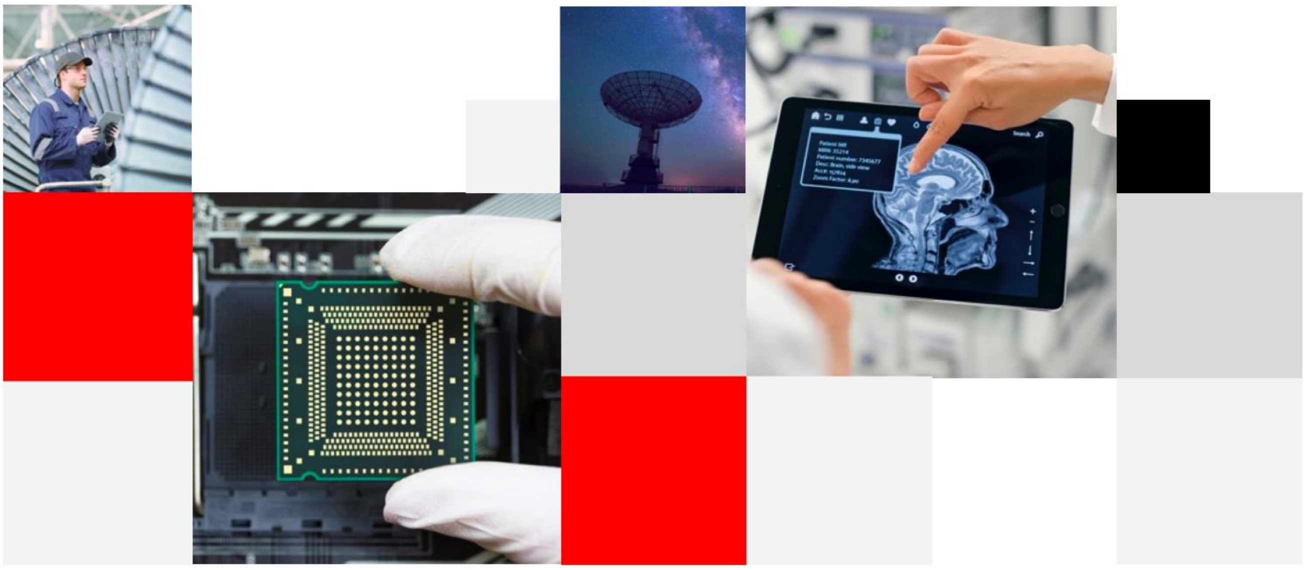
BG95&BG77&BG600L Series
TCP/IP Application Note

LPWA Module Series

Version: 1.1

Date: 2021-03-29

Status: Released



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About the Document

Revision History

Version	Date	Author	Description
1.0	2019-08-12	Terrence YANG	Initial
1.1	2021-03-29	Terrence YANG/ Sherlock ZHAO	1. Added an applicable module BG600L-M3. 2. Updated the valid value range of <timeout> in AT+QICLOSE from 1–65535 to 0–65535 (Chapter 2.3.5). 3. Added <RAI_info> for AT+QISENDEX to configure RAI (Chapter 2.3.9). 4. Changed the default value of <max_backoffs> of AT+QICFG="tcp/retranscfg" from 8 to 12 (Chapter 2.3.15). 5. Added AT+QICFG="sack" and AT+QICFG="tcp/keepalive" commands (Chapter 2.3.15). 6. Added some examples about TCP/UDP operations under IPv6 (Chapter 3.3, 3.7 and 3.9) and an example about UDP client with RAI feature (Chapter 3.10).

Contents

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1 Introduction

Quectel BG95 series, BG77 and BG600L-M3 modules feature an embedded TCP/IP stack, which enables the host to access the Internet directly via AT commands. This greatly reduces the dependence on external PPP and TCP/IP protocol stacks and thus minimizes the cost.

BG95 series, BG77 and BG600L-M3 modules provide the following socket services:

- TCP client
- UDP client
- TCP server
- UDP server

1.1. Applicable Modules

Table 1: Applicable Modules

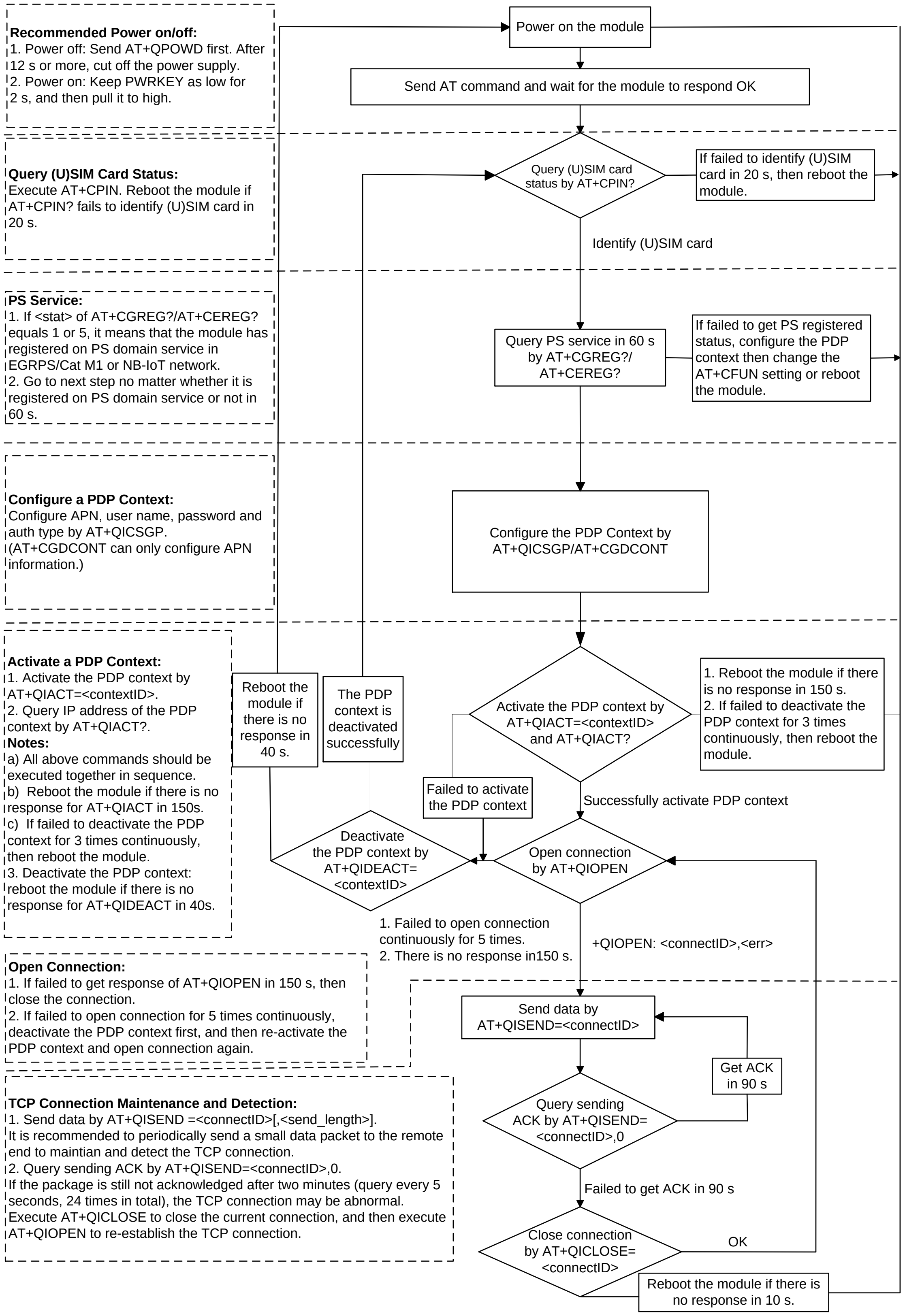
Module Series	Model	Description
BG95	BG95-M1	Cat M1 only
	BG95-M2	Cat M1/Cat NB2
	BG95-M3	Cat M1/Cat NB2/EGPRS
	BG95-M4	Cat M1/Cat NB2, 450 MHz Supported
	BG95-M5	Cat M1/Cat NB2/EGPRS, Power Class 3
	BG95-M6	Cat M1/Cat NB2, Power Class 3
	BG95-MF	Cat M1/Cat NB2, Wi-Fi Positioning
BG77	BG77	Cat M1/Cat NB2
BG600L	BG600L-M3	Cat M1/Cat NB2/EGPRS

NOTE

See the firmware release notes of corresponding module models to check whether the function has been supported.

1.2. Usage of TCP/IP AT Commands

Through TCP/IP AT commands, the host can configure a PDP context, activate/deactivate the PDP context, open/close a socket service and send/retrieve data via the socket service. The following illustrates how to use TCP/IP AT commands.



Recommended Power on/off:
1. Power off: Send AT+QPOWD first. After 12 s or more, cut off the power supply.
2. Power on: Keep PWRKEY as low for 2 s, and then pull it to high.

Query (U)SIM Card Status:
Execute AT+CPIN. Reboot the module if AT+CPIN? fails to identify (U)SIM card in 20 s.

PS Service:
1. If <stat> of AT+CGREG?/AT+CEREG? equals 1 or 5, it means that the module has registered on PS domain service in EGRPS/Cat M1 or NB-IoT network.
2. Go to next step no matter whether it is registered on PS domain service or not in 60 s.

Configure a PDP Context:
Configure APN, user name, password and auth type by AT+QICSGP.
(AT+CGDCONT can only configure APN information.)

Activate a PDP Context:
1. Activate the PDP context by AT+QIACT=<contextID>.
2. Query IP address of the PDP context by AT+QIACT?.
Notes:
a) All above commands should be executed together in sequence.
b) Reboot the module if there is no response for AT+QIACT in 150s.
c) If failed to deactivate the PDP context for 3 times continuously, then reboot the module.
3. Deactivate the PDP context: reboot the module if there is no response for AT+QIDEACT in 40s.

Open Connection:
1. If failed to get response of AT+QIOPEN in 150 s, then close the connection.
2. If failed to open connection for 5 times continuously, deactivate the PDP context first, and then re-activate the PDP context and open connection again.

TCP Connection Maintenance and Detection:
1. Send data by AT+QISEND =<connectID>[,<send_length>].
It is recommended to periodically send a small data packet to the remote end to maintian and detect the TCP connection.
2. Query sending ACK by AT+QISEND=<connectID>,0.
If the package is still not acknowledged after two minutes (query every 5 seconds, 24 times in total), the TCP connection may be abnormal. Execute AT+QICLOSE to close the current connection, and then execute AT+QIOPEN to re-establish the TCP connection.

Power on the module
Send AT command and wait for the module to respond OK
Query (U)SIM card status by AT+CPIN?
If failed to identify (U)SIM card in 20 s, then reboot the module.
Identify (U)SIM card
Query PS service in 60 s by AT+CGREG?/ AT+CEREG?
If failed to get PS registered status, configure the PDP context then change the AT+CFUN setting or reboot the module.
Configure the PDP Context by AT+QICSGP/AT+CGDCONT
Reboot the module if there is no response in 40 s.
The PDP context is deactivated successfully
Activate the PDP context by AT+QIACT=<contextID> and AT+QIACT?
1. Reboot the module if there is no response in 150 s.
2. If failed to deactivate the PDP context for 3 times continuously, then reboot the module.
Failed to activate the PDP context
Successfully activate PDP context
Deactivate the PDP context by AT+QIDEACT= <contextID>
Open connection by AT+QIOPEN
1. Failed to open connection continuously for 5 times.
2. There is no response in150 s.
+QIOPEN: <connectID>,<err>
Send data by AT+QISEND=<connectID>
Get ACK in 90 s
Query sending ACK by AT+QISEND= <connectID>,0
Failed to get ACK in 90 s
Close connection by AT+QICLOSE= <connectID>
OK
Reboot the module if there is no response in 10 s.

Notes:
1. Please note that you need to wait for the final response (for example OK, CME error, CMS error) of the last AT command you entered before you enter the next AT command. You can reboot the module if the module fails to get response in 60 s.
2. Reboot the module if the module has not got response of AT+QIACT in 150 s or response of AT+QICLOSE in 10 s and AT+QIDEACT in 40 s.
3. It is NOT recommended to frequently reboot the module. When the module has been continuously rebooted for 3 times due to failed AT command execution, it can be rebooted immediately for the first time after that. If it still fails, reboot the module after 10 minutes for the second time, and reboot after 30 minutes for the third time, one hour for the fourth time, etc.

Figure 1: Flow Chart of Using TCP/IP AT Commands

1.3. Description of Data Access Modes

The modules support three data access modes:

- Buffer access mode
- Direct push mode
- Transparent transmission mode

When opening a socket service with **AT+QIOPEN**, you can specify the data access mode by **<access_mode>**. After the socket service is opened, the data access mode can be changed with **AT+QISWTMD**.

1. In buffer access mode, the module buffers data upon receiving it and reports a URC in the format of **+QIURC: "recv",<connectID>[,<data_len>]** to notify the host of the incoming data. The host can read the buffered data with **AT+QIRD**.

2. In direct push mode, the module outputs the received data directly through a URC in the format of **+QIURC: "recv",<connectID>,<currectrecvlength><CR><LF><data>** or **+QIURC: "recv",<connectID>,<currentrecvlength>,<remoteIP>,<remote_port><CR><LF><data>**.
   See ***Chapter 2.4.2*** for more details.

3. In transparent transmission mode, the corresponding COM port (such as UART port, USB modem port, etc.) enters exclusive mode, where data received from the port is sent to the Internet directly, and data received from the Internet is outputted via the port directly.

   - **Exit from transparent transmission mode**

   The module can exit from transparent transmission mode through either of the following ways.

   1) Execute **+++**. Follow the requirements below to prevent the **+++** from being misinterpreted as data:

      a) Do not input any character within 1 second before and after inputting **+++**.
      b) Input **+++** within 1 second, and wait until **OK** is returned. When **OK** is returned, the module is switched to buffer access mode.

   2) Change MAIN_DTR from LOW to HIGH to make the module enter command mode. In this case, **AT&D1** (see ***document [1]***) should have been set before the module enters transparent transmission mode.

   - **Return to transparent transmission mode**

   1) By **AT+QISWTMD**. Specify **<access_mode>** as 2 when executing this command. When transparent transmission mode is entered successfully, **CONNECT** is returned.

   2) By **ATO**. After a connection exits from transparent transmission mode, executing **ATO** will switch

the data access mode back to transparent transmission mode. When transparent transmission mode is entered successfully, **CONNECT** is returned. If no connection has entered transparent transmission mode before, **ATO** returns **NO CARRIER**.

NOTES

1. In buffer access mode, if the buffer is not empty, the module does not report a new URC until all the received data has been read with **AT+QIRD** from the buffer.
2. In transparent transmission mode, AT commands cannot be executed. If the socket connection is closed because of network error or other errors, the module reports **NO CARRIER** and exits from the transparent transmission mode. In this case, **AT+QICLOSE** should be executed to close the socket service.

2 TCP/IP AT Commands

2.1. AT Command Introduction

2.1.1. Definitions

- **<CR>** Carriage return character.
- **<LF>** Line feed character.
- **<...>** Parameter name. Angle brackets do not appear on command line.
- **[...]** Optional parameter of a command or an optional part of TA information response. Square brackets do not appear on command line. When an optional parameter is omitted, the new value equals its previous value or its default setting, unless otherwise specified.
- **Underline** Default setting of a parameter.

2.1.1. AT Command Syntax

All command lines must start with **AT** or **at** and end with **<CR>**. Information responses and result codes always start and end with a carriage return character and a line feed character: **<CR><LF><response><CR><LF>**. Throughout this document, only the commands and responses are presented, while carriage return and line feed characters are deliberately omitted.

Table 2: Types of AT Commands

Command Type	Syntax	Description
Test Command	**AT+<cmd>=?**	Test the existence of corresponding Write Command and return information about the type, value, or range of its parameter.
Read Command	**AT+<cmd>?**	Check the current parameter value of a corresponding Write Command.
Write Command	**AT+<cmd>=<p1>[,<p2>[,<p3>[...]]]**	Set user-definable parameter value.
Execution Command	**AT+<cmd>**	Return a specific information parameter or perform a specific action.

2.2. Declaration of AT Command Examples

The AT command examples in this document are provided to help you familiarize with AT commands and learn how to use them. The examples, however, should not be taken as Quectel's recommendation or suggestions about how you should design a program flow or what status you should set the module into. Sometimes multiple examples may be provided for one AT command. However, this does not mean that there exists a correlation among these examples and that they should be executed in a given sequence.

2.3. Description of TCP/IP AT Commands

2.3.1. AT+QICSGP Configure Parameters of a TCP/IP Context

This command configures the **<APN>**, **<username>**, **<password>** and other parameters of a TCP/IP context.

AT+QICSGP Configure Parameters of a TCP/IP Context	
Test Command **AT+QICSGP=?**	Response **+QICSGP: (**range of supported **<contextID>**s**),(**range of supported **<context_type>**s**),<APN>,<username>,<password>,(**range of supported **<authentication>**s**)** **OK**
Write Command Query/configure a specified context **AT+QICSGP=<contextID>[,<context_type>,<APN>[,<username>,<password>[,<authentication>]]]**	Response If the optional parameters are omitted, query the current setting: **+QICSGP: <context_type>,<APN>,<username>,<password>,<authentication>** **OK** If any of the optional parameters is specified, configure a specified context: **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately (actually determined by network). The configuration is saved automatically.

Parameter

<contextID>	Integer type. Context ID. Range: 1–16.
<context_type>	Integer type. Protocol type. 1 IPv4 2 IPv6 3 IPv4v6
<APN>	String type. Access Point Name.
<username>	String type. Username.
<password>	String type. Password.
<authentication>	Integer type. Authentication methods. 0 None 1 PAP 2 CHAP 3 PAP or CHAP

Example

```
AT+QICSGP=1                          //Query the configuration of context 1.
+QICSGP: 1,"","","",0

OK
AT+QICSGP=1,1,"CMNBIOT","","",1      //Configure context 1. APN is "CMNBIOT" for China Mobile
                                      NB-IoT network.
OK
```

2.3.2. AT+QIACT Activate a PDP Context

Before activating a PDP context with **AT+QIACT**, the context should be configured by **AT+QICSGP**. After activation, the IP address can be queried with **AT+QIACT?**.

Although the range of **<contextID>** is 1–16, the module supports maximum three PDP contexts activated simultaneously under LTE Cat M/EGPRS and maximum two under LTE Cat NB2. Depending on the network, it may take at most 150 seconds to return **OK** or **ERROR** after executing **AT+QIACT**. Before the response is returned, other AT commands cannot be executed.

AT+QIACT Activate a PDP Context	
Test Command **AT+QIACT=?**	Response **+QIACT: (**range of supported **<contextID>**s**)** **OK**

Read command **AT+QIACT?**	Response Return the list of the currently activated contexts and their IP addresses: **+QIACT: 1,<context_state>,<context_type>[,<IP_address>]** **[.....** **+QIACT: 16,<context_state>,<context_type>[,<IP_address>]]** **OK**
Write Command Activate a specified PDP context **AT+QIACT=<contextID>**	Response **OK** Or **ERROR**
Maximum Response Time	150 s, determined by the network.
Characteristics	/

Parameter

<contextID>	Integer type. Context ID. Range: 1–16.
<context_state>	Integer type. Context state. 0 Deactivated 1 Activated
<context_type>	Integer type. Protocol type. 1 IPv4 2 IPv6
<IP_address>	String type. Local IP address after the context is activated.

2.3.3. AT+QIDEACT Deactivate a PDP Context

This command deactivates a specific context and close all TCP/IP connections set up in this context. Depending on the network, it may take at most 40 seconds to return **OK** or **ERROR** after executing **AT+QIDEACT**. Before the response is returned, other AT commands cannot be executed.

AT+QIDEACT Deactivate a PDP Context	
Test Command **AT+QIDEACT=?**	Response **+QIDEACT: (**range of supported **<contextID>**s**)** **OK**
Write Command	Response

AT+QIDEACT=<contextID>	**OK** Or **ERROR**
Maximum Response Time	40 seconds, determined by the network.
Characteristics	/

Parameter

<contextID>	Integer type. Context ID. Range: 1–16.

2.3.4. AT+QIOPEN Open a Socket Service

This command opens a socket service. The service type can be specified by **<service_type>**. The data access mode (buffer access mode, direct push mode and transparent transmission mode) can be specified by **<access_mode>**. The response **+QIOPEN: <connectID>,<result>** indicates whether the socket service has been opened successfully.

1. If **<service_type>** is "TCP LISTENER", the module works as TCP server. After accepting a new TCP connection, the module automatically specifies a **<connectID>** and reports URC **+QIURC: "incoming",<connectID>,<serverID>,<remoteIP>,<remote_port>**. The range of **<connectID>** is 0–11. The type of this new incoming connection is "TCP INCOMING" and the **<access_mode>** of "TCP INCOMING" is the same with that of "TCP LISTENER".

2. If **<service_type>** is "UDP SERVICE", UDP data can be sent to or received from the remote IP via **<local_port>**.
   - Send data: execute **AT+QISEND=<connectID>,<send_length>,<remoteIP>,<remote_port>**.
   - Receive data in direct push mode: the module reports the URC **+QIURC: "recv",<connectID>,<currentrecvlength>,<remoteIP>,<remote_port><CR><LF><data>**.
   - Receive data in buffer access mode: the module reports the URC **+QIURC: "recv",<connectID>[,<data_len>]**, and then the received data can be retrieved with **AT+QIRD=<connectID>**.

3. It is suggested to wait for 150 seconds for **+QIOPEN: <connectID>,<result>** to be outputted after executing the Write Command. If the response cannot be received in 150 seconds, **AT+QICLOSE** should be used to close the socket.

AT+QIOPEN Open a Socket Service	
Test Command **AT+QIOPEN=?**	Response **+QIOPEN: (**range of supported **<contextID>**s**),(**range of supported **<connectID>**s**),"TCP/UDP/TCP LISTENER/UDP**

	SERVICE","<IP_address>/<domain_name>",(range of supported **<remote_port>**s**),(**range of supported **<local_port>**s**),(**range of supported **<access_mode>**s**)** **OK**
Write Command **AT+QIOPEN=<contextID>,<connectID>,<service_type>,<IP_address>/<domain_name>,<remote_port>[,<local_port>[,<access_mode>]]**	Response If in transparent transmission mode (**<access_mode>**=2) and the service is opened successfully: **CONNECT** If there is any error: **ERROR** Error description can be got via **AT+QIGETERROR**. If in buffer access mode (**<access_mode>**=0) or direct push mode (**<access_mode>**=1): **OK** **+QIOPEN: <connectID>,<result>** **<result>** is 0 when the service is opened successfully. In other cases, **<result>** is not 0.
Maximum Response Time	150 seconds, determined by the network.
Characteristics	/

Parameter

<contextID>	Integer type. Context ID. Range: 1–16.	
<connectID>	Integer type. Socket service index. Range: 0–11.	
<service_type>	String type. The socket service type.	
	"TCP"	Start a TCP connection as a client
	"UDP"	Start a UDP connection as a client
	"TCP LISTENER"	Start a TCP server to listen for TCP incoming connections
	"UDP SERVICE"	Start a UDP service
<IP_address>	String type. If **<service_type>** is "TCP" or "UDP", it indicates the IP address of remote server, such as "220.180.239.212". If **<service_type>** is "TCP LISTENER" or "UDP SERVICE", enter "127.0.0.1".	
<domain_name>	String type. Domain name address of the remote server.	
<remote_port>	Integer type. Port number of the remote server. Range: 0–65535. If **<service_type>** is "TCP" or "UDP", this parameter must be specified. Range: 1–65535.	

	If **<service_type>** is "TCP LISTENER" or "UDP SERVICE", specify this parameter as 0.
<local_port>	Integer type. Local port number. Range: 0–65535. If **<service_type>** is "TCP LISTENER" or "UDP SERVICE", this parameter must be specified. Range: 1–65535. If **<service_type>** is "TCP" or "UDP", this parameter can be omitted and the default value is 0. The local port will be assigned automatically if **<local_port>** is 0. Otherwise the local port is assigned as specified.
<access_mode>	Integer type. Data access mode of the socket service. 0 Buffer access mode 1 Direct push mode 2 Transparent transmission mode
<result>	Integer type. Result code of the operation. See ***Chapter 4*** for details.

NOTES

1. Only one socket service can be set to transparent transmission mode at a time.
2. If **<service_type>** is "TCP LISTENER", **<access_mode>** cannot be specified to transparent transmission mode directly. When a remote client connects to this server, **AT+QSWTMD** can be used to switch the incoming connection to transparent transmission mode.

2.3.5. AT+QICLOSE Close a Socket Service

This command closes a specified socket service. Depending on the network, it takes at most 10 seconds (default value, can be modified by **<timeout>**) to return **OK** or **ERROR** after executing **AT+QICLOSE**. Before the response is returned, other AT commands cannot be executed.

AT+QICLOSE Close a Socket Service	
Test Command **AT+QICLOSE=?**	Response **+QICLOSE: (**range of supported **<connectID>**s**),(**range of supported **<timeout>**s**)** **OK**
Write Command **AT+QICLOSE=<connectID>[,<timeout>]**	Response If the socket service is closed successfully: **OK** If it is failed to close the socket service: **ERROR**
Maximum Response Time	Determined by <timeout>
Characteristics	/

Parameter

<connectID>	Integer type. Socket service index. Range: 0–11.
<timeout>	Integer type. Timeout value for the response to be outputted. If the FIN ACK of the other peer is not received within **<timeout>**, the module will be forced to close the socket. Range: 0–65535. Default value: 10. Unit: second.

2.3.6. AT+QISTATE Query Socket Service Status

This command queries the socket service status. If the **<query_type>** is 0, it returns the status of all existing socket services in the specified context. If the **<query_type>** is 1, it returns the status of a specified socket service.

AT+QISTATE Query Socket Service Status	
Test Command **AT+QISTATE=?**	Response **OK**
Read/Execution Command **AT+QISTATE?** or **AT+QISTATE**	Response Return the status of all existing connections: **+QISTATE: <connectID>,<service_type>,<IP_address>,<remote_port>,<local_port>,<socket_state>,<contextID>,<serverID>,<access_mode>,<AT_port>** **[…]** **OK**
Write Command If **<query_type>** is 0, query the connection status of a specified context **AT+QISTATE=<query_type>,<contextID>**	Response Return the status of all existing connections in a specified context: **+QISTATE: <connectID>,<service_type>,<IP_address>,<remote_port>,<local_port>,<socket_state>,<contextID>,<serverID>,<access_mode>,<AT_port>** **[…]** **OK**
Write Command If **<query_type>** is 1, query the connection status of a specified socket service **AT+QISTATE=<query_type>,<connectID>**	Response **+QISTATE: <connectID>,<service_type>,<IP_address>,<remote_port>,<local_port>,<socket_state>,<contextID>,<serverID>,<access_mode>,<AT_port>** **OK**
Maximum Response Time	300 ms
Characteristics	/

Parameter

<query_type>	Integer type. Query type. 0 Query connection status of all socket services in a specified context 1 Query connection status of a specified socket service
<contextID>	Integer type. Context ID. Range: 1–16.
<connectID>	Integer type. Socket service index. Range: 0–11.
<service_type>	String type. The socket service type. "TCP" Start a TCP connection as a client "UDP" Start a UDP connection as a client "TCP LISTENER" Start a TCP server to listen for TCP incoming connections "TCP INCOMING" Start a TCP connection accepted by a TCP server "UDP SERVICE" Start a UDP service
<IP_address>	String type. IP address. If **<service_type>** is "TCP" or "UDP", it is the IP address of a remote server. If **<service_type>** is "TCP LISTENER" or "UDP SERVICE", it is the local IP address. If **<service_type>** is "TCP INCOMING", it is the IP address of a remote client.
<remote_port>	Integer type. Remote port number. If **<service_type>** is "TCP" or "UDP", it is the port of a remote server. If **<service_type>** is "TCP LISTENER" or "UDP SERVICE", the port is invalid. If **<service_type>** is "TCP INCOMING", it is the port of a remote client.
<local_port>	Integer type. Local port number. If **<local_port>** is 0, then the local port is assigned automatically.
<socket_state>	Integer type. Socket service status. 0 "Initial": connection has not been established 1 "Opening": client is connecting or server is trying to listen 2 "Connected": client/incoming connection has been established 3 "Listening": server is listening 4 "Closing": connection is closing
<serverID>	Integer type. Only valid when **<service_type>** is "TCP INCOMING". **<serverID>** represents the ID of the server that accepts this TCP incoming connection, and the value is the same as **<connectID>** of "TCP LISTENER".
<access_mode>	Integer type. Data access mode. 0 Buffer access mode 1 Direct push mode 2 Transparent transmission mode
<AT_port>	String type. COM port of socket service. "usbmodem" USB modem port "uart1" UART1 port

2.3.7. AT+QISEND Send Data

In buffer access mode (**<access_mode>**=0) or direct push mode (**<access_mode>**=1), the data can be sent with **AT+QISEND**. If the data is sent to the module successfully, **SEND OK** is returned. Otherwise **SEND FAIL** or **ERROR** is returned.

- **SEND FAIL** indicates the sending buffer is full. In this case, data can be resent.
- **ERROR** indicates there is an error in the process of sending data. In this case, wait for some time before you resend the data.
- **SEND OK** does not mean the data has been sent to the peer successfully. You can query whether the data has reached the peer with **AT+QISEND=<connectID>,0**.

AT+QISEND Send Data	
Test Command **AT+QISEND=?**	Response **+QISEND: (**range of supported **<connectID>**s**),(**range of supported **<send_length>**s**)** **OK**
Write Command Send variable-length data when **<service_type>** is "TCP", "UDP" or "TCP INCOMING" **AT+QISEND=<connectID>**	Response **>** After the response **>**, input the data to be sent. Tap **Ctrl+Z** to send, and tap **Esc** to cancel the operation If the connection is established and the data is sent successfully: **SEND OK** If the connection is established but the sending buffer is full: **SEND FAIL** If the connection is not established, abnormally closed, or any parameter is incorrect, response: **ERROR**
Write Command Send fixed-length data when **<service_type>** is "TCP", "UDP" or "TCP INCOMING" **AT+QISEND=<connectID>,<send_length>**	Response **>** After the response **>**, input the data until the data length equals **<send_length>** If the connection is established and the data is sent successfully: **SEND OK** If the connection is established but the sending buffer is full: **SEND FAIL**

	If the connection is not established, abnormally closed, or any parameter is incorrect: **ERROR**
Write Command When **<service_type>** is "UDP SERVICE" **AT+QISEND=<connectID>,<send_length>,<remoteIP>,<remote_port>**	Response Send fixed length data to specified remote IP address and remote port. The **<service_type>** must be "UDP SERVICE". **>** After response **>**, type the data until the data length equals **<send_length>** If the connection is established and the data is sent successfully: **SEND OK** If the connection is established but the sending buffer is full: **SEND FAIL** If the connection is not established, abnormally closed, or any parameter is incorrect: **ERROR**
Write Command When **<send_length>** is 0, query the sent data **AT+QISEND=<connectID>,0**	Response If the specified **<connectID>** exists: **+QISEND: <total_send_length>,<ackedbytes>,<unackedbytes>** **OK** If the specified **<connectID>** does not exist, or there is any other error: **ERROR**
Maximum Response Time	120 s, determined by network.
Characteristics	/

Parameter

<connectID>	Integer type. Socket service index. Range: 0–11.
<send_length>	Integer type. Length of the data to be sent. Range: 0–1460.
<remoteIP>	String type. Remote IP address (must be dot format). It is valid only when **<service_type>** is "UDP SERVICE".
<remote_port>	Integer type. Remote port. It is valid only when **<service_type>** is "UDP

	SERVICE".
<total_send_length>	Integer type. Total length of sent data. Unit: byte.
<ackedbytes>	Integer type. Total length of acknowledged data. Unit: byte.
<unackedbytes>	Integer type. Total length of unacknowledged data. Unit: byte.

2.3.8. AT+QIRD Retrieve the Received TCP/IP Data

In buffer access mode, after receiving data, the module buffers it and reports **+QIURC: "recv",<connectID>[,<data_len>]**, then the data can be retrieved with **AT+QIRD**.

Please note that if the buffer is not empty, and the module receives data again, it does not report a new URC until all the received data has been retrieved with **AT+QIRD** from the buffer.

AT+QIRD Retrieve the Received TCP/IP Data	
Test Command **AT+QIRD=?**	Response **+QIRD: (**range of supported **<connectID>**s**),(**range of supported **<read_length>**s**)** **OK**
Write Command When **<service_type>** is "TCP", "UDP" or "TCP INCOMING" **AT+QIRD=<connectID>[,<read_length>]**	Response If the specified connection has received the data: **+QIRD: <read_actual_length><CR><LF><data>** **OK** If there is no data: **+QIRD: 0** **OK** If the connection does not exist: **ERROR**
Write Command When **<service_type>** is "UDP SERVICE" **AT+QIRD=<connectID>**	Response If the data exists: **+QIRD: <read_actual_length>,<remoteIP>,<remote_port><CR><LF><data>** **OK** If there is no data: **+QIRD: 0** **OK**

	If the connection does not exist: **ERROR**
Write Command When **<read_length>** is 0, query the retrieved data length **AT+QIRD=<connectID>,0**	Response If the specified connection exists: **+QIRD: <total_receive_length>,<have_read_length>,<unread_length>** **OK** If there is any error: **ERROR**
Maximum Response Time	120 s, determined by network.
Characteristics	/

Parameter

<connectID>	Integer type. Socket service index. Range: 0–11.
<read_length>	Integer type. Maximum length of the data to be retrieved. Range: 0–1500. Default value: 1500. Unit: byte.
<read_actual_length>	Integer type. Length of the data that has been actually retrieved. Unit: byte.
<remoteIP>	String type. Remote IP address. It is valid only when **<service_type>** is "UDP SERVICE".
<remote_port>	Integer type. Remote port number. It is valid only when **<service_type>** is "UDP SERVICE".
<data>	String type. Retrieved data.
<total_receive_length>	Integer type. Total length of received data. Unit: byte.
<have_read_length>	Integer type. Length of the data that has been retrieved. Unit: byte.
<unread_length>	Integer type. Length of the data that has not been retrieved. Unit: byte.

2.3.9. AT+QISENDEX Send Hex String Data

This command sends hex string data and cannot be applied for "UDP SERVICE" and "TCP LISTENER" sockets.

AT+QISENDEX Send Hex String Data	
Test Command **AT+QISENDEX=?**	Response **+QISENDEX: (**range of supported **<connectID>**s**),<hex_string>,(**range of supported **<RAI_info>**s**)**

	OK
Write Command **AT+QISENDEX=<connectID>,<hex_string>[,<RAI_info>]**	Response If the hex string is sent successfully: **SEND OK** If the sending buffer is full: **SEND FAIL** If the connection does not exist: **ERROR**
Maximum Response Time	120 s, determined by network.
Characteristics	/

Parameter

<connectID>	Integer type. Socket service index. Range: 0–11.
<hex_string>	String type. Hex string data. The maximum length is 512 bytes.
<RAI_info>	Integer type. The RAI (Release Assistance Indication) information. 0 No RAI information available. 1 No further uplink or downlink data transmission. 2 Only a single downlink data transmission and no further uplink data transmission.

NOTES

1. RAI (Release Assistance Indication) is introduced in *3GPP Release 14* and it is primarily a MAC layer feature.
2. The RAI feature is only applicable to NB-IoT RAT. This feature allows to track predictable nature of data traffic and requests for connection release when there is no additional data to be sent. It is essentially a ‘fast dormancy’ feature to save battery power of the UE.

2.3.10. AT+QISWTMD Switch Data Access Mode

This command switches the data access mode among buffer access mode, direct push mode and transparent transmission mode. When starting a socket service, the data access mode can be specified via the **<access_mode>** of **AT+QIOPEN**. After a socket has been opened, the data access mode can be changed with **AT+QISWTMD**.

AT+QISWTMD Switch Data Access Mode	
Test Command **AT+QISWTMD=?**	Response **+QISWTMD: (**range of supported **<connectID>**s**),(**range of supported **<access_mode>**s**)** **OK**
Write Command **AT+QISWTMD=<connectID>,<access_mode>**	Response If **<access_mode>** is 0 or 1, and data access mode is switched successfully: **OK** If **<access_mode>** is 2 and data access mode is switched successfully, the module enters data mode (i.e. transparent transmission mode): **CONNECT** If there is any error: **ERROR**
Maximum Response Time	300 ms
Characteristics	/

Parameter

<connectID>	Integer type. Socket service index. Range: 0–11.
<access_mode>	Integer type. Data access modes of the connection. 0 Buffer access mode 1 Direct push mode 2 Transparent transmission mode

2.3.11. AT+QPING Ping a Remote Host

This command tests the reachability of a host on an Internet protocol network. Before using the ping utility, the host should activate the context of corresponding **<contextID>** with **AT+QIACT** first. The command returns the result within **<timeout>**.

AT+QPING Ping a Remote Host	
Test Command **AT+QPING=?**	Response **+QPING: (**range of supported **<contextID>**s**),<host>,(**range of supported **<timeout>**s**),(**range of supported **<pingnum>**s**)**

	OK
Write Command **AT+QPING=<contextID>,<host>[,<timeout>[,<pingnum>]]**	Response If a remote host is pinged successfully: **OK** **+QPING: <ping_result>[,<IP_address>,<bytes>,<time>,<TTL>]** **[…]** **+QPING: <finresult>[,<sent>,<rcvd>,<lost>,<min>,<max>,<avg>]** If there is any error: **ERROR**
Maximum Response Time	300 s
Characteristics	/

Parameter

<contextID> Integer type. Context ID. Range: 1–16.

<host> String type. Host address. It is a domain name or a dotted decimal IP address.

<timeout> Integer type. Maximum time to wait for the response of each ping request. Range: 1–255. Default value: 4. Unit: second.

<pingnum> Integer type. Maximum number of ping requests. Range: 1–10. Default value: 4.

<ping_result> Integer type. Result of each ping request.
0 Received the ping response from the host. In this case, it is followed by **,<IP_address>,<bytes>,<time>,<TTL>**.
Others See ***Chapter 4*** for specific result codes.

<IP_address> String type. IP address of the remote host in dotted-decimal notation.

<bytes> Integer type. Length of each sent ping request. Unit: byte.

<time> Integer type. Time wait for the response of the ping request. Unit: ms.

<TTL> Integer type. Time to live value of the response packet for the ping request.

<finresult> Integer type. The final result of the command.
0 Pinged successfully. It is successful to activate the context and find the host. In this case, it is followed by **,<sent>,<rcvd>,<lost>,<min>,<max>,<avg>**.
Others See ***Chapter 4*** for specific result codes.

<sent> Integer type. Total number of the ping requests that have been sent.

<rcvd> Integer type. Total number of the ping requests that have received responses.

<lost>	Integer type. Total number of the ping requests that are time out.
<min>	Integer type. Minimum response time. Unit: ms.
<max>	Integer type. Maximum response time. Unit: ms.
<avg>	Integer type. Average response time. Unit: ms.

2.3.12. AT+QNTP Synchronize Local Time with NTP Server

This command synchronizes the local time with the Universal Time Coordinated (UTC) through the NTP server. Before time synchronization, the host should activate the context corresponding to **<contextID>** with **AT+QIACT** first.

AT+QNTP Synchronize Local Time with NTP Server	
Test command **AT+QNTP=?**	Response **+QNTP: (**range of supported **<contextID>**s**),<server>,(**range of supported **<port>**s**),(**list of supported **<auto_set_time>**s**)** **OK**
Read command **AT+QNTP?**	Response If in the process of local time synchronization: **+QNTP: <server>,<port>** **OK**
Write command **AT+QNTP=<contextID>,<server>[,<port>[,<auto_set_time>]]**	Response If the local time is synchronized with NTP server successfully: **OK** **+QNTP: <result>,<time>** If there is any error: **ERROR**
Maximum Response Time	125s, determined by the network.
Characteristics	The command takes effect immediately (actually determined by network). The configuration is not saved.

Parameter

<contextID>	Integer type. Context ID. Range: 1–16.
<server>	String type. Address of NTP server.
<port>	Integer type. Port number of NTP server. Range: 1–65535. Default value: 123.
<auto_set_time>	Integer type. Whether to automatically set synchronized time as local time. 0 Not set

	1 Set
<result>	Integer type. Result code of the operation. See ***Chapter 4*** for details.
<time>	String type. The time synchronized from NTP server. The format is "YYYY/MM/DD,hh:mm:ss±zz". Range of "zz": -48 to 56.

2.3.13. AT+QIDNSCFG Configure Address of DNS Server

Before setting the DNS server address, the host must activate the context of corresponding **<contextID>** with **AT+QIACT** first.

AT+QIDNSCFG Configure Address of DNS Server	
Test command **AT+QIDNSCFG=?**	Response **+QIDNSCFG: (**range of supported **<contextID>**s**),<pridnsaddr>,<secdnsaddr>** **OK**
Write Command **AT+QIDNSCFG=<contextID>[,<pridnsaddr>[,<secdnsaddr>]]**	Response If the optional parameters are omitted, query the current DNS server addresses of a specified PDP context: **+QIDNSCFG: <contextID>,<pridnsaddr>,<secdnsaddr>** **OK** If any of the parameters is specified, configure the primary and secondary DNS server addresses of a specified PDP context: **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configurations will not be saved.

Parameter

<contextID>	Integer type. PDP context ID. Range: 1–16.
<pridnsaddr>	String type. Primary DNS server address.
<secdnsaddr>	String type. Secondary DNS server address.

2.3.14. AT+QIDNSGIP Get IP Address by Domain Name

This commands gets an IP address by domain name. Before querying the DNS, the host should activate the context of corresponding **<contextID>** with **AT+QIACT** first.

AT+QIDNSGIP Get IP Address by Domain Name	
Test Command **AT+QIDNSGIP=?**	Response **+QIDNSGIP: (**range of supported **<contextID>**s**),<host_name>** **OK**
Write Command **AT+QIDNSGIP=<contextID>,<host_name>**	Response **OK** **+QIURC: "dnsgip",<result>,<IP_count>**,**<DNS_ttl>** **[.....** **+QIURC: "dnsgip",<host_IP_addr>]** If there is any error: **ERROR**
Maximum Response Time	60 s, determined by the network.
Characteristics	/

Parameter

<contextID>	Integer type. Context ID. Range: 1–16.
<host_name>	String type. Domain name.
<result>	Integer type. Result code of the operation. See ***Chapter 4*** for details.
<IP_count>	Integer type. Number of the IP addresses corresponding to the **<host_name>**.
<DNS_ttl>	Integer type. Time to live of the DNS.
<host_IP_addr>	String type. IP address of **<host_name>**.

2.3.15. AT+QICFG Configure Optional Parameters

This command configures optional parameters.

AT+QICFG Configure Optional Parameters	
Test Command **AT+QICFG=?**	Response **+QICFG: "transpktsize",(**range of supported **<transpkt_size>**s**)** **+QICFG: "transwaittm",(**range of supported **<transwaittm>**s**)** **+QICFG: "dataformat",(**list of supported **<send_data_format>**s**),(**list of supported **<recv_data_format>**s**)** **+QICFG: "viewmode",(**list of supported **<view_mode>**s**)** **+QICFG: "recvind",(**list of supported **<recv_ind>**s**)** **+QICFG: "sack",(**list of supported **<SACK>**s**)** **+QICFG: "tcp/keepalive",(**list of supported **<keepalive>**s**),(**range of supported **<idle_time>**s**),(**range of supported

	<interval_time>s),(range of supported **<probe_cnt>>**s) **+QICFG: "tcp/retranscfg",(**range of supported **<max_backoffs>**s),(range of supported **<max_rto>**s) **OK**
Write Command Query/set the packet size for transparent transmission mode **AT+QICFG="transpktsize"[,<transpkt_size>]**	Response If the optional parameter is omitted, query the current setting: **+QICFG: "transpktsize",<transpkt_size>** **OK** If the optional parameter is specified, set the packet size for transparent transmission mode: **OK** Or **ERROR**
Write Command Query/set the waiting time for transparent transmission mode **AT+QICFG="transwaittm"[,<transwaittm>]**	Response If the optional parameter is omitted, query the current setting: **+QICFG: "transwaittm",<transwaittm>** **OK** If the optional parameter is specified, set the waiting time for transparent transmission mode: **OK** Or **ERROR**
Write Command Query/set the format of the data to be sent and received (only for buffer access mode and direct push mode) **AT+QICFG="dataformat"[,<send_data_format>,<recv_data_format>]**	Response If the optional parameter is omitted, query the current setting: **+QICFG: "dataformat",<send_data_format>,<recv_data_format>** **OK** If the optional parameter is specified, set the format for the data to be sent and received: **OK** Or **ERROR**
Write Command Query/set the output format of received data (only for non-transparent mode) **AT+QICFG="viewmode"[,<view_**	Response If the optional parameter is omitted, query the current setting: **+QICFG: "viewmode",<view_mode>** **OK**

mode>]	If the optional parameter is specified, set the output format of received data: **OK** Or **ERROR**
Write Command Query/set the URC format in buffer access mode. **AT+QICFG="recvind",[<recv_ind>]**	Response If the optional parameter is omitted, query the current setting: **+QICFG: "recvind",<recv_ind>** **OK** If the optional parameter is specified, set the URC format in buffer access mode: **OK** Or **ERROR**
Write Command Query/set whether to enable SACK option in TCP header. **AT+QICFG="sack",[<SACK>]**	Response If the optional parameter is omitted, query the current setting: **+QICFG: "sack",<SACK>** **OK** If the optional parameter is specified, configure whether to enable SACK option in TCP header: **OK** Or **ERROR**
Write Command Query/set whether to enable TCP keepalive feature and the relevant parameter values. **AT+QICFG="tcp/keepalive"[,<keepalive>[,<idle_time>,<interval_time>,<probe_cnt>]]**	Response If the optional parameters are omitted, query the current setting: **+QICFG: "tcp/keepalive",<keepalive>,<idle_time>,<interval_time>,<probe_cnt>** **OK** If any of the optional parameter is specified, set whether to enable TCP keepalive feature and the relevant parameter values: **OK** Or **ERROR**
Write Command Query/set the maximum interval time and number of TCP retransmission **AT+QICFG="tcp/retranscfg"[,<m**	Response If the optional parameters are omitted, query the current setting: **+QICFG: "tcp/retranscfg",<max_backoffs>,<max_rto>** **OK**

ax_backoffs>,<max_rto>]	If the optional parameters are specified, set the maximum interval and the number of TCP retransmission: **OK** Or **ERROR**
Maximum Response Time	300ms
Characteristics	The command takes effect immediately. The configuration is not saved.

Parameter

<transpkt_size>	Integer type. Maximum length of the data packet to be sent. Range: 1–1460. Default value: 1024. Unit: byte.
<transwaittm>	Integer type. In transparent transmission mode, if the length of data received from the port is less than the specified value of **<transpkt_size>**, after exceeding the time specified by **<transwaittm>**, the data will be sent directly. Range: 0–20. Default value: 2. Unit: 100 ms.
<send_data_format>	Integer type. Format of the data to be sent. 0 Text mode 1 Hex mode
<recv_data_format>	Integer type. Format of the data to be received. 0 Text mode 1 Hex mode
<view_mode>	Integer type. Output format of received data. 0 Output format of received data: data header\r\ndata. 1 Output format of received data: data header,data.
<recv_ind>	Integer type. URC format. 0 URC format without data length. URC format is **+QIURC: "recv",<connectID>**. 1 URC format with data length. URC format is **+QIURC: "recv",<connectID>,<data_len>**.
<SACK>	Integer type. Whether to enable SACK option in TCP header. 0 Disable 1 Enable
<keepalive>	Integer type. Whether to enable TCP keepalive feature. When it is 0, **<idle_time>**, **<interval_time>** and **<probe_cnt>** should be ignored. 0 Disable 1 Enable
<idle_time>	Integer type. Default keepalive time. Range: 1–120. Unit: minute.
<interval_time>	Integer type. Interval between keepalive probes. Range: 25–100. Unit: second.
<probe_cnt>	Integer type. Maximum number of keepalive probes. Range: 3–10.
<max_backoffs>	Integer type. Maximum number of TCP retransmissions. Range: 3–20. Default value: 12.

<max_rto>	Integer type. Maximum interval between TCP retransmissions. Range: 5–1000. Default value: 600. Unit: 100 ms.

NOTE

The settings of **AT+QICFG="tcp/retranscfg",<max_backoffs>,<max_rto>** and **AT+QICFG="tcp/keepalive",<keepalive>,<idle_time>,<interval_time>,<probe_cnt>** take effect to all TCP sockets.

2.3.16. AT+QISDE Control Whether to Echo the Data for AT+QISEND

This command controls whether to echo the data for **AT+QISEND**.

AT+QISDE Control Whether to Echo the Data for AT+QISEND	
Test command **AT+QISDE=?**	Response **+QISDE: (**list of supported **<echo>**s**)** **OK**
Read command **AT+QISDE?**	Response **+QISDE: <echo>** **OK**
Write Command **AT+QISDE=<echo>**	Response **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration is not saved.

Parameter

<echo>	Integer type. Whether to echo the data for **AT+QISEND**. 0 Not echo the data 1 Echo the data

2.3.17. AT+QIGETERROR Query the Last Error Code

If **<result>** is returned after executing TCP/IP commands, the details of an error can be queried with **AT+QIGETERROR**. Please note that **AT+QIGETERROR** just returns error code of the last TCP/IP AT command.

AT+QIGETERROR Query the Last Error Code	
Test command **AT+QIGETERROR=?**	Response **OK**
Execution Command **AT+QIGETERROR**	Response **+QIGETERROR: <result>,<result_code_description>** **OK**
Maximum Response Time	300 ms
Characteristics	/

Parameter

<result>	Integer type. Result code of the operation. See ***Chapter 4*** for details.
<result_code_description>	String type. Details of error information. See ***Chapter 4*** for details.

2.4. Description of URCs

The URC of TCP/IP AT commands will be reported to the host in the format of beginning with **+QIURC:**. It contains the reports about incoming data, connection closed and incoming connection and so on. Actually, there is **<CR><LF>** both before and after URC, but **<CR><LF>** is not presented intentionally.

2.4.1. +QIURC: "closed" Indicate Connection Closed

When TCP socket service is closed by remote peer or due to a network error, the URC is outputted, and the status of socket service is “closing” (**<socket_state>**=4). **AT+QICLOSE=<connectID>** can be used to change the **<socket_state>** to “initial”

+QIURC: "closed" Indicate Connection Closed	
+QIURC: "closed",<connectID>	Socket service connection is closed.

Parameter

<connectID>	Integer type. Socket service index. Range: 0–11.

2.4.2. +QIURC: "recv" Indicate Incoming Data

In buffer access mode or direct push mode, after receiving data, the module reports a URC to the host.

In buffer access mode, after receiving data, the module reports **+QIURC: "recv",<connectID>[,<data_len>]** to notify the host. Then host can retrieve data with **AT+QIRD**. Please note that if the buffer is not empty, and the module receives data again, it does not report a new URC until all the received data has been retrieved with **AT+QIRD** from the buffer.

In direct push mode, the received data is outputted to COM port directly.

+QIURC: "recv" Indicate Incoming Data	
+QIURC: "recv",<connectID>[,<data_len>]	Indicating incoming data in buffer access mode. The host can retrieve data with **AT+QIRD**.
+QIURC: "recv",<connectID>,<currentrecvlength><CR><LF><data>	Indicating incoming data in direct push mode when the **<service_type>** is "TCP", "UDP" or "TCP INCOMING".
+QIURC: "recv",<connectID>,<currentrecvlength>,<remoteIP>,<remote_port><CR><LF><data>	Indicating data incoming in direct push mode when **<service_type>** is "UDP SERVICE".

Parameter

<connectID>	Integer type. Socket service index. Range: 0–11.
<data_len>	Integer type. Data length. Unit: byte.
<currentrecvlength>	Integer type. Length of actually received data.
<remoteIP>	String type. Remote IP address.
<remote_port>	Integer type. Remote port number.
<data>	String type. Received data.

2.4.3. +QIURC: "incoming full" Indicate Incoming Connection Reaches the Limit

If the number of incoming connections reaches the limit, or no socket system resources can be allocated, the module reports **+QIURC: "incoming full"** for the new incoming connection request.

+QIURC: "incoming full" Indicate Incoming Connection Reaches the Limit	
+QIURC: "incoming full"	Indicating the number of incoming connections reaches the limit.

2.4.4. +QIURC: "incoming" Indicate Incoming Connection

If **<service_type>** is "TCP LISTENER", when a remote client connects to this server, the host automatically assigns a free **<connectID>** to the new connection, and the range of **<connectID>** is 0–11.

In this case, the module reports **+QIURC: "incoming"**. The **<service_type>** of the new connection will be “TCP INCOMING”, and the **<access_mode>** will be buffer access mode.

+QIURC: "incoming" Indicate Incoming Connection	
+QIURC: "incoming",<connectID>,<serverID>,<remoteIP>,<remote_port>	When the new incoming connection is accepted by **<serverID>**, the allocated **<connectID>**, **<remoteIP>** and **<remote_port>** are informed by this URC.

Parameter

<connectID>	Integer type. Index of the socket service assigned for the incoming connection, which is automatically specified by the module. Range: 0–11.
<serverID>	Integer type. ID of the listening socket whose **<service_type>** is "TCP LISTENER" and which accepts the incoming **<connectID>**.
<remoteIP>	String type. Remote IP address of the incoming **<connectID>**.
<remote_port>	Integer type. Remote port number of the incoming **<connectID>**.

2.4.5. +QIURC: "pdpdeact"   Indicate PDP Deactivation

PDP context may be deactivated by the network. The module reports this URC to the host about PDP deactivation. In such a case, the host must execute **AT+QIDEACT** to deactivate the context and reset all connections.

+QIURC: "pdpdeact" Indicate PDP Deactivation	
+QIURC: "pdpdeact",<contextID>	**<contextID>** context is deactivated.

Parameter

<contextID>	Integer type. Context ID. Range: 1–16.

3 Examples

3.1. Configure and Activate a Context

3.1.1. Configure a Context

```
AT+QICSGP=1,1,"CMNBIOT","","",1          //Configure context 1. APN is "CMNBIOT" for China Mobile
                                           NB-IoT network.
OK
```

3.1.2. Activate a Context

```
AT+QIACT=1                      //Activate context 1. Depending on the network, the maximum
                                  response time is 150 s.
OK                              //Activated the context successfully.
AT+QIACT?                       //Query the context state, protocol type and IP address of context 1.
+QIACT: 1,1,1,"10.7.157.1"

OK
```

3.1.3. Deactivate a Context

```
AT+QIDEACT=1                          //Deactivate context 1.
OK                                    //Deactivated the context successfully. Depending on the
                                      network, the maximum response time is 40s.
```

3.2. TCP Client Works in Buffer Access Mode under IPv4

3.2.1. Set up a TCP Client Connection and Enter Buffer Access Mode

```
//Context is 1 and <connectID> is 0. Before using AT+QIOPEN, the host should activate the context
with AT+QIACT first.
AT+QIOPEN=1,0,"TCP","220.180.239.212",8009,0,0
```

```
OK

+QIOPEN: 0,0                 //TCP client connected successfully. It is suggested to wait for 150
                             seconds for the URC +QIOPEN: <connectID>,<result>. If the URC
cannot                           be received in 150 seconds, the host could use AT+QICLOSE to
close                            the socket.
AT+QISTATE=1,0               //Query connection status of socket service 1.
+QISTATE: 0,"TCP","220.180.239.212",8009,65514,2,1,0,0,"usbmodem"

OK
```

3.2.2. Send Data in Buffer Access Mode

```
AT+QISEND=0                       //Send variable-length data.
>test1<Ctrl+Z>
SEND OK                           //SEND OK does not mean the data has been sent to the
                                  server successfully. The host can query whether the data has
                                  reached the server with AT+QISEND=0,0.
AT+QISEND=0,4                     //Send fixed-length data and the data length is 4 bytes.
>test
SEND OK
AT+QISEND=0,0                     //Query the length of sent data, acknowledged data and
                                  unacknowledged data.
+QISEND: 9,9,0                    //A total of 9 bytes data has been sent, and the 9-byte data has
                                  been acknowledged by the server.

OK
AT+QISENDEX=0,"3132333435"        //Send Hex string data.
SEND OK
AT+QISEND=0,0                     //Query the length of sent data, acknowledged data and
                                  unacknowledged data.

+QISEND: 14,14,0

OK
```

3.2.3. Retrieve Data from Remote Server in Buffer Access Mode

```
+QIURC: "recv",0             //The <connectID> 0 has received data.
AT+QIRD=0,1500               //Retrieve the data, and the maximum length of data to be retrieved is
                             1500 bytes.
+QIRD: 5                     //The length of actually retrieved data is 5 bytes.
```

```
test1

OK
AT+QIRD=0,1500
+QIRD: 0                      //No data in buffer.

OK
AT+QIRD=0,0                   //Query the total length of received data, including read and unread data.
+QIRD: 5,5,0

OK
```

3.2.4. Close a Connection

```
AT+QICLOSE=0                  //Close a connection whose <connectID> is 0. Depending on the
                              network, the maximum response time is 10s.
OK
```

3.3. TCP Client Works in Buffer Access Mode under IPv6

3.3.1. Set up a TCP Client Connection and Enter Buffer Access Mode

```
//Context is 1 and <connectID> is 0. Before using AT+QIOPEN, the host should activate the context
with AT+QIACT first.
AT+QIOPEN=1,0,"TCP","2001:468:2100:1:0:0:0:0",5001,0,0
OK

+QIOPEN: 0,0           //TCP client is connected successfully. It is suggested to wait for 150 seconds for
                        the URC +QIOPEN: <connectID>,<result>. If the URC cannot be received in
                        150 seconds, the host can use AT+QICLOSE to close the socket.
AT+QISTATE=1,0         //Query the connection status of socket service 1.
+QISTATE: 0,"TCP","2001:468:2100:1:0:0:0:0",5001,11921,2,1,0,0,"usbmodem"

OK
```

3.3.2. Send Data in Buffer Access Mode

```
AT+QISEND=0                     //Send variable-length data.
>test1<Ctrl+Z>
SEND OK                         //SEND OK does not mean the data has been sent to the server
```

```
                              successfully. The host can query whether the data has reached the
                              server with AT+QISEND=0,0.
AT+QISEND=0,4                 //Send fixed-length data and the data length is 4 bytes.
>test
SEND OK
AT+QISEND=0,0                 //Query the length of sent data, acknowledged data and
                              unacknowledged data.
+QISEND: 9,9,0                //A total of 9 bytes data has been sent, and the 9-byte data has
                              been acknowledged by the server.

OK
AT+QISENDEX=0,"3132333435"    //Send Hex string data.
SEND OK
AT+QISEND=0,0                 //Query the length of sent data, acknowledged data and
                              unacknowledged data.
+QISEND: 14,14,0

OK
```

3.3.3. Receive Data from Remote Server in Buffer Access Mode

```
+QIURC: "recv",0          //<connectID> 0 has received data.
AT+QIRD=0,1500            //Retrieve the data. The maximum length of data to be retrieved is 1500 bytes.
+QIRD: 5                  //The length of actually retrieved data is 5 bytes.
test1

OK
AT+QIRD=0,1500
+QIRD: 0                  //No data in buffer.

OK
AT+QIRD=0,0               //Query the total length of received data, including read and unread data.
+QIRD: 5,5,0

OK
```

3.3.4. Close a Connection

```
AT+QICLOSE=0                //Close a connection whose <connectID> is 0. Depending on the
                            network, the maximum response time is 10 seconds.
OK
```

3.4. TCP Client Works in Transparent Transmission Mode

3.4.1. Set up a TCP Client Connection and Enter Transparent Transmission Mode

```
//Context is 1 and <connectID> is 0. Before using AT+QIOPEN, the host should activate the context
with AT+QIACT first.
AT+QIOPEN=1,0,"TCP","220.180.239.212",8009,0,2
CONNECT                                              //TCP client connected successfully. It is
                                                     suggested to wait for 150 seconds for the URC
                                                     CONNECT. If the URC cannot be received in
                                                     150 seconds, the host could use AT+QICLOSE
                                                     to close the socket.
```

3.4.2. Send Data in Transparent Transmission Mode

```
<All data got from COM port will be sent to internet directly>
```

3.4.3. Retrieve Data from Remote Server in Transparent Transmission Mode

```
Test 1                  //All data received from internet is outputted via COM port directly.
```

3.4.4. Close a TCP Client

```
AT+QICLOSE=0                //After using +++ to exit from the transparent transmission mode, the
host                                could use AT+QICLOSE to close the TCP link. Depending on
the                                 network, the maximum response time is 10 seconds.
OK
```

3.5. TCP Client Works in Direct Push Mode

3.5.1. Set up a TCP Client Connection and Enter Direct Push Mode

```
AT+QIOPEN=1,0,"TCP","220.180.239.212",8009,0,1   //Context is 1 and <connectID> is 0. Before
                                                  using AT+QIOPEN, the host should activate
                                                  the context with AT+QIACT first.
OK
```

```
+QIOPEN: 0,0                 //TCP client connected successfully. It is suggested to wait for 150
                             seconds for the URC +QIOPEN: <connectID>,<result>. If the URC
                             cannot be received in 150 seconds, the host could use AT+QICLOSE to
                             close the socket.
AT+QISTATE=1,0               //Query the connection state of socket service 0.
+QISTATE: 0,"TCP","220.180.239.212",8009,65344,2,1,0,1,"usbmodem"

OK
```

3.5.2. Send Data in Direct Push Mode

```
AT+QISEND=0          //Send variable-length data.
>test1<Ctrl+Z>
SEND OK              //SEND OK does not mean the data has been sent to the server successfully. The
                       host can query whether the data has reached the server with AT+QISEND=0,0.
AT+QISEND=0,5        //Send fixed-length data and the data length is 5 bytes.
>test2
SEND OK
AT+QISEND=0,0        //Query the length of sent data, acknowledged data and unacknowledged data.
+QISEND: 10,10,0     //A total of 10 bytes data has been sent, and all the 10-byte data has been
                       acknowledged.

OK
```

3.5.3. Retrieve Data from Remote Server in Direct Push Mode

```
+QIURC: "recv",0,4           //Retrieve data from remote server.
test
```

3.5.4. Close a TCP Client

```
AT+QICLOSE=0                 //Close the connection whose <connectID> is 0. Depending on the
                             network, the maximum response time is 10 seconds.
OK
```

3.6. TCP Server Works in Buffer Access Mode under IPv4 Network

3.6.1. Start a TCP Server

```
//Context is 1 and <connectID> is 1. Before using AT+QIOPEN, the host should activate the context
with AT+QIACT first.
AT+QIOPEN=1,1,"TCP LISTENER","127.0.0.1",0,2020,0
OK

+QIOPEN: 1,0                                         //TCP server is opened successfully.
AT+QISTATE=0,1                                       //Query the connection status of context 1.
+QISTATE: 1,"TCP LISTENER","10.7.157.1",0,2020,3,1,1,0,"usbmodem"

OK
```

3.6.2. Accept TCP Incoming Connection

```
+QIURC: "incoming",11,1,"172.31.242.222",54091    //A new TCP connection is accepted. The
                                                  <service_type> is "TCP incoming", and
                                                  <connectID> is 11.
```

3.6.3. Retrieve Data from Incoming Connection

```
+QIURC: "recv",11        //Received data from remote incoming connection.
AT+QIRD=11,1500          //Retrieve the data received from incoming connection.
+QIRD: 4                 //Actually retrieved data length is 4 bytes.
test

OK
AT+QIRD=11,1500
+QIRD: 0                 //No data in buffer.

OK
AT+QIRD=11,0             //Query the total length of received data, including read and unread data.
+QIRD: 4,4,0

OK
```

3.6.4. Close a TCP Server

```
AT+QICLOSE=11                           //Close the incoming connection. Depending on the network,
                                        the maximum response time is 10 seconds.
OK
AT+QICLOSE=1                            //Close TCP server listening.
OK
```

3.7. TCP Server Works in Buffer Access Mode under IPv6 Network

3.7.1. Start a TCP Server

```
//Context is 1 and <connectID> is 1. Before using AT+QIOPEN, the host should activate the context
with AT+QIACT first.
AT+QIOPEN=1,1,"TCP LISTENER","0:0:0:0:0:0:0:1",0,12345,0
OK

+QIOPEN: 1,0                      //TCP server is opened successfully.
AT+QISTATE=0,1                    //Query the connection status of context 1.
+QISTATE: 1,"TCP LISTENER","2001:468:2100:1:2001:468:2100:1",0,12345,3,1,1,0,"usbmodem"

OK
```

3.7.2. Accept TCP Incoming Connection

```
+QIURC: "incoming",11,1,"2001:468:2100:1:0:0:0:0",54091   //A new TCP connection is accepted.
                                                          The <service_type> is "TCP incoming",
                                                          and <connectID> is 11.
```

3.7.3. Retrieve Data from Incoming Connection

```
+QIURC: "recv",11            //Received data from remote incoming connection.
AT+QIRD=11,1500              //Retrieve the data received from incoming connection.
+QIRD: 4                     //Actually retrieved data length is 4 bytes.
test

OK
AT+QIRD=11,1500
+QIRD: 0                     //No data in buffer.
```

```
OK
AT+QIRD=11,0                  //Query the total length of received data, including read and unread data.
+QIRD: 4,4,0

OK
```

3.7.4. Switch Incoming Connection to Transparent Transmission Mode

```
AT+QSWTMD=11,2                          //Switch the incoming connection whose socket service
                                        index is 11 to transparent transmission mode.
CONNECT
1234567890                              //Send data directly.
+++                                     //Exit from transparent transmission mode.
OK
```

3.7.5. Close a TCP Server

```
AT+QICLOSE=11                           //Close the incoming connection. Depending on the
                                        network, the maximum response time is 10 seconds.
OK
AT+QICLOSE=1                            //Close TCP server listening.
OK
```

3.8. UDP Service under IPv4 Network

3.8.1. Start a UDP Service

```
//Start a UDP service whose <connectID> is 2 and <context> is 1. Before using AT+QIOPEN, the host
should activate the context with AT+QIACT first.
AT+QIOPEN=1,2,"UDP SERVICE","127.0.0.1",0,3030,0
OK

+QIOPEN: 2,0                       //UDP service is opened successfully.
AT+QISTATE=0,1                     //Query the connection status of context 1.
+QISTATE: 2,"UDP SERVICE","10.7.157.1",0,3030,2,1,2,0,"usbmodem"

OK
```

3.8.2. Send UDP Data to Remote Client

```
AT+QISEND=2,10,"10.7.89.10",6969     //Send 10 bytes data to a remote client whose IP is 10.7.89.10
                                     and the port is 6969.
>1234567890
SEND OK
```

3.8.3. Retrieve Data from Remote Client

```
+QIURC: "recv",2                     //Received data from the remote client.
AT+QIRD=2                            //Retrieve UDP data. One whole UDP packet will be outputted.
                                     There is no need to specify the read length.
+QIRD: 4,"10.7.76.34",7687           //The retrieved data length is 4 bytes. The IP address of the
                                     remote client is 10.7.76.34 and the port is 7687.
AAAA

OK
AT+QIRD=2                            //Retrieve data.
+QIRD: 0                             //No data in buffer.

OK
AT+QISEND=2,10,"10.7.76.34",7687     //Send data to the remote client whose IP is 10.7.76.34 and the
                                     port is 7687.
>1234567890
SEND OK
```

3.8.4. Close a UDP Service

```
AT+QICLOSE=2                                   //Close the service.
OK
```

3.9. UDP Service under IPv6 Network

3.9.1. Start a UDP Service

```
//Start a UDP service whose <connectID> is 2 and <context> is 1. Before using AT+QIOPEN, the host
should activate the context with AT+QIACT first.
AT+QIOPEN=1,2,"UDP SERVICE","0:0:0:0:0:0:0:1",0,12345,0
OK
```

```
+QIOPEN: 2,0                                        //UDP service is opened successfully.
AT+QISTATE=0,1                                      //Query the connection status of context 1.
+QISTATE: 2,"UDP SERVICE","2001:468:2100:1:2001:468:2100:1",0,12345,2,1,2,0,"usbmodem"

OK
```

3.9.2. Send UDP Data to Remote Client

```
AT+QISEND=2,10,"2001:468:2100:1:0:0:0:0",5001      //Send 10 bytes data to a remote client whose
                                                    IP is 2001:468:2100:1:0:0:0:0 and the port is
                                                    5001.
>1234567890
SEND OK
```

3.9.3. Receive Data from Remote Client

```
+QIURC: "recv",2                            //Received data from the remote client.
AT+QIRD=2                                   //Retrieve UDP data. One whole UDP packet will be
                                            outputted. There is no need to specify the read length.
+QIRD: 4,"2001:468:2100:1:0:0:0:0",5001     //The retrieved data length is 4 bytes. The IP address of
                                            the remote client is 2001:468:2100:1:0:0:0:0 and the port
                                            is 5001.
AAAA

OK
AT+QIRD=2                                   //Retrieve data.
+QIRD: 0                                    //No data in buffer.

OK
```

3.10. UDP Client with RAI Feature

3.10.1. Start a UDP Client

```
//Start a UDP client whose <connectID> is 0 and <context> is 1. Before using AT+QIOPEN, the host
should activate the context with AT+QIACT first.
AT+QIOPEN=1,0,"UDP","220.180.239.212",8009
OK
```

3.10.2. Send UDP Data with RAI Information

```
AT+QCSCON=1                             //Enable RRC state reported via URC.
OK
AT+QISENDEX=0,"313233",0                //Send "123" without RAI information.
SEND OK

//18:48:14:649
+QCSCON: 1,1                            //RRC connection setup successfully.

//18:48:35:790
+QCSCON: 1,0                            //After 20 s, RRC connection released.
AT+QISENDEX=0,"313233",1                //Send "123" and release RRC connection right now.
SEND OK

//18:51:59:905
+QCSCON: 1,1                            //RRC connection setup successfully.

//18:52:01:135
+QCSCON: 1,0                             //Within 1 s, RRC connection released.
AT+QISENDEX=0,"313233",2                //Send "123" and release RRC connection after receive a
                                        packet of downlink data.
SEND OK

//19:00:28:037
+QCSCON: 1,1                            //RRC connection setup successfully.

//19:00:35:115
+QIURC: "recv",0                        //Receive a packet of downlink data from peer.

//19:00:35:264
+QCSCON: 1,0                            //After receive downlink data, RRC became idle state.
```

3.10.3. Close a UDP Client

```
AT+QICLOSE=0                             //Close the client.
OK
```

3.11. PING

```
AT+QPING=1,"www.baidu.com"                  //Ping www.baidu.com in context 1. Before pinging the destination IP address, the host should activate the context by AT+QIACT first.
OK

+QPING: 0,"61.135.169.125",32,192,255

+QPING: 0,"61.135.169.125",32,240,255

+QPING: 0,"61.135.169.125",32,241,255

+QPING: 0,"61.135.169.125",32,479,255

+QPING: 0,4,4,0,192,479,287
AT+QPING=1,"2001:468:2100:1:0:0:0:0"        //Ping 2001:468:2100:1:0:0:0:0 in context 1. Before pinging the destination IP address, the host should activate the context with AT+QIACT first.
OK

+QPING: 0,"2001:468:2100:1:0:0:0:0",32,58,255

+QPING: 0,"2001:468:2100:1:0:0:0:0",32,49,255

+QPING: 0,"2001:468:2100:1:0:0:0:0",32,39,255

+QPING: 0,"2001:468:2100:1:0:0:0:0",32,40,255

+QPING: 0,4,4,0,39,58,46
```

3.12. Synchronize Local Time

```
AT+QNTP=1,"202.120.2.101",123               //Synchronize local time with NTP server "202.120.2.101:123". Before synchronizing the time, the host should activate the context with AT+QIACT first.
OK

+QNTP: 0,"2013/08/19,11:10:10+32"
AT+CCLK?
+CCLK: "13/08/19,11:10:57+32"
```

```

OK
```

3.13. Getting the Last Error Code

```
AT+QIOPEN=1,"TCP","220.180.239.212",8009,0,1       //Start a socket service but and <connectID>
                                                   is not present.
ERROR
AT+QIGETERROR
+QIGETERROR: 552, invalid parameters

OK
```

4 Summary of Result Codes

If **<result>** is returned after executing TCP/IP AT commands, the details of error can be queried with **AT+QIGETERROR**. Please note that **AT+QIGETERROR** just returns error code of the last TCP/IP AT command.

Table 3: Summary of Result Codes

<result>	<result_code_description>
0	Operation successful
550	Unknown error
551	Operation blocked
552	Invalid parameters
553	Memory not enough
554	Create socket failed
555	Operation not supported
556	Socket bind failed
557	Socket listen failed
558	Socket write failed
559	Socket read failed
560	Socket accept failed
561	Open PDP context failed
562	Close PDP context failed
563	Socket identity has been used
564	DNS busy

565	DNS parse failed
566	Socket connect failed
567	Socket has been closed
568	Operation busy
569	Operation timeout
570	PDP context broken down
571	Cancel send
572	Operation not allowed
573	APN not configured
574	Port busy

5 Appendix A References

Table 4: Related Document

No.	Document Name	Description
[1]	Quectel_BG95&BG77&BG600L_Series_AT_Commands_Manual	The AT command manual of BG95 series, BG77 and BG600L-M3 modules

Table 5: Terms and Abbreviations

Abbreviation	Description
3GPP	3rd Generation Partnership Project
ACK	Acknowledge
APN	Access Point Name
CHAP	Challenge Handshake Authentication Protocol
DNS	Domain Name System
FIN	Finish
ID	Identify
IP	Internet Protocol
IPv4	Internet Protocol Version 4
IPv6	Internet Protocol Version 6
NTP	Network Time Protocol
NVM	Non-Volatile Memory
PAP	Password Authentication Protocol l
PDP	Packet Data Protocol
PPP	Point-to-Point Protocol

QoS	Quality of Service
SACK	Selective Acknowledgment
TCP	Transmission Control Protocol
UART	Universal Asynchronous Receiver & Transmitter
UDP	User Datagram Protocol
URC	Unsolicited Result Code
USB	Universal Serial Bus
UTC	Coordinated Universal Time