

# **EG800Q&EG91xQ Series**

## **Software Thermal Management Guide**

**LTE Standard Module Series**

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# About the Document

## Revision History

Version	Date	Author	Description
-	2024-05-22	Bronson ZHAN	Creation of the document
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# 1 Introduction

This document describes the AT commands related to the software thermal mitigation policy on Quectel LTE Standard EG800Q series and EG91xQ family (EG915Q series and EG916Q-GL) modules. When the temperature reaches a specific threshold, the thermal mitigation policy is implemented to cool down the module.

# 2 AT Command Description

## 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 the command line.
- **[...]** Optional parameter of a command or an optional part of TA information response. Square brackets do not appear on the command line. When an optional parameter is not given in a command, the new value equals its previous value or the default settings, unless otherwise specified.
- **Underline** Default setting of a parameter.

### 2.1.2. 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>**. In tables presenting commands and responses throughout this document, only the commands and responses are presented, and **<CR>** and **<LF>** are deliberately omitted.

Table 1: Types of AT Commands

Command Type	Syntax	Description
Test Command	<b>AT+&lt;cmd&gt;=?</b>	Test the existence of the corresponding command and return information about the type, value, or range of its parameter.
Read Command	<b>AT+&lt;cmd&gt;?</b>	Check the current parameter value of the corresponding command.
Write Command	<b>AT+&lt;cmd&gt;=&lt;p1&gt;[,&lt;p2&gt;[,&lt;p3&gt;[...]]]</b>	Set user-definable parameter value.
Execution Command	<b>AT+&lt;cmd&gt;</b>	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 learn about the use of the AT commands introduced herein. The examples, however, should not be taken as Quectel's recommendations or suggestions about how to design a program flow or what status to set the module into. Sometimes multiple examples may be provided for one AT command. However, this does not mean that there is a correlation among these examples, or that they should be executed in a given sequence.

## 2.3. AT+QTEMP Query Module Temperature

This command queries module temperature.

AT+QTEMP Query Module Temperature	
Test Command <b>AT+QTEMP=?</b>	Response <b>+QTEMP: &lt;bb_temp&gt;,&lt;XO_temp&gt;,&lt;PA_temp&gt;</b>  <b>OK</b>
Execution Command <b>AT+QTEMP</b>	Response <b>+QTEMP: &lt;bb_temp&gt;,&lt;XO_temp&gt;,&lt;PA_temp&gt;</b>  <b>OK</b> Or <b>ERROR</b>
Maximum Response Time	300 ms
Characteristics	-

### Parameter

<b>&lt;bb_temp&gt;</b>	Integer type. Baseband temperature. Unit: Degree Celsius.
<b>&lt;XO_temp&gt;</b>	Integer type. XO temperature. Unit: Degree Celsius. (Not supported and 225 is returned currently)
<b>&lt;PA_temp&gt;</b>	Integer type. PA temperature. Unit: Degree Celsius. (Not supported and 225 is returned currently)

### Example

```
AT+QTEMP //Query module temperature.
+QTEMP: 30,255,255
```

OK

## 2.4. AT+QCFG="thermal/txpwrImt" Control Transmit Power

This command controls the transmit power.

AT+QCFG="thermal/txpwrImt" Control Transmit Power	
Write Command <b>AT+QCFG="thermal/txpwrImt"</b> [, <enable>,<sensor>,<temp_thre shold>,<duration>,<trig_cnt>,< clr_cnt>]	Response If the optional parameters are omitted, query the current setting: <b>+QCFG: "thermal/txpwrImt",&lt;enable&gt;,&lt;sensor&gt;,&lt;temp_thresh old&gt;,&lt;duration&gt;,&lt;trig_cnt&gt;,&lt;clr_cnt&gt;</b>  <b>OK</b>  If the optional parameters are specified, set whether to enable transmit power control: <b>OK</b> Or <b>ERROR</b>
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module is rebooted. The configurations are saved automatically.

### Parameter

<enable>	Integer type. Enable/disable transmit power control. 0 Disable 1 Enable
<sensor>	Integer type. Temperature sensor ID. It corresponds to the temperature value detected by the sensor that is returned by <b>AT+QTEMP</b> . 2 Baseband temperature sensor 5 PA temperature sensor (Not supported) 7 XO temperature sensor (Not supported)
<temp_threshold>	Integer type. Temperature threshold that controls the transmit power. Range: -150–150. Default value: 105. Unit: Degree Celsius.
<duration>	Integer type. Length of temperature detection cycle. Range: 1000–360000. Default value: 1000 (It is recommended not to modify it.). Unit: ms.
<trig_cnt>	Integer type. Number of times the threshold for transmit power restriction detection has been triggered. Range: 1–10000. Default value: 3 (It is recommended not to modify it.).
<clr_cnt>	Integer type. Number of times the threshold for transmit power recovery detection

has been triggered. Range: 1–10000. Default value: 10 (It is recommended not to modify it.).

### Example

```
AT+QCFG="thermal/txpwrlimt",1,2,105,1000,3,10 //Enable transmit power control.
OK
AT+QCFG="thermal/txpwrlimt" //Query the transmit power setting.
+QCFG: "thermal/txpwrlimt",1,2,105,1000,3,10
OK
```

### NOTE

In the module default configuration, i.e., without resetting **<temp\_threshold>** via the AT command, the transmit power will be restricted if the temperature reaches 110 °C, and the transmit power will recover if the temperature decreases to 105 °C. Once the command is used, the temperatures for restricting and recovering the transmit power are set to the same value. Please use this command with caution.

## 2.5. AT+QCFG="thermal/limit\_rates" Enable/Disable Software Thermal

### Mitigation

This command enables/disables the software thermal mitigation.

AT+QCFG="thermal/limit_rates" Enable/Disable Software Thermal Mitigation	
Write Command <b>AT+QCFG="thermal/limit_rates"</b> <b>"[,&lt;enable&gt;"]</b>	Response If the optional parameter is omitted, query the current setting: <b>+QCFG: "thermal/limit_rates",&lt;enable&gt;</b>  <b>OK</b>  If the optional parameter is specified, enable or disable software thermal mitigation: <b>OK</b> Or <b>ERROR</b>
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module is rebooted. The configurations are saved automatically.

## Parameter

<b>&lt;enable&gt;</b>	Integer type. Enable/disable software thermal mitigation.
0	Disable
1	Configure software thermal mitigation policy based on the default values of <b>AT+QCFG="thermal/txpwrImt"</b> automatically

## Example

```
AT+QCFG="thermal/limit_rates" //Query the software thermal mitigation policy state.
+QCFG: "thermal/limit_rates",0
```

OK

```
AT+QCFG="thermal/limit_rates",1 //Enable software thermal mitigation.
```

OK

### NOTE

To ensure module reliability and stability, it is recommended not to disable software thermal mitigation during normal operation of the module.

# 3 Software Thermal Mitigation Policy

## 3.1. Limiting Transmit Power

The PA's workload can be reduced by limiting the transmit power, thus cooling down the module temperature. However, the transmit power during field tests is configured by the network. If the network signal is strong, the transmit power is typically low, making thermal mitigation through transmit power restriction less effective. Besides, when the transmit power is restricted below the network's configured level, the network may fail to receive or decode signals from the module, leading to decreased data transmission performance.

The transmit power influences both the power consumption and heat generation in the PA. Theoretically, reducing transmit power can lower module temperature. Transmit power is categorized into seven levels (Level 0–Level 6), which respectively correspond to different maximum transmit power levels 23–17 dBm.

For example, if transmit power control is enabled with **AT+QCFG="thermal/txpwrlimt",1,2,105,1000,3,10**, the module will detect the current temperature every second (1000 milliseconds) for 3 times, by default. If the temperature exceeds 105 °C for 3 seconds, the maximum transmit power will be reduced by 1 dBm until it reaches 17 dBm. If the temperature remains below 105 °C for 10 consecutive detection cycles (10 seconds), the maximum transmit power will increase by 1 dBm until it reaches 23 dBm.

## 3.2. Entering Minimum Functionality Mode

When the temperature of the module reaches about 120 °C, the module automatically enters minimum functionality mode (execute **AT+CFUN=0**) to protect the hardware. When the temperature decreases to about 110 °C, the module automatically reverts to the full functionality mode (execute **AT+CFUN=1**). Users cannot configure the functionality mode and the temperature threshold.

## 4 Appendix Reference

Table 2: Terms and Abbreviations

Abbreviation	Description
LTE	Long-Term Evolution
PA	Power Amplifier
TA	Terminal Adapter
XO	Crystal Oscillators