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# RG50xQ&RM5xxQ Series
# DFOTA Application Note

**5G Module Series**

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## Revision History

| Version | Date | Author | Description |
|---|---|---|---|
| - | 2020-09-28 | Shannon LIU | Creation of the document |
| 1.0 | 2020-11-04 | Shannon LIU | First official release |

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# **1** Introduction

Quectel RG50xQ series and RM5xxQ series modules support DFOTA (Firmware Upgrade Over-The-Air function.

With this function, the firmware can be upgraded to a new version and also reverted to the old version. The delta firmware package only contains the difference between the original firmware version and the target firmware version, with the amount of data transmission greatly reduced and the transmission time greatly shortened.

This document is applicable to the following modules:

- RG500Q Series
- RG502Q-EA
- RM500Q Series
- RM502Q-GL
- RM505Q-AE
- RM510Q-GL

# **2** Firmware Upgrade Procedure Over DFOTA

The following chart illustrates the firmware upgrade procedure via (D)FOTA when the delta firmware package is stored on an FTP/HTTP/HTTPS* server.
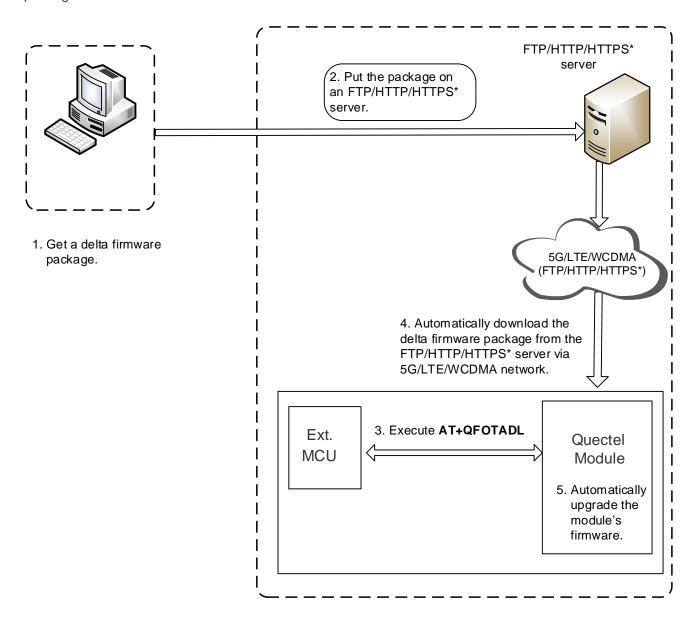


**Figure 1: Firmware Upgrade Procedure via DFOTA**

As shown in the above figure, the following steps need to be performed to update the firmware when the delta firmware package is stored on an FTP/HTTP/HTTPS* server:

**Step 1:** Get a delta firmware package from Quectel.
**Step 2:** Put the delta firmware package on an FTP/HTTP/HTTPS* server.
**Step 3:** Execute **AT+QFOTADL**.
**Step 4:** The module will automatically download the package from the FTP/HTTP/HTTPS* server or local file system via 5G/LTE/WCDMA network.
**Step 5:** The module's firmware will be automatically upgraded.

## 2.1. Get Delta Firmware Package

Before upgrading, check the source firmware version with **ATI** and confirm the target firmware version, and then send the two firmware versions to Quectel or the agent to get a delta firmware package.

## 2.2. Put Delta Firmware Package on FTP/HTTP/HTTPS* Server

**Step 1:** Please set up an FTP/HTTP/HTTPS* server before using DFOTA function. (Quectel does not provide such servers.)
**Step 2:** Put the delta firmware package on the server, and record the storage path.

## 2.3. Execute AT Command to Update the Firmware

After putting the delta firmware package on the FTP/HTTP/HTTPS* server, execute **AT+QFOTADL**, and then the module will download the delta firmware package from the FTP/HTTP/HTTPS* server over the air and update the firmware automatically. For more details about the AT commands, see *Chapter 3*.

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**NOTE**

"*" means the related function of HTTPS server is under development.

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# 3 Description of DFOTA AT Commands

## 3.1. AT Command Syntax

AT commands are involved in the DFOTA procedures. This chapter mainly introduces the AT command types and responses as well as related definitions.

### 3.1.1. 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.

### 3.1.2. AT Command Syntax

The **AT** or **at** prefix must be added at the beginning of each command line. Entering **<CR>** will terminate a command line. Commands are usually followed by a response that includes **<CR><LF><response><CR><LF>**. Throughout this document, only the response **<response>** will be presented, **<CR><LF>** are omitted intentionally.

**Table 1: Types of AT Commands and Responses**

| Test Command | AT+<cmd>=? | This command returns the list of parameters and value ranges set by the corresponding Write Command or internal processes. |
|---|---|---|
| Read Command | AT+<cmd>? | This command returns the currently set value of the parameter or parameters. |
| Write Command | AT+<cmd>=<p1>[,<p2>[,<p3>[...]]] | This command sets the user-definable parameter values. |

| Execution Command | AT+<cmd> | This command reads non-variable parameters affected by internal processes in the module. |
|---|---|---|

## 3.2. AT+QFOTADL Enable DFOTA

This command enables automatic firmware upgrade via DFOTA. After executing the corresponding command, the module will automatically download the delta firmware package from FTP/HTTP/HTTPS* server or local file system. After the package is successfully downloaded, the module will automatically upgrade the firmware and then reboot.

| AT+QFOTADL Enable DFOTA | |
|---|---|
| Test Command<br>**AT+QFOTADL=?** | Response<br>**OK** |
| Maximum Response Time | 300 ms |

### 3.2.1. AT+QFOTADL=<FTP_URL> Upgrade Firmware over FTP Server

If the delta firmware package is stored on an FTP server, execute **AT+QFOTADL=<FTP_URL>** to enable automatic firmware upgrade via DFOTA. Then the module will download the package from the FTP server over the air and upgrade the firmware automatically.

| AT+QFOTADL=<FTP_URL> Upgrade Firmware over FTP Server | |
|---|---|
| Write Command<br>**AT+QFOTADL=<FTP_URL>** | Response<br>**OK**<br><br>**+QIND: "FOTA","FTPSTART"**<br>**+QIND: "FOTA","FTPEND",<FTP_err>**<br><br>**+QIND: "FOTA","START"**<br>**+QIND: "FOTA","UPDATING",<percent>**<br>**+QIND: "FOTA","UPDATING",<percent>**<br>**...**<br>**+QIND: "FOTA","END",<err>**<br><br>If there is any error:<br>**ERROR** |
| Maximum Response Time | 300 ms |
| Characteristics | / |

## Parameter

| | | |
|---|---|---|
| **<FTP_URL>** | String type. The URL that the delta firmware package stored on the FTP server. The maximum length is 100 bytes. It should be started with "ftp://". For example: "ftp://**<username>**:**<password>**@**<serverURL>**:**<port>**/**<file_path>**". | |
| | **<username>** | String type. The user name for authentication. The maximum length is 50 bytes. |
| | **<password>** | String type. The password for authentication. The maximum length is 50 bytes. |
| | **<serverURL>** | String type. The IP address or domain name of the FTP server. The maximum length is 50 bytes. |
| | **<port>** | Integer type. The port of the FTP server. Range: 1–65535. Default: 21. |
| | **<file_path>** | String type. The file name on FTP server. The maximum length is 50 bytes. |
| **<FTP_err>** | Integer type. The FTP error code. | |
| | 0 | Downloaded the delta firmware package from the FTP server successfully |
| | Others | Failed to download the delta firmware package from the FTP server. See *Chapter 4* for details. |
| **<percent>** | Integer type. The upgrade progress in percentage. Range: 0–100. | |
| **<err>** | Integer type. Error code of upgrading. | |
| | 0 | Upgraded the firmware successfully |
| | Others | Failed to upgrade the firmware. See *Chapter 4* for more details. |

## Example

//Upgrade firmware after the delta firmware package is stored on an FTP server. The FTP server address is "ftp://test:test@124.74.41.170:21/RG500QEAV01-to-V02.zip". Execute the following command to enable automatic firmware upgrade via DFOTA. The module will start to download the delta firmware package and upgrade firmware automatically.
**AT+QFOTADL="ftp://test:test@124.74.41.170:21/ RG500QEAV01-to-V02.zip"**
**OK**

**+QIND: "FOTA","FTPSTART"**
**+QIND: "FOTA","FTPEND",0**          //Finish downloading the delta firmware package from the FTP server.

//The module will reboot automatically and the USB port will be re-initialized. If the current port is USB port, MCU should close and reopen it.
**+QIND: "FOTA","START"**
**+QIND: "FOTA","UPDATING",1**
**+QIND: "FOTA","UPDATING",20**
**...**
**+QIND: "FOTA","UPDATING",100**

| +QIND: "FOTA","END",0 | //Firmware is updated successfully. |
|---|---|

### 3.2.2. AT+QFOTADL=<HTTP_URL>   Upgrade Firmware over HTTP/HTTPS* Server

If the delta firmware package is stored on an HTTP/HTTPS server, execute **AT+QFOTADL=<HTTP_URL>** to enable automatic firmware upgrade via DFOTA. Then the module will download the package from the HTTP/HTTPS server over the air and upgrade the firmware automatically.

| AT+QFOTADL=<HTTP_URL>   Upgrade Firmware over HTTP/HTTPS* Server | |
|---|---|
| Write Command<br>**AT+QFOTADL=<HTTP_URL>** | Response<br>**OK**<br><br>**+QIND: "FOTA","HTTPSTART"**<br>**+QIND: "FOTA","HTTPEND",<HTTP_err>**<br><br>**+QIND: "FOTA","START"**<br>**+QIND: "FOTA","UPDATING",<percent>**<br>**+QIND: "FOTA","UPDATING",<percent>**<br>**...**<br>**+QIND: "FOTA","END",<err>**<br><br>If there is any error:<br>**ERROR** |
| Maximum Response Time | 300 ms |
| Characteristics | / |

**Parameter**

| | | |
|---|---|---|
| **<HTTP_URL>** | String format. The maximum length is 100 bytes. It should be started with "http(s)://".<br>For example: "http(s)://**<HTTP_server_URL>:<HTTP_port>/<HTTP_file_path>**". | |
| | **<HTTP_server_URL>** | String type. The IP address or domain name of the HTTP/HTTPS server. |
| | **<HTTP_port>** | Integer type. The port of the HTTP/HTTPS server. Range: 1–65535. Default: 80. |
| | **<HTTP_file_path>** | String type. The file name on HTTP/HTTPS server. |
| **<HTTP_err>** | Integer type. The HTTP/HTTPS error code. | |
| | 0 | Downloaded the delta firmware package from the HTTP/HTTPS server successfully |
| | Others | Failed to download the delta firmware package from the HTTP/HTTPS server. See ***Chapter 4*** for details. |
| **<percent>** | Integer type. The upgrade progress in percentage. Range: 0–100. | |

| <err> | Integer type. Error code of upgrading. |
|---|---|
| | 0      Upgraded the firmware successfully |
| | Others   Failed to upgrade the firmware. See *Chapter 4* for more details. |

### Example

//Upgrade firmware after the delta firmware package is stored on an HTTP/HTTPS server. The HTTP/HTTPS server address is "http://www.quectel.com:100/update.zip". Execute the following command to enable automatic firmware upgrade via DFOTA, and then the module will start to download the delta firmware package and upgrade firmware automatically.

**AT+QFOTADL="http://www.quectel.com:100/update.zip"**
**OK**

**+QIND: "FOTA","HTTPSTART"**
**+QIND: "FOTA","HTTPEND",0**      //Finish downloading the delta firmware package from the HTTP server.

//The module will reboot automatically and the USB port will be re-initialized. If the current port is USB port, MCU should close and reopen it.
**+QIND: "FOTA","START"**
**+QIND: "FOTA","UPDATING",1**
**+QIND: "FOTA","UPDATING",2**
**...**
**+QIND: "FOTA","UPDATING",100**
**+QIND: "FOTA","END",0**      //Firmware is updated successfully.

### 3.2.3. AT+QFOTADL=<file_name>  Upgrade Firmware over Local File System

If the delta firmware package has already been stored in the module's file system, **AT+QFOTADL=<file_name>** command should be executed to enable automatic firmware upgrade via DFOTA. Then the module will download the delta firmware package from the local file system and upgrade the firmware automatically.

| AT+QFOTADL=<file_name>  Upgrade Firmware over Local File System | |
|---|---|
| Write Command<br>**AT+QFOTADL=<file_name>** | Response<br>**OK**<br><br>**+QIND: "FOTA","START"**<br>**+QIND: "FOTA","UPDATING",<percent>**<br>**+QIND: "FOTA","UPDATING",<percent>**<br>**...**<br>**+QIND: "FOTA","END",<err>** |

| | |
|---|---|
| | If there is any error: **ERROR** |
| Maximum Response Time | 300 ms |
| Characteristics | / |

## Parameter

| | |
|---|---|
| **\<file_name\>** | String type. The path that the delta firmware package stores in the local file system. The maximum length is 90 bytes. It should be started with "/cache/ufs/" in UFS. |
| **\<percent\>** | Integer type. The upgrade progress in percentage. Range: 0–100. |
| **\<err\>** | Integer type. Error code of upgrading. |
| | 0      Upgraded the firmware successfully |
| | Others   Failed to upgrade the firmware. See *Chapter 4* for more details. |

## Example

//Upgrade firmware when the delta firmware package is stored on the local file system.
**AT+QFOTADL="/cache/ufs/update-v13-to-v12.zip"**
**OK**
//The module will reboot automatically and the USB port will be re-initialized. If the current port is USB port, MCU should close and reopen it.

**+QIND: "FOTA","START"**
**+QIND: "FOTA","UPDATING",1**
**+QIND: "FOTA","UPDATING",2**
**...**
**+QIND: "FOTA","UPDATING",100**
**+QIND: "FOTA","END",0**               //Updated successfully.

---

**NOTES**

1. If the module is powered off during "UPDATING" process, the module will automatically enter Forced Upgrade Mode. When it is powered on next time, the upgrade continues. The update display is shown as below:
   **+QIND: "FOTA","START"**
   **+QIND: "FOTA","UPDATING",20**
   **+QIND: "FOTA","UPDATING",30**
   **...**
   **+QIND: "FOTA","END",0**
2. When the module enters the Recovery Mode, it will first check the delta firmware package. If there is an error in the package, URC will report the error code. If the firmware is upgraded successfully, the

module will restart and enter the Normal Mode; otherwise, the module will enter the Recovery Mode and re-upgrade the firmware five times in a row.

# 4 Summary of Error Codes

This chapter introduces the error codes related to Quectel modules or network. The details about **<FTP_err>**, **<HTTP_err>** and **<err>** are described in the following tables.

**Table 2: Summary of <FTP_err> Codes**

| <FTP_err> | Description |
|---|---|
| 0 | Downloaded the delta firmware package from the FTP server successfully |
| 601 | FTP Unknown error |
| 602 | URL length beyond limit |

**Table 3: Summary of <HTTP_err> Codes**

| <HTTP_err> | Description |
|---|---|
| 0 | Downloaded the delta firmware package from the HTTP/HTTPS* server successfully |
| 701 | HTTP/HTTPS* unknown error |
| 702 | HTTP/HTTPS* URL length beyond limit |

**Table 4: Summary of <err> Codes**

| <err> | Description |
|---|---|
| 0 | DFOTA process successful |
| 502 | The upgrade process exits due to some unknown errors or exceptions, or the delta firmware package is incorrect. |
| 505 | The delta firmware package check failed due to a Zip format check error. If the Zip format is wrong, the delta firmware package will be deleted. |

| | |
|---|---|
| 510 | The delta firmware package file does not match the source package file of the module, and needs to be checked if it is wrong. |
| 511 | The file system has no enough space for upgrade. |
| 520–530 540–546 | Firmware upgrading failed. The module will reboot and retry to upgrade the firmware until the upgrade is successful. |

**NOTE**

"*" means the related function of HTTPS server is under development.

# 5 Appendix A Reference

**Table 5: Terms and Abbreviations**

| Abbreviation | Description |
| --- | --- |
| 5G | 5th Generation Mobile Networks |
| DFOTA | Delta Firmware Upgrade Over-The-Air |
| FTP | File Transfer Protocol |
| GPRS | General Packet Radio Service |
| HTTP | Hyper Text Transport Protocol |
| HTTPS | Hypertext Transfer Protocol (Secure/over Secure Socket Layer) |
| IP | Internet Protocol |
| LTE | (Long-Term Evolution) a 4G mobile communications standard |
| MCU | Microcontroller Unit |
| UFS | User File System |
| URC | Unsolicited Result Code |
| URL | Uniform/Universal Resource Locator |
| WCDMA | Wideband Code Division Multiple Access |