



HUAWEI MU509-65 HSDPA LGA Module
V100R001

Application Guide

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About This Document

Revision History

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		All	Revised and deleted the description related to ^IPRCVST



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1 Overview

This document is intended to provide references for customers to choose appropriate command sequences to start using the MU509-65 in a faster manner. This document also contains examples and relevant description.

This document will be updated based on customers' requirements.

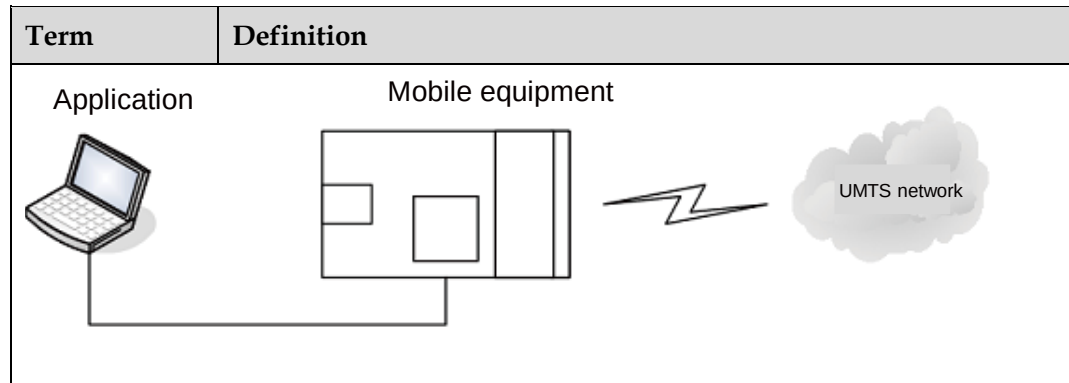
1.1 Conventions and Definitions

1.1.1 Conventions

Convention	Description
<...>	Value range of AT command parameters
XXXX	Personal Identification Number (PIN), Personal Unlock Key (PUK), or password

1.1.2 Definitions

Term	Definition
Connected	Indicates that a link has been set up between two modules or a module and a terminal.
Registered	Indicates that the module is registered with a UMTS network.
Module	HUAWEI UMTS module



1.2 Basic AT Command Processing Principles

1.2.1 Ports

The MU509-65 provides three ports to interact with USB connection.

- MODEM port: simulated using USB, for AT command interaction and establishing data connection.
- DIAG port: simulated using USB, for DIAG (diagnostic) command interaction (mainly used to debug modules at present).
- PCUI port: simulated using USB, for AT command interaction only.

The MU509-65 also provides a physical serial port.

UART port: a physical serial port, for AT command interaction and establishing data connection.

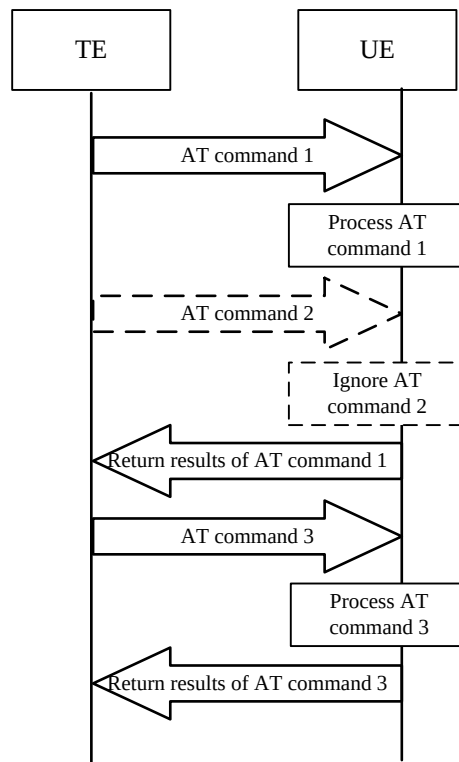
A host controls a module using AT commands. If AT commands are unavailable, a module can be deemed unavailable.

1.2.2 AT Command Processing Mechanism

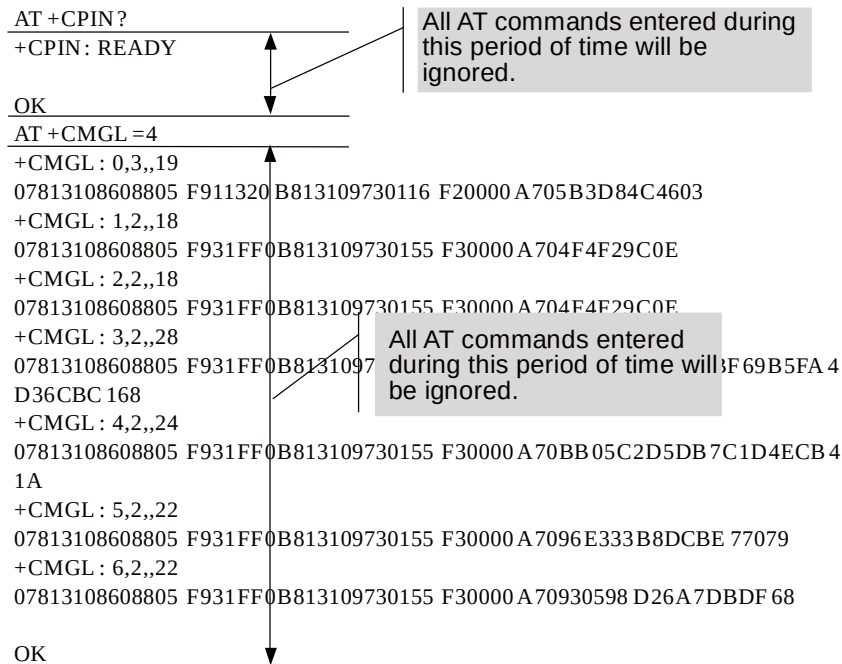
A module processes AT commands from the ports (MODEM, PCUI, Control, and UART) in series. An AT command can be processed when and only when the previous AT command processing has been completed. If the module is processing an AT command, most new AT commands from the same port will be ignored and other commands from other ports will be buffered until the current AT command is processed.

This rule also applies to COM ports converted from USB ports.

The processing of an AT command starts when the AT command is entered from the TE, and ends when the UE (the module) returns all the results in response to the command.

Figure 1-1 AT command processing sequence diagram


Example:



Some special AT commands can be aborted by new AT commands. Such special commands are called abortive commands.

The MU509-65 supports the following abortive AT commands:

- AT+COPS
- AT+CLCK
- AT+CLCC
- AT+CLIP
- ATD
- ATA
- AT^IPINIT
- AT^IPOPEN
- AT^IPSEND
- AT^IPSENDEX
- AT^IPCLOSE

Example:

```
AT+COPS=1,2,23415
OK
```

Before the results of AT+COPS is returned, enter any characters (such as "AT"), the module will terminate the processing of AT+COPS and return **OK**. The entered characters are used to abort the command only.

Some commands can be executed when SIM card is inserted. MU509-65 would return to SIM failure if SIM card is not inserted. For more information, see Property Description of related AT in the latest version of [HUAWEI MU509-65 HSDPA LGA Module AT Command Interface Specification](#).

Example:

```
AT+CREG?
```

```
+CME ERROR: SIM failure
```

**NOTE**

SIM failure indicates that SIM card is not inserted.

1.2.3 Recommended Timeout Mechanism for AT Commands Processed by a Host

A module processes AT commands in series. Do not send another AT command before the result for the current command is returned or the current command times out (except when the current command is an abortive AT command). The following table lists AT command timeout durations (starting from the time when an AT command arrives at a port).

Table 1-1 AT command timeout duration

AT Command	Timeout Duration
General AT commands	30s
AT+CMSS/AT+CMGS (used to send text messages)	60s
AT+COPS=? (used to search for networks)	120s

After an AT command times out, it is recommended that the host check whether the module is functioning normally. The following procedure is provided for your reference:

1. The host sends AT command to the module.
2. If the module returns failure information, go to step 5. Otherwise, go to step 3.
3. If the module returns success information, the module is functioning normally.
4. If the host times out (the host waits for a response for over 30 seconds) three times when waiting for the response from the module, go to step 5. Otherwise go to step 1.
5. The host deems that the current module does not exist or is unavailable. Close the port, stop sending all AT commands, exit the procedure to determine whether the module is normal, and re-search for modules.

2 Initialization Application Scenarios

2.1 Startup Indication ^SYSSTART

2.1.1 Reference Process

Command	Description
	A module, without solicitation, presents ^SYSSTART to its host to indicate that the module is starting.
^SYSSTART	Indicate that a module is starting.

**NOTE**

- ^SYSSTART is presented only when a module is starting and will not be presented after a module has started.
- ^SYSSTART is presented only after the radio frequency (RF) initialization completes and will not be presented in offline mode.

2.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
The module presents ^SYSSTART during startup. After that, the module presents ^SYSSTART again.	Indicate that the module has been reset.	If ^SYSSTART is presented repeatedly, send the module to the specified repair center.

2.2 Querying Basic Information

2.2.1 Reference Process

Command	Description
AT+GMR/AT+CGMR	Query software version.
Software version OK	Software version. e.g. 11.815.01.09.00
AT+GMI/AT+CGMI	Query manufacturer identification.
Manufacturer Identification OK	For example: Huawei Technologies Co., Ltd.
AT+GMM/AT+CGMM	Query model identification.
Model identification OK	For example: MU509-65
AT+GSN/AT+CGSN	Query product IMEI.
IMEI OK	For example: 865261010004010

**NOTE**

The previously listed commands are query commands and cannot be used to configure settings.

2.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+GSN/AT+CGSN	+CME ERROR: memory failure	This error occurs when a module's IMEI is not specified. This problem is solved after the IMEI is written into the module.

2.3 Network Service Operations

2.3.1 Reference Process

Command	Description
AT+CFUN?	Query a module's current mode.
+CFUN: 1 OK	1 indicates online mode.
AT+CPIN?	Query whether a module's SIM card is password protected.
+CPIN: READY OK	READY indicates that the SIM card is ready.
AT+CSQ	Query the network's signal strength.
+CSQ: 31,99 OK	
AT+COPS?	Return the current network selection mode, information about the operator with which the module is registered, and the wireless access standard.
+COPS: "Network status information" OK	For example: +COPS: 0,0,"AT&T Mobility",2
AT+COPS=0 OK	Automatically search for networks.
AT+CREG?	Query the state of the currently registered network.
+CREG: 0,1 OK	
AT+CREG=1 OK	Set the +CREG unsolicited indication.



2.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+COPS?	+CME ERROR: SIM failure	No SIM card is detected. Insert a SIM card.
AT+CREG?	+CME ERROR: SIM failure	No SIM card is detected. Insert a SIM card.

3

Serial Port Configuration Application Scenarios

3.1 Baud Rate Configuration

3.1.1 Reference Process

Command	Description
AT+IPR?	Query the baud rate currently used by a module.
+IPR: 115200 OK	
AT+IPR="<baud rate>"	Set a module's baud rate. After a new baud rate is specified, the module communicates using the new baud rate.
OK	

 NOTE

- If a module's baud rate is too low, its communication speed will be slow.
- At present, the MU509-65 supports the following baud rates: 600 bit/s, 1200 bit/s, 2400 bit/s, 4800 bit/s, 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s (default value), 230400 bit/s, 460800 bit/s and 921600 bit/s.

3.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
Specify a baud rate not supported by a module.	AT+IPR="<baud rate>" ERROR	Check that the specified baud rate is within the range of supported baud rates.

3.2 DTR Hang Up Data Services

3.2.1 Reference Process

Command	Description
AT&D0	Establish a dial-up connection through a serial port for data services. After this command is executed, data can be transferred properly.
OK	
AT&D2	This command is used to configure the action to be executed when DTR pin is high level or low level. Which is: After AT&D2 is executed, when DTR pin is high level, data will be transmitted normally; when DTR pin is low level, data transmission will be terminated.
OK	

**NOTE**

At present, only **AT&D0** and **AT&D2** are supported. **AT&D1** is not supported.

3.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT&D1	ERROR	At present, only AT&D0 and AT&D2 are supported. AT&D1 is not supported.

3.3 DCD Pin Control

3.3.1 Reference Process

Command	Description
AT&C0	Set the DCD pin to be always valid regardless of data services.
OK	
AT&C1	Set the DCD pin to be valid when there are ongoing data services and invalid after data services are disconnected.
OK	

3.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT&C2	ERROR	Unsupported parameter value

3.4 Setting Hardware Flow Control

3.4.1 Reference Process

Command	Description
AT+IFC=0,0	Turn hardware flow control off. After hardware flow control is turned off, communication between the UE and the DTC is not restricted by flow control.
OK	
AT+IFC=2,2	Turn hardware flow control on. After hardware flow control is turned on, communication between the UE and the TE is restricted by flow control: Data transmission stops when UE's or TE's buffer level exceeds 80% and resumes when the buffer level is below 20%.
OK	

**NOTE**

If hardware flow control is enabled, no AT commands can be executed.

3.4.2 Troubleshooting

None

3.5 Character Framing Setting

3.5.1 Reference Process

Command	Description
AT+ICF=3,3	Used to determine the local serial port start-stop (asynchronous) character framing. First parameter 3 means 8 data bits, 1 stop bit, second parameter 3 means no verify bit.
OK	



NOTE

At present, only AT+ICF=3,3 is supported.

3.5.2 Troubleshooting

None

4 External Protocol Stack Application Scenarios

4.1 Prerequisites

4.1.1 Reference Process

Command	Description
AT+CGDCONT=1,"IP","1234"	Configure PDP contexts. In this example provided in the left column, the APN is 1234 . In fact, the APN is provided by your network service provider.
OK	
AT+CGATT?	Obtain PS domain service status.
+CGATT: 1	If 1 is returned, attaching to the PS domain succeeded.
OK	If OK is returned, the command has been executed successfully



NOTE

External protocol stack supports UART or MODEM ports only. After the pre-configuration is complete, ensure that the desired port is not occupied by other processes.

4.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+CGATT?	+CGATT: 0 OK The UE does not obtain any PS domain services.	Run AT+ CGATT=1 to manually attach to the PS domain. If attaching to the PS domain still fails or times out, refer to 3GPP TS 24.008 4.7.3.

4.2 Establishing Data Connections

Reference process 1:

Command	Description
ATD*99#	*99# is the dial string. This command is usually used in Windows and only used in the modem port. The UE switches from command mode to data mode. After the TE starts the PPP negotiation process, the UE automatically performs the actions (including PS domain attaching and PDP activation) required for establishing data connections.
CONNECT xxx	CONNECT indicates that the data service dial-up command is being processed by the module. xxx indicates the data rate, which depends on the network standard and capability level.

Reference process 2:

Command	Description
AT+CGDATA="PPP",1	This command is equivalent to ATD*99# . This command is usually used in the Android Radio Interface Layer (RIL).
CONNECT	

NOTE

- Using the previously configured profile, the PPP negotiation between the TE and the UE, and the PDP negotiation between the UE and the network, the TE obtains the IP and DNS addresses to establish the routing between the TE and the network.
- When establishing data service connections, the TE must start the PPP negotiation after the UE enters data mode. Otherwise the UE will only enter data mode but will not establish data connections with the network.
- The data mode means: After entering data mode, the UE only transfers data packets between the UE and the network, and will not respond to any AT commands except that comes from the PCUI port.

4.2.1 Troubleshooting

Scenario	Possible Error Information	Solution
Failure to open ports or register with a network	Error xxx: The modem (or other connected device) is in use. Note: xxx is usually a number indicating an error. For example, 633 .	1. Check whether the Modem port is in use. Ensure that the Modem port is not being used by other connections. 2. Check that the current network is operating normally. Data service connections can be established only when the network is operating normally.

4.3 Data Transmission

1. Data can be transmitted after data service connections are established.
2. According to 3GPP TS 25.306, HSDPA (FDD) terminals are classified into 24 categories. Different categories have different peak data rates. The following table lists common categories and their key parameters.

Common Terminal Category	Maximum Number of Codewords	Soft Channel Size (Bits)	Minimum Transmission Time Interval (TTI)	Modulation Mode	Theoretical Peak Rate (Mbit/s)
Category 6	5	67200	1	QPSK 16QAM	3.6
Category 8	10	134400	1	QPSK 16QAM	7.2
Category 10	15	172800	1	QPSK 16QAM	14.4
Category 14	15	259200	1	QPSK 16QAM 64QAM	21.6
Category 16	15	345600	1	QPSK 16QAM MIMO+16QAM Note: 64QAM is not supported.	28.8
Category 18	15	345600	1	QPSK 16QAM 64QAM MIMO+16QAM	28.8
Category 20	15	518400	1	QPSK 16QAM 64QAM MIMO+16QAM MIMO+64QAM	43.2
Category 24	15	518400	1	QPSK 16QAM 64QAM DC	43.2

3. According to the Radio Resource Control (RRC) version, the WCDMA/HSDPA rate in theory are as follows:

WCDMA RRC Version	Modulation Mode		Theoretical Peak Rate (Mbit/s)	
	Downlink	Uplink	Downlink	Uplink
3GPP Rel				
R99/R4	QPSK	BPSK	0.384	0.384
Rel-5	16QAM	QPSK	3.6	0.38

4.4 Switching Between Data Mode and Command Mode

4.4.1 Reference Process

Command	Description
ATD*99#	UE dials up.
CONNECT	
+++	Enter +++ (three plus signs) to switch the data service port from data mode to command mode. The UE can then respond to AT commands and perform corresponding actions.
ATO	Switch the data service port back to data mode so that the UE can continue to transmit data.
CONNECT	

NOTE

- If there are no data links available, the module will not switch back to data mode but remains in command mode.
- If the data link is connected, when the module switches from data mode to command mode, data transmission will be suspended.
- If the data link is connected, when the module switches from command mode to data mode, data transmission will be resumed.
- Switching between data mode and command mode applies to UART and Modem ports.

4.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
+++	Failed to switch to command mode.	+++ must be consecutively entered within 0.9s.

4.5 Disconnecting Data Service Connections

4.5.1 Reference Process

Reference Process 1:

Command	Description
+++	
ATH	Before this command is executed, the +++ sequence must be sent to the data service port. This command is used to disconnect data service connections. This command is usually used in Windows.
OK	

Reference Process 2:

Command	Description
AT+CGACT=0	In Android RIL, after a PPP connection is disconnected, this command is executed to deactivate the PDP context to release the data link and disconnect the data services. The use of this command is the same as that of ATH .
OK	

1. Terminating a data service connection from the TE: the TE sends a PPP Terminate packet to the UE to pull down the DTR signal. The UE disconnects the PPP connection, releases the wireless link resource, pulls down the CD signal, and returns **NO CARRIER**. As a result, the data service connection is disconnected. This method of disconnecting data service connections is usually implemented by the disconnection function of the TE's application.
2. Terminating a data service connection from the UE: The TE sends an AT command to the UE to pull down the DTR signal. After receiving the AT command, the UE releases the connection to the network, pulls down the CD signal, and returns **NO CARRIER**. As a result, the data service connection is disconnected. This mode of disconnecting data service connections requires an AT command interaction tool.
3. When disconnecting data service connections in Android RIL, Android RIL must kill pppd to disconnect PPP connections before using **AT+CGACT=0** to deactivate PDP contexts and release wireless link resources.

5 Internal Protocol Stack Application Scenarios-TCP/UDP

5.1 Overview

In a TCP/UDP/FTP/HTTP link, the module transmits data without encryption. To transmit security data, use the following method:

Enable the host computer to encrypt the data and transmit the encrypted data in the TCP/UDP link.

5.1 Initializing Internet Services

5.1.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	In this example provided in the left column, the APN is 1234 , and the user name and password are both card . After this command is executed, the PDP active process will be caused.
OK	
AT^IPINIT?	Query the obtained IP and DNS addresses.
^IPINIT: 1,"192.168.70.59","1234","172.16.44.200", "172.16.44.201" OK	



NOTE

Internal protocol stack supports UART ports only.

5.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPINIT?	^IPINIT: 0 OK	Initialization has not been performed. Initialize the internal protocol stack and query again.
AT^IPINIT="1234", "card","card"	+CME ERROR: Normal error	Initialization failed. 1. Check that the current network signal strength is good and the parameters are set correctly. 2. Ensure that no IP stack termination command has been executed.
AT^IPINIT="1234", "card","card"	+CME ERROR: The link has been established already	AT^IPINIT? queries whether the internal protocol stack has been initialized. If the internal protocol stack has been initialized, it does not need to be initialized again. If it has not been initialized, there are ongoing dial-up services. Hang up the dial-up services and re-send AT^IPINIT to start initialization.

5.2 Creating a Listen Server

5.2.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	Initialize the internal protocol stack.
OK	
AT^IPLISTEN="TCP",5000	Create a TCP server whose listen port number is 5000 (users can specify this number as required). For the method to create UDP servers, refer to the AT command document.
OK	
AT^IPLISTEN?	Query the information about the server that has been created.
^IPLISTEN: "TCP",5000,5 OK	


NOTE

- Only one server is supported by the internal protocol stack.
- The internal protocol stack must be initialized before you create a listen server.

5.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPLISTEN="TCP",5000	+CME ERROR: The network has not been opened yet	Run AT^IPINIT to initialize the internal protocol stack, and then create the listen server.
AT^IPLISTEN="UDP",5000	+CME ERROR: The server has been established already	A listen server already exists. Run AT^IPCLOSE=6 to close the existing listen server.
AT^IPLISTEN="UDP",5000	+CME ERROR: Fail to bind the specified port with server	The local port is in use. Change the port and re-send the command.

5.3 Creating TCP/UDP Links

5.3.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	Initialize the internal protocol stack.
OK	
AT^IPOPEN=1,"TCP","172.22.44.33",5000,5500	Use a specified IP address to connect to the remote server and establish a TCP link. For the method to create UDP links link, refer to the AT command document.
OK	
AT^IPOPEN=2,"TCP","www.example.com",80,3081	Use a specified domain name to connect to the remote server and establish a TCP link.
OK	
AT^IPOPEN?	Query link information.
^IPOPEN:1,"TCP",5500,"172.22.44.33",5000,3,0	
OK	

Command	Description
^IPOPEN: 2,"TCP",5600,"172.22.44.33",80,3,0 OK	


NOTE

- When creating a listen server, the local port number can be ignored. If the port number is ignored, the module will randomly assign a local port number.
- When creating a TCP link, ensure that the remote server has been started.
- The maximum segment size (MSS) for creating TCP links is 1220 bytes. Data larger than the MSS will be segmented into several packets.

5.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPOPEN=1,"TCP","172.22.44.33",5000	+CME ERROR: The network has not been opened yet	Initialize the internal protocol stack before sending the command to create the link.
AT^IPOPEN=1,"TCP","172.22.44.33",5000	+CME ERROR: The link has been established already	Run AT^IPCLOSE to close the corresponding link. Alternatively, change the link ID and send the command to create the link.
AT^IPOPEN=1,"TCP","172.22.44.33",5000,5000	+CME ERROR: Fail to bind the specified port	Change the local port number, or leave the local port number blank.
AT^IPOPEN?	OK	No link information is available. Create a link, or accept the link as a server, and then query the link information again.

5.4 Sending Data

5.4.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	Initialize the internal protocol stack.
OK	

Command	Description
AT^IPOPEN=1,"TCP", "172.22.44.33",5000,5500	Create a link.
OK	
AT^IPSEND=1,"31323334"	Send data. In this example, 31323334 is sent.
^IPSEND: 1 OK ^IPDATA: 1,8,31323334	Data is successfully sent and received.
AT^IPSENDEX=1,0,"31323334"	Send data in mode 0. In this example, 31323334 is sent.
^IPSENDEX: 1 OK ^IPDATA: 1,8,31323334	
AT^IPSENDEX=1,1,"31323334"	Send data in mode 1. In this example, 1234 is actually sent.
^IPSENDEX: 1 OK ^IPDATA: 1,4,1234	
AT^IPSENDEX=1,2,<datalen>	Send data in mode 2.
OK (Wait for the user to enter user data with a length of <datalen>) ^IPSENDEX: 1 OK	

NOTE

- **AT^IPSEND** and mode 0 of **AT^IPSENDEX** can send displayable characters only. Mode 1 and mode 2 of **AT^IPSENDEX** can send all characters.
- In mode 2 of **AT^IPSENDEX** (length restriction mode), except the port that receives data entered by the user, all other ports are unavailable before the user finishes entering the user data.

5.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPSEND=1,"data"	+CME ERROR: The network has not been opened yet	Before sending data, initialize the protocol stack or accept the link as a server.
AT^IPSEND=1,"data"	+CME ERROR: Remain data is sending	The module is exiting transparent transmission mode and cannot send data. Wait until the module completely exits transparent transmission mode.
AT^IPSEND=1,"data"	+CME ERROR: The link has not been established yet	Before sending data, create a link or accept the link as a server.
AT^IPSEND=1,"data"	+CME ERROR: Normal error	The module failed to send the data. Ensure that the current network's signal strength is good.
AT^IPSENDEX=1,2,<datalen>	+CME ERROR: Too many data to be sent	The length of the data entered by the user exceeds the length specified by the command. Ensure that the length of the data is equal to the data length specified by mode 2 of AT^IPSENDEX .

5.5 Closing TCP/UDP Links

5.5.1 Reference Process

Command	Description
AT^IPCLOSE=<link_id>	Close the specified link, server, or network, and at the same time release the corresponding resources. For details about the parameters, refer to the related AT command document.
OK	
AT^IPCLOSE?	Query the current link status. 1 indicates that the link is open, and 0 indicates that the link is closed.
^IPCLOSE: 1,0,0,0,0 OK	

5.5.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPCLOSE=<link_id>	+CME ERROR: Normal error	The command is terminated. Run the AT^IPCLOSE command again.

5.6 Transmission Mode

5.6.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	Initialize the internal protocol stack.
OK	
AT^IPOPEN=1,"UDP","172.22.44.33",5000,5500	Create a link.
OK	
AT^IPCFL=12,0	Set the transparent transmission mode to time- and length-based transmission mode.
OK	
AT^IPCFL=5,100	Set the timer for triggering transparent transmission to 10s (100 x 0.1s).
OK	
AT^IPCFL=10,1220	Set the TCP/UDP MSS to 1220 bytes.
OK	
AT^IPENTRANS=1	Enable transparent transmission mode.
OK	
313233347D5D7D5E7E	Send user data. User data is sent once the data length reaches the segment length specified by parameter 10 of AT^IPCFL. If the user data length is shorter than the specified length, the data will be sent when the timer set by parameter 5 of AT^IPCFL counts down to 0. For details about the transmission mechanism, refer to the description of AT^IPENTRANS in the AT command document. In this example, the data entered by the user is 313233347D5D7D5E7E in hexadecimal

Command	Description
	format. The data sent by the module is the original data entered by the user.
313233347D5D7D5E7E	Receive user data in time- and length-based transmission mode. In this example, the data received by the module is 313233347D5D7D5E7E. The original data received by the module is presented.
+++	Exit transparent transmission mode. For the rules about the +++ sequence, refer to the AT command document.
OK	
AT^IPCFL=12,1	Set the transparent transmission mode to 7E detection mode.
OK	
AT^IPENTRANS=1	Enable transparent transmission mode.
OK	
AT^IPENTRANS?	Query the link ID for entering transparent transmission mode from a non-transparent port.
^IPENTRANS: 1	
313233347D5D7D5E7E	Send data in 7E detection mode (applies to UDP only). In this example, the data that the user wants to send is 313233347D7E in hexadecimal format. Therefore, the user needs to transform 7D to 7D5D and 7E to 7D5E, and adds 7E as the ending characters to the end of the data. After the module recognizes the data packet, the data actually sent by the module is 313233347D7E.
313233347D5D7D5E7E	Receive data in 7E detection mode (applies to UDP only). The data received by the module is 313233347D7E in hexadecimal format. After receiving the data, the module transforms 7D to 7D5D and 7E to 7D5E, and adds 7E as the ending characters to the end of the data before presenting the data to the user.


NOTE

- The transparent transmission mode of the internal protocol stack supports UART only.
- The internal protocol stack allows only one link to enter transparent transmission mode. In addition, before entering transparent transmission mode, ensure that only one link exists at the current physical port. If the module functions as a server, the link can enter transparent transmission mode only when the link is requested by a remote client and accepted by the server.
- The settings (including the time- and length-based transmission mode and 7E detection mode) of transparent transmission mode must be configured using **AT^IPCFL** before the transparent transmission mode is enabled. For details about how to configure the settings, refer to the AT command document.
- Because the platform's memory is restricted, you need firstly divide the file into ones that are smaller than 4 KB if the uploaded file size is large, and then transport them.

5.6.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPENTRANS=1	+CME ERROR: Invalid port for transparent mode	This indicates that the link is not established at a UART port. To solve this problem, establish a link from a UART port and set the UART port to enter transparent transmission mode.
AT^IPENTRANS=1	+CME ERROR: More than one link in physical port	There are more than one link. Use AT^IPCLOSE to close other links before entering transparent transmission mode.
AT^IPENTRANS=1	+CME ERROR: The physical port is in listen state and has no client	The module functions as the server but does not accept the link requested by the client. Accept the link before entering transparent transmission mode.
AT^IPCFL=5,10	+CME ERROR: Forbidden operation in transparent mode	AT^IPCFL cannot be used during transparent transmission. Exit transparent transmission mode before running AT^IPCFL .

5.7 Packet Statistics

5.7.1 Reference Process

Command	Description
AT^IPFLOWQ?	Query packet statistics. In this example, the returned result indicates that 3 bytes of characters are successfully received by and sent from link 1. For details about the parameters. Refer to the AT command document.
^IPFLOWQ: 1,3,3,3,3,3 ^IPFLOWQ: 2,0,0,0,0,0 ^IPFLOWQ: 3,0,0,0,0,0 ^IPFLOWQ: 4,0,0,0,0,0 ^IPFLOWQ: 5,0,0,0,0,0 OK	
AT^IPFLOWQ=<linkid>	Clear the traffic statistics on the specified link (link ID 1–5).
OK	
AT^IPFLOWQ=0	Clear the traffic statistics on all links.
OK	

5.8 Link Change Indication

5.8.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	Initialize the internal protocol stack.
OK	
AT^IPLISTEN="TCP",5000	Create a server.
OK (The client requests to connect to the server.) ^IPSTATE: 1,1,1	The server accepts the link requested by the client.
(The other party of the link closest the link.) ^IPSTATE: 1,0,0	



Command	Description
(Network connection is broken.)	
^IPSTATE: 1,0,2 ^IPSTATE: 6,0,2 ^IPSTATE: 7,0,2	Indicate presented without solicitation for broken links, connection to the server, and network connections.
	The number of current links has reached the supported maximum. New link requests will be rejected.
^IPSTATE: 0,0,3	
	The module rejects new link requests because it functions as the server and is in transparent transmission mode.
^IPSTATE: 0,0,4	

6 Internal Protocol Stack Application Scenarios-FTP

6.1 Overview

An FTP link can only be used in the modem and UART port.

6.2 Creating an FTP Control Link

6.2.1 Reference Process

Command	Description
AT^IPOPEN=1,"FTP","192.168.63.41",21,"username","password"	Create a normal FTP control link, an FTP user is successfully logged in FTP server.
OK ^IPSRVST: 1,10,230	



NOTE

- Only one FTP service can be enabled at a time. Not concurrent operate with other built-in protocols, including TCP, UDP, etc.
- PDP must be activated.

6.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
Create the link. AT^IPOPEN=1,"FTP","192.168.63.41",21,"username",	+CME ERROR: The network has not been opened yet	Initialize the internal protocol stack before sending the command to create the link.

Scenario	Possible Error Information	Solution
password"	+CME ERROR: The link has been established already	Try to open an already established link.

6.3 Configuring Data Transmission Mode

In FTP, data can be transferred (GET) in three different modes.

- Transparent transmission mode:**
For GET operation, files will be downloaded from the server and the content will be displayed to the user.
During the data transfer process, we cannot execute other AT commands.
- Command transmission mode:**
For GET operation, contents of downloaded file from server will be displayed to users through **AT^IPDATA** report.
During the data transfer process, we can execute any other AT commands than GET.
- Buffer mode:**
For GET operation, contents of downloaded file from server will be stored in a buffer.
And an **^IPSRVST** report will be displayed which indicates whether there is data to be read. After that, users need to issue "**AT^IPRCV=<link_id>,<reqReceiveLength>**" to read the data from buffer. For more information on **AT^IPRCV**, please refer AT command document.
The size of the buffer is 65536 bytes.
During the data transfer process, we can execute any other AT commands other than GET.

6.3.1 Reference Process

Command	Description
AT^IPCFL=14,0	Set data transmission mode to transparent transmission mode.
OK	
AT^IPCFL=14,1	Set data transmission mode to command transmission mode.
OK	
AT^IPCFL=14,2	Set data transmission mode to buffer transmission mode.
OK	

The **AT^IPCFL** command is used to set the processing mode for FTP file data. By default, transparent transmission mode will be set. Users can change the data transmission mode as per the need.

6.4 Configuring FTP Data Channel Mode

6.4.1 Reference Process

Command	Description
AT^FTPCMD=1,PORT	Configure the connection mode in PORT mode for downloading data.
OK	
AT^FTPCMD=1,PASV	Configure the connection mode in PASV mode for downloading data. The default mode is PASV mode.
OK	

- In PORT mode, the client creates the control channel and provides the data port number which it will be listening on. The server then creates the data channel with the client provided port.
- In PASV mode, the client creates both control channel and data channel. PASV mode is generally used in scenarios where the server will not be able to setup the data channel; one of the major reasons for this would be the network firewall limitation.

6.5 Downloading File Using "GET" Command in Transparent Mode

6.5.1 Reference Process

Command	Description
AT^IPINIT="example.com"	Initialize the internal protocol stack.
OK	
AT^IPCFL=14,0	Set data transmission mode to transparent mode. By default it will be in transparent mode only.
OK	
AT^IPOPEN=1,"FTP","192.168.63.41", 21,,"username","password"	Create the link.
OK	
^IPSRVST: 1,10,230	
AT^FTPCMD=1,PORT	Set the FTP data channel mode to PORT mode for downloading the data. By default it will be PASV mode.

Command	Description
OK	
AT^FTPCMD=1,GET,"ftp.txt"	Give the FTP GET command for downloading data.
CONNECT Hello OK ^IPSRVST: 1,11,1	

6.5.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^FTPCMD=1,GET,"ftp.txt"	+CME ERROR: The link has not been established yet	Make sure that the get operation link ID is established.

6.6 Downloading File Using "GET" Command in Command Mode

6.6.1 Reference Process

Command	Description
AT^IPINIT="example.com"	Initialize the internal protocol stack.
OK	
AT^IPOPEN=1,"FTP","192.168.63.41",21,"username","password"	Create the link.
OK ^IPSRVST: 1,10,230	
AT^IPCFL=14,1	Set data transmission mode to command mode.
OK	

Command	Description
AT^FTPCMD=1,PORT	Set the FTP data channel mode to PORT mode for downloading the data. By default it will be PASV mode.
OK	
AT^FTPCMD=1,GET,"ftp.txt"	Give the FTP GET command for downloading data.
OK	
^IPDATA: 1, 5, Hello	
^IPSRVST: 1,11,1	

6.7 Download File Using "GET" Command in Buffer Mode

6.7.1 Reference Process

Command	Description
AT^IPINIT="example.com"	Initialize the internal protocol stack.
OK	
AT^IPOPEN=1,"FTP","192.168.63.41", 21,,"username","password"	Create the link.
OK	
^IPSRVST: 1,10,230	
AT^IPCFL=14,2	Set data transmission mode to buffer mode.
OK	
AT^FTPCMD=1,PORT	Set the FTP data channel mode PORT for downloading and uploading the data. By default it will be PASV mode. For more information on when to use PORT or PASV mode, refer section 6.3 Configuring Data Transmission Mode.
OK	
AT^FTPCMD=1,GET,"ftp.txt"	Give the FTP GET command for downloading data.

Command	Description
OK	
^IPSRVST: 1,11,1	
AT^IPRCV=1,5	Receive the data stored in the buffer.
^IPRCV: 1,5 Hello OK	

6.8 FTP Error Codes

<state code>	<state code> representative's meaning
100	The server has not responded
110	Restarts the mark reply
120	Prepares in n minutes
125	The connection opens the preparation to transmit
150	Opens the data connection
200	Command Execution Success
202	Command Execution Failure
211	System Status
212	List Status
213	FILE SIZE
214	Help information
215	Name system type
220	The new client prepared
221	Service closure pilot connection, may withdraw registers
225	The data connection opens, does not have the transmission to be in progress
226	That the closure data connection, requested file operation successfully
227	Enters the passive pattern
230	Successful Login

<state code>	<state code> representative's meaning
250	File operation of request completes
257	Setup PATH NAME
331	A user correctness, needs the password
332	When registers needs the account information
350	Next order
421	Cannot provide the service, closes the pilot connection
425	Cannot open the data connection
426	The closure connection, stops transmitting

7

Internal Protocol Stack Application Scenarios-HTTP

7.1 Overview

An HTTP link can only be used in the modem and UART port.

7.1 Creating an HTTP Server Link

7.1.1 Reference Process

Command	Description
<code>AT^IPOPEN=1,"HTTP","www.example.com",80</code>	Open a normal HTTP server link, an HTTP user is successfully logged in HTTP.
<code>OK</code>	



NOTE

- Only one HTTP service can be enabled at a time.
- Before an HTTP service is enabled, Internet configuration and HTTP configuration must be completed.

7.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
Create the link. <code>AT^IPOPEN=1,"HTTP","www.example.com",80</code>	+CME ERROR: The network has not been opened yet	Initialize the internal protocol stack before sending the command to create the link.
	+CME ERROR: The link has been established already	Try to open an already established link.

7.2 Configuring Data Transmission Mode

7.2.1 Reference Process

Command	Description
AT^IPCFL=14,0	Sets data transmission mode to transparent transmission mode.
OK	
AT^IPCFL=14,1	Sets data transmission mode to command transmission mode.
OK	
AT^IPCFL=14,2	Sets data transmission mode to buffer transmission mode.
OK	

The **AT^IPCFL** command is used to set the data processing mode for HTTP, which is same as FTP. By default, transparent transmission mode will be set. Users can change the data transmission mode as per the need.

7.3 Downloading File Using "GET" Command in Transparent Mode

7.3.1 Reference Process

Command	Description
AT^IPINIT="mhahuawe1.com"	Initialize the internal protocol stack.
OK	
AT^IPOPEN=1,"HTTP","www.example.com",80	Create the link.
OK	
AT^IPCFL=14,0	Set data transmission mode to transparent mode. By default it will be in transparent mode only.
OK	
AT^HTTPCMD=1,GET, http://www.example.com:80/n_index.txt	Download the file from the HTTP server n_index.txt (in the following example, <link_id> is 1).
CONNECT hello123 OK	

Command	Description
^IPSRVST: 1,12,200	

7.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^HTTPCMD=1,GET, http://www.example.com:80 /n_index.txt	+CME ERROR: The link has not been established yet	Make sure that the get operation link ID is established.

7.4 Downloading File Using "GET" Command in Command Mode

7.4.1 Reference Process

Command	Description
AT^IPINIT="mhahuawe1.com"	Initialize the internal protocol stack.
OK	
AT^IPCFL=14,1	Set data transmission mode to command mode.
OK	
AT^IPOPEN=1,"HTTP","www.example.com",80	Create the link.
OK	
AT^HTTPCMD=1,GET,"http://www.example.com:80/n_index.txt"	Download the file from the HTTP server n_index.txt (in the following example, <link_id> is 1.
OK	
^IPDATA: 1,5,hello123 ^IPSRVST: 1,12,200	

7.5 Downloading File Using "GET" Command in Buffer Mode

7.5.1 Reference Process

Command	Description
AT^IPINIT="mhahuawe1.com"	Initialize the internal protocol stack.
OK	
AT^IPOPEN=1,"HTTP","www.example.com",80	Create the link.
OK	
AT^IPCFL=14,2	Set data transmission mode to buffer transmission mode.
OK	
AT^HTTPCMD=1,GET,"http://www.example.com:80/n_index.txt"	Download the file from the HTTP server n_index.txt (In the following example, <link_id> is 1)
OK	
AT^IPRCV=1,5	Receive the data stored in the buffer.
^IPRCV: 1,5 Hello OK	

7.6 Uploading File Using "POST" Command in Transparent Mode

7.6.1 Reference Process

Command	Description
AT^IPINIT="mhahuawe1.com"	Initialize the internal protocol stack.
OK	
AT^IPOPEN=1,"HTTP","www.example.com",80	Create the link.
OK	
AT^IPCFL=14,0	Set data transmission mode to online mode.

Command	Description
OK	
AT^HTTPCMD=1,POST,"http://www.example.com:80/example.html",1000,"text/plain"	Upload the data using this command .If the upload has to be cancelled, then give +++ to terminate.
CONNECT textcontext=hello123 Enter 20 bytes of data <phtml><head><title>Text Area - Fifth CGI Program</title></phead><body> EnteredText Content is hello123 </body></html> OK ^IPSRVST: 1,12,200	

7.7 Uploading File Using "POST" Command in Command Mode and Buffer Mode

There is no difference in HTTP POST operation of "Command and Buffer mode". In both modes, AT^IPSENDEX is used to enter the data.

7.7.1 Reference Process

Command	Description
AT^IPINIT="mhahuawe1.com"	Initialize the internal protocol stack.
OK	
AT^IPOPEN=1,"HTTP","www.example.com",80	Create the link.
OK	
AT^IPCFL=14,1	Set data transmission mode to command mode.
OK	
AT^HTTPCMD=1,POST,"http://www.example.com:80/cgi-bin/textarea.cgi",20,"text/plain"	Upload the data content to the post script textarea.cgi.
OK	
AT^IPSEND=1,"textcontext=hello123"	Transmit the data through the link established (in this case, <link_id> is 1).
^IPSEND: 1	

Command	Description
OK ^IPSRVST: 1,12,200	
AT^IPSENDEX=1,0,"textcontent=hello123"	Transmit the data through the link established in IPSENDEX Mode 0 (in this case, <link_id> is 1).
^IPSEND: 1 OK ^IPSRVST: 1,12,200	
AT^IPSENDEX=1,2,20,1 textcontext=hello123	Transmit the data through the link established in IPSENDEX Mode 2 (in this case, <link_id> is 1).
^IPSEND: 1 OK ^IPSRVST: 1,12,200	
AT^IPSENDEX=1,1,"74657874636F6E74656E743D68"	Transmit the data through the link established in IPSENDEX Mode 1(in this case, <link_id> is 1).
^IPSEND: 1 OK ^IPSRVST: 1,12,200	
AT^IPCLOSE=1	Close the link.
OK	


NOTE

The <textcontent> specifies the corresponding field in the POST script.

7.7.2 Troubleshooting

Scenario	Possible Error Information	Solution
Close the specified link. AT^IPCLOSE=<link_id>	+CME ERROR: Normal error	The command is terminated. Run the AT^IPCLOSE command again.
Create the link. AT^IPOPEN=1,"HTTP","www.example.com",80	+CME ERROR: The network has not been opened yet	Initialize the internal protocol stack before sending the command to create the link.
	+CME ERROR: The link has been established already	Run AT^IPCLOSE to close the corresponding link. Alternatively, change the link ID and send the

Scenario	Possible Error Information	Solution
		command to create the link.
	+CME ERROR: Fail to bind the specified port	Change the local port number, or leave the local port number blank.
Query link information. AT^IPOPEN?	OK	No link information is available. Create a link, or accept the link as a server, and then query the link information again.
AT^HTTPCMD=?	^HTTPCMD: (1-5),("GET","POST")	Get the current HTTP command
AT^HTTPCMD=1,GET,"http://www.example.com:80/example.html"	+CME ERROR: The link has not been established yet	Run AT^IPOPEN to open the link and then perform the download operation.
AT^HTTPCMD=1,POST,"http://www.example.com:80/example.html",1000,"text/plain"	+CME ERROR: The link has not been established yet	Run AT^IPOPEN to open the link and then perform the upload operation.

7.8 HTTP Error Codes

<state code>	<state code> representative's meaning
200	Operation successful
301	Moved permanently
302	Moved temporarily
401	Requested action requires authorization
403	Forbidden
404	Resource not found
405	Method not allowed on resource
406	Requested representation not accepted
408	Request timed out
410	Requested source is no longer available server
500	Internal server error
501	Requested HTTP operation not supported



<state code>	<state code> representative's meaning
505	HTTP version not supported

8 Voice and Supplementary Service Application Scenarios

8.1 Pre-configuration (PCM Voice Pre-configuration)

8.1.1 Reference Process

Command	Description
AT^CPCM=0,0,0,0,0 or AT^CPCM=0,1,0,0,0	Set the PCM voice channel as the master mode. The module generates 2.048 MHz clock signals and 8 kHz short synchronization signals. Data is in 16 bit Linear format. Set the PCM voice channel as the master mode. The module generates 2.048 MHz clock signals and 8 kHz short synchronization signals. Data is in 8 bit μ -Law format.
OK	
AT^ECHO=0 or AT^ECHO=1 or AT^ECHO=2 or AT^ECHO=3 or AT^ECHO=4 or AT^ECHO=5	Close the echo canceller Handset mode Headset mode Carkit mode Speakerphone mode Bluetooth headset mode
OK	
AT^SMUT=0	Unmute the transmit (TX) channel.
OK	

8.2 Voice Call Initialization

8.2.1 Reference Process

Command	Description
ATS0=5	Set the module to automatically answer a call when the module receives five ring indications.
OK	
ATS0?	
005	
OK	
AT+CMUT=1	Mute the microphone during a call.
OK	

8.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
ATS0=<value>	ERROR	The specified value exceeds the value range 0–255.
AT+CMUT=<value>	ERROR	This command can be executed only during an ongoing call.

8.3 Voice Call Handling

8.3.1 Reference Process

Command	Description
ATD13912345678;	User 1 makes a voice call to 13912345678.
OK ^ORIG: 1,0 ^CONF: 1	User 1 presents the ^ORIG indication.
RING	User 2 receives the indication.
ATA	User 2 answers the call.

Command	Description
OK ^CONN: 1,0 ^CONN: 1,0	User 2 presents the ^CONN indication. User 1 presents the ^CONN indication.
AT+CHUP	User 1 hangs up
^CEND: 1,6,29,16 OK (User 2) ^CEND: 1,6,104,16	User 1 presents ^CEND to indicate that it has ended the call. User 1 presents the ^CEND indication. User 2 presents ^CEND to indicate that it has ended the call.

8.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
Make a voice call when no network is found.	^ORIG: 1,0 Presents ^CEND indication.	Make the call after the network is found.
The PIN is not authenticated.	+CME ERROR: SIM PIN required	Enter the correct PIN.

8.4 DTMF Application

8.4.1 Reference Process

Command	Description
ATD10086;	The user dials 10086.
OK ^ORIG: 1,0 ^CONF: 1 ^CONN: 1,0	^CONN: 1,0 is presented to indicate that the call is connected.
AT+VTS=1	Follow the voice instructions, and send a DTMF tone to select option 1 to enter the sub-option of querying the local area to which the module belongs.
OK	
AT+VTS=3	Send a DTMF tone to select option 3.

Command	Description
OK	
AT+CHUP	The user hangs up.
^CEND: 1,6,29,16	^CEND: 1,6,29,16 is presented to indicate that user ends the call.
OK	

8.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
Make a voice call when no network is found.	^ORIG: 1,0 Presents ^CEND indication.	Make the call after the network is found.
The PIN is not authenticated.	+CME ERROR: SIM PIN required	Enter the correct PIN.

8.5 ID Presentation

8.5.1 Reference Process

Caller ID presentation:

Command	Description
AT+CLIP=1	User 1 enables the calling line identification presentation (CLIP) indication.
OK	
AT+CLIP?	User 1 queries the CLIP indication.
+CLIP: 1,1	
OK	
ATD13903710616;	User 2 calls user 1 whose number is 13903710616.
OK	
^ORIG: 1,0	User 2 presents the ^ORIG indication.
^CONF: 1	User 2 presents the ^CONF indication.
(User 1)	

Command	Description
RING +CLIP: " +8613903702766",145, ,,,0	User 1 presents the +CLIP indication. User 1 presents the +CLIP indication every 5 seconds. User 2's number is 13903702766.


NOTE

All the previous actions can be performed only when user 1 has subscribed to CLIP.

Caller ID presentation restriction:

Command	Description
AT+CLIP=1	User 1 enables the CLIP indication.
OK	
AT+CLIR?	User 2 queries the calling line identification restriction (CLIR).
+CLIR: 0,1	User 2 subscribes to permanent CLIR.
OK	
ATD13903710616;	User 2 calls user 1 whose number is 13903710616.
OK ^ORIG: 1,0 ^CONF: 1 (User 1) RING +CLIP: "",128,,,1	User 2 presents the ^ORIG indication. User 2 presents the ^CONF indication. User 1 presents the +CLIP indication User 1 presents the +CLIP indication every 5 seconds.


NOTE

All the previous actions can be performed only when user 1 has subscribed to CLIP and user 2 has subscribed to permanent CLIR.

Command	Description
AT+CLIP=1	User 1 enables the CLIP indication.
OK	
AT+CLIR=2	User 2 has subscribed to CLIR.
OK	
AT+CLIR?	User 2 queries the CLIR.
+CLIR: 2,4	

Command	Description
OK	
ATD13903710616;	User 2 calls user 1 whose number is 13903710616.
OK ^ORIG: 1,0 ^CONF: 1 (User 1) RING +CLIP: " +8613903702766",145,,0	User 2 presents the ^ORIG indication. User 2 presents the ^CONF indication. User 1 presents the +CLIP indication. User 1 presents the +CLIP indication every 5 seconds. User 2's number is 13903702766.

8.5.2 Troubleshooting

Scenario	Possible Error Information	Solution
Make a voice call when no network is found.	^ORIG: 1,0 Presents ^CEND.	Make the call after the network is found.
The PIN is not authenticated.	+CME ERROR: SIM PIN required	Enter the correct PIN.

8.6 Call Forwarding

8.6.1 Reference Process

Command	Description
AT+CCFC=0,3,"13903710453",129,1	User 1 subscribes to the service of forwarding all calls to user 3 whose number is 13903710453.
OK	
AT+CCFC=0,2	User 1 queries the CCFC status.
+CCFC: 1,1," +8613903710453",145,, OK	
ATD13903702766;	User 2 calls user 1 whose number is 13903702766.

Command	Description
OK (User 3) RING	Instead of user 1, user 3 presents the Ring indication.


NOTE

The previous actions are based on call forwarding without any restrictions. Those actions can be performed only after the user has subscribed to the call forwarding service.

Command	Description
AT+CCFC=1,3,"13903710453",129,1	User 1 subscribes to the service of forwarding busy calls to user 3 whose number is 13903710453.
OK	
AT+CCFC=0,2	User 1 queries the CCFC status.
+CCFC: 1,1,"+8613903710453",145,,,	
OK	
(User 1) ATD13903711234;	User 1 calls user 4 (13903711234), and user 4 answers the call.
OK ^ORIG: 1,0 ^CONF: 1 ^CONN: 1,0	
(User 2) ATD13903702766;	User 2 calls user 1
OK ^ORIG: 1,0 ^CONF: 1	
(User 3) RING	Forwards the call when busy. User 3 presents the ring indication, while user 1 presents no indications.


NOTE

The previous actions are based on call forwarding without any restrictions. Those actions can be performed only after the user has subscribed to the call forwarding service.

8.6.2 Troubleshooting

Scenario	Possible Error Information	Solution
Make a voice call when no network is found.	^ORIG: 1,0 Presents ^CEND.	Make the call after the network is found.
The PIN is not authenticated.	+CME ERROR: SIM PIN required	Enter the correct PIN.
The user has not subscribed to the call forwarding service.	Network reject	Subscribe to the call forwarding service.

8.7 Multi-party Calling

8.7.1 Reference Process

Command	Description
AT+CCWA=1,1,1	The convener activates the call waiting function and enables the +CCWA indication.
OK	
(Convener) ATD13903702766;	The convener calls participant 1.
OK	
(Participant 1) ATA	Participant 1 answers the call.
^CONN: 1,0	Participant 1 presents ^CONN: 1,0.
(Convener) ^CONN: 1,0	Then convener presents ^CONN: 1,0.
(Convener) AT+CHLD=2	The convener maintains the call between the convener and participant 1.
OK	
(Convener) ATD13903710453;	The convener calls participant 2.
OK	
(Participant 2)	Participant 2 answers the call.

Command	Description
ATA	
^CONN: 1,0 (Convener) ^CONN: 2,0	Participant 2 presents ^CONN: 1,0 . Then convener presents ^CONN: 2,0 .
(Convener) AT+CLCC	The convener queries the call status.
+CLCC: 1,0,1,0,0,"13903702766",129 +CLCC: 2,0,0,0,0,"13903710453",129 OK	
(Convener) AT+CHLD=3	The convener establishes a three-party call.
OK	
(Convener) AT+CLCC	The convener queries the call status.
+CLCC: 1,0,0,0,1,"13903702766",129 +CLCC: 2,0,0,0,1,"13903710453",129 OK	
(Participant 3) ATD13903710616;	Participant 3 calls the convener.
OK (Convener) +CCWA: "+8613903710426",145,1	Then convener presents +CCWA: "+8613903710426",145,1
(Convener) AT+CHLD=2	The convener keeps two active calls and answers the call from participant 3.
^CONN: 3,0 (Convener) ^CONN: 1,0	Then convener presents ^CONN: 3,0 Participant 3 presents ^CONN: 1,0 .
(Convener) AT+CLCC	The convener queries the call status.
+CLCC: 1,0,1,0,0,"13903702766",129	

Command	Description
+CLCC: 2,0,1,0,0,"13903710453",129 +CLCC: 3,1,0,0,0,"+8613903710426",145 OK	
(Convener) AT+CHLD=3	The convener establishes a four-party call.
OK	
(Convener) AT+CLCC	The convener queries the call status.
+CLCC: 1,0,0,0,1,"13903702766",129 +CLCC: 2,0,0,0,1,"13903710453",129 +CLCC: 3,1,0,0,1,"+8613903710426",145 OK	
(Participant 1) AT+CHUP	Participant 1 leaves the meeting.
^CEND: 1,197,29,16 OK (Convener) ^CEND: 1,198,104,16	Participant 1 presents ^CEND: 1,197,29,16 . Participant 1 rejoins the meeting. Then convener presents ^CEND: 1,198,104,16
(Convener) AT+CLCC	The convener queries the call status.
+CLCC: 2,0,0,0,1,"13903710453",129 +CLCC: 3,1,0,0,1,"+8613903710426",145 OK	
(Convener) AT+CHUP	The convener ends the meeting.
^CEND: 2,174,29,16 ^CEND: 3,48,29,16 OK	The convener presents ^CEND: 2,174,29,16 The convener presents ^CEND: 3,48,29,16 The convener rejoins the meeting.

Command	Description
(Participant 2) ^CEND: 1,175,104,16	Participant 2 presents ^CEND: 1,175,104,16 .
(Participant 3) ^CEND: 1,48,104,16	Participant 3 presents ^CEND: 1,48,104,16 .


NOTE

- To make a multi-party call, the user must subscribe to and activate the call waiting and holding services.
- Convener number: 13903710616
- Participant 1 number: 13903702766
- Participant 2 number: 13903710453
- Participant 3 number: 13903710426

8.7.2 Troubleshooting

Scenario	Possible Error Information	Solution
Make a voice call when no network is found.	^ORIG: 1,0 Presents ^CEND.	Make the call after the network is found.
The PIN is not authenticated.	+CME ERROR: SIM PIN required	Enter the correct PIN.
The user has not subscribed to the call waiting or call holding service.	Network reject	Subscribe to the required service.

8.8 Call Restriction

8.8.1 Reference Process

Command	Description
AT+CPWD="AO","0000","1111"	Modify the call restriction password.
OK	
(User 1) AT+CLCK="AO",1,"1111",1	User 1 activates the barring of all outgoing calls (BAOC) service.
OK	
(User 1)	User 1 queries the BAOC service.

Command	Description
AT+CLCK="AO",2	
+CLCK: 1,1 OK	The returned result indicates that the BAOC service has been activated.
(User 1) ATD13903710453;	User 1 calls user 2.
OK ^ORIG: 1,0 ^CONF: 1 ^CEND: 1,0,100,21	User 1 returns OK . User 1 presents the ^ORIG indication. User 2 presents no indication.
(User 1) AT+CLCK="AO",0,"1111",1	User 1 deactivates the BAOC service.
OK	
(User 1) ATD13903710453;	User 1 calls user 2.
OK ^ORIG: 1,0 ^CONF: 1	User 1 returns OK User 1 presents the ^ORIG indication. User 1 presents the ^CONF indication.
(User 2) RING	User 2 presents the Ring indication.
(User 1) AT+CLCK="AI",1,"1111",1	User 1 activates BAIC service.
OK	
(User 1) AT+CLCK="AI",2	User 1 queries the BAIC service.
+CLCK: 1,1 OK	User 1 returns the response indicating that the BAIC service is deactivated.
(User 2) ATD13903710426;	User 2 calls user 1.
OK ^ORIG: 1,0 ^CONF: 1 ^CEND: 1,0,100,21	User 2 returns OK User 2 presents the ^ORIG indication. User 2 presents the ^CONF indication. User 2 presents the ^CEND indication.

Command	Description
	User 1 presents no indication.
(User 1) AT+CLCK="AI",0,"1111",1	User 1 deactivates the BAIC service.
OK	
(User 2) ATD13903710426;	User 2 calls user 1.
OK ^ORIG: 1,0 ^CONF: 1	User 2 returns OK User 2 presents the ^ORIG indication. User 2 presents the ^CONF indication.
(User 1) RING	User 1 presents the Ring indication.


NOTE

- The user must subscribe to the call restriction service provided by the network operator. The right to use the call restriction service can be guaranteed or canceled by the operator only.
- User 1 number: 13903710426
- User 2 number: 13903710453

8.8.2 Troubleshooting

Scenario	Possible Error Information	Solution
Make a voice call when no network is found.	^ORIG: 1,0 Presents ^CEND .	Make the call after the network is found.
The PIN is not authenticated.	+CME ERROR: SIM PIN required	Enter the correct PIN.

8.9 Debugging the Audio Quality

8.9.1 Reference Process

Command	Description
AT+CMIC=5	Set the microphone gain to 5.
OK	

Command	Description
AT+CLVL=5	Set the speaker gain to 5.
OK	
AT^SWSPATH=0	Set the sound path to Handset.
OK	
AT^STN=1	Enable sidetone.
OK	
AT^KEYTONE=0	Set the Key Tone to no stop.
OK	
AT^AUDIOCFG=0,0	Set the Incoming call ring to turn off.
OK	

**NOTE**

Make sure the modem's microphone and speaker gains are appropriate. If the gain is too small, the volume will be low. If the gain is too large, saturated distortion will occur. To adjust the uplink and downlink gains, both the codec's and modem's gains must be set.

8.9.2 Troubleshooting

None

9

Message Application Scenarios

9.1 Pre-configuration (CPMS)

9.1.1 Reference Process

Command	Description
AT+CPMS=?	Query the types of supported storage.
+CPMS: ("SM"),("SM"),("SM") OK	
AT+CPMS="SM","SM","SM"	For details about the parameters, refer to HUAWEI MU509-65 HSDPA LGA Module AT Command Interface Specification . It is recommended that you keep the three types of storage consistent.
+CPMS: 3,40,3,40,3,40 OK	
AT+CPMS?	Query the current storage type, used storage space and maximum storage capacity.
+CPMS: "SM",3,40,"SM",3,40,"SM",3,40 OK	

9.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	+CME ERROR: SIM PIN required	Enter the correct PIN.
	+CMS ERROR: 500	SIM card initialization has not completed. Try again later.
	ERROR	Unsupported storage.

9.2 Sending English Text Messages in PDU Format

9.2.1 Reference Process

Command	Description
AT+CMGF=0	Set the message format to PDU format (see the note).
OK	
AT+CMGS=21 >0891683108608805F911000B8131097301 37F10000FF07EDF27C1E3E9701 \0x1A	Send a text message using PDU of 21 bytes in length (excluding the service center number 0891683108608805F9). The message content is "message". Press ctrl+z (0x1A) to stop entering message content and send the message.
+CMGS: 4 OK	The message is successfully sent. <TP-MR> is returned. For details about <TP-MR>, refer to the <i>3GPP TS 23.040</i> .
AT+CMGS=10 >0891683108608805F911000B8131097301 37F10008FF0677ED6D88606F \0x1A	Send a text message using PDU of 20 bytes in length (excluding the service center number 0891683108608805F9). The message content is "短消息". Press ctrl+z (0x1A) to stop entering message content and send the message.
+CMGS: 5 OK	The message is successfully sent.


NOTE

For details about the structure of a PDU packet, refer to the *3GPP TS 23.040*.

9.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	+CMS ERROR: 500	The text message cannot be sent because of network errors, incorrect service center number, or other errors. Resend the message.
	+CMS ERROR: 304	Incorrect PDU packet content.

9.3 Sending Chinese Character Text Messages in Text Format

9.3.1 Reference Process

Command	Description
AT+CMGF=1	Set the message format to Text format.
OK	
AT+CSMP=,,0,8	Set the data coding scheme to UCS2.
OK	
AT+CSCA="8613800688509",145	Set the service center number.
OK	
AT+CSCS="UCS2"	Set the TE's character set to UCS2 encoding.
OK	
AT+CMGS="00310033003300310032003300340035003600370038" > 534E4E3A \0x1A	Send the message to the destination address "13312345678" that must be enclosed in double quotation marks. The message content is the UCS2 codes for the Chinese characters "华为". Press ctrl+z (0x1A) to stop entering message content and send the message.
+CMGS: 6	The message is successfully sent.

Command	Description
OK	
AT+CSMP=,,0,0	Set the data coding scheme to GSM 7bit
OK	
AT+CSCS="GSM"	Set the TE's character set to GSM 7bit encoding.
OK	
AT+CMGS="13312345678" >huawei \0x1A	Send the message to the destination address "13312345678" that must be enclosed in double quotation marks. The message content is the UCS2 codes for the Chinese characters "华为". Press ctrl+z (0x1A) to stop entering message content and send the message.
+CMGS: 7	The message is successfully sent.
OK	

9.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	+CMS ERROR: 305	The message content does not comply with the encoding scheme specified by AT+CSMP .

9.4 Receiving Text Messages

9.4.1 Reference Process

Command	Description
AT+CNMI=2,1,0,0,0	Store the message on the SIM card or ME, and presents the new message indication.
OK +CMTI: "SM",4	Present the storage and location without solicitation.
AT+CNMI=1,2,0,0,0	Receive and directly present the message instead of storing it.

Command	Description
OK +CMT: " +8613312345678" , "12/05/05,18:10:36+00" huawei ^SMMEMFULL: "SM"	Directly present the message instead of storing it. In this example, the message is in Text mode. In PDU mode, PDU packets are presented. Present an indication, without solicitation, when the message storage is full.
AT+CMGR=4	Read the message stored in index 4.
+CMGR: "REC UNREAD" , " +8613312345678" , "12/05/17,16:13:08+00" huawei OK	
AT+CMGL="ALL"	In Text mode, list all the messages in the current storage.
+CMGL: 2,"REC READ" , " +8613903710742" , "12/05/17,16:12:30+00" test1 +CMGL: 3,"REC READ" , " +8613903710742" , "12/05/17,16:13:08+00" test2 OK	
AT+CMGL=0	In PDU mode, list all the received unread messages.
+CMGL: 1,0,,25 0891683108608805F9040D91683109730147F200002150716172350005F4F29C4E03 OK	
AT+CMGD=1	Delete the message stored in index 1.
OK	
AT+CMGD=1,4	Delete all the messages in the current storage.
OK	

9.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	ERROR	In Text mode, run AT+CMGL=4 (number), or in PDU mode, run AT+CMGL="ALL" (string), and ERROR is returned.
	+CMS ERROR: 500	During SIM card initialization, run AT+CMGL or AT+CMGD to read or delete a message, and an error is returned.

9.5 Segmenting and Reassembling Long Text Messages

9.5.1 Segmenting

In PDU mode, text messages can be encoded using GSM 7-bit, 8-bit or UCS2. The GSM 7-bit encoding scheme is used to encode common ASCII characters, compressing every 8 characters into 7 characters. The 8-bit encoding scheme is usually used to encode data such as pictures and ringtones. The UCS2 encoding scheme is used to encode Unicode characters. According to the existing 3GPP protocols, the size of the user data contained a PDU is 140 bytes. Therefore, the maximum number of characters contained in a single message is 160, 140 and 70 for the GSM 7-bit, 8-bit, and UCS2 encoding schemes respectively. If the number of characters contained in a text message exceeds the maximum number, the message will be segmented into several messages. An English letter, a Chinese character, or a byte of data is considered as a character.

According to the existing 3GPP protocols, after a long text message is segmented, the number of characters that each message segment can contain is as follows:

- GSM 7-bit encoding: 153 characters
- 8-bit encoding: 134 characters
- UCS2 encoding: 67 characters

The number of available characters per segment is lower, because each segment must contain segmentation information.

The storage space occupied by a character is as follows:

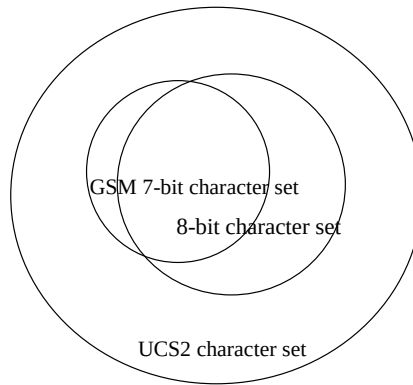
- GSM 7-bit encoding: 7 bits
- 8-bit encoding: 8 bits
- UCS2 encoding: 16 bits

The storage space occupied by a segment of a long text message is as follows:

- GSM 7-bit encoding: $153 \text{ bits} \times 7 = 1071 \text{ bits}$
- 8-bit encoding: $134 \text{ bits} \times 8 = 1072 \text{ bits}$
- UCS2 encoding: $67 \text{ bits} \times 16 = 1072 \text{ bits}$

For all the three encoding schemes, a short message occupies a maximum of 1120 bits (160 x 7, 140 x 8, or 70 x 16) in the storage. If a text message's size is larger than 1120 bits, the message is a long message.

Figure 9-1 Relationships between character sets



Relationships between character sets

9.5.2 Reassembling

The host applications can reassemble the segments of a long text based on the following:

- The protocol header in the user data (TP-UD) of a PDU (see the *3GPP TS 23.040 9.2.3.24.1*)
- The sender's number contained in each segment
- The interval between the time when each segment is received (The interval between the two neighboring segments' receiving time is less than 60 seconds, and the maximum interval between the first and the last segments' receiving time is 24 hours)

10 Phonebook Application Scenarios

10.1 Memory Operations

10.1.1 Reference Process

Command	Description
AT+CPBS=?	Query the current storage type.
+CPBS: ("SM","FD","EN","ON") OK	
AT+CPBS="SM"	Set the current storage type to "SM".
OK	
AT+CPBS?	241 indicates that 241 entries have been stored in the storage. 250 indicates that the maximum storage capacity of the current storage ("SM") is 250 entries.
+CPBS: "SM",241,250 OK	

10.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	+CME ERROR: SIM busy	Phonebook initialization has not completed. Try again later.
	+CME ERROR: SIM PIN required	Enter the correct PIN.

Scenario	Possible Error Information	Solution
	+CME ERROR: SIM PUK required	Enter the correct PUK.

10.2 Writing/Deleting Phonebook Entries

10.2.1 Reference Process

Command	Description
AT^CPBW=1,"1234567890",129,"HUAWEI",0	Write an entry in GSM 7-bit format into index 1 in the phonebook.
OK	
AT^CPBW=1,"1234567890",129,"80534E4E3A",1	Write an entry in raw data format into index 1 in the phonebook.
OK	
AT^CPBW=,"12345678901234567890123",128,"80534E4E3A",1	Write an entry into the first empty location in the phonebook.
OK	
AT^CPBW=1	Delete the entry in index 1 in the phonebook.
OK	

10.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	+CME ERROR: SIM busy	Phonebook initialization has not completed. Try again later.
	+CME ERROR: SIM PIN required	Enter the correct PIN.
	+CME ERROR: SIM PUK required	Enter the correct PUK.
Error information is returned when writing an entry into the phonebook.	+CME ERROR: dial string too long	Check that the phone number is not too long.

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	+CME ERROR: invalid index	Check that the location index and phone number type are valid.
Error information is returned when writing an entry into the phonebook.	+CME ERROR: invalid characters in dial string	The phone number to be written into the phonebook contains invalid characters. Delete the invalid characters and try again.
AT^CPBW="12345678901234567890123",128,"80534E4E3A",1	+CME ERROR: memory full	The storage is full. Delete some entries and try again.

10.3 Reading Phonebook Entries

10.3.1 Reference Process

Command	Description
AT^CPBR=<index1>	Read the entry stored in index 1 in the phonebook memory.
OK	
AT^CPBR=<index1>,<index2>	Read all entries stored in locations between index 1 and index 2 (including index 1 and index 2).
^CPBR: <index1>,<number>,<type>,<text>,<coding> ^CPBR: <index2>,<number>,<type>,<text>,<coding> OK	
AT^CPBR=?	Query the index range of storage locations in the phonebook, the maximum length (<nlength>) of a phone number, and the maximum length (<tlength>) of a name.
(list of supported<index>s,<nlength>,<tlength>) OK	

10.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	+CME ERROR: SIM busy	Phonebook initialization has not completed. Try again later.
	+CME ERROR: SIM PIN required	Enter the correct PIN.
	+CME ERROR: SIM PUK required	Enter the correct PUK.
AT^CPBR=<index1>	+CME ERROR: invalid index	The index is invalid. Check that index 1 is within the supported range.
AT^CPBR=<index1>,<index2>	+CME ERROR: invalid index	The index is invalid. Check that index 1 and index 2 are within the supported range and that index 1 is not greater than index 2.
AT^CPBR=<index1>	+CME ERROR: not found	No entries are found in the storage locations in index 1. Check that there have been entries successfully written into these locations.
AT^CPBR=<index1>,<index2>	+CME ERROR: not found	No entries are found in the storage locations between index 1 and index 2. Check that there have been entries successfully written into these locations.

10.4 Searching for Phonebook Entries

10.4.1 Reference Process

Command	Description
AT+CPBF=<findtext>	Search the current storage for phonebook entries that contain the <findtext> field.
+ CPBF: <index1>,<number>,<type>,<text> + CPBF: <index2>,<number>,<type>,<text>	

Command	Description
...	
OK	
AT+CPBF=?	Return the maximum phone number length and maximum name length supported by the current phonebook storage.
+CPBF: <nlength>,<tlength>	
OK	

10.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	+CME ERROR: SIM busy	Phonebook initialization has not completed. Try again later.
	+CME ERROR: SIM PIN required	Enter the correct PIN.
	+CME ERROR: SIM PUK required	Enter the correct PUK.
AT+CPBF=<findtext>	+CME ERROR: not found	No matches were found. Check whether the current phonebook storage has entries that match the search criterion.

10.5 Querying User Number

10.5.1 Reference Process

Command	Description
AT+CNUM	Query the SIM number.
+CNUM: [<alpha1>],<number1>,<type1> +CNUM: [<alpha2>],<number2>,<type2> ...	

Command	Description
OK	

10.5.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	+CME ERROR: SIM busy	Phonebook initialization has not completed. Try again later.
	+CME ERROR: SIM PIN required	Enter the correct PIN.
	+CME ERROR: SIM PUK required	Enter the correct PUK.

10.6 Setting the TE's Character Sets

10.6.1 Reference Process

Command	Description
AT+CSCS=?	Query the character sets supported by the UE.
+CSCS: ("IRA","GSM","UCS2") OK	
AT+CSCS?	Query the current character set.
+CSCS: "IRA" OK	
AT+CPBR=1	Read the first phonebook entry. The TE character set is the International Reference Alphabet (IRA). The content of the first entry's name field is "HUAWEI".
+CPBR: 1,"0123456789",129,"HUAWEI" OK	

Command	Description
AT+CSCS="UCS2"	Set the TE's character set to UCS2 alphabet.
OK	
AT+CPBW=1,"0123456789",129,"004800550041005700450049"	The character set is the UCS2 alphabet. The content of the phonebook entry's name field is 004800550041005700450049, which is "HUAWEI" in the IRA.
OK	
AT+CPBR=1	Read the first phonebook entry. The TE character set is UCS2 alphabet. The content of the first entry's name field is 004800550041005700450049 ("HUAWEI" in the IRA).
+CPBR: 1,"0123456789",129,"004800550041005700450049" OK	

10.6.2 Troubleshooting

None

11

SIM Operation Application Scenarios

11.1 PIN Operations

11.1.1 Reference Process

Command	Description
AT+CLCK="SC",1,"<pwd>"	Enable PIN authentication. (<pwd> specifies the PIN ^[1])
OK	
AT+CPIN="<pwd>"	Request the PIN after the module restarts.
OK	
AT+CPWD="SC","<oldpwd>","<newpwd>"	Change the PIN (<newpwd> will be the new PIN).
OK	



NOTE

- [1] After PIN authentication is enabled using **AT+CLCK**, the module must be restarted for the change to take effect.
- Either **AT^CPIN** or **AT+CPIN** can be used to authenticate the PIN.

11.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+CLCK="SC",1,"<pwd>"	+CME ERROR: operation not allowed	If PIN authentication has been enabled, it cannot be enabled again. Check whether PIN authentication has been enabled.
AT+CPIN="<pwd>"	+CME ERROR: incorrect password	Enter the correct PIN. The original PIN is provided by the operator.
	+CME ERROR: SIM PUK	Incorrect PINs have been entered

Scenario	Possible Error Information	Solution
	required	three times and the SIM card is blocked. Run AT+CPIN="<PUK>","<pwd>" to enter the PUK to unblock the SIM card. The PUK is provided by the operator and cannot be changed by users. If incorrect PUKs are entered 10 times, the SIM card will be permanently blocked.
AT+CPWD="SC","<oldpwd>","<newpwd>"	+CME ERROR: incorrect password	<oldpwd> must be the current PIN. Like the PIN authentication, if incorrect PINs are entered three times, the PUK will be required. If incorrect PUKs are entered 10 times, the SIM card will be permanently blocked.

11.2 CRSM Command

11.2.1 Reference Process

Command	Description
AT+CRSM=176,12258,0,0,10	Read the file EF _{ICCID} with a transparent structure. (12258 is 0X2FE2, the EF _{ICCID} file's FID).
+CRSM: 144,0,"<record>" OK	After the command is processed successfully, the EF _{ICCID} file's content (<record>) is returned.
AT+CRSM=178,28476,1,4,176,"7F10"	Use an absolute path to read the first entry from the EF _{SMS} file on the SIM card's DFtelecom folder.
+CRSM: 144,0,"<record>" OK	<record> is the content of the first entry. The length of <record> is 176 bytes.
AT+CRSM=192,12258	Get response of EF _{ICCID} .
+CRSM: 144,0,"<response>" OK	<response> is the response data of EF _{ICCID} . For details about <response>, refer to the <i>ETSI TS 102.221</i> protocol.
AT+CRSM=214,28421,0,0,2,"0012"	Update the content of the transparent

Command	Description
	structure EF _{li} file on the SIM card.
+CRSM: 144,0,"" OK	Update succeeded.
AT+CRSM=220,28476,1,4,176,"1111","7F10"	Update the content of the linear fixed structure EF _{ICCID} file on the SIM card.
+CRSM: 144,0,"" OK	Update succeeded.
AT+CRSM=242	Obtain the current directory information.
+CRSM: 144,0,"<status>" OK	<status> indicates the current directory status.


NOTE

- To read or update a file, appropriate commands must be used according to the file's structure type (for details, refer to the description of file properties in the *3GPP TS 31.102* protocol). For transparent structure files, use 176 (Read Binary) and 214 (Update Binary). For linear fixed structure files, use 178 (Read Record) and 220 (Update Record).
- If <pathid> is not contained in the command, the module will prefer to access the files with the same FID in the current directory.
- Files can be accessed only when the access criteria are met. Otherwise the SIM card will return PSWs indicating that the access authentication failed. If an EF file's read privilege is PIN protected and the module does not have the PIN authenticated, PSWs indicating that the access authentication failed will be returned after the **AT+CRSM** command is used to read the EF file.
- To use the **AT+CRSM** command to access the file content on the SIM card, the parameters contained in the command must strictly meet the requirements in the *ETSI TS 102.221* and *3GPP TS 31.102*. For detailed requirements, refer to the *ETSI TS.102.221* and *3GPP TS 31.102*.

11.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+CRSM=178,12258,0,0,10	+CRSM: 105,129,"" OK	The status word (SW) indicates a Read command error occurred. Files with a transparent structure should be read using 176 (READ BINARY).
AT+CRSM=220,28476,1,4,176,"1111","7F10"	+CRSM: 105,130,"" OK	The PSW indicates that the security conditions were not met. To update the EF _{SMS} file, the correct PIN is required.

12 Thermal Protection Application Scenarios

- When the module's temperature is lower than 100 °C, the module works normally.
- When the module's temperature reaches 100 °C, the module enables thermal protection: turns off its RF.
- When the module's temperature is lower than 95 °C, the module disables thermal protection: turns on its RF transmission.
- When the module's temperature reaches 105 °C, the module automatically shuts down.

**NOTE**

- During an emergency call, if thermal protection is enabled, the module will present an indication but will not take thermal protection actions such as turning off its RF or shutting down.
- After thermal protection is enabled, users cannot make emergency calls.
- Thermal protection is designed to protect the module from being damaged by overtemperature. To work in high temperature environments, both the module and its peripheral components must be able to resist the same temperature.

13

Sleeping and Waking Up Application Scenarios

As an embedded component in the host, the module also consumes power, which increases the power consumption of the integrated product. Therefore, the most important task of power management is to reduce the power consumption of the integrated product by enabling the module's sleep mode when necessary.

The host and the module need to wake each other up from sleep if communication is required. Therefore, another task of power management is to provide a wake-up control mechanism for the host and module.

Power management involves three parts: the host system software (including the USB driver/UART driver/GPIO driver/sleep mechanism functions), connection hardware between the host and module, and the module's software wake-up mechanism.

This chapter is mainly concerned with the module's software wakeup mechanism, including the wake-up principle, how USB related events impact on the waking up of the module and remotely waking up the module, and how the module remotely wakes up the host.

This chapter briefly describes the power management related connection hardware between the host and module.

This chapter does not describe the host system software. For example, if the host runs on a Windows or Mac system, Huawei will provide a USB driver program corresponding to the module. If the host runs on an Android system, Huawei will provide [Guide to Kernel Driver Integration in Linux for Huawei Modules](#) for users to configure the USB-based wakeup function of the module.

This document describes typical module application scenarios. A host can be designed based on the actual system features and the application scenarios of the module to reduce power consumption of both the module and integrated product.

After the host is designed as recommended by this document, the module's power consumption and the whole unit's power consumption can meet the performance requirements. For details, see related description in the product manual.

13.1 Hardware Interfaces

The module communicates with the host using mainly USB or UART. For details about pins related to power management, see Table 13-1.

For corresponding interface numbers and reference design for the pins, see *Hardware Guide* for each product.

Table 13-1 Power management related pins

Interface	Pin name	Pin Name	Input/Output	Description
LGA	WAKEUP_OUT	Output	When a wake-up source (see section 13.3.5 Host Woken up by Module) arrives, these pins output a high-level-voltage pulse lasting for 1s during which if other wake-up sources arrive, the module will ignore the later wake-up requests. In other words, the module will not output a second pulse during this 1s.	Figure 13-1
LGA	WAKEUP_IN	Input	When the pin carries a high-level voltage, the states of the module are as follows: The module will be prohibited to enter sleep mode if the module is awake. The module will be woken up if the module is in sleep mode. When the pin carries a low-level voltage, the module is allowed to enter sleep mode. (By default, the pin is set to INPUT/PD, which is, the software detects a low-level voltage on the pin when the pin is not connected.)	Figure 13-2

13.2 Sequence Diagram

Figure 13-1 WAKEUP_OUT (when a NPN triode is externally connected to the WAKEUP_OUT pin) output sequence

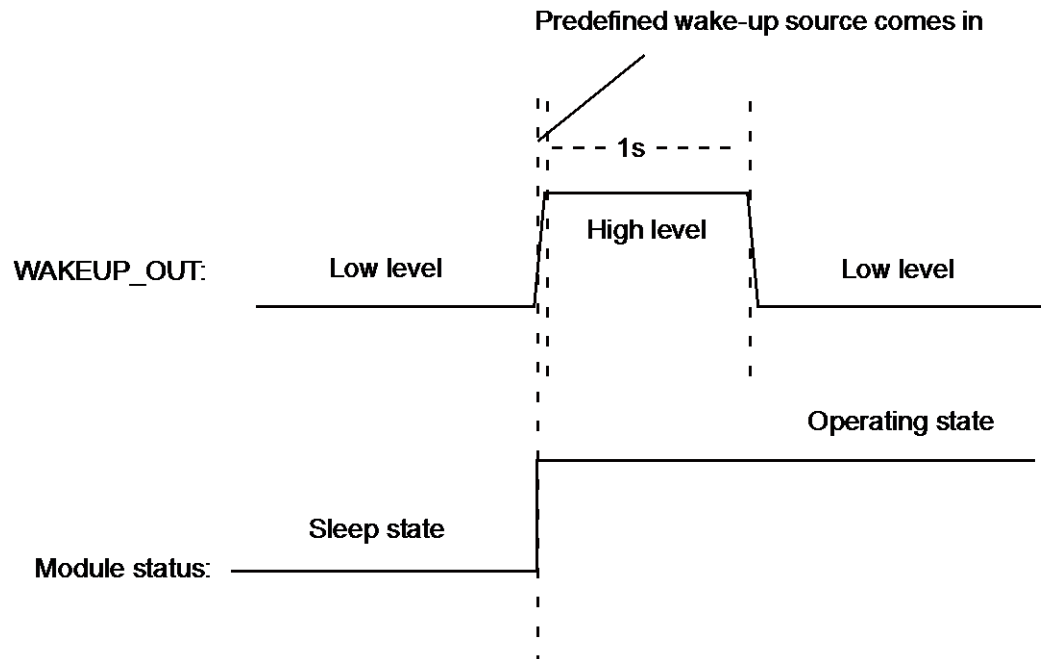
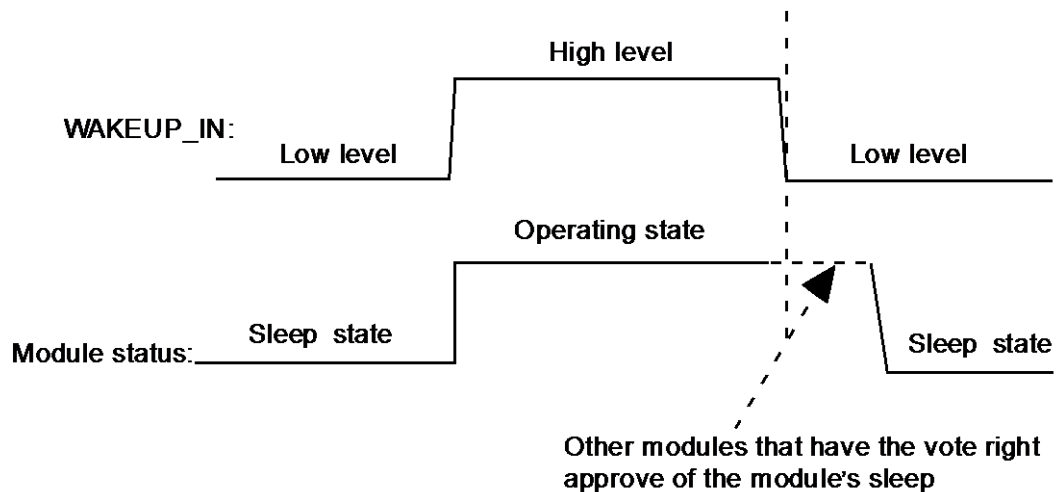


Figure 13-2 WAKEUP_IN input sequence



NOTE

When setting the sleep configuration parameters with "AT^SLEEPCFG=5,0", make sure data services are disconnected before pulling down WAKEUP_IN#.

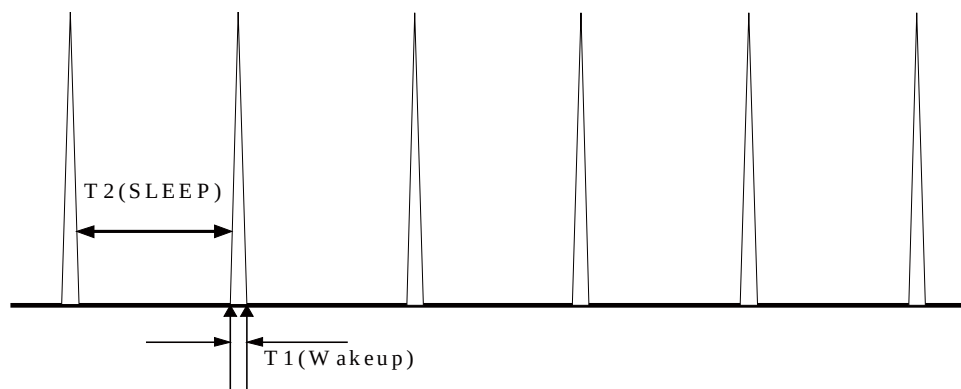
About the vote, see section 13.3.1 Principle.

13.3 Software Interfaces

13.3.1 Principle

The module runs on a multi-task software system. The sleep task is granted with the lowest priority and assigned to detect whether the module can enter sleep mode. Other tasks (such as the RF, SIM card, USB, and UART) have voting rights. They vote to decide whether the module can enter sleep mode. When no other tasks are running, the sleep task is executed. If the sleep task detects that all other tasks agree on the module's sleep, the module enters sleep mode, as shown in Figure 13-3. At this time, the baseband chip reduces the work frequency, and the RF enters the Discontinuous Reception (DRX) mode.

Figure 13-3 Currency state when the module is in sleep mode



For more information about the module's sleep procedure, see Figure 13-4.

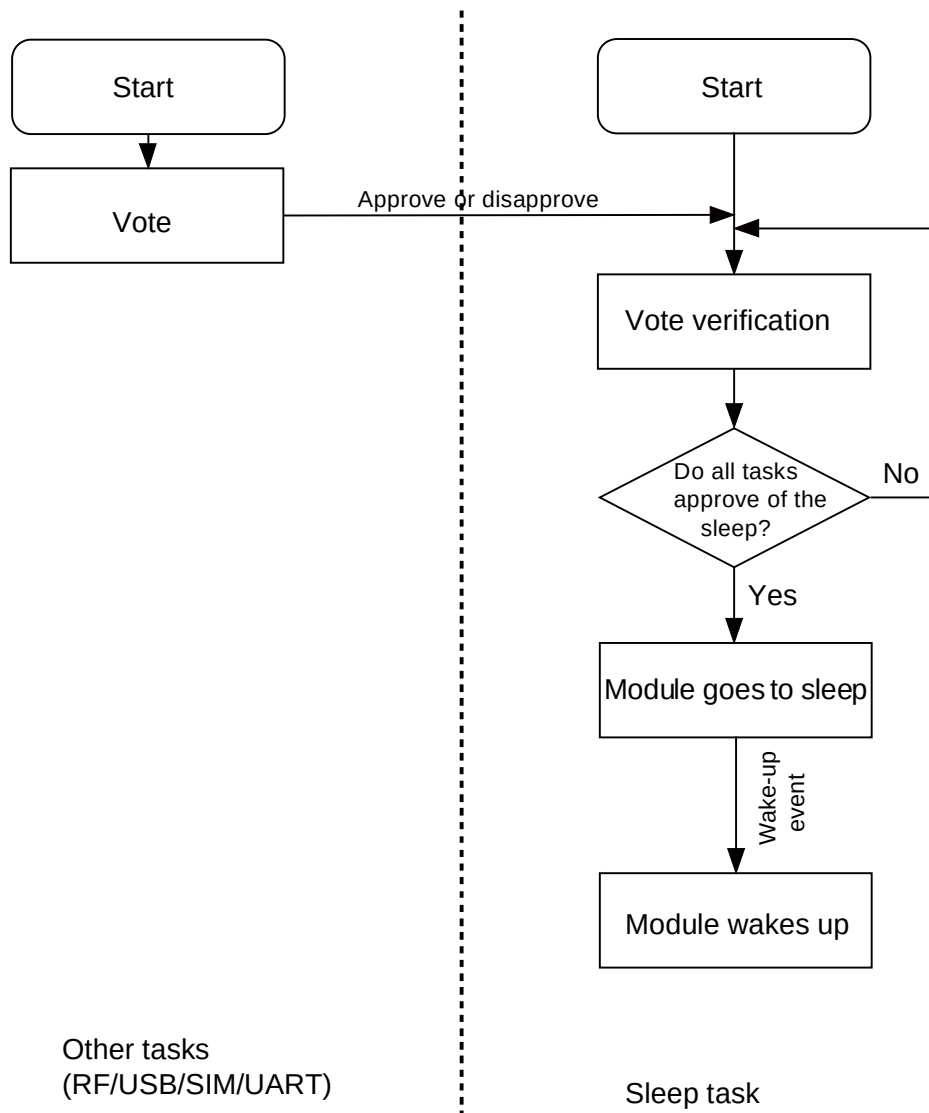


NOTE

The module's sleep mode is different from working mode or flight mode set using the **AT+CFUN** command. The RF will be turned off when the module enters LPM mode using the command **AT+CFUN=0** while the RF will enter DRX mode without being turned off when the module is in sleep mode. For more details, refer to [HUAWEI MU509-65 HSDPA LGA Module AT Command Interface Specification](#).

The module enters sleep mode automatically when the sleep task detects that all other tasks agree on the module's sleep. The sleep period of the module depends on the current working state and circumstance. The period may last for several seconds, or up to several minutes.

Figure 13-4 Sleep procedure



13.3.2 USB and Sleep

USB is an important communication channel between the module and the host. According to the USB protocol, normally a hub or a root hub periodically sends Start of Frame (SOF) data packages (one data package per ms using full-speed USB). Through this mechanism, USB always votes to stop the module from entering sleep mode.

When the USB driver provided by Huawei detects that the module and the host have not exchanged data in 5 seconds, the USB driver will enable the port's suspend feature, stopping SOF data packages being sent and suspending the USB controller. This enables the USB to vote to agree the module's sleep.



NOTE

If the USB driver used is developed by users or is integrated with external application, ensure that the USB driver supports the USB suspend features (including selective suspend and global suspend, as defined in the USB standard.)

13.3.3 UART and Sleep

UART is an important communication channel between the module and the host. If the host uses UART (a TTL level Interface), it can connect to the module's UART directly. If the host uses RS232, it can connect to the module's UART through a conversion chip such as MAX232.

**NOTE**

Regardless of the connection modes, when there is no data transmitted on the UART, the host should set the RX pin of the module's UART to low level so that the module can enter sleep mode.

13.3.4 Module Wake-up

RF periodically wakes up the module based on the DRX cycle (depending on the actual configuration of the network system), as shown in Figure 13-3.

Other aperiodic events include:

1. The host sends data using USB/UART or pulls WAKEUP_IN up.
2. Changes on the network, for example, an incoming call, an incoming text message, a signal change, a network working mode change, a network search, an IP data package (when a dial-up network connection is set up).
3. Software system events such as a timer
4. Abnormal events, for example, an antenna drops or a SIM card becomes loose.

13.3.5 Host Woken up by Module

Wake-up Source

A wake-up source is a module event that can wake up the host, for example, an incoming voice call, a text message, data (PPP data, TCP/UDP data from the network), and unsolicited messages.

Remotely Waking up the Host Using USB

When the host is in sleep mode and the USB controller is in suspended mode, if the module needs to send data to the host (for example, a wake-up source has arrived), the module sends a remote wake-up signal that lasts 3 ms to inform the host to start USB resume (as shown in Figure 13-5). To complete the procedure, the following conditions must be met:

1. The USB controller on the host supports USB remote wake-up and can wake up the host.
2. The USB driver enables or disables remote wake-up by executing SET_FEATURE and CLEAR_FEATURE commands. Therefore, remote wake-up must be enabled on the USB driver before USB enters suspended mode.
3. When the host receives the remote wake-up signal from the module, the host needs to send a full speed K signal that lasts at least 20 ms. When the USB controller resumes, the host must send the SOF token within 3 ms from the startup of the idle state. Otherwise, the module enters suspended mode again, as shown in Figure 13-5.

Figure 13-5 USB resume time sequence

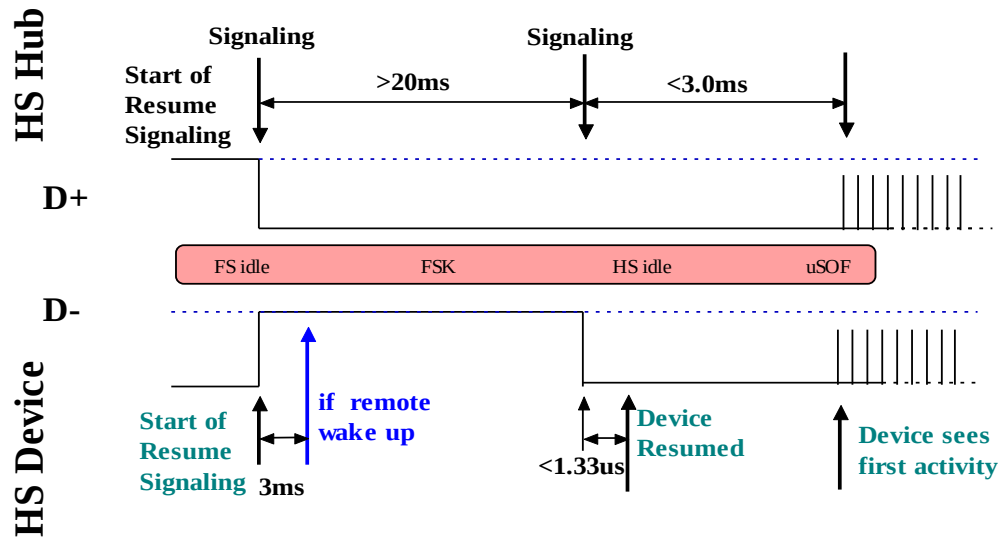


Figure 13-6 Successful procedure of remote wake-up

Transfer	F	Control	ADDR	ENDP	bRequest	wValue	wIndex	wLength	Time	Time Stamp
1237	S	SET	2	0	SET_FEATURE	DEVICE_REMOTE_WAKEUP	0x0000	0	4.184 ms	400 . 854 634 516

Ch0	Packet	H ↓	Suspend	Time Stamp
	181391		27.946 sec	400 . 858 818 200

Ch0	Packet	? ↓	Resume	Time Stamp
	181392		21.926 ms	428 . 804 846 500

Ch0	Packet	H ↓	Resume EOP	Time	Time Stamp
	181393		1.317 μs	35.208 ms	428 . 826 772 316

Transfer	F	Control	ADDR	ENDP	bRequest	wValue	wIndex	wLength	Data Select	Time	Time Stamp
1238	S	GET	2	0	GET_STATUS	0x0000	USB 2.0 Standard Status	2	0x0002	1.165 ms	428 . 861 980 666

Transfer	F	Control	ADDR	ENDP	bRequest	wValue	wIndex	wLength	Time	Time Stamp
1239	S	SET	2	0	CLEAR_FEATURE	0x0001	0x0000	0	1.835 ms	428 . 863 145 566

WAKEUP_OUT Waking up the Host

The module will output a 1s pulse using WAKEUP_OUT as shown in Figure 13-1, when a wake-up source arrives. The host wakes itself up after detecting the level change.

Remote Wake-up Configuration

The power consumption of the host increases if it is frequently woken up. The host can configure the module's wake-up sources using **AT^WAKEUPCFG** and **AT^CURC** command so as to reduce the power consumption.

The **AT^WAKEUPCFG** command can be used to choose wake-up sources and the wake-up channel (USB or WAKEUP_OUT). The **AT^CURC** command can choose unsolicited messages. For more details, refer to AT Command Interface Specification.

13.4 Application Scenarios: System with USB Connection only

A host runs Android, with support for USB suspend, USB remote resume, voice calling, and text messages.

13.4.1 Hardware Connection

The host connects to the module using USB.

13.4.2 Software Procedure

Command	Description
AT^WAKEUPCFG=?	Query the parameter range of AT^WAKEUPCFG .
^WAKEUPCFG: 1,1,(3,7) OK	
AT^WAKEUPCFG=1,1,7	Configure the module to make sure that incoming calls, text messages, data, and unsolicited messages can remotely wake up the host using USB.
OK	
AT^CURC=?	Query the parameter range of AT^CURC .
^CURC: (0-1) OK	
AT^CURC=1	The unsolicited reports open.
OK	

13.4.3 Advantages

With software configuration, while the system requirements (calling and text messages) are met, the number of times the host is woken up by unsolicited messages, and consequently the power consumption, are reduced.

13.5 Application Scenarios: System with USB and WAKEUP_OUT

A host runs in Android, with support for text messages, but not USB remote resume or voice calling.

13.5.1 Hardware Connection

The host must connect to the module using USB and WAKEUP_OUT pins.

13.5.2 Software Procedure

Command	Description
AT^WAKEUPCFG=?	Query the parameter range of AT^WAKEUPCFG .
^WAKEUPCFG: 1,1,(3,7) OK	
AT^WAKEUPCFG=1,1,7	Configure the module to make sure that text messages, data, and unsolicited messages can remotely wake up the host using the WAKEUP_OUT pin.
OK	
AT^CURC=?	Query the parameter range of AT^CURC .
^CURC: (0-1) OK	
AT^CURC=1	The unsolicited reports open.
OK	
AT^SLEEPCFG=?	Queries the parameter range of AT^SLEEPCFG .
^SLEEPCFG: (0-1) OK	
AT^SLEEPCFG=0,3000	Configures the delay time for module to report unsolicited indication to host since the 1s high-level-voltage wakeup pulse through WAKEUP_OUT pin.
OK	

13.5.3 Advantages

A solution is provided for systems not supporting USB remote resume.

With software configuration, while the system requirements (calling and text messages) are met, the number of times the host is woken up by unsolicited messages, and consequently the power consumption, are reduced.

13.6 Application Scenarios: System with UART and WAKEUP_OUT

A host is constructed based on a single-chip microcomputer. There is no user interface. The host supports UART and text messages. After receiving a text message, the host decodes it and takes corresponding actions.

13.6.1 Hardware Connection

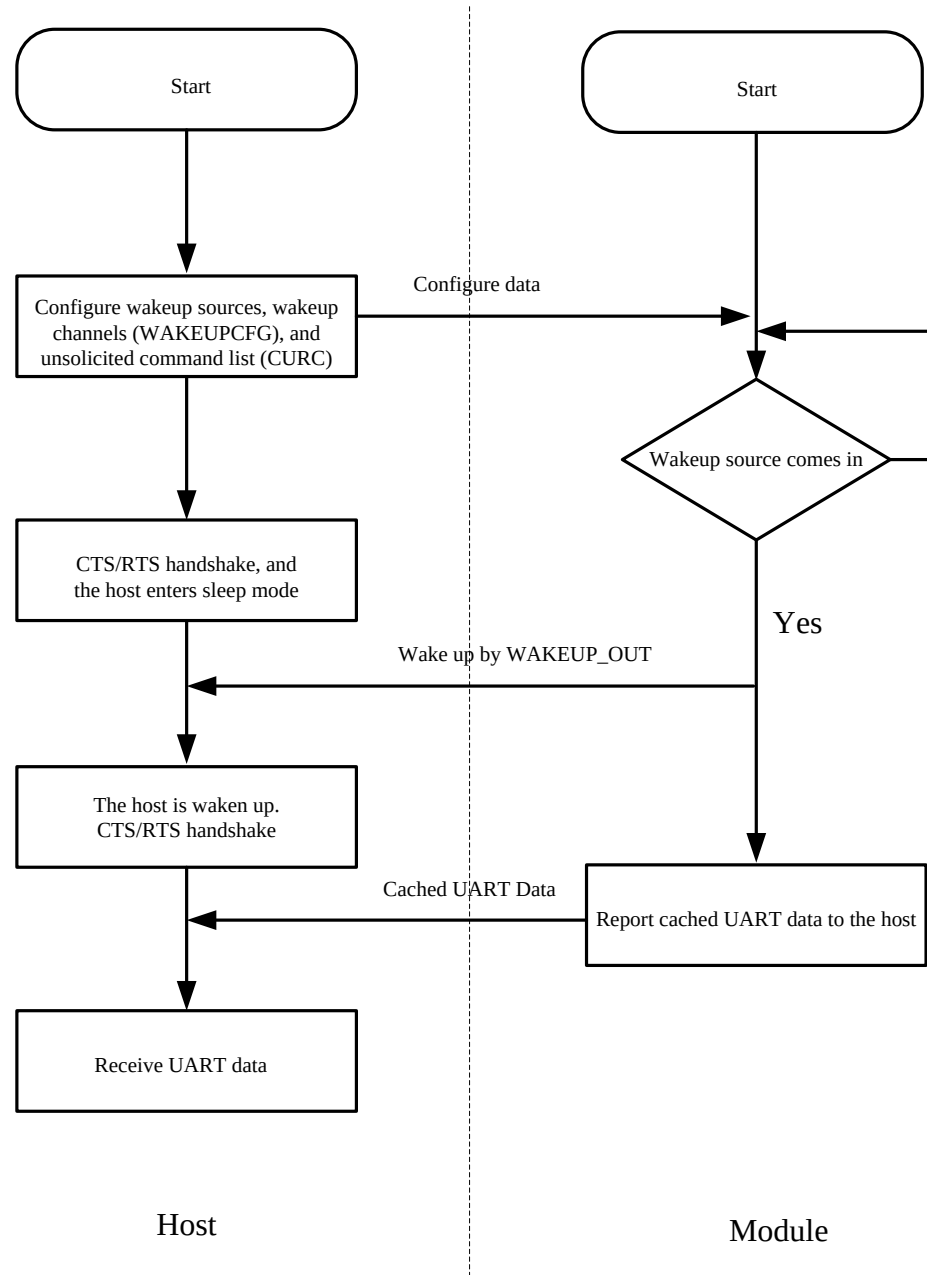
The host must connect to the module using the UART and WAKEUP_OUT pins.

13.6.2 Software Procedure

Command	Description
AT^WAKEUPCFG=?	Query the parameter range of AT^WAKEUPCFG .
^WAKEUPCFG: 1,1,(3,7) OK	
AT^WAKEUPCFG=1,1,3	Configure the module to make sure that text messages can remotely wake up the host by WAKEUP_OUT.
OK	
AT^CURC=?	Query the parameter range of AT^CURC .
^CURC: (0-1) OK	
AT^CURC=1	The unsolicited reports open.
OK	

The host and the module must handshake to prevent data loss when the module wakes up the host.

Figure 13-7 Wake-up and hand-shaking using UART (CTS/RTS) and WAKEUP_OUT pins



NOTE

If the host connects to the module using the TXD or RXD pin only, handshake is not implemented and consequently data on the UART may be lost when the host is in sleep mode.

13.6.3 Advantages

This solution enables handshake between UART and WAKEUP_OUT.

With software configuration, the host can go to sleep with no data loss.



13.7 System with Other Connection Methods

If the host can be connected to the module only using UART, refer to [HUAWEI MU509-65 HSDPA LGA Module Hardware Guide](#). If the host can connect to the module using USB/UART/WAKEUP_OUT and can support USB remote wake-up and UART remote wake-up, prioritize USB remote wake-up over WAKEUP_OUT remote wake-up. For details about the software procedure, refer to the earlier sections while considering the host system feature.

14

Concurrent Service Application Scenarios

14.1 Voice Calls and Text Messaging

On a WCDMA network, the module uses the same wireless channel to establish voice calls and send text messages. Therefore, when the module provides voice call and text messaging services at the same time, it may fail to make the voice call or the message may be delayed.

Command	Description
ATD13912345;	Make a voice call to 13912345 from the module.
OK	
^ORIG: 2,0	
AT+CMSS=0	Send the text message before the voice call is connected.
^CEND: 1,0,100,17	The voice call is hung up because the user is busy.
+CMSS: 36	
OK	



NOTE

When a voice call has been connected, text messages can be sent without conflicting with the voice call.

14.2 Internal/External Protocol Stacks and Text Messaging

WCDMA networks support concurrent internal/external protocol stack services and text messaging.

When data is transmitted using the external protocol stack, text messages can be sent through only the ports on which no data is being transmitted.

When the internal protocol stack is in use, text messages can be sent through all ports in non-transparent transmission mode and through only the USB in transparent transmission mode. Table 14-1 describes the details.

Table 14-1 Ports available to text messaging during data services

	Service Port	Message Sending Port	Message Receiving Port
External protocol stack application	MODEM	PCUI, UART	PCUI, UART
	UART	PCUI, MODEM	PCUI, MODEM
Internal protocol stack application	UART (non-transparent transmission mode)	MODEM, PCUI, UART	MODEM, PCUI, UART
	UART (transparent transmission mode)	MODEM, PCUI	MODEM, PCUI

Command	Description
AT^IPOPEN=1,"TCP","172.22.44.33",7000,6000	Establish a TCP link at the module's UART port.
OK ^IPDATA: 1,1024,No.6:**...**	The module transmits data through the UART port.
AT+CMSS=0	The module sends text messages through the PCUI port.
+CMSS: 48 OK (UART) ^IPDATA: 1,1024,No.7:**...** ^IPDATA: 1,1024,No.8:**...** +CMTI: "SM",4 ^IPDATA: 1,1024,No.9:**...**	The module can send text messages without interrupting the data transmission through the UART. After receiving text messages, the module presents them through all ports (the format of the text messages is set by AT+CNMI).

14.3 Internal/External Protocol Stacks and Voice Calls

WCDMA networks support concurrent internal/external protocol stack services and voice calls.

First Service	Concurrent Service	Service State
Internal protocol stack	MO voice call	Suspend data transmission through the UART port until a voice call is hung up.
	MT voice call	Huawei's extended AT command AT^DVCFG can be used to configure the priorities of the internal protocol stack service and MT voice call.
External protocol stack	MO voice call	Suspend data transmission through the MODEM port until a voice call is hung up.
	MT voice call	
Voice calls	Internal protocol stack	Data connections through the UART port cannot be established (executing AT^IPINIT fails).
	External protocol stack	Data connections can be established through the MODEM port, but data cannot be transmitted until the voice call is hung up.

The following table describes the process of concurrent internal protocol stack services and voice calls.



NOTE

Settings configured by **AT^DVCFG** take effect immediately and are effective only in transparent transmission mode of the internal protocol stack services.

Command	Description
(UART) AT^IPOPEN=1,"TCP", "172.22.44.33", 7000, 6000	Establish a TCP link at the module's UART port.
OK ^IPDATA: 1,536,No.51:*****...	The module transmits data in non-transparent transmission mode.
	(Another party calls the module.)
(all ports) RING RING	Data transmission through the UART port is suspended, and all ports present the Ring indication.
(PCUI) AT+CHUP	

Command	Description
OK ^CEND: 1,0,102,17 (UART) ^IPDATA: 1,536,No.52:*****...	After the call is hung up, data transmission through the UART port is resumed. Packets received/transmitted when data transmission is suspended will not be lost.
(UART) AT^IPENTRANS=1	The module enters transparent transmission mode to transmit data continuously.
OK No.230:*****...	
	(An MT call comes in)
(PCUI) RING RING	By default, voice calls have priority over data transmission (which is set by AT^DVCFG=0). Data transmission through the UART port is suspended, and the USB (PCUI and MODEM) ports present Ring indications.
(PCUI) AT+CHUP	
OK ^CEND: 1,0,102,17 (UART) No.231:*****...	After the voice call is hung up, resumes data transmission through the UART port.
(PCUI) AT^DVCFG=1	Sets data transmission to have priority over voice calls.
OK (UART) No.240:*****...	The module transmits data in transparent transmission mode.
	(An MT call comes in)
(PCUI) ^CEND: 1,0,29,16 (UART) No.241:*****...	The module suspends data transmission through the UART port, hangs up the incoming call automatically, presents the AT^CEND indications through the USB (PCUI and MODEM) ports, and resumes the data transmission through the UART port.
(UART)	The module exits transparent transmission

Command	Description
+++	mode to transmit data continuously.
OK ^IPDATA: 1,536,No.61:*****...	
	(An MT call comes in)
(all ports) RING RING	Data transmission through the UART port is suspended, and all ports present the Ring indication. AT^DVCFG=1 is invalid in non-transparent transmission mode.
(PCUI) AT+CHUP	
OK ^CEND: 1,0,102,17 (UART) ^IPDATA: 1,536,No.62:*****...	After the call is hung up, data transmission through the UART port is resumed. Packets received/transmitted when data transmission is suspended will not be lost.

14.4 Other Services

Configuration operations (initialization and serial port configuration), phonebook operations, and PIN operations can be performed when the module is not in sleep mode, no matter the module is idle or processing services, because no interaction between the module and the network is required.

Especially, if the module is processing internal/external protocol stack services, operations such as configuration, phonebook and PIN operations must be performed at ports that are not used to provide data services.

Table 14-2 Ports available to configuration, phonebook and PIN operations when the module is processing data services

	Service Port	Ports Available to Configuration, Phonebook and PIN Operations
External protocol stack application	MODEM	PCUI, UART
	UART	PCUI, MODEM
Internal protocol stack application	UART	MODEM, PCUI

15

USSD Application Scenarios

15.1 USSD Initialize and Configuration

15.1.1 Reference Process

Command	Description
AT+CSCS="IRA"	Set the TE supported character set as "IRA".
OK	
AT^USSDMODE=0	Set the transmitted mode, select USSD non-transparent mode.
OK	

**NOTE**

- The default transmitted mode is transparent mode.
- In non-transparent transmission mode:
When running AT+CSCS="IRA", the MT will transfer the USSD string to GSM 7 bit directly;
When running AT+CSCS="UCS2", the MT will encode every four characters of the USSD string as hexadecimal.
- In transparent transmission mode, the USSD string is not controlled by AT+CSCS. The MT will transfer the USSD string to hexadecimal directly.

15.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
The parameter is out of the correct range.	ERROR	Refer to the AT command document.

15.2 Sending the USSD Command in non-Transparent Mode

15.2.1 Reference Process

Command	Description
AT^USSDMODE=0	Set as non-Transparent mode.
OK	
AT+CSCS="IRA"	Set the TE supported character set as "IRA".
OK	
AT+CUSD=1,"*133*950#",15	Send the USSD code to network.
OK +CUSD: 1,"0031002E80A17968537365F6884C60C5000A0032002E80A18BC4000A0033002E90FD5E02751F6D3B000A0034002E5F697968000A0035002E751F6D3B5B9D5178000A0036002E65F65C1A751F6D3B000A0037002E5A314E504F1195F2000A0038002E516C51714FE1606F000A0039002E592753434E16754C000A002A002E900051FA000A0000",72	The network sends the menu information to the TE.
AT+CUSD=2	End the USSD session.
OK	
AT+CSCS="UCS2"	
OK	
AT+CUSD=1,"00310032",15	Send the USSD code to network, encoded as UCS2.
OK +CUSD: 2	The network does not support.



NOTE

"*133*950#" is just available in China Mobile network in Shen Zhen area. The USSD code is various in different networks.

15.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
Network does not support the USSD	+CUSD: 2	Use correct USSD code that the network supports.
The PIN is not authenticated.	+CME ERROR: SIM PIN required	Enter the correct PIN.

15.3 Sending the USSD Command in Transparent Mode

15.3.1 Reference Process

Command	Description
AT^USSDMODE=1	Set as transparent mode.
OK	
AT+CUSD=1,"aad808",15	Send the USSD code to network.
OK +CUSD: 0,"CD69724A74EA1A385B6C9683CD6E B1184E4603",15	The network sends the MSISDN to the TE.



NOTE

"aad808" is just available in dedicated lab network. The USSD code is various in different networks.

15.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
Network doesn't support the USSD.	+CUSD: 2	Use correct USSD code that the network supports.
The PIN is not authenticated.	+CME ERROR: SIM PIN required	Enter the correct PIN.

15.4 Network Initiated USSD Operation

15.4.1 Reference Process

Command	Description
+CUSD: 1,"7076393C2F83D26E789D0E0ABB416 97AB90D9287DDE732C82C7FB7413010 FD0DCA01"	USSD request is initiated by network. One of the digits "0–9" is required to be input.
AT+CUSD=1,"31",15	"1" is input to the network.
OK +CUSD: 0,"CF6508",15	The network notifies user that no response is needed.

**NOTE**

This function must be supported by the network. The request and notification content sent by the network depends on the manufacturers.

15.4.2 Troubleshooting

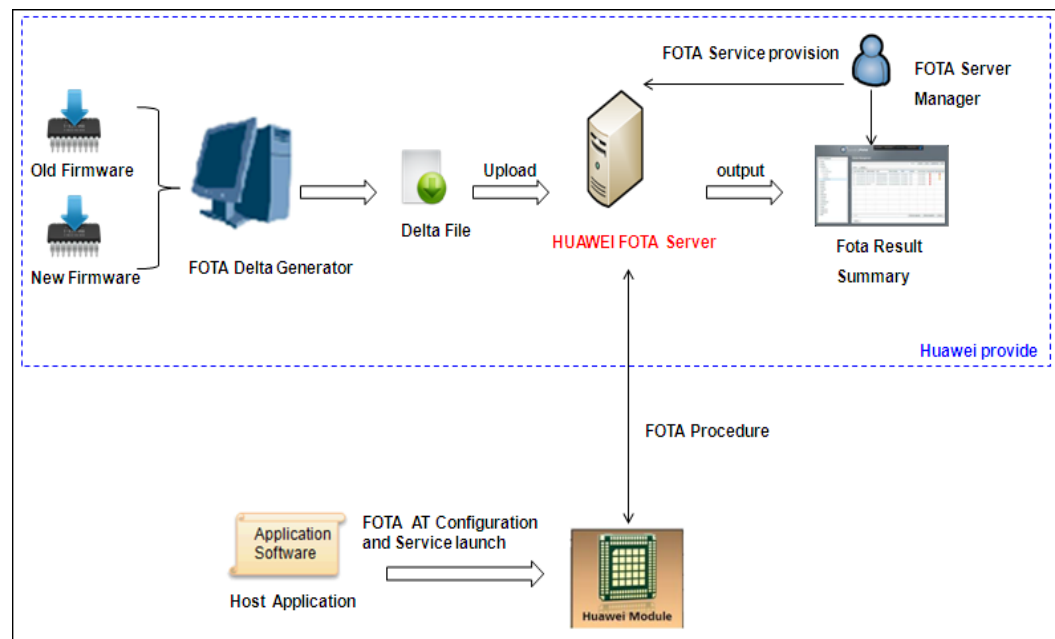
Scenario	Possible Error Information	Solution
The PIN is not authenticated.	+CME ERROR: SIM PIN required	Enter the correct PIN.
Network has sent USSD request or notification, yet which is not unsolicitedly reported by the module.	None	USSD unsolicited report: AT+CUSD=1
The module cannot report USSD request or notification with non-GSM7bit code sent by network (such as UCS2 8bit code)	None	Set the transmitted mode as USSD transparent mode: AT^USSDMODE=1

16 FOTA Application Scenarios

16.1 FOTA Process

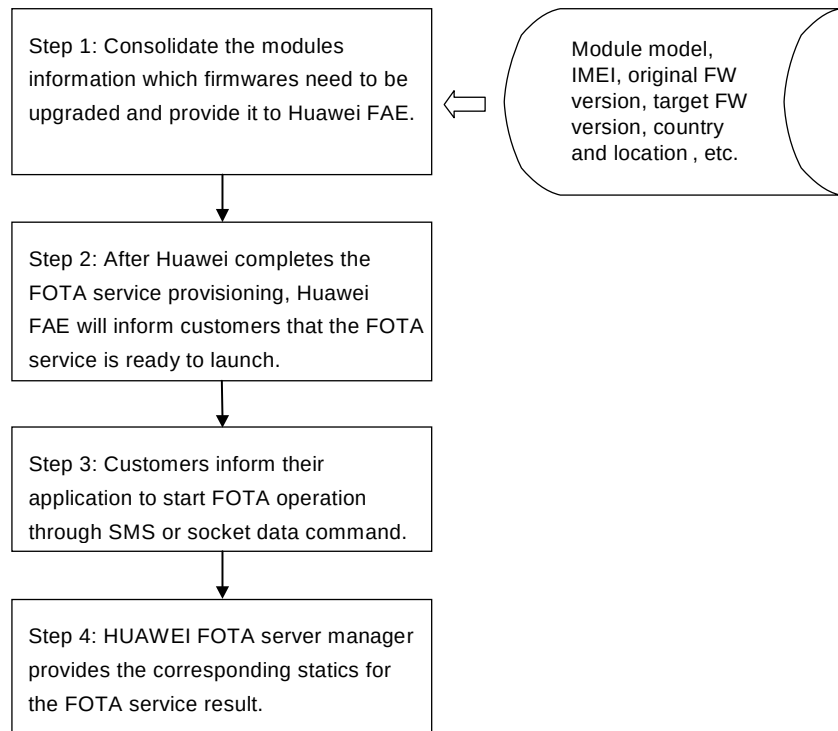
16.1.1 Upgrade Module Firmware Over Air Through Delta Package

Figure 16-1 Upgrade module firmware over air through delta package



16.1.2 Procedure for FOTA Implementation

This chapter describes the workflow of HUAWEI Module FOTA feature.

Figure 16-2 FOTA data flow

NOTE

If the module is powered off during the firmware installing progress, after the module is restarted, the firmware will resume installing at the last point.

AT command example (after customer's application received SMS or socket command to perform FOTA upgrade):

Command	Description
AT+GMR	Query the module's software version.
12.815.01.03.00	
OK	
AT^FOTACFG="1234","", "",2	Configure APN.
OK	
AT^FOTAMODE=0,0,1,1	Set FOTA mode.
OK	
AT^FOTASTATE?	
^FOTASTATE: 10	Indicate that the FOTA state is idle.
OK	

Command	Description
AT^FOTADET	Start to detect if new version exists in Huawei FOTA server.
OK ^FOTASTATE: 11 ^FOTASTATE: 12,12.815.01.04.00,79114,"Support send sms background"	Get the module's new version "12.815.01.04.00".
AT^FOTADL=1	Start to download the new version and upgrade.
OK ^FOTASTATE: 30	Indicate that it is downloading FW delta file.
AT^FOTADLQ	Query file download.
^FOTADLQ: 1,"IMAGE",1324,1324 ^FOTADLQ: 2,"XNV",47104,77778 OK ^FOTASTATE: 40 ^FOTASTATE: 50 ^FOTASTATE: 90	Indicate that FW delta file is completely downloaded. Indicate that FW is ready to update. After few minutes, FW is successfully upgraded.
AT+GMR	Query the module's software version after the upgrade.
12.815.01.04.00 OK	The software version has been changed.

16.2 Setting FOTA Mode

16.2.1 Reference Process

Command	Description
AT^FOTAMODE=?	Check the parameter range supported by the command.
^FOTAMODE: (0-1),(0-1),(0-1),(0-1),(1-65535) OK	
AT^FOTAMODE?	Query the current settings.
^FOTAMODE: 0,0,0,1,7 OK	Return the current FOTA mode: manual query, manual download, manual upgrade, and resumable data transfer enabled The value 7 indicates that the query cycle is seven days, which is meaningless when manual query is used.
AT^FOTAMODE=1,1,1,1,15	Configure FOTA mode as auto query, auto download, auto upgrade, and resumable data transfer enabled. And the auto query cycle is set to 15 days.
OK	



NOTE

- Parameter settings are all saved upon power-off.
- All parameters will be saved after the upgrade.

16.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	+CME ERROR: Error command parameters	The parameter is incorrectly set.

16.3 Setting FOTA Connection Parameters

16.3.1 Reference Process

Command	Description
AT^FOTACFG="cmnet","","",2	Set the APN to cmnet and authentication mode to CHAP . Leaves the user name and password blank. These parameters should be set according to the contracted values.
OK	
AT^FOTACFG?	Query the current settings.
^FOTACFG: "cmnet","","",2	
OK	



NOTE

- Parameter settings are all saved upon power-off.
- This command does not provide a test command. For details, see [HUAWEI MU509-65 HSDPA LGA Module AT Command Interface Specification](#).

16.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	+CME ERROR: Operation not supported	The operation is not supported.
An error message is returned.	+CME ERROR: Error command parameters	The parameter is incorrectly set.

16.4 Manually Querying for Upgrade Firmware Version

16.4.1 Reference Process

Command	Description
AT^FOTACFG="cmnet","","",2	This command is used to configure the PDP context. For example, sets the APN to cmnet (the value of APN is provided by the network server) and authentication mode to CHAP .

Command	Description
OK	
AT^FOTAMODE=0,0,0,1	Configure FOTA mode as manual query, manual download, manual upgrade, and resumable data transfer enabled.
OK	
AT^FOTASTATE?	Query the current FOTA state.
^FOTASTATE: 10	Indicate that the FOTA state is idle.
OK	
AT^FOTADET	Check for updates. Ensure that the module is registered with a valid network before you run this command.
OK	Return OK (success) or return +CME ERROR (failure).
^FOTASTATE: 11	Report that the query operation is in process.
^FOTASTATE: 12,12.815.01.04.00,79114,"Support send sms background"	Report information about the new version, including the version number, size of the file to be downloaded, and change description.
AT^FOTASTATE?	Query the current FOTA state.
^FOTASTATE: 12	Indicate that a new version is found.
OK	
AT^FOTADL=0	Delete the detected new version.
OK	
AT^FOTASTATE?	Query the current FOTA state.
^FOTASTATE: 10	Indicate that the FOTA state is idle.
OK	
AT^FOTADET	Check for updates after deleting the new version on the server.
OK	
^FOTASTATE: 11	
^FOTASTATE: 14	Report that no new version is found.


NOTE

- Version detection is allowed only if the FOTA state is idle.
- If the module is undergoing the PS data service or IPSTACK service, the FOTA service cannot be initiated, including version detection, download, and upgrade.
- The parameter <description> of the ^FOTASTATE command is a string composed of ASCII characters. This parameter is used to describe the changed items (corresponding to the feature items in **changelog.xml** in the upgrade package) of the new version. The parameter contains a maximum of five records, each containing up to 255 characters. Records are separated by semicolon.

16.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	+CME ERROR: FOTA is in collision state	Check whether the PS data service or IPSTACK service is going on, or use AT^FOTASTATE? command to check whether the FOTA state is idle.
An error message is returned.	+CME ERROR: Previous command is not complete	Wait for the previous command to be completely executed.
An error message is returned.	+CME ERROR: SIM PIN required	Use the PIN to unlock the SIM card.
The module reports a query failure.	^FOTASTATE: 13,<error_code>	Upon a query failure, the module restores the FOTA state to idle and deletes the downloaded files.

16.5 Periodically Querying the Version

16.5.1 Reference Process

Command	Description
AT^FOTAMODE=1,0,0,1,7	Configure FOTA mode as auto query, manual download, manual upgrade, and resumable data transfer enabled and the query cycle to seven days.
OK	The command is successfully executed.
	The module automatically checks for updates when the query time arrives.
^FOTASTATE: 11	Report that the query operation is in process.

Command	Description
^FOTASTATE: 12,12.815.01.04.00,79114,"Support send sms background"	Report information about the new version.


NOTE

- Periodical query is based on either of the two timekeeping modes: network timekeeping or local timekeeping. If network timekeeping is unavailable, local timekeeping is used. Local timekeeping may not be accurate.
- Local timekeeping is affected by **AT+CCLK** command. Upon a power-off event, the CCLK value changes to **1980**. After you choose to use local timekeeping and change the CCLK value, the query operation cannot be carried out at the correct time.

16.5.2 Troubleshooting

Scenario	Possible Error Information	Solution
Auto query is in use.	No query operation is initiated when the query time arrives.	1. Check if the FOTA state is idle. If not, change the FOTA state to idle by using the AT^FOTADL=0 command. 2. Check whether the PS data service or IPSTACK service is going on. If yes, terminate the service.

16.6 Manually Downloading the Version

16.6.1 Reference Process

Command	Description
AT^FOTASTATE?	Query the current FOTA state.
^FOTASTATE: 12 OK	Indicate that a new version is found.
AT^FOTADL=1	Run this command to manually download the version.
OK	The command is successfully executed.
^FOTASTATE: 30	Report that the download is in process.
AT^FOTADLQ	Query the download progress.

Command	Description
^FOTADLQ: 1,"IMAGE",1324,1324 ^FOTADLQ: 2,"XNV",47104,77778 OK ^FOTASTATE: 40	Return that the IMAGE file size is 1324 bytes, and 1324 bytes have been downloaded. The XNV file size is 77778 bytes, and 47104 bytes have been downloaded. Report that the version is completely downloaded and passes the MD5 verification.
AT^FOTADL=?	Query the parameters supported by the command.
^FOTADL: (0-1) OK	Return the supported parameters. 0: not to download. 1: download.


NOTE

- Version download is allowed only if the FOTA state is **12** (new version detected) and **31** (download pending).
- The prerequisites for version download and query are:
Module registered with a valid network.
No ongoing PS data service or IPSTACK service.

16.6.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	+CME ERROR: Operation not supported	The command is incorrect.
An error message is returned.	+CME ERROR: SIM PIN required	Use the PIN to unlock the SIM card.
An error message is returned.	ERROR	The command is executed in incorrect FOTA state. Ensure that the FOTA state is 12 or 31 before you run the command.
The module reports a download failure.	^FOTASTATE: 20,<error_code>	Upon a download failure, the module restores the FOTA state to idle and deletes the downloaded file.

16.7 Automatically Downloading the Firmware

16.7.1 Reference Process

Command	Description
AT^FOTAMODE=0,1,0,1	Configure auto download mode.
OK	
AT^FOTADET	Run this command to manually check for upgrades.
OK	
^FOTASTATE: 11	Report that the query operation is in process.
^FOTASTATE: 12,12.815.01.01.00,79102,"Support send sms background"	Report that a new version is found and information about the new version.
^FOTASTATE: 30	Automatically download the new version and reports that the download is in process.
^FOTASTATE: 40	Report that the version is completely downloaded and passes the MD5 verification.

16.7.2 Troubleshooting

None

16.8 Using the Resumable Data Transfer Function

16.8.1 Reference Process

Command	Description
AT^FOTAMODE=0,0,0,1	Enable resumable data transfer.
OK	
AT^FOTASTATE?	Query the FOTA state.
^FOTASTATE: 31	Indicate that the download is pending.
OK	
AT^FOTADL=1	Resume the transmission from the break

Command	Description
	point.
OK	
^FOTASTATE: 30	Report that the download is in process.
^FOTASTATE: 40	Report that the download is complete.


NOTE

If resumable data transfer is disabled, the download pending due to network disconnection or TCP link breakoff will be regarded as a download error.

16.8.2 Troubleshooting

Scenario	Possible Error Information	Solution
The function of resumable data transfer is disabled, and the network or TCP link is disconnected.	^FOTASTATE: 20,18 Or other download error	The module deletes the downloaded file and restores the FOTA state to idle.
The function of resumable data transfer is enabled, and the module is powered off.	^FOTASTATE: 31	The module prompts that the download can be resumed.

16.9 Manually Canceling the Download

16.9.1 Reference Process

Command	Description
AT^FOTADL=1	Initiate the version download.
OK	
^FOTASTATE: 30	Report that the download is in process.
AT^FOTADL=0	Cancel the download, deletes the downloaded file, and restores the FOTA state to idle.
OK	The command is successfully executed.
AT^FOTASTATE?	

Command	Description
^FOTASTATE: 10 OK	Report that the operation to cancel the download is complete. The FOTA state is idle.

16.9.2 Troubleshooting

None

16.10 Manually Upgrading the Version

16.10.1 Reference Process

Command	Description
AT^FOTASTATE?	
^FOTASTATE: 40 OK	Report that the download is complete.
AT^FWUP	Run this command to manually start the upgrade.
OK ^FOTASTATE: 50 ^FOTASTATE: 90	The command is successfully executed. Report that the upgrade starts. The module restarts, and then starts the upgrade. Report that the upgrade succeeds.

NOTE

- The module restarts several times during the upgrade. Ensure that during this process, the module is powered on. Do not send AT commands during the upgrade.
- If the upgrade fails, the module enters forcible loading mode, you can perform any of the following:
 - One-click upgrade from devices running Windows (full upgrade using the .exe file)
 - Upgrade from devices that run Android or Linux using **UpdateWizard** (full upgrade using the .bin file)

16.10.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	+CME ERROR: Previous command is not complete	Wait for the previous command to be completely executed.

Scenario	Possible Error Information	Solution
An error message is returned.	+CME ERROR: FOTA is in collision state	1. Check whether the PS data service or IPSTACK service is going on. 2. Check that the FOTA state is not 40 (download is complete).
An error message is returned.	ERROR	The command format is incorrect. Please see HUAWEI MU509-65 HSDPA LGA Module AT Command Interface Specification .
The module reports an upgrade failure.	^FOTASTATE: 80,<error_code>	The module automatically changes the FOTA state to idle and deletes the downloaded file. You can use the AT^FOTADL=0 command to set the FOTA state to idle manually. For error codes, see HUAWEI MU509-65 HSDPA LGA Module AT Command Interface Specification .

16.11 Automatically Upgrading the Version

16.11.1 Reference Process

Command	Description
AT^FOTAMODE=0,1,1,1	Configure FOTA mode as auto download and auto upgrade.
OK	
AT^FOTADET	Check for upgrades.
OK ^FOTASTATE: 11 ^FOTASTATE: 12,12.815.01.02.00,79114,"Support send sms background" ^FOTASTATE: 30	Return information about the new version. Automatically download the version.

Command	Description
^FOTASTATE: 40 ^FOTASTATE: 50 ^FOTASTATE: 90	Report that the version is completely downloaded and passes the MD5 verification. Report that the module is ready for the upgrade. Report that the upgrade succeeds.
AT^FOTASTATE?	Query the FOTA state.
^FOTASTATE: 10 OK	The FOTA state changes to idle after the upgrade.

16.11.2 Troubleshooting

None

16.12 Enabling or Disabling FOTA SMS Auto-Download

16.12.1 Reference Process

Command	Description
AT^FOTASMSCFG=1	Enable FOTA SMS auto-download.
OK ^FOTASMS ^FOTASTATE: 11	Report that the query operation is in process.
^FOTASTATE: 12,12.815.01.01.00,79102,"Support send sms background"	Return information about the new version.
^FOTASTATE: 30 ^FOTASTATE: 40	Automatically download the version Report that the version is completely downloaded and passes the MD5 verification.
^FOTASTATE: 50	Report that the module is ready for the upgrade.

Command	Description
^FOTASTATE: 90	Report that the upgrade succeeds.
AT^FOTASTATE?	Query the FOTA state.
^FOTASTATE: 10 OK	The FOTA state changes to idle after the upgrade.
AT^FOTASMSCFG=0	Disable FOTA SMS auto-download.
OK ^FOTASMS	
AT^FOTAP=1	The host decides that an upgrade is required.
OK ^FOTASTATE: 11	Report that the query operation is in process.
^FOTASTATE: 12,12.815.01.01.00,79102,"Support send sms background"	Return information about the new version.
^FOTASTATE: 30 ^FOTASTATE: 40 ^FOTASTATE: 50	Automatically download the version Report that the version is completely downloaded and passes the MD5 verification. Report that the module is ready for the upgrade.
^FOTASTATE: 90	Report that the upgrade succeeds.
AT^FOTASTATE?	Query the FOTA state.
^FOTASTATE: 10 OK	The FOTA state changes to idle after the upgrade.

**NOTE**

- If FOTA SMS auto-download is enabled and AT^FOTAP is not received within 10 seconds after ^FOTASMS is reported, the module automatically downloads the new version.
- When FOTA SMS auto-download is disabled, after ^FOTASMS is reported, the module downloads the new version only if it receives AT^FOTAP=1.
- Enables FOTA SMS auto-download may incur data usage fees charged by the operator.

16.12.2 Troubleshooting

None

16.13 FOTA Notification Reception Application Scenarios

16.13.1 Reference Process

Command	Description
AT^FOTASMSCFG=1	Enable FOTA SMS auto-download.
OK	
^FOTASMS	This command is used by the module to report to the host computer when receiving an update request so the host computer can decide whether to perform the update.

**NOTE**

- After receiving an update request, the module sends the ^FOTASMS command three times (once every four seconds; this frequency may change) within 10 seconds to the host computer.
- If the module receives "OK" or does not receive any response from the host computer within 10 seconds, the module starts an FOTA process.
- If the host computer returns "REJ" within 10 seconds, the process ends.

16.13.2 Troubleshooting

None

16.14 FOTA Process Startup Application Scenarios

16.14.1 Reference Process

Command	Description
AT^FOTAP=1	The host computer needs to accept an FOTA update request.
OK	

Command	Description
^FOTAMODE?	Query the mode settings.
^FOTAMODE: 0,1,1,1,7	Set the download mode and update mode to automatic and enable resumable data transfer. The settings are not saved to the NV.
OK	
AT^FOTACFG?	Query dial-up connection profile settings for FOTA.
^FOTACFG: "1234","hwtest","hwtest",2	
OK	
^FOTASTATE: 11	Report that the query operation is in process.
^FOTASTATE: 12,25.635.65.00.01,19553132,1 add 1;2 del;3 mod;4 add 2;5 add 3	Report information about the new version, including the version number, size of the file to be downloaded, and update description.
AT^FOTASTATE?	Query the FOTA status.
^FOTASTATE: 12	A new version is detected.
OK	
^FOTASTATE: 30	Report that the download is in process.
^FOTASTATE: 40	Report that the download is complete.
^FOTASTATE: 50	Report that the update starts.

NOTE

- Query the message-driven FOTA flag byte. If the flag byte is 0, a FOTA process is active. Stop the process to forcibly recover the FOTA state to idle. If the flag byte is 1, the last message-driven FOTA update is still in progress. In this case, query the FOTA state and wait for message to push the state machine to the next state.
- If no new version is detected (state 14), the process ends.
- If the attempt to check for or download updates fails, the module makes another attempt every half an hour within 24 hours until the attempt succeeds or the number of attempts reaches 48.
- If the module fails to check for updates within 24 hours, it saves the flag byte that indicates a detection failure.

- When implementing the FOTA service, the host computer sends the AT^FOTADL=0 command, and the module performs the update as if it received a FOTA notification and removes the message-driven FOTA flag byte.
- If the module detects the flag byte next time it is powered back on, it attempts to check for updates again. If the attempt succeeds, it sets message-driven FOTA flag byte to 0. If the attempt fails, it removes the message-driven FOTA flag byte, and the FOTA state recovers to idle.

16.14.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	+CME ERROR: FOTA is in collision state	Use the AT^FOTASTATE command to check whether the data service or IP stack service is used or whether FOTA state is idle.
An error message is returned.	+CME ERROR: Previous command is not complete	Wait for the previous command to be completely executed.
An error message is returned.	+CME ERROR: SIM PIN required	Use the PIN to unlock the module.
The module reports a query failure.	^FOTASTATE: 13,<error_code>	Upon a query failure, the module recovers the FOTA state to idle and deletes the downloaded files. See the AT command guide for error codes.

17 OMA DM

17.1 OMA DM Session Process

17.1.1 Reference Process

Command	Description
AT^OMADM=1,1	The user initiates an OMA DM session.
OK	

**NOTE**

When the connection between the module and server is set up, the module is added to the DM tree on the server. You can obtain the module information, and add or replace settings to configure or diagnose the module.

17.1.2 Troubleshooting

None

18 Appendix

18.1 Relative Documents

1. HUAWEI MU509-65 HSDPA LGA Module AT Command Interface Specification
2. 3GPP TS 27.007 AT command set for User Equipment (UE)
3. 3GPP TS 27.005 Equipment (DTE-DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
4. 3GPP TS 23.040 Technical realization of the Short Message Service(SMS)
5. 3GPP TS 31.102 Universal Subscriber Identity Module (USIM) application
6. 3GPP TS 24.008 Mobile radio interface Layer 3 specification; Core network protocols; Stage 3
7. 3GPP TS 29.002 Mobile Application Part (MAP) specification
8. 3GPP TS 22.004 General on supplementary services
9. ETSI TS 102.221 Smart Cards; UICC-Terminal interface; Physical and logical characteristics

18.2 Acronyms and Abbreviations

Table 18-1 List of Abbreviations

Acronym or Abbreviation	Expansion
3GPP	Third Generation Partnership Project
APN	Access Point Name
AT	Attention
CS	Circuit Switched (CS) domain
DCE	Data Circuit-terminating Equipment
DTE	Data Terminal Equipment
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications

Acronym or Abbreviation	Expansion
IMEI	International Mobile Equipment Identity
IP	Internet Protocol
ME	Mobile Equipment
MS	Mobile Station
PDP	Packet Data Protocol
PDU	Protocol Data Unit
PIN	Personal Identity Number
PPP	Point-to-Point Protocol
PUK	PIN Unblocking Key
PS	Packet Switched (PS) domain
QoS	Quality of Service
SIM	Subscriber Identity Module
SMS	Short Message Service
TE	Terminal Equipment
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
USIM	Universal Subscriber Identity Module
WCDMA	Wideband CDMA
NDIS	Network Driver Interface Specification
ECM	Ethernet Control Model
FOTA	Firmware Over The Air

Table 18-2 Phonebook-related abbreviations

Abbreviation	Full Name
SM	SIM phonebook
EN	SIM emergency number
ON	SIM own numbers

18.3 Exception Handling

In the industrial product design, in order to ensure reliable operation of the device for a long time, the host need take into account fault-tolerant design. This is because that the operation of the terminal environment is very complex and not easy to design the system architecture for complete simulation. Since the environment maybe change, and the various hardware components within the device are not always guaranteed to work at the expected condition, even if the module is able to maintain the electrical specifications claimed to work, but the external signal may also lead to abnormal changes in the module beyond the normal working condition. For example, the power supply voltage drop may cause the module reboots, so we recommend in the system design customers should consider the types of abnormal events, and add a corresponding recovery process, so that the module can be restored after a brief interruption to the normal communication.

18.3.1 Module Reset

- Exception Description

In some extreme condition (for example, the power voltage is not stable), the module may be reset.

- How to Detect the Exception by the Host

The module will report "**^SYSSTART**" to the host.

- Host Resume Steps

After the module reset, the host need reconfigure the configuration, and reconnect the data service, if the module was connected to network before resetting. If the module is connected to network by embedded protocol IP stack or external protocol stack, the host need reconnect too.

- Host Resume Example

For the data service reconnected by external protocol stack, please take the following two steps.

Step 1 Input **AT+CGDCONT=1,"IP","1234"**

Step 2 Input **ATD*99#**

----End

For detail, please refer to Chapter 4 External Protocol Stack Application Scenarios.

18.3.2 Module Going to Dump Status

- Exception Description

In some extreme condition, the module may go to dump status to protect itself. In this status, it cannot response to any AT command, and its USB port status is not the same as normal status.

- How to Detect the Exception by the Host

Any AT command input will have no response, and the module only has two USB ports.

- Host Resume Steps

If the module goes to dump status, please make sure the power voltage are recommended in Hardware Guide of the module. And then power off the UE for several minutes, then power on it again.

18.3.3 Module Data Service Disconnected

- Exception Description

In some extreme condition, the data service may be disconnected automatically. The reason maybe the network signal is not good, or the network is busy, or it is disconnected by the network.

- How to Detect the Exception by the Host

Query the current PDP Activation state:

Run:	AT+CGACT?
Response:	+CGACT: 1,0 OK

For details, please refer to [HUAWEI MU509-65 HSDPA LGA Module AT Command Interface Specification](#).

- Host Resume Steps

In this condition, the host need reconnect the network.

- Host Resume Example

For data service reconnected by internal protocol stack

Step 1

Run:	AT^IPINIT="1234"
Response:	OK

Step 2

Run:	AT^IPOPEN=1,"TCP","172.22.44.33",5000,5500
Response:	OK

----End

For details, please refer to Chapter 5 Internal Protocol Stack Application Scenarios-TCP/UDP.

18.3.4 User Configuration Lost

- Exception Description

In some extreme condition, the user configuration maybe loses after reset for several times.

- How to Detect the Exception by the Host

The AT command "**AT+IPR?**" will return the baud rate, but the baud is not what the host set or have no response by the UART.

The AT command "**AT+CGDCONT?**" will return the pdp profile, but the pdp profile will be empty or not the same as that the host set.

- Host Resume Steps

In this condition, the host need reconfigure the setting. We suggest the host configure the setting after powering on the module.

- Host Resume Example

Try to connect the module with the baud rates the module supports, and change the baud rate that the host needs.

Run:	AT+IPR=115200
Response:	OK