

USR-G786-G User Manual

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1. Introduction

1.1. Overview

USR-G786-G is the cellular product launched in 2020, high speed low latency and global band . It has perfect functions and covers most common application scenarios. It can realize bidirectional data transparent transmission between serial port and network by simple settings. And it supports HTTPD mode, SMS mode, customized identity package, heartbeat package, supports 2 sockets, TCP Server, **FTP upgrade** and remote self-upgrade.

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- Tiny Size Serial to Ethernet Converters
- Industrial 4G Routers
- Industrial Cellular Modems
- Industrial Ethernet Gateways
- Serial to WiFi Converters
- Embedded Cellular Modules
- Embedded Ethernet Modules
- Industrial Ethernet Switches
- Embedded WiFi Modules
- CAN to Ethernet Converters
- LPWAN



USR-G786-G
RS485 Electrical Isolation Protection 4G IP cellular modem

USR-G786-G is a RS485 Electrical Isolation Protection 4G IP cellular modem which has perfect functions and covers most of the conventional application scenarios. User can use the cellular modem USR-G786-G to realize data transmission between RS232 / RS485 and 4G network through simple configuration.

Global Bands, Covering Global Regions
 Terminal Interface
 RS485 Electrical Isolation
 High Reliability, High Rate
 Low Latency
 Support USR Cloud Platform
 FOTA Remote Upgrade

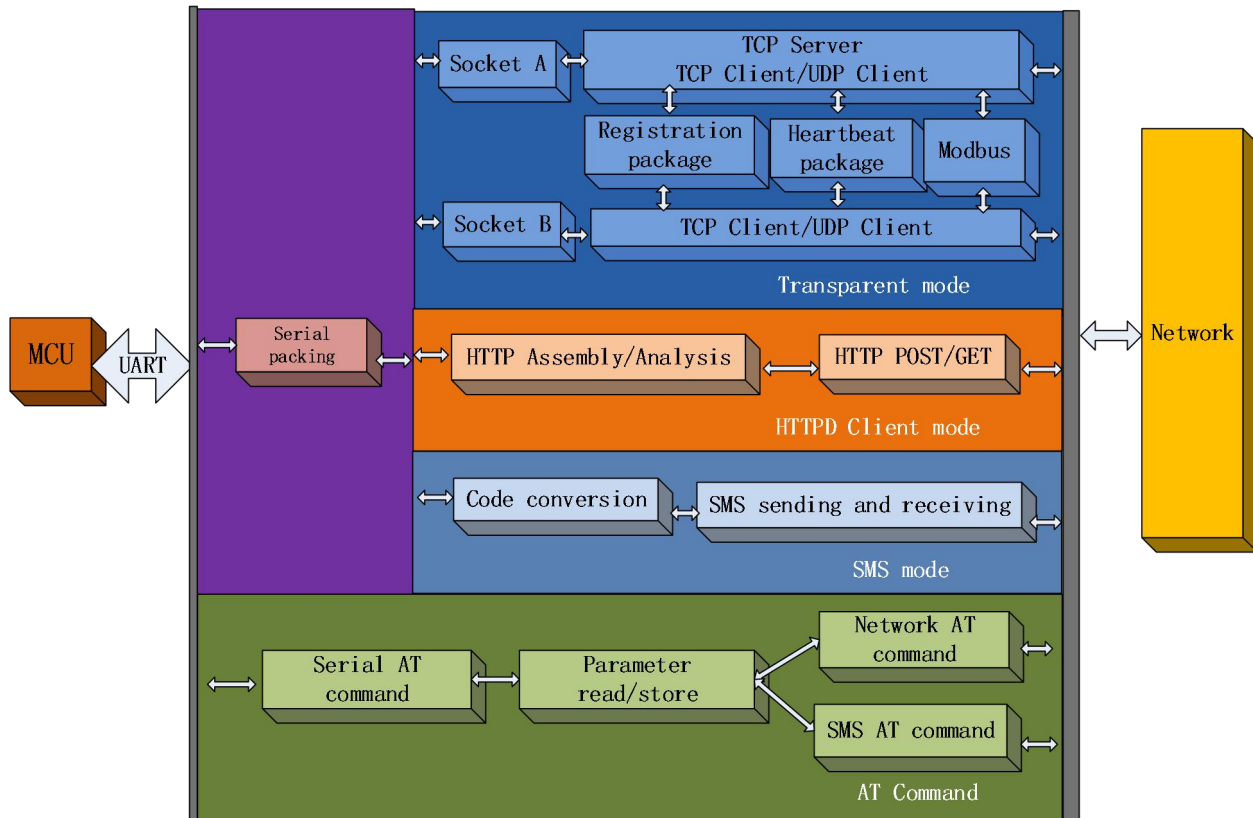
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1.2. Features



- Supports global bands.
- Supports 2 sockets, TCP Server, TCP Client and UDP Client.
- Hardware watchdog.
- Each socket supports buffering 5 packets of serial port data, each packet is up to 1000byte .
- Supports identity package and heartbeat package.
- Supports setting parameters by serial / SMS / network.
- Supports Modbus RTU to Modbus TCP.
- Supports base station positioning.
- Supports multiple work modes: transparent (transmission) mode, HTTPD Client mode and SMS mode.
- Supports basic commands.
- Supports remote upgrade, keep the firmware up to date.
- Supports sending English SMS.

2. Get Started

2.1. Specification

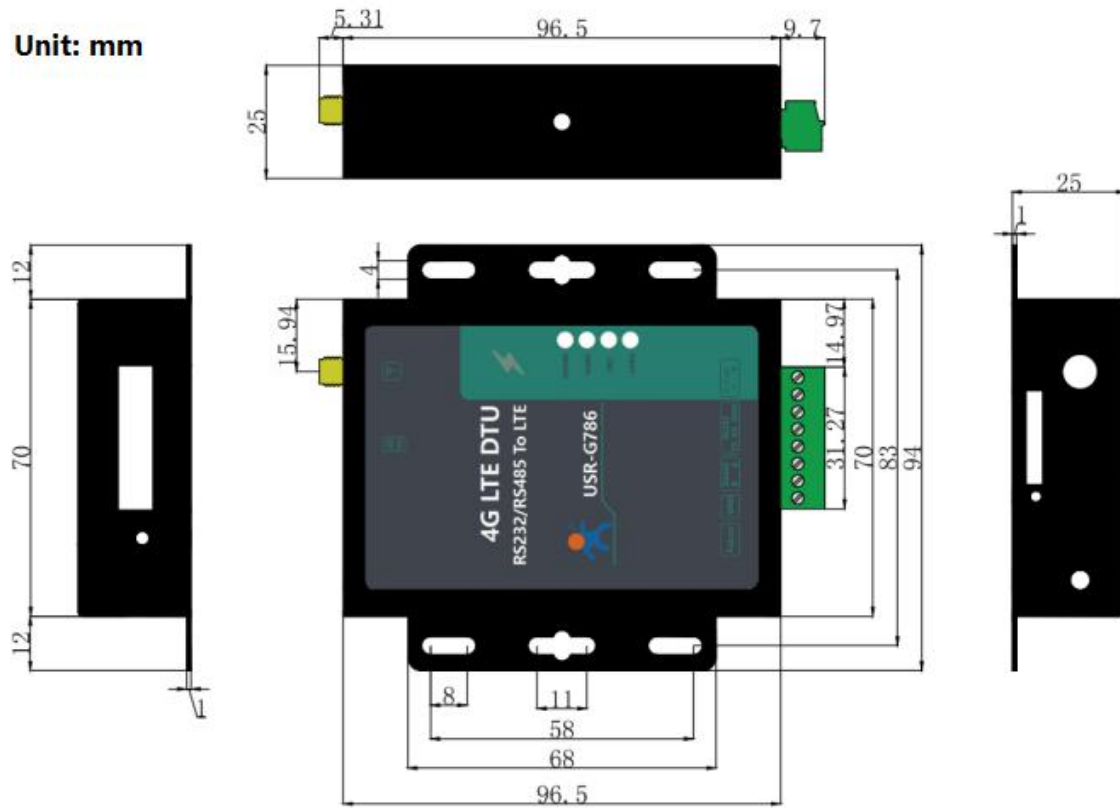
Parameter	Item	Index	
Wireless Parameters	Wireless standard	FDD-LTE, TDD-LTE, UMTS, GSM	
	Standard frequency range	FDD-LTE	Band 2/4/5/12/ 13
	Transmitting power	TDD-LTE	+23dBm±2dB(Power class 3)
	Technical specifications	FDD-LTE	Download 150Mbps, upload 50Mbps
	Antenna	SMA interface	
Hardware parameters	Data interface	RS232: 2400bps - 460800bps	
		RS485: 2400bps - 230400bps	
	Power protection	Anti-surge, ESD protection, anti-reverse connection	
	Serial protection	RS485: Anti-surge, ESD protection RS232: ESD protection	
	RS485 Up and down resistance	2.2KΩ	
	Working voltage	DC 9V~36V	
	Working current	48.95mA-54.78mA	
	Working temperature	-35°C - 75°C	
	Storage temperature	-40°C - 90°C	
	Size (mm)	111.51*94*25(L*W*H)	

Software parameters	Work mode	Transparent mode, HTTPD mode, SMS mode
	Setting command	AT+Command
	Network protocol	TCP/UDP/DNS/HTTP/FTP
	Maximum TCP connection number	2
	User configuration	Serial AT command, Net AT command, SMS AT command
	Customer application software	Support customized application software
Software function	Domain name resolution DNS	Support
	Modbus protocol conversion	Support
	Simple transmission	Support TCP Client/TCP Server/UDP Client
	SMS functions	Support
	HTTP transmission	Support
	Heartbeat package	Support
	Identity package mechanism	Custom identity package/ICCID /IMEI
	FTP upgrade	Support
	Remote update	Support

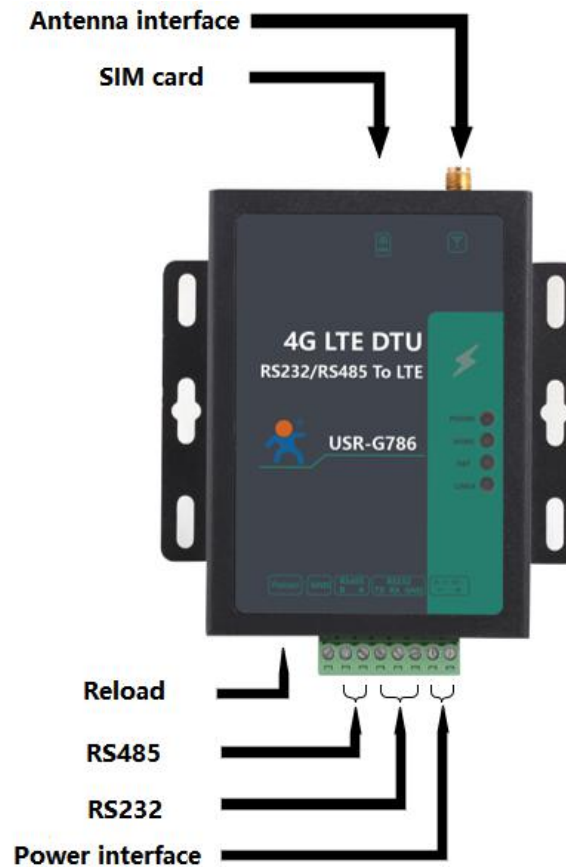
2.2. Hardware

2.2.1. Dimensions

Unit: mm



2.2.2.Interface



2.2.3.Indicators

There are four indicators on USR-G786-G, PWR,WORK,NET,LINKA.

Indicator	Function	Status
POWER	Power indicator	Always on when power supply working normally
WORK	System operation indicator.	Flashing after system running
NET	Network status indicator	Always on after registering the network
LINKA	Socket A indicator	Always on after socket A is connected

2.3. Connecting Hardware

2.3.1. Hardware Preparation

If you have purchased, there will be the following accessories:

			
USR-G786-G	Sucker antenna	Power adapter	Conversion cable

Required additional equipment:



RS232 serial to USB cable



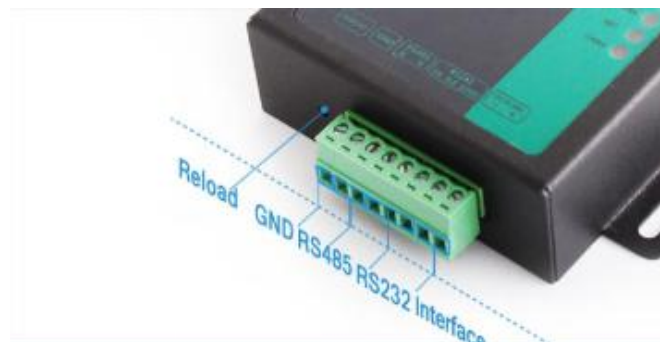
PC

2.3.2.Installing SIM card and antenna



Press the yellow button and the SIM card slot will pop up. Then Install the antenna.

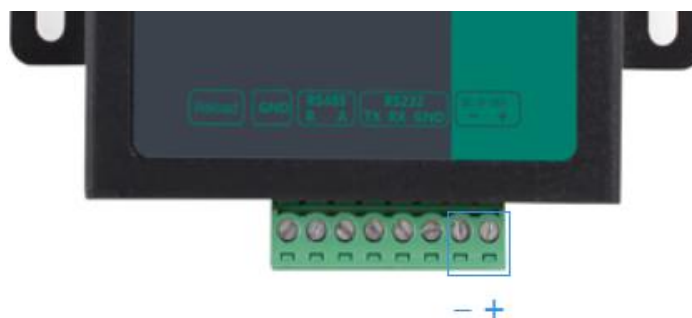
2.3.3.Serial Connecting



RS232: When connecting to a RS232 serial device, connect TX pin of RS232 interface of G786-G to RX pin of the serial device, RX pin of G786-G to TX pin of the serial device, GND to GND.

RS485: When connecting to a RS485 serial device, connect A pin of RS485 interface of G786-G to A pin of the serial device, B pin of G786-G to B pin of serial device.

2.3.4.Power Supply



Connect 9-36V DC power adapter to the terminal to power G786-G. Then "POWER" indicator will always on and the "WORK" indicator will flash.

3. Utility Configuration

3.1. Download the Utility

Please download the utility in this link:

<https://www.usriot.com/products/rs485-electrical-isolation-protection-4g-ip-cellular-modem.html>

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Specifications

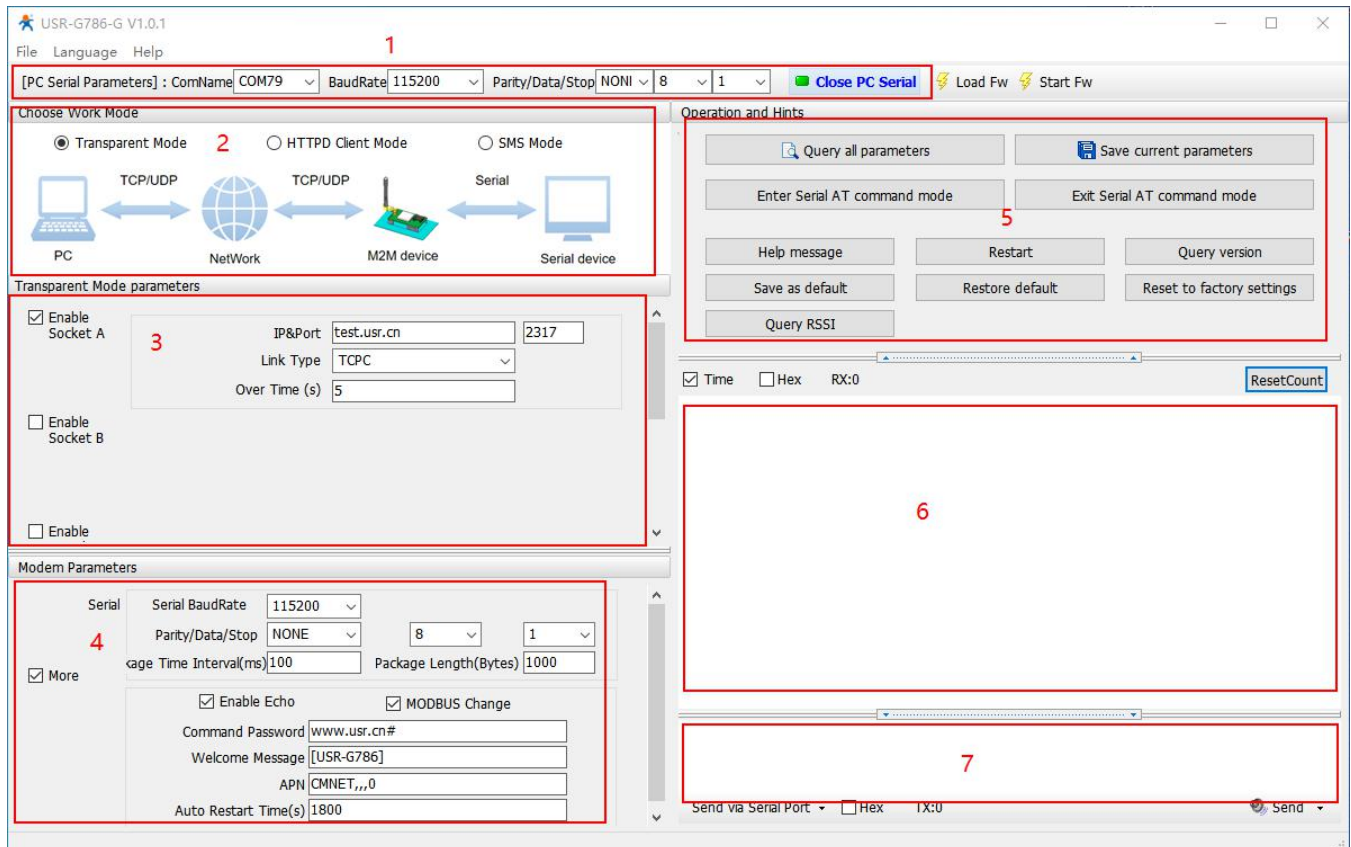
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Models

3.2. Starting the Configuration Utility

USR-G786-G Software is shown as following:

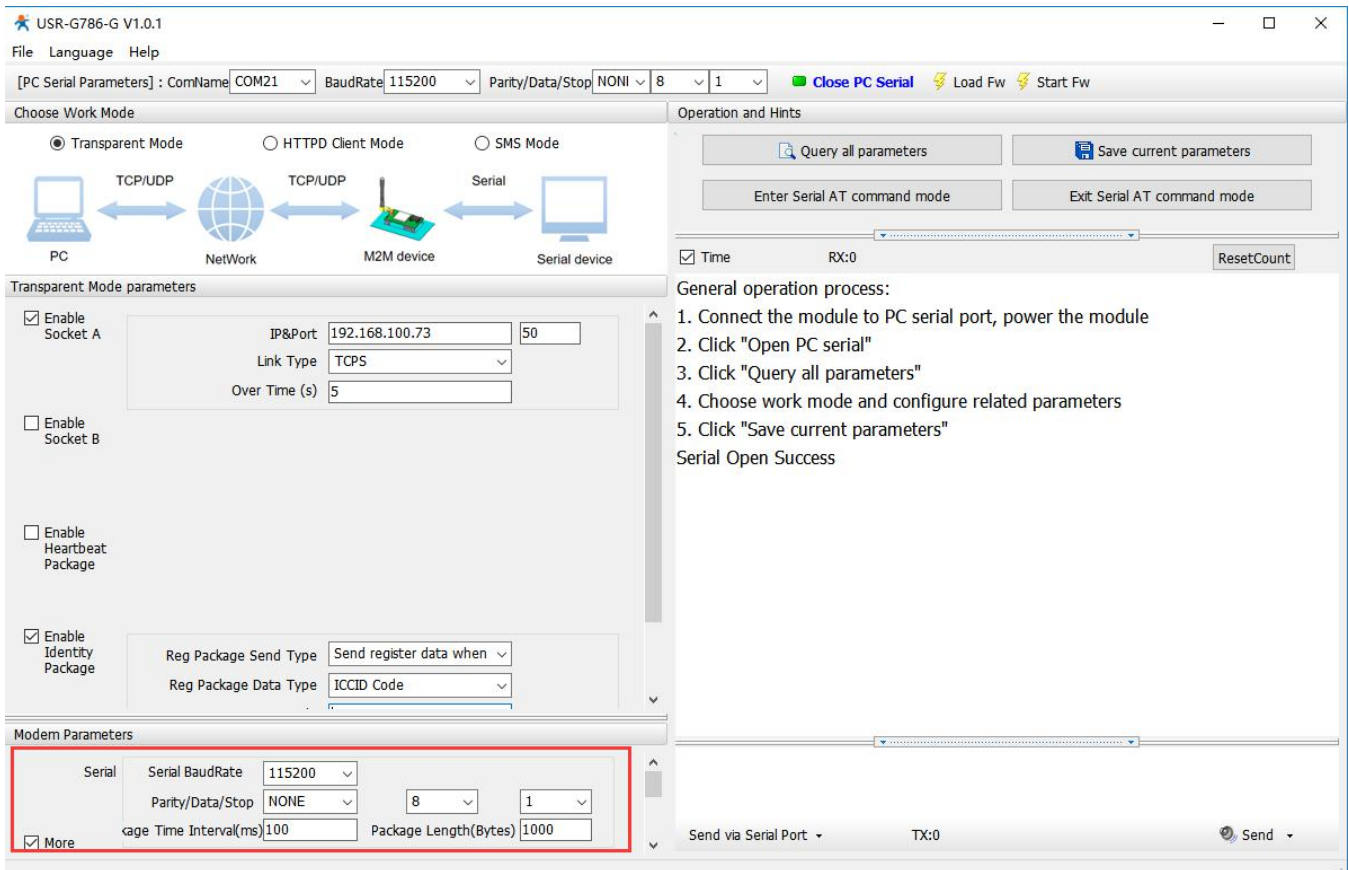


Description:

1. In PC serial parameter setting area, it is necessary to set parameters consistent with the current serial port of DTU, otherwise it cannot communicate with DTU.
2. Working mode selection area, select the work mode of DTU.
3. In the parameter setting area of characteristic functions, set parameters related to DTU's featured functions
4. Modern parameter area, setup DTU 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 USR-G786-G must be consistent with the parameters of the serial device. Serial port parameters setting here are divided into two parts: serial port basic parameter and serial port framing parameter.

Figure 1 Serial port basic parameter

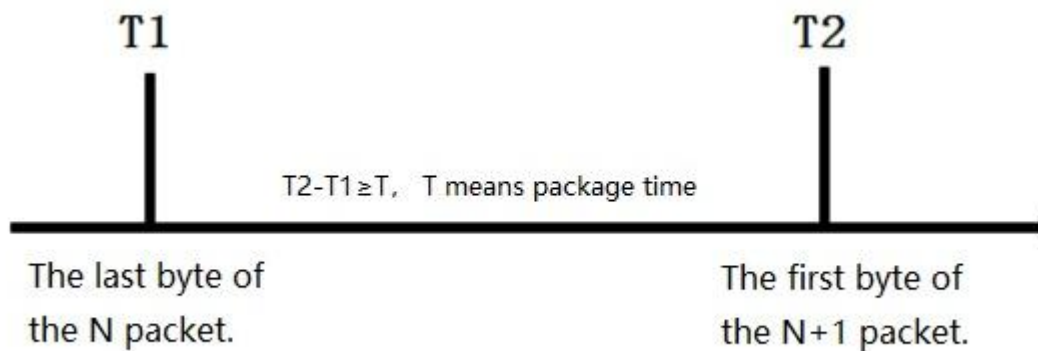
Item	Parameter
Baud rate	RS232: 2400,4800,9600,14400,19200,28800,33600,38400,57600,115200,230400,460800
	RS485: 2400,4800,9600,14400,19200,28800,33600,38400,57600,115200,230400
Data bit	8
Stop bit	1,2
Check bit	NONE
	EVEN

4.2. Frame forming mechanism

4.2.1. Time Trigger

When G786-G 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 100ms~60000ms. Factory default: 100ms.

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

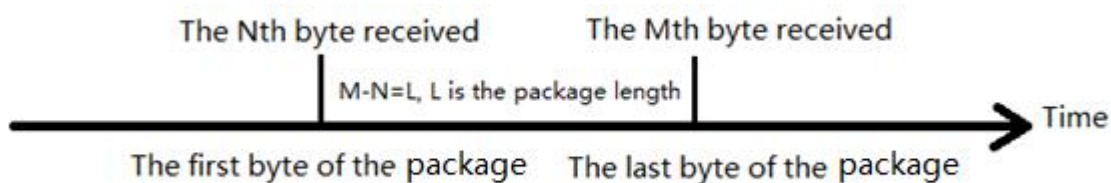


4.2.2. Length trigger

When G786-G 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 100~1000. Factory default 1000.

(Note: when using "command password +AT command" function, the package length must be larger than the "command password +AT command", otherwise AT command is invalid)

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



4.2.3. Network Data Output Port

We need to set the output serial port of the USR-G786-G network data. Setting commands and parameters as follows:

Figure 3 Network data output serial port setting instructions

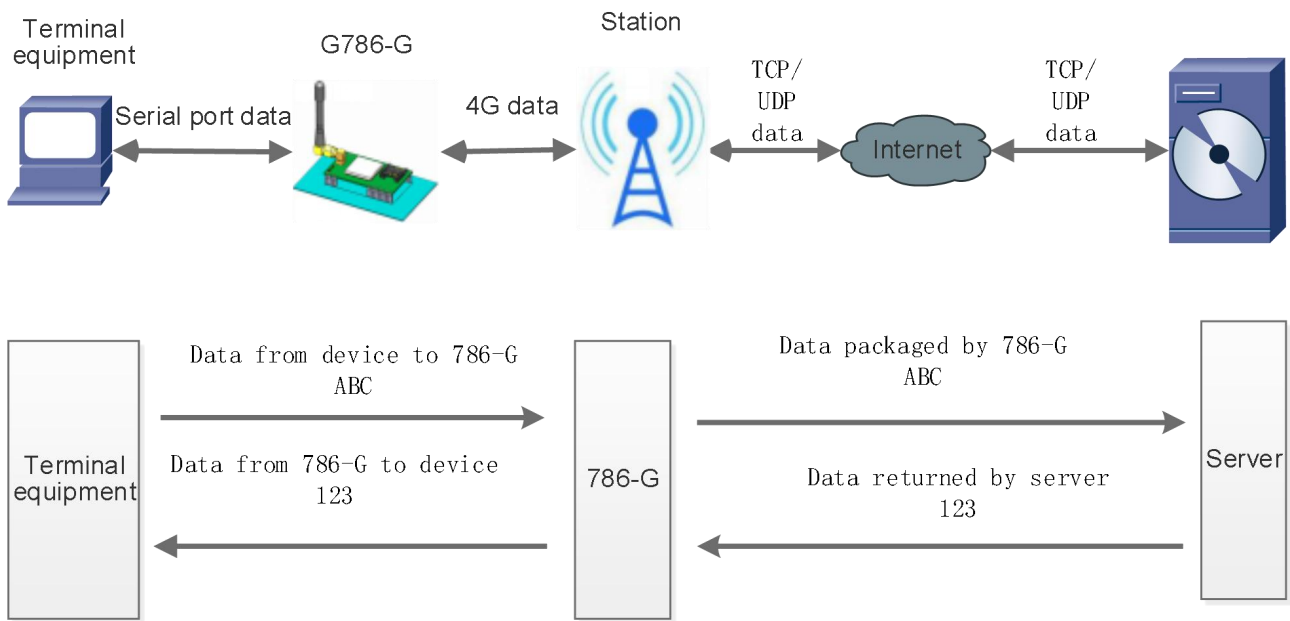
Command	Descriptions
AT+CMDPT=RS232	Data sent from network is output on 232 serial port.
AT+CMDPT=RS485	Data sent from network is output on 485 serial port.
AT+CMDPT=RSALL	Data sent from network is output on 232 and 485 port. (Default)

In order to ensure the data output efficiency, please select one serial port as the network data output port according to needs.

5. Selecting an Operating Mode

USR-G786-G has three working modes: net transparent mode, HTTPD Client mode and SMS mode.

5.1. Net Transparent Mode



In this mode, user's serial device can directly send data to the specified network server through G786-G. Module can also receive data from the server and directly forward to the serial device.

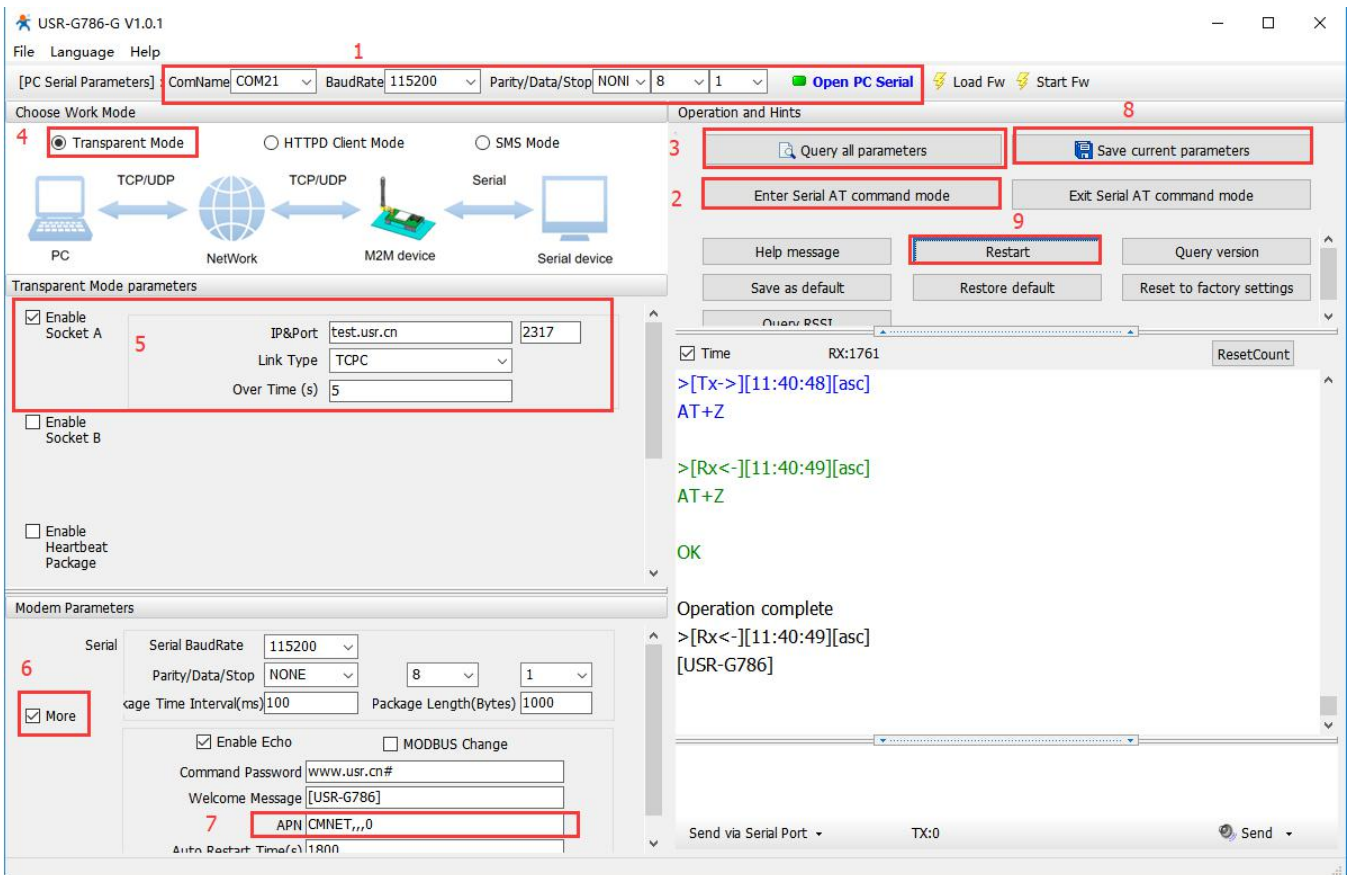
In this mode, users do not need to pay attention to the data conversion process between serial port and network data packets. They only need to set simple parameters to realize the transparent transmission of data between serial devices and network servers.

G786-G supports 2 socket connections, Socket A and Socket B, which are independent of each other. Only Socket A supports as TCP Client, TCP Server and UDP Client. Socket B only supports TCP Client and UDP Client.

It supports up to 3 TCP Clients when works as a TCP Server. Because the conventional operator network can not be accessed through the external network, so for the Server function need to use a dedicated APN card.

5.1.1. TCP Client Mode

- ① Set parameters by software:



1. Open the setup software. Set the Serial port parameters according to the serial device and click "Open PC Serial".
2. Click "Enter Serial AT command mode" and wait for the device to enter AT command mode.
3. Click "Query all parameters" and wait for obtaining all current parameters.
4. In "Choose Work Mode", select "Transparent Mode".
5. Set "IP&Port" to test.usr.cn and 2317, link type to TCPC(TCP Client).
6. Check "More". If using an APN card, need to set the APN information.
7. Set APN parameter: CMNET,,0. E.g: APN: CMNET, username: empty, password: empty, authentication method: NONE.
8. Click "Save current parameters".
9. Click the "Restart" button to restart the module.
10. After the device restarts, NET and LINKA lights will be on, then we can transmit data in both directions.

② Set by AT command:

1. Set the work mode to net transparent transmission:

AT+WKMOD=NET

2. Enable socket A:

AT+SOCKAEN=ON

3. Set socket A to TCP Client:

AT+SOCKA=TCPC,test.usr.cn,2317

4. Set APN. E.g: APN is CMNET, username is empty, password is empty, authentication method is NONE:

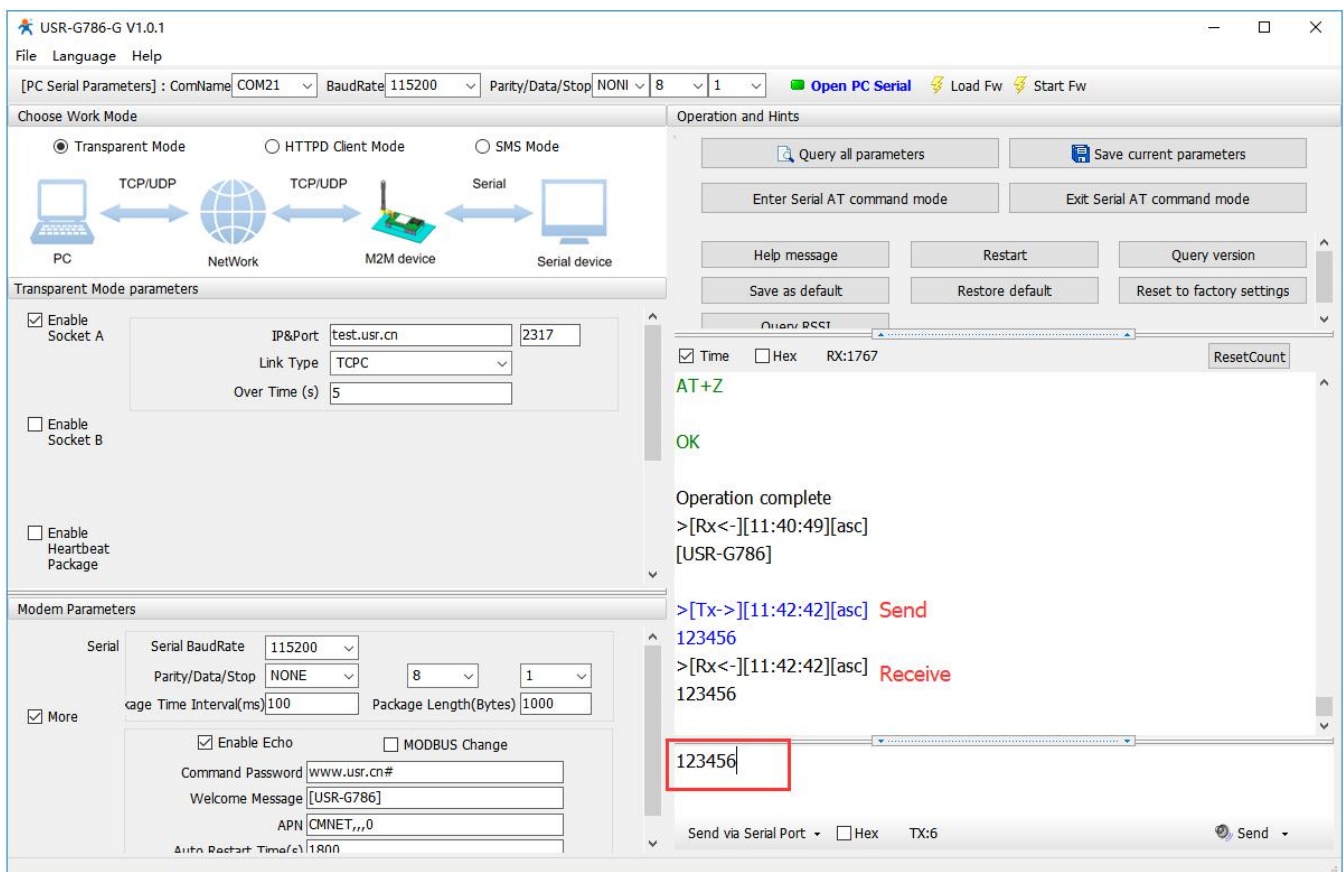
AT+APN=CMNET,,0

5. Reboot:

AT+Z

③ Test

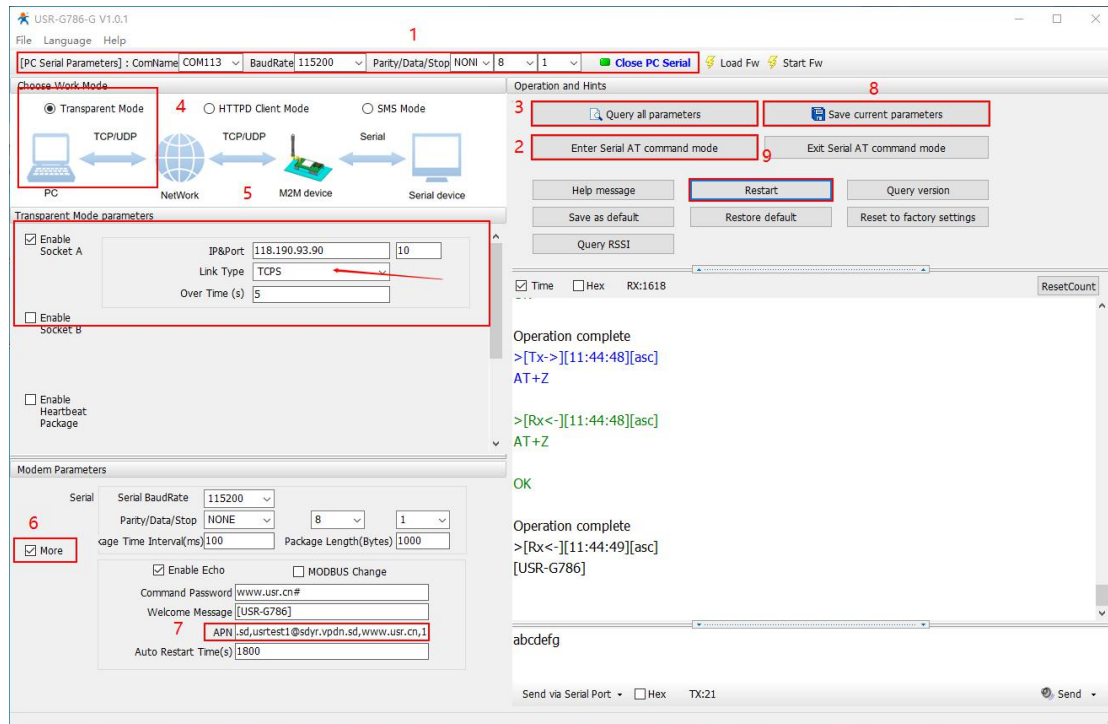
Connect the serial port of USR-G786-G to the computer via a RS232 serial to USB cable, send data from the setup software, our test server will return the same data to serial port.



5.1.2. TCP Server Mode

TCP Server function needs to be test through an APN dedicated network card.

- ① Set parameters by setup software:



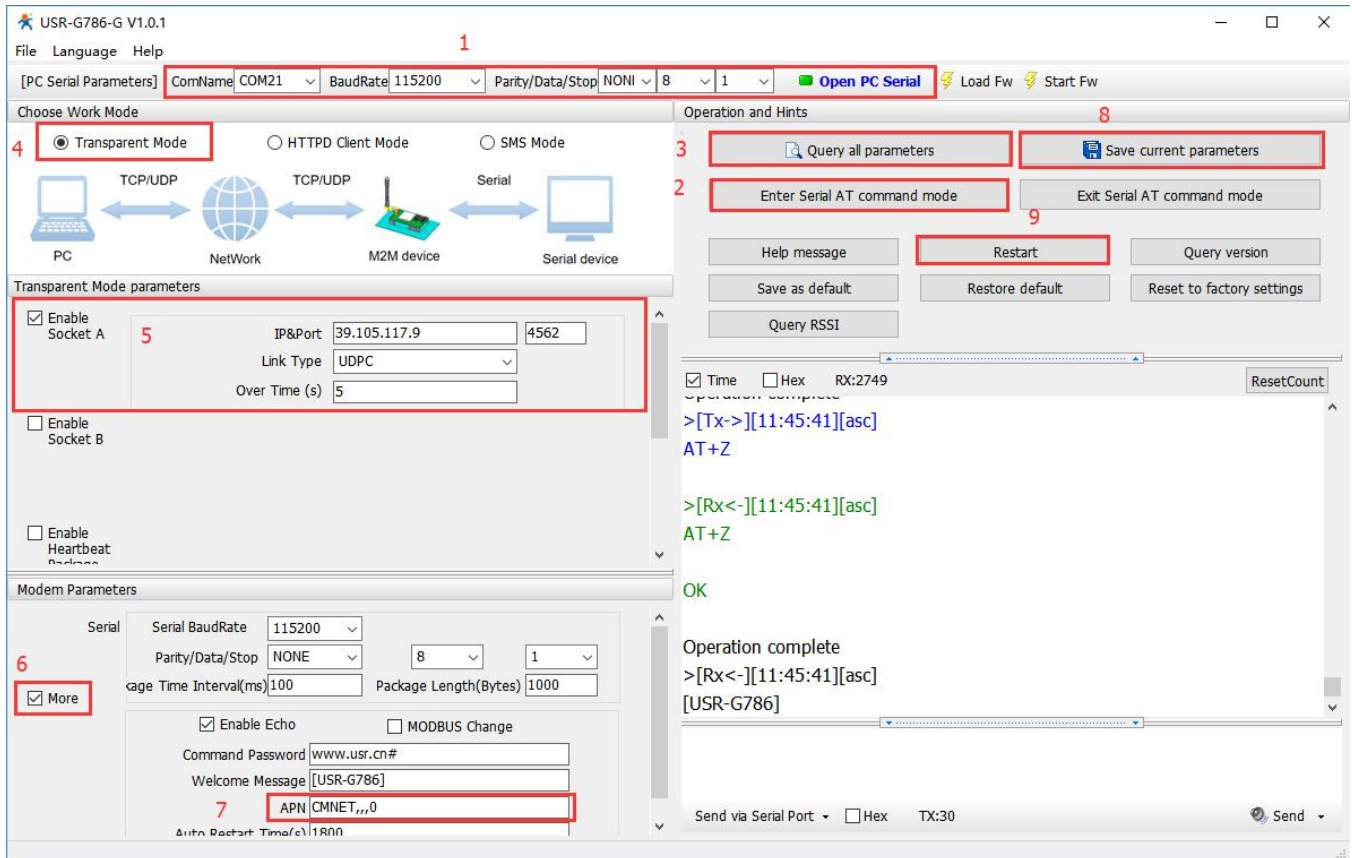
Device works as TCP Server, and need to be filled in the IP and port of itself in "IP & Port".

- ② Set by AT command:

- Set the work mode to net transparent mode:
AT+WKMOD=NET
- Enable socket A:
AT+SOCKAEN=ON
- Set socket A as TCP Server, local port 2317, IP has no reference meaning in Server:
AT+SOCKA=TCPS,test.usr.cn,2317
- Set APN. E.g: APN:CMNET, username: empty, password: empty, authentication method: NONE:
AT+APN=CMNET,,,0
- Reboot:
AT+Z

5.1.3.UDP Client Mode

- ① Set parameters by software:



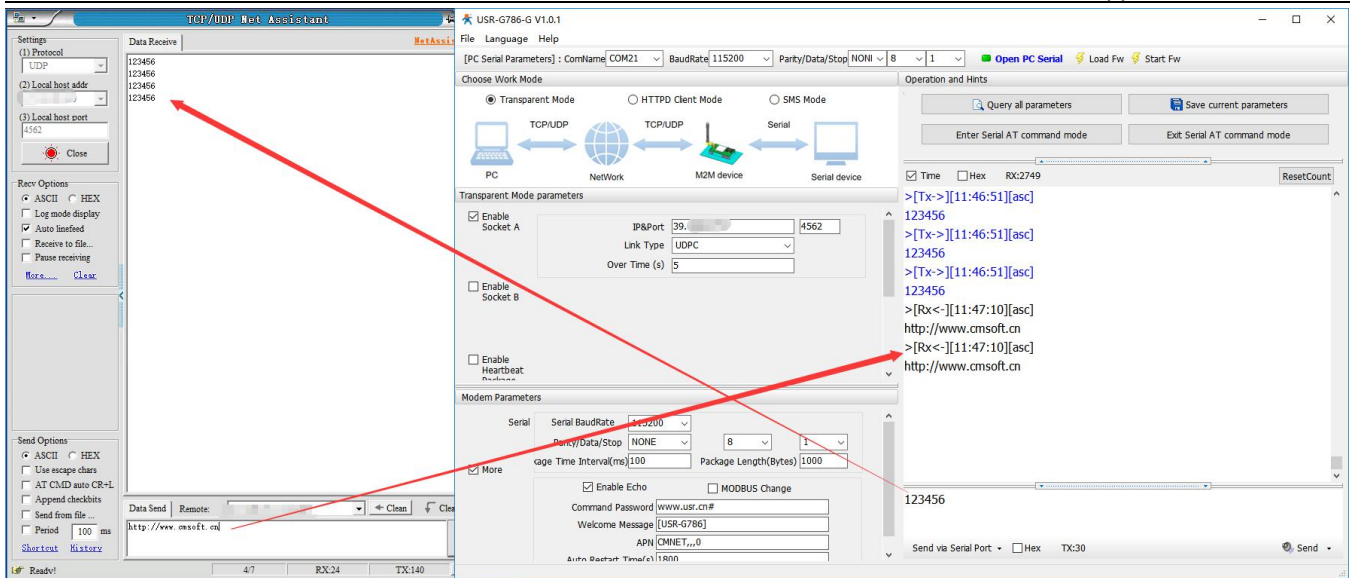
Set the link type to UDPC, fill in the IP and port of UDC server.

- ② Set by AT command:

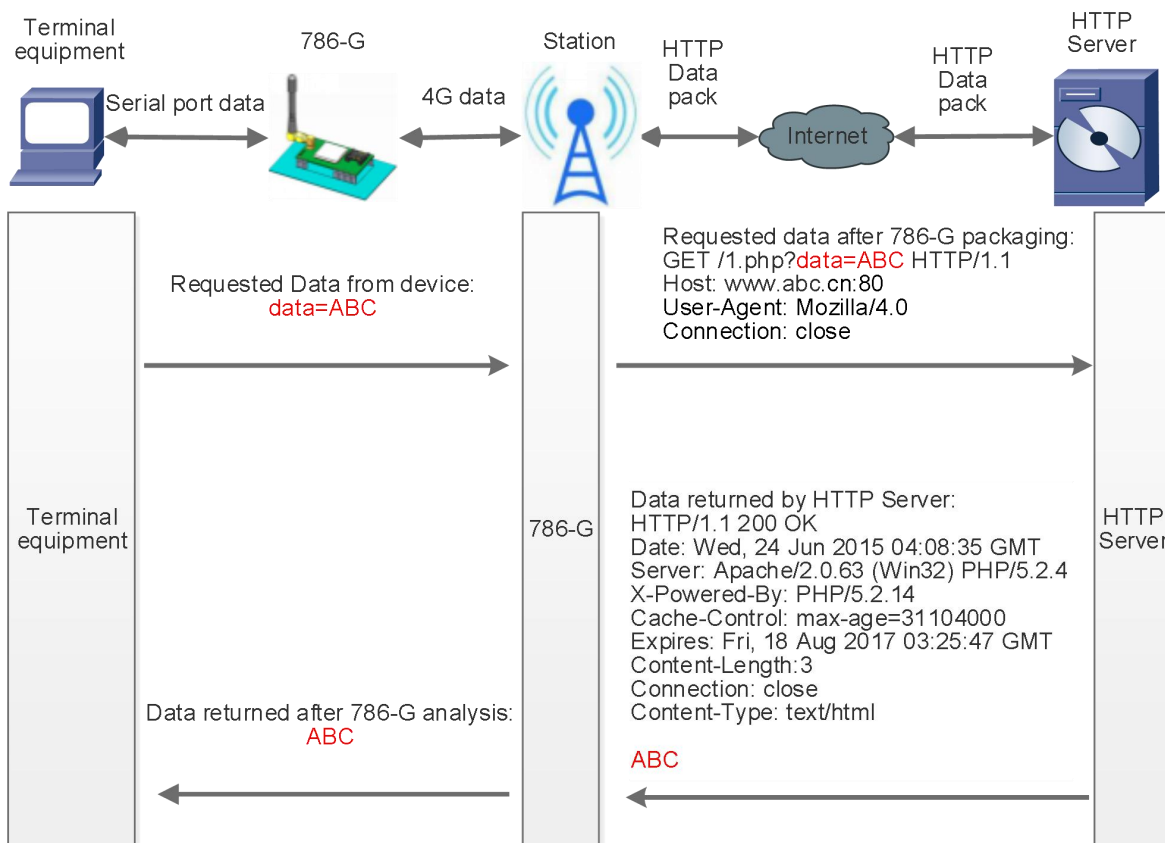
- Set the work mode to net transparent mode:
AT+WKMOD=NET
- Enable socket A:
AT+SOCKAEN=ON
- Set socket A as UDP Client, port 2317:
AT+SOCKA=UDPC,test.usr.cn,2317
- Set APN. E.g: APN:CMNET, username: empty, password: empty, authentication method: NONE:
AT+APN=CMNET,,0
- Reboot:
AT+Z

- ③ Test

Connect the serial port of USR-G786-G to the computer via a serial to USB cable, realize the data transmission of serial port and network



5.2. HTTPD Client Mode



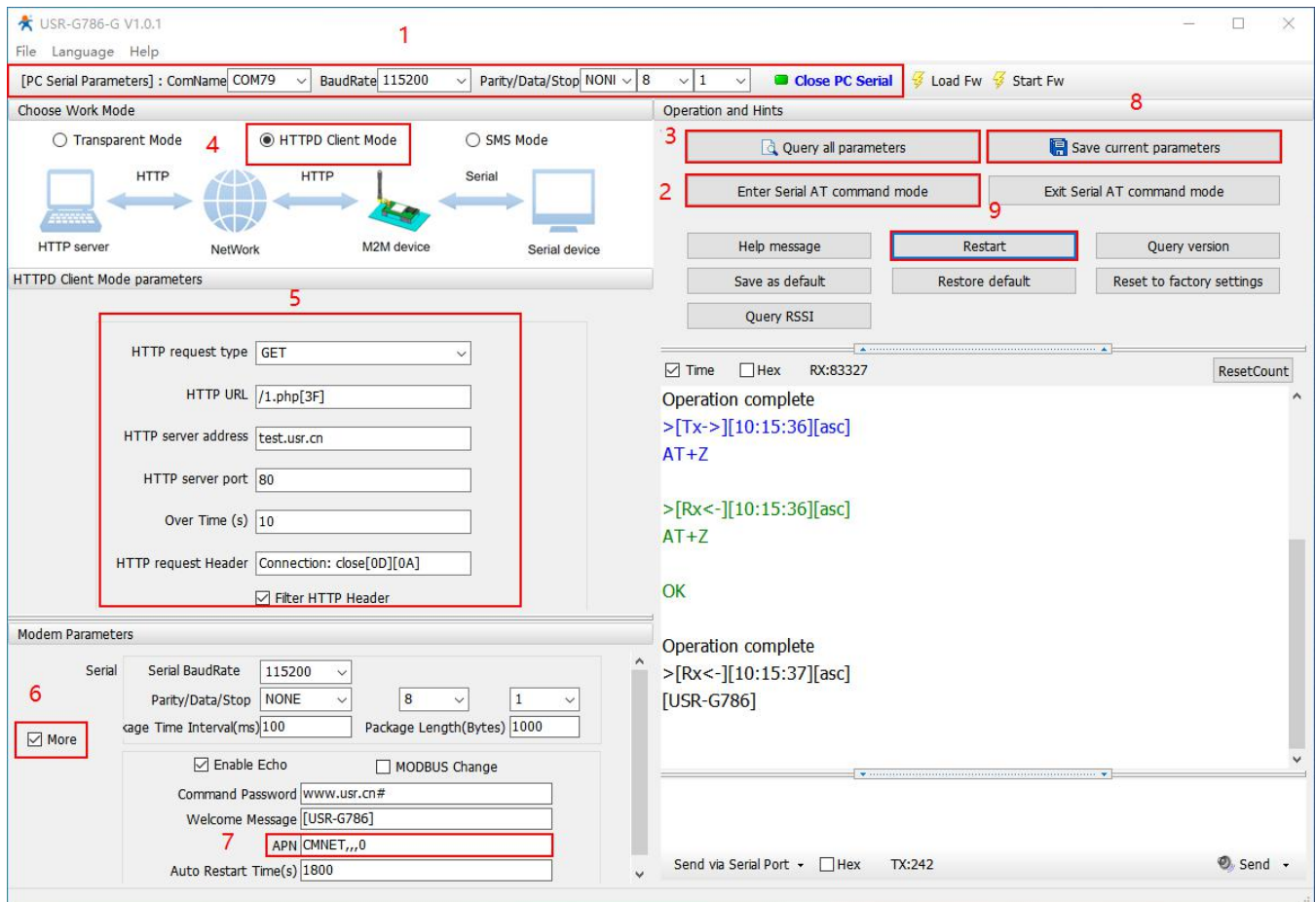
In this mode, user's terminal device can send request data to the specified HTTP server through this module, then the module receives data from HTTP server, parses and sends data to the serial device.

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. Customers can choose whether to filter HTTPD header data by AT command.

① Set parameters by software:



1. Open the setup software. Set the serial port parameters according to the serial device and click "Open PC Serial".
2. Click "Enter Serial AT command mode" and wait for the device to enter AT command mode.
3. Click "Query all parameters" and wait for obtaining all current parameters.
4. In "Choose Work Mode" column, select "HTTPD Client Mode".
5. Set HTTPD Client mode parameters.
6. Check "More".
7. If using an APN card, need to set the APN information.
Set APN parameter: CMNET,,0. E.g: APN: CMNET, username:empty, password:empty, authentication method: NONE.
8. Click "Save current parameters" to set and save all parameters.
9. Click "Restart" to restart the module.

② Set by AT command:

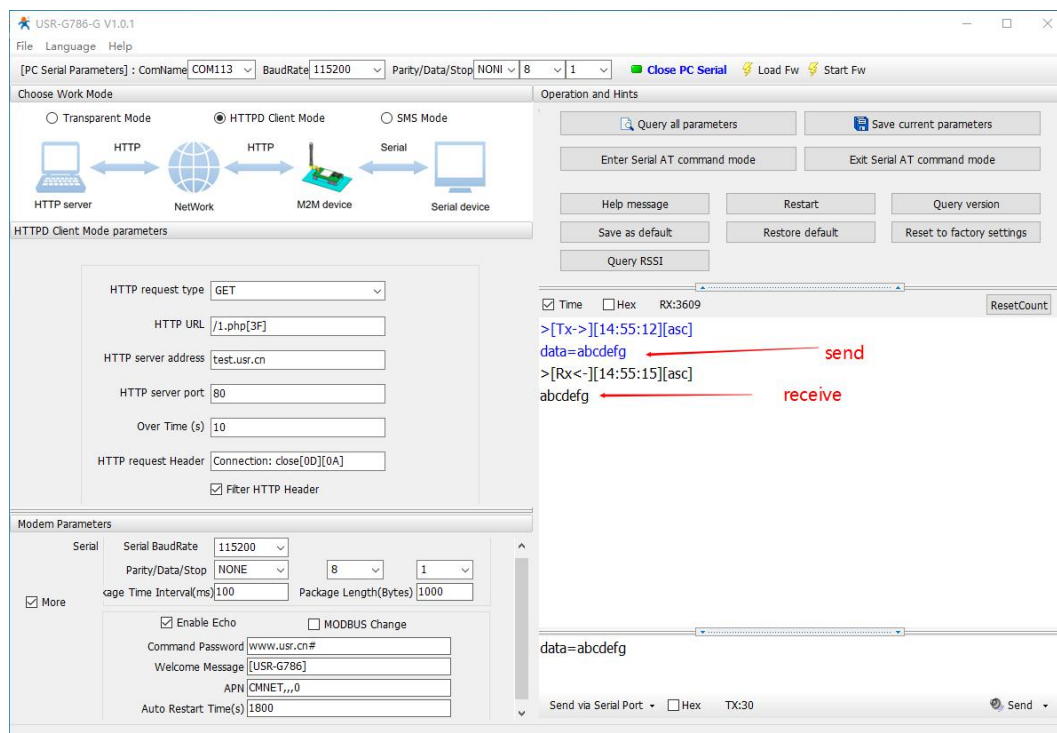
1. Set the work mode to HTTPD:

AT+WKMOD=HTTPD

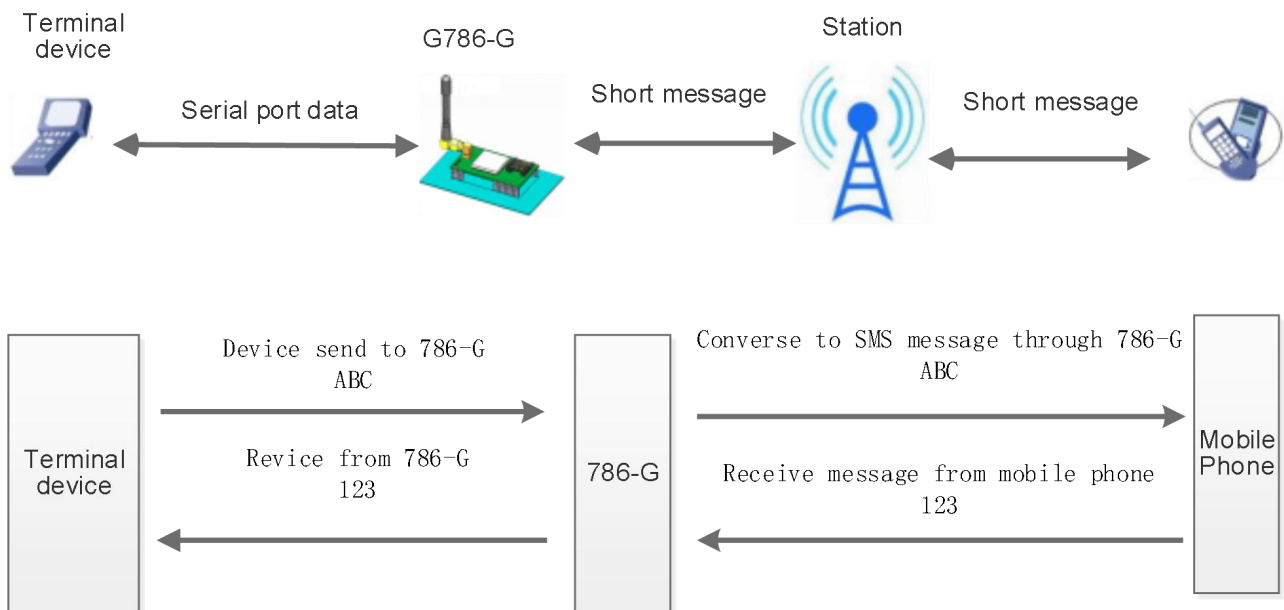
2. Set the request type:
AT+HTPTP=GET
3. Set HTTP URL:
AT+HTPURL=/1.php[3F]
4. Set the HTTP server address:
AT+HTPSV=test.usr.cn,80
5. Set HTTP request header:
AT+HTPHD=Connection: close[0D][0A]
6. Set HTTP over time:
AT+HTPTO=10
7. Whether to filter HTTP header:
AT+HTPFLT=ON
8. Reboot
AT+Z

③ 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

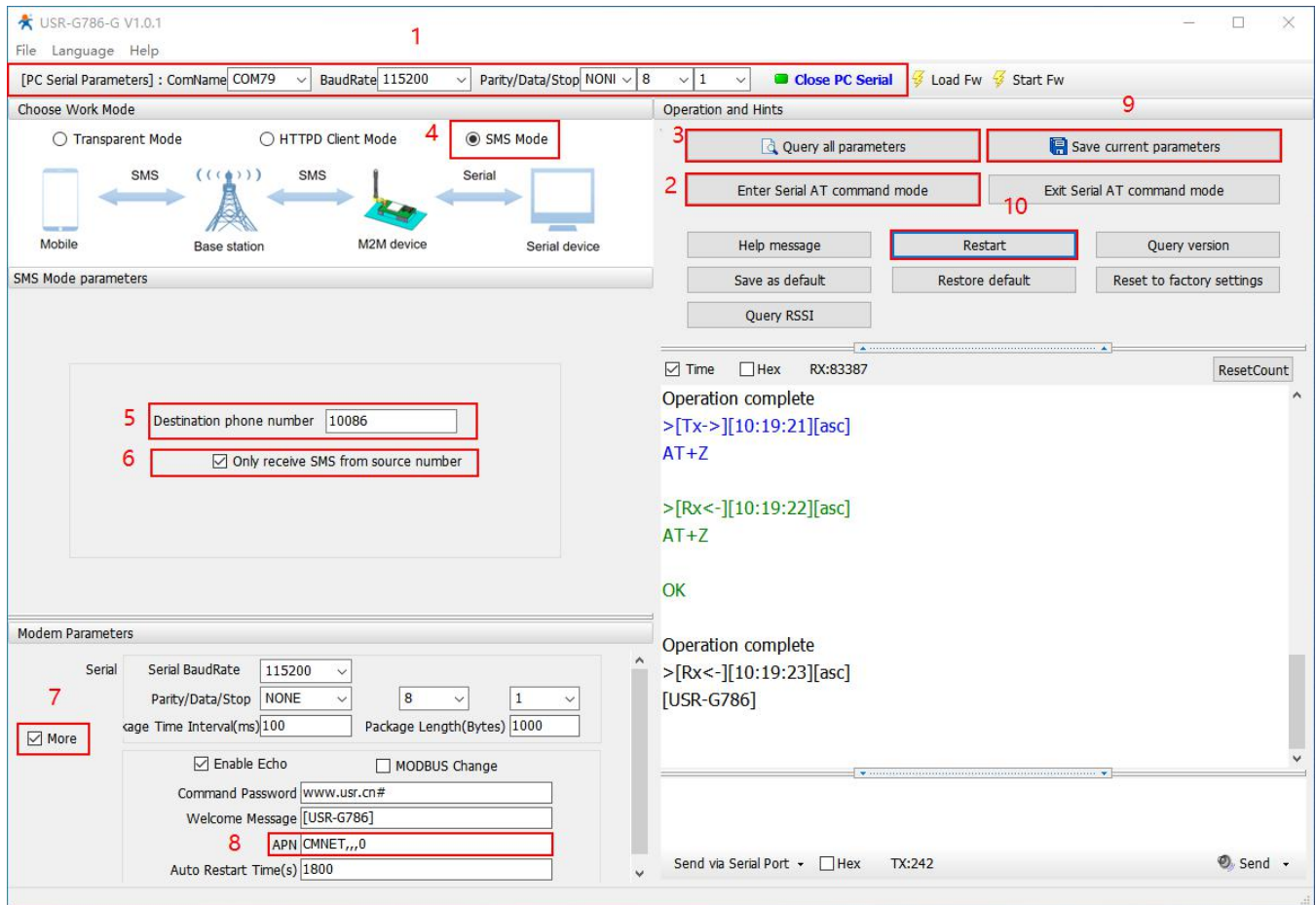


In this mode, user's serial device can send SMS to the specified mobile phone and receive SMS from any mobile phone. User can decide whether to transmit the data of the specified mobile phone to the serial device through settings.

Users do not need to pay attention to the data conversion process between serial port data and SMS. They only need to set simple parameters to realize transparent data communication between mobile phones and serial port devices.

If the user's serial device is placed in a remote place, G786-G can be used to check the running status of the device or control the running parameters by sending and receiving SMS.

- ① Set by software:



1. Open the setup software. Setting the serial port parameters according to the serial device and click "Open PC Serial".
2. Click "Enter Serial AT command mode" and wait for the device to enter AT command mode.
3. Click "Query all parameters" and waiting for obtaining all current parameters.
4. In "choose work Mode", select "SMS Mode".
5. Set the destination phone number to "10086".
6. If need to filter SMS from other mobile numbers, enable "Only receive SMS from source number".
7. Click "More".
8. Set APN parameter: CMNET,,0.
E.g: APN: CMNET, username:empty, password:empty, authentication method: NONE.
9. Click "Save current parameters" to set and save all parameters.
10. Click "Restart" to restart the module.

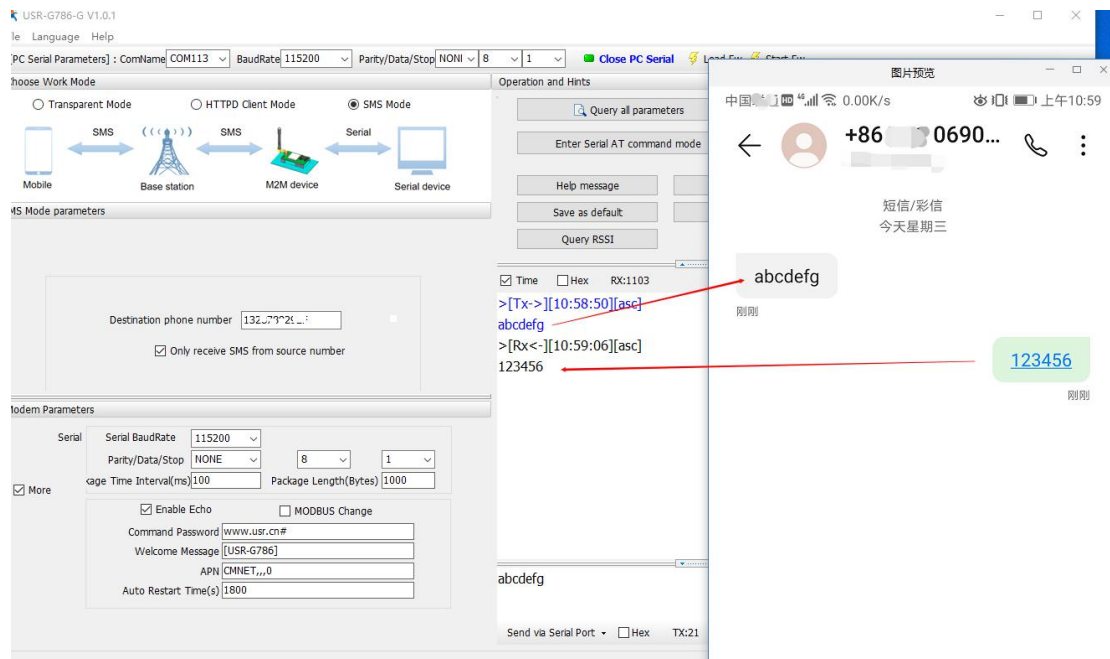
② Set by AT command:

1. Set work mode to SMS mode:
AT+WKMOD=SMS
2. Set the target mobile phone number to 10086. E.g:10086:
AT+DSTNUM=10086
3. Restart the module:
AT+Z

- Note:**
- 1. The target phone number of SMS should be added with the international number.**
 - 2. When non-target mobile phone number filtering is enabled, the non-target mobile phone number can still query or set parameters.**

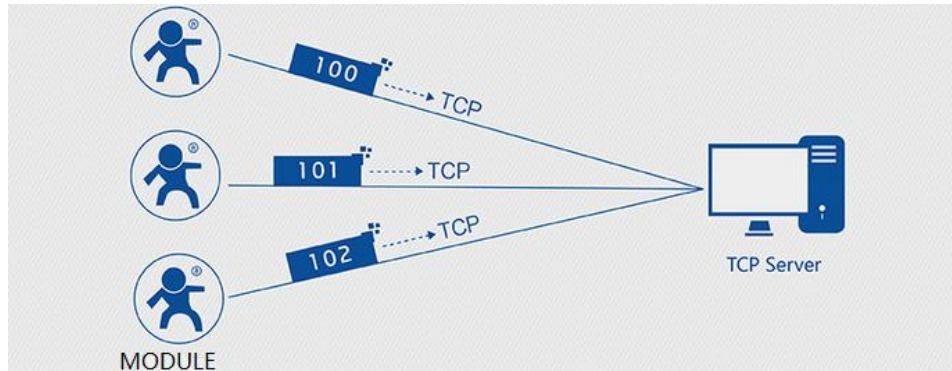
③ Test

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



6. General Function

6.1. Identity Package

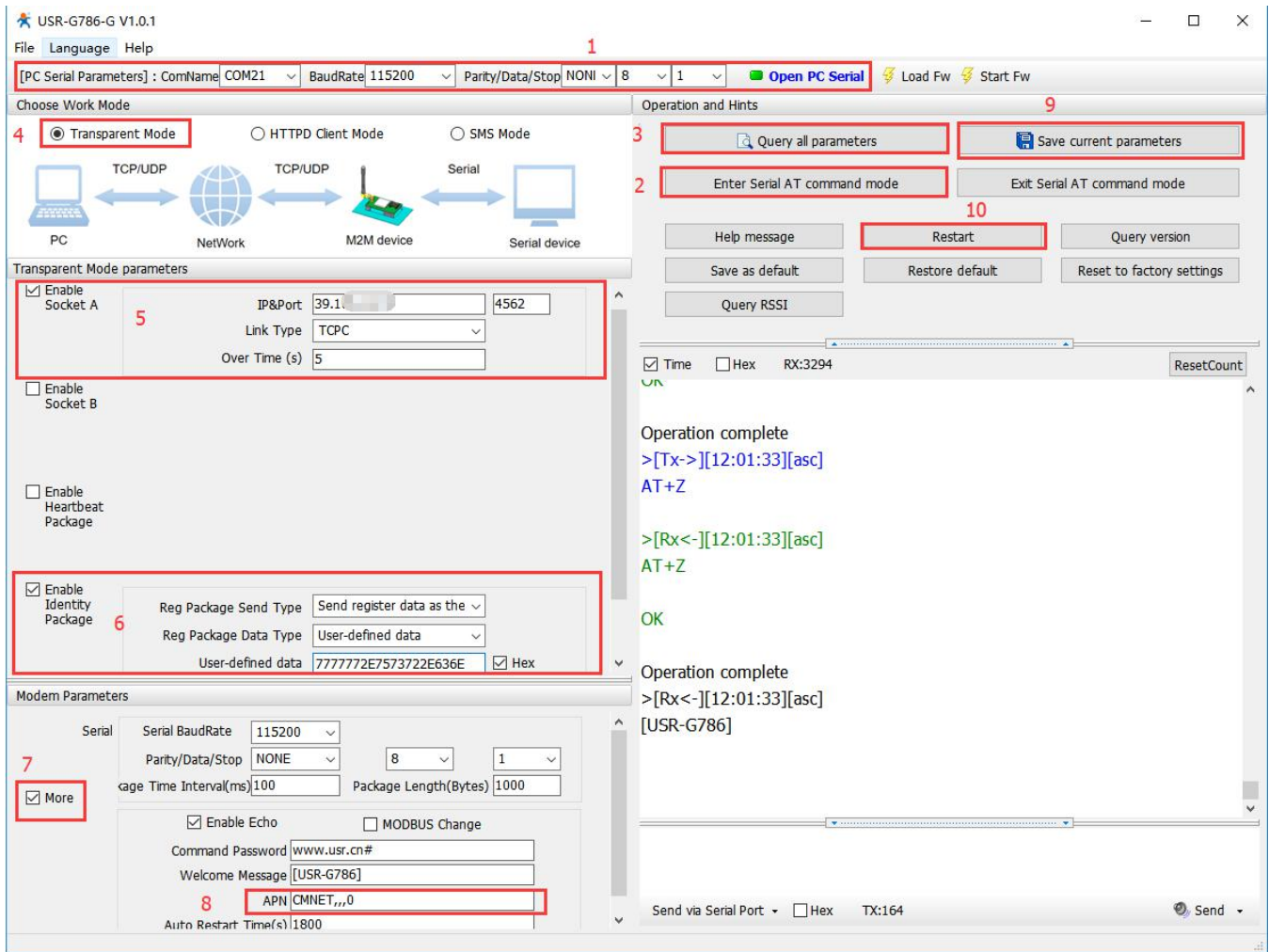


In network transparent mode, user can set the device to send identity package to the server. Identity package is intended to allow the server to identify the data from which device or to use it as a password to obtain authorization for the server's functions. Identity package can be sent when the module establishes a connection with the server, or be added at the forefront of each data packet to form a data packet to be sent to the network. Identity package data can be ICCID code, IMEI code, 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.

- ① Set by software:



1. Open the setup software. Set the Serial port parameters according to the actual serial device and click "Open PC Serial".
2. Click "Enter Serial AT command mode" and wait for the device to enter AT command mode.
3. Click "Query all parameters" and wait for obtaining all current parameters.
4. In "Choose Work Mode", select "Transparent Mode".
5. Set the parameter of Socket A.
6. Enable identity package and set various parameters.
7. Click "More".
8. Set APN parameters.
9. Click "Save current parameters" to save all parameters.
10. Restart the module.

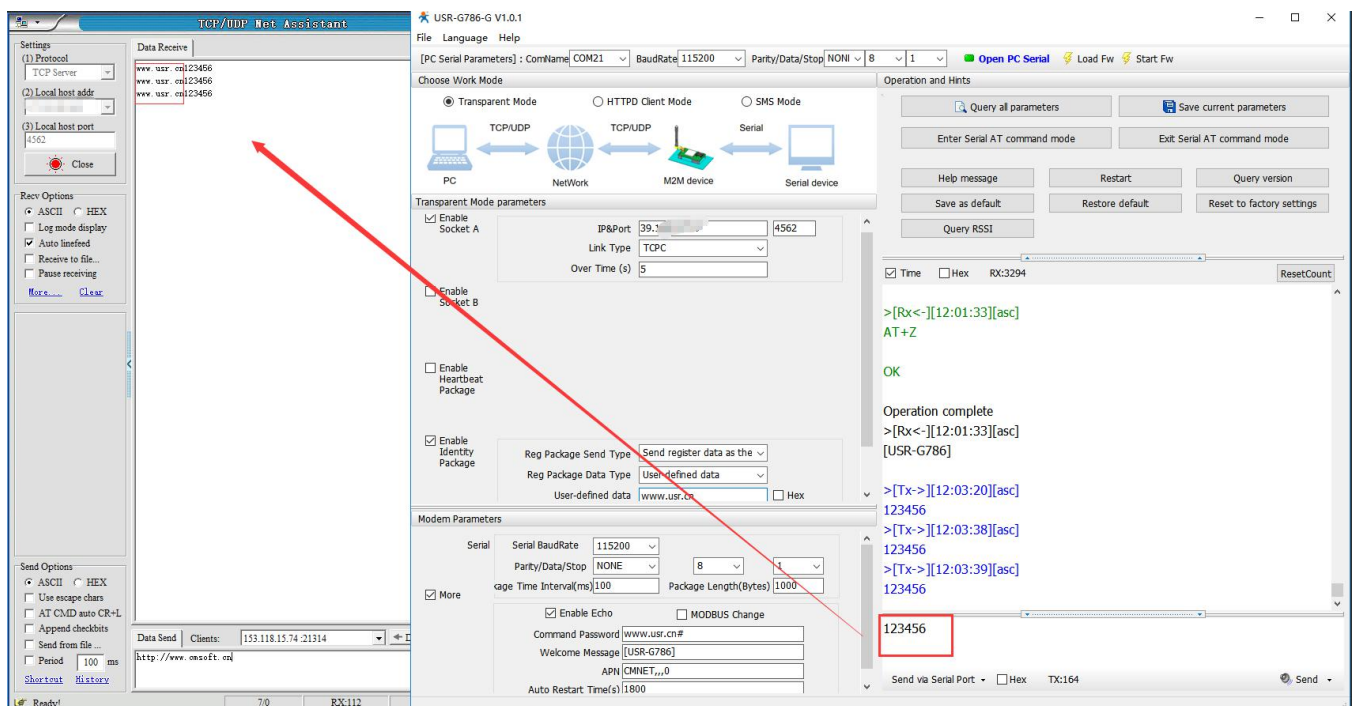
② Set by AT command:

Command	Function	Default
AT+REGEN	Query/setting enable identity package	OFF
AT+REGTP	Query/setting the type of identity package content	USER
AT+REGDT	Query/setting user-defined information	7777772E7573722E636E
AT+REGSND	Query/setting the sending mode of identity package	DATA

1. Enable identity package function:
AT+REGEN=ON
2. Set the type to User-defined data:
AT+REGTP=USER
3. Setup the contents:
AT+REGDT=7777772E7573722E636E
4. Setup the sending mode:
AT+REGSND=DATA
5. Reboot:
AT+Z

③ Test

Connect the serial port of USR-G786-G to the computer via a serial to USB cable, send data from serial port:



The screenshot displays the 'TCP/UDP Net Assistant' software interface. The 'Data Receive' section on the left shows a list of received data. The 'Data Send' section on the right shows the command window with the following text:

```
>[Rx<-][12:01:33][asc]
AT+Z
OK
Operation complete
>[Rx<-][12:01:33][asc]
[USR-G786]
>[Tx->][12:03:20][asc]
123456
>[Tx->][12:03:38][asc]
123456
>[Tx->][12:03:39][asc]
123456
```

The 'Data Send' section also shows the command '123456' being sent. The 'Data Receive' section shows the received data '123456'.

6.2. Heartbeat Package

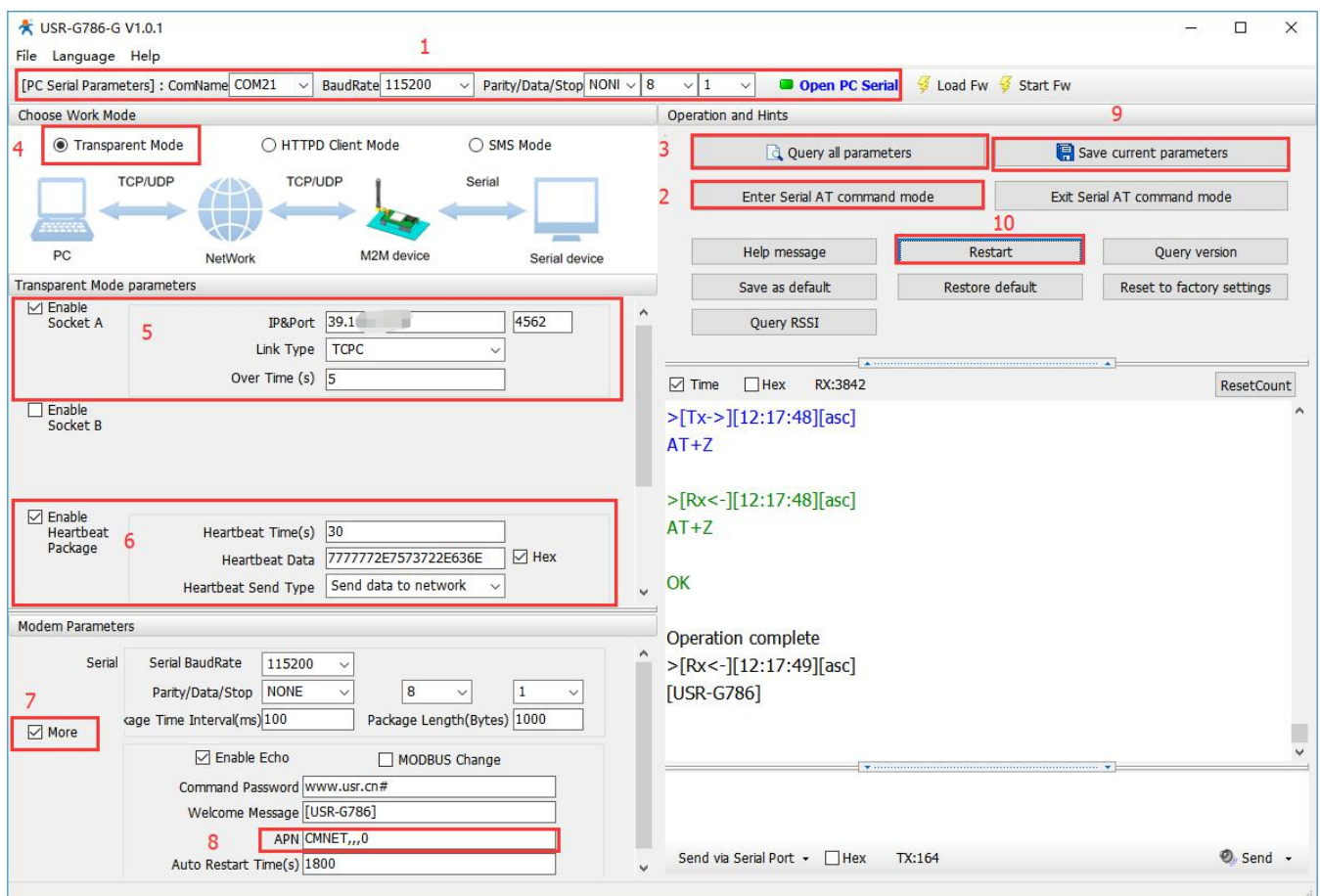


In network transparent mode, user can send the heartbeat package from the module to meet specific requirements.

Heartbeat package can be sent to the network or serial port device. The main purpose of sending to the network is to keep the connection stable and reliable, to ensure the normal connection of the module, and at the same time, to let the server know the online status of the module.

In the application of fixed query commands sent by the server to the device, in order to reduce communication traffic, user can choose to send heartbeat package (query commands) to the serial device instead of sending query commands from the server, so as to save traffic and respond faster.

① Set by software:



1. Open the dedicated setup software. Set the Serial port parameters according to the serial device and

click "Open PC Serial".

2. Click "Enter Serial AT command mode" and wait for the device to enter AT command mode.
3. Click "Query all parameters" and wait for obtaining all current parameters.
4. In "Choose Work Mode", select "Transparent Mode".
5. Set the parameters of Socket A.
6. Enable heartbeat package function and set various parameters.
7. Click "More".
8. Set APN parameters.
9. Click "Save current parameters" to set and save all parameters.
10. Restart the module.

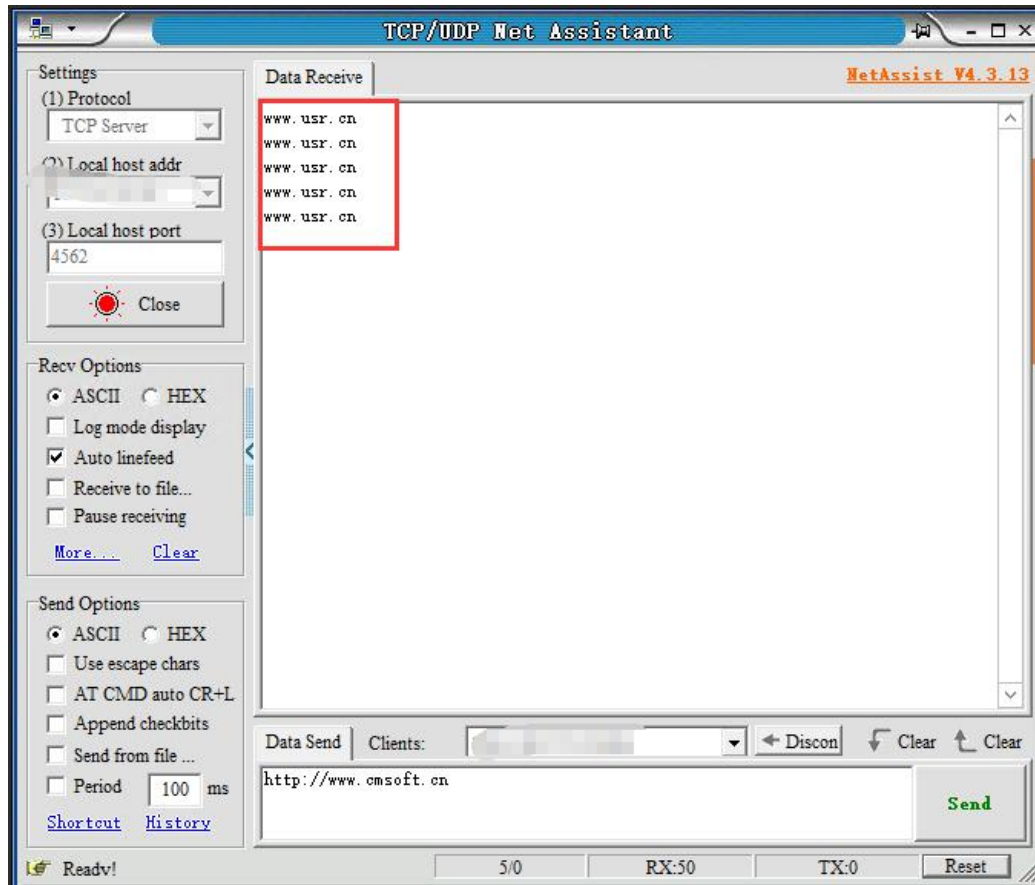
② Set by AT command:

Command	Function	Default parameter
AT+HEARTEN	Query/Setting enable heartbeat package	ON
AT+HEARTDT	Query/Setting heartbeat data	7777772E7573722E636E
AT+HEARTSND	Query/Setting heartbeat package sending mode	NET
AT+HEARTTM	Query/Setting heartbeat package interval	30

1. Enable heartbeat function:
AT+HEARTEN=ON
2. Setup the contents of heartbeat data:
AT+HEARTDT=7777772E7573722E636E
3. Set the mode of heartbeat data:
AT+HEARTTP=NET
4. Setup the sending interval:
AT+HEARTTM=30
5. Reboot:
AT+Z

③ Test

Heartbeat package data sent from G786-G to the network:



6.3. Base Station Position

USR-G786-G supports LBS base station positioning function, and can obtain general location of the device through the operator's network. Base station positioning information is obtained through AT command, which can be used flexibly with serial AT and SMS AT command.

AT command

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

Note: This function does not obtain positioning information directly(E.g: latitude and longitude information), but base station location information. Users need to obtain direct positioning information through calculation on a third-party platform. Third-party location information services are generally require charges. User can go to the URL to convert the actual location to test:

<http://www.minigps.net/cellsearch.html> (This URL is for testing only and does not guarantee site stability)

Query interface is shown below:

Click the query to get the converted location information

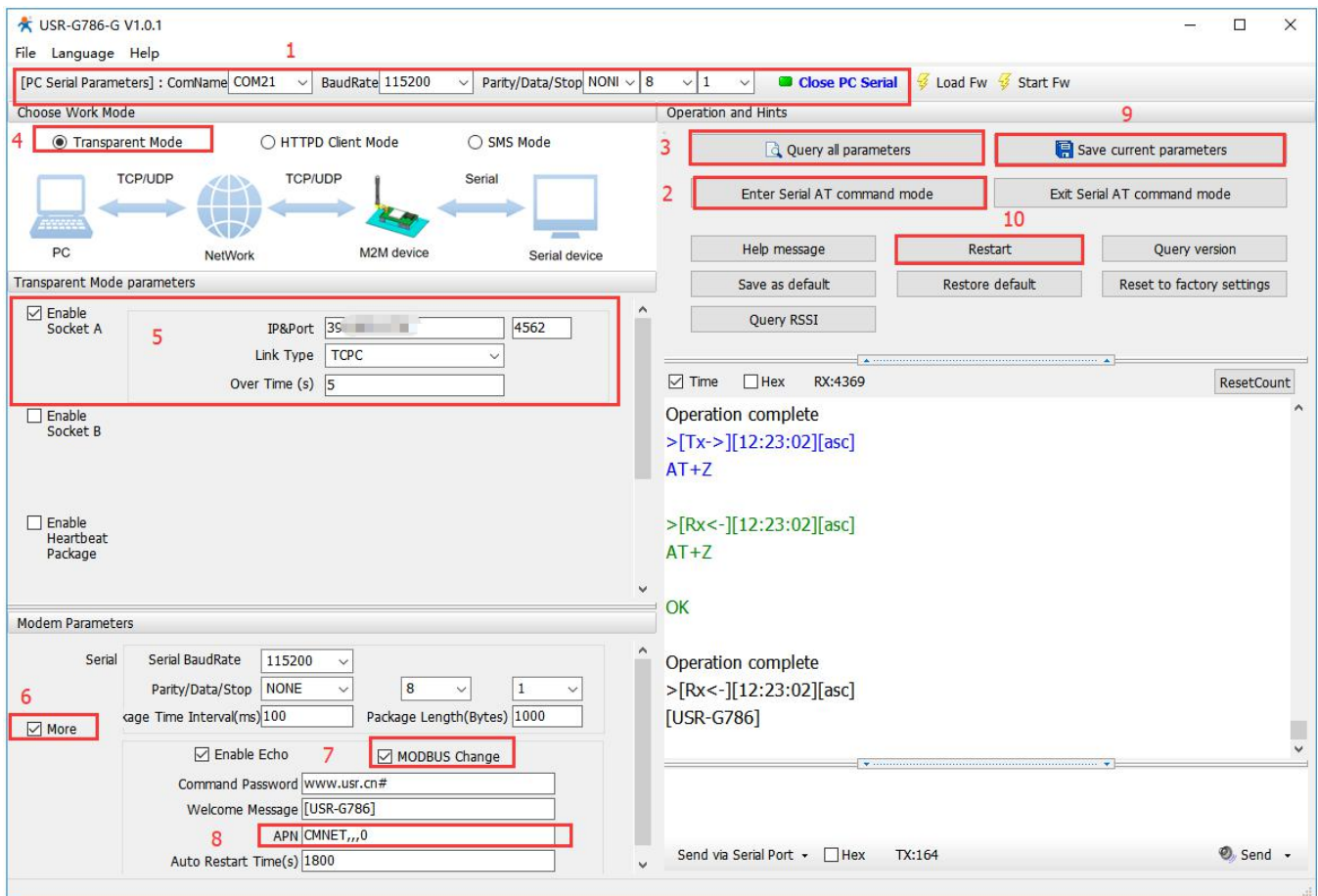


6.4. Modbus



In network transparent mode, if the terminal device transmits data through Modbus RTU protocol and the server communicates through Modbus TCP protocol, user can enable Modbus function. After this function is enabled, G786-G converts the Modbus TCP protocol data sent by the server into Modbus RTU data and sends it to the terminal device, and converts the Modbus RTU protocol data sent by the terminal device into Modbus TCP data and sends it to the server.

- ① Set by software:



1. Open the dedicated setup software. Set the serial port parameters according to the serial device and click "Open PC Serial".
2. Click "Enter Serial AT command mode".
3. Click "Query all parameters", waiting to get all current parameters.
4. In "Choose Work Mode", check "Transparent Mode"
5. Set the parameters of Socket A.
6. Click "More".
7. Check "MODBUS Change".
8. Set the APN parameters.
9. Click "Save current parameters" to set and save all parameters.
10. Click "Restart" to restart the module.

② Set by AT command:

Command	Functions	Default parameter
AT+MODBUSEN	Query/Setting whether to enable Modbus function	OFF

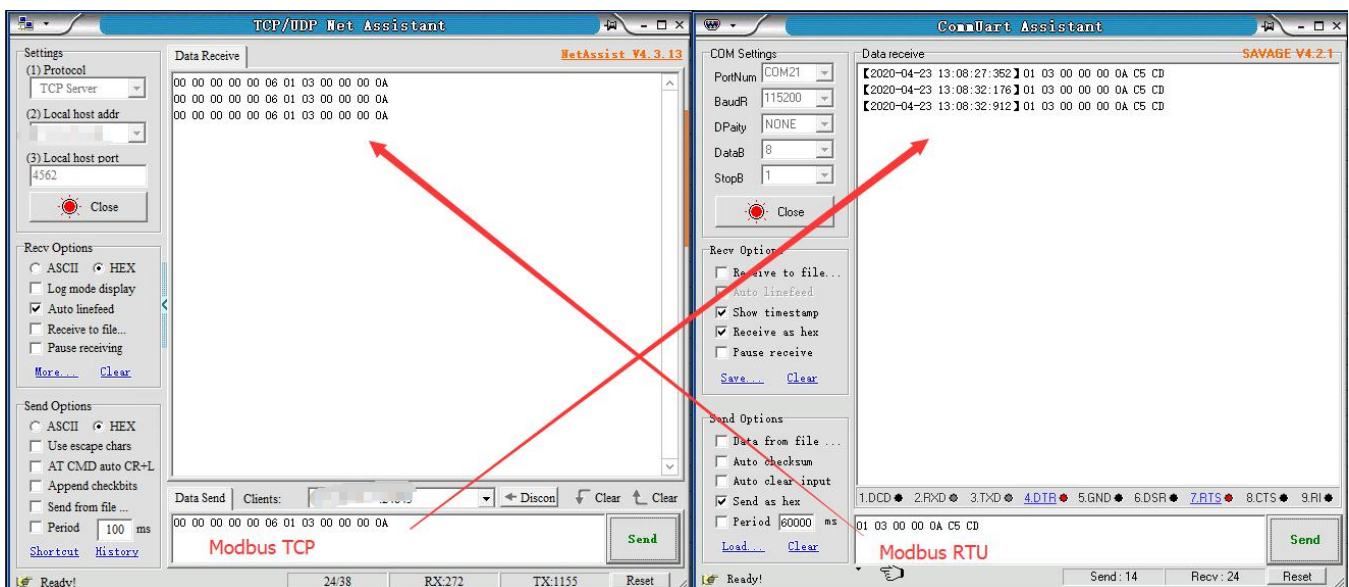
1. Set work mode to Transparent mode.:

AT+WKMOD=NET

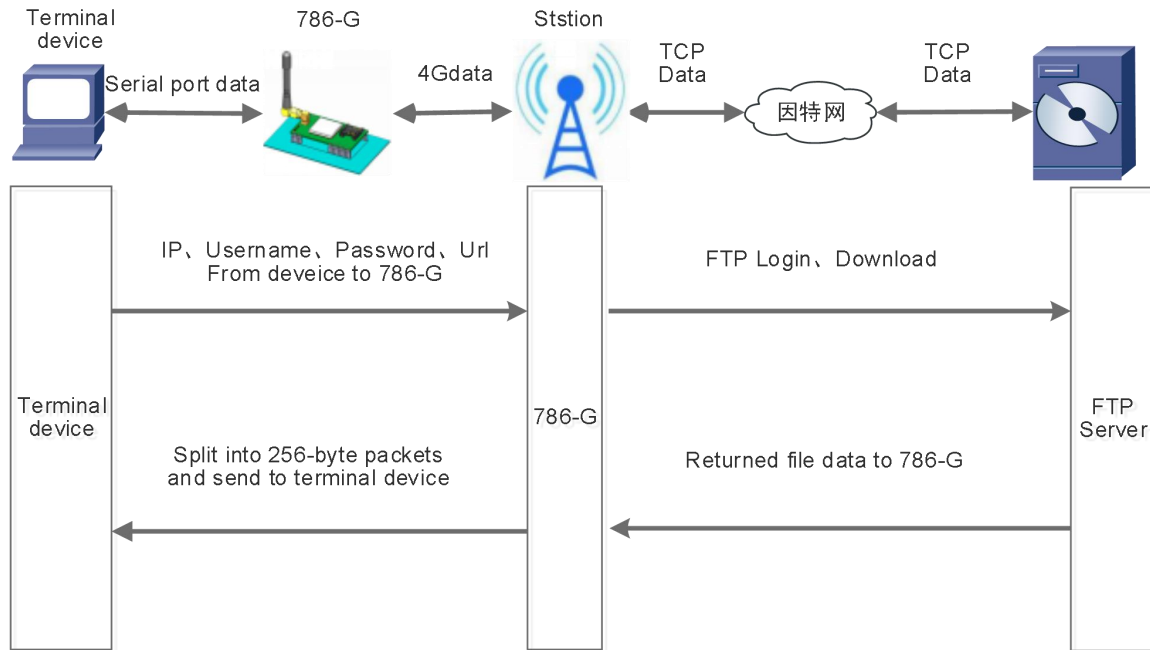
2. Enable Socket A:
AT+SOCKAEN=ON
3. Set socket A to TCP Client:
AT+SOCKA=TCP;test.usr.cn,2317
4. Enable Modbus protocol conversion:
AT+MODBUSEN=ON
5. Restart the module:
AT+Z

③ Test

Connect the serial port of USR-G786-G to the computer via a serial to USB cable, Modbus RTU data sent by the serial port is converted into MODBUS TCP data by G786-G and then sent to the network side. Similarly, G786-G converts the MODBUS TCP data on the network side into MODBUS RTU data and transmits it to the serial port.



6.5. FTP Upgrade



G786-G 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".

6.6. Restore to Factory Default Settings

After power on, press the "Reload" button for 3~15S and release it to restore the device parameters to factory default parameters.



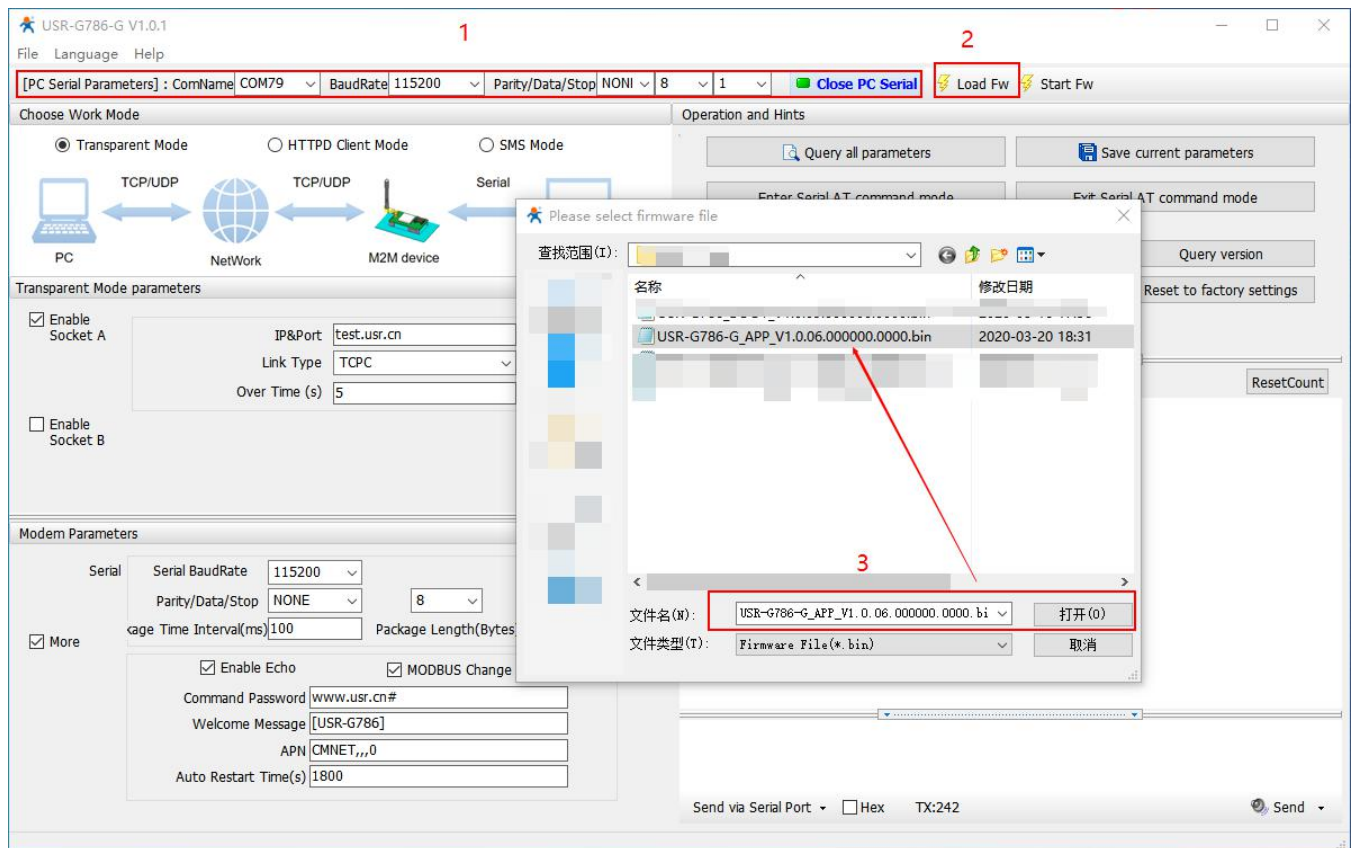
6.7. Upgrade Firmware

6.7.1. Upgrade by Serial Port

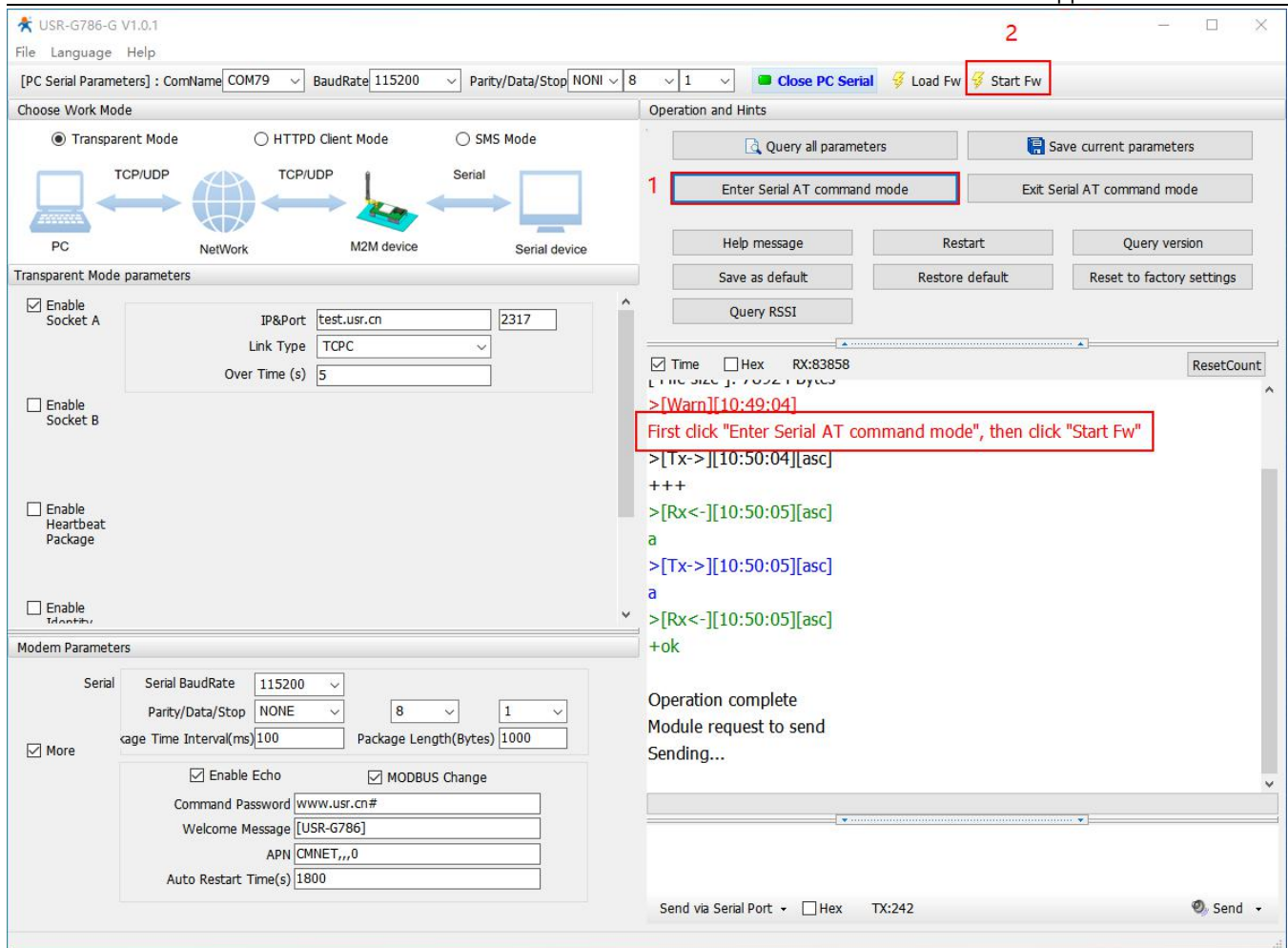
In order to reduce the complexity of firmware upgrade, USR-G786-G has set up the firmware upgrade with

serial ports. As follows:

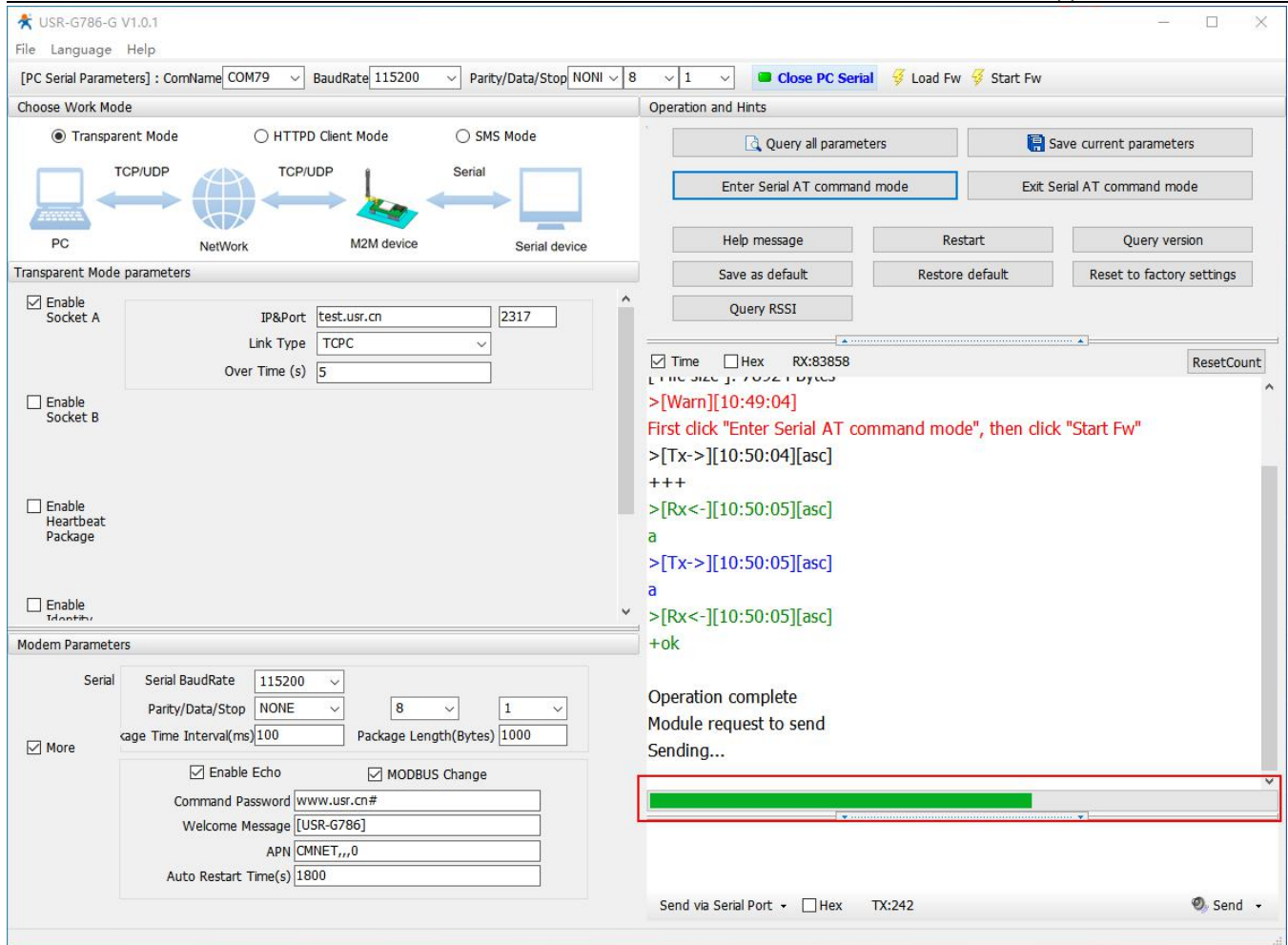
(1) Set baud rate to 115200, no check bit, data bit 8, stop bit 1, open serial port, click "Load Fw", and select the firmware to be upgraded.



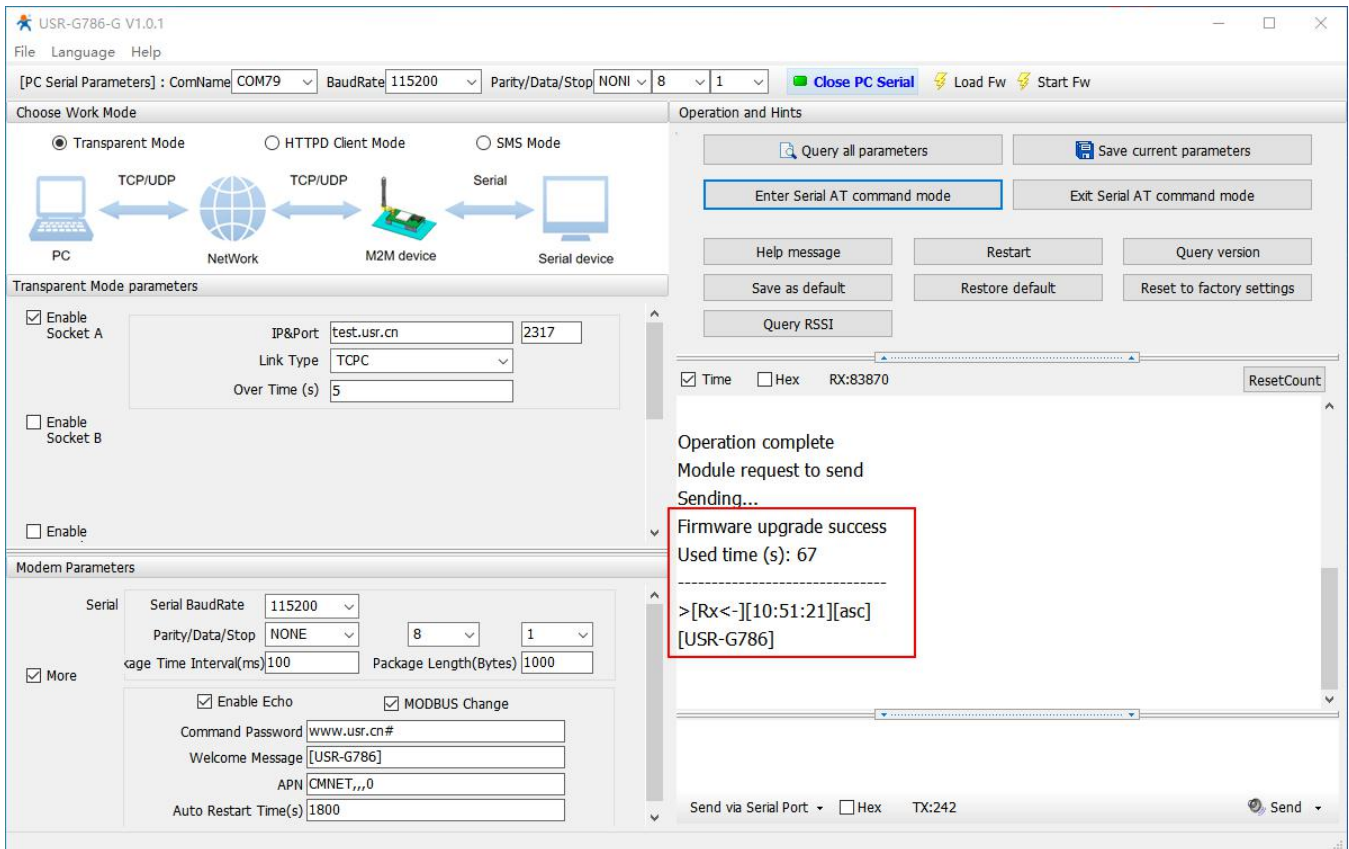
(2) Follow the prompts and wait for the device to be upgraded.



(3) Now the firmware is being downloaded, waiting for the upgrade to complete.



(4) Firmware update is completed and the device is restarted.



6.7.2. Remote Upgrade

G786-G queries by polling, request the server once every 30 minutes by default to get whether there is an upgrade demand. If the upgrade is needed, the firmware data will be downloaded from the server for the upgrade; if not, the system will sleep and wait for the next round. The polling time of Fota upgrade can be set through "AT+FOTATIME" with a range of 10~65535s. Set to 0 to close the upgrade request.

7. AT Command Set

7.1. AT Command Examples

When the device works in network transparent mode, can switch to "AT command mode" by sending time-specific data by serial port. When the operation is completed in "AT command mode", send specific commands to return to the previous working mode.

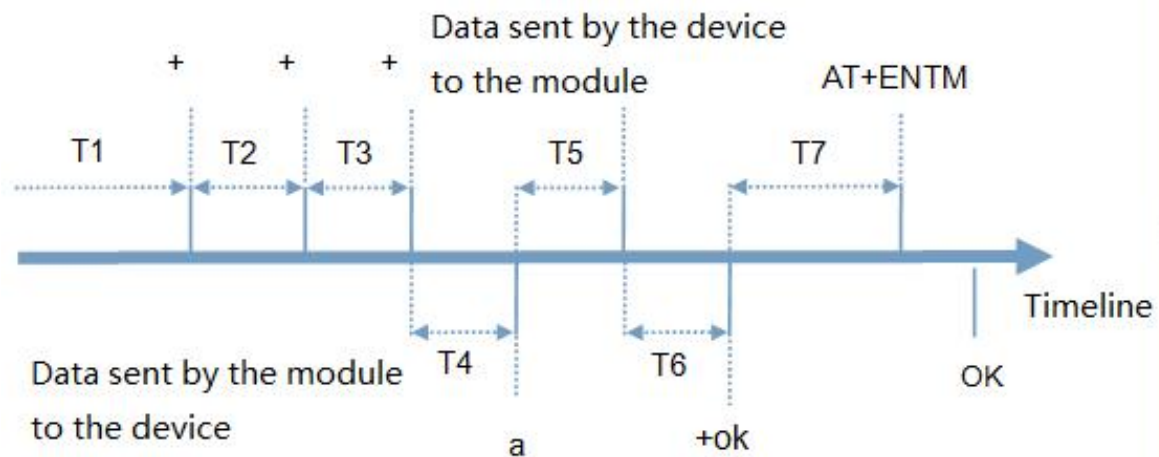


Diagram 1 Toggles the timing of command

Toggles the timing of command mode:

In the figure above, the horizontal axis is time, data above the time axis is sent by the serial device to G786-G, data below the time axis is sent by G786-G to the serial port.

Time requirement:

- T1 > current serial port packaging interval (refer to AT+UARTFT)
- T2 < current serial port packaging interval time (refer to AT+UARTFT)
- T3 < current serial port packaging interval time (refer to AT+UARTFT)
- T4 = current serial port packaging interval time (refer to AT+UARTFT)
- T5 < 3 s
- T6 = current serial port packaging interval time (refer to AT+UARTFT)

The time sequence of switching from Transparent mode to "AT Command mode" :

Serial device continuously sends "+++" to the device. After receiving "+++", the device will send an "a" to the serial device. No data can be sent during a packaging cycle before sending "+++".

When the serial device receives "a", a "a" must be sent to the device within 3 seconds.

After receiving 'a', the device returns "+ok" and enter "temporary command mode".

After receiving "+ok", the device has enter "temporary command mode" and now can send AT command to it.

Time sequence of switching from AT command mode to network transparent mode:

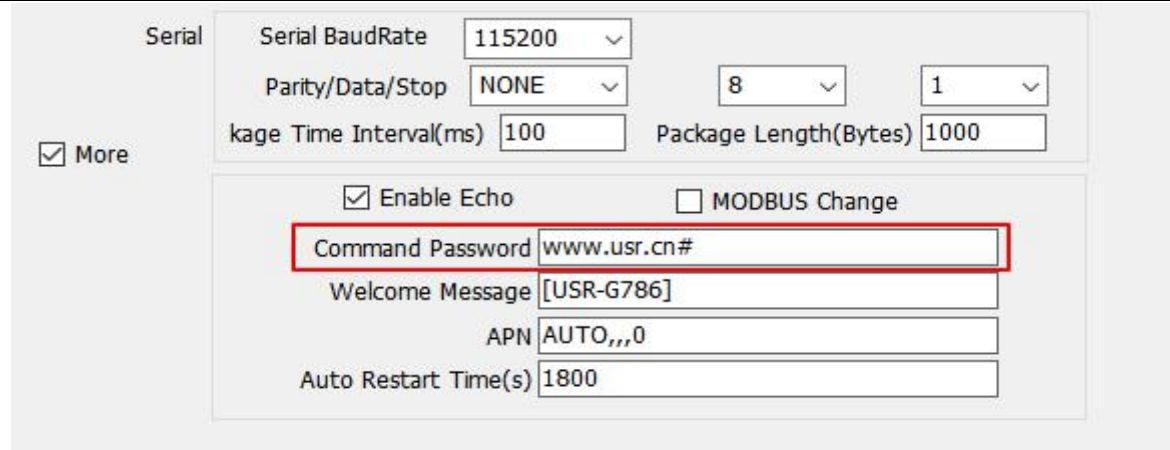
Serial device sends "AT+ENTM" to G786-G.

After receiving the command, sends "OK" to the serial device and returns to the previous working mode.

After the serial device receives "OK", it knows that the device has returned to its previous working mode.

7.1.1.Serial AT Command

In transparent mode, do not need to switch to the command mode, we can use "password + AT command" to query and set parameters. Generally, it is used when user's equipment needs to query or modify parameters when G786-G is running. It does not need complicated "+++" timing sequence to enter AT command mode, so as to quickly query or set parameters.



Serial

Serial BaudRate: 115200

Parity/Data/Stop: NONE 8 1

Package Time Interval(ms): 100 Package Length(Bytes): 1000

☒ More

☒ Enable Echo ☐ MODBUS Change

Command Password: www.usr.cn#

Welcome Message: [USR-G786]

APN: AUTO,,,0

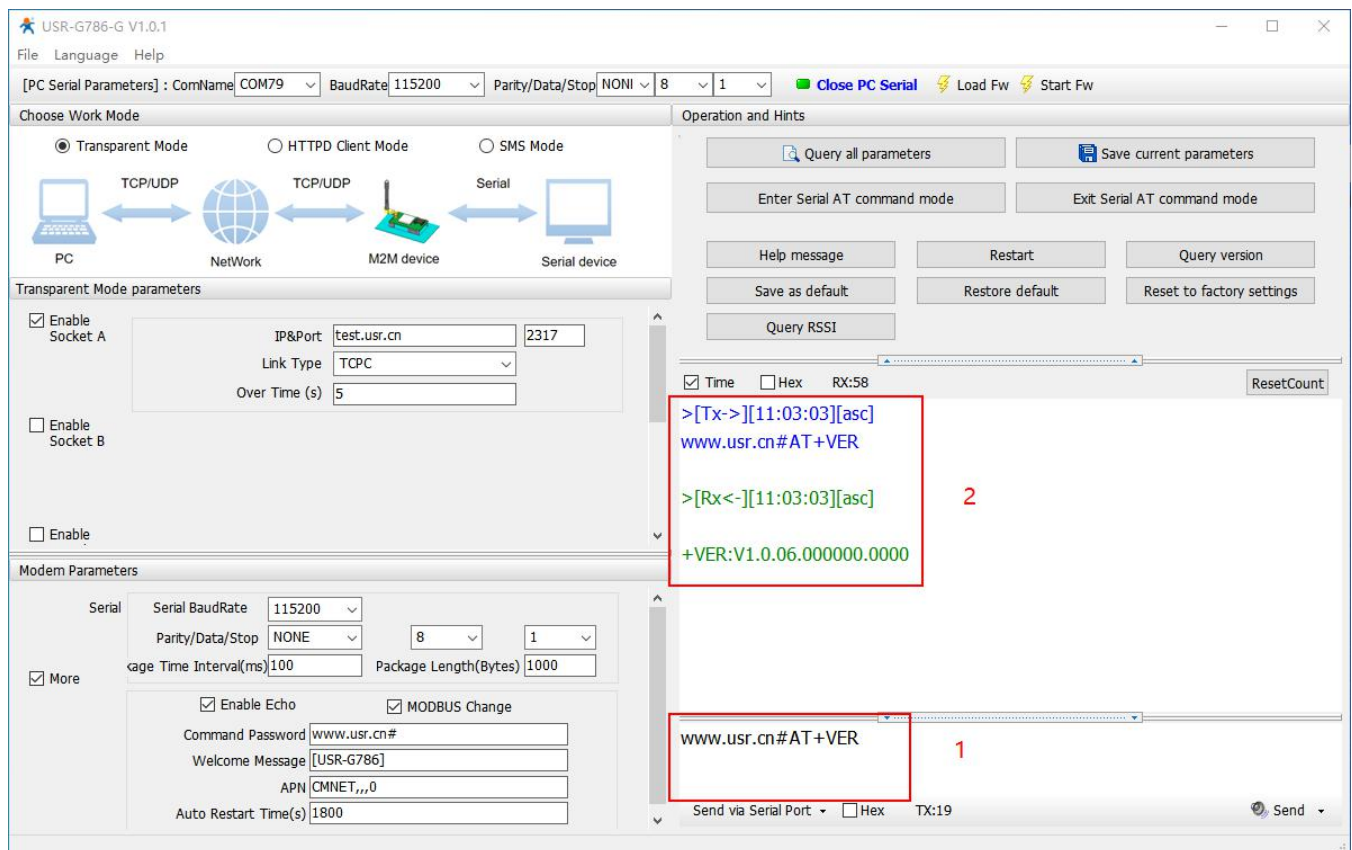
Auto Restart Time(s): 1800

Diagram 2 Software schematic diagram

Query current password , query/setting command: **AT+CMDPW**

We can check the current command password by setup software is: www.usr.cn#

After the setting is completed, restart the module, and send www.usr.cn#AT+VER (Note: there is an Carriage Return at the end of the string) from the serial port to the module. After receiving the string, module will return the response information.



7.1.2. Network AT Command

Network AT command refers to set and query parameters by sending "password + AT command" through the network when working in transparent mode. Network AT command is similar to serial AT command. The difference is that network AT command is issued through the network, which is used for remote inquiry or parameter modification by customer's server. Customers can use the network AT command for batch parameter modification and query, which is convenient for managing owned equipment.

For example, query the firmware version and send www.usr.cn#AT+VER (note: there is an Carriage Return at the end of the string) from the server to the module. After receiving the command, the module will return a response message:

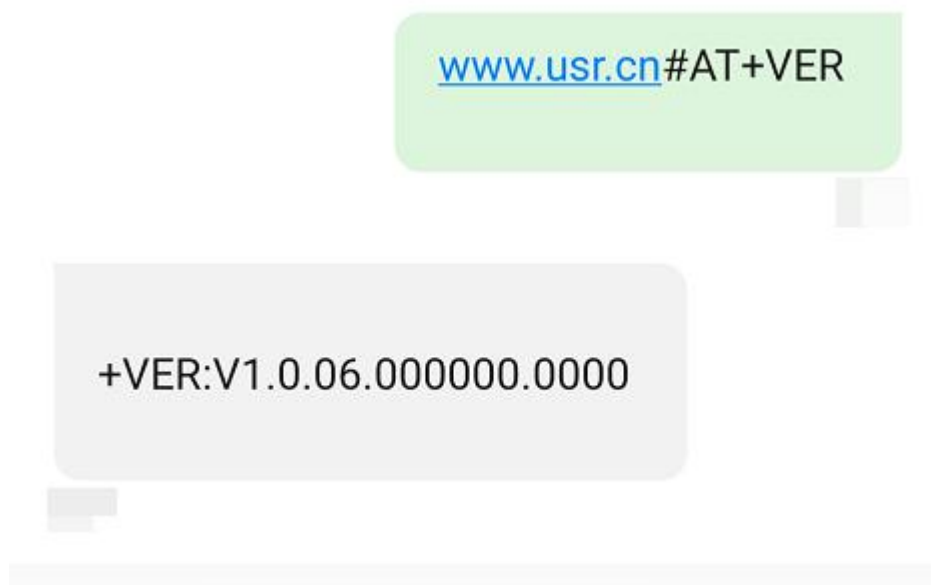


7.1.3.SMS AT Command

SMS AT command means that we can use SMS to query and configure the parameters of G786-G.

SMS AT command is generally used when customers need to query or modify parameters temporarily. We can query and modify parameters as long as know the phone number of the device, which is very convenient for equipment management in remote areas.

Take the query of firmware version as an example, send AT command. Send "www.usr.cn#AT+VER" (Note: there is an Carriage Return at the end of the string) from the mobile phone to the module. After receiving it, the module will return the response information as shown in the figure below:



7.1.4.Command Format

AT command is "query and reply" command, divided into "query" and "reply" two parts."Query" means that the device sends an AT command to G786-G, and "reply" means that G786-G sends a reply to the device.

Note: characters in instructions are case-insensitive.

7.1.4.1 Symbol Introduction

Figure 9 Symbol introduction

Symbol	Implication
<>	The content is essential items
[]	The content is non-essential items
{}	The content is a string with special meaning
~	Parameter range, e.g. A~B. Parameter 's range is from A to B
CMD	Command code
OP	The operator
PARA	Parameters

CR	Carriage Return in ASCII, 0X0D in hex
LF	Line Feed in ASCII, 0X0A in hex

7.1.4.2 Query format in command

Command string: <AT+>[CMD][OP][PARA]<CR>

Figure 10 symbol description

Command code	Implication	Necessary or not
AT+	AT command header	YES
CMD	Command name	NO
OP	Operator, such as =,?	YES
PARA	Executed Parameter	NO
CR	Carriage Return, command terminator	YES

Command type description

Figure 11 Command string format description

Type	String format	Description
0	<AT+><CMD>?<CR>	Query current parameters
1	<AT+><CMD><CR>	Execute the action of this command or query current parameters
2	<AT+><CMD>=<PARA><CR>	Set this command's parameter

7.1.4.3 Reply format in command

Note: the response information of the command can be divided into two types: echo and no echo. Echo means to return the input content when the command is input, and then make a response to the command. No echo means no input is returned and only the command is responded to. In the following instructions, no echo mode is used as an example.

Command String: [CR][LF][+CMD][OP][PARA][CR][LF]<CR><LF>[OK]<CR><LF>

Figure 11 Symbol descriptions

Command	Implication	Necessary or not
CR	Carriage Return	No
LF	Line Feed	No
+CMD	Response header	No
OP	Operator , e.g: ":"	No
PARA	Returned parameter	No
CR	Carriage Return	No
LF	Line Feed	No
CR	Carriage Return	Yes
LF	Line Feed	Yes

OK	Operate successfully	No
CR	Carriage Return	Yes
LF	Line Feed	Yes

Response command type description:

Figure 13 The description of string format

Type	String Format	Description
0	<CR><LF><OK><CR><LF>	Means command send success
1	<CR><LF><+CMD:><PARA><CR><LF><CR><LF><OK><CR><LF>	Return current parameters

7.1.4.4 Special symbols

In AT commands, "=", ",", "?", carriage return, line feed are special symbols, so the parameter can not directly contain "=", ",", "?". All need to be escaped.

Escape rule: use [] to enclose the hexadecimal code of a special symbol, representing the ASCII code represented by an input hexadecimal code.

E. g:

"?": The hexadecimal encoding of 0x3F is expressed as [3F] after escaping by this escape method.

Symbol	Implication	Escape characters
=	Equal sign	[3D]
,	Comma	[2C]
?	Question mark	[3F]
<CR>	Enter key	[0D]
<LF>	Line break	[0A]

7.2. AT Command Set

Figure 15 AT command error code

Code	Implication
Err1	Does not conform to the AT commands format, is not the beginning of AT
Err2	The AT command was not found and does not exist
Err3	Not meet the format of query or settings
Err4	Wrong parameters or number
Err5	Setting parameter failed

Figure 16 AT commands

Command	Command description
Executive command	

AT	Test Command
H	Help information
Z	Module reboot
E	Query/set whether to enable command echo
ENTM	Exit AT command mode
WKMOD	Query/set work mode
CMDPW	Query/set command password
STMSG	Query/set module start information
RSTIM	Query/set the time of equipment automatically restart
CSQ	Query signal strength information of device currently
SYSINFO	Query network information of device
UCPIN	Query/set PIN code
Query/set query commands	
RELD	Restore to the user default settings
CLEAR	Restore original factory settings
CFGTF	Save current settings to default settings
Query/set information query commands	
VER	Query version information
SN	Query SN code
ICCID	Query ICCID code
IMEI	Query IMEI code
CIP	Query IP address
LBS	Query base station positioning information
CCLK	Query current time
PING	Query the network status
Serial parameter commands	
UART	Query / set the parameters of serial ports
CMDPT	Query/set network data output serial port
UARTFT	Query/set serial port package time
UARTFL	Query/set the serial port package length
Network commands	
APN	Query/set APN information
SOCKA	Query/set socket A parameter
SOCKB	Query/set socket B parameter
SOCKAEN	Query/setup whether to enable socket A
SOCKBEN	Query/setup whether to enable socket B
SOCKALK	Query socket A connection status
SOCKBLK	Query socket B connection status
SOCKATO	Query/set reconnect time after disconnection of socket A
SOCKBTO	Query/set reconnect time after disconnection of socket B
SOCKRSTM	Query/Set the max number of reconnect when socket connection failure

MODBUSEN	Query/set whether to enable Modbus protocol conversion
Identity package commands	
REGEN	Query/set whether to enable identity package
REGTP	Query/set the content type of identity package
REGDT	Query/set user-defined identity package data
REGSND	Query/set identity package sending type
Heartbeat package commands	
HEARTEN	Query/set whether to enable heartbeat
HEARTDT	Query/set heartbeat package data
HEARTSND	Query/set heartbeat package sending type
HEARTTM	Query/set heartbeat package sending interval
HTTPD commands	
AT+HTPTP	Query/set HTTP request type
AT+HTPURL	Query/set URL
AT+HTPSV	Query/set HTTP server address and port
AT+HTPHD	Query/set HTTP request header
AT+HTPTO	Query/set HTTP timeout
AT+HTPFLT	Query/set whether to filter HTTP header
SMS commands	
DSTNUM	Query/set the target mobile phone number of SMS mode
SMSFLT	Query/set whether to enable only receive SMS from source number
CISMSEND	Send SMS

7.2.1.AT

- Function: Test commands to test whether the current device is active
- Format
 - ◆ Query:


```
AT{CR}
{CR}{LF}OK{CR}{LF}
```

7.2.2.AT+H

- Function: Helping command
- Format
 - ◆ Query:


```
AT+H{CR}
{CR}{LF} help message {CR}{LF}
```
- Parameter:
 - ◆ help message: command.

7.2.3.AT+Z

- Function: Reload the module.

- Format
AT+Z{CR}
{CR}{LF}OK{CR}{LF}

7.2.4.AT+E

Function: Query/set the echo status of AT commands.

Format:

- ◆ Query current parameter:
AT+E{CR} or AT+E?{CR}
{CR}{LF}+E:status{CR}{LF}
 - ◆ Setting:
AT+E=status{CR}
{CR}{LF}OK{CR}{LF}
- Parameter:
- ◆ status: echo status, including:
ON: open
OFF: close
- Command echo default is on.
- E.g: AT+E=ON

7.2.5.AT+ENTM

- Function: set the device to return to the previous working mode.
- Format:
 - ◆ Perform specified function:
AT+ENTM{CR}
{CR}{LF}OK{CR}{LF}

7.2.6.AT+WKMOD

- Function: Query/Setting module's work mode
 - Format:
 - ◆ Query current parameter:
AT+WKMOD{CR} or AT+WKMOD?{CR}
{CR}{LF}+WKMOD:mode{CR}{LF}
 - ◆ Setting:
AT+WKMOD=mode{CR}
{CR}{LF}OK{CR}{LF}
- Parameter:
- ◆ mode: work mode, including:
NET: Network transparent mode
HTTPD: HTTPD Client mode
SMS: SMS mode
- Default in NET mode:
- E.g: AT+WKMOD=NET

7.2.7. AT+CMDPW

- Function: Query/Setting command password
 - Format:
 - ◆ Query current parameter:
AT+CMDPW{CR} or AT+CMDPW?{CR}
{CR}{LF}+CMDPW:password{CR}{LF}
 - ◆ Setting:
AT+CMDPW=password{CR}
{CR}{LF}OK{CR}{LF}
 - Parameter:
 - ◆ password: Command password, 1~11 bytes ASCII code, default is www.usr.cn#.
- E.g: AT+CMDPW=www.usr.cn#

7.2.8. AT+STMSG

- Function: Query/Setting module's welcome message.
- Format:
 - ◆ Query current parameter:
AT+STMSG{CR} or AT+STMSG?{CR}
{CR}{LF}+STMSG:message{CR}{LF}
 - ◆ Setting:
AT+STMSG=message{CR}
{CR}{LF}OK{CR}{LF}
- Parameter:
 - ◆ message: Welcome message, after the device is powered on. ASCII of 1~20 bytes, default is [USR-G786].
- E.g: AT+STMSG=www.usr.cn

7.2.9. AT+RSTIM

- Function: Query/Setting module's automatic restart time.
- Format:
 - ◆ Query current parameter:
AT+RSTIM{CR} or AT+RSTIM?{CR}
{CR}{LF}+RSTIM:time{CR}{LF}
 - ◆ Setting:
AT+RSTIM=time{CR}
{CR}{LF}OK{CR}{LF}
- Parameter:
 - ◆ Time: s. Range can be set from 60s to 60000s. When the network does not respond to data longer than this time, device will restart. The default time is 1800s. When the parameter is set to 0, this function is disabled.
- E.g: AT+RSTIM=1800

7.2.10. AT+CSQ

- Function: Query module's current signal strength.

➤ Format:

- ◆ Query current parameter
 AT+CSQ{CR} or AT+CSQ?{CR}
 {CR}{LF}+CSQ: rssi {CR}{LF}

➤ Parameter:

- ◆ rssi: Received signal strength information.

Figure 2 Mapping relation

Number	Implication
0	Less than -113 dBm
1	-111 dBm
2....31	-109... -53 dBm
99	Unknown or unmeasured

7.2.11. AT+SYSINFO

➤ Function: Query module 's network information

➤ Format:

- ◆ Query current parameter:
 AT+SYSINFO{CR} or AT+SYSINFO?{CR}
 {CR}{LF}+SYSINFO: state,srv_domain ,roam_status,sys_mode,sim_state{CR}{LF}

➤ Parameter

- ◆ state: current network status

Figure 3 Sever status list

Number	Implication
0	No service
1	Restricted service
2	Network service
3	Restricted regional services
4	Power saving state

- ◆ srv_domain: business domain

Figure 4 Business domain list

Number	Implication
0	No service
1	Only CS service
2	Only PS service
3	PS+CS service
4	CS,PS is not registered and is in the search state

- ◆ roam_status: Roaming state
 0: Non-roaming state
 1: Roaming state
- ◆ sys_mode: System mode

Figure 5 System mode list

Number	Implication
0	No service

1	AMPS mode
2	CDMA mode
3	GSM mode
4	HDR mode
5	WCDMA mode
6	GPS mode
7	GSM/WCDMA mode
8	CDMA/HDR mixed mode
9	LTE mode
10	GSM/WCDMA/LTE mode
11	TDS mode

- ◆ sim_state: UIM state.

Figure 6 UIM status list

Number	Implication
0	UIM card status is invalid
1	UIM card status is effective
2	UIM card status is invalid under CS
3	UIM is invalid under PS
4	UIM is invalid under PS+CS
240	ROMUIM version
255	UIM card not exist

7.2.12. AT+UCPIN

Function: Query/Setting PIN code.

- Function: Query/Setting PIN code
- Format
 - ◆ Query current parameter:
AT+UCPIN{CR} or AT+UCPIN?{CR}
{CR}{LF}+UCPIN:pin{CR}{LF}
 - ◆ Setting:
AT+UCPIN=pin{CR}
{CR}{LF}OK{CR}{LF}
- Parameter:
 - ◆ pin: PIN code, default is empty.
- E.g: AT+PIN=1234

7.2.13. AT+RELD

- Function: Restore to default settings and the device will restart.
- Format:
 - ◆ Execute the specified function
AT+RELD{CR}
{CR}{LF}OK{CR}{LF}

7.2.14. AT+CLEAR

- Function: Reload the default settings, device will restart.
- Format:
 - ◆ Execute specified function:
AT+CLEAR{CR}
{CR}{LF}OK{CR}{LF}

7.2.15. AT+CFGTF

- Function: Save current parameter to default parameter.
- Format:
 - ◆ Execute specified function:
AT+CFGTF{CR}
{CR}{LF}OK{CR}{LF}

7.2.16. AT+VER

- Function: Query module's firmware version.
- Format:
 - ◆ Query current parameter:
AT+VER{CR} or AT+VER?{CR}
{CR}{LF}+VER:version{CR}{LF}
- Parameters:
 - ◆ version: Firmware version.

7.2.17. AT+SN

- Function: Query module's SN code.
- Format:
 - ◆ Query current parameter:
AT+SN{CR} or AT+SN?{CR}
{CR}{LF}+SN:code{CR}{LF}
- Parameters:
 - ◆ code:SN code

7.2.18. AT+ICCID

- Function: Query module's ICCID code.
- Format:
 - ◆ Query current parameter:
AT+ICCID{CR} or AT+ICCID?{CR}
{CR}{LF}+ICCID:code{CR}{LF}{CR}{LF}
- Parameters:
 - ◆ code: ICCID code.

7.2.19. AT+IMEI

- Function: Query module's IMEI code.

- Format:
 - ◆ Query current parameter:
AT+IMEI{CR} or AT+IMEI?{CR}
{CR}{LF}+IMEI:code{CR}{LF}
- Parameters:
 - ◆ code: IMEI code.

7.2.20. AT+CIP

- Function: Query local IP address.
- Format:
 - ◆ Query current parameter:
AT+CIP{CR} or AT+CIP?{CR}
{CR}{LF}+CIP: IP {CR}{LF}
- Parameters:
 - ◆ IP: local IP address.

7.2.21. AT+LBS

- Function: Query base station positioning.
- Format:
 - ◆ Query:
AT+LBS{CR}
{CR}{LF}+IMEI : <lac>,<cid>{CR}{LF}
- Parameters:
 - ◆ <lac>: LAC information, Range: 1~65535
 - ◆ <cid>: CID information, Range: 2G: (1-65535) 3G/4G (1~268435455)
- E.g: AT+LBS

7.2.22. AT+CCLK

- Function: Query current time.
- Format:
 - ◆ Query:
AT+CCLK{CR}
{CR}{LF}+CCLK : <data>,<time>{CR}{LF}
- Parameters:
 - ◆ <data>: Data information
 - ◆ <time>: Time information
- E.g: AT+CCLK

7.2.23. AT+PING

- Function: Query network continuity.
- Format:
 - ◆ Query:

AT+PING="ip_address"{CR}

{CR}{LF}+PING: <result>,<ip_address>, <bytes>, <time>, <ttd>{CR}{LF}

{CR}{LF}+PING: <finresult>, <sent>, <rcvd>, <lost>, <min>,<max>,<avg>{CR}{LF}

➤ Parameters:

- ◆ <result>: The result of each ping request. 0 means success.
- ◆ <ip_address>: IP address.
- ◆ <bytes>: The length of each sent ping request. Unit: byte.
- ◆ <time>: The time wait for the response of the ping request. Unit: ms.
- ◆ <ttd>: Time to live value of the response packet for the ping request.
- ◆ <finresult>:The final result of the command. 0 means success.
- ◆ <sent>: Total number of sent ping requests.
- ◆ <rcvd>: Total number of the ping requests that received the response.
- ◆ <lost>: Total number of the ping requests that are timeout.
- ◆ <min>: The minimum response time. Unit: ms.
- ◆ <max>: The maximum response time. Unit: ms.
- ◆ <avg>: The average response time. Unit: ms.

➤ E.g: AT+PING="www.baidu.com"

7.2.24. AT+UART

➤ Function: Query/Setting serial port parameters

➤ Format:

AT+UART{CR} or AT+UART?{CR}

{CR}{LF}+UART:baud,data bit,stop bit,parity {CR}{LF}

◆ Setting:

AT+UART=baud,data bit,stop bit,parity {CR}

{CR}{LF}OK{CR}{LF}

➤ Parameters:

- ◆ Baud:band rate:2400,4800,9600,14400,19200, 28800, 33600,38400,57600,115200,230400,460800
Default rate 115200.

- ◆ data bit: data bit, including:

8: 8 data bits.

Default data bit :8.

stop bit: stop bit, including:

8. Contact Us

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9. Disclaimer

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10. Update History

2020-03-23 V1.0.1. established.

FCC STATEMENT :

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.