

BG95-S5 GNSS Jamming Detection Application Note

Satellite Communication Module Series

Version: 1.0

Date: 2024-11-06

Status: Released



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About the Document

Revision History

Version	Date	Author	Description
-	2024-09-02	Hal FU	Creation of the Document
1.0	2024-11-06	Hal FU	First official release

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1 Introduction

This document describes how to implement GNSS jamming detection for Quectel BG95-S5 module via AT commands.

1.1. GNSS Jamming Indicator

GNSS jamming indicator is a metric that is linearly proportional to the sum of jammer and noise power at the GNSS antenna port.

The jamming indicator can be used to measure the relative increase in the current noise floor, including jammer, versus the observed reference noise level (RNL) — both measured at the GNSS receiver input. In an interference environment, the measured value of the GNSS jamming indicator will increase. Interference to the signal received by the module is assessed based on the comparison between the measured value of the GNSS jamming indicator and RNL.

1.2. Reference Noise Level (RNL)

To detect jamming events, BG95-S5 module uses a relative measure of the noise level (i.e., RNL) at the input of the GNSS receiver.

RNL value is unavailable by default. It will be automatically calculated and updated, once the following conditions are met.

- a. Jamming detection is enabled (See **Chapter 2.3.1**).
- b. GNSS is turned on and the module has been successfully positioned.
- c. Positioning accuracy is less than 20 m and lasts for 20 s.

Therefore, the RNL is changing and automatically adapts to the environment. To avoid too frequent saving of the RNL value to NVRAM, RNL is saved to NVRAM only once at the first update after the module is powered on.

The module supports setting an estimated RNL with **AT+QGPSCFG="agnssjamming"**, which is generally not recommended because the module can automatically update the RNL when jamming detection is enabled and the module works properly.

1.3. Limitations

GNSS jamming indicator is a relative measure, therefore there are certain limitations associated with it.

Limitations on the use of GNSS jamming detection feature:

- a. When detecting jammers at the beginning of a GNSS tracking session, the jamming indicator assumes that the antenna input signal conditions are similar to those of a previous GNSS tracking session, i.e., the surrounding environment and the location of the device did not change dramatically.
- b. When GNSS signals are strong, it is possible to get a good GNSS position fix in the presence of jammers. Jammers can cause RNL bias by several dB, thus impacting RNL reliability in detecting them.
- c. "Moderately" and "severely" jammed conditions as well as their associated thresholds assume open sky and strong GNSS signal conditions. When the GNSS signals are weaker, jammer impact is more pronounced. For example, in challenging GNSS signal conditions, a 5 dB jammer may severely impact GNSS performance.
- d. Jamming detection cannot be supported when an active antenna is used for GNSS signal reception.

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	AT+<cmd>=?	Test the existence of the corresponding command and return information about the type, value, or range of its parameter.
Read Command	AT+<cmd>?	Check the current parameter value of the corresponding 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 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. The URLs, domain names, IP addresses, usernames/accounts, and passwords (if any) in the AT command examples are provided for illustrative and explanatory purposes only, and they should be modified to reflect your actual usage and specific needs.

2.3. Jamming Detection Related AT Command

2.3.1. AT+QGPSCFG="agnssjamming" Enable/Disable GNSS Jamming Detection

AT+QGPSCFG="agnssjamming" Enable/Disable GNSS Jamming Detection	
Test Command AT+QGPSCFG=?	Response: ... +QGPSCFG: "agnssjamming", (list of supported <mode>s),(list of supported <esti_RNL>s) ... OK
Write Command AT+QGPSCFG="agnssjamming" [,<mode>[,<esti_RNL>]]	Response If the optional parameters are omitted, query the current setting. +QGPSCFG: "agnssjamming",<mode>,<state>,[<RNL>/<esti_RNL>],<metric_val> OK If any of the optional parameters is specified, enable/disable jamming detection and/or set the estimated RNL value. OK If there is any error related to the ME functionality: +CME ERROR: <errcode>
Maximum Response Time	300 ms
Characteristics	This command takes effect immediately. The <mode> configuration is not saved.

The **<esti_RNL>** configuration is saved automatically.

Parameter

<mode>	Integer type. Enable/disable GNSS jamming detection and configure URC reporting mode. 0 Disable jamming detection function 1 Enable jamming detection function and report URC every second 2 Enable jamming detection and report URC when the jamming state changes URC is presented below: +QGPSURC: "jamming_ind",<state>,<RNL>,<metric_val>
<esti_RNL>	Integer type. Estimated Reference Noise Level. Range: 0–105. It is recommended NOT to set this value.
<state>	Integer type. Jamming state. 0 Jamming does not exist 1 Jamming exists
<RNL>	Integer type. Reference Noise Level. NULL means there is no valid RNL. Range: 0–105.
<metric_val>	Integer type. Jamming metric measured in real time. Unit: dB.
<errcode>	Integer type. Error code. See Chapter 3 for more information.

NOTE

If **<esti_RNL>** has not been specified, the RNL returned by **AT+QGPSCFG="agnssjamming"** is the actual RNL, and NULL means there is no valid RNL. If **<esti_RNL>** has been specified, the RNL returned by **AT+QGPSCFG="agnssjamming"** is the estimated RNL, and it will be updated into the actual RNL after the RNL is available.

Example

```

AT+QGPSCFG="agnssjamming",1           //Enable jamming detection function and reporting
                                         URC every second.

OK
AT+QGPS=1                               //Start GNSS, and wait until GNSS gets position fix
                                         and RNL is updated.

OK

AT+QGPSCFG="agnssjamming"              //Query the current jamming detection and URC state.
+QGPSCFG: "agnssjamming",1,1,55,55

OK

//When jammer is detected, the module reports GNSS jamming detection URCs

```

+QGPSURC: "jamming_ind",1,55,67

+QGPSURC: "jamming_ind",1,55,67

+QGPSURC: "jamming_ind",1,55,67

AT+QGPSCFG="agnssjamming",0

//Disable jamming detection function

OK

3 Summary of Error Codes

The **<errcode>** indicates an error related to the GNSS operation. The details about **<errcode>** are presented in the following table.

Table 2: Summary of Error Codes

<errcode>	Meaning
501	Invalid parameter
502	Operation not supported
503	GNSS subsystem busy
504	Active session
505	Inactive session
506	Operation timeout
549	Unknown error

4 Appendix Reference

Table 3: Terms and Abbreviations

Abbreviation	Description
EGPRS	Enhanced General Packet Radio Service
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
LPWA	Low Power Wide Area
NVRAM	Non-Volatile Random Access Memory
RNL	Reference Noise Level
URC	Unsolicited Result Code
Wi-Fi	Wireless Fidelity