

# **BG95-S5** GNSS Jamming Detection Application Note

**Satellite Communication Module Series**

Version: 1.0

Date: 2024-11-06

Status: Released



At Quectel, our aim is to provide timely and comprehensive services to our customers. If you require any assistance, please contact our headquarters:

**Quectel Wireless Solutions Co., Ltd.**

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

Tel: +86 21 5108 6236

Email: [info@quectel.com](mailto:info@quectel.com)

**Or our local offices. For more information, please visit:**

<http://www.quectel.com/support/sales.htm>.

**For technical support, or to report documentation errors, please visit:**

<http://www.quectel.com/support/technical.htm>.

Or email us at: [support@quectel.com](mailto:support@quectel.com).

## Legal Notices

We offer information as a service to you. The provided information is based on your requirements and we make every effort to ensure its quality. You agree that you are responsible for using independent analysis and evaluation in designing intended products, and we provide reference designs for illustrative purposes only. Before using any hardware, software or service guided by this document, please read this notice carefully. Even though we employ commercially reasonable efforts to provide the best possible experience, you hereby acknowledge and agree that this document and related services hereunder are provided to you on an “as available” basis. We may revise or restate this document from time to time at our sole discretion without any prior notice to you.

## Use and Disclosure Restrictions

### License Agreements

Documents and information provided by us shall be kept confidential, unless specific permission is granted. They shall not be accessed or used for any purpose except as expressly provided herein.

### Copyright

Our and third-party products hereunder may contain copyrighted material. Such copyrighted material shall not be copied, reproduced, distributed, merged, published, translated, or modified without prior written consent. We and the third party have exclusive rights over copyrighted material. No license shall be granted or conveyed under any patents, copyrights, trademarks, or service mark rights. To avoid ambiguities, purchasing in any form cannot be deemed as granting a license other than the normal non-exclusive, royalty-free license to use the material. We reserve the right to take legal action for noncompliance with abovementioned requirements, unauthorized use, or other illegal or malicious use of the material.

### Trademarks

Except as otherwise set forth herein, nothing in this document shall be construed as conferring any rights to use any trademark, trade name or name, abbreviation, or counterfeit product thereof owned by Quectel or any third party in advertising, publicity, or other aspects.

## **Third-Party Rights**

This document may refer to hardware, software and/or documentation owned by one or more third parties (“third-party materials”). Use of such third-party materials shall be governed by all restrictions and obligations applicable thereto.

We make no warranty or representation, either express or implied, regarding the third-party materials, including but not limited to any implied or statutory, warranties of merchantability or fitness for a particular purpose, quiet enjoyment, system integration, information accuracy, and non-infringement of any third-party intellectual property rights with regard to the licensed technology or use thereof. Nothing herein constitutes a representation or warranty by us to either develop, enhance, modify, distribute, market, sell, offer for sale, or otherwise maintain production of any our products or any other hardware, software, device, tool, information, or product. We moreover disclaim any and all warranties arising from the course of dealing or usage of trade.

## **Privacy Policy**

To implement module functionality, certain device data are uploaded to Quectel’s or third-party’s servers, including carriers, chipset suppliers or customer-designated servers. Quectel, strictly abiding by the relevant laws and regulations, shall retain, use, disclose or otherwise process relevant data for the purpose of performing the service only or as permitted by applicable laws. Before data interaction with third parties, please be informed of their privacy and data security policy.

## **Disclaimer**

- a) We acknowledge no liability for any injury or damage arising from the reliance upon the information.
- b) We shall bear no liability resulting from any inaccuracies or omissions, or from the use of the information contained herein.
- c) While we have made every effort to ensure that the functions and features under development are free from errors, it is possible that they could contain errors, inaccuracies, and omissions. Unless otherwise provided by valid agreement, we make no warranties of any kind, either implied or express, and exclude all liability for any loss or damage suffered in connection with the use of features and functions under development, to the maximum extent permitted by law, regardless of whether such loss or damage may have been foreseeable.
- d) We are not responsible for the accessibility, safety, accuracy, availability, legality, or completeness of information, advertising, commercial offers, products, services, and materials on third-party websites and third-party resources.

***Copyright © Quectel Wireless Solutions Co., Ltd. 2024. All rights reserved.***

# 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

---

## Contents

About the Document.....	3
Contents.....	4
Table Index.....	5
<b>1 Introduction .....</b>	<b>6</b>
1.1. GNSS Jamming Indicator .....	6
1.2. Reference Noise Level (RNL).....	6
1.3. Limitations .....	7
<b>2 AT Command Description.....</b>	<b>8</b>
2.1. AT Command Introduction .....	8
2.1.1. Definitions.....	8
2.1.2. AT Command Syntax .....	8
2.2. Declaration of AT Command Examples .....	9
2.3. Jamming Detection Related AT Command.....	9
2.3.1. AT+QGPSCFG="agnssjamming" Enable/Disable GNSS Jamming Detection.....	9
<b>3 Summary of Error Codes .....</b>	<b>12</b>
<b>4 Appendix Reference .....</b>	<b>13</b>

## Table Index

Table 1: Types of AT Commands .....	8
Table 2: Summary of Error Codes.....	12
Table 3: Terms and Abbreviations .....	13

# 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	<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. 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

<b>AT+QGPSCFG="agnssjamming" Enable/Disable GNSS Jamming Detection</b>	
Test Command <b>AT+QGPSCFG=?</b>	Response: ... <b>+QGPSCFG: "agnssjamming",</b> (list of supported <mode>s),(list of supported <esti_RNL>s) ... <b>OK</b>
Write Command <b>AT+QGPSCFG="agnssjamming" [,&lt;mode&gt;[,&lt;esti_RNL&gt;]]</b>	Response If the optional parameters are omitted, query the current setting. <b>+QGPSCFG: "agnssjamming",&lt;mode&gt;,&lt;state&gt;,[&lt;RNL&gt;/&lt;esti_RNL&gt;],&lt;metric_val&gt;</b> <b>OK</b> If any of the optional parameters is specified, enable/disable jamming detection and/or set the estimated RNL value. <b>OK</b> If there is any error related to the ME functionality: <b>+CME ERROR: &lt;errcode&gt;</b>
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**

<code>&lt;mode&gt;</code>	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: <b>+QGPSURC: "jamming_ind",&lt;state&gt;,&lt;RNL&gt;,&lt;metric_val&gt;</b>
<code>&lt;esti_RNL&gt;</code>	Integer type. Estimated Reference Noise Level. Range: 0–105. It is recommended <b>NOT</b> to set this value.
<code>&lt;state&gt;</code>	Integer type. Jamming state. 0 Jamming does not exist 1 Jamming exists
<code>&lt;RNL&gt;</code>	Integer type. Reference Noise Level. NULL means there is no valid RNL. Range: 0–105.
<code>&lt;metric_val&gt;</code>	Integer type. Jamming metric measured in real time. Unit: dB.
<code>&lt;errcode&gt;</code>	Integer type. Error code. See <b>Chapter 3</b> 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**

<b>&lt;errcode&gt;</b>	<b>Meaning</b>
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