

## **ICP Programmer User Manual**

### **Introduction**

This user manual gives an overview of Artery ICP Programmer. ICP Programmer acts as a graphic interface application designed to facilitate the use of Artery MCU. AT-Link or J-Link simulator is required to operate Artery MCU device.

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# 1 Introduction

## 1.1 Environmental requirements

- **Software requirements**

Windows 7 and above is required.

Software version below 3.0.02, .Net framework 4.0 is required.

Software version 3.0.02 and above, .Net framework 4.6 is required.

There is no need to install a driver when using the AT-Link simulator.

A driver is required when using the J-Link simulator. J-Link V6.20C and above is used. The version below J-Link V6.20C will not work with this software.

- **Hardware requirements**

AT-Link simulator

J-Link simulator

PC/AT compatible, Pentium or higher CPU

XVGA (1024 \* 768) color display.

At least 512M RAM

At least 20 M disk space

## 1.2 Glossary

- **ICP:**

ICP (in-circuit programming). It allows users to update the Flash of MCU through software without the need of removing the MCU from the target PCB.

- **AT-Link simulator:**

AT-Link is a simulator developed by Artery to support the simulation of the kernel chip.

- **J-Link simulator:**

J-Link is a simulator developed by SEGGER to support the simulation of the kernel chip.

## 2 Installation

- **Software installation**

No need to install software, just run the executable program "ArteryICPProgrammer.exe" directly.

- **Hardware installation**

Step 1: connect the AT-Link/ J-Link simulator to the USB interface of PC.

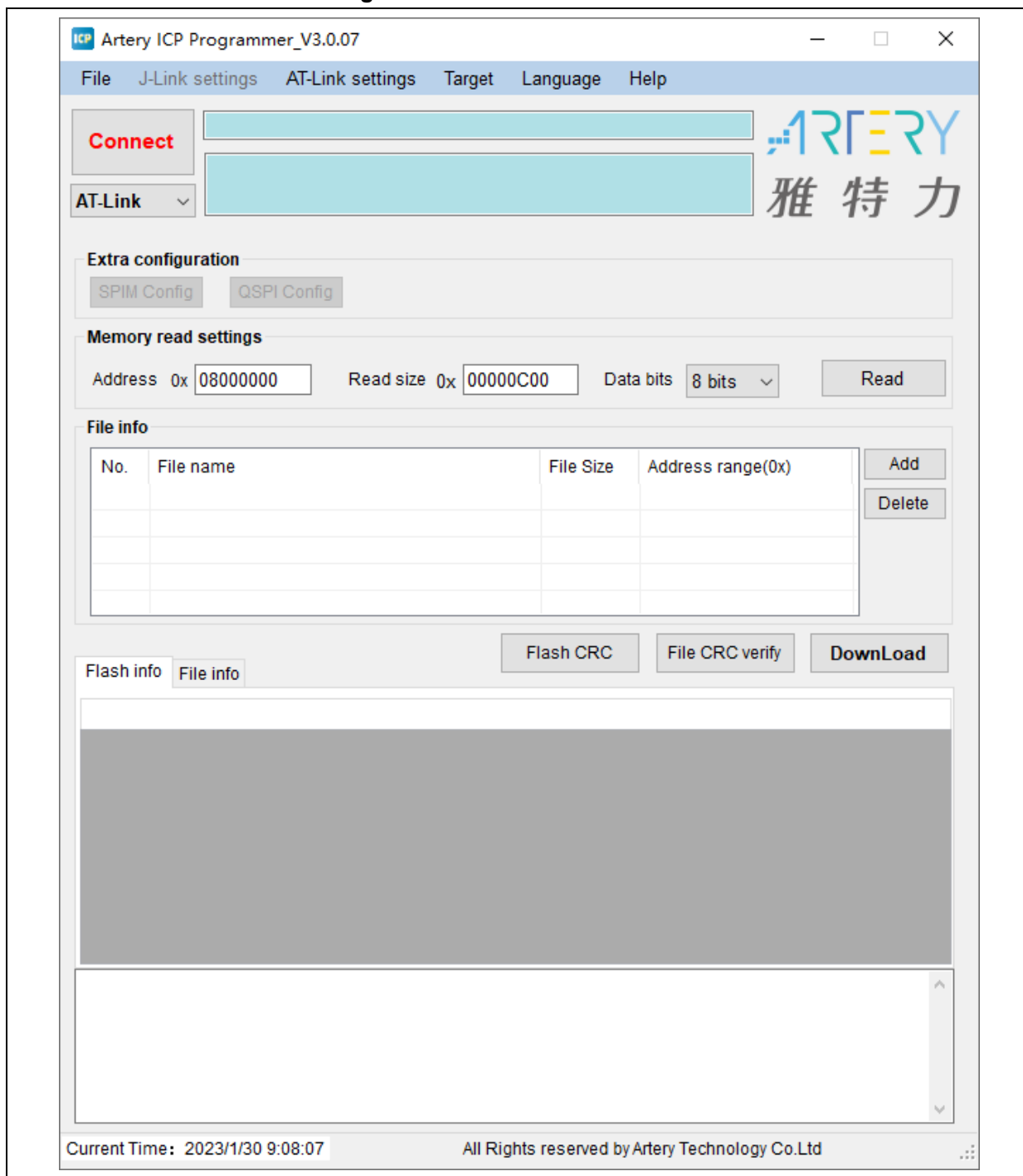
Step 2: connect the AT-Link/ J-Link simulator to the ICE interface of the target development board.



### 3 Function overview

This section gives an overview of tool operations. The main interface is shown in Figure 1:

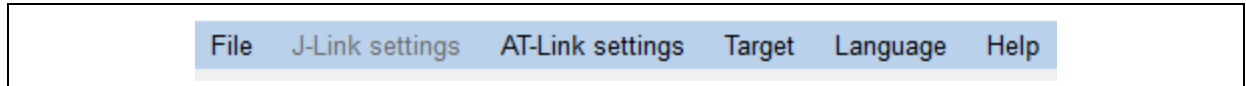
Figure 1. Main window



#### 3.1 Menu bar

The content of Menu Bar is shown in Figure 2. (This section only gives a brief description of menu bar, and the specific functions will be detailed in subsequent chapters).

Figure 2. Menu bar



■ “**File**” menu

- Save file as: save the data in the “**File Info**” as a file in the format of \*.bin/ \*.hex/\*.srec/\*.s19.
- Save flash data as: save the memory data in the “Flash Info” as a file in the format of \*.bin/\*.hex/\*.srec / \*.s19.
- Make encryption file: encrypt the bin file as a benc file, hex file as a henc file, srec and s19 file as a senc file. (encrypted files are suited to AT-Link)
- Exit: exit the software.

■ “J-Link Setting” menu:

J- Link simulator settings.

■ “AT-Link Setting” menu:

AT- Link simulator settings.

■ “Target” menu:

- Mass erase: erase the whole main flash. When SPIM is selected, the whole SPIM will also be erased (AT32F403/F413/F403A/F407). When the boot memory is in AP mode, the boot memory is also erased (AT32F415/F421/F425/WB415/L021/F423).
- Erase main flash: erase the whole main flash.
- Erase SPIM: erase the whole SPIM.
- Erase boot memory: erase the boot memory (AT32F415/F421/F425/WB415/L021/F423 AP mode)
- Erase sector: users select the sector to erase.
- User system data: User system data settings, including access protection and erase and program protection, etc.
- Access protection:  
For AT32F403/F413/F403A/F407/F435/F437, enable / disable access protection.  
For AT32F415/F421/F425/WB415/L021/F423, enable access protection, high level access protection (access protection and user system data erase protection) and disable access protection. (AT32F425/L021/F423 high level access protection is irreversible. Once enabled, it will never be unlocked, with its debugging interface permanently disabled. Please use with caution.)
- sLib status: the user can check the current status (enabled or disabled) of sLib, and disable sLib (AT32F413/F415/F403A/F407/F421/F435/F437/F425/WB415/L021/F423).
- Boot memory AP mode: the boot memory is set in AP mode. The boot memory cannot be restored after being set as AP mode. (AT32F415/F421/F425/WB415/L021/F423)
- Download: set download options and download files to flash.
- Flash CRC: calculate the CRC value for the selected sectors in flash.

■ “BLE Module” menu (AT32WB415CCU7-7)

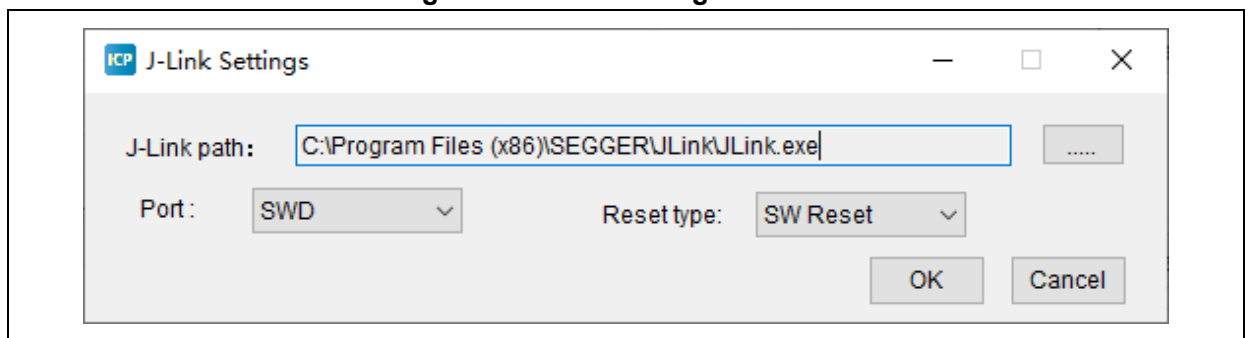
- Erase all space (Main,NVR,RDN): Erase the whole area of BLE module, including Main code space, NVR space and RDN space.
- Erase main space: Erase Main code space only.
- Erase sectors: User select the sectors of Main code to be erased.

- Access protection: Disable or enable access protection.
- BLE Debug: Open BLE module debug.
- “Language” menu:
  - English
  - Chinese (Simplified)
- “Help” menu:
  - User manual: open the user manual of this software.
  - AT-Link firmware manual upgrade: the user needs to manually select the file to upgrade AT-Link firmware.
  - AT-Link firmware online upgrade: automatic online upgrade AT-Link firmware. The computer must be connected to the Internet.
  - ICP new version download: automatically detect whether there is a new version of ICP software, if so, download it. The computer must be connected to the Internet.
  - Artery MCU resources download: provide links to download Artery MCU resources. The computer must be connected to the Internet.
  - Version: check the software version.

## 3.2 J-Link settings

This section shows how to set J-Link. (Menu bar — “**J-Link Settings**”)  
(As shown in Figure 3)

Figure 3. J-Link settings



- **J-Link path:** if J-Link driver is installed, the software will automatically obtain the installation path. The user can also select it manually.
- **Port:** SWD port.
- **Reset type:** software reset or hardware reset. It is effective when using J-Link to operate the device.
- **OK:** make the setting take effect and close the dialog box.
- **Cancel:** cancel the setting and close the dialog box.

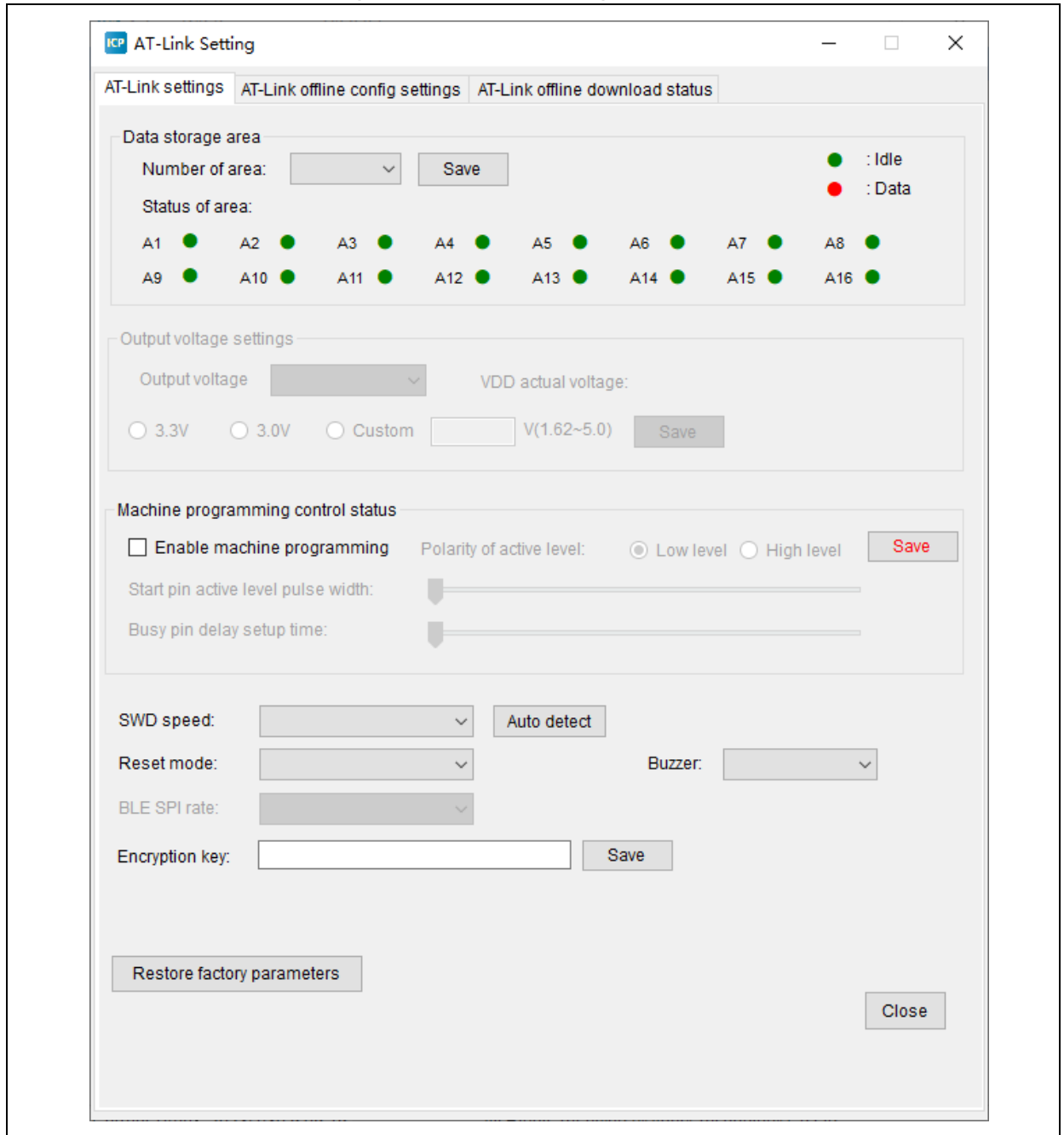
## 3.3 AT-Link settings

This section shows how to set AT-Link. (Menu bar — “**AT-Link Settings**”)

### 3.3.1 Parameter settings

This section gives an overview of the configuration of AT-Link parameters. (As shown in Figure 4)

Figure 4. AT-Link settings



#### ■ Number of area

This represents the number of codes stored offline, supporting 1/2/4/8/16, and the maximum capacity corresponding to each code is 16/8/4/2/1 MB, respectively. Offline download also supports downloading multi-section code files (up to 5) at a time. Multi-section code files will occupy multiple storage areas.

*Note: modifying this option will clear all offline stored project data.*

#### ■ Output voltage settings

This option is for the enable and range selection of output voltage, and the customized range is

1.65V-5V.

■ Machine programming control status

Enable machine programming: enable or disable.

Polarity of active level: low level or high level

Start pin active level pulse width: 20-1000ms.

Bus pin delay setup time: 20-1000ms.

■ SWD speed

Configure the SWD transmission speed for non-IDE operation, and 100kHz/500kHz/1MHz/2MHz/5MHz are available for selection.

■ Auto detect

SWD speed will be automatically detected.

■ Reset mode

It contains software system reset and hardware NRST pin reset, which are mainly used for reset after the target board download is completed or some operations that need to be reset, such as FAP, EPP operations.

■ Buzzer

Buzzer enable option. When this function is disabled, all other operations are silent except for power-on initialization.

■ BLE SPI rate

BLE SPI rate is selectable, including 375 KHz/750 KHz/1500 KHz.

*Note: This option is applicable to AT-Link only that supports BLE module.*

■ Encryption key

Support the combination configuration of 6-24 bytes of letters or numbers, which is customized by AT-Link users. The initial default value is a 24-byte AT-Link serial number.

*Note: modifying this option will clear all existing offline project data.*

■ Restore factory parameters

Clear all AT-Link parameters and stored data, and restore to factory default values.

### 3.3.2 AT-Link offline project settings

This section describes how to configure the content of offline projects (As shown in Figure 5).

Figure 5. Offline config settings

The screenshot shows the 'AT-Link Setting' window with the 'AT-Link offline config settings' tab selected. The window contains the following elements:

- Offline project**: A dropdown menu and a 'Delete' button.
- Project name**: A text input field.
- Device**: A dropdown menu.
- Table**: A table with 5 columns: No., File name, File size, Address range(0x), and Storage location. It has 4 rows. To the right of the table are 'Add' and 'Delete' buttons.
- Erase option**: A dropdown menu set to 'Erase the sectors of file size'.
- Download times**: A text input field.
- Verify**: A checked checkbox.
- Encryption transmit**: An unchecked checkbox.
- Reset and run**: An unchecked checkbox.
- Download interface**: A dropdown menu.
- Write user system data**: An unchecked checkbox.
- Enable FAP after download**: A checked checkbox.
- Boot memory AP mode**: An unchecked checkbox.
- Key(0x)**: A text input field with the value '(0xA35F6D24)'.
- Software serial number(SN)**: A tabbed section with sub-tabs for 'SPIM settings', 'sLib settings', and 'Bluetooth module Mac setting'. The 'Software serial number(SN)' sub-tab is active, showing:
  - Write software serial number**: An unchecked checkbox.
  - Write address in flash:** 0x 08010000
  - Initial SN:** 0x 00000001
  - Increase step:** 0x 00000001
- Buttons**: 'Load parameters' and 'Save parameters' buttons are located below the SN settings. At the bottom of the window are 'Open project file', 'Save project file', 'Save project to AT-Link', and 'Close' buttons.

#### ■ Offline project

It displays the currently stored offline projects.

Select from the drop-down menu to view the configuration parameters of project.

#### ■ Delete/Create

Delete the selected project in the drop-down menu or create a new one.

#### ■ Project name

Customize the project name when creating a new project, supporting up to 16 bytes length.

#### ■ Device

When creating a new project, it allows the user to only download the target MCU of a specific model of certain series. However, if AT32F413-Universal is selected, it means that all the MCUs of AT32F413 series are allowed to download.

#### ■ Add/Delete

When creating a new project, add and delete the code file to be downloaded. The format can be bin/hex/srec/s19/benc/henc/senc. Multi-section code file configuration is supported. The address of multi-section code files cannot be on the same Flash sector. The maximum length of file name is 32 bytes.

#### ■ Erase option

Configure as required. Support various erase operations before download.

#### ■ Bluetooth module erase options (AT32WB415CCU7-7)

Erase options can be configured as required to enable an erase operation before download.

*Note: If "Erase the sectors of file size" is configured, the last sector of the Main code cannot be erased.*

#### ■ Enable BLE FAP after download (AT32WB415CCU7-7)

Enable BLE module access protection after download.

#### ■ Download interface

Select SWD or ISP interface when downloading the project offline.

#### ■ Download times

If this option checked, the total number of downloads will be limited in the range of 1-4000000. Both success and failure are included in the total number. If the total number is exceeded, no more downloads are allowed.

#### ■ Reset and run

After the project download is completed, it will reset and run. This option and enable FAP after download option cannot be enabled at the same time

#### ■ Encryption transmit

The download process works with the Hex Encryption function of Artery MCU to implement encryption transmit to ensure the security of data during the transmission.

#### ■ Verify

Verify whether the data is correct after download, and a hardware verify method will be used during encryption transmit to ensure data security.

#### ■ Enable FAP after download

Enable this option when the download is completed. For AT32F415/F421/F425/WB415/L021/F423, users can choose to enable access protection and high level access protection (access protection

and user system data erase protection). (AT32F425/L021/F423 high level access protection is irreversible. Once enabled, it will never be unlocked, with its debugging interface permanently disabled. Please use with caution.)

■ Boot memory AP mode (AT32F415/F421/F425/WB415/L021/F423)

Configure the boot memory as AP mode. Some MCUs can configure the boot memory as an extended user code area for user code storage.

*Note: this mode setting is irreversible and can only be modified once.*

■ Write user system data

Users can select to download user system data file at the same time. The format can only be bin or hex.

■ Write software serial number

32-bit data. The address can be customized. The address and code address cannot be on the same flash sector. Serial number value = initial serial number + number of successful downloads x each increment value, if overflow occurs, the high bit will be cleared and the low 32 bit will be reserved.

■ Write Bluetooth module MAC address (AT32WB415CCU7-7)

48-bit data. The address is 0x00027FF0 by default, within the Bluetooth module address range. The MAC address is in big-endian, and the current address is set in the interface. When the “Auto Increase” is ticked, the last digit of the MAC address is automatically increased by 1 after successful programming.

■ SPIM settings (AT32F403/F413/F403A/F407)

If there are files with the address range in SPIM (including code or serial number), users need to select the corresponding external Flash model, IO mapping, and external encryption programming range and other information.

■ sLib settings (AT32F403 does not support)

Configure sLib-related parameters, including disabling the existing sLib before download and enabling a new sLib during download, and users need to set sLib password and sLib range.

■ Save parameters (valid only for new projects)

When creating a new project, users can save various parameters of project configuration to a file. It is convenient for users to configure multi-projects with the same or similar parameters next time.

■ Load parameters (valid only for new projects)

When creating a new project, user can load the stored parameter files so as to configure project conveniently and quickly (Save and load function only refer to the parameters, rather than save or load the downloaded documents).

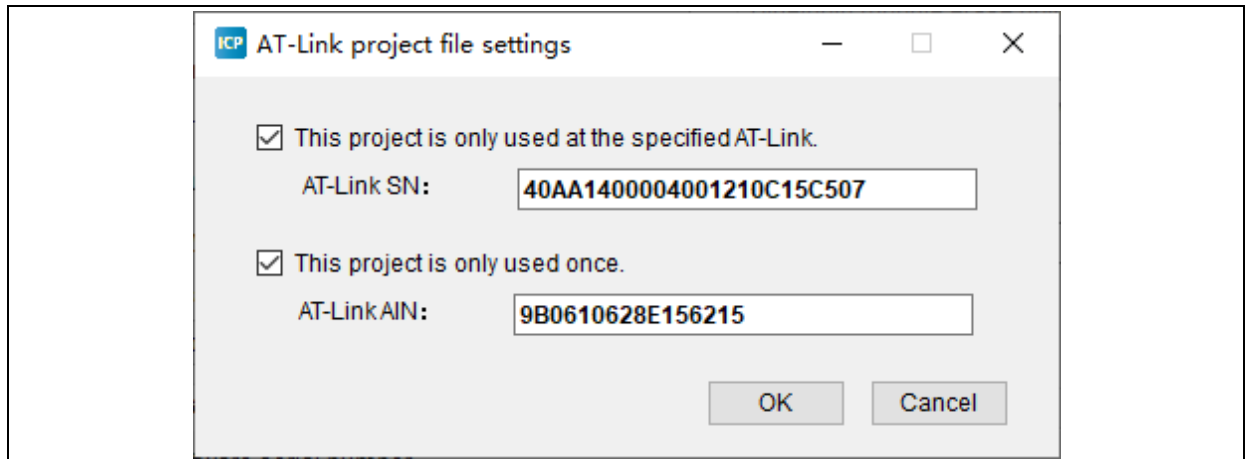
■ Save project file

After all the above files and parameters configuration are completed, they can be packaged to generate an encrypted project file in the format of \*.atcp for remote transmission or local storage.



When saving project file, the following settings can be made: (As shown in Figure 6)

**Figure 6. Project file settings**

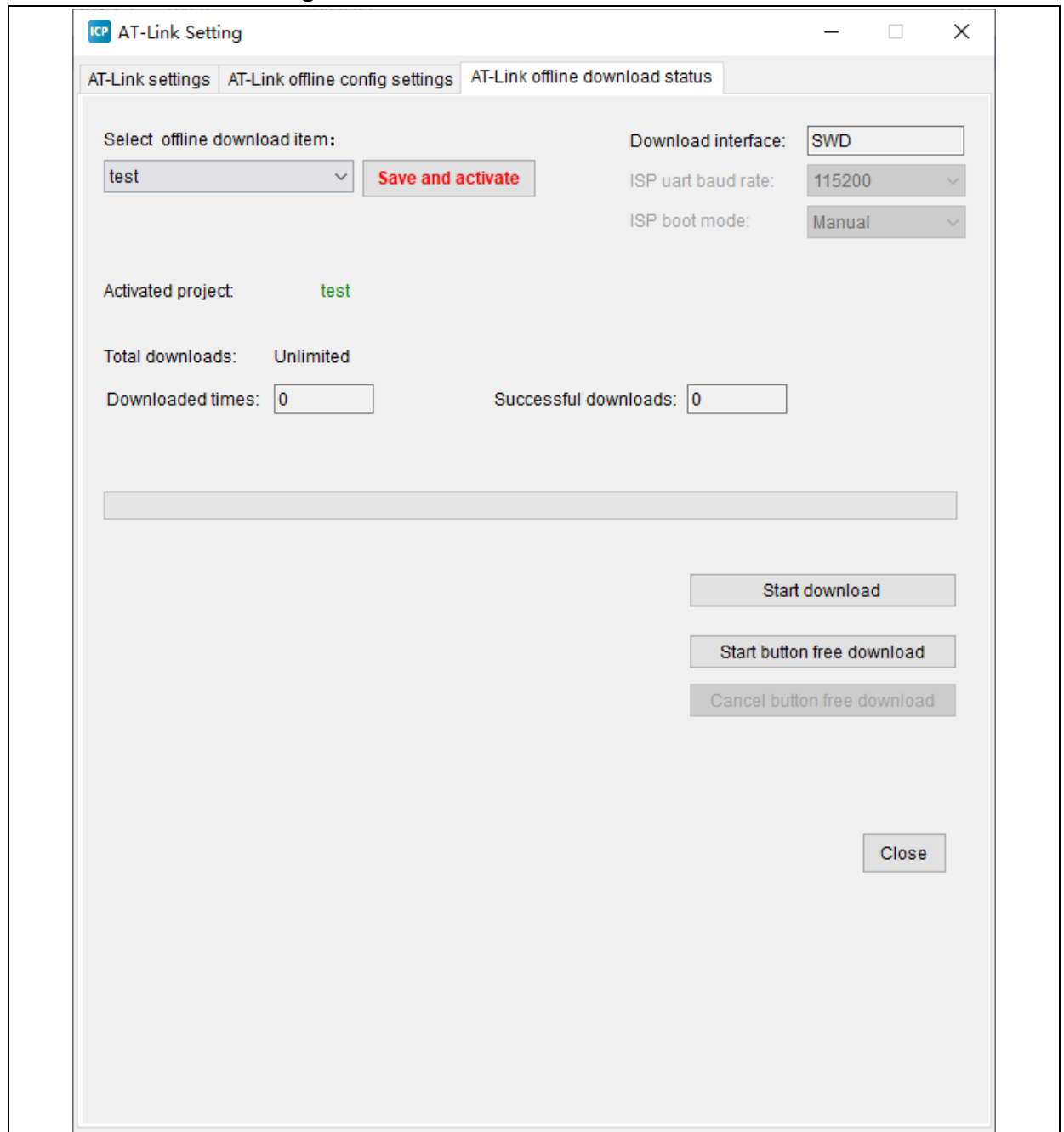


- This project is only used at the specified AT-Link:  
This project is bound to AT-Link and can only be used in the specified AT-Link. The AT-Link serial number must be set.
- This project is only used once:  
This project can only be used once, and is used in conjunction with “This project is only used at the specified AT-Link”, and AT-Link SN and AIN is required.
- Open project:  
Open an existing project file in \*.atcp format and load its configuration into the software for viewing.
- Save project to AT-Link  
Save the configured project or opened project in the AT-Link through a dynamic encryption algorithm for offline download.

### 3.3.3 AT-Link offline download

As shown in Figure 7:

Figure 7. Offline download window



■ Select offline download item

At-Link can store multiple offline projects. Users need to select one project to activate. The activated project will be selected for downloading. If the current active project is deleted, select it again. Click on "Save and activate" to take effect.

■ Download interface

Only displays the interface of the activated project, and this cannot be changed. If it is an ISP interface, the baud rate and boot mode can be changed according to the target board circuit.

■ Total downloads

Set the total number of downloads.

- Downloaded times

Displays the number of downloads of the activated project, including the number of successes and failures. When the total downloads are reached, the project file can no longer be downloaded.

- Successful downloads

Displays the number of successful downloads of the activated project.

- Start download

Start a single offline download, and the corresponding message will pop up according to the download progress. If failed, error message will be displayed.

- Start/Cancel button free download

This feature means that there is no need to operate the ICP interface, only need to replace the target board MCU according to the prompt message to complete the automatic continuous download.

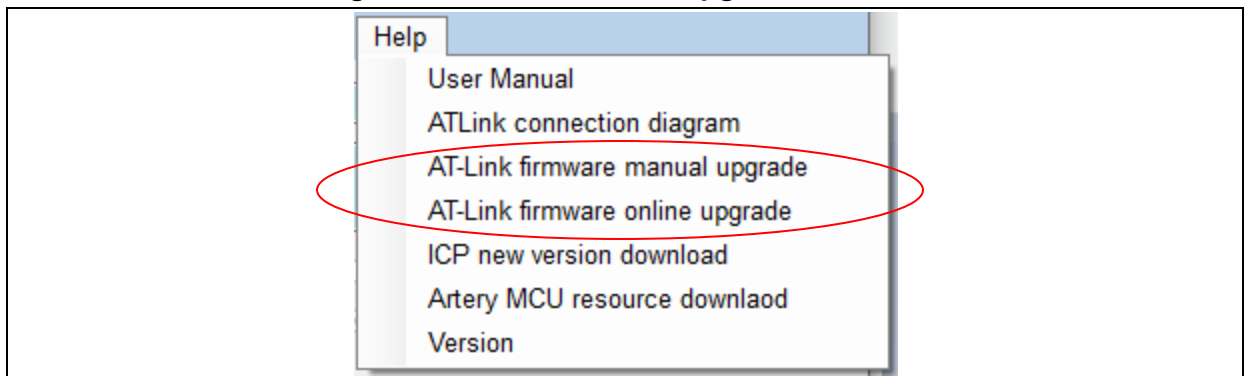
This option allows the switching of Start/Cancel only when AT-Link is in idle state.

*Note: other operations are not allowed in button free mode. Users must cancel the button free mode before operation.*

## 3.4 AT-Link firmware upgrade

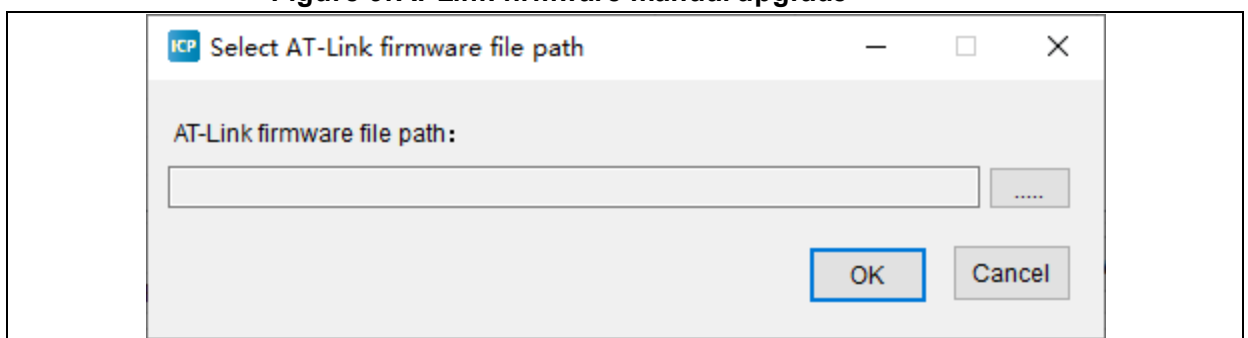
This option can be found in the “**Help**” menu. (As shown in Figure 8)

Figure 8. AT-Link firmware upgrade



- AT-Link firmware manual upgrade (As shown in Figure 9)

Figure 9. AT-Link firmware manual upgrade



Need to select the path where the firmware file in \*.benc format is.

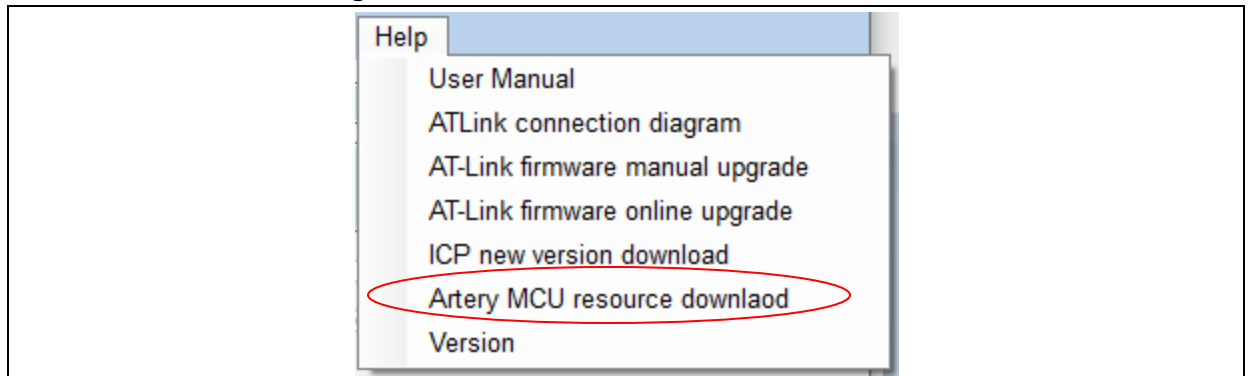
■ AT-Link firmware online upgrade

It will automatically upgrade AT-Link firmware via internet. The computer must be connected to the Internet.

### 3.5 Artery MCU resources download

Artery MCU resources download option can be found in the “**Help**” menu (this function is available when the computer is connected to the Internet), (As shown in Figure 10)

Figure 10. MCU resource download



The download link is as shown in Figure 11:

Figure 11. MCU download link

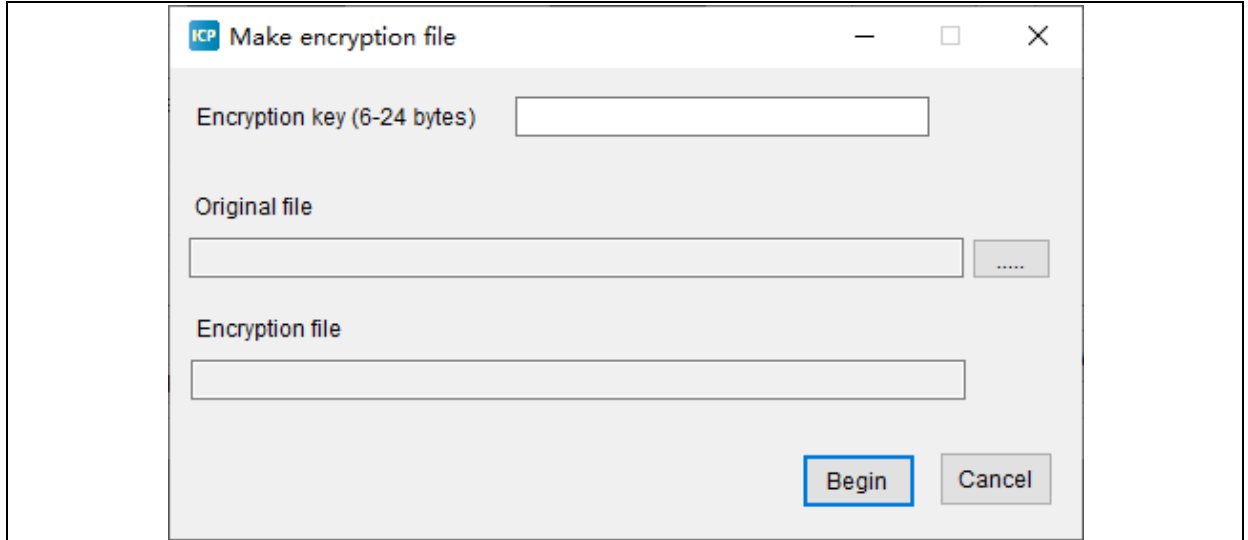


Click the above link to enter the corresponding webpage.

### 3.6 Make encryption file

“**File**”-“**Make encryption file**”. The encryption files are mainly used for AT-Link. J-Link does not support downloading encryption files, as shown in Figure 12:

Figure 12. Make encryption file



■ Encryption key

It is the encryption key for making encryption files, 6 to 24 bit letters or numbers.

■ Original file

It means the original file that needs to be encrypted. Support in the format of \*.bin, \*.hex, \*.srec and \*.s19.

■ Encryption file

It means the encrypted file in the format of \* .benc/\* .henc/\* .senc.

## 3.7 Device connection

Please select the simulator to be used before connecting. (As shown in Figure 13)

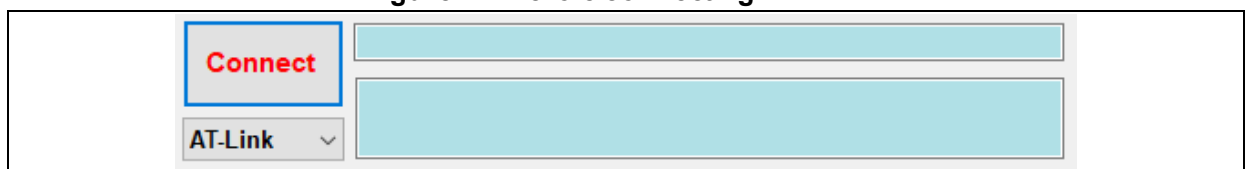
Figure 13. Select simulator



### 3.7.1 AT-Link connected to device:

- Before connecting ----- no device is available at this time. (As shown in Figure 14)

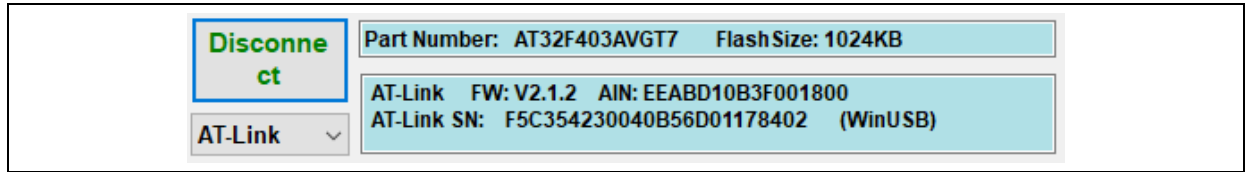
Figure 14. Before connecting



Click on "**Connect**" to connect to device.

- Successful connection----- the device is correctly identified at this time. (As shown in Figure 15)

Figure 15. Successful connecting

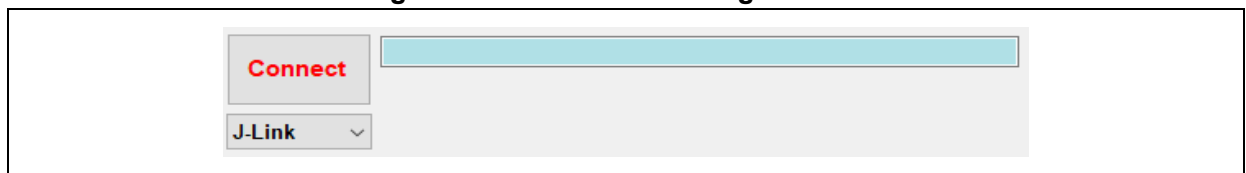


After successful connection, AT-Link related information will be displayed, including AT-Link part number, firmware version, AT-Link AIN; and MCU related information, including MCU part number, Flash size, etc. If click on "**Disconnect**", you can disconnect from the device

### 3.7.2 J-Link connected to device:

- Before connecting ----- no device is available at this time. (As shown in Figure 16)

Figure 16. Before connecting



Click on "**Connect**" to connect to the device.

- Successful connection ----- the device is correctly identified at this time, (As show in Figure 17)

Figure 17. Successful connecting



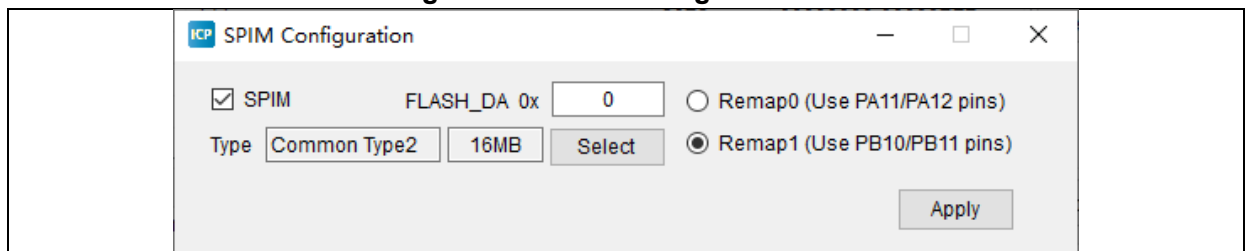
After successful connection, MCU related information will be displayed, including MCU part number, Flash size, etc. If click on "Disconnect", you can disconnect from the device.

## 3.8 SPIM setting

(AT32F403/F413/F403A/F407)

The SPIM must be set before using, otherwise it will not work normally. (As shown in Figure18)

Figure 18. SPIM settings



- Checked "**SPIM**"

SPIM operation is allowed.

- Uncheck "**SPIM**"

SPIM operation is not allowed.

### ■ FLASH\_DA

Set the encryption range when downloading files to the SPIM, and the encryption range is calculated starting from the address 0x08400000

### ■ Remap 0 (use PA11/PA12 pins)

### ■ Remap 1 (use PB10/PB11 pins)

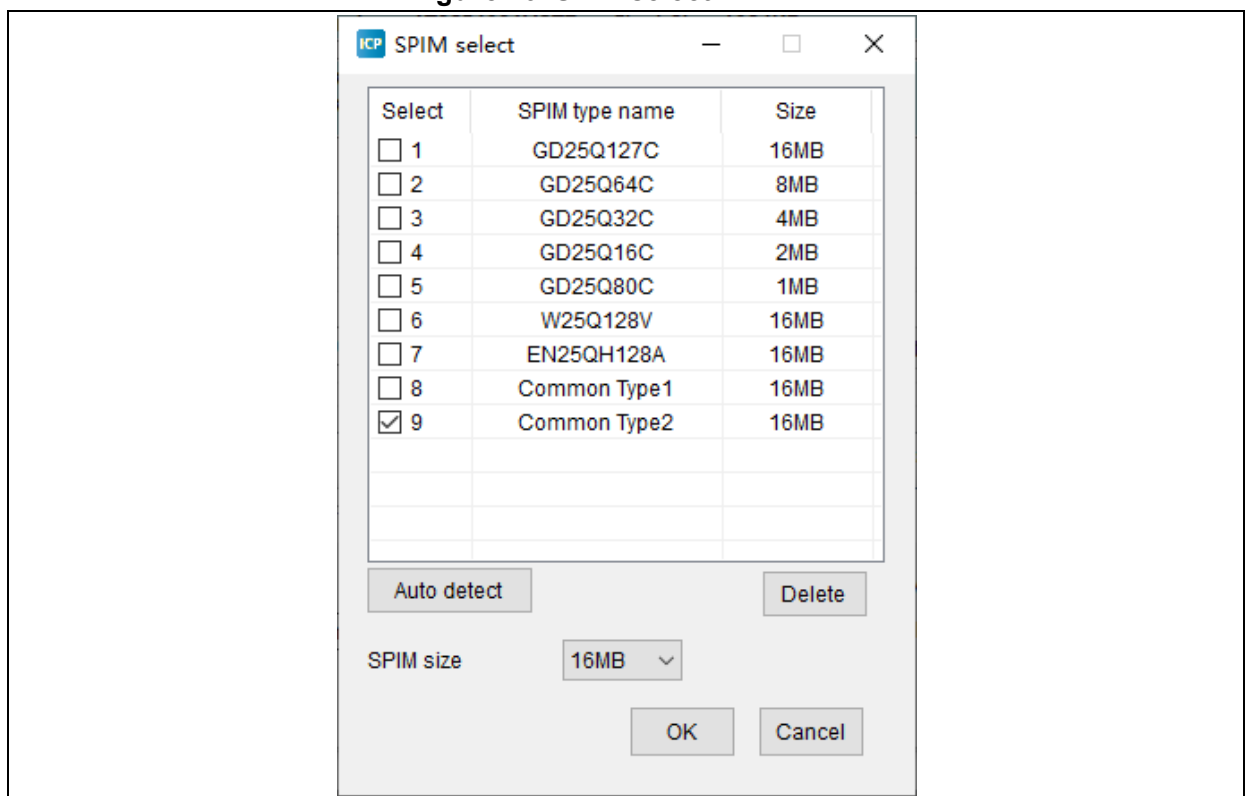
Select SPIM connection pins.

### ■ Type

Users can select the SPIM type through "Select" button.

Click on the "Select" button, a dialog box pops up. (As shown in Figure 19)

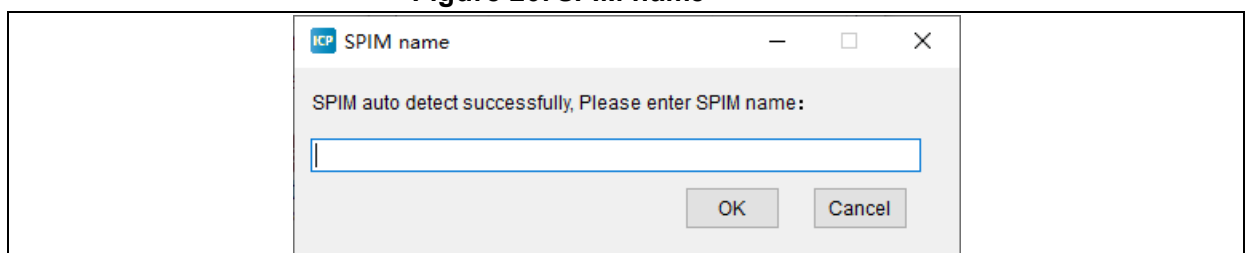
**Figure 19. SPIM select**



**Auto detect:** it will automatically detect whether the SPIM meets the requirements of this software Operation (Auto detect will overwrite some data of SPIM, please use it with caution)

If Auto detect is successful, a dialog box will pop up. (As shown in Figure 20)

**Figure 20. SPIM name**

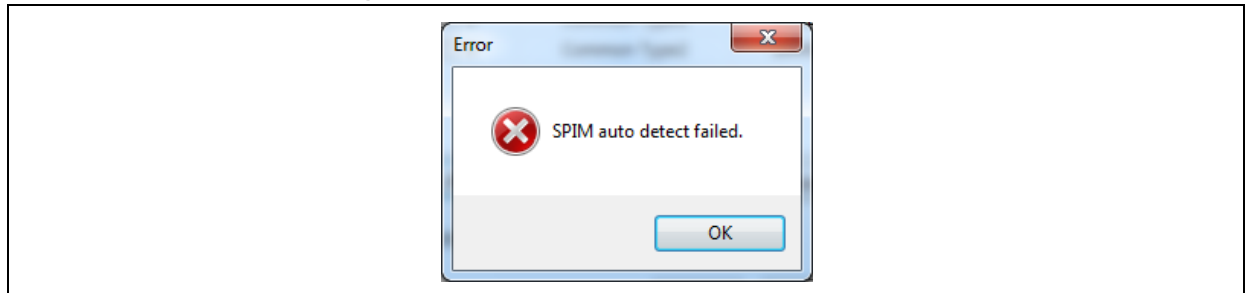


Click on "**OK**" to add the detected SPIM to the SPIM list.

Click on "**Cancel**" to cancel auto detect.

If auto detect failed, a failure dialog box will pop up. (As shown in Figure 21)

**Figure 21. SPIM auto detect failed**

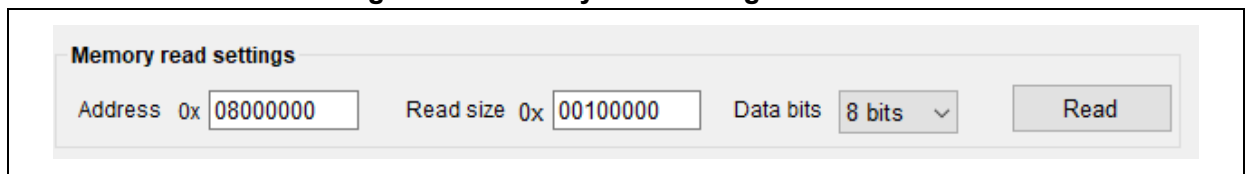


- SPIM size: select the SPIM size, except for the default type.
- Delete: delete the selected SPIM in the list, except for the default type.
- OK: SPIM selected.
- Cancel: cancel.

### 3.9 Memory read settings

This function is used to read the content of flash memory. (As shown in Figure 22)

**Figure 22. Memory read settings**



- Address: the start address of the flash memory to be read.
  - Read size: the range of memory to be read
  - Data bits:
    - 8-bit: read and display flash data in 8-bit mode. At the same time, the files are displayed in 8-bit mode.
    - 16-bit: read and display flash data in 16-bit mode. At the same time, the files are displayed in 16-bit mode.
    - 32-bit: read and display flash data in 32-bit mode. At the same time, the files are displayed in 32-bit mode.
- Once selected, the "Read" operation will be performed automatically.
- Read: read flash and display flash data.
- In 8-bit mode. (As shown in Figure 23)



Figure 23. 8-bit data

Flash info		File info															
Address range:[0x08000000 0x08000FFF] checksum: 0x0005A6F8																	
Address	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	A
0x08000000	90	F7	20	20	3F	20	08	3F	20	08	F9	A0	20	08	3F	20	愼
0x08000010	08	3F	20	08	3F	20	08	20	20	20	20	20	20	20	20	20	?.
0x08000020	20	20	20	20	20	20	20	3F	20	08	3F	20	08	20	20	20	?.
0x08000030	20	4B	03	20	08	E5	81	01	08	3F	20	08	3F	20	08	3F	K
0x08000040	20	08	F9	56	01	08	3F	20	08	3F	20	08	61	3F	08	3F	鵲
0x08000050	20	08	99	91	20	08	01	91	20	08	09	3F	08	3F	20	08	慇

In 16-bit mode. (As shown in Figure 24)

Figure 24. 16-bit data

Flash info		File info									
Address range:[0x08000000 0x08000FFF] checksum: 0x0005A6F8											
Address	0	2	4	6	8	A	C	E	ASCII		
0x08000000	F790	2020	203F	3F08	0820	A0F9	0820	203F	愼	?.	鵲.?
0x08000010	3F08	0820	203F	2008	2020	2020	2020	2020	?.	?.	.
0x08000020	2020	2020	2020	3F20	0820	203F	2008	2020	?.	?.	.
0x08000030	4B20	2003	E508	0181	3F08	0820	203F	3F08	K	鍋	?.?.?
0x08000040	0820	56F9	0801	203F	3F08	0820	3F61	3F08	鵲	?.?.	.a?.
0x08000050	0820	9199	0820	91D1	0820	3F09	3F08	0820	慇	鬼	??

In 32-bit mode. (As shown in Figure 25)

Figure 25. 32-bit data

Flash info

File info

Address range:[0x08000000 0x08000FFF] checksum: 0x0005A6F8

Address	0	4	8	C	ASCII
0x08000000	2020F790	3F08203F	A0F90820	203F0820	愼 ??鵲?
0x08000010	08203F08	2008203F	20202020	20202020	?.?.
0x08000020	20202020	3F202020	203F0820	20202008	??.
0x08000030	20034B20	0181E508	08203F08	3F08203F	K 鍋口???.
0x08000040	56F90820	203F0801	08203F08	3F083F61	鵲口???.a?.
0x08000050	91990820	91D10820	3F090820	08203F08	慇 鬼??

## 3.10 File info

Display the file info to be downloaded, including file name, file size, download location, etc.

Support \*. bin, \*. hex, \*. srec, \*. s19, \*. benc, \*. Henc and \*. senc files. (As shown in Figure 26)

Figure 26. File info

File info					
No.	File name	File size	Address range(0x)	Add	Delete
1	test_156k.bin	147472	08000000-0802400F		

■ Add

Add files to the download list and display the file data in the "file info" list. It can support up to 5 files. When the file is successfully opened, the file content is automatically displayed in the "File Info". (As shown in Figure 27)

Figure 27. File info data

Address	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	A...
0x08000000	90	F7	00	20	C1	02	00	08	C9	02	00	08	F9	A0	00	08	...
0x08000010	CD	02	00	08	CF	02	00	08	D1	02	00	08	00	00	00	00	...
0x08000020	00	00	00	00	00	00	00	00	00	00	00	00	D3	02	00	08	...
0x08000030	D5	02	00	08	00	00	00	00	4B	03	00	08	E5	81	01	08	...
0x08000040	DB	02	00	08	DB	02	00	08	DB	02	00	08	F9	56	01	08	...

■ Delete

Delete the selected files in the file list.

■ Right click menu

Figure 28. Right click menu

No.	File name	File size	Address range(0x)
1	test_156k.bin		0F

- Display: displays the content of the selected file in the "File Info" list.
- Read memory of file size: read the data of the selected file from the memory.
- Verify memory of file size: read and select the data from the files for verification.
- Flash CRC Verify: CRC check between the selected file and the corresponding memory data. (AT32F403 does not support)

## 3.11 MCU Erase function

Erase the main Flash and SPIM. (Menu bar — "**Target**")

■ Mass erase

Erase the whole main flash.

When SPIM is selected, the whole SPIM will be erased. (AT32F403/F413/F403A/F407)

When the boot memory is in AP mode, erase the boot memory.

(AT32F415/F421/F425/WB415/L021/F423)

■ Erase main flash

Erase the whole main Flash.

■ Erase SPIM

Erase the whole SPIM.

■ Erase boot memory

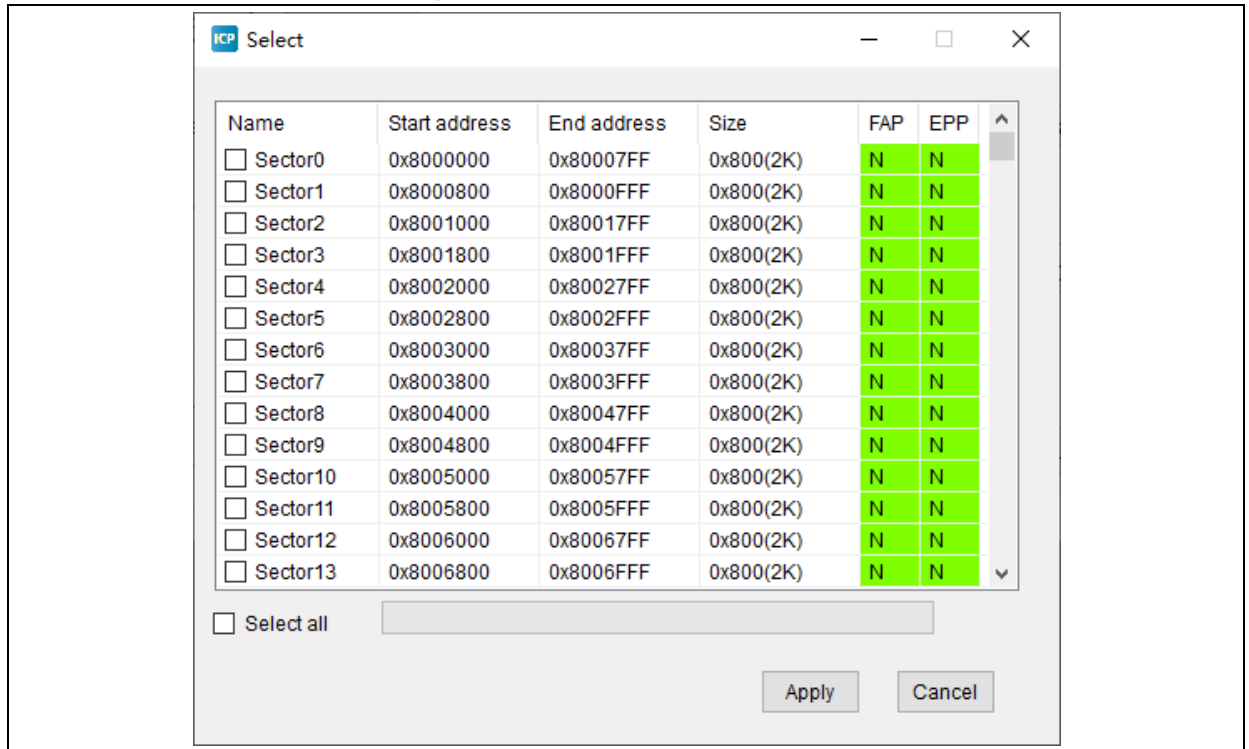
When the boot memory is in AP mode, erase the boot memory.

(AT32F415/F421/F425/WB415/L021/F423)

■ Erase sectors

User selects sectors to erase. **"Target"** - **"Erase sectors"**. (As shown in Figure 29)

Figure 29. Sector erase

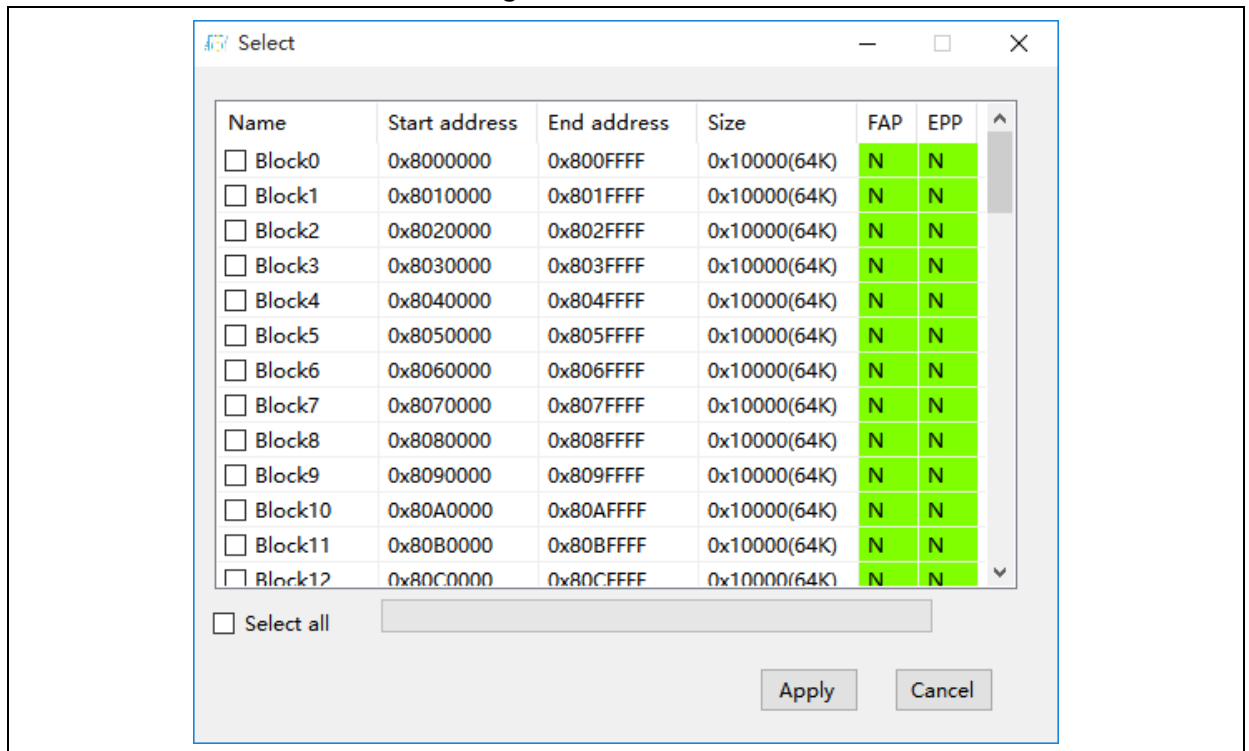


- Apply: erase the selected sectors.
- Cancel: cancel the erase operation during the erase process.

■ Erase blocks

User selects blocks to erase. **"Target"** - **"Erase blocks"**. (As shown in Figure 30)

Figure 30. Block erase



### 3.12 BLE Erase function

Erase the whole area of BLE module (AT32WB415CCU7-7) (Menu —“BLE Module”)

- Erase all space (Main, NVR, RDN)

Erase the whole area of BLE module, including Main code space, NVR space and RDN space.

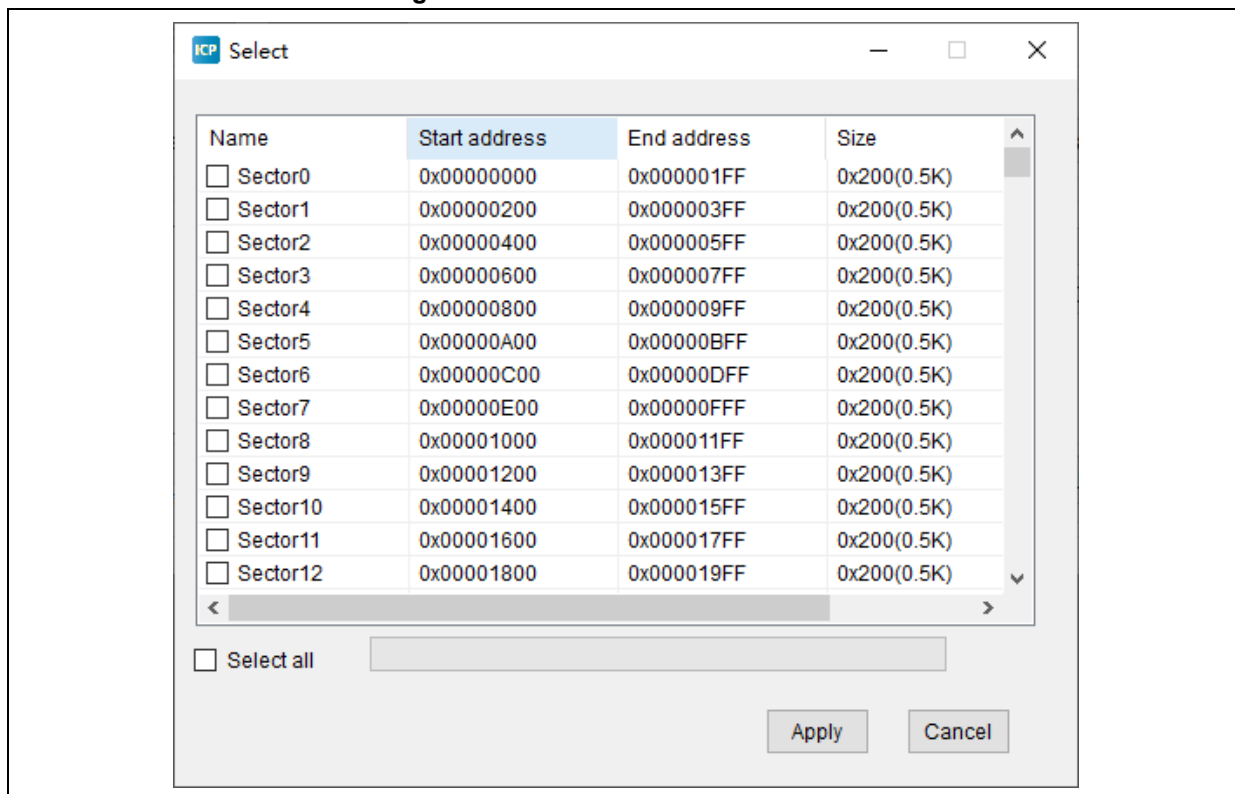
- Erase main space

Erase Main code space only.

- Erase sectors

Users can select the sectors to be erased by going to “BLE module” – “Erase sectors”, as shown below:

Figure 31. BLE module sector erase

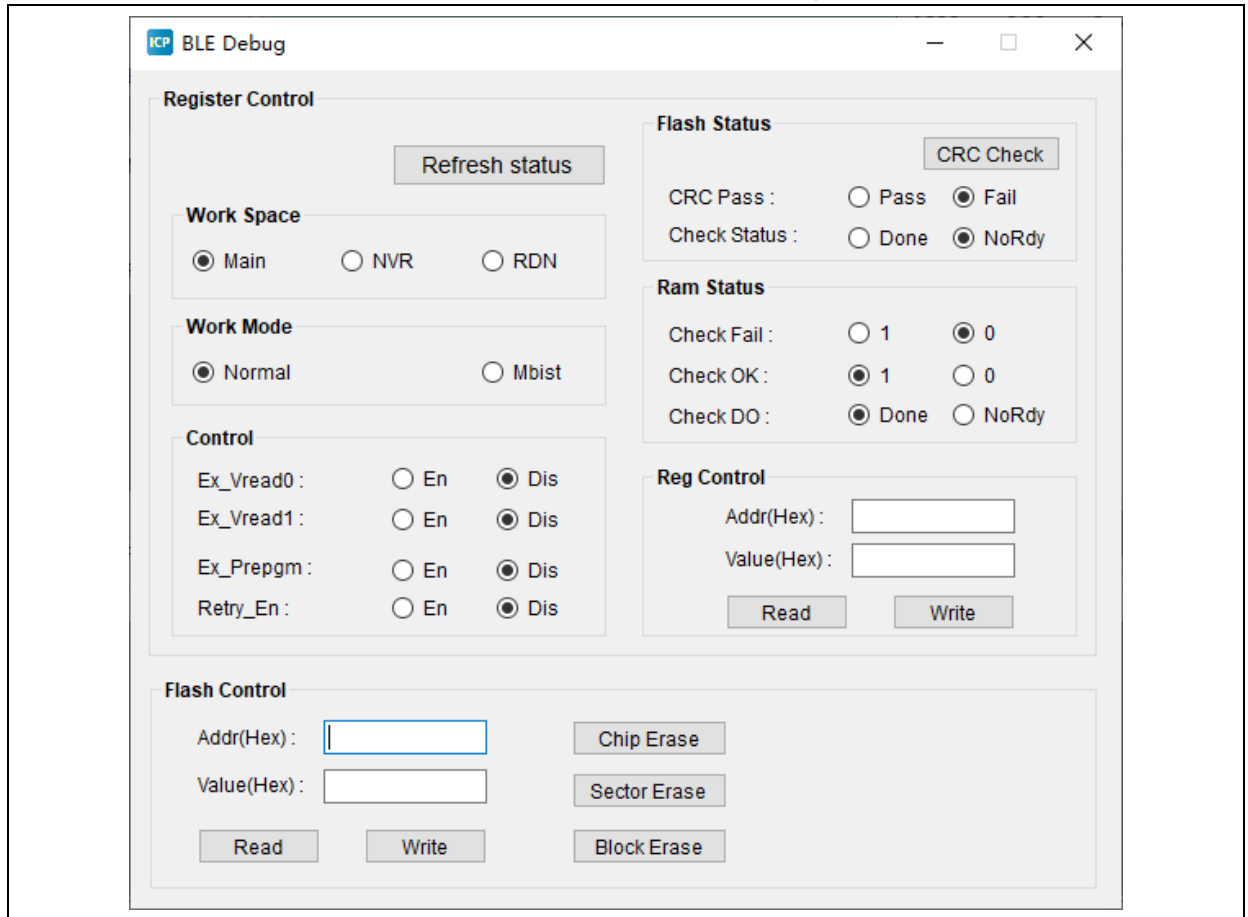


- Apply: erase the selected sectors.
- Cancel: cancel the erase operation during the erase process.

### 3.13 BLE Debug

To debug BLE module (AT32WB415CCU7-7), go to Menu — BLE module — BLE debug, as shown below:

Figure 32. BLE module debug



#### ■ Work Space

Select a work space from Main code space, NVR space and RDN space.

#### ■ Work Mode

Select one of Normal and Mbist modes

#### ■ Control

Enable or disable Ex\_Vread0, Ex\_Vread1, Ex\_Prepgrm and Retry\_En

#### ■ Flash Status

It indicates the status of Flash CRC check. This can be used to check whether the downloaded file is correct or not.

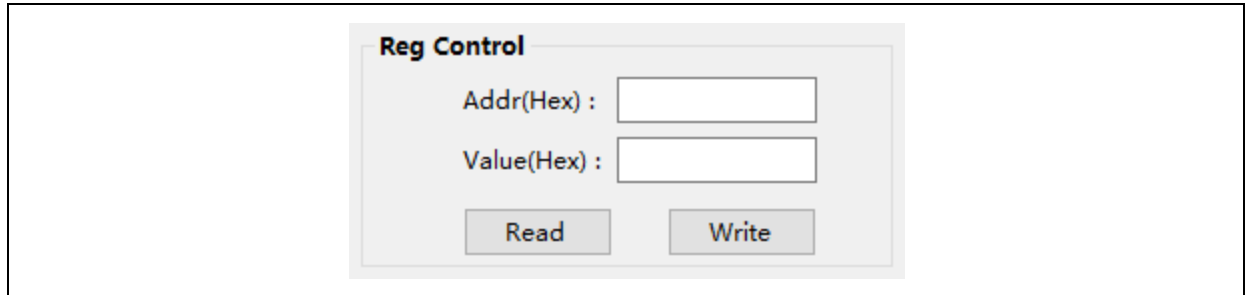
#### ■ Ram Status

It indicates the status of Ram check.

#### ■ Reg Control

Enable read/write access to BLE module registers.

Figure 33. BLE Register Control



Reg Control

Addr(Hex) :

Value(Hex) :

Read Write

Addr(Hex): Register address.

Value(Hex): Value to be read or written.

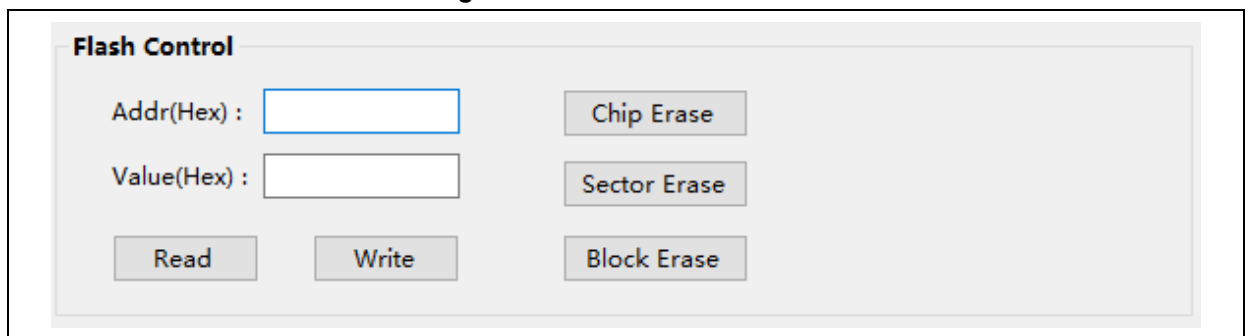
Read: Read registers.

Write: Write access to registers.

#### ■ Flash Control

This option is used to control the Main code space, NVR space and RDN space in the Flash memory of BLE module.

Figure 34. BLE Flash Control



Flash Control

Addr(Hex) :

Value(Hex) :

Read Write Chip Erase Sector Erase Block Erase

Addr(Hex): Flash address.

Value(Hex): Value to be read or written

Read: Read from Flash address.

Write: Write to Flash address.

Chip Erase: Erase the Main code space, NVR space and RDN space of BLE module.

Sector Erase: Erase the sector where the "Addr(Hex)" is.

Block Erase: Erase the block where the "Value(Hex)" is.

### 3.14 User system data

This is for the programming of user system data, (Menu bar — "**Target**" — "**User system data**").  
(As shown in Figure 35)

Figure 35. User system data config

ICP User system data

Access protection  
FAP

EOPB0(SRAM)

System setting byte  
SSB  ☒ nWDT\_ATO\_EN ☒ nDEPSLP\_RST ☒ nSTDBY\_RST ☒ BTOPT

Erase and program protection bytes

Name	Start addr...	End addr...	Size	EPP
<input type="checkbox"/> Sector0	0x8000000	0x80007FF	0x800(2K)	N
<input type="checkbox"/> Sector1	0x8000800	0x8000FFF	0x800(2K)	N
<input type="checkbox"/> Sector2	0x8001000	0x80017FF	0x800(2K)	N
<input type="checkbox"/> Sector3	0x8001800	0x8001FFF	0x800(2K)	N
<input type="checkbox"/> Sector4	0x8002000	0x80027FF	0x800(2K)	N
<input type="checkbox"/> Sector5	0x8002800	0x8002FFF	0x800(2K)	N
<input type="checkbox"/> Sector6	0x8003000	0x80037FF	0x800(2K)	N

EPP0-3     ☐ Select all

User data

Date	0	1	2	3	4	5	6	7
Data 0---7 (0x)	FF	FF	FF	FF	FF	FF	FF	FF

SPIM encryption key

KEY0 0x  KEY1 0x  KEY2 0x  KEY3 0x   
KEY4 0x  KEY5 0x  KEY6 0x  KEY7 0x

■ Access protection: Enable / disable access protection.

AT32F403/F413/F403A/F407/F435/F437:

Enabled: FAP----0xFF

Disabled: FAP---0xA5

AT32F415/F421/F425/WB415/L021/F423:

Access protection: FAP----0xFF.

High level access protection: FAP----0xCC. (Access protection and user system data erase protection) (AT32F425/L021/F423 high level access protection is irreversible. Once enabled, it will never be unlocked, with its debugging interface permanently disabled. Please use with caution.)

Disabled: FAP----0xA5.



When access protection is enabled, neither flash nor the user system data will be readable. The operation can only be performed after the access protection is disabled.  
When access protection is disabled, both the main flash and the user system data will be erased.

## ■ System setting byte

nWDT\_ATO\_EN:

Unchecked—Hardware watchdog.

Checked—Software watchdog.

nDEPSLP\_RST:

Unchecked—Reset occurs when entering Deep Sleep mode.

Checked—No reset occurs when entering Deep Sleep mode.

nSTDBY\_RST:

Unchecked—Reset occurs when entering Standby mode.

Checked—No reset occurs when entering Standby mode.

BTOPT: (AT32F403/F413/F403A/F407/F435/F437)

Unchecked—when the device is set to boot from flash memory bank 1 or bank 2, if bank 2 has no startup program, boots from bank 1, otherwise, bank 2.

Checked—when the device is set to boot from flash memory (default value), it starts from bank 1.

nBOOT1: (AT32F421/F425/L021/F423)

Boot mode is determined together with BOOT0, and when BOOT0 = 1,

Unchecked----SRAM is selected as boot space.

Checked---Boot memory is selected as boot space.

nWDT\_DEPSLP:

Unchecked----WDT stop count when entering Deep Sleep mode.

Checked---WDT does not stop count when entering Deep Sleep mode.

nWDT\_STDBY:

Unchecked---- WDT stop count when entering Standby mode.

Checked--- WDT does not stop count when entering Standby mode.

nRAM\_PRT\_CHK: (AT32L021)

Unchecked---- Enable odd check of RAM.

Checked--- Disable odd check of RAM.

## ■ EOPB0(SRAM)

AT32F403/F403A/F407: (AT32F403CBT6 not support)

224 KB SRAM—SRAM 224 KB.

96 KB SRAM—SRAM 96 KB.

AT32F413: (AT32F413C8T7/AT32FEBKC8T7 not support)

64 KB SRAM—SRAM 64 KB.  
 32 KB SRAM—SRAM 32 KB.  
 16 KB SRAM—SRAM 16 KB.

AT32F415/F421/F425/WB415/L021/F423: (not support)

AT32F435/F437:

Flash size 256K and below:

512 KB SRAM—SRAM 512 KB.  
 448 KB SRAM—SRAM 448 KB.  
 384 KB SRAM—SRAM 384 KB.

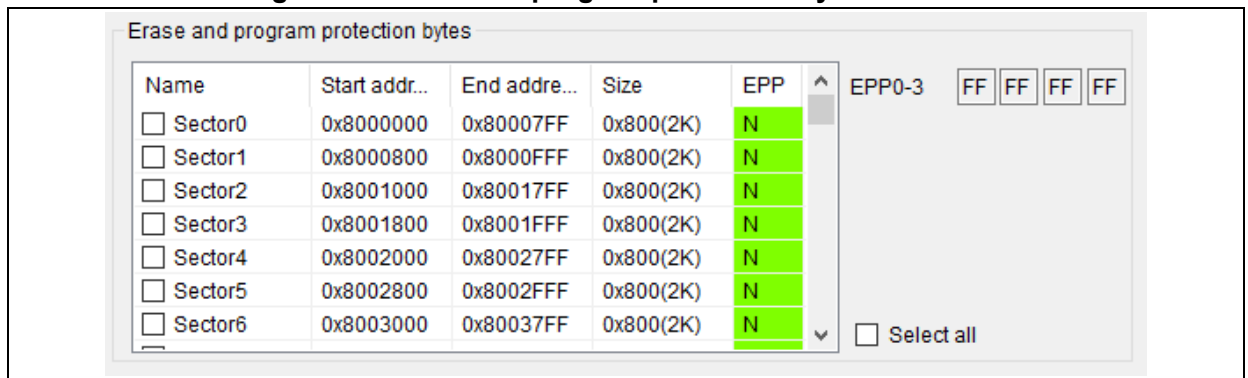
Flash size 1024K and above:

512 KB SRAM—SRAM 512 KB.  
 448 KB SRAM—SRAM 448 KB.  
 384 KB SRAM—SRAM 384 KB.  
 320 KB SRAM—SRAM 320 KB.  
 256 KB SRAM—SRAM 256 KB.  
 192 KB SRAM—SRAM 192 KB.  
 128 KB SRAM—SRAM 128 KB.

## ■ Erase and program protection bytes

Users can select the sector that needs to be erase and program protected. (As shown in Figure 36)

**Figure 36. Erase and program protection bytes**



EPP0:

AT32F403/F413/F403A/F407: controls the erase and program protection of sectors in the range of Flash 1K-32K.

AT32F415/WB415/F423: controls the erase and program protection of Sector0-Sector15.

AT32F421: controls the erase and program protection of Sector0-Sector31.

AT32F435/F437: controls the erase and program protection of sectors in the range of Flash 1K-32K. Each bit protects 4K bytes sectors.

AT32F425: controls the erase and program protection of Sector0-Sector31.

AT32L021: controls the erase and program protection of Sector0-Sector31.

EPP1:

AT32F403/F413/F403A/F407: controls the erase and program protection of sectors in the range of Flash 33K-64K.

AT32F415/WB415/F423: controls the erase and program protection of Sector16-Sector31.

AT32F421: controls the erase and program protection of Sector32-Sector63.

AT32F435/F437: controls the erase and program protection of sectors in the range of Flash 33K-64K. Each bit protects 4K bytes sectors.

AT32F425: controls the erase and program protection of Sector32-Sector63.

AT32L021: controls the erase and program protection of Sector32-Sector63.

#### EPP2:

AT32F403/F413/F403A/F407: controls the erase and program protection of sectors in the range of Flash 65K-96K.

AT32F415/WB415/F423: controls the erase and program protection of Sector32-Sector47.

AT32F435/F437: controls the erase and program protection of sectors in the range of Flash 65K-96K. Each bit protects 4K bytes sectors.

#### EPP3:

AT32F403/F413/F403A/F407:

Bit 0-6 controls the erase and program protection of sectors in the range of 97K-124K;

Bit 7 controls the erase and program protection of all Sectors after Flash 124K, including SPIM.

AT32F415/WB415/F423:

Bits 0-6 control the erase and program protection of Sector48-Sector61;

Bit 7 controls the erase and program protection of all subsequent sectors, including boot memory (boot memory in AP mode).

AT32F421: Bit 7 controls the boot memory area (boot memory in AP mode)

AT32F435/F437: controls the erase and program protection of sectors in the range of Flash 97K-128K. Each bit protects 4K bytes sectors.

AT32F425: Bit 7 controls the boot memory area (boot memory in AP mode)

AT32L021: Bit 7 controls the boot memory area (boot memory in AP mode)

#### EPP4:

AT32F435/F437: controls the erase and program protection of sectors in the range of Flash 129K-1152K. Each bit protects 128K bytes sectors.

#### EPP5:

AT32F435/F437: controls the erase and program protection of sectors in the range of Flash 1153K-2176K. Each bit protects 128K bytes sectors.

#### EPP6:

AT32F435/F437: controls the erase and program protection of sectors in the range of Flash 2177K-3200K. Each bit protects 128K bytes sectors.

#### EPP7:

AT32F435/F437: Bit 0-6 controls the erase and program protection of sectors in the range of Flash 3201K-4032K. Each bit protects 128K bytes sectors.

■ User data

Figure 37. User data

Date	0	1	2	3	4	5	6	7
Data 0---7 (0x)	FF	FF	FF	FF	FF	FF	FF	FF

Buttons: Clear, Load file, Save to file

AT32F403/F413/F403A/F407: user data 8 bytes.

AT32F415/WB415: user data 506 bytes.

AT32F421: user data 250 bytes.

AT32F435/F437: Flash size is less than 4032K, user data 220 bytes. Flash size 4032K, user data 2012 bytes.

AT32F425: user data 250 bytes.

AT32L021: user data 250 bytes.

AT32F423: user data 250 bytes.

Clear: Reset all user data to 0xFF, which is not saved to the device

Load file: Load the user data file into the table for display

Save to file: Save the user data in the table to the file.

#### ■ SPIM encryption key (AT32F403/F413/F403A/F407)

Users can set the encryption key when downloading. (As shown in Figure 38)

Figure 38. SPIM encryption key config

SPIM encryption key

KEY0 0x	FF	KEY1 0x	FF	KEY2 0x	FF	KEY3 0x	FF
KEY4 0x	FF	KEY5 0x	FF	KEY6 0x	FF	KEY7 0x	FF

#### ■ QSPI encryption key (AT32F435/F437)

Users can set the encryption key when downloading. (As shown in Figure 39)

Figure 39. QSPI encryption key config

QSPI encryption key

KEY0 0x	FF	KEY1 0x	FF	KEY2 0x	FF	KEY3 0x	FF
KEY4 0x	FF	KEY5 0x	FF	KEY6 0x	FF	KEY7 0x	FF

#### ■ Load from device

Read the user system data from the device and update it to the interface for display.

#### ■ Apply to device

Save the settings of the user system data to the device.

- Load from file

Load the content of the saved user system data file and update it to the interface for display.

- Save to file

Save the user system data settings to file.

### 3.15 Download function

Users can go to "**Menu bar**" — "**Target**" — "**Download**", or click on "**Download**" on the main interface.

(As shown in Figure 40)

Figure 40. Online download config

The screenshot shows the "ICP Download Form" window. It contains several sections for configuring the download process:

- Extra options:**
  - Erase options:** A dropdown menu set to "Erase the sectors of file size".
  - ☒ **Verify**: A checkbox that is checked, with a text input field for a "Custom encryption key for verify:".
  - ☐ **Disable FAP before download**
  - ☐ **Enable FAP after download**
  - Access protection**: A dropdown menu.
  - ☐ **Write user system data**
  - User system data file path**: A text input field with a browse button.
- Bluetooth module:**
  - Erase options:** A dropdown menu set to "Erase main space".
  - ☐ **Disable BLE FAP before download**
  - ☐ **Enable BLE FAP after download**
- Jump to the user program**: ☐
- Button free mode**: ☐
- sLib settings** (selected tab):
  - sLib status:** "Disable".
  - ☐ **Enable sLib**: A checkbox.
  - sLib enable password**: "0x" followed by a text input field.
  - ☐ **Disable sLib before download**: A checkbox.
  - sLib disable password**: "0x" followed by a text input field.
  - Disable sLib**: A button.
  - sLib position**: A dropdown menu set to "Main Flash".
  - Start sector**: A dropdown menu.
  - DATA start sector**: A dropdown menu.
  - End sector**: A dropdown menu.
- Software serial number(SN)** and **Bluetooth module Mac setting**: Tabs for additional configuration.

At the bottom of the window are three buttons: "Start Download", "Cancel Download", and "Close".

#### 1) Extra options

- Mass erase for Main Flash

If the download address of the file is located in main flash, the whole main flash will be erased.

#### ■ Mass erase for SPIM

If the download address of file is located in SPIM, the whole SPIM will be erased.

#### ■ Mass erase for Main Flash and SPIM

If the download address of the file is located in both the main flash and the SPIM, the main flash and the SPIM will be completely erased.

#### ■ Mass erase for Main Flash and Boot memory (AT32F415/F421/F425/WB415/L021/F423)

If the download address of the file is located in both the main flash and the boot memory, the main flash and the boot memory will be completely erased.

(For "Mass erase for Main Flash", "Mass erase for SPIM", "Mass erase for Main Flash and SPIM", and "Mass erase for Main Flash and Boot memory", these four options will be selected automatically based on the download files)

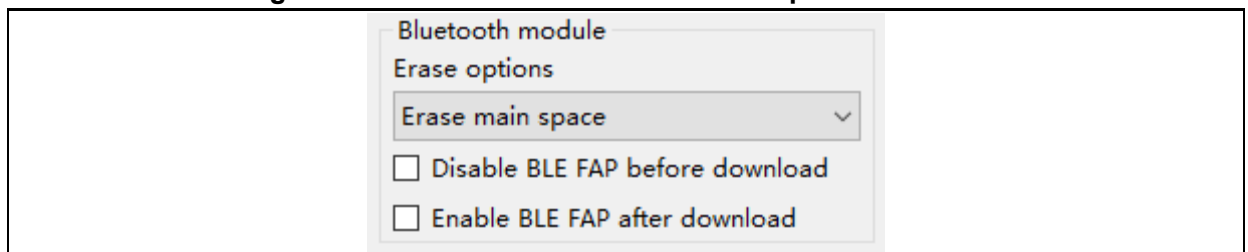
#### ■ Erase the sectors of file size

According to the download address of the file, it will automatically determine which sector needs to be erased.

#### ■ Bluetooth module

This can be set as Figure 41:

**Figure 41. Bluetooth module download options**



- Erase options: Select an erase mode.
- Disable BLE FAP before download: Disable BLE module access protection before download.
- Enable BLE FAP after download: Enable BLE module access protection after download

#### ■ Disable sLib before download

To disable sLib before download, you need to enter the password you last enabled.

#### ■ Enable sLib

Enable the sLib function when download. It is necessary to enter sLib password, start sector, DATA start sector/ INSTR start sector, and end sector.

#### ■ Disable FAP before download (for button free download)

If the chip is in the access protection state, the access protection will be automatically disabled before download.

#### ■ Verify

After the download is completed, the corresponding data in the memory is read and then verified to

determine whether the download is successful. If this option is unchecked, no verify is performed after download, so it is impossible to determine whether the downloaded content is correct.

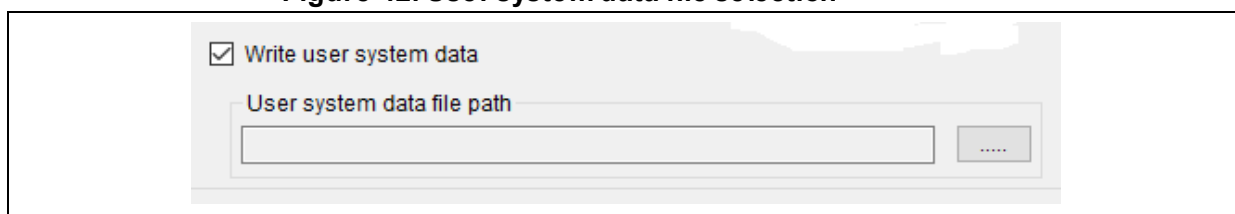
- Jump to the user program


After the download is complete, the code downloaded to the Flash address 0x08000000 will be executed.

- Write user system data

Select this option to automatically write user system data to the device after the program file is downloaded and the serial number is programmed. This can be set as in Figure 43:

**Figure 42. User system data file selection**



: Select the user system data file. BIN and HEX formats are supported.

- Enable FAP after download

After the above operations such as download are completed, enable access protection.

AT32F415/F421/F425/WB415/L021/F423 can be set to enable access protection and high level access protection (access protection and user system data erase protection).

(AT32F425/L021/F423 high level access protection is irreversible. Once enabled, it will never be unlocked, with its debugging interface permanently disabled. Please use with caution.)

- Button free mode (Only for AT-Link)

After one device download is completed, replace it with another device for continuous downloading.

## 2) sLib Setting

(AT32F403 not support sLib function)

- sLib status

Displays the current sLib status, disable or enable.

- Remaining usage times (AT32F413/F403A/F407)

It means the remaining usage times of sLib, and it can be used up to 256 times, which will be reduced one by one after each use. When the remaining time is 0, the sLib function will not be available.

- Enable password

It refers to the password when the sLib is enabled.

- Disable password

It is the password when the sLib is disabled.

■ sLib position (AT32F415/F421/F425/WB415/L021/F423)

sLib can be configured in main flash or boot memory (boot memory is in AP mode).

■ Start sector

AT32F413/F415/F403A/F407/WB415:

The start position of sLib area. The instruction area is the area from "Start sector" to "DATA start sector" (excluding DATA start sector). Once sLib is enabled, the data in this area cannot be erased, written or read.

AT32F421/F435/F437/F425/L021/F423:

The start position of sLib area. The area from "Start sector" to "INSTR start sector" (not including "INSTR start sector") is a mixed instruction and data (read only area). Once sLib is enabled, the data in this area cannot be erased, written, but can be read.

■ DATA start sector/ INSTR start sector

AT32F413/F415/F403A/F407/WB415:

The start sector of sLib data area. The data area is from "DATA start sector" to "End sector" (including "End sector"). After sLib is enabled, the data in this area cannot be erased or written, but can be read. When it is set to "none", it is no data area.

AT32F421/F435/F437/F425/L021/F423:

The start sector of sLib instruction area. The instruction area is from "INSTR start sector" to "End sector" (including "End sector"). After sLib is enabled, the data in this area cannot be erased, written or read. When it is set to "none", it is no instruction area.

■ End sector

The end position of the sLib area.

■ Disable sLib

Disable sLib. Users need to enter the password that last enabled. When sLib is successfully disabled, the whole chip will be erased.

### 3) Write software serial number

■ Write software serial number(SN)

Select this option to automatically program the serial number for each device after the program file is downloaded. This can be set as Figure 42:

**Figure 43. Write software serial number**

<input checked="" type="checkbox"/> Write software serial number		
Write address	0x	<input type="text" value="08010000"/>
Current SN	0x	<input type="text" value="00000007"/>
Increase step	0x	<input type="text" value="00000001"/>

- Write address: the address where the serial number is programmed into the memory.
- Current SN: the serial number of the current programming.
- Increase step: this is the amount added to the next serial number after each serial number is



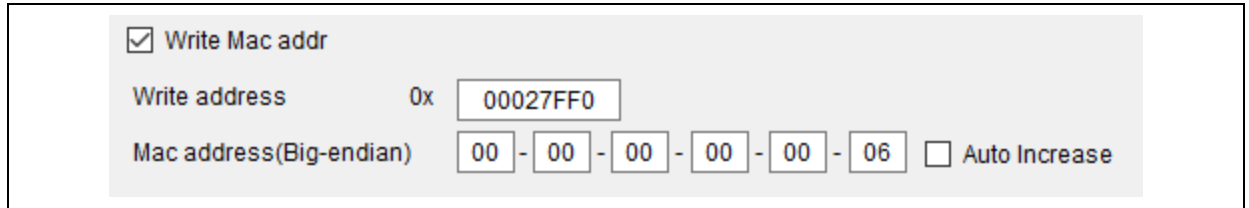
programmed.

#### 4) Write Bluetooth module Mac Setting

##### ■ Write Mac addr

Select this option to automatically program the Mac address for each device after the program file is downloaded. This can be set as Figure 44:

**Figure 44. Write Mac address**



☒ Write Mac addr

Write address      0x    00027FF0

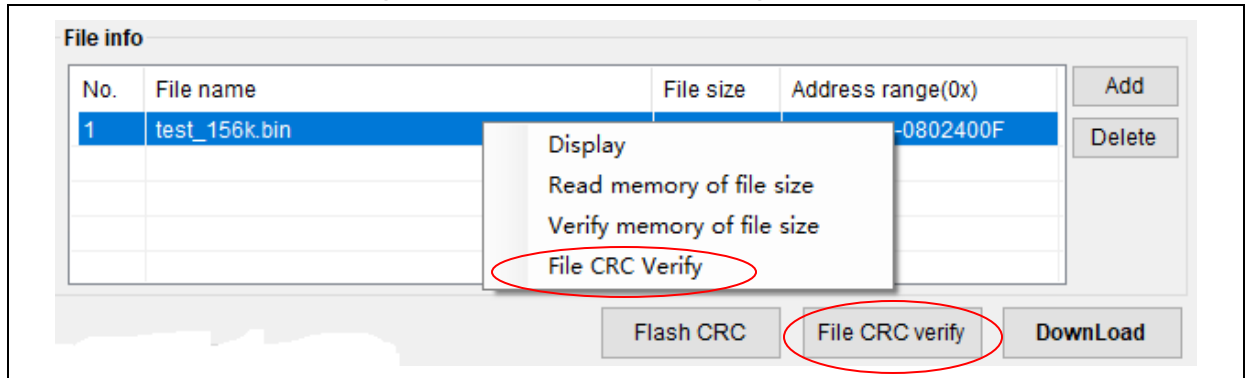
Mac address(Big-endian)    00 - 00 - 00 - 00 - 00 - 06    ☐ Auto Increase

- Write address: the address where the Mac address is programmed into the memory.
- Mac address (Big-endian): the Mac address of the current programming.
- Auto Increase: After each mac address is written, the next mac address is added by 1.

### 3.16 File CRC verify function

(AT32F413/F415/F403A/F407/F421/F435/F437/F425/WB415/L021/F423 support CRC check function (SPIM not supported)) (As shown in Figure 44)

Figure 45. CRC function config



■ Method 1:

Select the file to be checked, right click, and select "**File CRC verify**" in the right-click menu.

■ Method 2:

Select the file to be verified and click "**File CRC verify**" button directly.

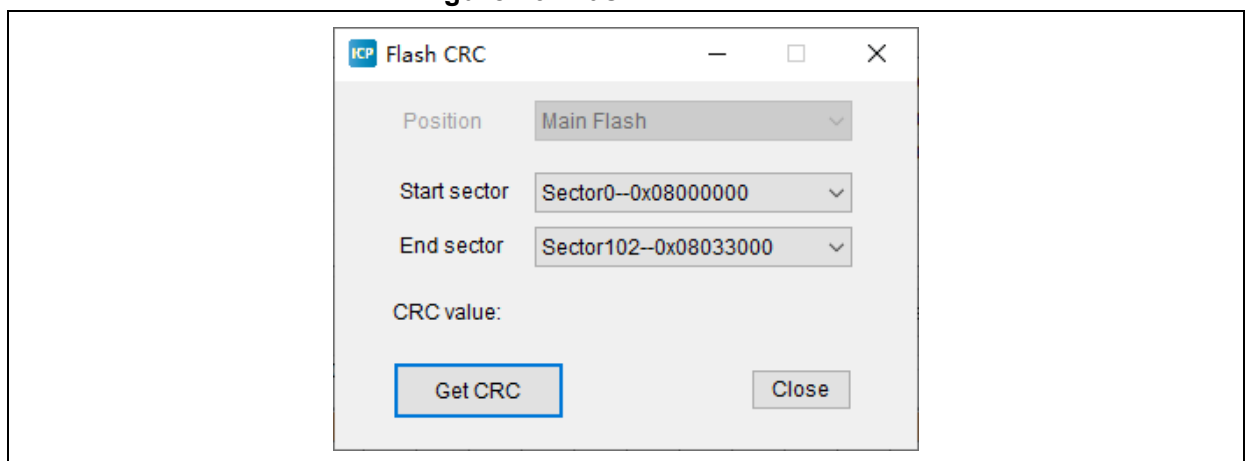
### 3.17 Flash CRC

AT32F413/F415/F403A/F407/F421/F435/F437/F425/WB415/L021/F423 series support Flash CRC function (SPIM does not support)

(Menu bar---"**Target**"---"**Flash CRC**") or (Main interface---"**Flash CRC**")

As shown in below Figure 45

Figure 46. Flash CRC



- Calculation area: main Flash and boot memory (AT32F415/F421/F425/WB415/L021/F423 in AP mode)
- Start sector: the start sector of calculating CRC
- End sector: the end sector of calculating CRC

- CRC value: the calculated CRC value
- Obtain CRC: start calculating CRC value.
- Close: close this dialog box.

### 3.18 SPIM encryption download

#### SPIM encryption principle:

When SPIM encrypted download is required, users must first configure the SPIM FLASH\_DA and SPIM encryption key (Key is set in the user system data) before download. In this case, the MCU will encrypt the downloaded original data according to the SPIM FLASH\_DA and encryption key as well as the algorithm set in the MCU, then write the encrypted data to SPIM.

When need to read the encrypted data of the SPIM, users also need to configure the SPIM FLASH\_DA and encryption key. Based on the SPIM FLASH\_DA and encryption key, MCU uses the MCU's internal algorithm to decrypt the encrypted data and restore it to the correct original data.

When downloading files to SPIM, the following steps can be set to encrypt the downloaded content. (AT32F403/F413/F403A/F407)

**Step 1:** set the FLASH\_DA of the SPIM. (As shown in Figure 46)

**Figure 47. SPIM encryption range config**

Users can set the range to be encrypted starting from 0x08400000.

If encryption is not required, set to 0.

**Step 2:** set the SPIM encryption key through the "user system data" page. (As shown in Figure 47)

**Figure 48. SPIM encryption key config**

This is the encryption / decryption key for downloading and reading data in the encrypted range of the SPIM. When the access protection is disabled, the key is also erased.

**Step 3:** Download the file to SPIM normally to implement encrypted download.

## 3.19 QSPI configuration and file download

### 3.19.1 Parameters

(For the AT32F435/F437 series)

Configure the QSPI before using QSP flash.

Click on the “QSPI Configuration” to open the configuration interface, as shown in Figure 49.

Figure 49. QSPI configuration

Discription	No.	Discription	No.
Write Enable	06H	Sector Erase	20H
Read Status Register-1	05H	Fast Read Quad I/O	EBH
Quad Input Page Program	32H	64KB Block Erase	D8H
Chip Erase	C7H		

- Tick “QSPI Enable”

Allow operations to QSPI.

- QSPI select

Select QSPI1 or QSPI2 as needed.

- Addr.

Select the QSPI address range.

- IO0, IO1, IO2, IO3, SCK and CS

Select the corresponding pin as needed.

- Apply

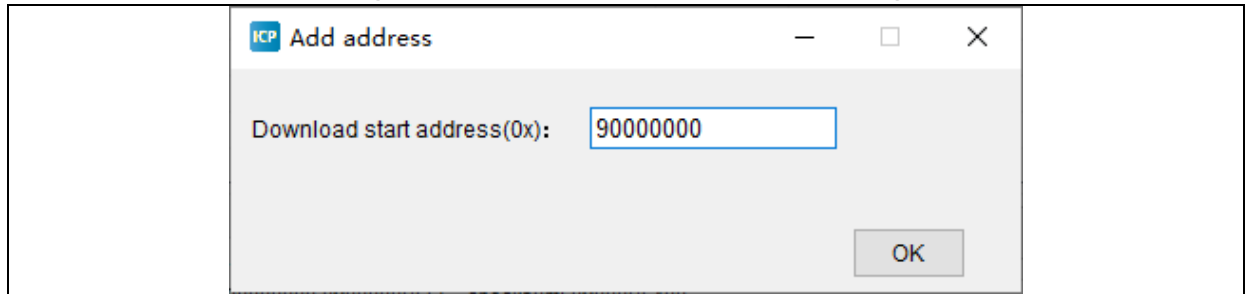
Click on “Apply” to save the QSPI configuration.

After the QSPI parameters are configured, the QSPI configuration icon in the main interface displays in different colors according to the corresponding configuration (green: QSPI Enable ticked; black: QSPI Enable unticked).

### 3.19.2 Download files to QSPI

After the QSPI parameters are configured, add files to be downloaded to QSPI into the download list. The download start address should be within the QSPI address range, as shown in Figure 50.

**Figure 50. Download start address setting**



Click on “Download” and open “Download options” to configure the corresponding parameters; then click on “Start download” to download files to QSPI flash.

## 4 Revision history

**Table 1. Document revision history**

Date	Revision	Changes
2023.02.21	V2.05	<ol style="list-style-type: none"> <li>Added "Write Bluetooth module MAC address (AT32WB415CCU7-7)" in Section 3.3.2.</li> <li>Added "3.19 QSPI configuration and file download".</li> <li>Support for AT32F423.</li> </ol>
2022.08.11	V2.04	<ol style="list-style-type: none"> <li>Modified some pictures.</li> </ol>
2022.07.15	V2.03	<ol style="list-style-type: none"> <li>Support for AT32L021.</li> </ol>
2022.01.26	V2.02	<ol style="list-style-type: none"> <li>Support for AT32WB415.</li> </ol>
2021.11.26	V2.01	<ol style="list-style-type: none"> <li>Support for AT32F425.</li> <li>Support for AT32F403AVGW.</li> </ol>
2021.10.13	V2.00	<ol style="list-style-type: none"> <li>Initial release. Support for AT32F403/F413/F415/F421/F403A/F407/F435/F437.</li> </ol>



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