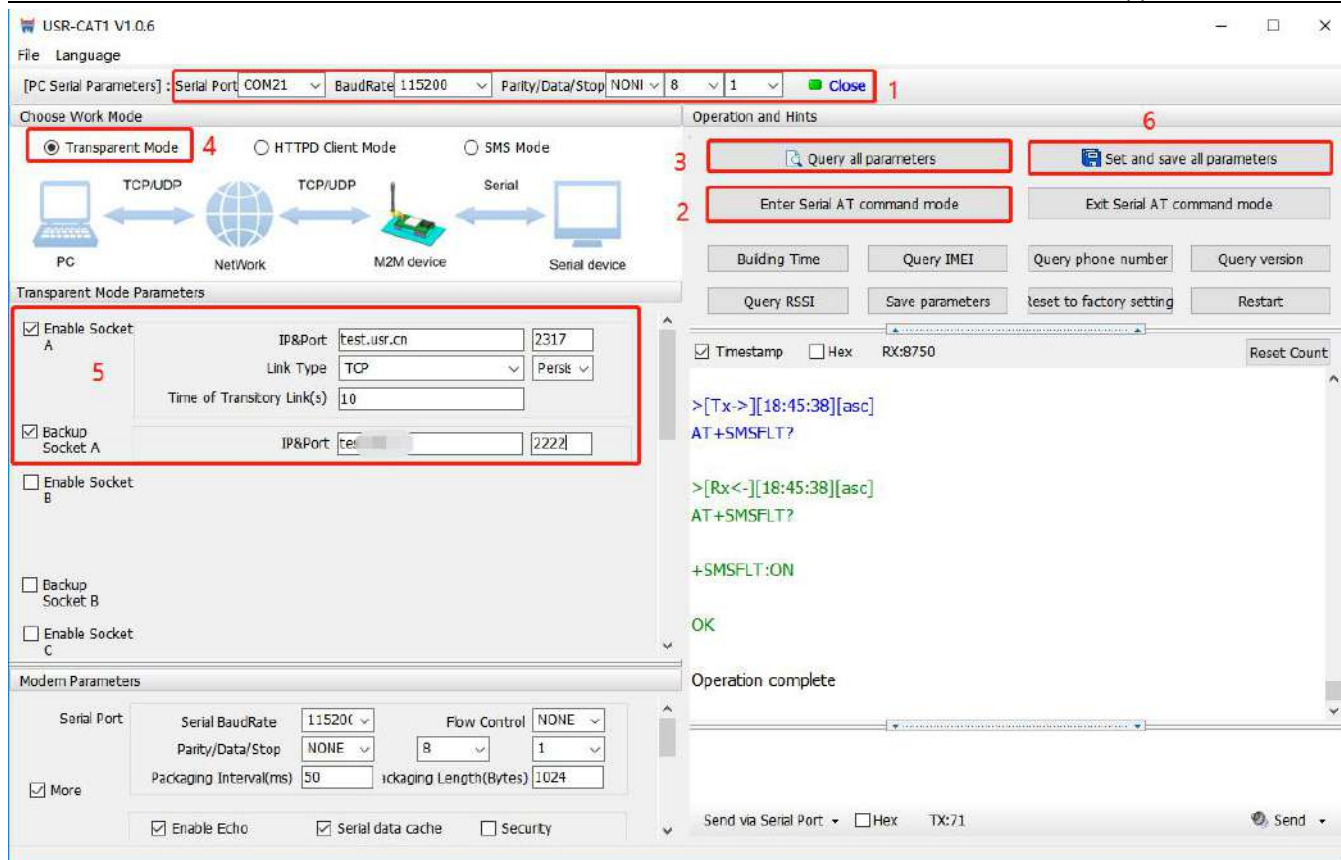
6.4. USR Cloud

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 WH-LTE-7S1-E also supports connecting to USR Cloud. For details, please check this link: mp.usriot.com.

6.5. Backup Socket

In transparent mode, you can set one backup socket for each socket, the module will try to connect to backup server when cannot connect to the main server. This function defaults to be unchecked.

➤ Set by the utility:



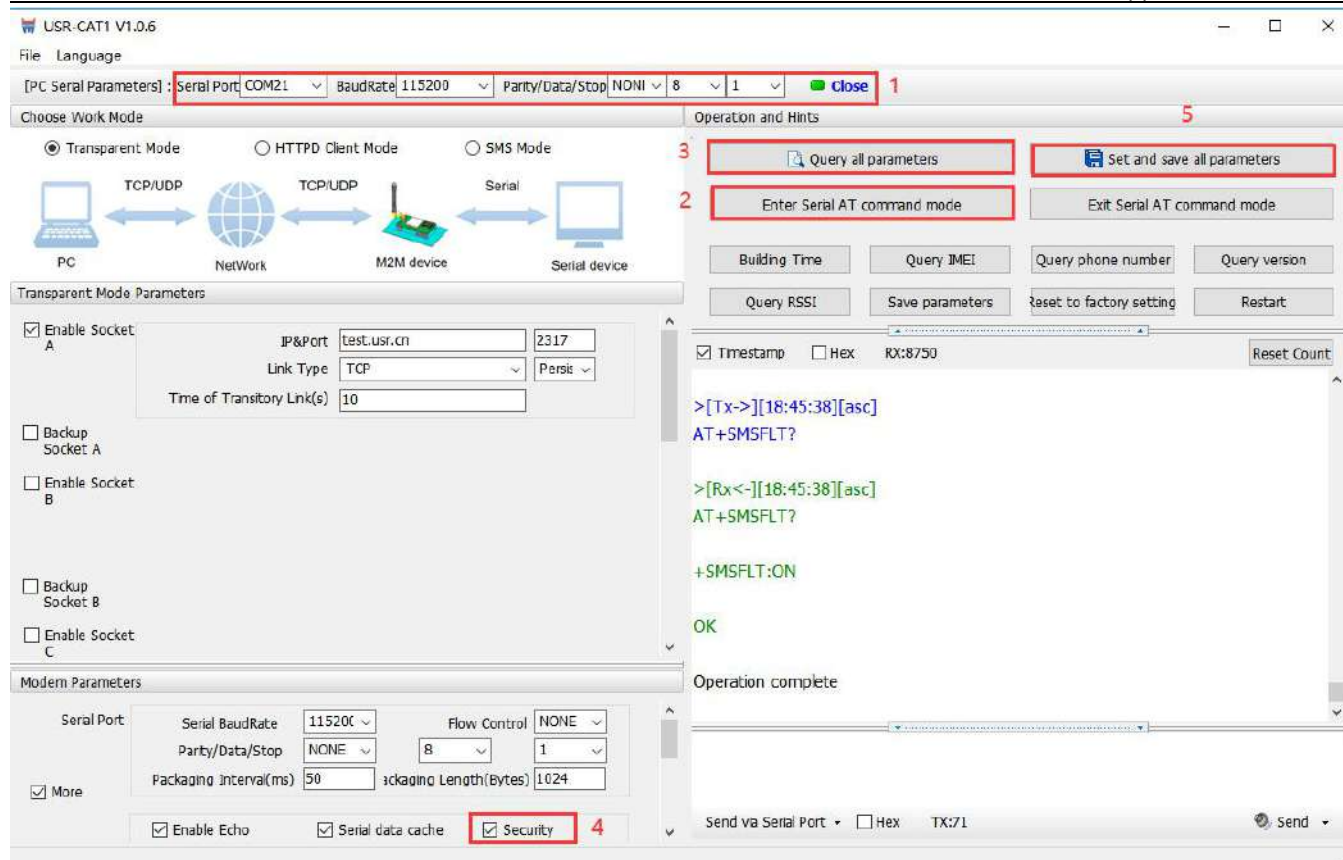
➤ Set by AT commands:

	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
5	AT+SOCKA=TCP,test.usr.cn,2317	Set the remote IP and port of Socket A
6	AT+SOCKABKEN=ON	Enable Socket backup function
7	AT+SOCKABK=TCP,test.usr.cn,2317	Set the backup server address and port
8	AT+S	Save all parameters and restart

6.6. Security

When enable Security function, after enter AT command mode, you need to input the correct password to login. After logging, you can also change the password by sending the login command again. The module will automatically exit AT command mode if there is no login command within 30s.

➤ Set by the utility:



➤ Set by AT commands:

Enable:

	Command	Operation
1	+++a	Enter serial AT command mode
2	AT+SAFEATEN=ON	Enable security function
3	AT+S	Save all parameters and restart

Change the password:

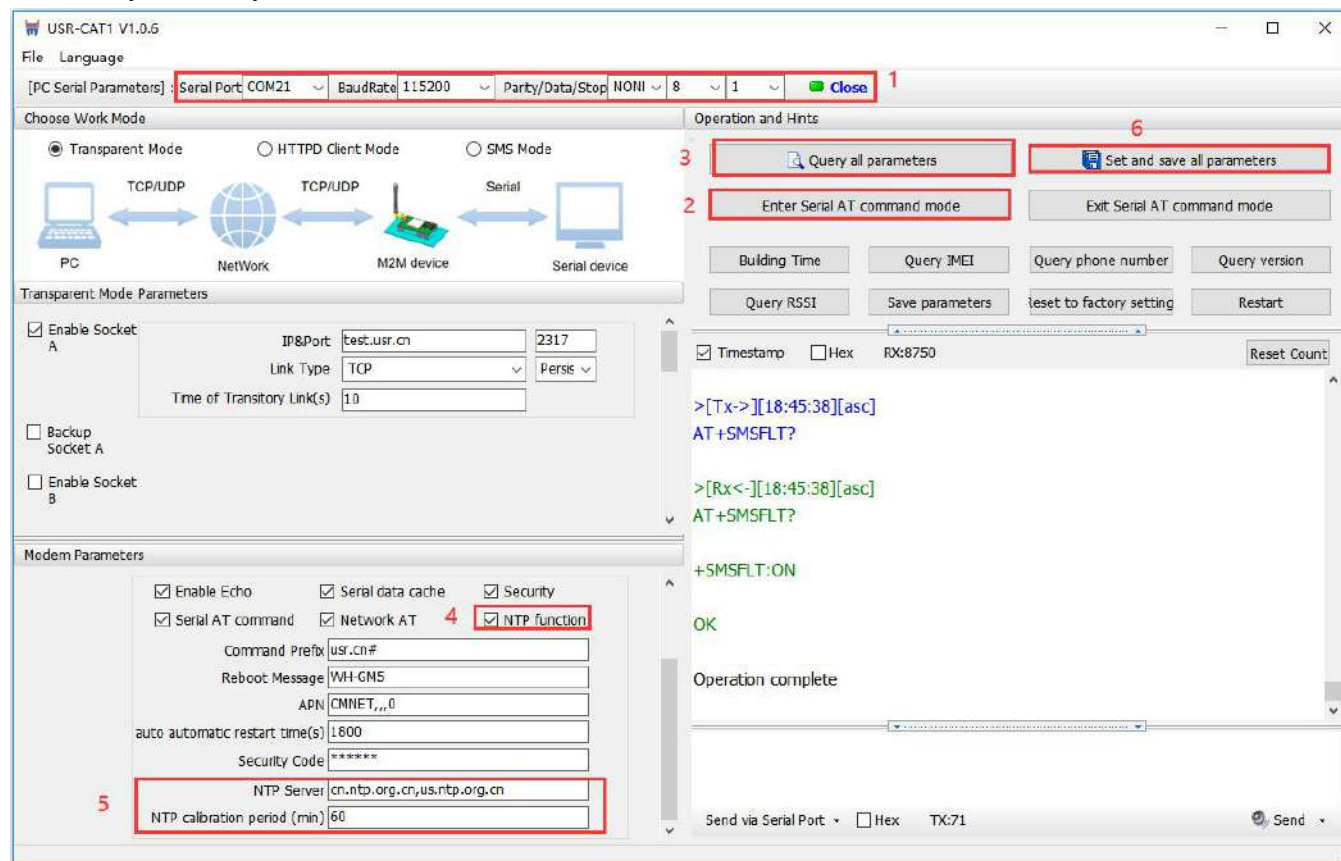
	Command	Operation
1	+++a	Enter serial AT command mode
2	AT+SIGNINAT=usr_cn	Login command
3	AT+VER	Query the firmware version
4	AT+SIGNINAT=usr_cn#	Change the password
5	AT+S	Save all parameters and restart

6.7. NTP

WH-LTE-7S1-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

6.8. FTP Upgrade

7S1-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](#)".

6.9. Base Station Geolocation

WH-LTE-7S1-E supports base station geolocation function, and can obtain general location of the device through the operator's network. Base station positioning information can be obtained through serial AT command or SMS AT command.

Command	Function	Default parameter
AT+LBS	Query station geolocation information	Empty

6.10. Restore to Factory Default Settings

1. Hardware reset: After power on, pull down the "Reload" pin for 3~15S to restore it to factory parameters.
2. Software reset: After enter AT command mode, send "AT+CLEAR" from the serial port to restore the module.

6.11. Timeout Restart

WH-LTE-7S1-E supports timeout restart function, defaults to be enabled, 1800s. When there is no data in 30min, the module will restart automatically. You can change it via AT command: AT+RSTIM.

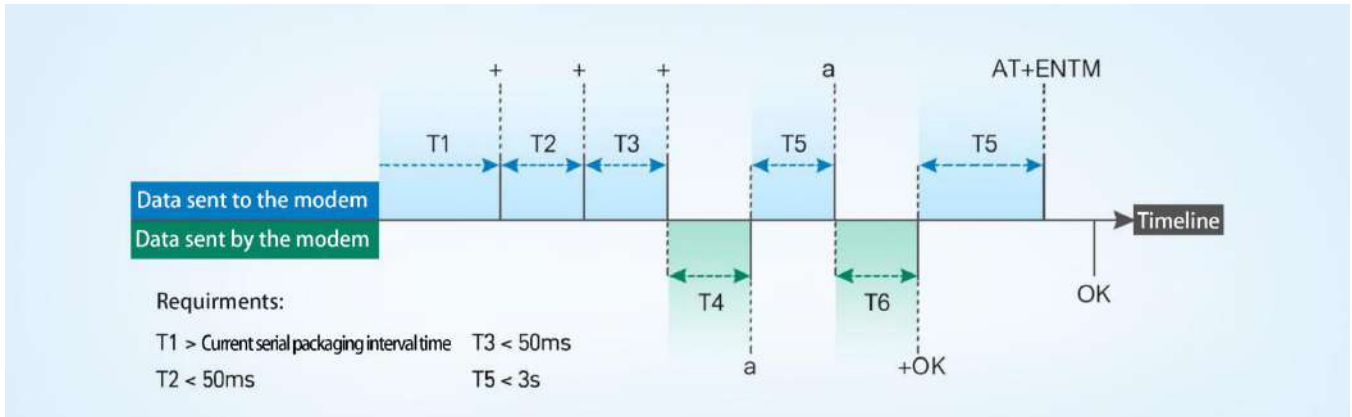
7. AT Commands

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.

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

For detailed AT command set, please check "[AT Command Set](#)".

7.1. 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 module has changed to AT command mode.
5. Then can send AT commands to the module.

➤ Exit AT command mode:

1. Send "AT+ENTM" from the serial port.
2. Receiving "+ok" means the module has exited AT command mode.

7.2. 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 "usr.cn#".

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

```
>[Tx->][10:18:49][asc]
usr.cn#AT+SOCKA

>[Rx<-][10:18:49][asc]
usr.cn#
+SOCKA:TCP,test.usr.cn,2317

OK
```

Operation complete

usr.cn#AT+SOCKA

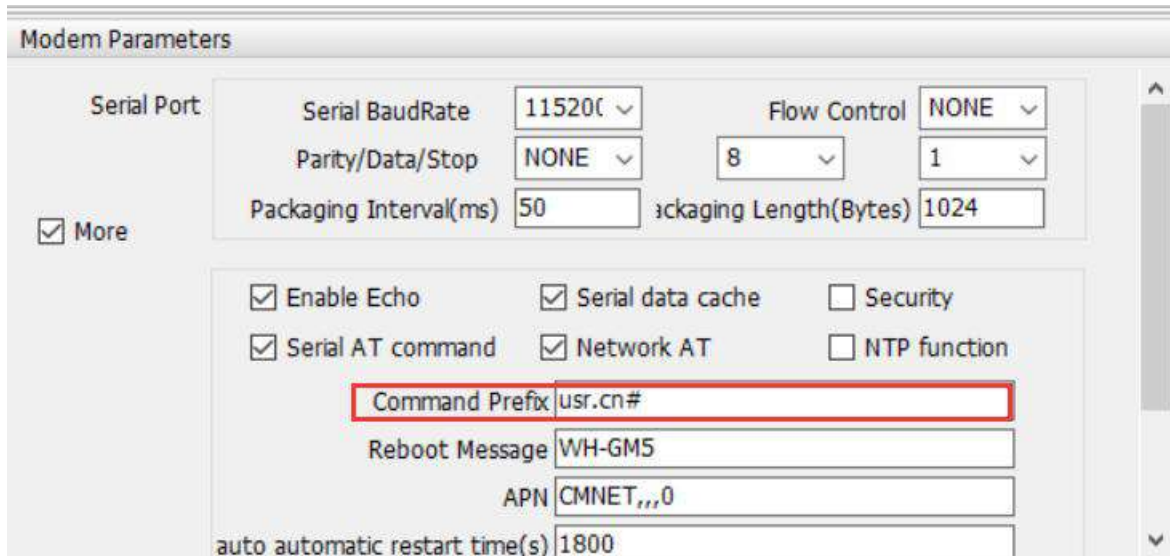
Send via Serial Port

TX:17

Send

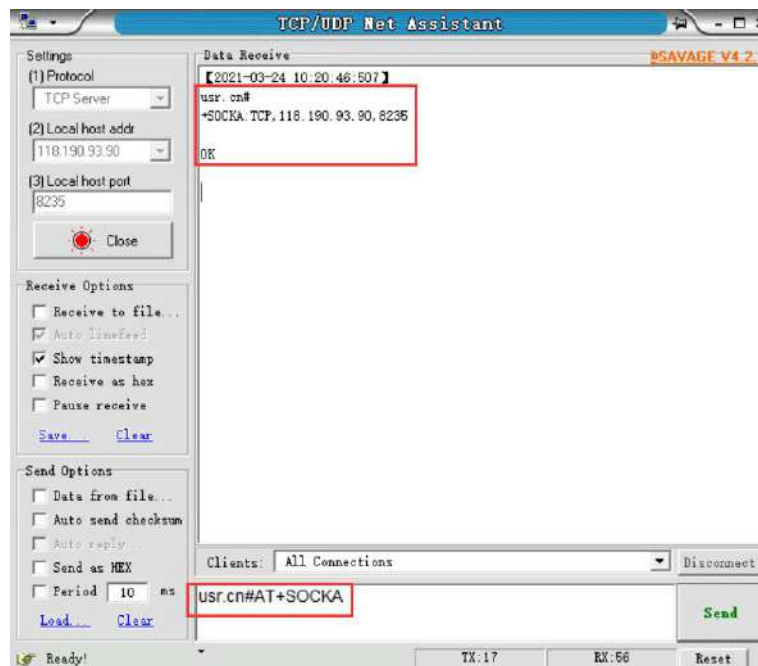
7.3. Network AT Commands

In transparent mode, you can also send "Command prefix+AT command" from the network side to query or change the module's parameter settings.



The image shows the 'Modem Parameters' configuration window. The 'Command Prefix' field is highlighted with a red box and contains the text 'usr.cn#'. Other visible fields include 'Serial BaudRate' (115200), 'Flow Control' (NONE), 'Parity/Data/Stop' (NONE, 8, 1), 'Packaging Interval(ms)' (50), 'Packaging Length(Bytes)' (1024), 'Enable Echo' (checked), 'Serial data cache' (checked), 'Security' (unchecked), 'Serial AT command' (checked), 'Network AT' (checked), 'NTP function' (unchecked), 'Reboot Message' (WH-GM5), 'APN' (CMNET,,,0), and 'auto automatic restart time(s)' (1800).

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



The image shows the 'TCP/UDP Net Assistant' window. The 'Data Receive' section shows a timestamped message: '2021-03-24 10:20:46:507' followed by 'usr.cn#', '+SOCKA: TCP, 118.190.93.90, 8235', and 'OK'. The 'Data Send' section shows the command 'usr.cn#AT+SOCKA' entered in the input field. The 'Settings' section on the left shows 'Protocol' set to 'TCP Server', 'Local host addr' as '118.190.93.90', and 'Local host port' as '8235'.

7.4. SMS AT Commands

If we know the phone number of the SIM card in 7S1-E, we can also query or modify the parameters of it by sending SMS AT command.

For example: query firmware version, there is a carriage return and line feed after the AT command.

usr.cn#AT+VER

4 min ago

usr.cn#

+VER:V1.2.04.000000.0000

OK

4 min ago



Text message

