



# **GProgrammer User Manual**

**Version: 2.7**

**Release Date: 2023-02-03**

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## **Shenzhen Goodix Technology Co., Ltd.**

Headquarters: Floor 12-13, Phase B, Tengfei Industrial Building, Futian Free Trade Zone, Shenzhen, China

TEL: +86-755-33338828      Zip Code: 518000

Website: [www.goodix.com](http://www.goodix.com)

## Preface

### Purpose

This document introduces how to install GProgrammer and operate its functional modules, enabling users to quickly get started with GProgrammer.

### Audience

This document is intended for:

- GR551x/GR5526 user
- GR551x/GR5526 developer
- GR551x/GR5526 tester

### Release Notes

This document is the thirteenth release of *GProgrammer User Manual*, corresponding to GProgrammer V1.2.32.

### Revision History

Version	Date	Description
1.5	2020-05-30	Initial release
1.6	2020-06-30	<ul style="list-style-type: none"><li>• Updated sector-related description in "Chip Configuration".</li><li>• Added "GR551x_console.exe", introducing a command-line program to erase and download commands; added "GR551x_encrypt_signature.exe" and "User-defined Windows Scripts".</li><li>• Introduced the public key hashes to verify signatures, updated the file name extension for encrypted and signed files, and introduced the firmware signing function in "Encrypt &amp; Sign".</li></ul>
1.7	2020-08-30	<ul style="list-style-type: none"><li>• Introduced the GR5515I0ND System-on-Chip (SoC) for GR551x SoCs in "SoC/MCU Selection".</li><li>• Changed icons for <b>Delete</b> and <b>Startup</b> in "Firmware".</li></ul>
1.8	2020-09-30	Added description on firmware download failure in "Download Firmware".
1.9	2020-11-26	Updated UI screenshots for software version.
2.0	2021-01-05	Updated software UI screenshots for SoC/MCU selection and firmware operations.
2.1	2021-03-02	<ul style="list-style-type: none"><li>• Added file modification description to "eFuse Settings".</li><li>• Added file export description to "Import and Export".</li><li>• Updated descriptions concerning operations prior to viewing device logs in "Device Log".</li><li>• Added description of <b>IO_LDO_SEL</b> field to "eFuse Layout".</li><li>• Deleted the parameter of nvds in erase and download commands in "GR551x_console.exe".</li></ul>
2.2	2021-05-13	Deleted functionalities for GMF03x series.
2.3	2021-07-16	Updated software UI figures for SoC selection.

Version	Date	Description
2.4	2021-09-06	Updated software UI figures for SoC selection.
2.5	2022-02-20	<ul style="list-style-type: none"> <li>Added GR5526 to descriptions specific to SoC models supported by GProgrammer.</li> <li>Updated the "Firmware" and "Encrypt &amp; Sign" sections where adding HEX firmware files via GProgrammer is supported.</li> <li>Updated the "Firmware" section where <b>Export</b> is added to the <b>Firmware</b> interface and exporting BIN firmware files by GProgrammer is supported.</li> <li>Modified the "External Flash" section where <b>QSPI2</b> is added to <b>SPI Type</b> and relevant configuration items are modified.</li> <li>Updated commands supported by <i>GR5xxx_console.exe</i> and <i>GR5xxx_encrypt_signature.exe</i>.</li> </ul>
2.6	2023-01-19	Deleted the GR5515I0ND SoC.
2.7	2023-02-03	<ul style="list-style-type: none"> <li>Updated description in "GR5xxx_console.exe" and added commands supported by <i>GR5xxx_console.exe</i>, including "device" and "load".</li> <li>Added description on the parameter "rand_number" to <i>GR5xxx_console.exe</i> commands.</li> <li>Added description on the software package <i>GProgrammer- Version.tar.bz2</i> (running on Linux).</li> <li>Added a tip in "Flash Configuration" in "External Flash".</li> <li>Added description on viewing/reselecting the chip model in use.</li> <li>Added description on refreshing and choosing the serial number of target boards in SWD connection mode.</li> <li>Added more data file formats (except BIN files) support during data download to Flash memories.</li> <li>Added the function button <b>Parse Para</b> for parsing data in the NVDS area.</li> </ul>

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# 1 Introduction

GProgrammer supports programming of Flash memories on GR551x and GR5526 System-on-Chips (SoCs). It provides the following features.

- Connection via SWD and UART
- Firmware download
- Flash programming & erasing
- Inputting product information (ID, name, description, and value)
- Downloading files to eFuse
- Viewing eFuse contents
- Firmware encryption and signing
- Configuring Non-Volatile Data Storage (NVDS) parameters
- Displaying device logs
- Programming on GR5xxx\_console

Figure 1-1 shows the Graphical User Interface (GUI) of GProgrammer.

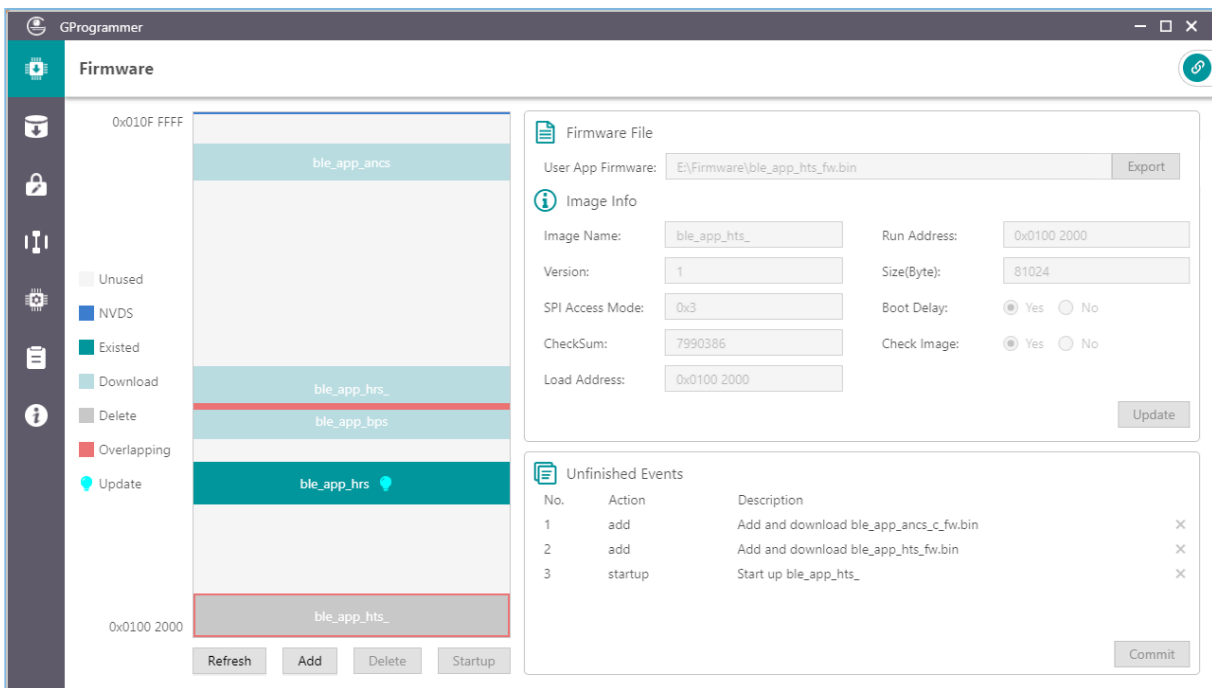


Figure 1-1 GProgrammer GUI

## 2 Installation Instructions

This chapter describes the environment requirements as well as installation steps for installing GProgrammer.

### 2.1 Installation Requirements

- **Hardware environment**

Table 2-1 Hardware environment

Name	Description
CPU	1.6 GHz and faster
RAM	1 GB and larger

- **Operating system**

Table 2-2 Operating system

Name	Description
Windows	Windows 7/Windows 10 (32-bit/64-bit)
Linux	Ubuntu 20.04 (64-bit)

### 2.2 Installation Steps

GProgrammer runs on Windows with an executable installation package: *GProgrammer Setup Version.exe*. Users can follow the steps below when installing GProgrammer:

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 **Note:**

To run GProgrammer on Linux (64-bit), you only need to unzip the software package *GProgrammer- Version.tar.bz2* and double-click the portable .exe program to launch GProgrammer.

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1. Double-click *GProgrammer Setup Version.exe*, and follow the steps in the **GProgrammer Setup** wizard (see [Figure 2-1](#)).

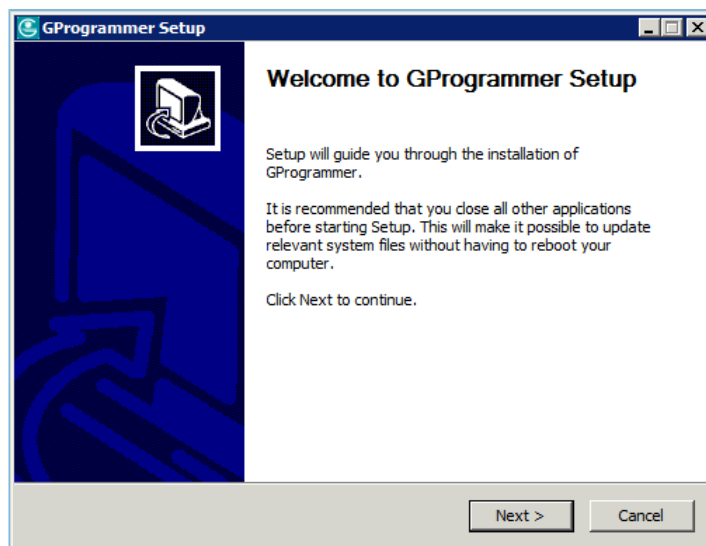


Figure 2-1 GProgrammer Setup installation wizard

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 **Note:**

*Version* indicates the GProgrammer software version number.

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2. After installing GProgrammer, you are prompted to install J-Link on demand. See [Figure 2-2](#).

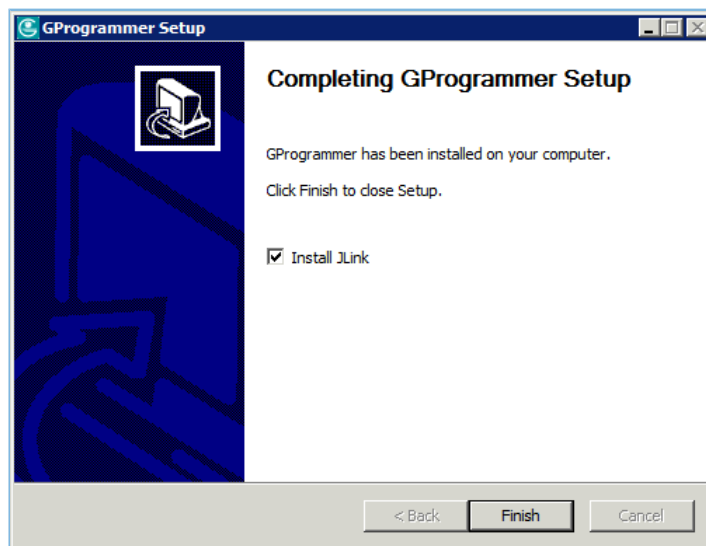


Figure 2-2 Prompt to install J-Link

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 **Tip:**

For users who have installed J-Link on their PCs before installing GProgrammer, clear **Install J-Link** in the installation wizard.

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3. After installing J-Link, you can start the GProgrammer by clicking the GProgrammer shortcut on desktop or **Start** menu.

## 3 GProgrammer Use Instructions

This chapter elaborates on how to use functional modules of GProgrammer.

### 3.1 Hardware Connection

Before starting GProgrammer, make sure the host (PC) is correctly connected to the target board. You can establish the connection in either SWD mode or UART mode.

- SWD mode

In SWD mode, users need a J-Link emulator with one end connecting to the host through a Micro USB cable and the other end connecting to SoC pins of the target board through Dupont wire cables.

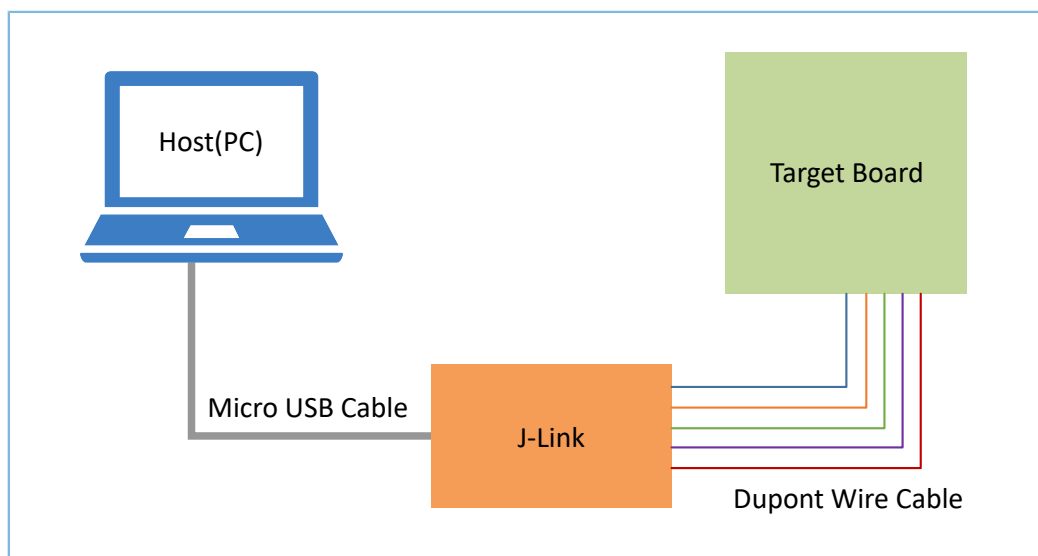


Figure 3-1 Host-target-board connection in SWD mode

The table below lists the mapping relations between J-Link emulator pins and SoC pins.

Table 3-1 Mapping relations between J-Link emulator pins and SoC pins

J-Link Emulator Pin	SoC Pin
VCC	VCC
GND	GND
SWDIO	GPIO_1
SWCLK	GPIO_0

**Note:**

- For target boards that have been integrated with J-Link emulator chips, you can connect the host to the target board directly through a Micro USB cable.
- For Goodix Starter Kit (SK) Boards, you cannot connect an SK Board to a PC directly via the on-board J-Link port for firmware programming because the integrated ROM upgrade program in the SoC shall be implemented based on a baud rate of 921600, a value which the integrated J-Link emulator chips on the SK Board fails to support.

- UART mode

In UART mode, users need a USB-to-serial converter with one end connecting to the host through a Micro USB cable and the other end connecting to SoC pins of the target board through Dupont wire cables.

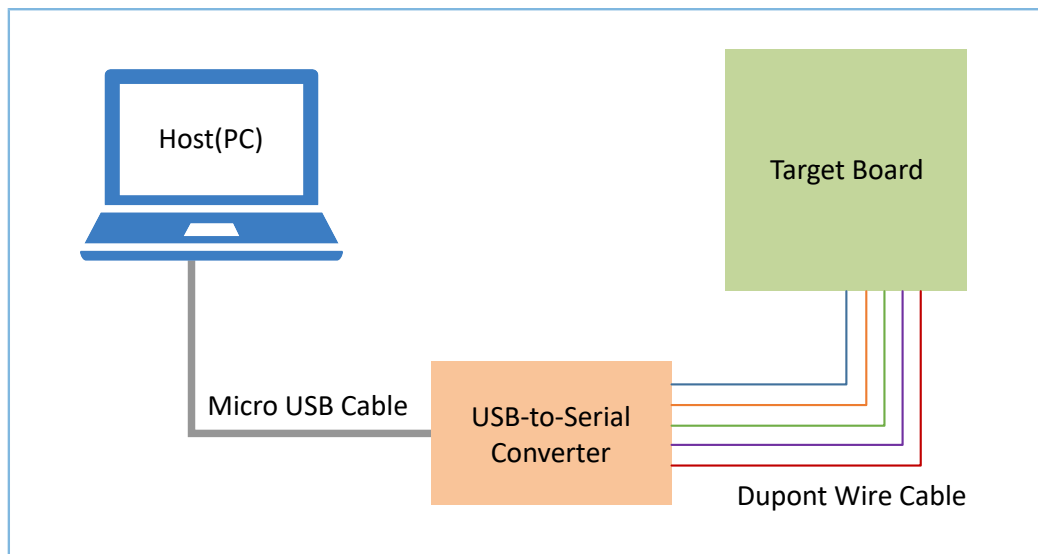


Figure 3-2 Host-target-board connection in UART mode

The table below lists the mapping relations between USB-to-serial converter pins and SoC pins.

Table 3-2 Mapping relations between USB-to-serial converter pins and SoC pins

USB-to-Serial Converter Pin	SoC Pin
VCC	VCC
GND	GND
TX	GPIO_1
RX	GPIO_0
RTS	CHIP_EN

**Tip:**

- For target boards that have been integrated with USB-to-serial converter chips, you can connect the host to the target board directly through a Micro USB cable.
- When the SWD interface is closed, firmware information in the Flash is to be erased after the Host and the target board is connected through UART.

## 3.2 SoC Selection

Start GProgrammer. Prior to other operations, you are required to choose the SoC model on your target board and click **OK**.

**Tip:**

By default, GProgrammer opens the SoC selection interface when being started.

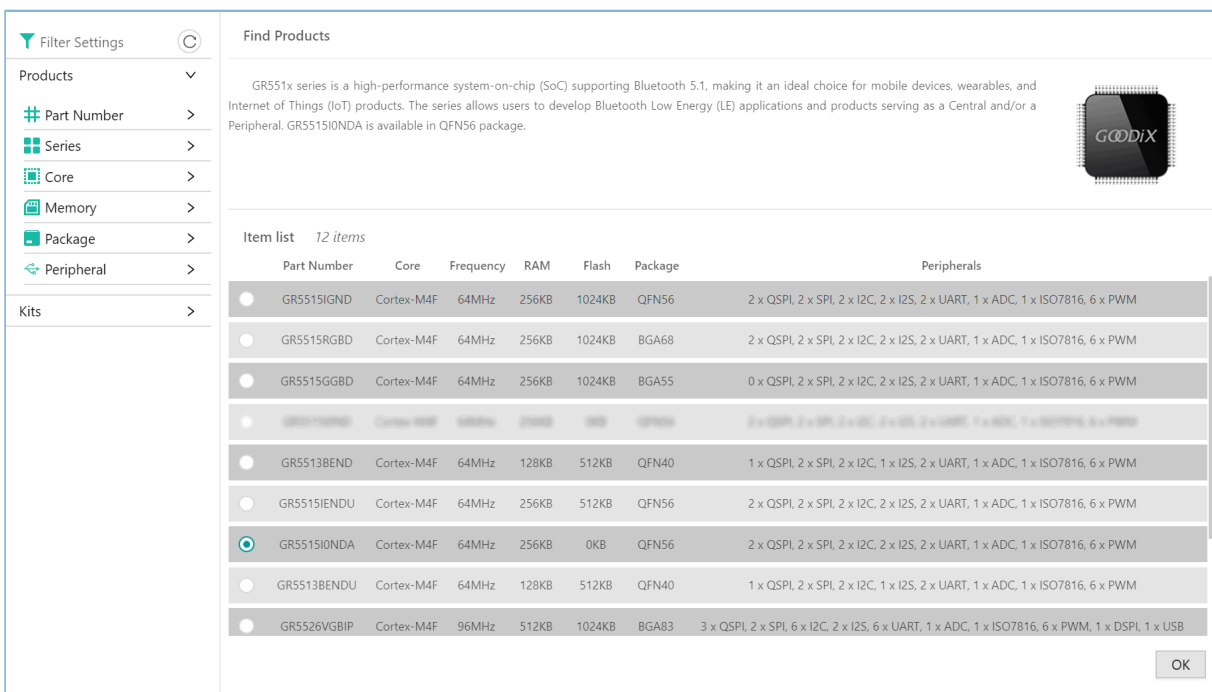


Figure 3-3 SoC selection interface

On the SoC selection interface, the left pane lists **Products** and **Kits** options, and the right pane shows the available choices. You can select an SoC by defining its **Part Number**, **Series**, **Core**, **Memory**, **Package**, or **Peripheral**.

**Tip:**

Peripherals listed on the SoC selection interface are only part of the peripherals of an SoC. For details of all peripherals, see the datasheet corresponding to SoC series.

## 3.3 GProgrammer GUI

After you choose an SoC, the main operational interface opens, as shown in the figure below.

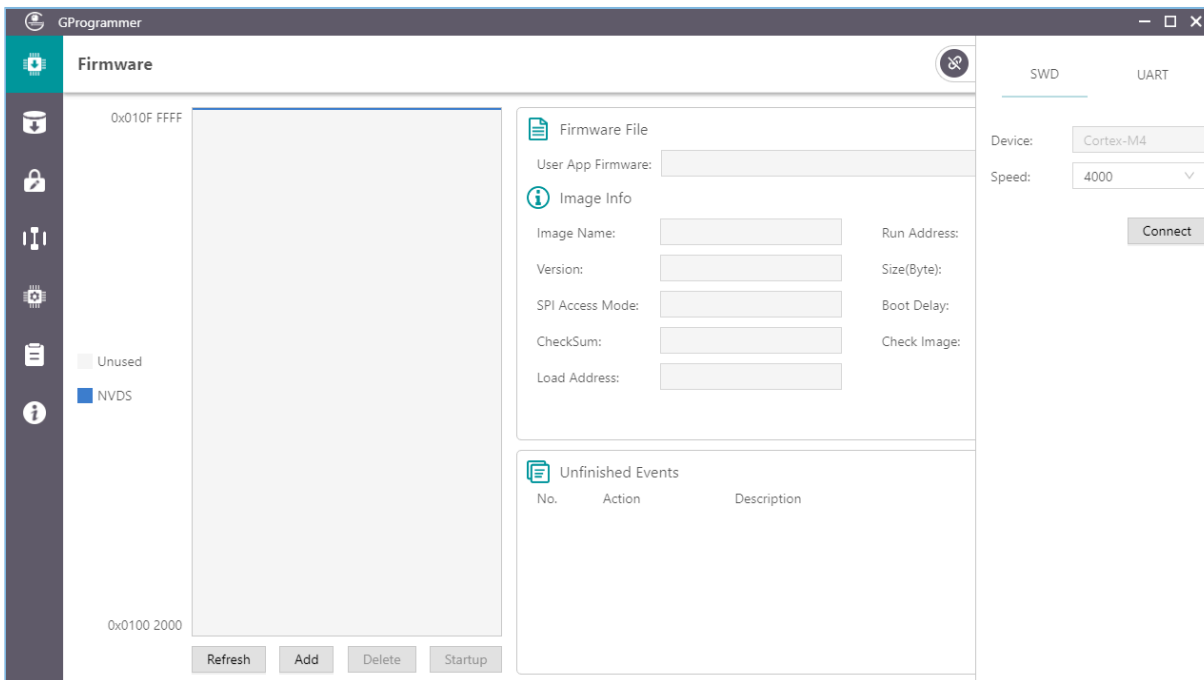


Figure 3-4 GProgrammer GUI


The GUI comprises a functional navigation bar on the left (see [Table 3-3](#)) and a function operational zone on the right.

Table 3-3 Options on the functional navigation bar

Icon	Function Name	Description
	-	View/Reselect the chip model in use. <ul style="list-style-type: none"> <li>You can view the selected chip model by moving the cursor onto this icon.</li> <li>You can select another chip model by clicking this icon to return to the SoC selection interface.</li> </ul> The current device is to be disconnected after clicking <b>OK</b> in the lower-right corner.
	Firmware	Display firmware-related operations.
	Flash	Display operations related to Flash memory.
	Encrypt & Sign	Display operations related to firmware encryption and signing.
	eFuse Layout	Display eFuse layout.
	Chip Configuration	Display operations related to chip configurations.
	Device Log	Display device logs.
	Help	Display help information.

## 3.4 Connection Management

GProgrammer helps users manage and control the connection between your host and target board.

Click  in the upper-right corner of the interface to open or hide the connection management window of GProgrammer.

GProgrammer supports two connection modes: SWD and UART.

- SWD

Users need to configure parameters below and click **Connect** to connect the target board to the host.

Table 3-4 Parameter description

Parameter	Description
Device	CPU of the on-board chip. It is "Cortex-M4" by default and cannot be modified.
Speed	Data transfer rate. The default value is <b>4000</b> .
SN	<p>Serial number of the target board. The default value is <b>0</b>.</p> <ul style="list-style-type: none"><li>◦ When the PC is connected with only one target board, you can keep the default value "0" or obtain the corresponding serial number by clicking <b>Refresh</b>.</li><li>◦ When the PC is connected with multiple target boards, you should obtain the corresponding serial numbers by clicking <b>Refresh</b>, and then choose the target one.</li></ul> <p>In this case, if you keep the default value "0" and start device connection, a window will pop up to inform you of choosing the target board S/N when GProgrammer runs on Windows.</p>

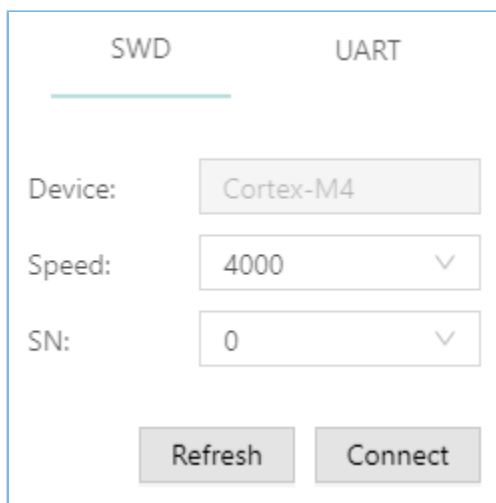


Figure 3-5 GProgrammer SWD connection

- UART

Users need to configure **Port** (click **Refresh** and select a correct **Port** value) and **Baudrate** on demand. The default configurations of other parameters (**Parity**, **DataBits**, **StopBits**, and **FlowControl**) cannot be modified.

After setting these parameters, click **Connect** to connect the target board to the host.

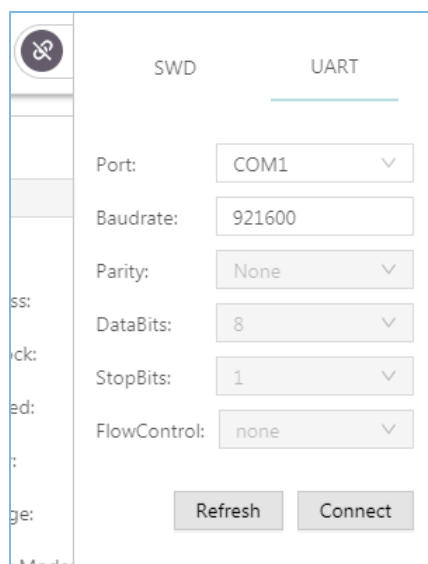



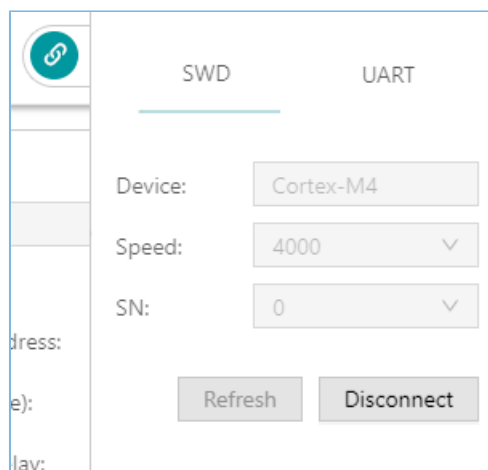



Figure 3-6 GProgrammer UART connection

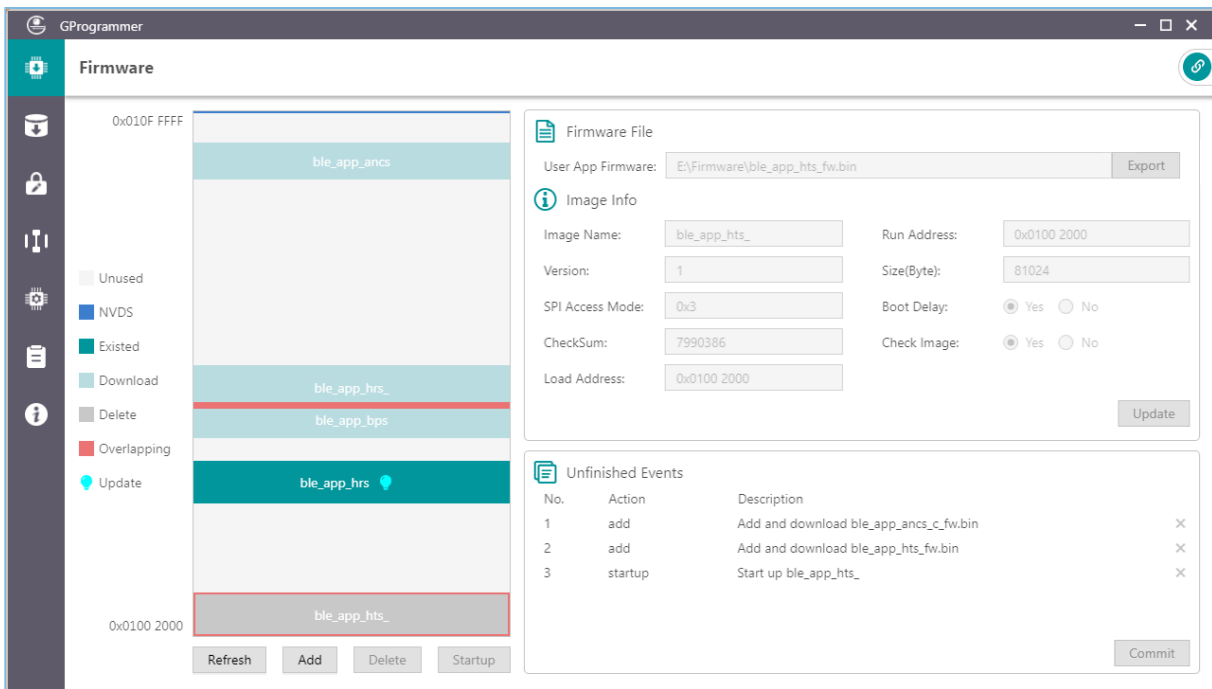
After the connection is successfully established, the connection management window automatically hides with the  button turning into , which indicates successful connection establishment.

To disconnect the host from the board, click  to open the connection management window, and click **Disconnect**.

Figure 3-7 Clicking **Disconnect** on GProgrammer

## 3.5 Firmware

Click  on the left side of the main interface of GProgrammer to open the **Firmware** interface.

Figure 3-8 GProgrammer **Firmware** interface

You can download your application firmware to the contiguous space of Flash memories, ranging from 0x01002000 to 0x010FFFFF.

#### Note:

The start and end addresses of Flash memories to which firmware can be downloaded vary depending on the Flash size of the specific SoC.

### 3.5.1 Downloading Firmware

GProgrammer graphically displays the Flash memory space layout occupied by firmware (see Figure 3-9), which helps you easily learn the Flash occupation status.

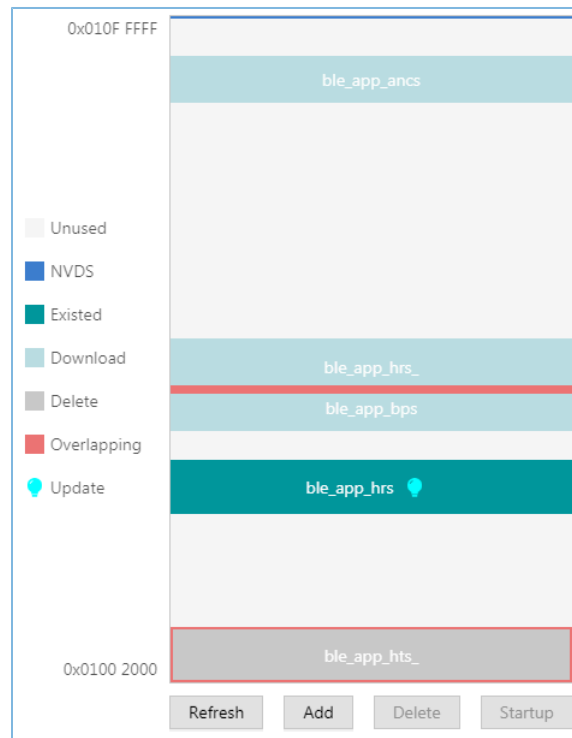


Figure 3-9 Flash firmware layout

- represents Flash space to which data can be downloaded.
- represents default NVDS area to which firmware cannot be downloaded.
- indicates space for storing to-be-deleted firmware. Example: ble\_app\_hrs\_.
- indicates space for storing to-be-downloaded firmware. Example: ble\_app\_ancs.
- indicates space for storing downloaded firmware in Flash memories. Example: ble\_app\_hrs.
- indicates space overlapped by two pieces of firmware. Examples: ble\_app\_hrs\_ and ble\_app\_bps.

Follow the steps below to download firmware to a Flash memory by using GProgrammer:

1. Click **Add** to add a local firmware file (HEX/BIN) to GProgrammer. GProgrammer presents details of the added firmware such as firmware directory (**User App Firmware**) and **Image Info**.  
In the **Firmware File** area, click **Export** to convert the imported firmware file to an unencrypted BIN file that can be used by the SoC.
2. Click **Commit** to download the firmware to Flash memories.

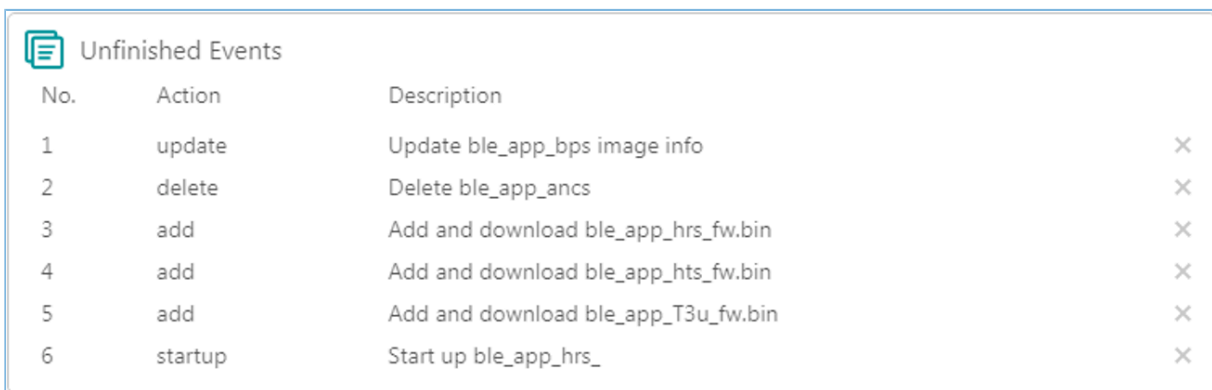
After downloading, the color of the firmware turns from to , indicating the firmware has been successfully downloaded.

 **Note:**

1. GProgrammer automatically reads firmware existing in the Flash memories after being connected a target board.
2. If J-Link cannot be connected when you download firmware, connection/firmware download to the SK Board fails. At this moment, the SoC may be in sleep mode (the firmware keeps running in sleep mode). You can press **RESET** on the SK Board, wait for around one second, and re-download the firmware. If this approach does not work, erase the Flash and re-download the firmware.

### 3.5.2 Action Order

You can execute multiple actions at a time. For example, download multiple pieces of firmware to Flash memories and set one piece of firmware as **Startup**. The user-defined actions are executed by clicking **Commit**. The action orders are displayed in **Unfinished Events**, as shown in [Figure 3-10](#).












No.	Action	Description	
1	update	Update ble_app_bps image info	×
2	delete	Delete ble_app_ancs	×
3	add	Add and download ble_app_hrs_fw.bin	×
4	add	Add and download ble_app_hts_fw.bin	×
5	add	Add and download ble_app_T3u_fw.bin	×
6	startup	Start up ble_app_hrs_	×

Figure 3-10 Action order


Executable actions for users are listed in the table below.

Table 3-5 Executable actions for users on GProgrammer

Name	Button/Icon	Description
Add firmware		<p>Click <b>Add</b> to add a local firmware file to GProgrammer.</p> <p>Alternatively, you can add a local firmware file to GProgrammer by directly dragging the file to GProgrammer from <b>Windows/File Explorer</b>.</p> <p><b>Note:</b></p> <p>Do not click <b>Open</b> after dragging the file to GProgrammer.</p>
Refresh firmware		<p>Click <b>Refresh</b> to obtain the information of firmware downloaded in the Flash memories of a target board.</p> <p>Unexecuted actions of Flash firmware on the living target board in the <b>Unfinished Events</b> pane, such as those labeled as <b>startup</b> or <b>update</b> are withdrawn with modified parameters being reset to values before refresh.</p>

Name	Button/Icon	Description
Delete firmware		Click the <b>Delete</b> button to delete existing firmware in Flash memories. Select firmware to be deleted in the Flash firmware layout, and click <b>Delete</b> . The firmware color turns to  . An action labelled as <b>delete</b> is added to the <b>Unfinished Events</b> .  Note: Delete operations result in deleting only image info of the selected firmware. The firmware information stored in the area will not be deleted.
Start execution		Set firmware as <b>startup</b> to run the firmware immediately. Select firmware in the Flash firmware layout, and click the <b>Startup</b> button.  displays on the right of the firmware. An action labelled as <b>startup</b> is added to the <b>Unfinished Events</b> . The host automatically disconnects from the target board after running the firmware.
Update firmware information		Click the <b>Update</b> button to update the information of existing firmware in Flash memories on a target board. Select firmware to be updated in the Flash firmware layout, and modify the firmware information (the color of modified parameters turns to  ). Click <b>Update</b> , and the  icon displays on the right side of the firmware. An action labelled as <b>update</b> is added to the <b>Unfinished Events</b> .  Execute update actions, and all parameters involved are locked. No editing is allowed. If modification is required, withdraw the previous update action.

#### Note:


- In the action order list, you can withdraw an action by clicking  on the right side of the action.
- For two associated actions, withdrawal of the associated action may lead to automatic withdrawal of the previous action. For example, add a firmware file to Flash memories, and set it as **startup**. Withdrawal of **Add** leads to withdrawal of **Startup**.

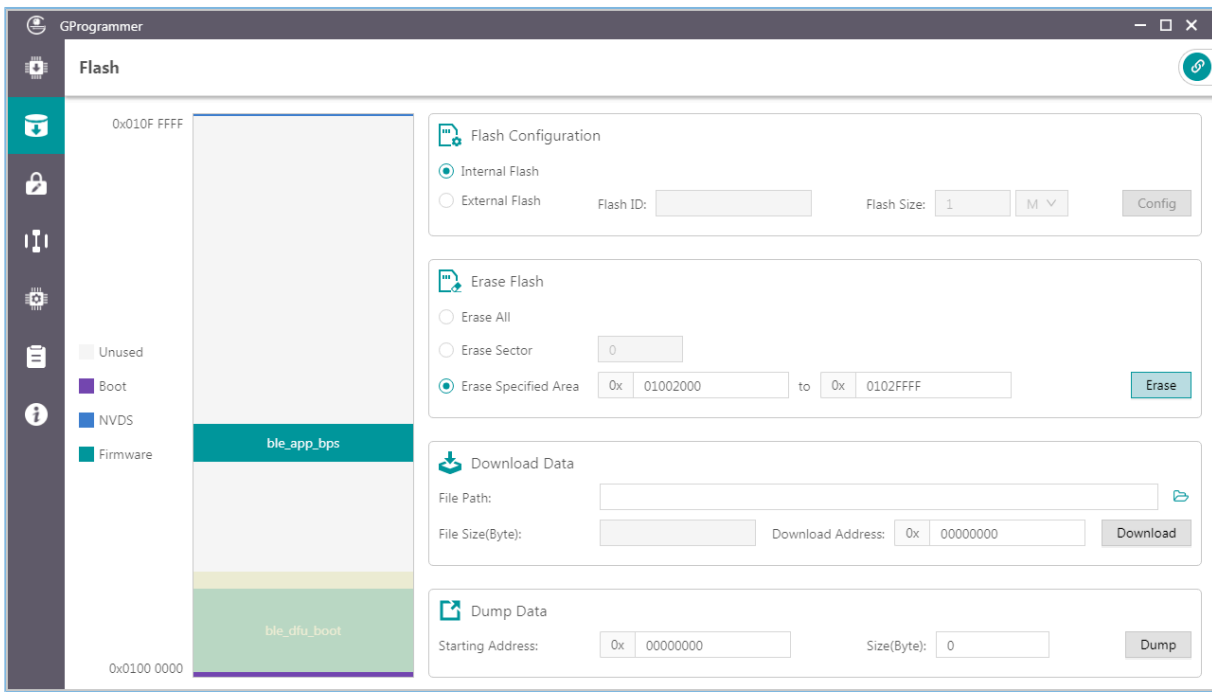
In addition, if there is overlapped space for firmware, **Commit** will not be available until the conflict is resolved.

#### Note:

For two pieces of firmware totally overlapping with each other, you can click the overlapping space to select one piece of firmware and double-click the space to select the other.

## 3.6 Flash

Click  on the left side of the main interface of GProgrammer to open the **Flash** interface.

Figure 3-11 GProgrammer **Flash** interface

GProgrammer allows users to program internal and external Flash memories of SoCs. Detailed programming actions include **Erase Flash**, **Download Data**, and **Dump Data**.

Similar to the firmware layout, the Flash module presents the Flash space occupation in a graphic manner.

- unused Flash space
- space for NVDS
- Boot info space (0x01000000 to 0x01002000, specific to SoC model). The Boot info space is automatically loaded and displayed when users choose internal Flash memories.
- space for storing downloaded firmware in Flash memories. Example: ble\_app\_bps
- space to be operated, such as Flash space to be erased

### 3.6.1 Internal Flash

#### 3.6.1.1 Flash Configuration

Select **Internal Flash** in the **Flash Configuration** list to program internal Flash memories.

The Flash layout on the left side of the **Flash** interface automatically synchronizes with updated firmware layout information to obtain the firmware, NVDS, and Boot info space.

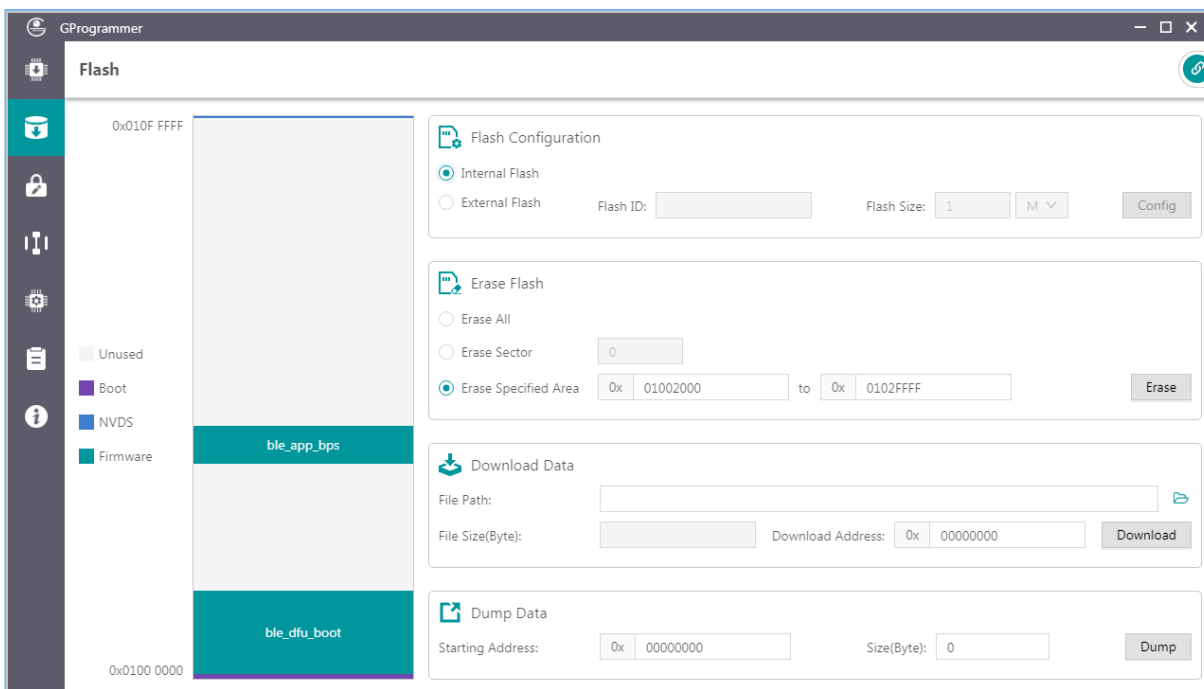


Figure 3-12 Selecting Internal Flash

### 3.6.1.2 Erase Flash

GProgrammer provides three Flash erasing mechanisms: **Erase All**, **Erase Sector**, and **Erase Specified Area**.

- **Erase All**

The mechanism helps erase all Flash spaces.

The Boot info and NVDS space is cleared with all firmware deleted.

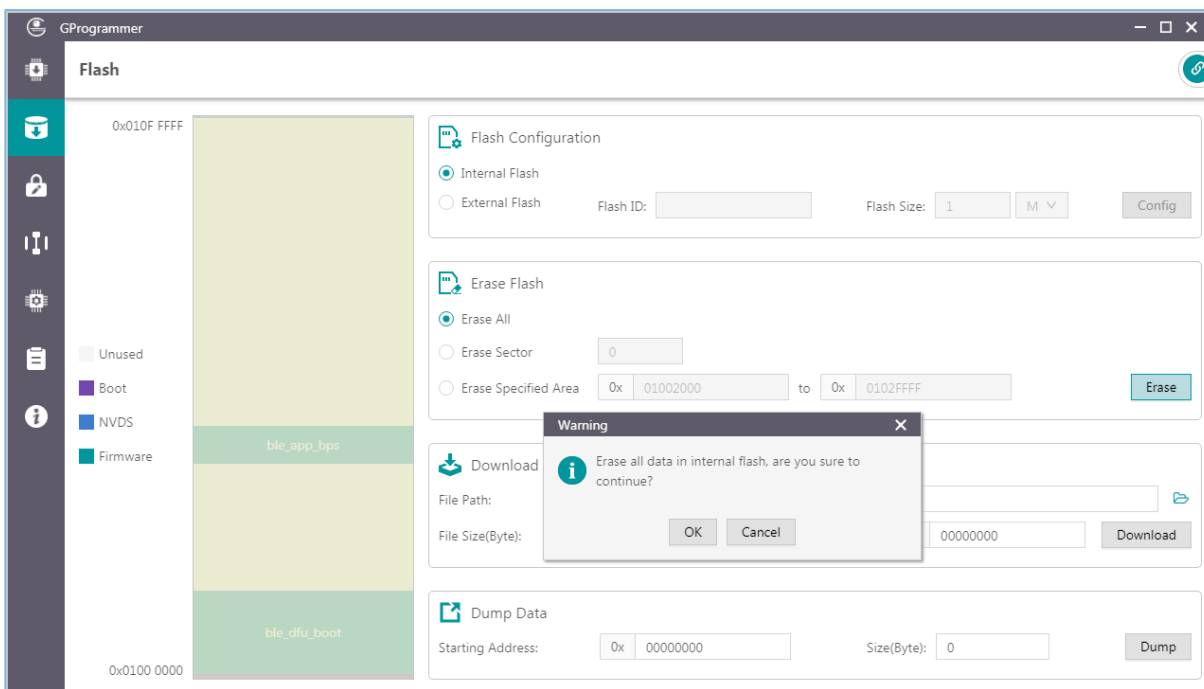


Figure 3-13 Erase All on GProgrammer

- **Erase Sector**

The mechanism helps erase a specified Flash sector (size: 4 KB).

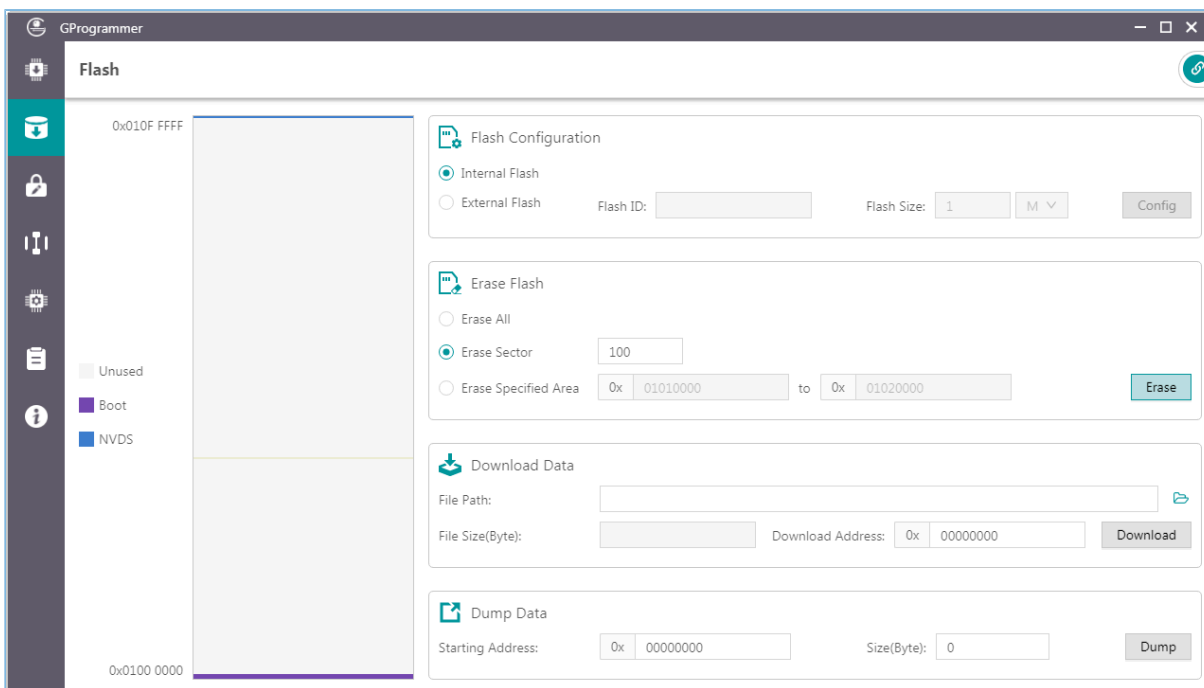


Figure 3-14 Erase Sector on GProgrammer

- **Erase Specified Area**

The mechanism helps erase an area within a specified address range, by sector.

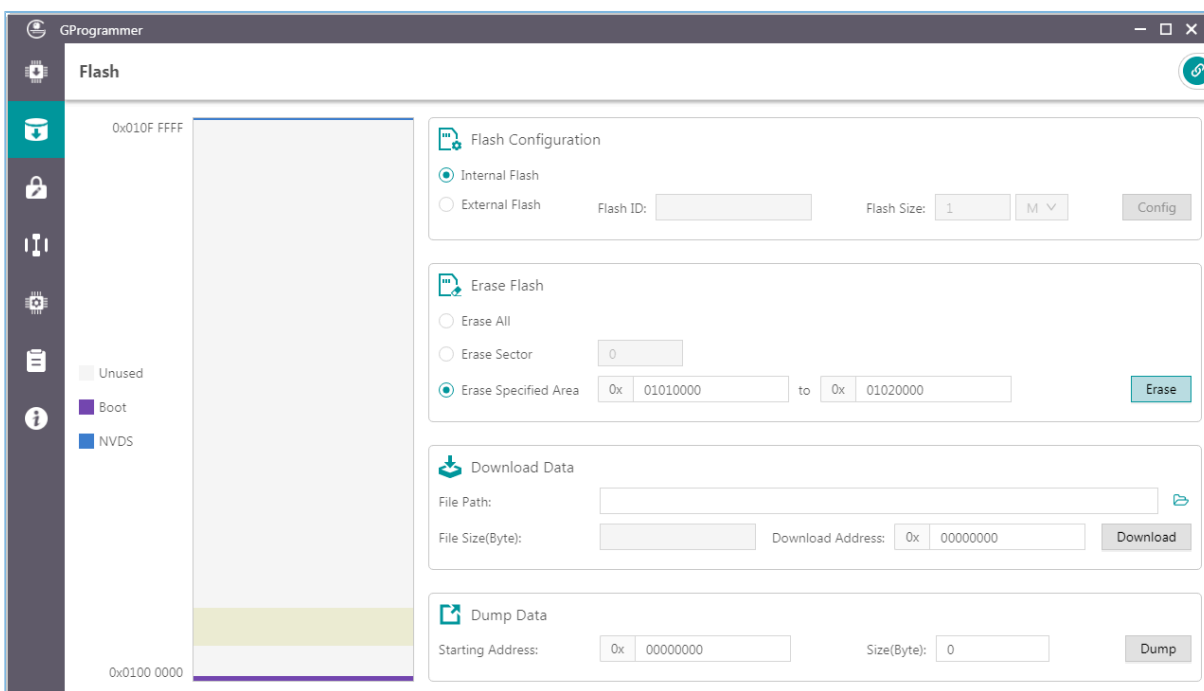


Figure 3-15 Erase Specified Area on GProgrammer

### 3.6.1.3 Download Data

When downloading data to Flash memories on GProgrammer, users only need to view and add the data file, as well as set a start address for downloading in **Download Address**.



**Tip:**

The download address shall be 4 KB-aligned.

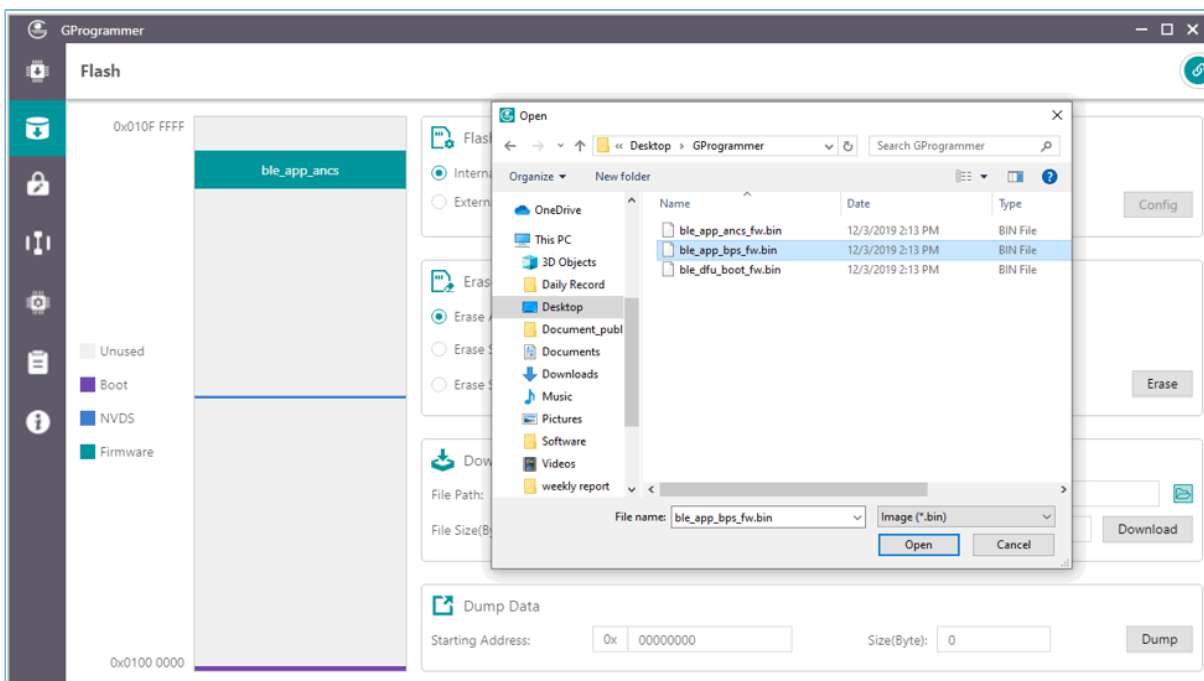


Figure 3-16 Viewing and selecting a data file to be downloaded

A Flash overflow error occurs when the downloaded file size is excessively large or the start address is out of range.

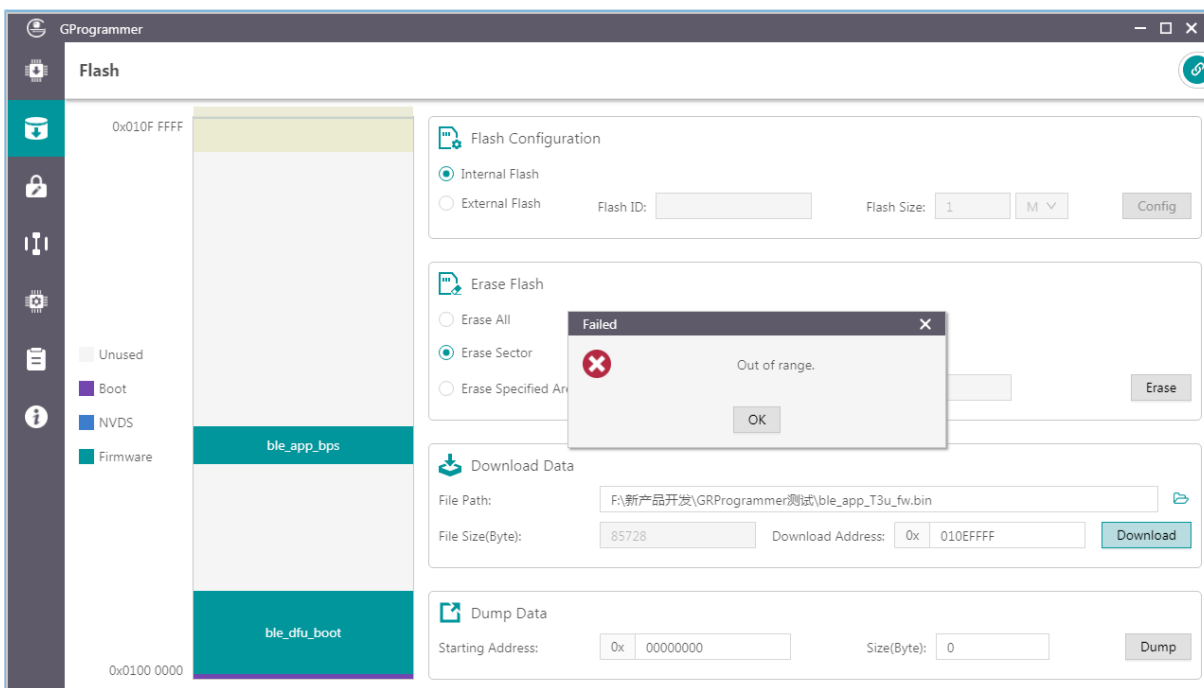


Figure 3-17 Flash overflow error

**Tip:**

- Users are allowed to forcibly download data to the Boot info space of GR551x series in SWD connection mode only. In UART mode, force download to the Boot info space is prohibited.
- Downloading data to the Boot info space is not supported by GR5526 series.

### 3.6.1.4 Dump Data

Users can dump any data in Flash memories to a local file by specifying a starting dump address and the data size.

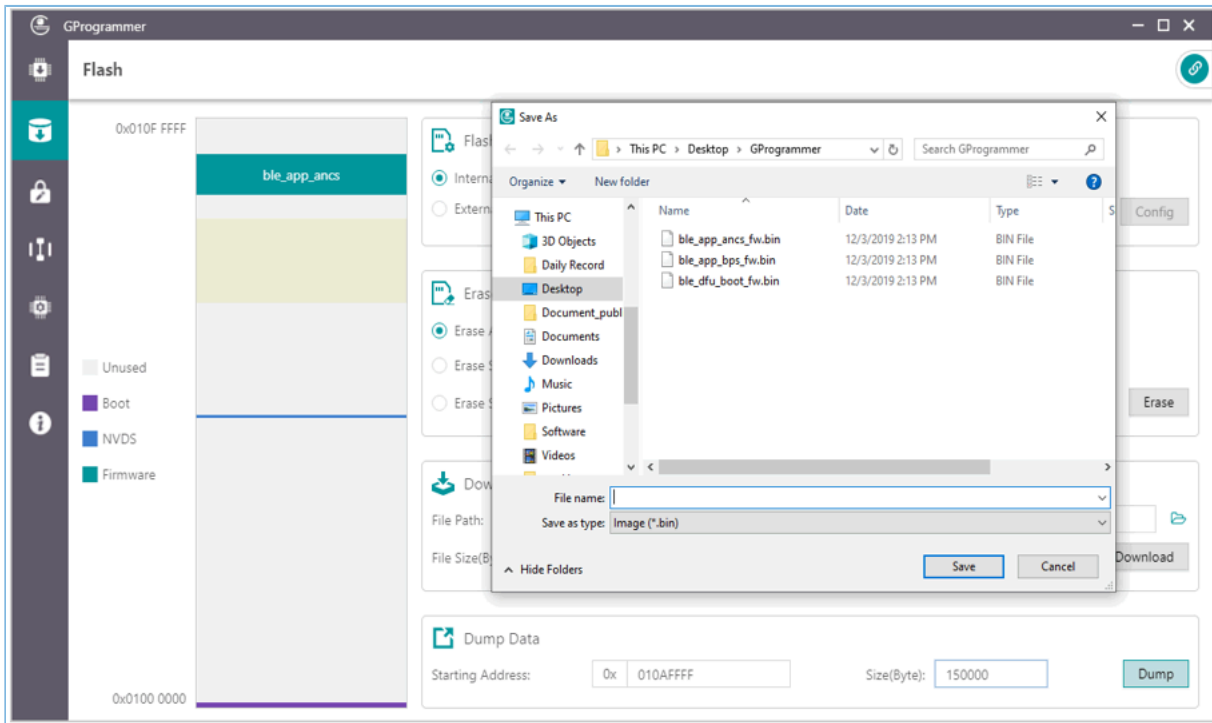


Figure 3-18 Dump Data on GProgrammer

## 3.6.2 External Flash

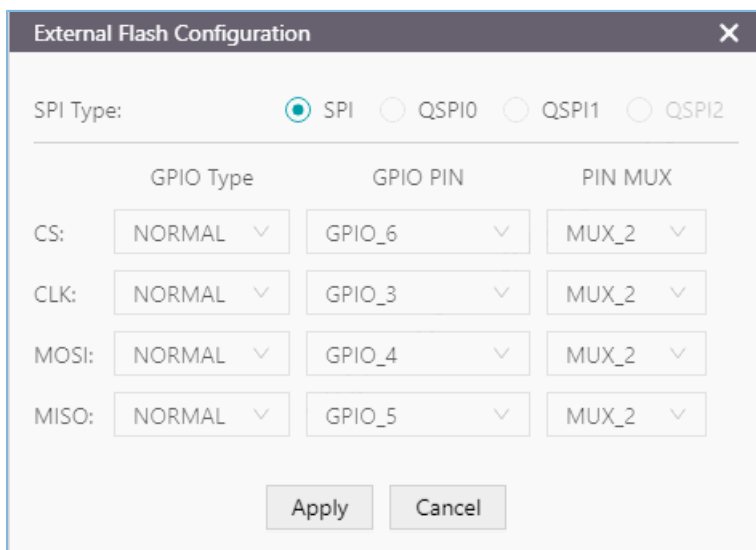
### 3.6.2.1 Flash Configuration

Select **External Flash** in the **Flash Configuration** list to program external Flash memories. Click **Config** to configure the SPI Type and pins based on actual demands.

Click **Apply** to complete the configuration.

**Tip:**

- Before clicking **Apply**, make sure external Flash memories are correctly connected to the target board in accordance with pin configurations. Incorrect connections lead to failures in communications between external Flash and the board.
- GPIO\_0 and GPIO\_1 are for device connection, and if they are configured as external Flash pins, GProgrammer will disconnect from the target board.

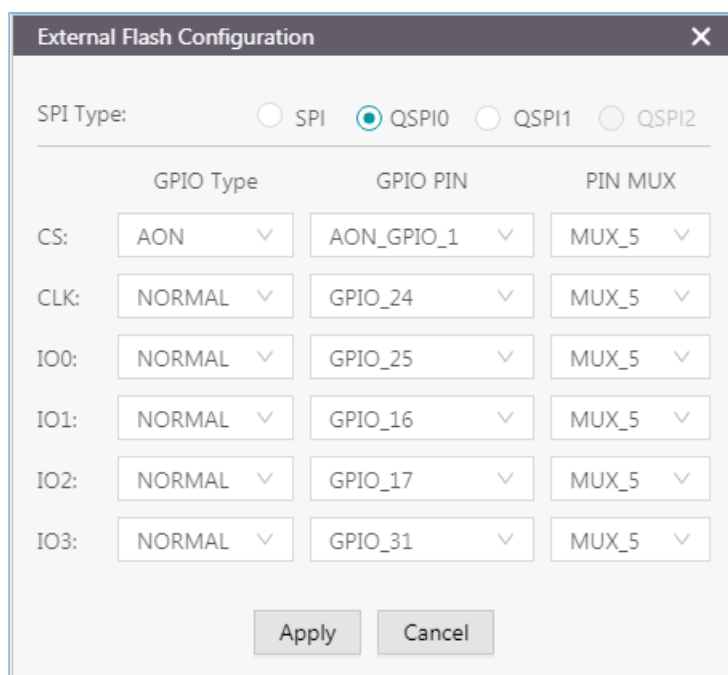


The screenshot shows the 'External Flash Configuration' dialog box with the 'SPI' radio button selected. The configuration table is as follows:

	GPIO Type	GPIO PIN	PIN MUX
CS:	NORMAL	GPIO_6	MUX_2
CLK:	NORMAL	GPIO_3	MUX_2
MOSI:	NORMAL	GPIO_4	MUX_2
MISO:	NORMAL	GPIO_5	MUX_2

Buttons: Apply, Cancel

Figure 3-19 SPI configurations



The screenshot shows the 'External Flash Configuration' dialog box with the 'QSPI0' radio button selected. The configuration table is as follows:

	GPIO Type	GPIO PIN	PIN MUX
CS:	AON	AON_GPIO_1	MUX_5
CLK:	NORMAL	GPIO_24	MUX_5
IO0:	NORMAL	GPIO_25	MUX_5
IO1:	NORMAL	GPIO_16	MUX_5
IO2:	NORMAL	GPIO_17	MUX_5
IO3:	NORMAL	GPIO_31	MUX_5

Buttons: Apply, Cancel

Figure 3-20 QSPI0 configurations

- Configure **Flash Size**

After users apply the pin configurations, GProgrammer reads and displays the external **Flash ID** based on which the **Flash Size** is automatically set.

Users need to manually set the **Flash Size** when GProgrammer fails to get the Flash size based on the accessed Flash ID.

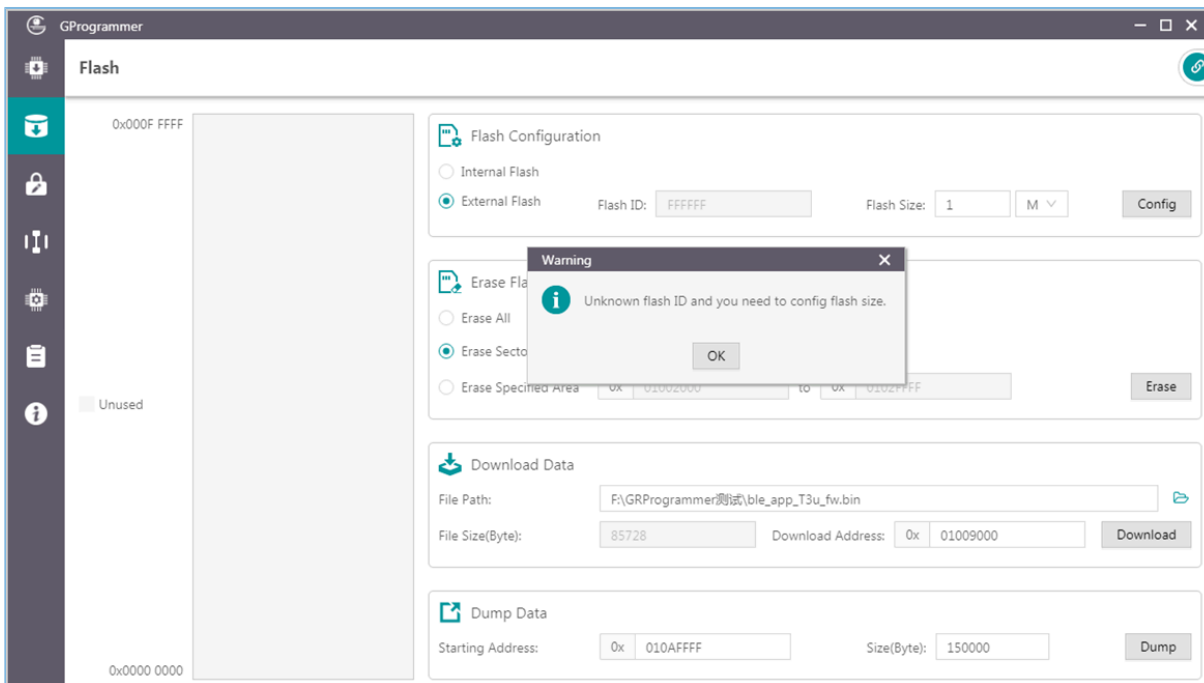


Figure 3-21 Unknown Flash ID

### 3.6.2.2 External Flash Programming

GProgrammer allows users to program Flash memories (erase Flash, download data to Flash, and dump data to a local file) within a valid address range.

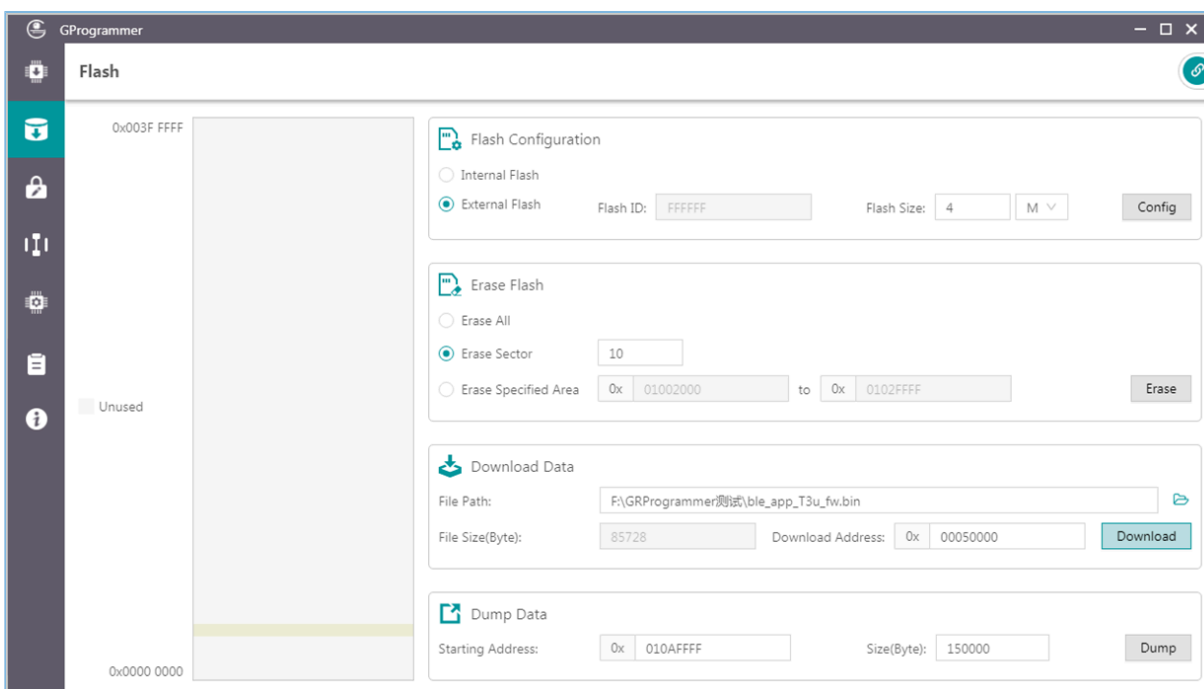


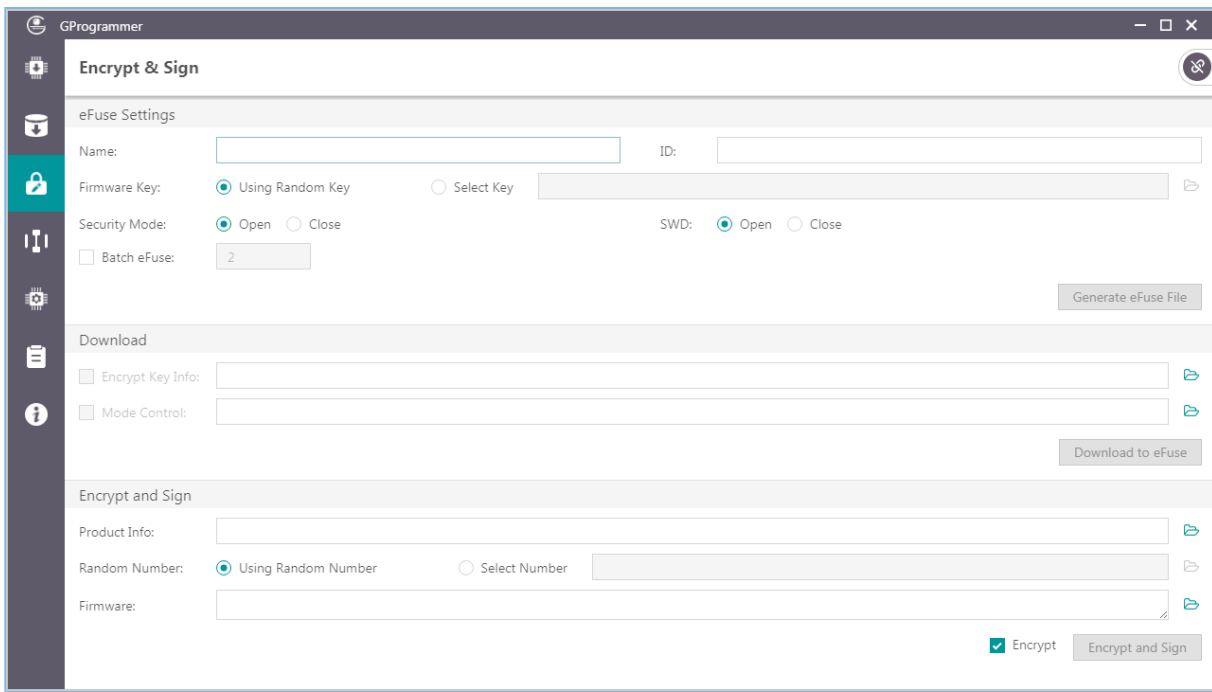
Figure 3-22 **Download Data** to external Flash on GProgrammer

 **Tip:**

No operation on external Flash is allowed before completing pin configurations.

## 3.7 Encrypt & Sign

Click  on the left side of the main interface of GProgrammer to open the **Encrypt & Sign** interface.

Figure 3-23 GProgrammer **Encrypt & Sign** interface

The selected SoCs support Security Mode and Non-security Mode. The mode is determined by the security mode of the product written in eFuse. When Security Mode is enabled, only firmware that has been encrypted and signed can be downloaded to Flash memories.

### 3.7.1 eFuse Settings

eFuse is a one-time programmable (OTP) memory with random access interfaces on SoCs. The eFuse stores product configurations, security mode control information, and keys for encryption and signing.

When using GProgrammer, users can generate eFuse files by specifying product names, IDs, and firmware keys, and by configuring security mode and SWD interfaces.

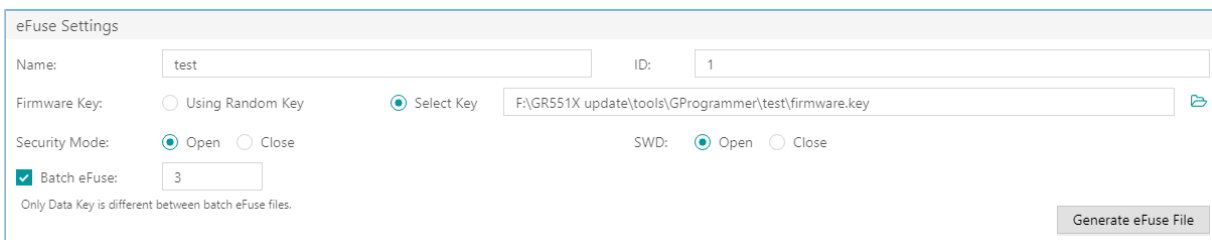


Figure 3-24 Setting eFuse parameters

#### Note:

- Firmware keys can be random keys generated by GProgrammer. Users can also add key files on demand.
- When **Security Mode** is enabled, users can choose to **Open** or **Close** the SWD interface.

GProgrammer allows users to generate multiple *Encrypt\_key\_info.bin* files in batches by checking **Batch eFuse**. The generated files are unique, meeting requirements of scenarios demanding one key for one device. For example, when users input “3” in the **Batch eFuse** box, GProgrammer generates three *Encrypt\_key\_info.bin* files: *Encrypt\_key\_info.bin*, *2\_Encrypt\_key\_info.bin*, and *3\_Encrypt\_key\_info.bin*.

Generated files are listed in the figure below:

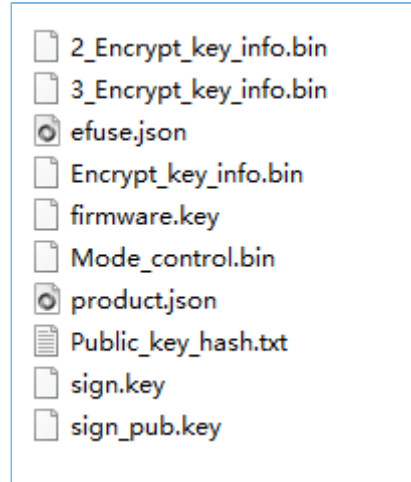


Figure 3-25 Generated files

- *efuse.json*: a temporary file
- *Encrypt\_key\_info.bin*, *2\_Encrypt\_key\_info.bin*, and *3\_Encrypt\_key\_info.bin*: files to be downloaded to eFuse, covering information on products, encryption, and signing. These files shall be downloaded to and stored in eFuse.
- *firmware.key*: a private key for encrypting firmware
- *Mode\_control.bin*: an eFuse file covering information on security mode and SWD. This file shall be downloaded to and stored in eFuse.
- *product.json*: a product information file. This file shall be imported to a GProgrammer when encrypting or signing firmware.
- *sign.key*: a private key to generate signatures
- *sign\_pub.key*: a public key to verify signatures
- *Public\_key\_hash.txt*: a public key hash file to verify signatures

To make files download to eFuse or firmware encryption and signing user-friendly, GProgrammer automatically loads the paths of the *Encrypt\_key\_info.bin* file and the *Mode\_control.bin* file to the **Download** area, and the path of the *product.json* file to the **Product Info** pane in the **Encrypt and Sign** area, as shown in the figure below.

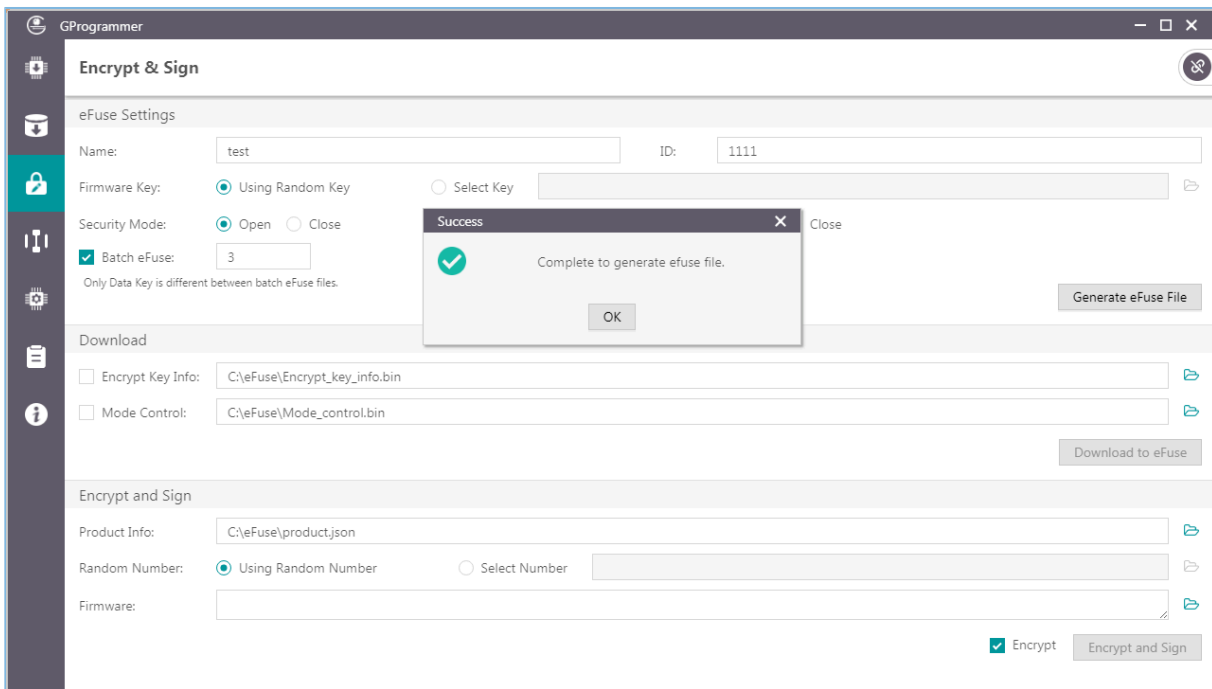


Figure 3-26 Paths for automatically loaded files

**Note:**

No modification of eFuse-generated files is allowed because any modification may lead to firmware encryption and signing failures.

### 3.7.2 Download

For users who have clicked **Generate eFuse File** to generate *Encrypt\_key\_info.bin* and *Mode\_control.bin* files in the **eFuse Settings** pane, select **Encrypt Key Info** and **Mode Control** in the **Download** pane, and click **Download to eFuse** to download the files to eFuse.

Otherwise, users need to manually add *Encrypt\_key\_info.bin* and *Mode\_control.bin* files before downloading the files to eFuse.

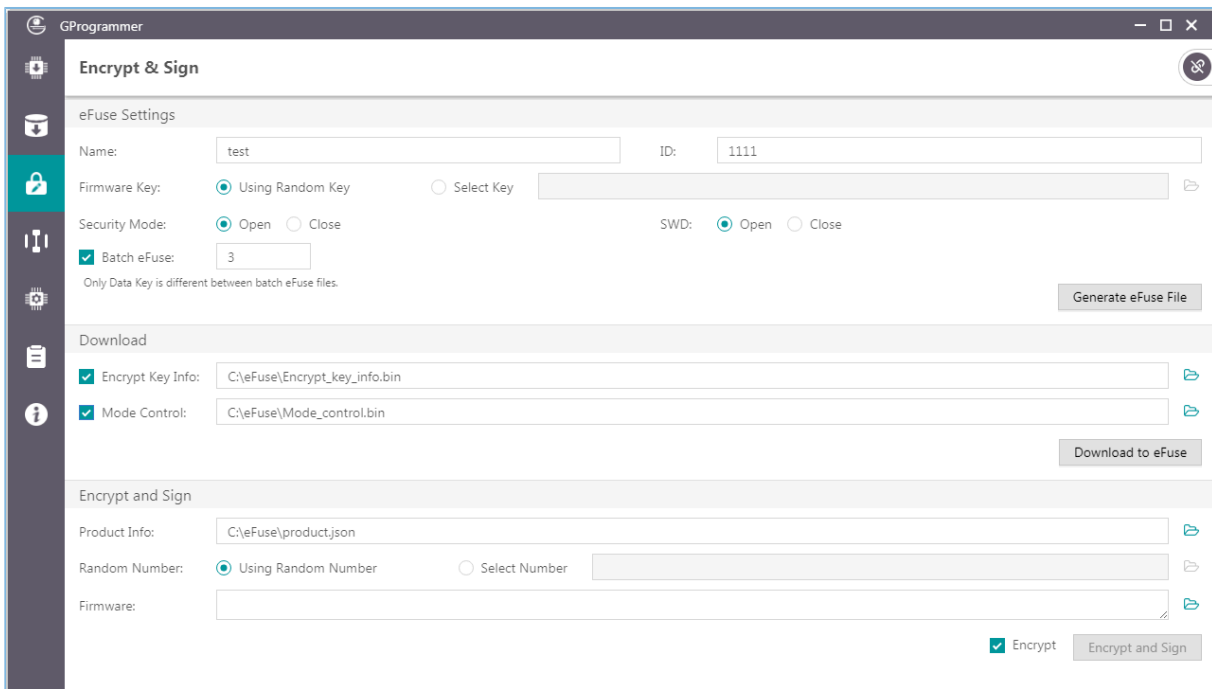


Figure 3-27 Downloading files to eFuse

#### Note:

eFuse information cannot be repeatedly downloaded to firmware.

### 3.7.3 Encrypt & Sign

When Security Mode is enabled, only firmware that has been encrypted and signed can be downloaded to Flash memories. GProgrammer allows users to encrypt and sign, or to sign multiple firmware files (HEX/BIN) by using one set of product information (**Product Info**) and one random number (**Random Number**).

The **Random Number** can be manually set by users or generated by GProgrammer.

When adding more than one firmware file, separate each file path with a semicolon (;), as shown in [Figure 3-28](#).

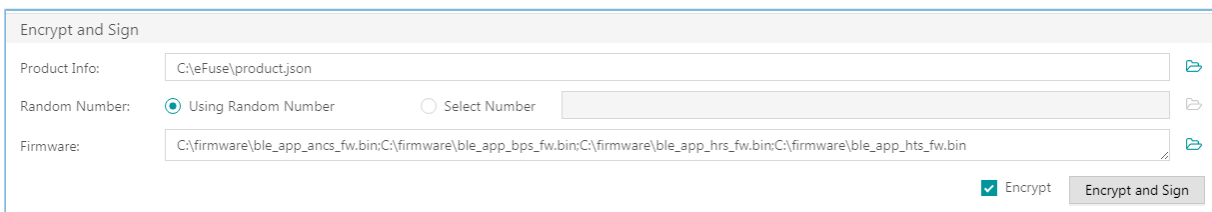


Figure 3-28 Adding more than one firmware file

To encrypt and sign the firmware, check the **Encrypt** box, and the button changes from **Sign** to **Encrypt and Sign**; to sign the firmware only, clear the **Encrypt** box, and the button changes back to **Sign**. Choose the directory to save the (encrypted and) signed firmware, and click **Encrypt and Sign/Sign**.

Files after being encrypted and signed are generated in BIN formats with details listed below:

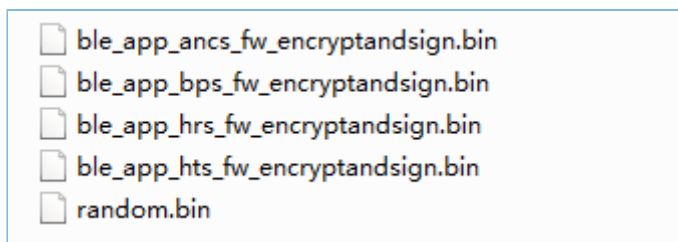


Figure 3-29 GProgrammer-generated files after encryption and signing

Files after being signed are listed below:

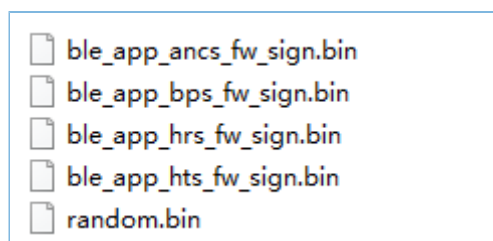


Figure 3-30 GProgrammer-generated files after signing

---

 **Note:**

The random number generated by GProgrammer is for encryption algorithms. After users perform encryption and signing of firmware files, the *random.bin* file is stored in the same directory as encrypted and signed firmware files. Users can view and add the *random.bin* file to GProgrammer next time they use the random number for firmware encryption and signing.

---

## 3.8 eFuse Layout

Click  on the left side of the main interface of GProgrammer to open the **eFuse Layout** interface.

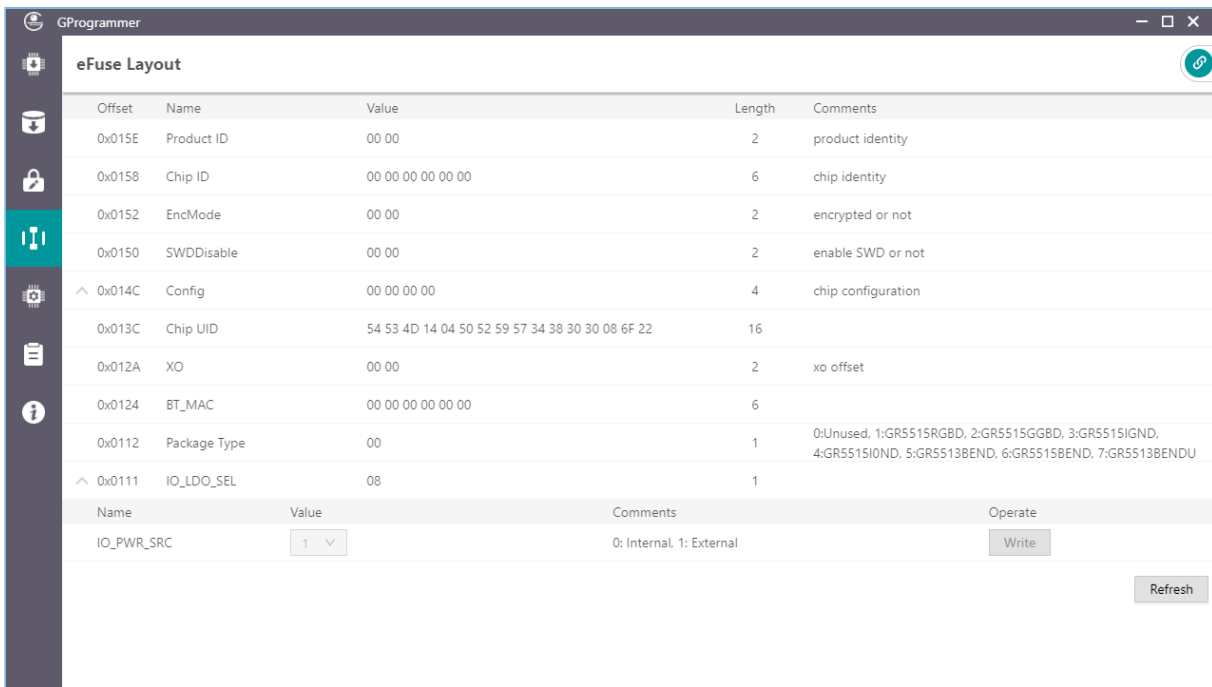


Figure 3-31 eFuse Layout interface

GProgrammer presents users with eFuse layout information: **Offset**, **Value**, **Length**, and **Comments** of fields including but not limited to **Product ID**, **Chip ID**, **EncMode**, **SWDDisable**, **Config**, and **IO\_LDO\_SEL**. Among them, the **Config** and **IO\_LDO\_SEL** fields contain multiple bit fields.

Click **Refresh** to obtain the values of all fields or bit fields.

Click ^ before **Offset** of **Config** or **IO\_LDO\_SEL** to expand the detailed bits, as shown in the figure below. Click ▼ or double-click **Config** or **IO\_LDO\_SEL** to collapse the detailed bits.

You can change the **IO\_PWR\_SRC** value in the **IO\_LDO\_SEL** field to set the power source of peripherals.

#### Note:

You can only change the **IO\_PWR\_SRC** value from "0" to "1". The contrary direction is not allowed.

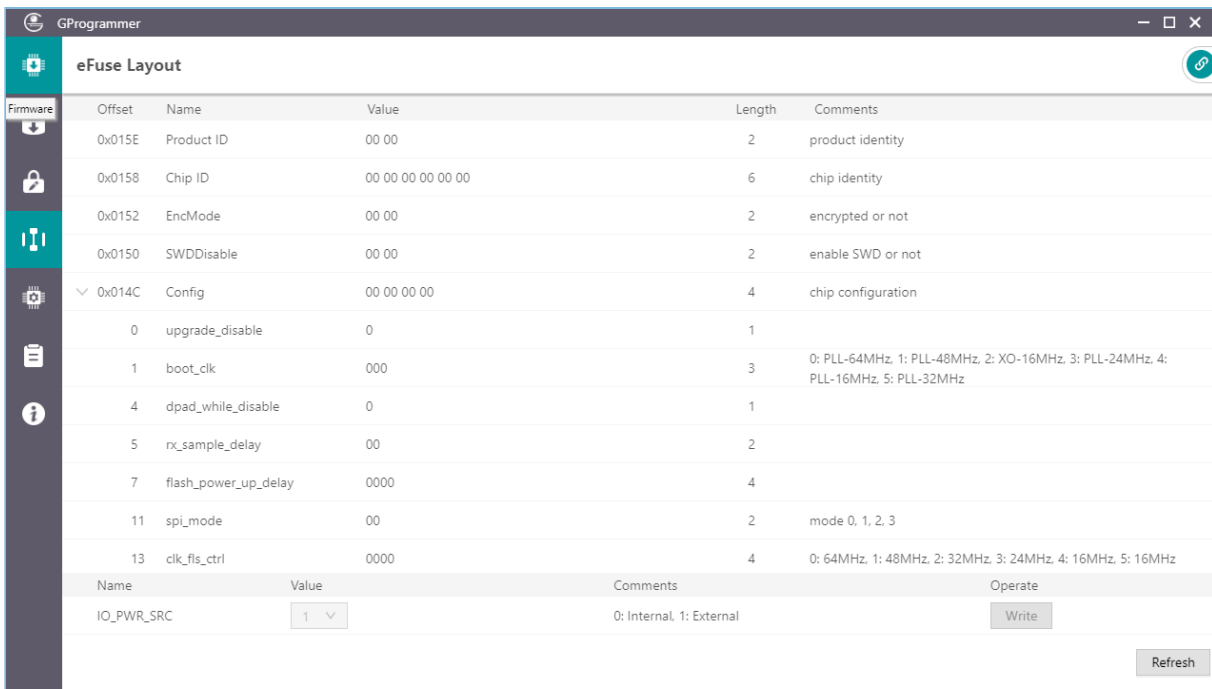


Figure 3-32 Expanded Offset

**Note:**

The fields and bit fields listed in the interface are stored in the *efuse\_config.json* file in the config folder. Information stored in eFuse is more than just the listed fields and bit fields.

### 3.9 Chip Configuration

Click  on the left side of the main interface of GProgrammer to open the **Chip Configuration** interface.

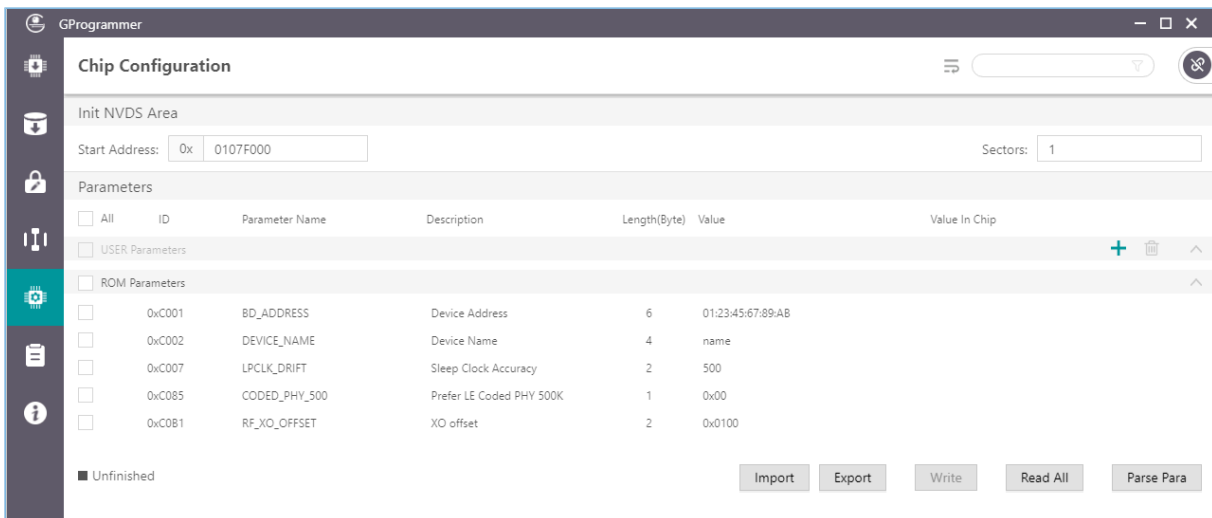


Figure 3-33 GProgrammer Chip Configuration interface

GProgrammer allows users to set the parameters (including **USER Parameters** and **ROM Parameters**) stored in the NVDS area.

- **USER Parameters:** user-defined parameters that can be added, deleted, and modified
- **ROM Parameters:** ROM parameters stored on GR551x SoCs, which can be modified only by users. Neither parameter addition nor deletion is allowed.

 **Note:**



- The default ROM parameters listed in the interface are stored in the *nvds\_config.json* file in the config folder. The parameters are not results accessed in real time from the NVDS area. For more information about ROM parameters, see [Table 3-6](#).
- Click  in the upper-right corner of the **Chip Configuration** interface to enable display of complete value contents of a parameter.
- Look up parameters quickly by using the  screening box in the upper-right corner of the interface.

Table 3-6 NVDS ROM parameters

ID	Parameter Name	Description
0xC001	BD_ADDRESS	This parameter sets the Bluetooth device address.
0xC002	DEVICE_NAME	This parameter sets the device name.
0xC007	LPCLK_DRIFT	This parameter sets the Sleep Clock Accuracy (SCA); range: 10 ppm to 500 ppm
0xC085	CODED_PHY_500	This parameter sets the default Coded PHY value; Value 0: 125 kbps; Value 1: 500 kbps
0xC0B1	RF_XO_OFFSET	This parameter sets the clock calibration byte; range: 0x000 to 0x1FF

### 3.9.1 Init NVDS Area

Prior to configuring NVDS parameters, users need to specify a start address (4 KB aligned) and the number of occupied sectors in the NVDS area.

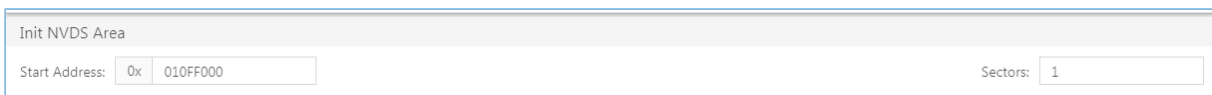


Figure 3-34 Setting the start address and sector quantity in the NVDS area

NVDS initialization fails when the configured NVDS area overlaps with the existing firmware area.

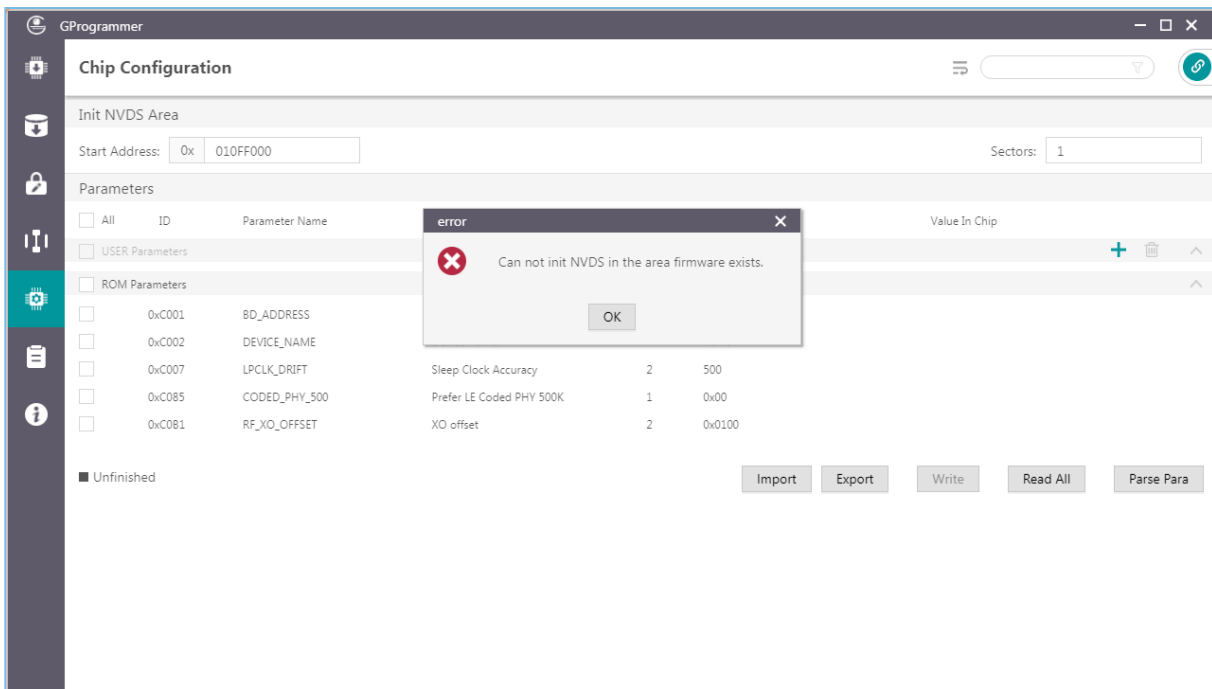


Figure 3-35 NVDS initialization failure

### 3.9.2 Read All

GProgrammer can read all parameters in the current NVDS area and display them in the **Parameters** pane.

To prevent operation failures in user applications due to parameter overlapping in the NVDS area, users are recommended to click **Read All** after connecting the target board to the host.

GProgrammer provides three parameter states: **Unfinished**, **Same**, and **Different**, which help you quickly identify the parameter state in the current NVDS. Details are listed below:

- **Unfinished:** Parameters in unfinished state are presented in black. These parameters are either new ones different from the default listed parameters after users click **Read All** (example: 0x4000 in [Figure 3-36](#)) or ones that have been listed in the NVDS area but with a different parameter length (example: 0x4001 in [Figure 3-36](#)).
- **Same:** Parameters in same state are presented in green, indicating the parameters already exist in the NVDS area and have the same length and value as those in the default list (example: 0x4002 in [Figure 3-36](#))
- **Different:** Parameters in different state are presented in orange, indicating the parameters already exist in the NVDS area and have the same length as but a different value from default listed parameters (example: 0x4003 in [Figure 3-36](#))

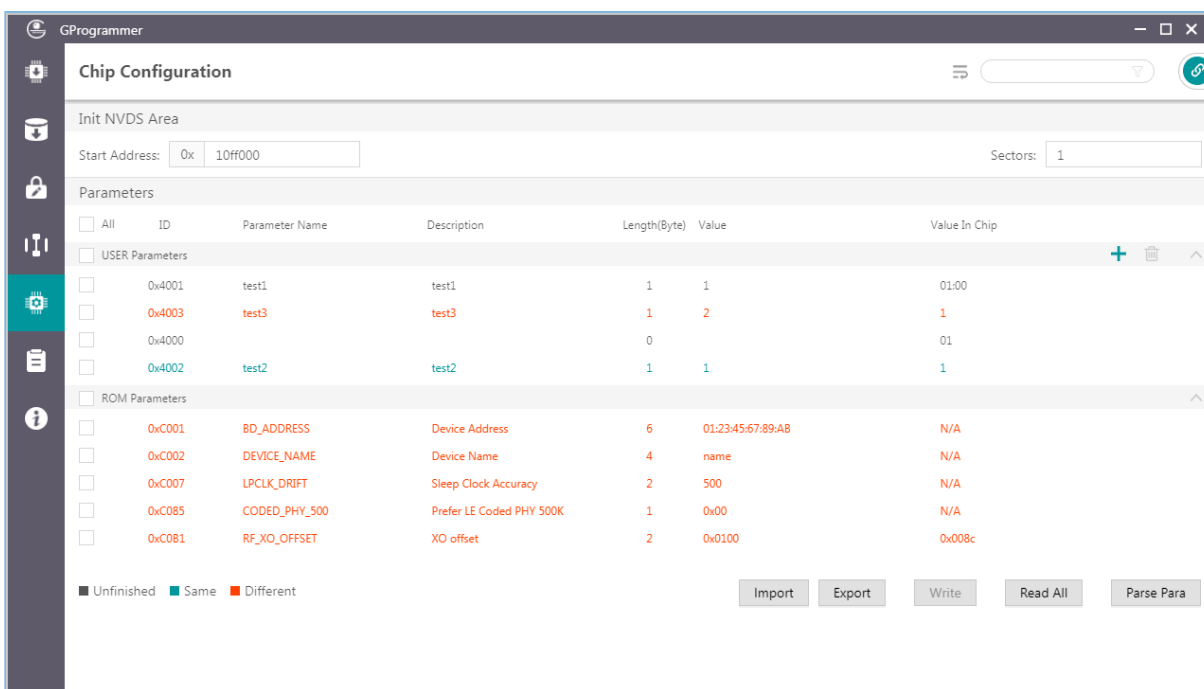


Figure 3-36 Read All interface

### 3.9.3 Write

Select parameters to be written to NVDS, and click **Write**.

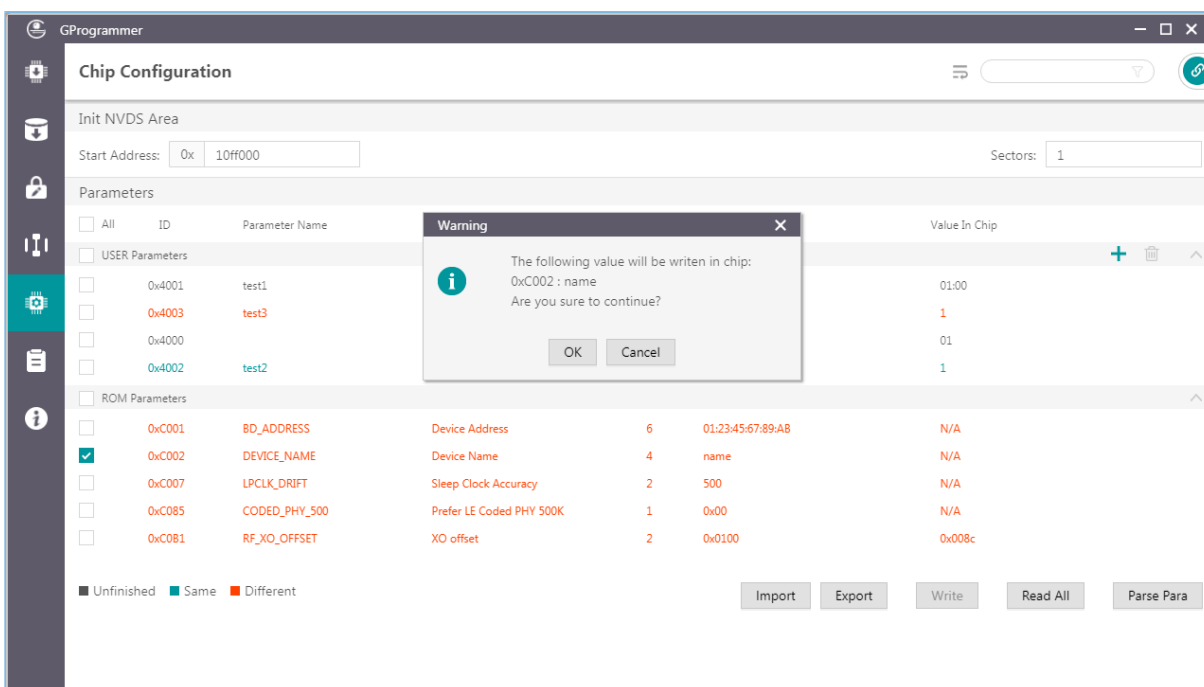



Figure 3-37 Write parameters to NVDS

 **Tip:**

- Parameters in unfinished state cannot be written to NVDS directly.
- You can select more than one parameter to implement a batch write.
- When an unfinished parameter is selected, **Write** is unavailable.

### 3.9.4 Add a User Parameter

Follow the steps below to add a user parameter to NVDS.

- Click  to open the **Add USER Parameter** window.
- Specify the **ID**, **Parameter Name**, **Description**, **Type**, **Length(Byte)**, **Value**, and data presentation format (**dec** or **hex**).

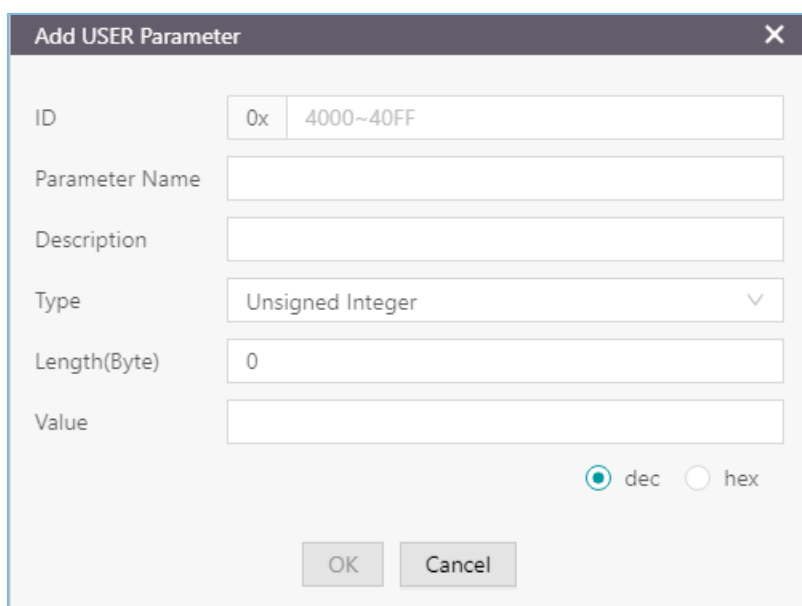


Figure 3-38 Adding a user parameter to NVDS

- Click **OK** to complete the adding.

 **Note:**

- You cannot input a parameter ID that is identical with those listed in the **Parameters** pane. Otherwise, a warning dialog box pops up, as shown in [Figure 3-39](#).
- If the added ID is different from those existing in the NVDS, the added parameter is directly written to NVDS.
- If the ID of a to-be-added parameter already exists in NVDS and the two parameters with the same ID are of the same length, the to-be-added parameter is written to NVDS.
- If the ID of a to-be-added parameter already exists in NVDS but the two parameters with the same ID are of different lengths, the to-be-added parameter is not written to NVDS. Users need to modify the parameter length before writing it to NVDS.

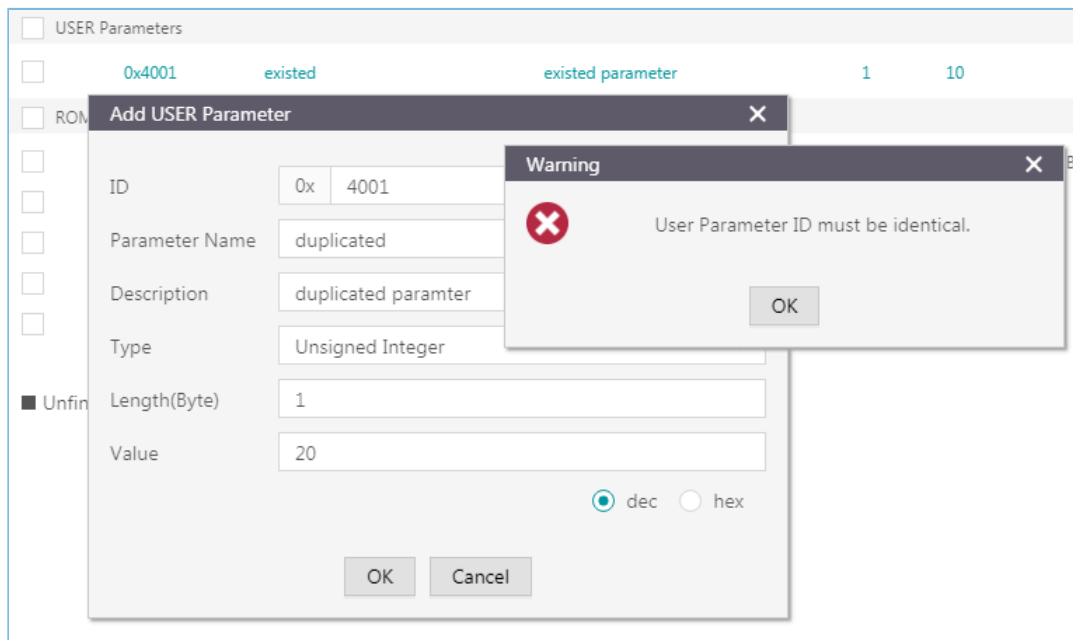


Figure 3-39 Failure to add a user parameter due to an identical parameter ID

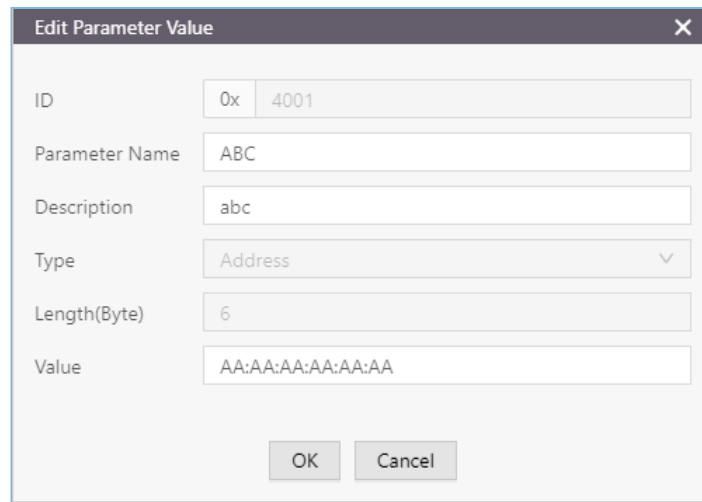
### 3.9.5 Modify NVDS Parameters

Users can modify both the **USER Parameters** and **ROM Parameters**.

**ROM Parameters:** You can modify the **Parameter Name**, **Description**, and **Value** of a ROM parameter. The modification on a parameter value does not lead to changes in the parameter length (except varying-length character strings).

**USER Parameters:** For user parameters in same and different states, the **Parameter Name**, **Description**, and **Value** can be modified. For user parameters in unfinished state, the **Type** and **Length(Byte)** can be modified.

Double-click a parameter to be modified, and edit the parameter information in the pop-up window. Click **OK** to write the modifications into NVDS.



The 'Edit Parameter Value' dialog box contains the following fields:

- ID:** 0x 4001
- Parameter Name:** ABC
- Description:** abc
- Type:** Address (dropdown menu)
- Length(Byte):** 6
- Value:** AA:AA:AA:AA:AA:AA

Buttons: OK, Cancel

Figure 3-40 Edit Parameter Value window

**Note:**

Parameters in unfinished state with a modified length that is different from that in the NVDS remain unfinished. Such parameters cannot be automatically written into the NVDS.

### 3.9.6 Remove a User Parameter

Users can remove user parameters only.

Select a parameter to be removed, and click **Delete** to remove the parameter from the NVDS.

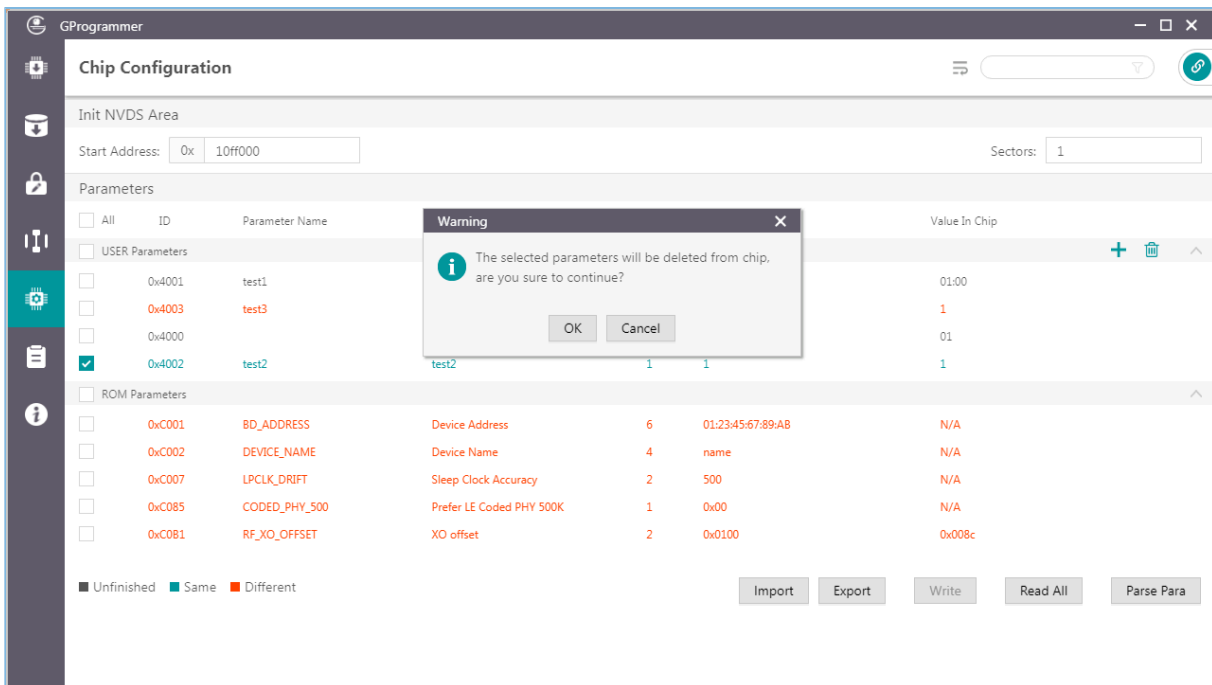


Figure 3-41 Removing a parameter

**Tip:**

- You can select more than one parameter and click **Delete** to implement a batch removal.
- When a ROM parameter is selected, **Remove** is unavailable ( **Delete** is in grey).

### 3.9.7 Import and Export

GProgrammer allows users to export the selected parameter data (**Parameter Name**, **Description**, **Length**, and **Value**) to a local JSON configuration file and import local JSON configuration files to GProgrammer.

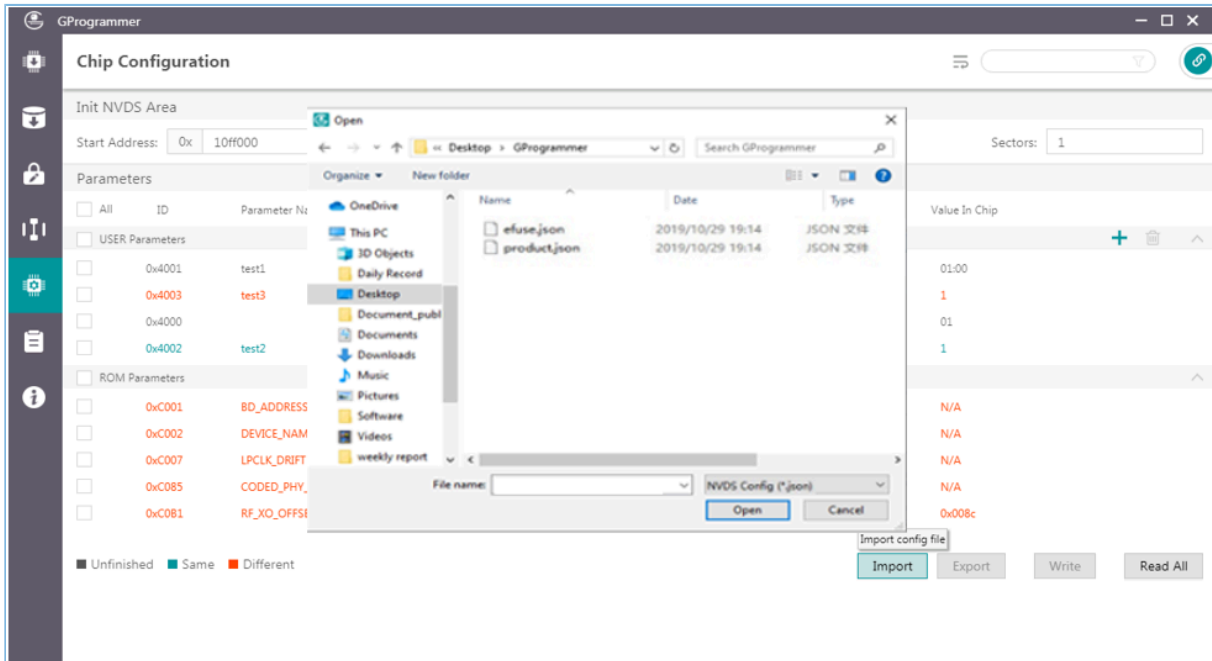


Figure 3-42 Importing local JSON configuration files to GProgrammer

**Tip:**

- Parameters in the imported JSON files replace all those listed in the **Parameters** pane.
- Export modified parameter data to a local JSON file to prevent repeated modification.
- Export** is unavailable when parameters in unfinished state exist.

### 3.9.8 Parse Data in the NVDS Area

GProgrammer provides users with data parsing functionality **Parse Para**. It supports parsing data read from the NVDS area or loaded from a local data file.

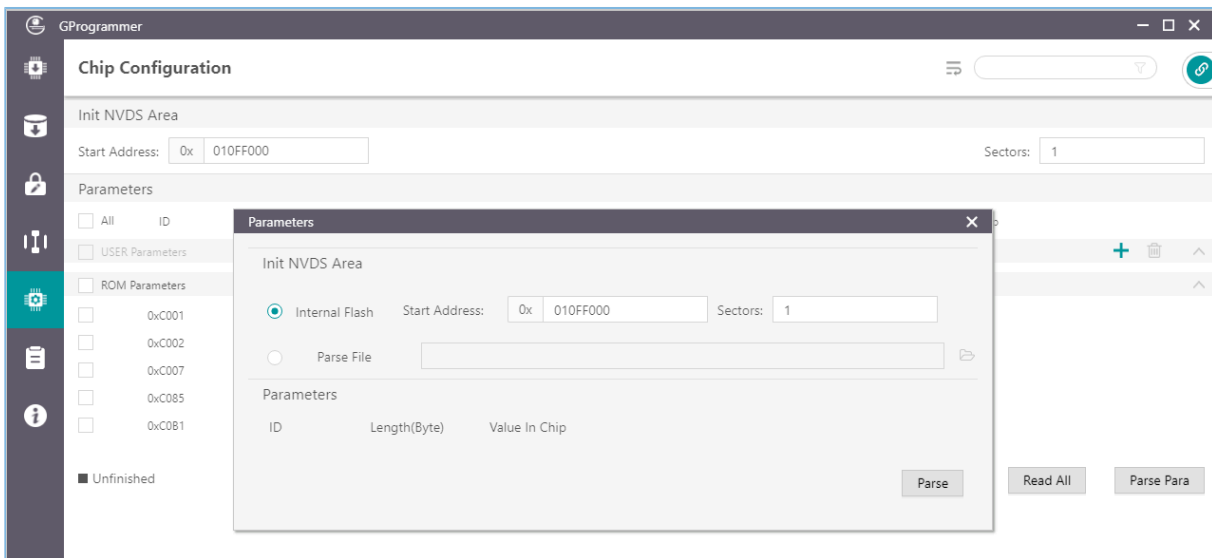


Figure 3-43 Configuring to-be-parsed data

- To parse data read from the NVDS area, choose **Internal Flash**, and then set the start address of the NVDS area (4 KB aligned) as well as the number of occupied sector(s).

The area shall be in the range configured for NVDS parameters, with start address and the number of occupied sector(s) as detailed in "[Section 3.9.1 Init NVDS Area](#)". Otherwise, data parsing fails.

- To parse data loaded from a local data file, choose **Parse File**, and then select an exported NVDS data file locally.

#### Note:

- This functionality is applicable to non-encrypted data only.
- When parsing starts by clicking **Parse**, the sequence of data parsing and result display is identical with that of Flash memory data. **Value in Chip** is in little-endian mode.

## 3.10 Device Log

Click  on the left side of the main interface of GProgrammer to open the **Device Log** interface.

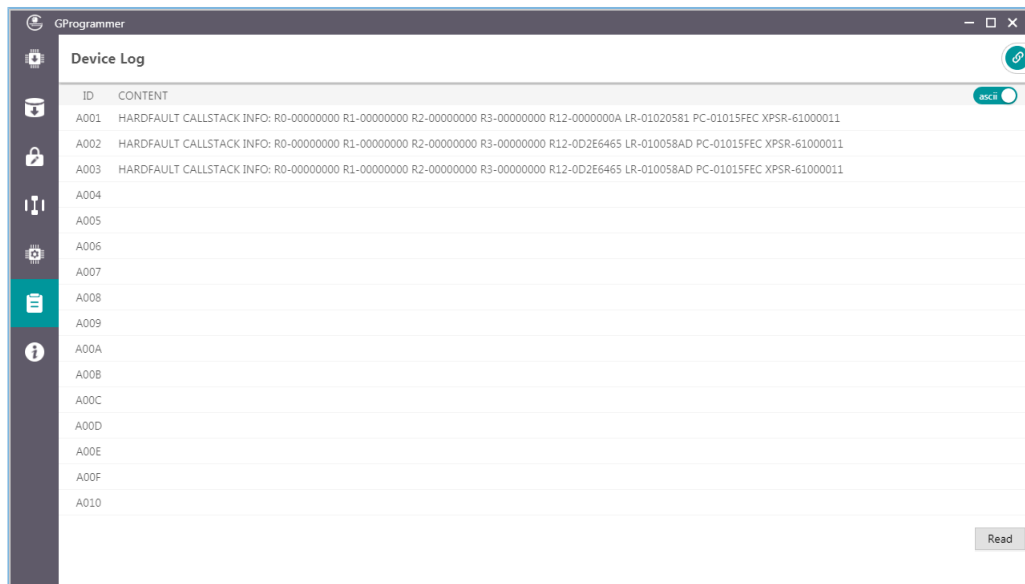




Figure 3-44 Device Log interface



Users can view device logs, mainly error information during SoC running, on GProgrammer. Click **Read** to retrieve the device logs.

 **Note:**

Prior to viewing device logs, make sure you have performed the following:

- Write device error code into the NVDS by using the application firmware (NVDS ID: A001–A010).
- Initialize the NVDS area correctly on GProgrammer, and the initialization result is identical with the value defined in the application firmware.

In the interface, click  or  in the upper-right corner to switch the mode in displaying device logs between ASCII and stream.

- : The device logs are displayed by ASCII character as shown in [Figure 3-45](#).
- : The device logs are displayed by byte stream as shown in [Figure 3-46](#).

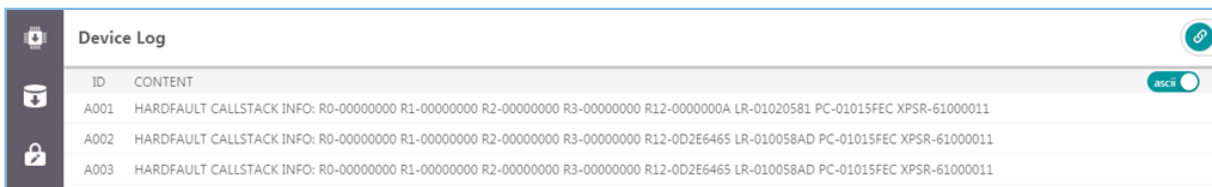


Figure 3-45 Device logs in ASCII characters

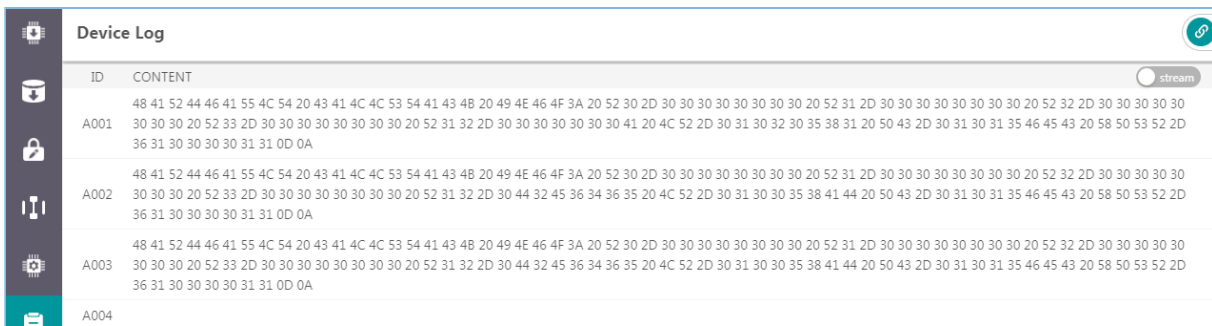


Figure 3-46 Device logs in byte streams

## 3.11 Command-line Programs

Goodix provides two command-line programs in the GProgrammer installation directory: *GR5xxx\_console.exe* and *GR5xxx\_encrypt\_signature.exe*.

### Note:

GR5xxx, representing the name of SoC series, includes GR551x and GR5526.

- *GR5xxx\_console.exe* supports firmware download and Flash programming in SoCs in a command-line interface.
- *GR5xxx\_encrypt\_signature.exe* supports firmware encryption and (or) signing in a command-line interface.

### 3.11.1 GR5xxx\_console.exe

Follow the steps below to run *GR5xxx\_console.exe*:

1. Open the **Command Prompt** window from the **Start** menu or by entering **cmd** in the **Run** window.
2. Navigate to the GProgrammer installation directory by using **cd** command.
3. Type the *GR5xxx\_console.exe* command to complete corresponding operations. The details about the command are shown in [Table 3-7](#).

Table 3-7 GR5xxx\_console supported commands

Command	Functional Description	Command Format and Parameter Description	Remarks
program	Programs firmware files to internal SoC Flash memories.	<p>program &lt;firmware file path&gt; &lt;run immediately:y   n&gt;            &lt;flash start address(hex)&gt; &lt;flash size&gt; &lt;product type&gt;            &lt;S/N(optional)&gt;</p> <p>Parameter description:</p> <ul style="list-style-type: none"> <li>• &lt;firmware file path&gt;: It sets the path of the to-be-downloaded firmware file.</li> <li>• &lt;run immediately:y   n&gt;: It decides on whether to run the firmware immediately after downloading.</li> </ul>	<p>The following parameters apply to all commands:</p> <ul style="list-style-type: none"> <li>• &lt;flash start address(hex)&gt;: It sets the start address in the Flash memories to which firmware files are downloaded. Value:</li> </ul>

Command	Functional Description	Command Format and Parameter Description	Remarks
erase	Erases Flash memory data within an SoC based on a specified address range.	<p>erase &lt;start address(hex)&gt; &lt;end address(hex)&gt;&lt;force erase when conflict with firmware/bootinfo:y   n&gt;</p> <p>&lt;flash start address(hex)&gt; &lt;flash size&gt; &lt;product type&gt;</p> <p>&lt;S/N(optional)&gt;</p> <p>Parameter description:</p> <ul style="list-style-type: none"> <li>&lt;start address(hex)&gt;: It represents the start address of the storage area to be erased (in hexadecimal).</li> <li>&lt;end address(hex)&gt;: It represents the end address of the storage area to be erased (in hexadecimal).</li> <li>&lt;force erase when conflict with firmware/bootinfo:y   n&gt;: This parameter decides whether to forcibly erase the flash memory data when its address conflicts with that of firmware, Boot info, or NVDS.</li> </ul>	<ul style="list-style-type: none"> <li>0x01000000: for GR551x</li> <li>0x00200000: for GR5526</li> </ul> <p>• &lt;flash size&gt;: It indicates the Flash size (unit: KB) of the selected SoC. For value details, see the <b>Flash</b> column in <a href="#">Figure 3-3</a>.</p> <p><b>Note:</b> For SoCs with 0 KB Flash, the external Flash size applies.</p> <ul style="list-style-type: none"> <li>&lt;product type&gt;: It indicates the SoC series. Valid value and description: <ul style="list-style-type: none"> <li>0: GR551x</li> <li>1: GR5526</li> </ul> </li> <li>&lt;S/N(optional)&gt;: Serial number to identify devices to be operated, which is required only when a PC is connected with multiple DUTs.</li> </ul>
eraseall	Erases all Flash memory data within an SoC.	eraseall <product type> <S/N(optional)>	
download	Downloads data files to internal SoC Flash memories.	<p>download &lt;data file path&gt; &lt;start address(hex)&gt;&lt;force download when conflict with firmware/bootinfo:y   n&gt; &lt;flash start address(hex)&gt; &lt;flash size&gt;</p> <p>&lt;product type&gt; &lt;S/N(optional)&gt;</p> <p>Parameter description:</p> <ul style="list-style-type: none"> <li>&lt;data file path&gt;: It sets the path of the to-be-downloaded data file.</li> <li>&lt;start address(hex)&gt;: It represents the start address of the download area (in hexadecimal).</li> <li>&lt;force download when conflict with firmware/bootinfo:y   n&gt;: This parameter decides whether to forcibly download the data files to internal SoC Flash memories when their addresses conflict with that of firmware or Boot info.</li> </ul>	
writeefuse	Writes Encrypt Key Info and Mode Control files to eFuse.	<p>writeefuse &lt;Encrypt Key Info file Path&gt; &lt;Mode Control file Path&gt; &lt;product type&gt; &lt;S/N(optional)&gt;</p> <p>Parameter description:</p> <ul style="list-style-type: none"> <li>&lt;Encrypt Key Info file Path&gt;: It sets the path of Encrypt Key Info file.</li> <li>&lt;Mode Control file Path&gt;: It sets the path of Mode Control file.</li> </ul>	
reset	Resets the GR551x SoC.	reset <product type> <S/N(optional)>	

Command	Functional Description	Command Format and Parameter Description	Remarks
generate	Converts firmware files into BIN files that can be used by the SoC	generate <input firmware file path> <output firmware file path> <flash start address(hex)> <flash size> <product type> Parameter description: <ul style="list-style-type: none"> <li>&lt;input firmware file path&gt;: It indicates the path of an imported file (HEX/BIN file generated via integrated development environment tools).</li> <li>&lt;output firmware file path&gt;: It indicates the output file of an exported file.</li> </ul>	
device	Obtains J-Link device information, such as device name and serial number.	device <display count(optional)> Parameter description: <ul style="list-style-type: none"> <li>&lt;display count(optional)&gt;: It sets the number of device information parameters to be displayed.</li> </ul>	
load	Loads firmware, such as Flash and RAM firmware.	load <firmware file path> <erase type> <run immediately:y   n> <S/N(optional)> Parameter description: <ul style="list-style-type: none"> <li>&lt;firmware file path&gt;: It sets the path of the to-be-downloaded firmware file.</li> <li>&lt;erase type&gt;: It sets the type to erase Flash, with the following options:               <ul style="list-style-type: none"> <li><b>sector</b>: Erases Flash space occupied by boot info and firmware.</li> <li><b>chip</b>: Erases all Flash spaces.</li> <li><b>none</b>: Erases the firmware space only.</li> </ul> </li> <li>&lt;run immediately:y   n&gt;: It decides on whether to run the firmware immediately after downloading.</li> </ul>	
help	Displays all help information.	help	

Take GR551x SoC as an example. The code below shows how to use the `program` command to download a firmware file to SoC Flash memories and run the firmware immediately after downloading. Command line:

```
GR5xxx_console.exe program "D:/test/test_fw.bin" y "0x01000000" 1024 0
```

The parameter descriptions are listed below:

- "D:/test/test\_fw.bin": It indicates the path for the to-be-downloaded firmware BIN file
- "0x01000000" 1024 0: It represents the start address in Flash to which the firmware is downloaded (0x01000000), the Flash size (1024 KB), and SoC model (GR551x) respectively.

The downloading progress is displayed in real time during executing the program command.

 **Note:**

You cannot operate *GR5xxx\_console.exe* while GProgrammer is running.

### 3.11.2 GR5xxx\_encrypt\_signature.exe

Follow the steps below to run *GR5xxx\_encrypt\_signature.exe*:

1. Open the **Command Prompt** window from the **Start** menu or by entering **cmd** in the **Run** window.
2. Navigate to the GProgrammer installation directory by using **cd** command.
3. Type **GR5xxx\_encrypt\_signature.exe --parameter** to complete corresponding operations.  
For most frequently used parameters, see [Table 3-8](#). To view all parameters, enter **GR5xxx\_encrypt\_signature.exe --help**.

Table 3-8 Frequently used parameters for *GR5xxx\_encrypt\_signature.exe*

Parameter	Description	Remarks
operation	Indicates the operation type. Options: <ul style="list-style-type: none"> <li>• encryptandsign: Encrypt and sign firmware.</li> <li>• sign: Sign firmware only</li> </ul>	
firmware_key	Shows the directory of <i>firmware.key</i> , which is used for firmware encryption and signing, or signing only.	The directories correspond to the paths you have set when you click <b>Generate eFuse File</b> in " <a href="#">Section 3.7.1 eFuse Settings</a> ".
signature_key	Shows the directory of <i>sign.key</i> , which is used for firmware encryption and signing, or signing only.	
signature_pub_key	Shows the directory of <i>sign_pub.key</i> , which is used for firmware encryption and signing, or signing only.	
product_json_path	Shows the directory of <i>product.json</i> , which is used for firmware encryption and signing, or signing only.	
rand_number	Shows the directory of <i>random.bin</i> , which is used for firmware encryption and signing, or signing only.	
ori_firmware	Shows the directory that saves the firmware before encryption and signing, or signing only.	
output	Shows the directory that saves the firmware after encryption and signing, or signing only.	
base_addr	Sets the start address in the Flash memories to which firmware files are downloaded. Value: <ul style="list-style-type: none"> <li>• 0x01000000: for GR551x</li> <li>• 0x00200000: for GR5526</li> </ul>	

Parameter	Description	Remarks
flash_size	Indicates the Flash size (unit: KB) of the selected SoC. For value details, see the <b>Flash</b> column in <a href="#">Figure 3-3</a> .  <b>Note:</b> For SoCs with 0 KB Flash, the external Flash size applies.	
product_type	Indicates the SoC series. Valid value and description: <ul style="list-style-type: none"><li>0: GR551x</li><li>1: GR5526</li></ul>	
help	Displays help information.	

Take GR551x SoC as an example. The code below shows how to encrypt and sign firmware by using *GR5xxx\_encrypt\_signature.exe*:

```
GR5xxx_encrypt_signature.exe --operation="encryptandsign" --firmware_key="D:/test/eFuse/firmware.key" --signature_key="D:/test/eFuse/sign.key" --signature_pub_key="D:/test/eFuse/sign_pub.key" --product_json_path="D:/test/eFuse/product.json" --rand_number="D:/test/eFuse/random.bin" --ori_firmware="D:/test/firmware/test_fw.bin" --output="D:/test/firmware_encryptAndSign/test_fw_encryptAndSign.bin" --random_output="D:/test/firmware_encryptAndSign/random.bin" --base_addr="0x01000000" --flash_size="1024" --product_type="0"
```

In the code snippet above, the **D:/test/eFuse/** directories show the user-defined folders where files are saved after users click **Generate eFuse File**, as described in “[Section 3.7.1 eFuse Settings](#)”. For descriptions of other parameter, see [Table 3-8](#).

- --ori\_firmware="D:/test/firmware/test\_fw.bin": the directory of the firmware before any operation
- --output="D:/test/firmware\_encryptAndSign/test\_fw\_encryptAndSign.bin": the directory of the encrypted and signed firmware
- --base\_addr="0x01000000" --flash\_size="1024" --product\_type="0": the start address in Flash to which the firmware is downloaded (0x01000000), the Flash size (1024 KB), and SoC model (GR551x) respectively
- --rand\_number: Refer to "[Section 3.7.3 Encrypt & Sign](#)" for specific descriptions on "Random Number".

Run the command to encrypt and sign the firmware.

### 3.11.3 User-defined Windows Scripts

Users can also write custom scripts on Windows to call command-line programs. Two sample script files are provided in the GR5xxx\_script file in the GProgrammer installation directory.


#### Note:

GR5xxx, representing the name of SoC series, includes GR551x and GR5526.

*encryptAndSignatureFirmware.bat* can encrypt and sign firmware with *firmware\_origin.bin* in the same directory and the files saved in the eFuse directory. The encrypted and signed firmware is available in *firmware\_encryptAndSign\firmware\_encryptAndSign.bin*.

`program_Firmware_EncryptAndSign.bat` can erase all internal Flash memories, and download the firmware `firmware_encryptAndSign\firmware_encryptAndSign.bin` and save the firmware file in the internal Flash memories.

## 3.12 Help

Click  on the left side of the main interface of GProgrammer to open the **Help** interface.

GProgrammer offers help and support to users.

- **About GProgrammer**

This section provides version information and features of GProgrammer.

- **Feedback**

If you have any questions or suggestions, please send an email to *software@reg.goodix.com*.

- **About Goodix**

For more information, please visit Goodix official website: [www.goodix.com](http://www.goodix.com).