AN0032

Application Note

One Time Programmable (OTP) ON AT32 MCU

Introduction

AT32 MCUs have factory-default bootloader, which can be programmed by users in application. With the increasing use of embedded applications, product security becomes more and more important, including hardware protection and protecting the product from being hacked. In the embedded system, all codes and data are stored in the Flash (it can be erased and programmed for several times, and internal data is not lost in case of power off) To protect data in the Flash, many Flash vendors provide an OTP (One Time Programmable) register that can be programmed only once and cannot be modified after programming. Users can store special information in the OTP register, such as the product's software version number, hardware version number, secret keys, etc.

This application note introduces how to use AT32 MCUs (with sLib) to implement functions similar to OTP register.

Reference:

Flash memory controller section of the reference manual for each series

Applicable products:

Part number	AT32 series with sLib

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1 Overview

Different AT32 MCUs may have different sLib (security library) configurations due to function improvement and optimization. Users can use the OTP function to store special data that can be read but not be modified or erased.

The sLib of AT32 MCUs mainly consists of:

- I-BUS area where instructions can be read through I-Code bus only;
- D-BUS area where data can be read through D-Code bus only;
- READ-ONLY area that can be read through I-Code and D-Code bus.

As long as the area is accessible through D-Code bus, the data in this area can be read but cannot be erased or modified (unless the original developer enters a custom secret key to disable sLib protection to perform mass erase), implementing the OTP function. Therefore, the developer only needs to store the data requiring OTP function in the area that is accessible through D-Code bus, so that the data can be read only but not be erased or modified.

2 Operation instruction

According to the structure of AT32 MCU sLib, the OTP data to be stored must be placed in the area (D-BUS area or READ-ONLY area) that is accessible through D-Code bus.

2.1 Operation through codes

This section introduces how to enable sLib on the demo AT-START-403A evaluation board and place the data to D-Code area.

Operating procedures:

1) Press USER button to trigger;
2) If the program is executed for the first time (MCU with sLib disabled), go to step 3; otherwise (MCU with sLib enabled), go to step 7;
3) Configure sLib, including password and range;
4) Write OTP data to the sLib D-code area;
5) LED2/3/4 light up simultaneously;
6) Press RESET button to reset, and repeat step 1;
7) The OTP function is enabled; sLib is enabled and cannot be configured again, and data in the corresponding area cannot be erased or modified; LED2 lights up;
8) Press USER button to trigger;
9) Disable sLib (when the program runs in the Flash, executing this step will trigger Flash mass erase, so that the program cannot continue running), and perform system reset.

Notes:

- In the demo, 256 bytes of data is defined as OTP data, and the selected sLib D-Code area is the last sector in the configurable sLib range of the corresponding MCU. For details about the configurable sLib range, refer to the sLib application note of each AT32 MCU series.
- After the demonstration is completed, disable sLib for follow-up MCU debugging. In practical application, after being enabled, the sLib OTP function will not be disabled.

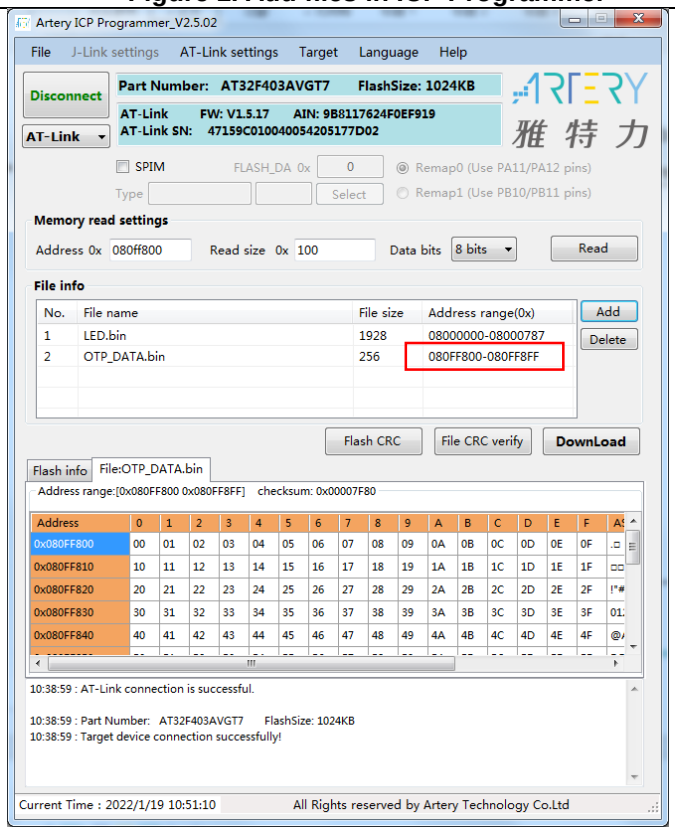
2.2 Operation through ICP/ISP

Users can implement OTP function more conveniently by using upper-computer software (such as ICP/ISP) provided by Artery. When programming the project file, the OTP data to be saved should be programmed together to implement sLib OTP function.

For online programming with ICP programmer, the following procedures are recommended:

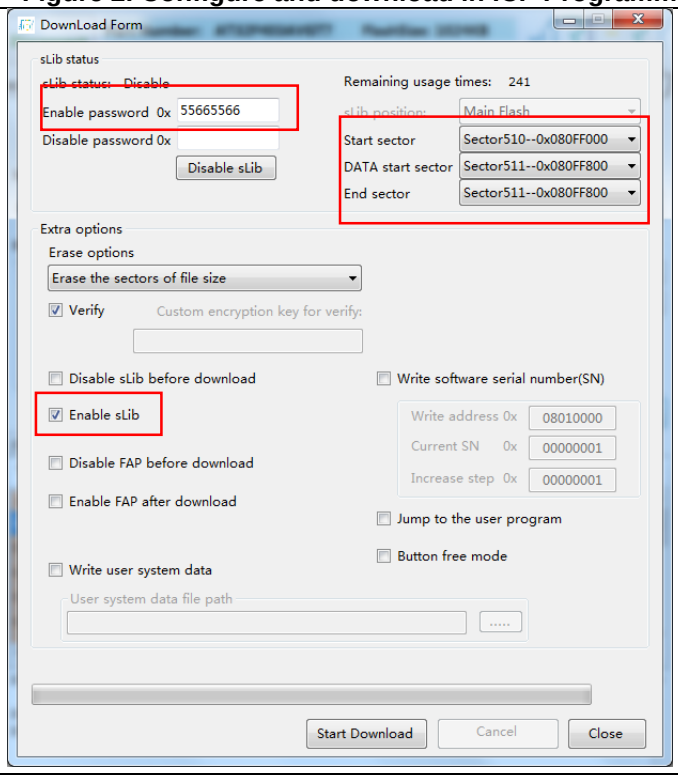
1) Add the corresponding files to be programmed: *LED.bin* is the project file, and *OTP_DATA.bin* is the OTP data to be saved;

Figure 1. Add files in ICP Programmer



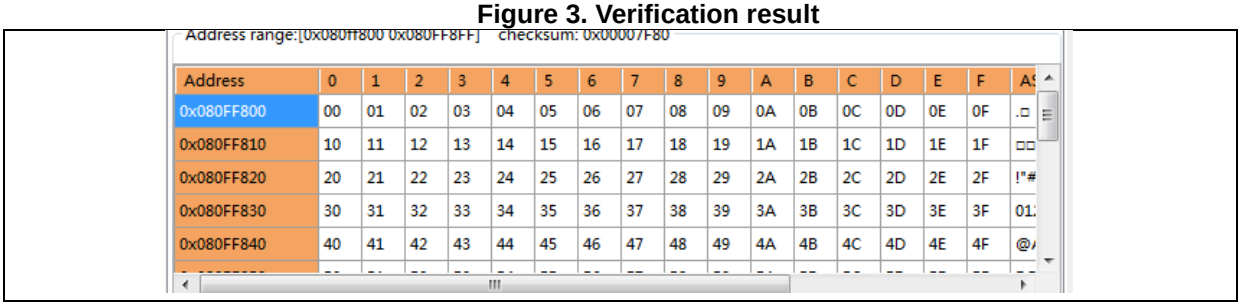
2) Configure the corresponding sLib parameters, and start download;

Figure 2. Configure and download in ICP Programmer



3) Verify OTP function: execute the main memory erase operation, and then read the OTP data storage location (the data cannot be erased, so it is valid).

Figure 3. Verification result



3 Revision history

Table 1. Document revision history

Date	Version	Revision note
2022.01.18	2.0.0	Initial release.

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