

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.

Contents

1	Introduction	8
1.1	Environmental requirements.....	8
1.2	Glossary	8
2	Installation	9
3	Function overview	10
3.1	Menu bar	10
3.2	J-Link settings	12
3.3	AT-Link settings.....	13
3.3.1	Parameter settings	13
3.3.2	AT-Link offline project settings.....	15
3.3.3	AT-Link offline download	18
3.4	AT-Link firmware upgrade.....	20
3.5	Artery MCU resources download	21
3.6	Make encryption file	21
3.7	Device connection.....	22
3.7.1	AT-Link connected to device:	22
3.7.2	J-Link connected to device:.....	23
3.8	SPIM setting.....	23
3.9	Memory read settings	25
3.10	File info	26
3.11	MCU Erase function.....	27
3.12	BLE Erase function	29
3.13	BLE Debug.....	31
3.14	User system data	33
3.15	Download function	39
3.16	File CRC verify function	45
3.17	Flash CRC.....	45
3.18	SPIM encryption download.....	47
3.19	QSPI configuration and file download	49

3.19.1	Parameters	49
3.19.2	Download files to QSPI	51
4	Application scenarios	52
4.1	Offline projects	52
4.2	Button free download	55
4.2.1	Online continuous download	55
4.2.2	Offline continuous download	56
4.3	Write software serial number	56
4.3.1	Online programming	56
4.3.2	Offline programming	57
4.4	sLib settings	57
4.4.1	Online settings	57
4.4.2	Offline settings	59
4.5	User system data programming	59
4.5.1	Direct application	61
4.5.2	Online download	61
4.5.3	Offline download	61
4.6	Multi-section code programming	62
4.7	Remote file	63
4.7.1	Generate remote file	63
4.7.2	Usage of remote file	64
4.8	Encryption file	65
4.8.1	Make encryption file	65
4.8.2	Usage of encryption file	66
4.8.3	Precautions	67
5	Revision history	68

List of tables

Table 1. Encryption key matching	67
Table 2. Document revision history	68

List of figures

Figure 1. Main window	10
Figure 2. Menu bar.....	11
Figure 3. J-Link settings.....	12
Figure 4. AT-Link settings.....	13
Figure 5. Offline config settings	15
Figure 6. Project file settings	18
Figure 7. Offline download window	19
Figure 8. AT-Link firmware upgrade.....	20
Figure 9. AT-Link firmware manual upgrade.....	20
Figure 10. MCU resource download	21
Figure 11. MCU download link.....	21
Figure 12. Make encryption file.....	22
Figure 13. Select simulator	22
Figure 14. Before connecting.....	22
Figure 15. Successful connecting.....	23
Figure 16. Before connecting.....	23
Figure 17. Successful connecting.....	23
Figure 18. SPIM settings.....	23
Figure 19. SPIM select.....	24
Figure 20. SPIM name	24
Figure 21. SPIM auto detect failed	25
Figure 22. Memory read settings	25
Figure 23. 8-bit data.....	26
Figure 24. 16-bit data.....	26
Figure 25. 32-bit data.....	26
Figure 26. File info	26
Figure 27. File info data	27
Figure 28. Right click menu	27
Figure 29. Sector erase	28
Figure 30. Block erase.....	29
Figure 31. BLE module sector erase	30
Figure 32. BLE module debug.....	31
Figure 33. BLE Register Control.....	32
Figure 34. BLE Flash Control	32

Figure 35. User system data config	33
Figure 36. User system data config	35
Figure 37. Erase and program protection bytes	37
Figure 38. User data	38
Figure 39. SPIM encryption key config	39
Figure 40. QSPI encryption key config	39
Figure 41. Online download config	40
Figure 42. Bluetooth module download options	41
Figure 43. User system data file selection.....	42
Figure 44. Write software serial number	43
Figure 45. Write Mac address.....	44
Figure 46. CRC function config.....	45
Figure 47. Flash CRC	45
Figure 48. SPIM encryption range config	47
Figure 49. SPIM encryption key config	47
Figure 50. QSPI configuration	49
Figure 51. Advanced Config Commands.....	50
Figure 52. Extra Commands.....	50
Figure 53. Download start address setting	51
Figure 54. AT-Link Settings – Data storage area.....	52
Figure 55. AT-Link offline config settings	53
Figure 56. Offline project settings	53
Figure 57. Optional settings for offline project	54
Figure 58. Optional settings for offline project	54
Figure 59. AT-Link offline download status	55
Figure 60. Online continuous download settings.....	55
Figure 61. Successful download	56
Figure 62. Offline continuous download settings.....	56
Figure 63. Write software serial number.....	56
Figure 64. SN write success	57
Figure 65. sLib settings.....	57
Figure 66. sLib settings – sector settings	58
Figure 67. Successful sLib settings	58
Figure 68. sLib disabled successfully	58
Figure 69. sLib offline settings	59

Figure 70. User system data config	59
Figure 71. Access protection status	60
Figure 72. Sector erase and program protection	60
Figure 73. User data settings	60
Figure 74. Direct application – Apply to device	61
Figure 75. Save to file	61
Figure 76. Click download	61
Figure 77. Write user system data	61
Figure 78. Offline download – user system data settings	62
Figure 79. BIN file download start address	62
Figure 80. Add files at discontinuous addresses	63
Figure 81. Save project file	63
Figure 82. Project file settings	63
Figure 83. Open project file	64
Figure 84. Save failed – not the specified AT-Link	64
Figure 85. Save failed – project only used once	64
Figure 86. Encryption key in AT-Link	65
Figure 87. Make encryption file	65
Figure 88. Binary comparison of original file versus encryption file	66
Figure 89. Add encryption file	66
Figure 90. Enter encryption key for verify	66
Figure 91. Verification failure	67

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**

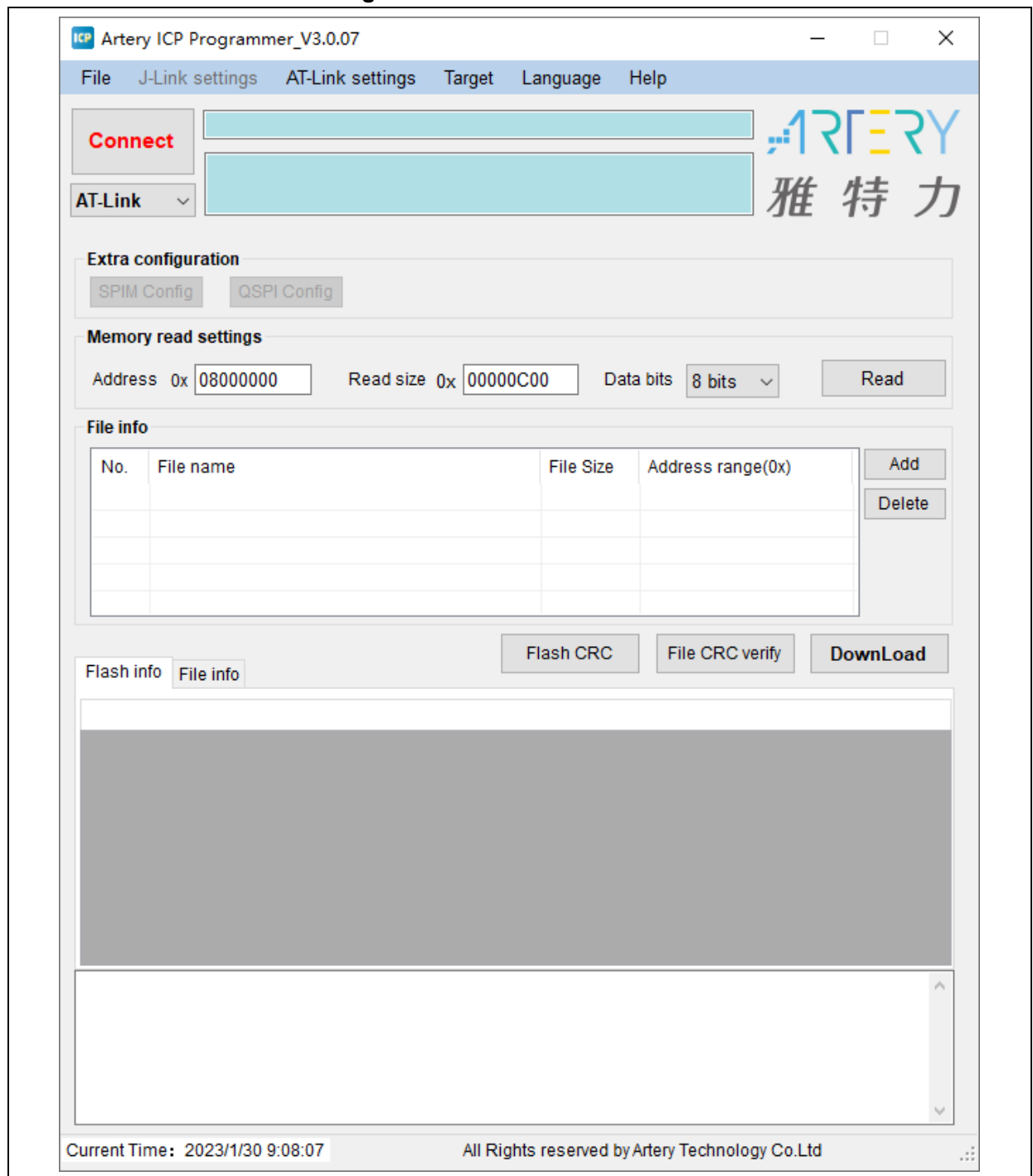
Step 1: connect the AT-Link/ J-Link simulator to the USB interface of PC.

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:

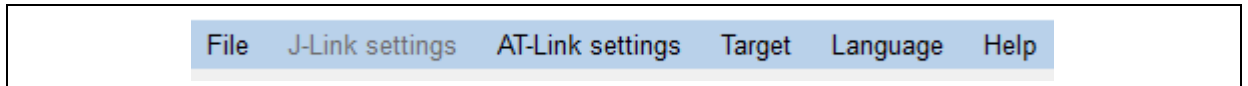
Figure 1. Main window



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/A403A). When the boot memory is in AP mode, the boot memory is also erased (AT32F415/F421/F425/WB415/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457).
- 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/A423/F402/F405/F490/M412/M416/F455/F456/F457 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/A403A/F435/F437, enable / disable access protection.
For AT32F415/F421/F425/WB415/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457, enable access protection, high level access protection (access protection and user system data erase protection) and disable access protection.
(AT32F425/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457 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/A403A/F421/F435/F437/F425/WB415/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457).
- 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/A423/F402/F405/F490/M412/M416/F455/F456/

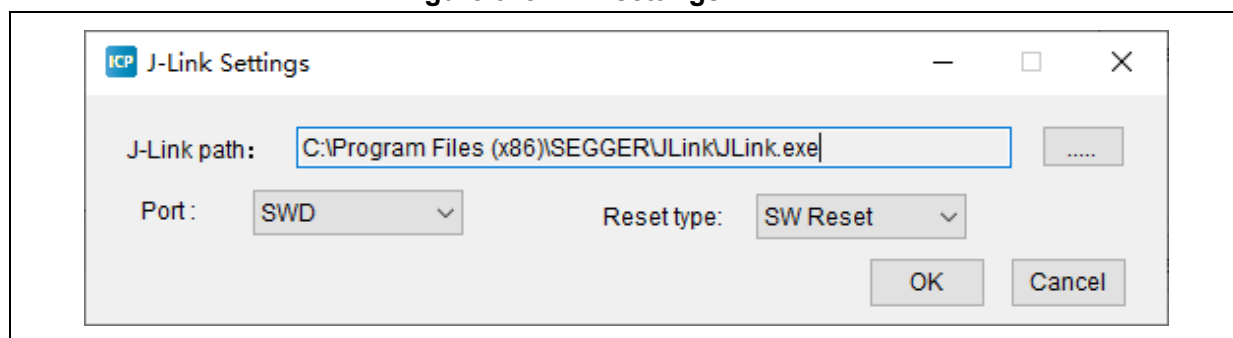
F457)

- 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.

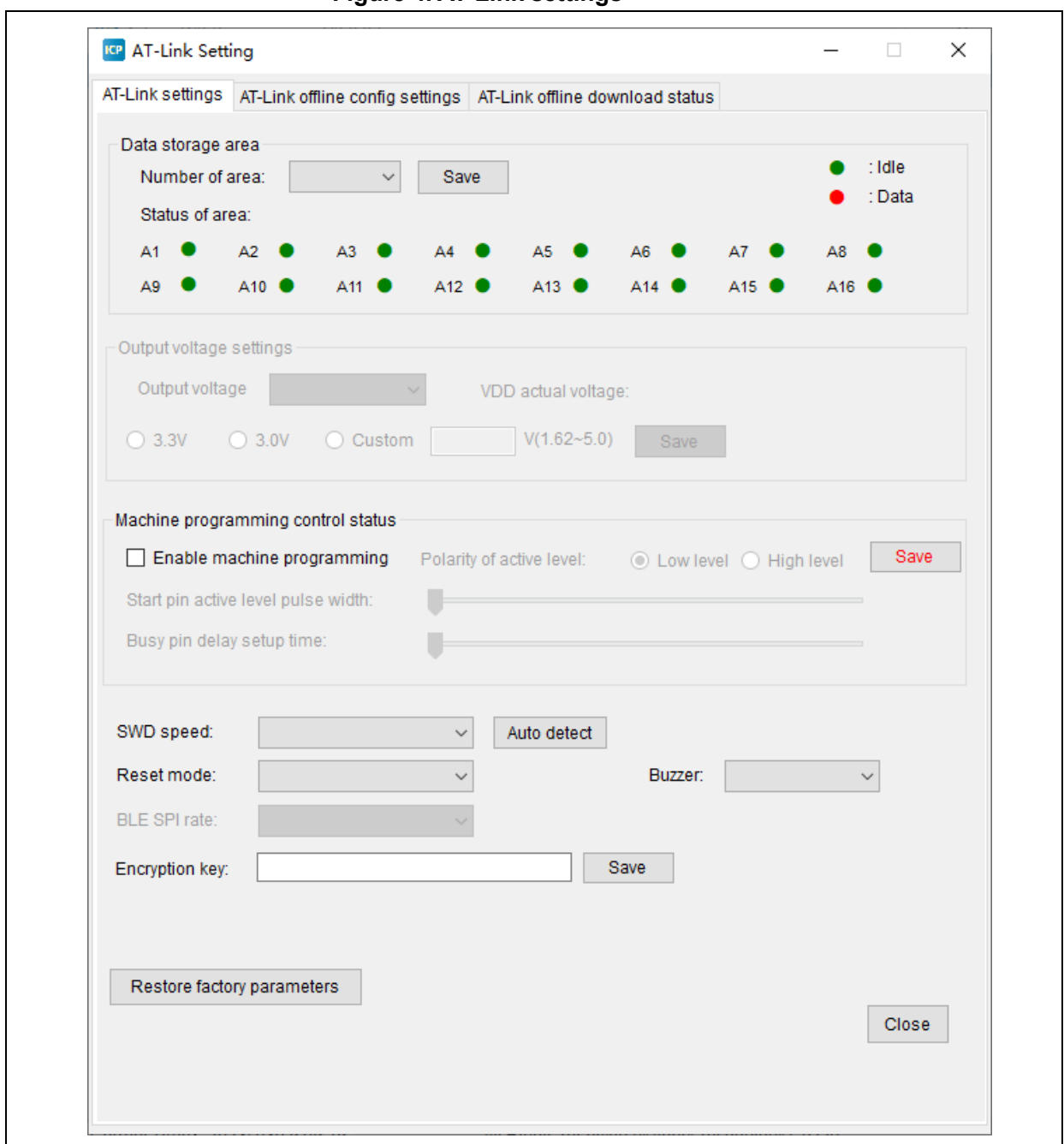
3.3 AT-Link settings

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 with a 'Delete' button and a 'Creat' 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 empty 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 checkbox and a text input field.
- Verify:** A checked checkbox.
- Encryption transmit:** A checkbox.
- Reset and run:** A checkbox.
- Download interface:** A dropdown menu.
- Write user system data:** A checkbox and a text input field.
- Enable FAP after download:** A checked checkbox.
- Boot memory AP mode:** An unchecked checkbox.
- Key:** A text input field with the value '(0xA35F6D24)'.
- Software serial number(SN):** A tabbed section with 'SPIM settings', 'sLib settings', and 'Bluetooth module Mac setting' tabs. The 'Software serial number(SN)' 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 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/A423/F402/F405/F490/M412/M416/F455/F456/F457, users can choose to enable access protection and high level access protection (access protection

and user system data erase protection).

(AT32F425/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457 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/A423/F402/F405/F490/M412/M416/F455/F456/F457)

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/A403A)

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.

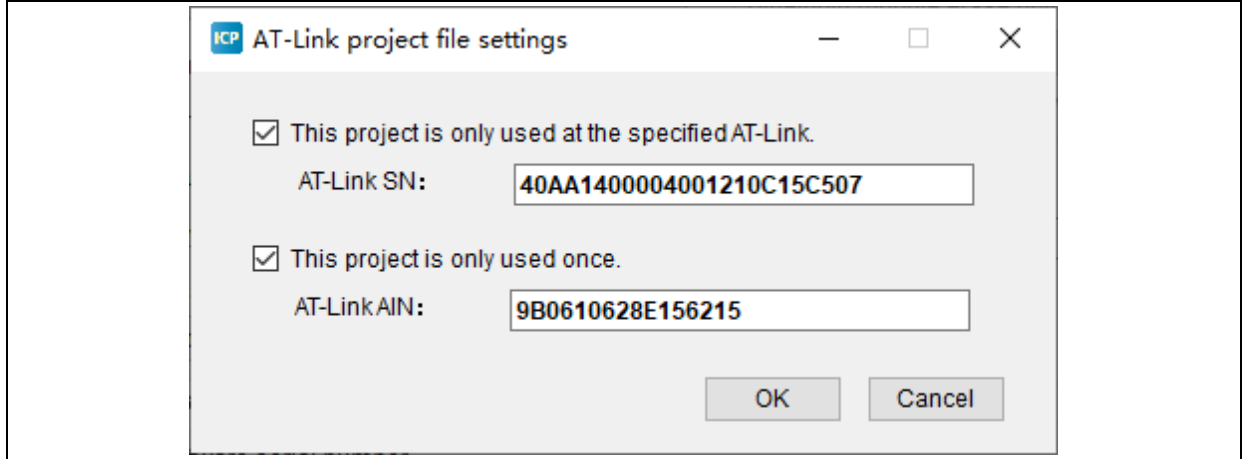
■ Load parameters (valid only for new projects)

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.

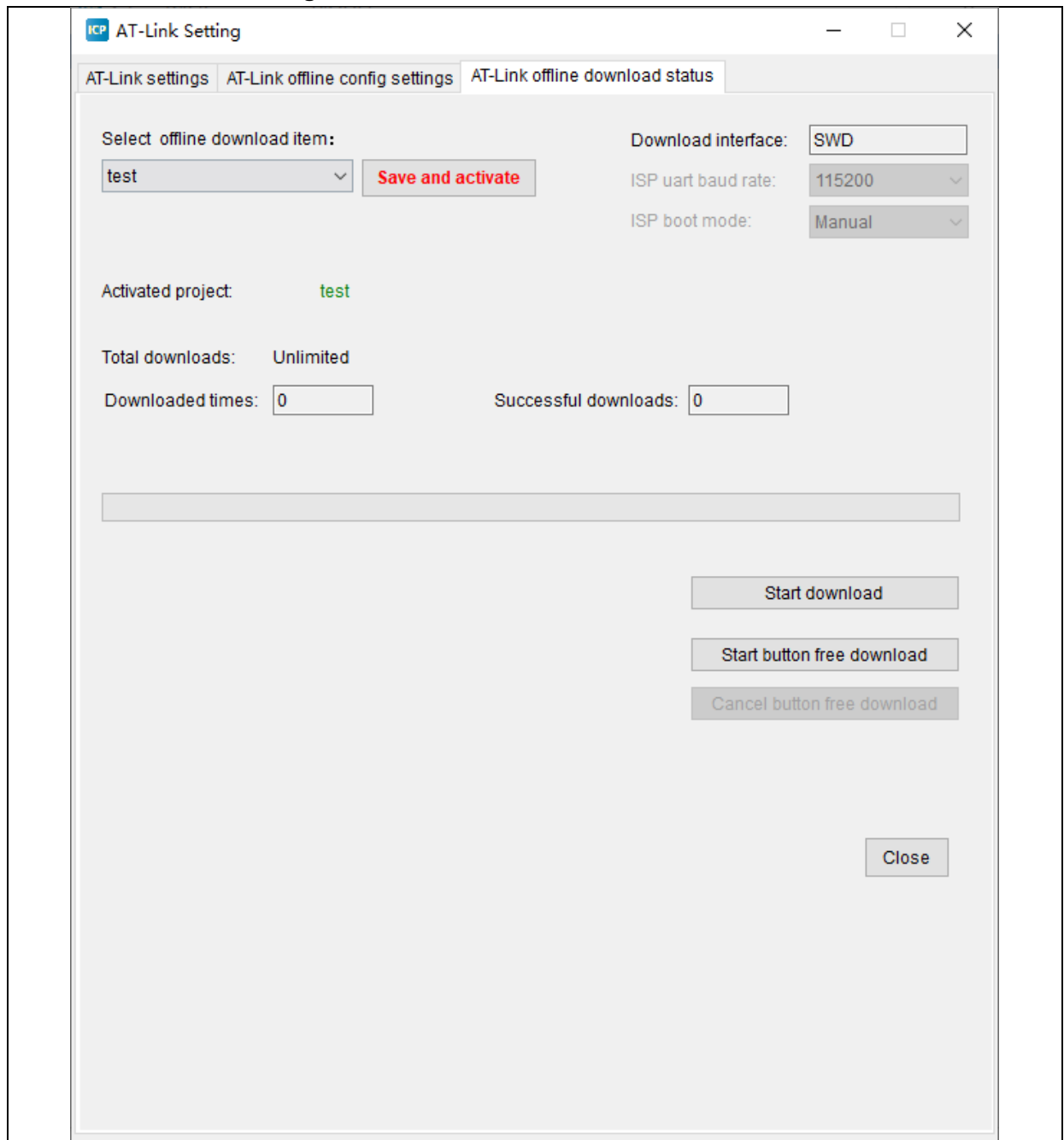
■ Save project to AT-Link

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.

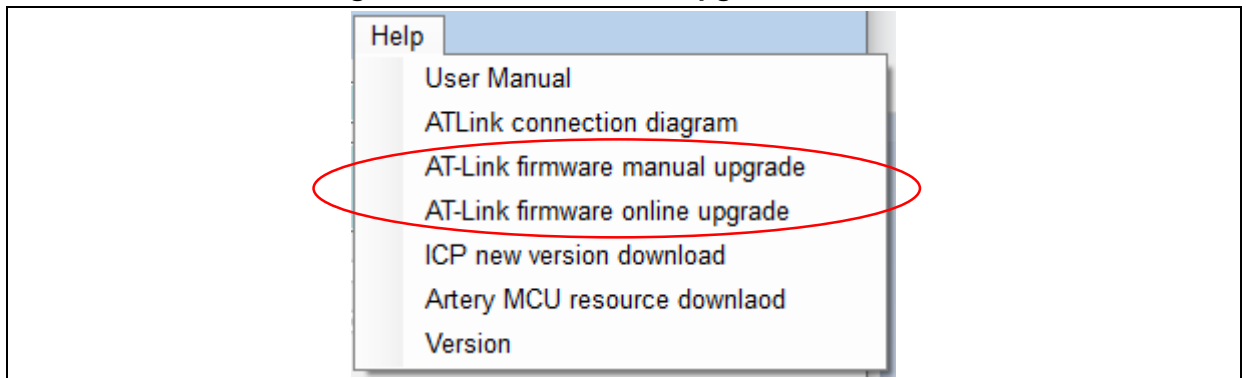
This option allows the switching of Start/Cancel only when AT-Link is in idle state.

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

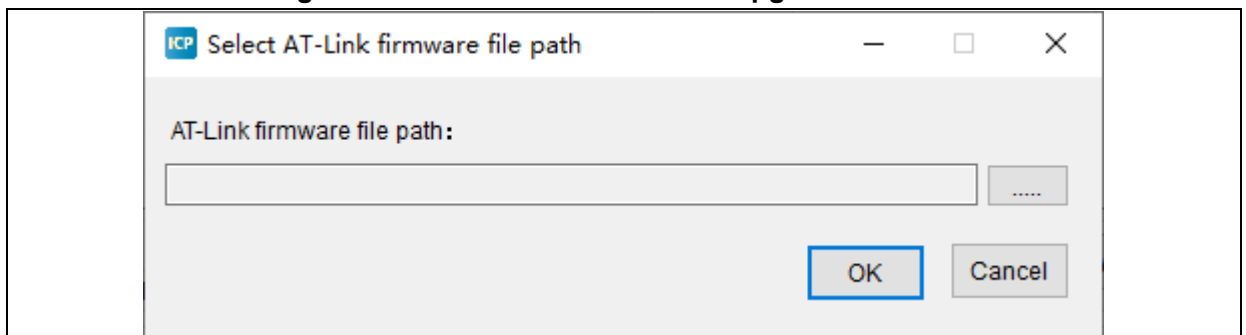
This option can be found in the “**Help**” menu. (As shown in Figure 8)

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.

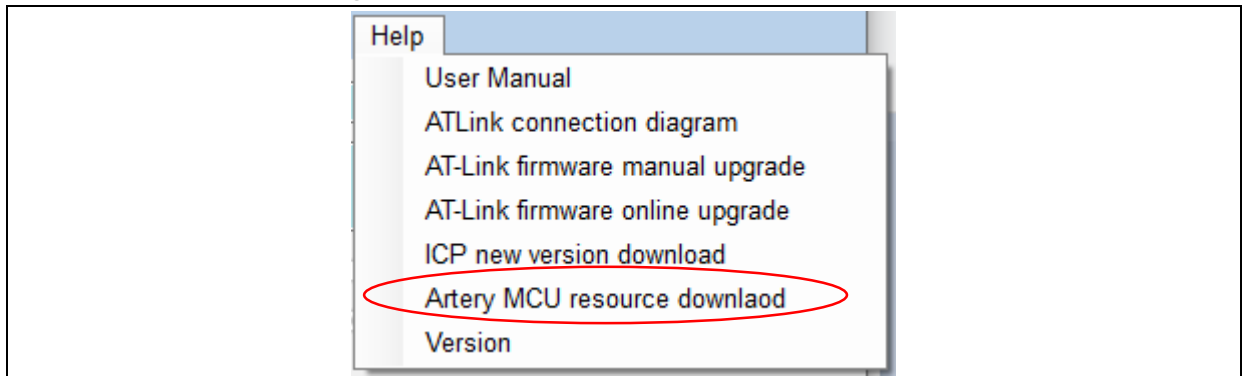
■ AT-Link firmware online upgrade

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

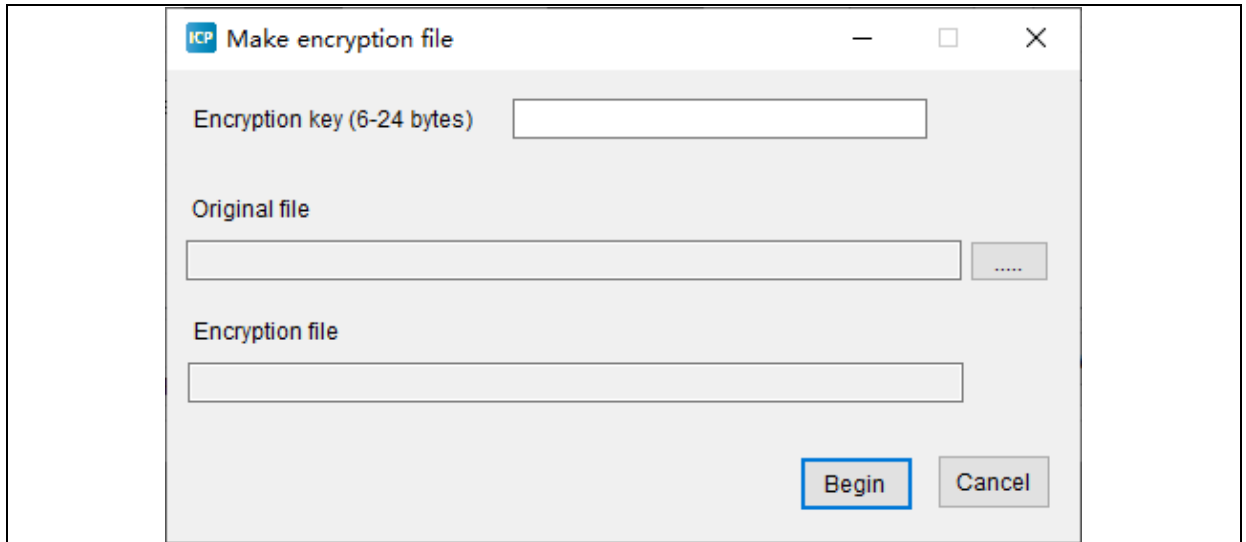


Click the above link to enter the corresponding webpage.

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



The dialog box titled "ICP Make encryption file" has three input fields: "Encryption key (6-24 bytes)", "Original file", and "Encryption file". At the bottom right, there are "Begin" and "Cancel" buttons.

- 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

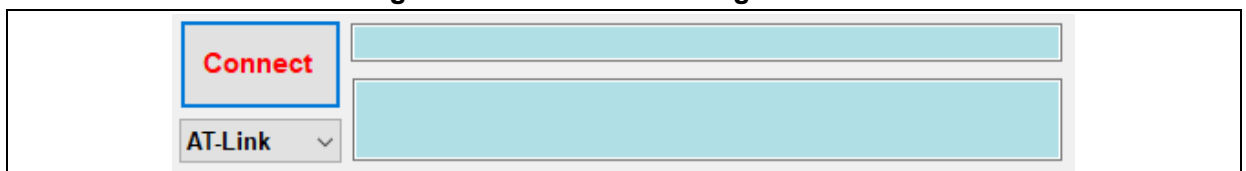


The interface shows a "Connect" button and a dropdown menu with the following options: "AT-Link", "AT-Link", and "J-Link".

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

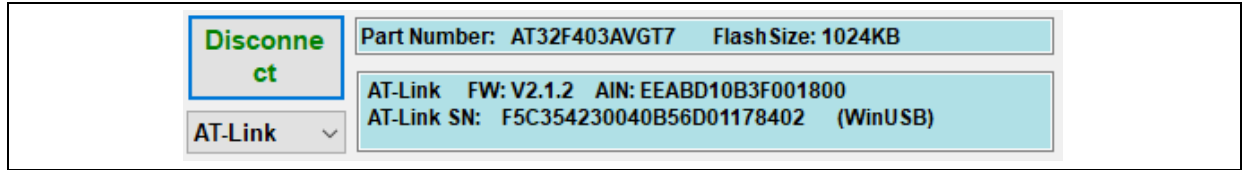


The interface shows a "Connect" button and a dropdown menu with "AT-Link" selected. There are two large empty rectangular areas to the right of the buttons.

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

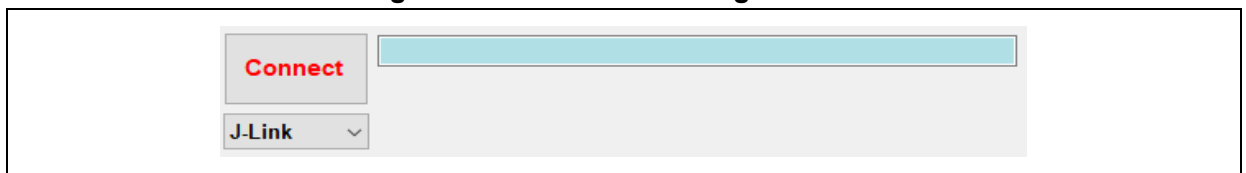


After successful connection, AT-Link related information will be displayed, including AT-Link part number, firmware version, AT-Link AIN; and MCU related information, including MCU part number, Flash size, etc. If click on "**Disconnect**", you can disconnect from the device

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



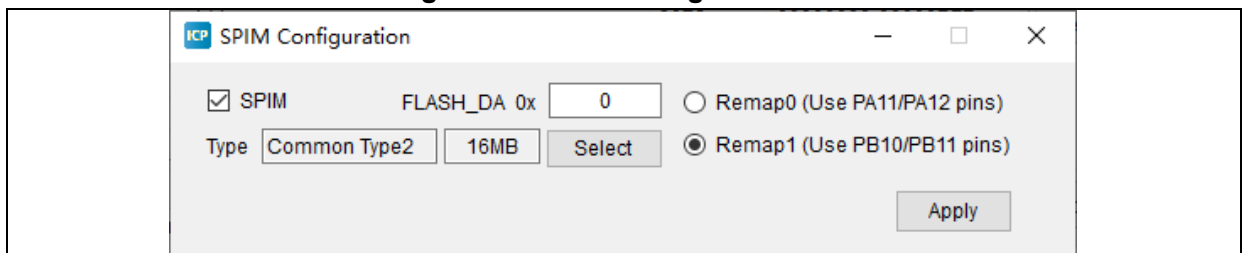
After successful connection, MCU related information will be displayed, including MCU part number, Flash size, etc. If click on "Disconnect", you can disconnect from the device.

3.8 SPIM setting

(AT32F403/F413/F403A/F407/A403A)

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)

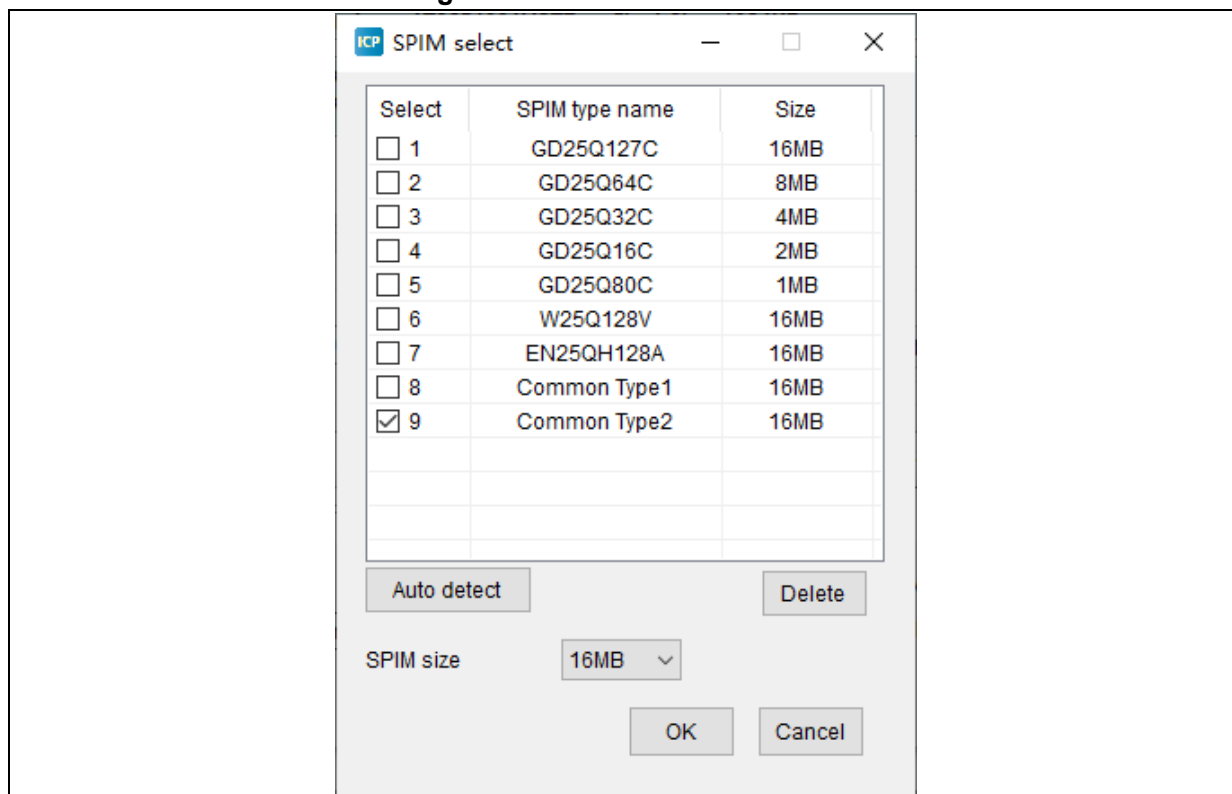
Select SPIM connection pins.

■ 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)

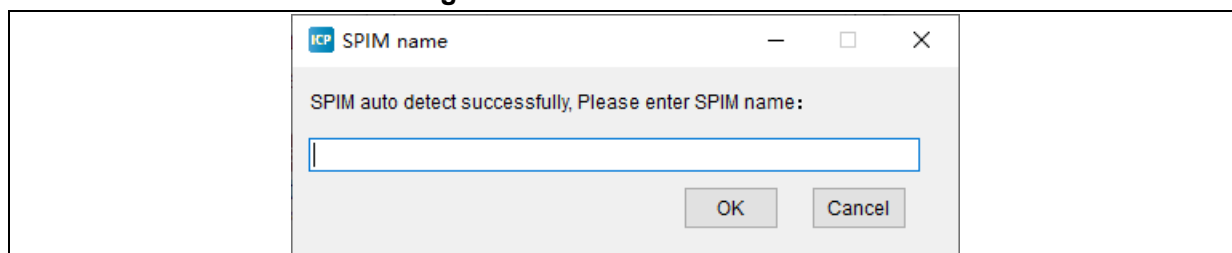
Figure 19. SPIM select



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

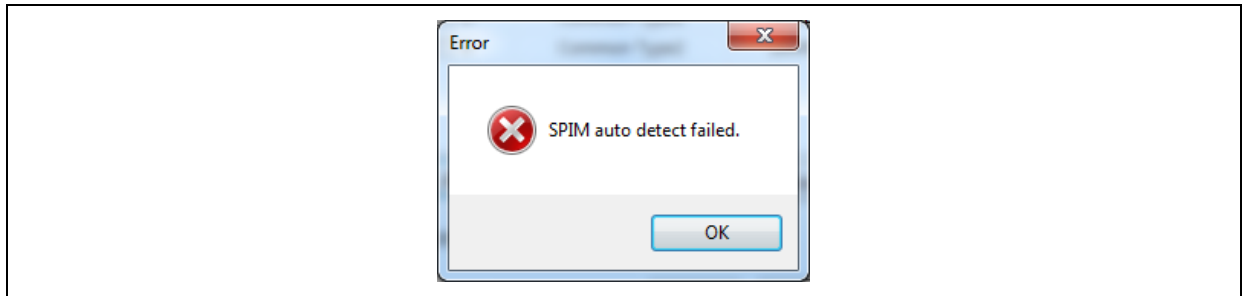


Click on "**OK**" to add the detected SPIM to the SPIM list.

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

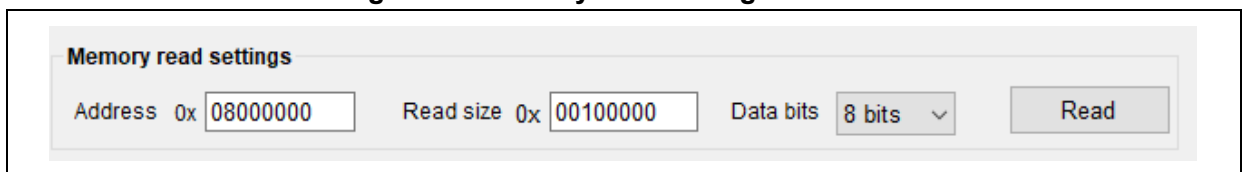


- SPIM size: select the SPIM size, except for the default type.
- Delete: delete the selected SPIM in the list, except for the default type.
- OK: SPIM selected.
- Cancel: cancel.

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口
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	懣

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口 鍋口.?.?.?
0x08000040	0820	56F9	0801	203F	3F08	0820	3F61	3F08	鵲口.?.?.a?.?
0x08000050	0820	9199	0820	9101	0820	3F09	3F08	0820	懣 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口 鍋口.?.?.?
0x08000040	56F90820	203F0801	08203F08	3F083F61	鵲口.?.?.a?.?
0x08000050	91990820	91010820	3F090820	08203F08	懣 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/A403A)

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

(AT32F415/F421/F425/WB415/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457)

■ Erase main flash

Erase the whole main Flash.

■ Erase SPIM

Erase the whole SPIM.

■ Erase boot memory

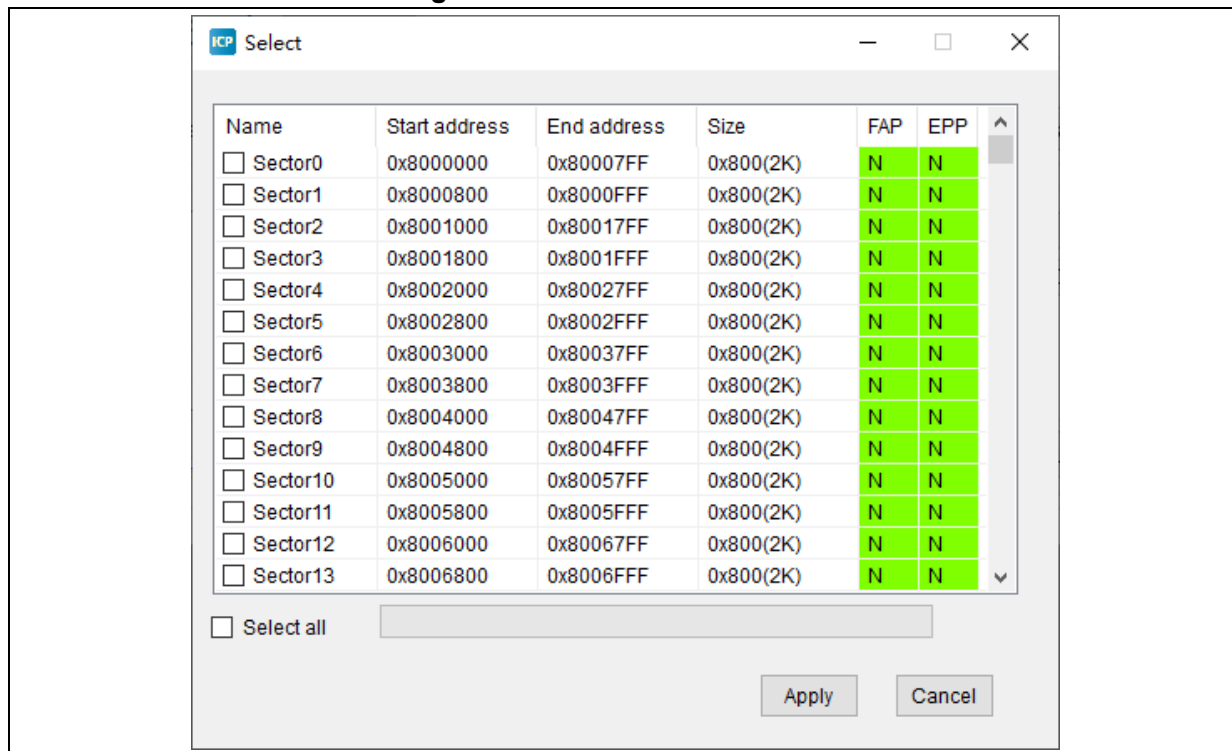
When the boot memory is in AP mode, erase the boot memory.

(AT32F415/F421/F425/WB415/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457)

■ Erase sectors

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

Figure 29. Sector erase

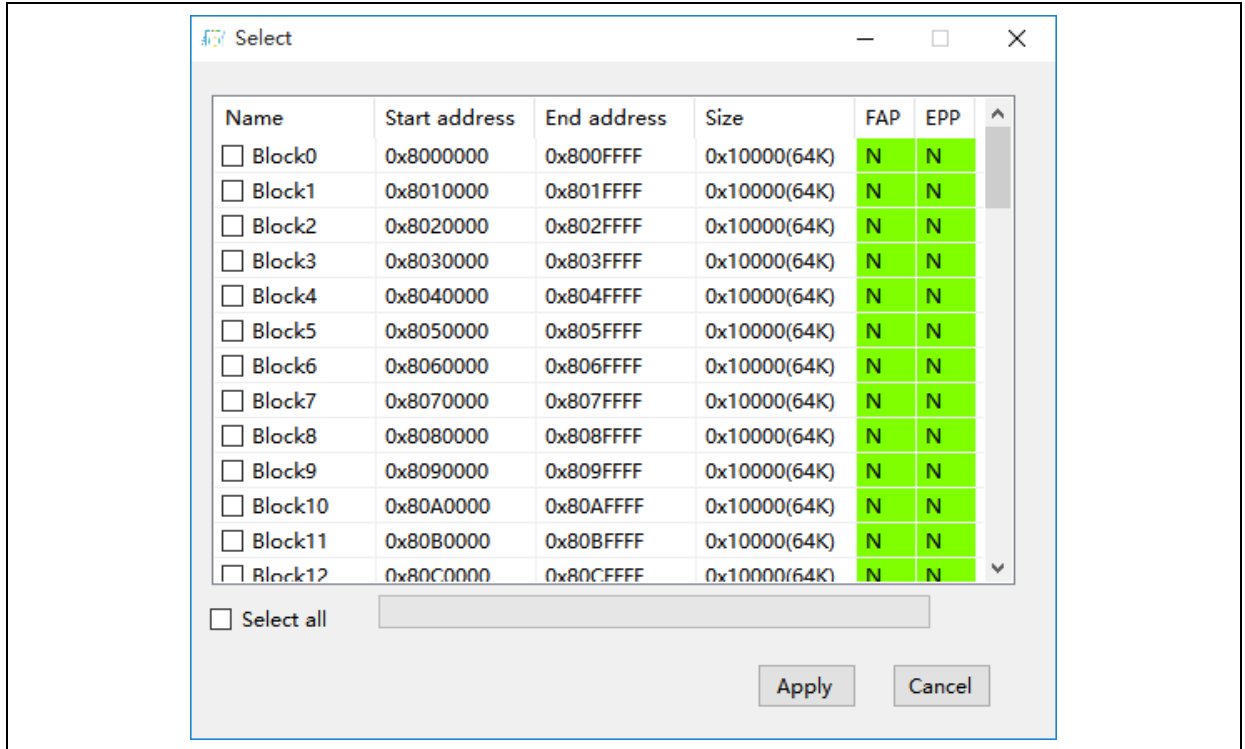


- Apply: erase the selected sectors.
- Cancel: cancel the erase operation during the erase process.

■ 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.

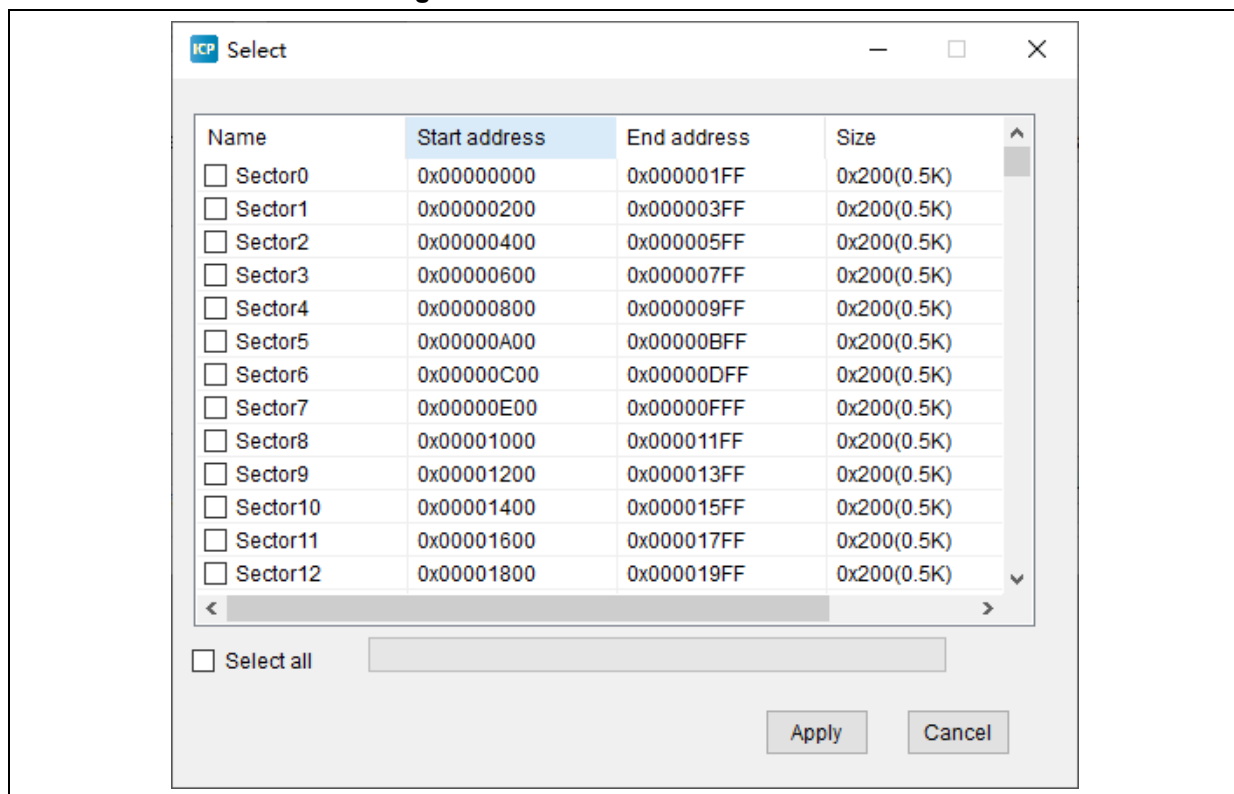
- Erase main space

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

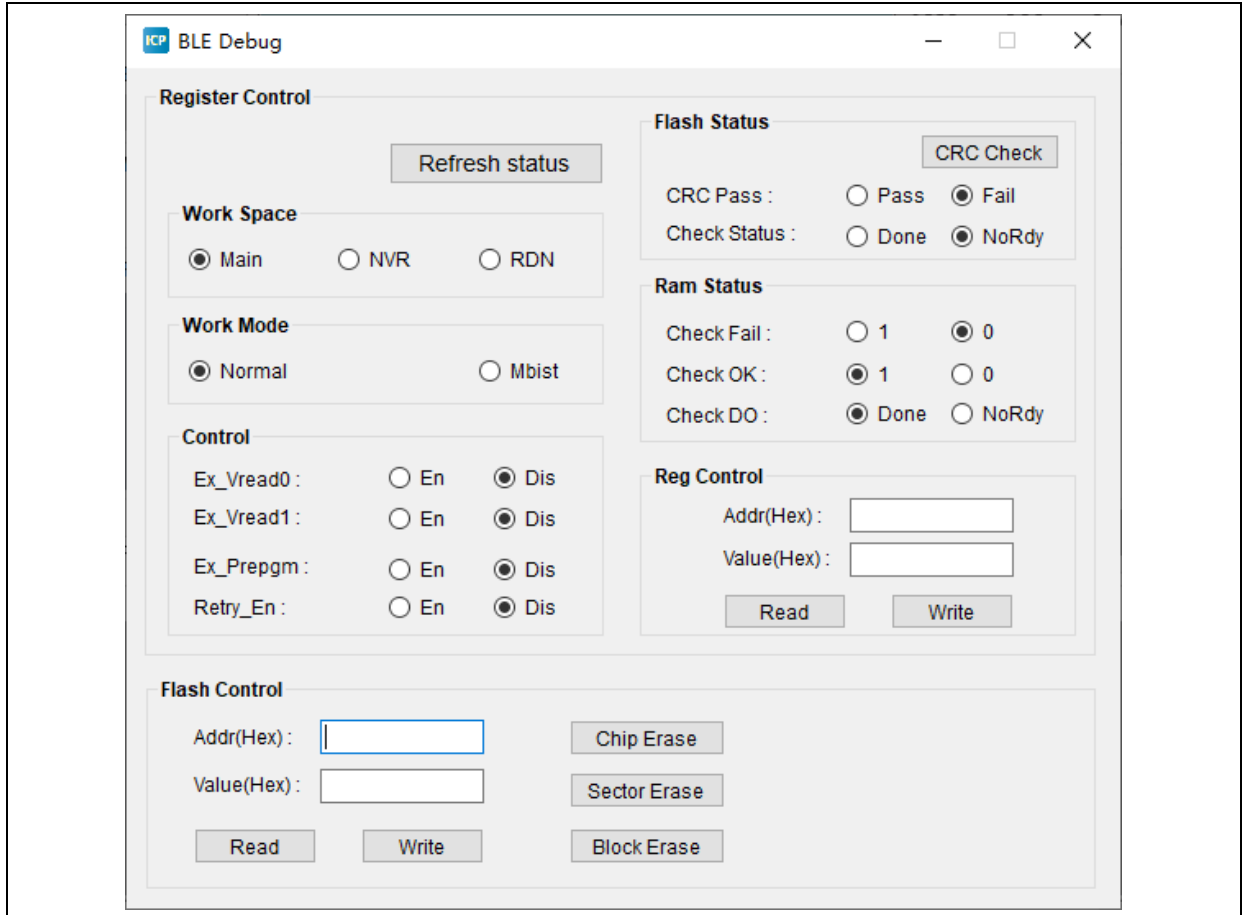


- Apply: erase the selected sectors.
- Cancel: cancel the erase operation during the erase process.

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.

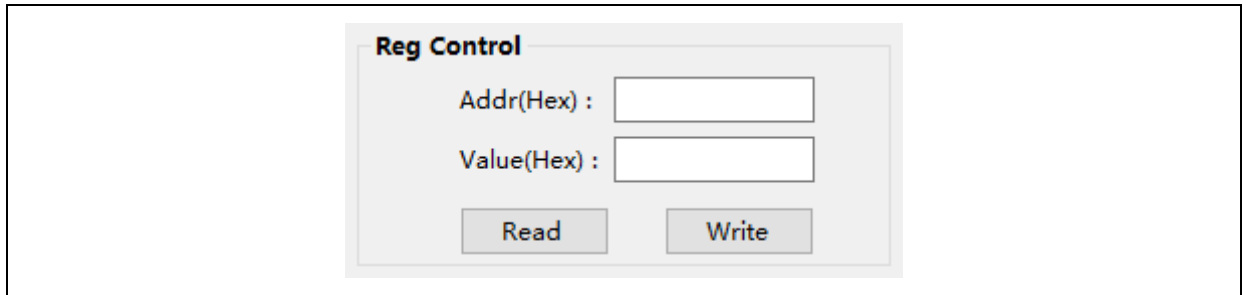
■ **Ram Status**

It indicates the status of Ram check.

■ **Reg Control**

Enable read/write access to BLE module registers.

Figure 33. BLE Register Control



Addr(Hex): Register address.

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

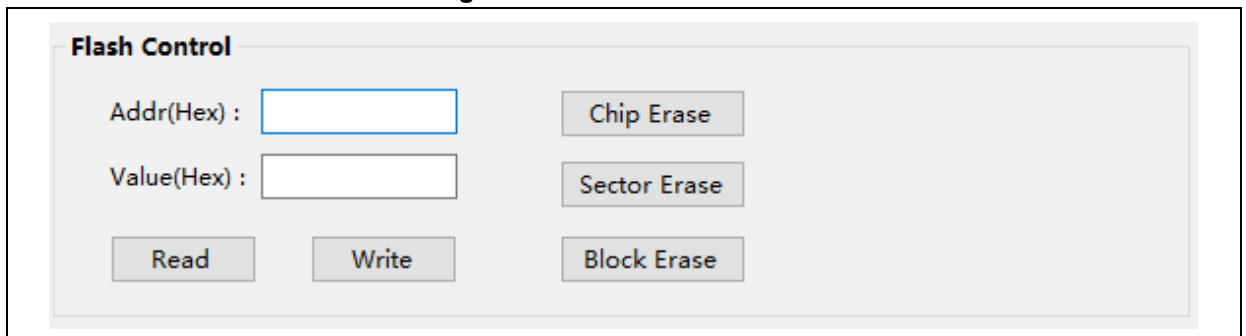
Read: Read registers.

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



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

Flash access protection
FAP A5 Disable

System setting byte Bootloader Configuration
SSB FF
☒ nWDT_ATO_EN ☒ nDEPSLP_RST ☒ nSTDBY_RST
☒ nWDT_DEPSLP ☒ nWDT_STDBY ☒ nRAM_PRT_CHK

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 FF FF FF FF

☐ 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
Data 8---15 (0x)	FF	FF	FF	FF	FF	FF	FF	FF
Data 16---23 (0x)	FF	FF	FF	FF	FF	FF	FF	FF
Data 24---31 (0x)	FF	FF	FF	FF	FF	FF	FF	FF

Clear

Load file

Save to file

QSPI encryption key
KEY0 0x FF KEY1 0x FF KEY2 0x FF KEY3 0x FF

Load from device Apply to device Load from file Save to file

■ Access protection: Enable / disable access protection.

AT32F403/F413/F403A/F407/A403A/F435/F437:

Enabled: FAP----0xFF

Disabled: FAP----0xA5

AT32F415/F421/F425/WB415/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457:

Access protection: FAP----0xFF.

High level access protection: FAP----0xCC. (Access protection and user system data erase protection) (AT32F425/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457 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/A403A/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/A423/F402/F405/F490/M412/M416/F455/F456/F457)

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.

■ Bootloader Configuration

Figure 36. User system data config

The screenshot shows the 'Bootloader Configuration' tab. The 'Bootloader Enable' dropdown is set to 'Disable'. Below it, there are three rows of checkboxes for enabling various peripherals: BOOT_EN1, BOOT_EN2, and a row with USART1_EN, USART2_EN, USART3_EN, and USB_EN. Each row also has a text box for a key value, all set to 'FF'. The checkboxes for all peripherals are checked.

Bootloader Enable:

Enable-----Bootloader peripherals enablement can be configured.

Disable-----Bootloader peripherals enablement cannot be configured. By default, all peripherals are enabled.

USART1_EN:

Unchecked -----Disable USART1.

Checked-----Enable USART1.

USART2_EN:

Unchecked -----Disable USART2.

Checked-----Enable USART2.

USART3_EN:

Unchecked -----Disable USART3.

Checked-----Enable USART3.

USB_EN:

Unchecked -----Disable USB.

Checked-----Enable USB.

I2C1_EN:

Unchecked -----Disable I2C1.

Checked-----Enable I2C1.

I2C2_EN:

Unchecked -----Disable I2C2.

Checked-----Enable I2C2.

I2C3_EN:

Unchecked -----Disable I2C3.

Checked-----Enable I2C3.

CAN1_EN:

Unchecked -----Disable CAN1.

Checked-----Enable CAN1.

CAN2_EN:

Unchecked -----Disable CAN2.

Checked-----Enable CAN2.

SPI1_EN:

Unchecked -----Disable SPI1.

Checked-----Enable SPI1.

SPI2_EN:

Unchecked -----Disable SPI2.

Checked-----Enable SPI2.

■ EOPB0(SRAM)

AT32F403/F403A/F407/A403A: (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/A423/F402/F405/F490/M412/M416/F455/F456/F457 (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 37. 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: FF FF FF FF

☐ Select all

EPP0:

AT32F403/F413/F403A/F407/A403A: controls the erase and program protection of sectors in the range of Flash 1K-32K.

AT32F415/WB415/F423/A423/F402/F405/F490/F455/F456/F457: 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.

AT32M412/M416: controls the erase and program protection of Sector0-Sector31.

EPP1:

AT32F403/F413/F403A/F407/A403A: controls the erase and program protection of sectors in the range of Flash 33K-64K.

AT32F415/WB415/F423/A423/F402/F405/F455/F456/F457: 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.

AT32M412/M416: controls the erase and program protection of Sector32-Sector63.

EPP2:

AT32F403/F413/F403A/F407/A403A: controls the erase and program protection of sectors in the range of Flash 65K-96K.

AT32F415/WB415/F423/A423/F402/F405/F455/F456/F457: 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.

AT32M412/M416: controls the erase and program protection of Sector64-Sector95.

EPP3:

AT32F403/F413/F403A/F407/A403A:

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/A423/F402/F405/F455/F456/F457:

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)

AT32M412/M416: controls the erase and program protection of Sector96-Sector127.

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 38. User data

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

Clear

Load file

Save to file

AT32F403/F413/F403A/F407/A403A: 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/A423: user data 250 bytes.

AT32F402/F405: user data 220 bytes.
 AT32M412/M416: user data 250 bytes.
 AT32/F455/F456/F457: user data 216 bytes.

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

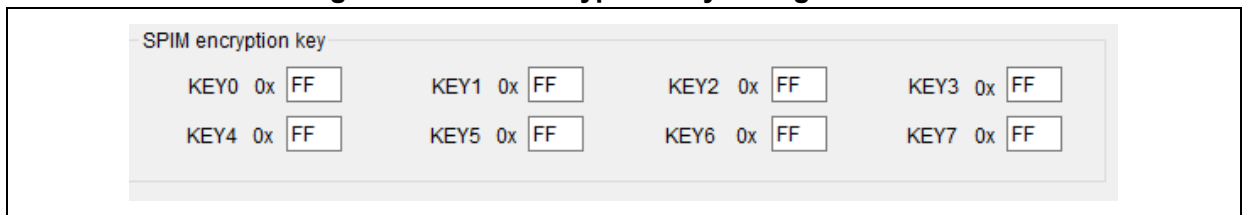
Load file: Load the user data file into the table for display

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

■ SPIM encryption key (AT32F403/F413/F403A/F407/A403A)

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

Figure 39. SPIM encryption key config

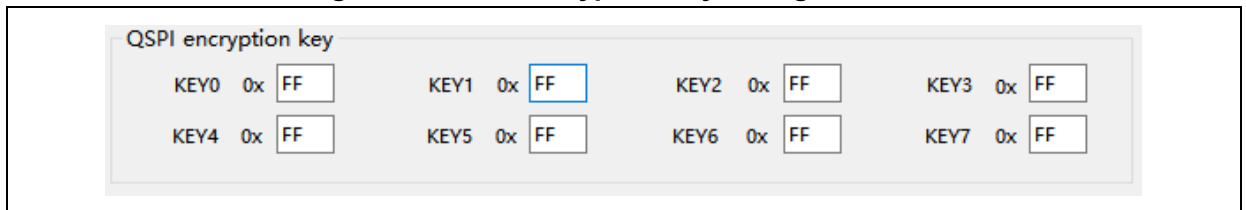


SPIM encryption key											
KEY0	0x	FF	KEY1	0x	FF	KEY2	0x	FF	KEY3	0x	FF
KEY4	0x	FF	KEY5	0x	FF	KEY6	0x	FF	KEY7	0x	FF

■ QSPI encryption key (AT32F435/F437/F402/F405/F455/F456/F457)

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

Figure 40. 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 41. 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'. Below it is a checked 'Verify' checkbox and a text field for 'Custom encryption key for verify:'.
 - Two unchecked checkboxes: 'Disable FAP before download' and 'Enable FAP after download'.
 - An 'Access protection' dropdown menu.
 - An unchecked checkbox for 'Write user system data' and a corresponding text field for 'User system data file path'.
- Bluetooth module:**
 - Erase options:** A dropdown menu set to 'Erase main space'.
 - Two unchecked checkboxes: 'Disable BLE FAP before download' and 'Enable BLE FAP after download'.
- sLib settings:**
 - sLib status:** Currently set to 'Disable'. There are checkboxes for 'Enable sLib' and 'Disable sLib before download', each followed by a password field (0x _____).
 - 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.
 - A 'Disable sLib' button.
- 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/A423/F402/F405/F490/M412/M416/F455/F456/F457)

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)

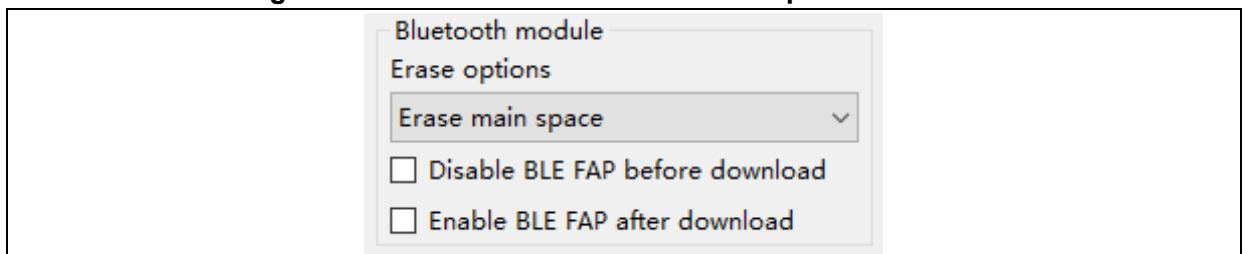
■ Erase the sectors of file size

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 42. 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

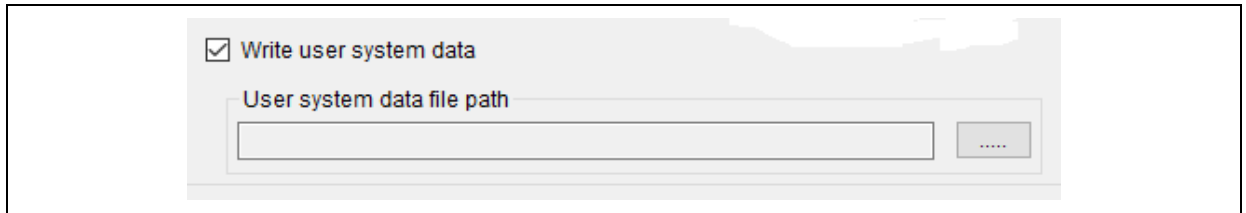
After the download is complete, the code downloaded to the Flash address 0x08000000 will be executed.


■ 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 43. 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/A423/F402/F405/F490/M412/M416/F455/F456/F457 can be set to enable access protection and high level access protection (access protection and user system data erase protection). (AT32F425/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457 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/A403A)

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/A423/F402/F405/F490/M412/M416/F455/F456/F457)

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

■ Start sector

AT32F413/F415/F403A/F407/A403A/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/A423/F402/F405/F490/M412/M416/F455/F456/F457:
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/A403A/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/A423/F402/F405/F490/M412/M416/F455/F456/F457:

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 44. 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"/>

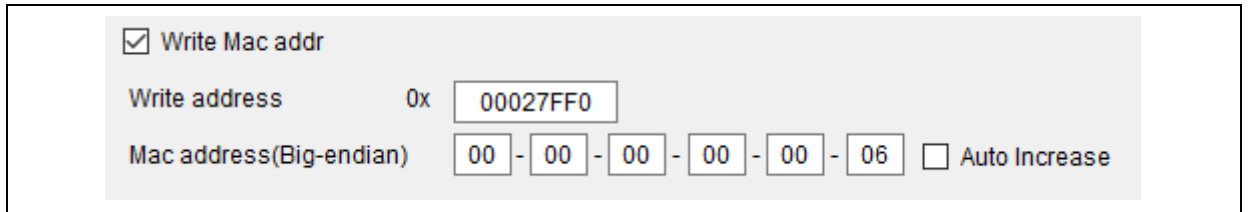
- Write address: the address where the serial number is programmed into the memory.
- Current SN: the serial number of the current programming.
- Increase step: this is the amount added to the next serial number after each serial number is programmed.

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 45. Write Mac address



☒ Write Mac addr

Write address 0x 00027FF0

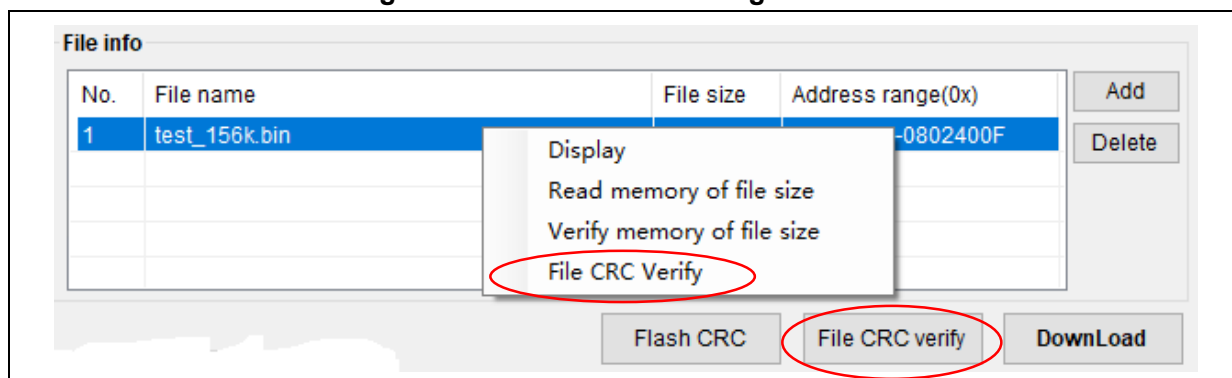
Mac address(Big-endian) 00 - 00 - 00 - 00 - 00 - 06 ☐ Auto Increase

- 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/A403A/F421/F435/F437/F425/WB415/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457 support CRC check function (SPIM not supported)) (As shown in Figure 44)

Figure 46. 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:

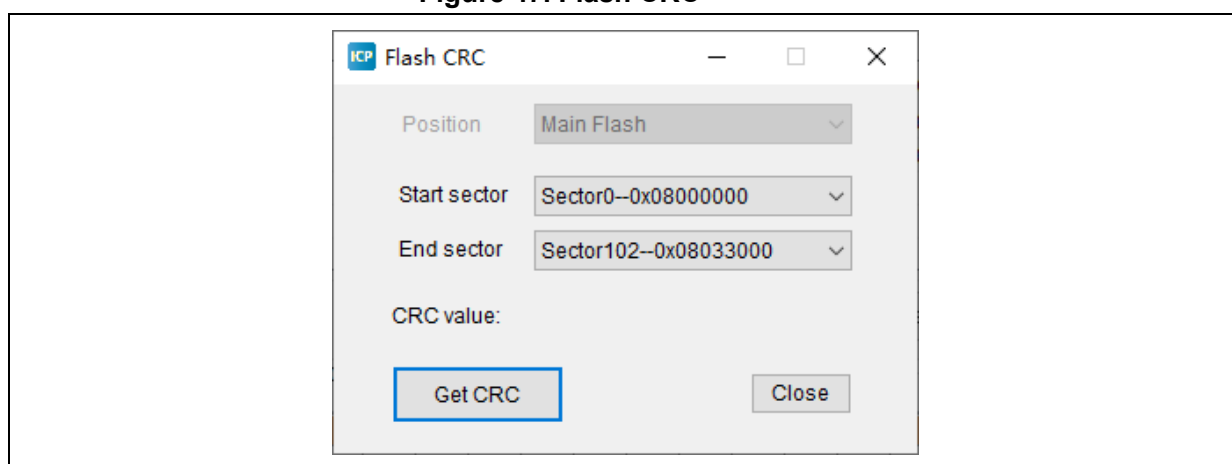
Select the file to be verified and click "**File CRC verify**" button directly.

3.17 Flash CRC

AT32F413/F415/F403A/F407/A403A/F421/F435/F437/F425/WB415/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457 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 47. Flash CRC



- Calculation area: main Flash and boot memory
(AT32F415/F421/F425/WB415/L021/F423/A423/F402/F405/F490/M412/M416/F455/F456/F457 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/A403A)

Step 1: set the FLASH_DA of the SPIM. (As shown in Figure 46)

Figure 48. 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 49. 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

(AT32F435/F437/F402/F405/F455/F456/F457 and other series supporting QSPI)

Configure the QSPI before using QSP flash.

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

Figure 50. QSPI configuration

QSPI Configuration

☒ QSPI Enable Save to file Load from file

Select: QSPI1 Addr.: 0x90000000-0x9FFFFFFF

IO0: PC9 IO1: PB10 IO2: PC8 IO3: PC5 SCK: PB1 CS: PC11

Read Device ID
 Note: This command is used only to determine the device connection.
 Device ID: 0x Read

Description	Instruction Code	Instruction Length	Addr Value	Addr Length	Data Counter	Dummy Cycle	Operation Mode
Read Device ID	0x90	1 byte	0x0	3 byte	0x2	0x0	111

☒ Enable Advanced Config Commands

Advanced Commands
 The QSPI flash must be compatible with the following commands:

BUSY Offset: 0 sckout mode: Mode 0 Sector Size(KB): 4 Block Size(KB): 64 Default

Description	Instruction Code	Instruction Length	Addr Value	Addr Length	Data Counter	Dummy Cycle	Operation Mode
write enable	0x6	1 byte	0x0	0 byte	0x0	0x0	111
read status register	0x5	1 byte	0x0	0 byte	0x0	0x0	114
write data	0x32	1 byte	0x0	3 byte	0x0	0x0	114
read data	0xEB	1 byte	0x0	3 byte	0x0	0x6	144
sector erase	0x20	1 byte	0x0	3 byte	0x0	0x0	111
block erase	0xD8	1 byte	0x0	3 byte	0x0	0x0	111
chip erase	0xC7	1 byte	0x0	0 byte	0x0	0x0	111

Extra Commands

If Use	Wait Busy	Description	Instruction Code	Instruction Length	Addr Value	Addr Length	Data Counter	Dummy Cycle	Operation Mode
<input checked="" type="checkbox"/>	<input type="checkbox"/>	custom cmd1	0x6	1 byte	0x0	0 byte	0x0	0x0	111
<input type="checkbox"/>	<input type="checkbox"/>	custom cmd2	0x5	1 byte	0x0	3 byte	0x0	0x0	114
<input type="checkbox"/>	<input type="checkbox"/>	custom cmd3	0x32	1 byte	0x0	3 byte	0x0	0x0	114
<input type="checkbox"/>	<input type="checkbox"/>	custom cmd4	0xEB	1 byte	0x0	3 byte	0x0	0x6	144
<input type="checkbox"/>	<input type="checkbox"/>	custom cmd5	0x20	1 byte	0x0	3 byte	0x0	0x0	111

Apply Cancel

- Save to file

Save the current configurations as a file to PC (default: QSPICfgData.ATQC).

- Load from file

Open the configuration file saved on PC (default: QSPICfgData.ATQC) and display configurations on the interface.

- 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.

■ Enable advanced config commands

Untick: Untick the “Enable Advanced Config Commands” to perform QSPI operations according to the default parameters and instructions, as shown below. Users can click on the “Default” to reset settings.

Figure 51. Advanced Config Commands

BUSY Offset

0

sckout mode

Mode 0

Sector Size(KB)

4

Block Size(KB)

64

Default

Description	Instruction Code	Instruction Length	Addr Value	Addr Length	Data Counter	Dummy Cycle	Operation Mode
write enable	0x6	1 byte	0x0	0 byte	0x0	0x0	111
read status register	0x5	1 byte	0x0	3 byte	0x0	0x0	114
write data	0x32	1 byte	0x0	3 byte	0x0	0x0	114
read data	0xEB	1 byte	0x0	3 byte	0x0	0x6	144
sector erase	0x20	1 byte	0x0	3 byte	0x0	0x0	111
block erase	0xD8	1 byte	0x0	3 byte	0x0	0x0	111
chip erase	0xC7	1 byte	0x0	0 byte	0x0	0x0	111

Tick: Tick the “Enable Advanced Config Commands” to modify parameters and instructions. Refer to the reference manual and BSP firmware for detailed parameter settings.

■ Extra commands

Users can compile up to five extra commands at the beginning of operation and send to QSPI device from top to bottom. When the “If Use” option is ticked, it indicates that this command is enabled and sent successfully. When the “Wait Busy” option is ticked, it indicates that a “read status register” instruction will be sent automatically after this command is sent to check whether the busy bit is cleared, as shown below.

Figure 52. Extra Commands

If Use	Wait Busy	Description	Instruction Code	Instruction Length	Addr Value	Addr Length	Data Counter	Dummy Cycle	Oper
<input checked="" type="checkbox"/>	<input type="checkbox"/>	custom cmd1	0xFF	1 byte	0x0	0 byte	0x0	0x0	444
<input checked="" type="checkbox"/>	<input type="checkbox"/>	custom cmd2	0x66	1 byte	0x0	0 byte	0x0	0x0	111
<input checked="" type="checkbox"/>	<input type="checkbox"/>	custom cmd3	0x99	1 byte	0x0	0 byte	0x0	0x0	111
<input checked="" type="checkbox"/>	<input type="checkbox"/>	custom cmd4	0x38	1 byte	0x0	0 byte	0x0	0x0	111
<input type="checkbox"/>	<input type="checkbox"/>	custom cmd5	0x0	1 byte	0x0	0 byte	0x0	0x0	111

■ Apply

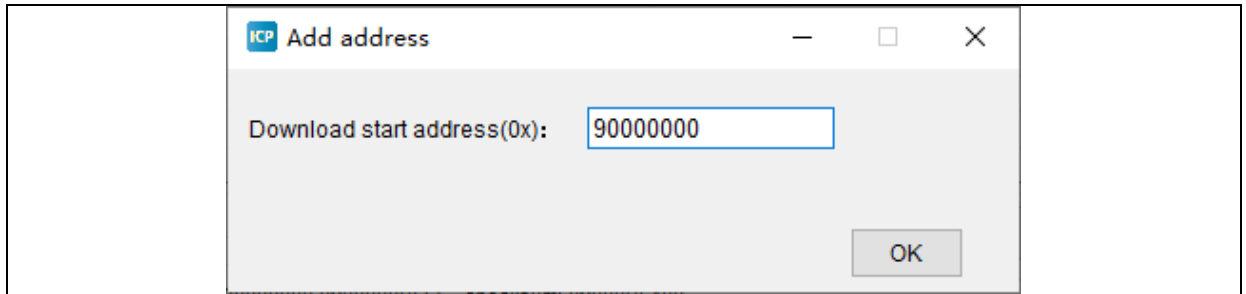
Click on “Apply” to save the QSPI configuration.

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 53. 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 Application scenarios

This section mainly introduces common application scenarios of ICP programmer, on the premise of ICP programmer being correctly connected to the target MCU through AT-Link.

4.1 Offline projects

Configure offline project settings when ICP programmer is not connected. In this case, offline project files stored in AT-Link can be used to program and configure the target MCU.

Firstly, configure offline projects and store them into AT-Link. This step requires connecting AT-Link to ICP Programmer. Click **Menu bar — AT-Link Settings**, and find the number of data storage area (16, by default) and status of area. The storage area size is 16 MB in total. When the “number of area” value is set to 16, each storage area is 1 MB.

Figure 54. AT-Link Settings – Data storage area



The capacity of each storage area is set according to the size of file to be programmed. When storing a multi-section code file into AT-Link, each code occupies one storage area. If a single storage area is not capable of storing one code, reduce the number of storage area to increase the size of each storage area.

Go to **AT-Link Settings – AT-Link offline config settings**, you can find offline projects and relevant settings of the selected project.

Figure 55. AT-Link offline config settings

AT-Link Setting

AT-Link settings | **AT-Link offline config settings** | AT-Link offline download status

Offline project: [Dropdown] [Delete] [Create]

Project name: [Text] Device: [Dropdown] [Dropdown]

No.	File name	File size	Address range(0x)	Storage location

[Add] [Delete]

Erase option: [Erase the sectors of file size]

☐ Download times [Text] ☒ Verify

☐ Encryption transmit

☐ Reset and run

☐ Write user system data [Text] [.....]

☒ Enable FAP after download ☐ Boot memory AP mode

[Dropdown] Key: (0x) [Text] (0xA35F6D24)

Software serial number(SN) | **SPIM settings** | sLib settings | Bluetooth module Mac setting | OTP settings

☐ Write software serial number

Write address in flash: 0x [08010000]

Initial SN: 0x [00000001]

Increase step: 0x [00000001]

[Load parameters] [Save parameters]

[Open project file] [Save project file] [Save project to AT-Link] [Close]

In initial state, AT-Link does not store any offline project. All offline projects stored in AT-Link are displayed in the drop-down menu of “**Offline project**”.

Click “**Create**” to create a new project. Enter the project name, select the target MCU of a specific model of certain series, and add firmware.

Figure 56. Offline project settings

Offline project: [Dropdown] [Delete] [Create]

Project name: [project1] Device: [AT32F413] [AT32F413RCT7]

No.	File name	File size	Address range(0x)	Storage locat...
1	A.hex	1928	08000000-08000787	
2	test_8k.bin	8192	08008000-08009FFF	

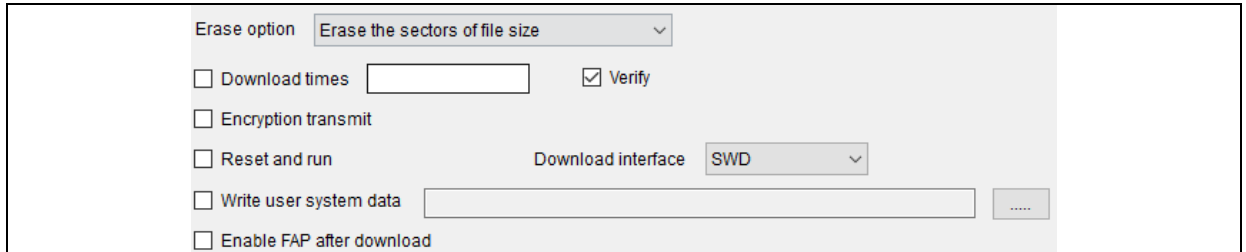
[Add] [Delete]

In addition to the above basic settings, there are optional specific settings, including:

- Download times: Set the total number of downloads. If the total number is exceeded, no more downloads are allowed, and an error is reported by AT-Link LED indicator and buzzer.
- Encryption transmit: Encrypt the data transmission between AT-Link and MCU, which does not affect user experience.

- Reset and run: Reset and run after the firmware is downloaded to the target MCU successfully.
- Write user system data: Import the user system data file stored in PC, and configure it in the offline project correspondingly.
- Enable FAP after download: Enable access protection after the firmware is downloaded to the target MCU successfully

Figure 57. Optional settings for offline project

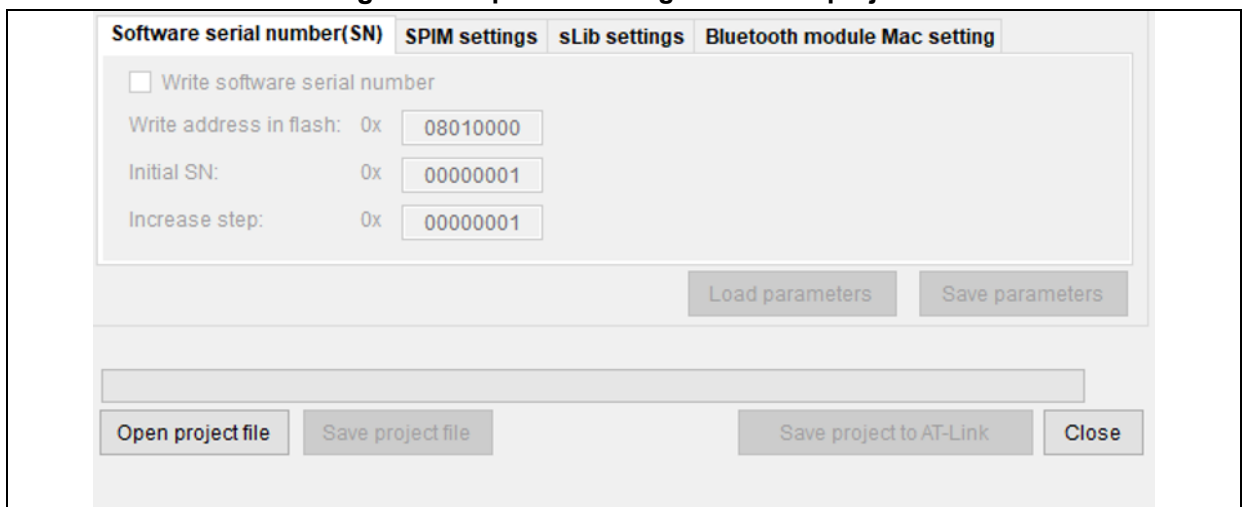


☐ Erase option: Erase the sectors of file size
☐ Download times: ☒ Verify
☐ Encryption transmit
☐ Reset and run: Download interface: SWD
☐ Write user system data:
☐ Enable FAP after download

Software serial number, sLib settings and other configurations are detailed in the subsequent chapters.

Complete offline project settings as required. Then, click “**Save project to AT-Link**”, ICP Programmer will prompt that this project is saved successfully, and the “**AT-Link settings**” will display that A1 and A2 areas are occupied (status: Data).

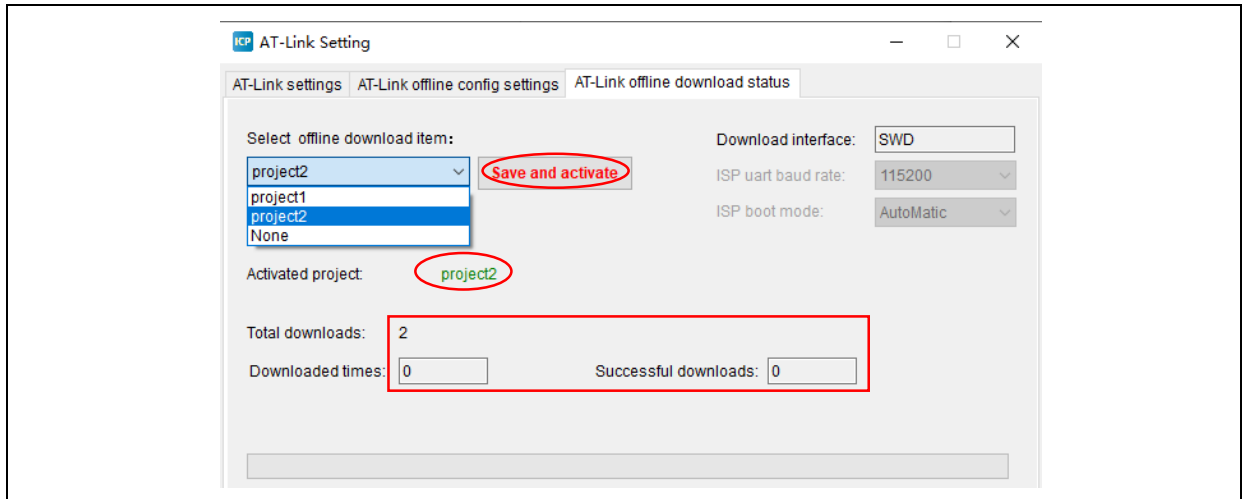
Figure 58. Optional settings for offline project



Software serial number(SN) | SPIM settings | sLib settings | Bluetooth module Mac setting
☐ Write software serial number
 Write address in flash: 0x
 Initial SN: 0x
 Increase step: 0x
 Load parameters | Save parameters
 Open project file | Save project file | Save project to AT-Link | Close

Go to “**AT-Link offline download status**”, select offline download items, and then click “**Save and activate**”, and the “**Activated project**” displays the successfully saved and activated project. This interface also displays the total downloads, downloaded times and successful downloads.

Figure 59. AT-Link offline download status



After the offline project is activated, press the “OFF-LINE DOWNLOAD” key on AT-Link to start offline project download.

In this case, there is no need to operate ICP Programmer, but the target MCU should be correctly connected to AT-Link and powered; then, users can press the “OFF-LINE DOWNLOAD” key again to repeat project download.

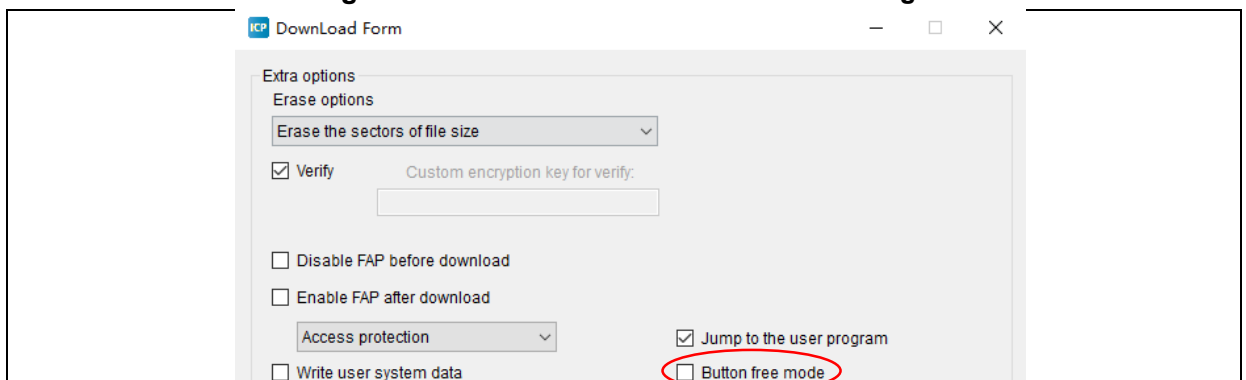
4.2 Button free download

The button free download is mainly used during batch programming. Configure project settings as required, and then enable button free mode to start continuous download. After programming is completed, replace with another device for programming automatically, without the need of repeated configuration.

4.2.1 Online continuous download

Connect ICP Programmer to the target MCU through AT-Link and load firmware (*.bin or *.hex). Then, click “**Start download**” to enter the “**Download Form**”, and then tick “**Button free mode**” to enable continuous download.

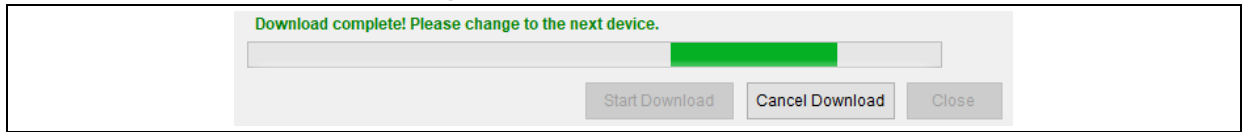
Figure 60. Online continuous download settings



Enable “Button free mode” and click “**Start Download**” to download the firmware to the target MCU. When the download is completed, a prompt of “Download complete! Please change to the next device.” pops up. At this point, keep the upper computer status, disconnect the debugger from the target MCU and then connect it to a new device. The upper computer automatically determines that

the new device is connected successfully and starts to download. Repeat until all devices have been downloaded and then click “**Cancel Download**”.

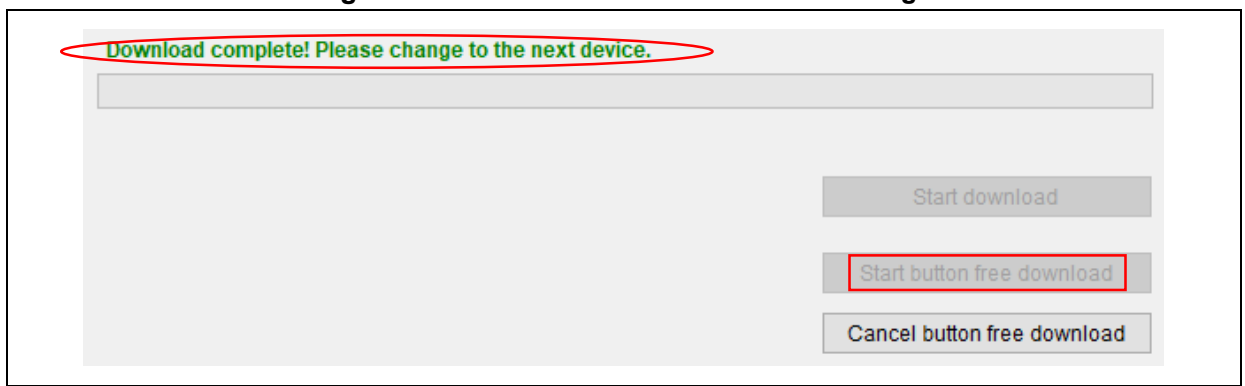
Figure 61. Successful download



4.2.2 Offline continuous download

After the offline project is configured and saved into AT-Link, go to “**AT-Link settings**” and click “**AT-Link offline download status**” to activate the corresponding project. Then, click “**Start button free download**” to start continuous download.

Figure 62. Offline continuous download settings



In offline continuous download mode, users need to replace the target board MCU according to the prompt message after successful download, which is the same as online continuous download.

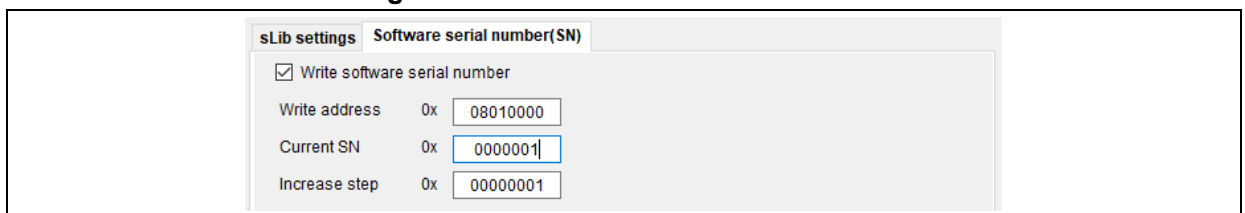
4.3 Write software serial number

When needed, it is configured in ICP Programmer and then downloaded to the target MCU together with firmware code, without repeated programming.

4.3.1 Online programming

Go to “**Download Form**” - “**Software serial number (SN)**”; tick “Write software serial number”, and users can configure parameters below.

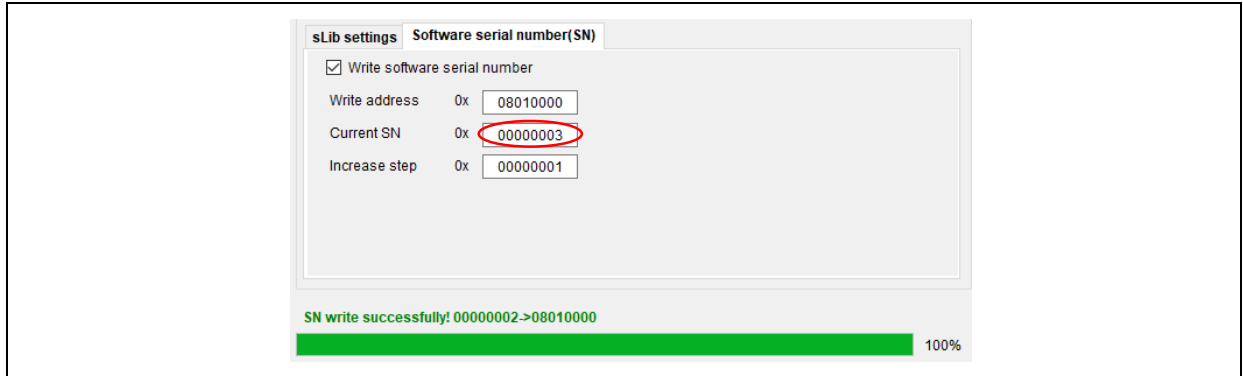
Figure 63. Write software serial number



- 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.

After these parameters are set, click **“Start Download”** to program the firmware to the target MCU. The current SN is written to the specified address; at this point, ICP Programmer prompts “SN write successfully!” (the serial number displayed is the result after the increment value is automatically added).

Figure 64. SN write success



4.3.2 Offline programming

Parameters for SN offline programming is basically the same as that of SN online programming. Go to **“AT-Link Setting”** – **“AT-Link offline config settings”** – **“Software serial number (SN)”**, and set parameters in the same way as the SN online programming.

4.4 sLib settings

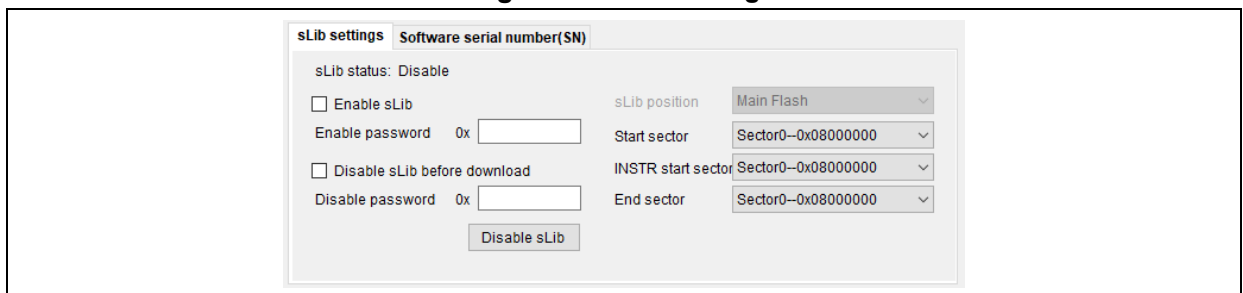
Security library (sLib) is a defined area protected by a code in the main memory. It is executable only, and cannot be read (except access through I-Code or D-Code bus), written or deleted unless the correct code is keyed in. The security library includes instruction security library and data security library. Users can select part of or the whole security library for instruction storage, but using the whole security library for storing data is not supported.

The security library can be used by solution providers to program and store core algorithm, and support secondary development by end customers.

4.4.1 Online settings

On ARTERY ICP Programmer, the sLib configuration is always completed in conjunction with download operation. Go to **“Download Form”** - **“sLib settings”**.

Figure 65. sLib settings



This window displays the current sLib status and settings.

Tick **“Enable sLib”** and enter the enable password; then, tick **“Disable sLib before download”** and

enter the disable password. The enable password and disable password should be equal.

Note: The enable password and disable password are set separately to support sLib enable, sLib disable or enable sLib + disable sLib before download.

After the enable password and disable password are set, users can configure sectors as needed.

Figure 66. sLib settings – sector settings

After all the above parameters are configured, click “**Start Download**”, and the downloaded content and sLib status are set to the target MCU. After successful download, the “sLib settings” window shows that the sLib is enabled, and the remaining usage times of sLib is decreased by 1.

Figure 67. Successful sLib settings

When the sLib is enabled, enter the correct disable password and click “**Disable sLib**” to unlock sLib protection separately.

Note: Disabling sLib performs mass erase of the main Flash.

Figure 68. sLib disabled successfully

4.4.2 Offline settings

The sLib offline setting is basically the same as sLib online setting. Go to “**AT-Link settings**” – “**AT-Link offline config settings**” – “**sLib settings**”. Save the AT-Link offline project, and then configure the sLib when programming the offline project.

Figure 69. sLib offline settings

4.5 User system data programming

Go to Menu bar - “**Target**” - “**User system data**” to enter the user system data setting window. The window content may be slightly different for different MCUs.

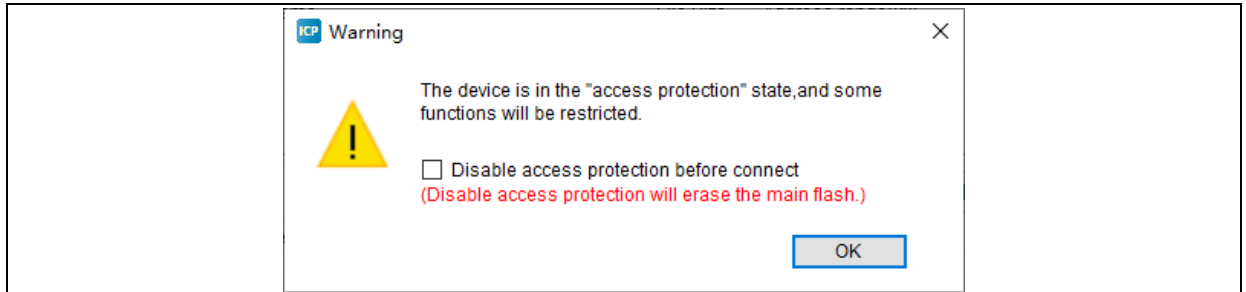
Figure 70. User system data config

There are four keys at the bottom, including:

- Load from device: Read the user system data from the target MCU and update it to the interface for display.
 - Apply to device: Save the settings of the user system data to the target MCU.
 - Load from file: Load the content of the saved user system data file (default: UserSystemData.bin) and update it to the interface for display.
 - Save to file: Save the user system data settings as a file (default: UserSystemData.bin) to PC.
- The user system data config window mainly includes access protection, memory extension (partial MCUs), system setting byte, erase and program protection bytes and user data, as detailed below.

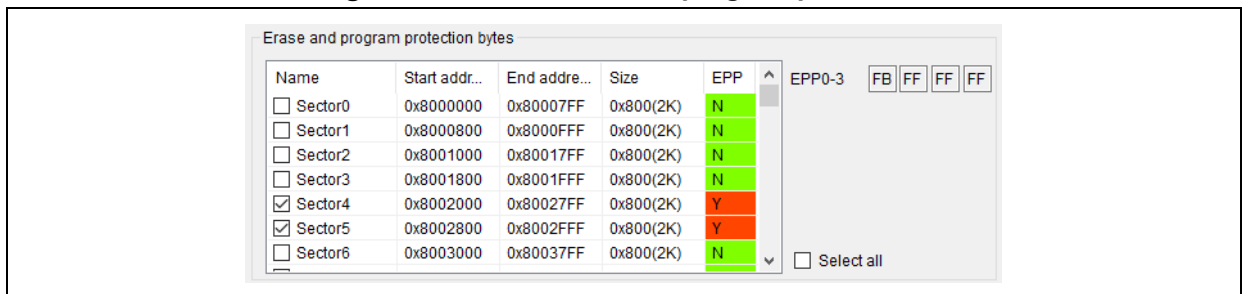
- Access protection: This feature is used to protect key firmware programmed in the MCU against being read. When access protection is enabled, ICP Programmer prompts “this device is in the ‘access protection’ state” as long as it is reconnected to the target MCU, and users decide whether disable access protection before connection. Note that disable access protection will erase the main Flash.

Figure 71. Access protection status



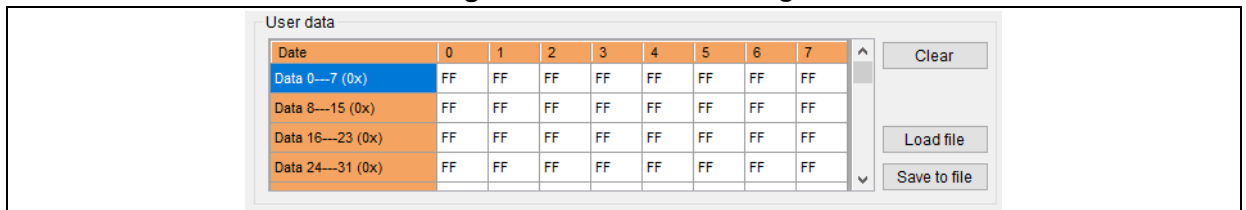
- Memory extension: This feature is applicable to some MCUs. Its parameters are different for different MCUs, which should be configured as needed.
- System setting byte: It is used to enable or disable system functions, such as auto WDT enable. For details, please refer to [3.14 User system data](#). After settings are completed, click “**Apply to device**” to save parameter settings to the target MCU.
- Erase and program protection bytes: This feature supports erase and program protection settings for specified sectors. Click to select the sector that needs to be erase and program protected, and then click “**Apply to device**” to save parameter settings to the target MCU.

Figure 72. Sector erase and program protection



- User data: The data (one-time-programmed) that should not be affected by normal Flash operations can be written into the “user data” (in limited size) of user system data area. In this way, data can be programmed to the target MCU together with the user system data.

Figure 73. User data settings



After the above settings are completed, users can apply to the target MCU in three ways, as detailed in the below subsections.

4.5.1 Direct application

After the user system area is configured as needed, click **“Apply to device”** to apply parameter settings to the target MCU directly.

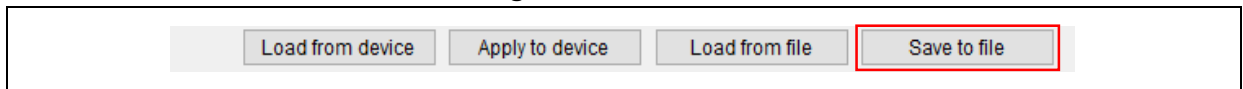
Figure 74. Direct application – Apply to device



4.5.2 Online download

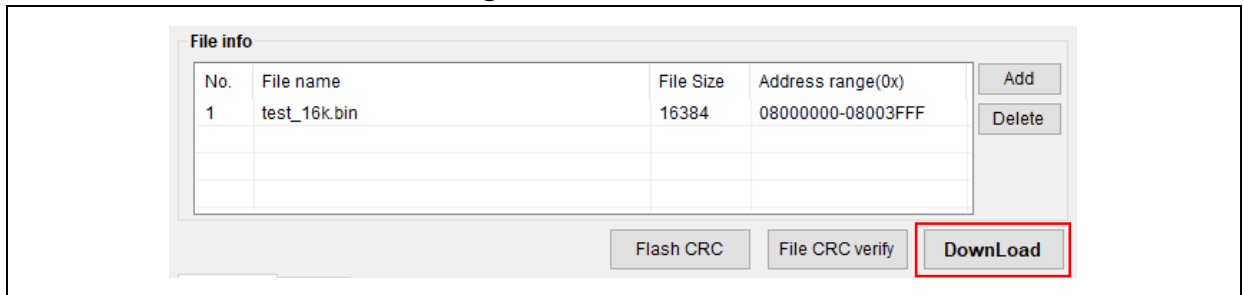
To configure the user system data by means of online download, firstly save parameter settings as a file. Users can click **“Save to file”** to select the desired file path and file name (default: UserSystemData.bin).

Figure 75. Save to file



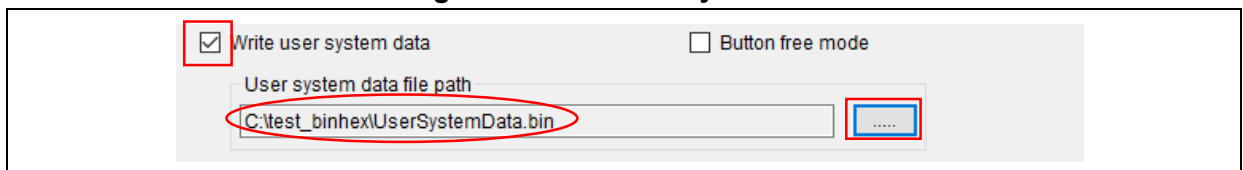
After user system data file is saved successfully, add the required firmware in the ICP Programmer main window, and click **“Download”** to enter the download menu.

Figure 76. Click download



Tick **“Write user system data”**, and select the saved user system data file.

Figure 77. Write user system data



After the above settings are completed, click **“Start Download”** to program the firmware and user system data into the target MCU.

4.5.3 Offline download

To configure the user system data by means of offline download, firstly save parameter settings as a file (same as the online download way).

After user system data file is saved successfully, go to ICP Programmer main interface - **“AT-Link Setting”** – **“AT-Link offline config settings”** – **“Create”**, then tick **“Write user system data”** and select the saved user system data file.

Figure 78. Offline download – user system data settings

After the above settings are completed, click “**Save project to AT-Link**” to save the current user system data settings to the project file.

Note: For details, please refer to [3.3.3 AT-Link offline download](#).

4.6 Multi-section code programming

When the firmware or data needs to be stored at multiple discontinuous addresses, users can add these codes at different addresses to ICP Programmer and then program them to the target MCU. This method is simple and less error-prone.

First, add files stored at discontinuous addresses to ICP Programmed. Attention should be paid to the address overlapping. The “.hex” file contains address information, so that it can be loaded to ICP Programmer directly, while users need to add the download start address to load “.bin” file.

Figure 79. BIN file download start address

After files are added, click “**Download**” to start download. ICP Programmer will automatically identify addresses and then download files to the corresponding Flash address one by one.

Figure 80. Add files at discontinuous addresses

No.	File name	File Size	Address range(0x)
1	1.bin	3072	08000000-08000BFF
2	2.bin	3072	08008000-08008BFF
3	3.bin	3072	08010000-08010BFF

Buttons: Add, Delete, Flash CRC, File CRC verify, DownLoad

Offline and online multi-section code programming operations are basically the same.

4.7 Remote file

After all the above files and parameters configuration are completed, they can be exported and saved as a file into PC for follow-up operations in conjunction with AT-Link.

4.7.1 Generate remote file

When saving project file, click “**Save project file**” to complete the following settings as needed.

Figure 81. Save project file

Buttons: Open project file, Save project file, Save project to AT-Link, Close

- This project is only used at the specified AT-Link: Tick this option and then enter the specified AT-Link serial number. This project is bound to AT-Link and can only be used in the specified AT-Link.
- This project is only used once: Tick this option, the “This project is only used at the specified AT-Link” is then ticked automatically, and then enter the specified AT-Link AIN.

Note: When the ICP Programmer is connected to AT-Link, the AT-Link SN and AIN are filled in automatically. If the AT-Link is not connected or other AT-Link is required, users need to enter the correct AT-Link SN and AIN.

Click “**OK**”, select storage path and enter file name to generate a remote file in the format of *.atcp.

Figure 82. Project file settings

AT-Link project file settings

☐ This project is only used at the specified AT-Link.
AT-Link SN: F2C354230040B56D0197E502

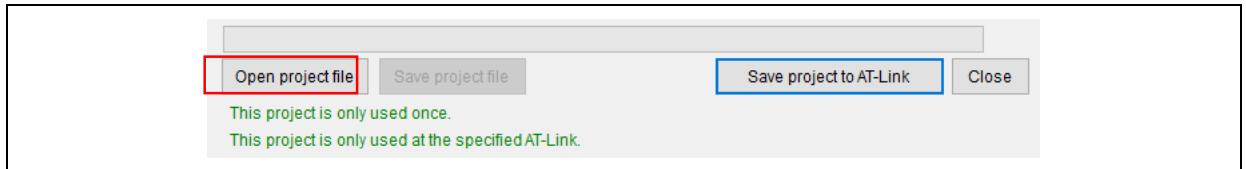
☐ This project is only used once.
AT-Link AIN: 330F71041A1FEE1E

Buttons: OK, Cancel

4.7.2 Usage of remote file

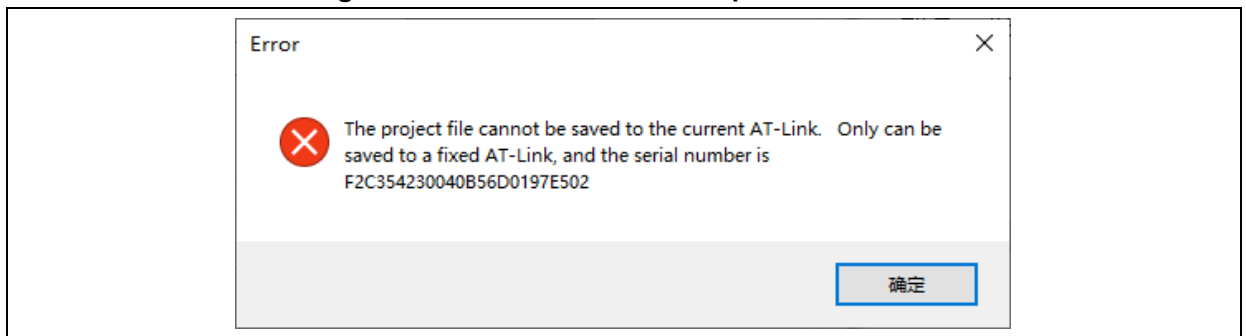
After the remote file (*.atcp) is received, open ICP Programmer, and ensure that AT-Link (or the specified AT-Link to which this remote file is bound) connected correctly. Go to “**AT-Link Setting**” – “**AT-Link offline config settings**” – “**Open project file**”; select the received remote file, and a message prompting file opened successfully will pop up.

Figure 83. Open project file



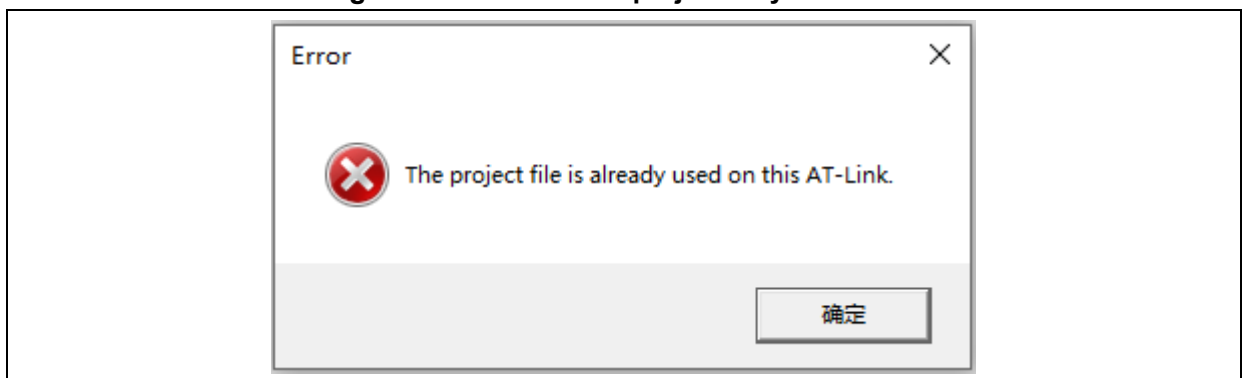
After the project file is opened, click “**Save project to AT-Link**” to save offline project settings into AT-Link, and a message prompting project saved successfully will pop up. If the AT-Link is not the specified one, an error message will pop up.

Figure 84. Save failed – not the specified AT-Link



If the “This project is only used once” option is ticked, the file that is saved successfully to AT-Link cannot be saved again. At this point, clicking “**Save project to AT-Link**” reports an error.

Figure 85. Save failed – project only used once

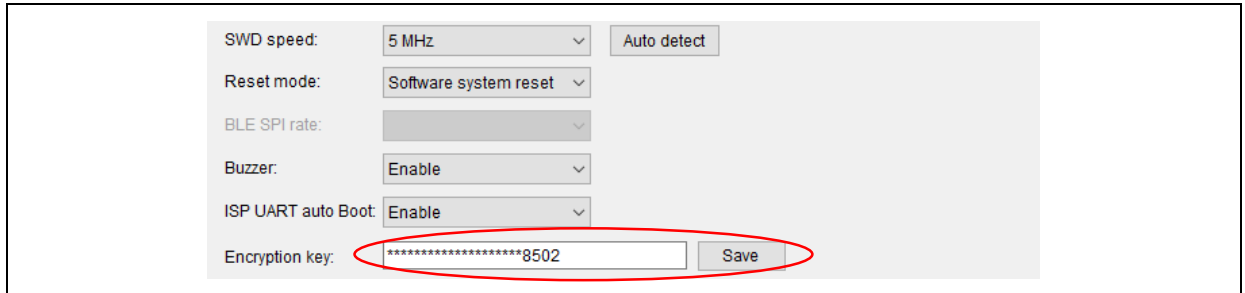


4.8 Encryption file

ICP Programmer can be used to encrypt firmware, and encrypted files are mainly used for AT-Link. ICP Programmer downloads and transmits encryption files to AT-Link, and then AT-Link decrypts and programs them into the target MCU.

AT-Link decrypts encryption files downloaded by ICP Programmer. It has an encryption key that can be found by clicking “**AT-Link Setting**” – “**Encryption key**”. By default, encryption key is the AT-Link SN, which can be changed to a new one by users and then saved to AT-Link.

Figure 86. Encryption key in AT-Link



Note: Encryption and decryption requires key pairing. The key used by ICP Programmer to encrypt firmware must be the same as the key saved in AT-Link for decryption, so that the firmware code can be programmed to the target MCU correctly.

4.8.1 Make encryption file

Go to “**File**” - “**Make encryption file**”, enter the encryption key (must be the same as the key saved in AT-Link, or change them into a new one), select the original file and click “**Begin**”. A message prompting encryption file generated successfully pops up, and an encrypted file (the file suffix depends on the original file) with the same name in the same directory as the original file.

Figure 87. Make encryption file

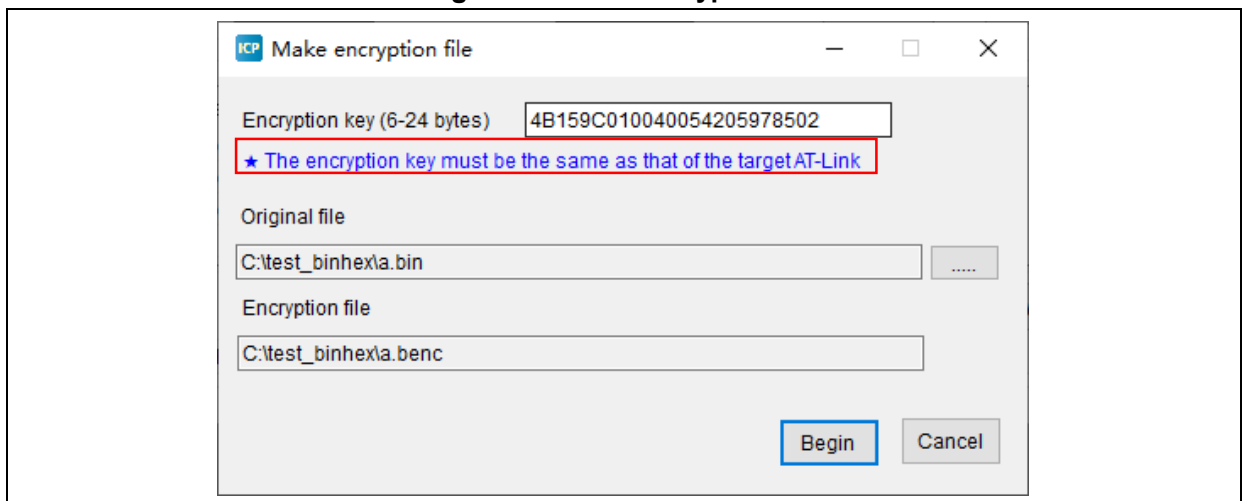
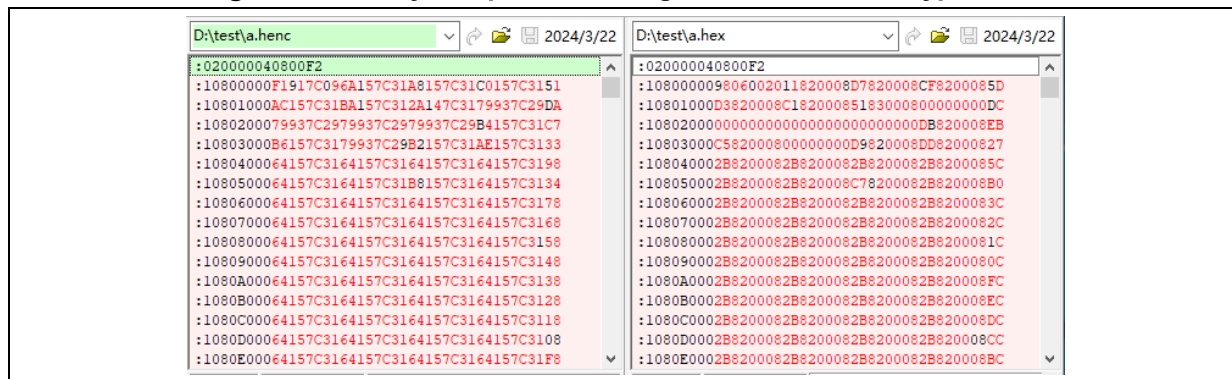


Figure 85 shows the binary comparison of the original file with the encryption file.

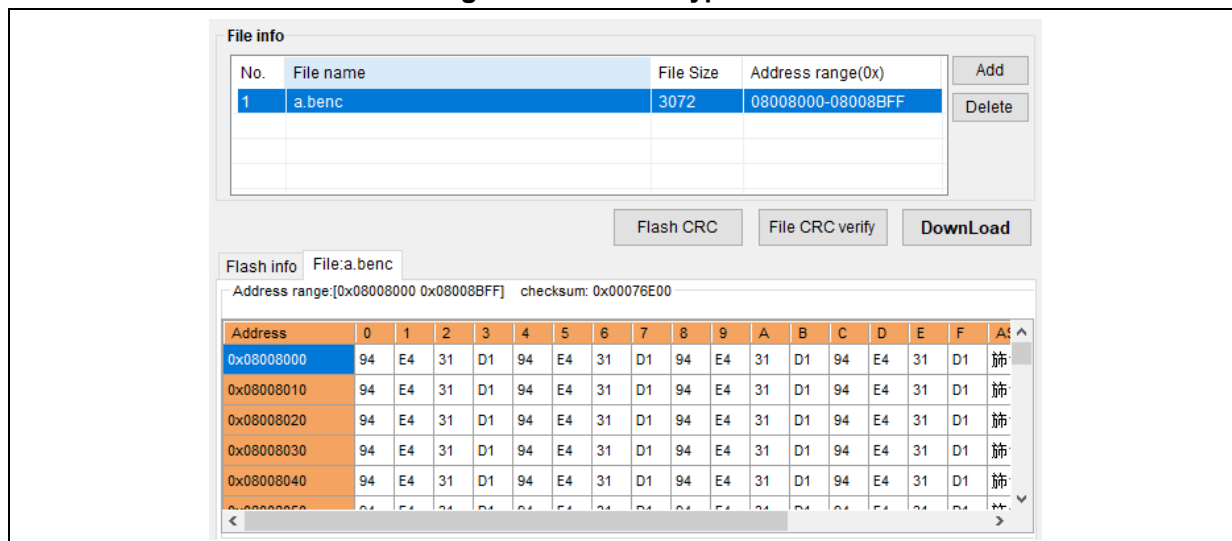
Figure 88. Binary comparison of original file versus encryption file



4.8.2 Usage of encryption file

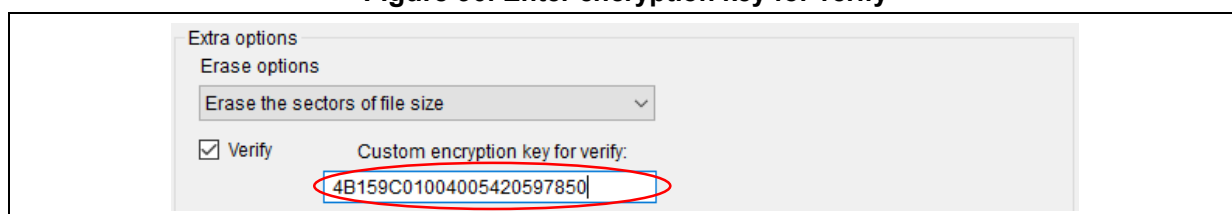
Add the encryption file into ICP Programmer following normal online/offline download operations, and then ICP Programmer shows the encrypted file content.

Figure 89. Add encryption file



Go to online download window and then “**Extra options**”. Tick “Verify” and enter the “**Custom encryption key for verify**”.

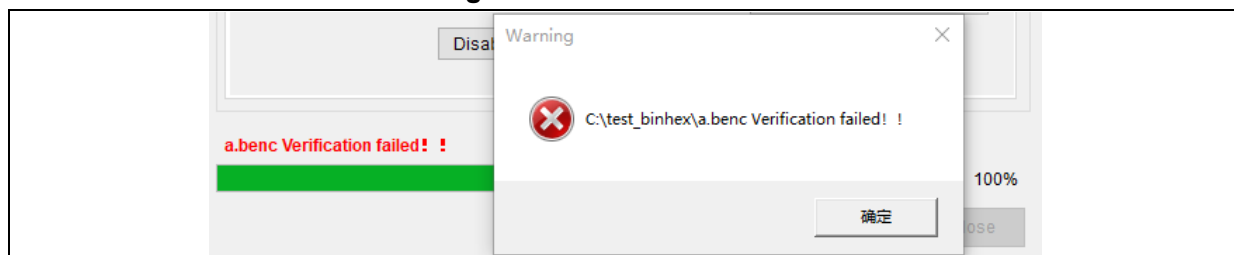
Figure 90. Enter encryption key for verify



Note: The custom encryption key for verify must be the same as that stored in AT-Link; otherwise, verification will fail.

Enter the correct encryption key and then click “**Start download**”. Verification fails if the encryption key is incorrect or download error occurs.

Figure 91. Verification failure



4.8.3 Precautions

As mentioned before, there are three scenarios requiring an encryption key. i.e., the key used to make an encryption file, the key stored in AT-Link, and the key for verification during online download.

It is recommended to set the same encryption key for these scenarios. Any inconsistency may lead to errors or unexpected results, as detailed in Table 1.

Table 1. Encryption key matching

Encryption key for encryption files	Encryption key in AT-Link	Encryption key for verify	Result
√	√	√	Verification success, and downloaded data is correct
x	√	√	Verification success, but downloaded data is wrong
√	x	√	Verification fails, and downloaded data is wrong
√	√	x	Verification fails, but downloaded data is correct

√: Match

x: Mismatch

5 Revision history

Table 2. Document revision history

Date	Revision	Changes
2024/12/20	V2.12	1. Support for AT32F455/F456/F457.
2024/07/11	V2.11	1. Support for AT32M412/M416.
2024/06/27	V2.10	1. Added the configuration description of advanced commands for QSPI.
2024/05/13	V2.09	1. Added Section 4 <i>Application scenarios</i> . 2. Support for AT32F490.
2024/03/12	V2.08	1. Support for AT32A423. 2. The J-Link connection does not support sLib.
2023/08/10	V2.07	1. Support for AT32F423VCW. 2. Support for AT32F402/F405.
2023.07.06	V2.06	1. Support for AT32A403A.
2023.02.21	V2.05	1. Support for AT32F423. 2. Added "Write Bluetooth module MAC address (AT32WB415CCU7-7)" in Section 3.3.2. 3. Added "3.19 QSPI configuration and file download".
2022.08.11	V2.04	4. Modified some pictures.
2022.07.15	V2.03	1. Support for AT32L021.
2022.01.26	V2.02	1. Support for AT32WB415.
2021.11.26	V2.01	1. Support for AT32F425. 2. Support for AT32F403AVGW.
2021.10.13	V2.00	1. Initial release. Support for AT32F403/F413/F415/F421/F403A/F407/F435/F437.

IMPORTANT NOTICE – PLEASE READ CAREFULLY

Purchasers are solely responsible for the selection and use of ARTERY's products and services; ARTERY assumes no liability for purchasers' selection or use of the products and the relevant services.

No license, express or implied, to any intellectual property right is granted by ARTERY herein regardless of the existence of any previous representation in any forms. If any part of this document involves third party's products or services, it does NOT imply that ARTERY authorizes the use of the third party's products or services, or permits any of the intellectual property, or guarantees any uses of the third party's products or services or intellectual property in any way.

Except as provided in ARTERY's terms and conditions of sale for such products, ARTERY disclaims any express or implied warranty, relating to use and/or sale of the products, including but not restricted to liability or warranties relating to merchantability, fitness for a particular purpose (based on the corresponding legal situation in any unjudicial districts), or infringement of any patent, copyright, or other intellectual property right.

ARTERY's products are not designed for the following purposes, and thus not intended for the following uses: (A) Applications that have specific requirements on safety, for example: life-support applications, active implant devices, or systems that have specific requirements on product function safety; (B) Aviation applications; (C) Aerospace applications or environment; (D) Weapons, and/or (E) Other applications that may cause injuries, deaths or property damages. Since ARTERY products are not intended for the above-mentioned purposes, if purchasers apply ARTERY products to these purposes, purchasers are solely responsible for any consequences or risks caused, even if any written notice is sent to ARTERY by purchasers; in addition, purchasers are solely responsible for the compliance with all statutory and regulatory requirements regarding these uses.

Any inconsistency of the sold ARTERY products with the statement and/or technical features specification described in this document will immediately cause the invalidity of any warranty granted by ARTERY products or services stated in this document by ARTERY, and ARTERY disclaims any responsibility in any form.