Application Note

Develop algorithms and tools based on MSPM0 MCU that supports MCF831x offline burning

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ABSTRACT

This document was translated from a simplified Chinese source. (ZHCAFE3)

MCF831x family provides customers with a single-chip, code-free sensorless FOC device for driving speed-controlled 12V - 24V brushless direct current motors (BLDC) or permanent magnet synchronous motors (PMSM) up to 8A peak current. This family is widely used in power tools, electric fans, hair dryers, car seat comfort, server cooling and other scenarios. Prior to formal mass production, users typically conduct small-batch production verification. During sample burning, users often encounter complex burning procedures, low burning efficiency, and even issues where registers are written incorrectly due to external noise interference. To improve the user experience and increase the reliability and efficiency of burning, an offline MCF831x burning tool is developed based on MSPM0 Launch Pad and it works seamlessly with the json configuration file generated by Motor Studio / GUI to complete profile import, automatic I2C address scanning and addressing, burning verification, status indication and other functions. This paper explains the features and functions of the burning tool, and how to use it.

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1 Profile

1.1 Profile of MCF831x

The MCF831x family is a single-chip, code-free and sensorless FOC device for driving speed-controlled 12V - 24V brushless direct current motors (BLDC) or permanent magnet synchronous motors (PMSM) up to 8A peak current. Its FOC algorithm configuration can be stored in non-volatile EEPROM, allowing the device to operate stand-alone once it has been configured. To meet the needs of different users and different application scenarios, MCF831x family provides a total of 1024 bits of configurable registers. This high configurability ensures exceptional flexibility for users when utilizing the device.

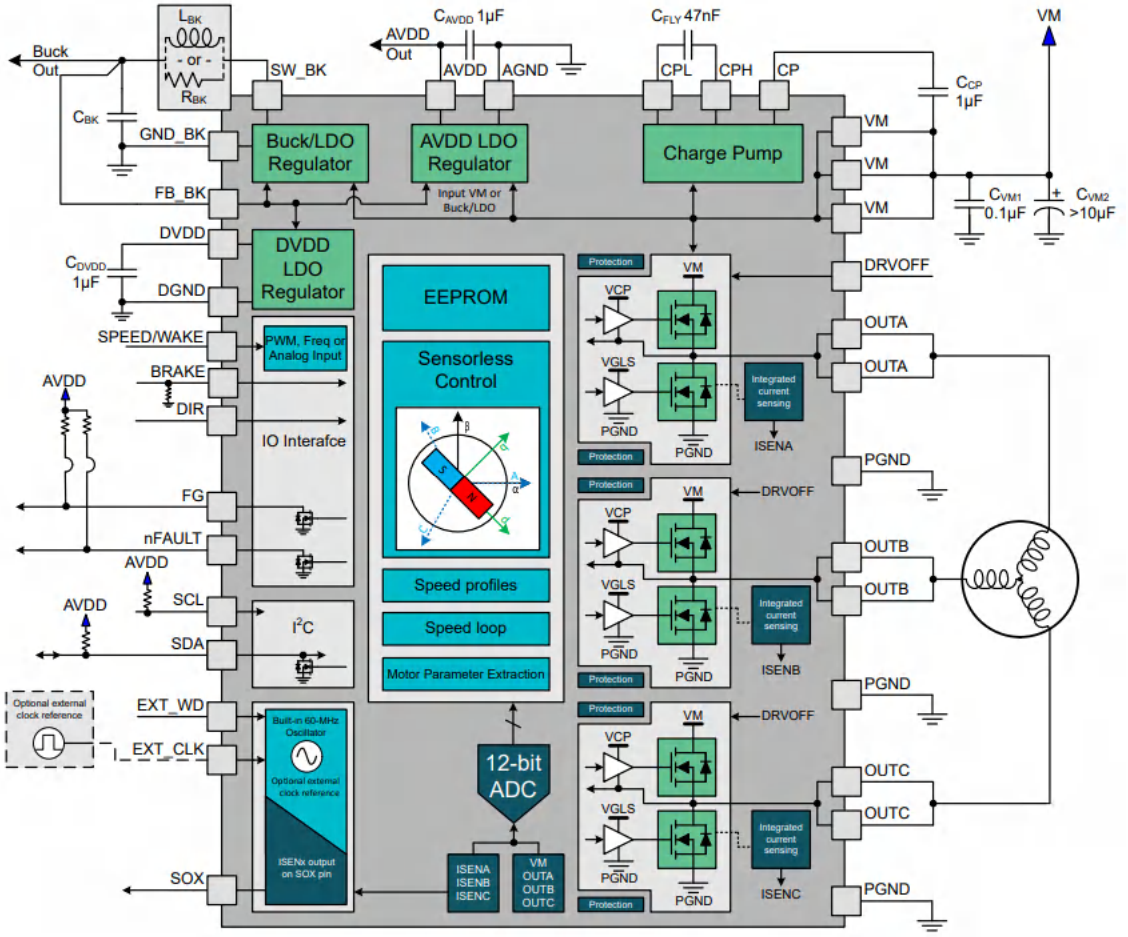


Figure 1-1. MCF831x function block diagram

1.2 Burning challenges

- Challenge 1: Low reliability

  This often results in register write errors due to, for example, noise. If using an EVM burning, the user needs to manually check the value of each register to make sure the burning is correct, however, this will lead to:
  - Inefficiency: Severely impact the development progress of users
  - High cost: Users need to invest more resources
  - Low reliability: It is still difficult for the user to control the behavior of the operator and to guarantee 100% correctness of the register values

  These issues have a serious impact on the user experience, and even in extreme cases there is a risk that the user will burn incorrectly. As a result, non-functional prototypes can be delivered to end customers, posing a risk of project bid failure!
- Challenge 2: Complex steps

If the evaluation board is combined with GUI burning, the customer must navigate a complex process to perform the burning:

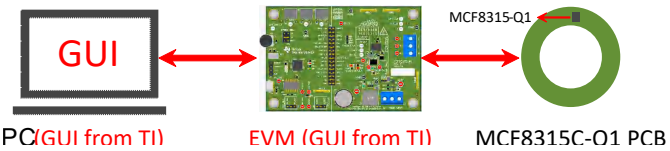


Figure 1-2. Based on evaluation board and GUI burning

Steps include:

- Open GUI
- Connect PC and EVM
- Connect EVM and MCF8315C-Q1 PCB
- Import Json file in GUI
- Check if the motor is in IDLE status in GUI
- Check GUI for any errors
- Click the Burn button in GUI
- Disconnect PC and EVM
- Disconnect EVM and MCF8315C-Q1 PCB
- Read values of all registers
- Compare whether the values of all registers are correct
- Close GUI

And the above steps need to be repeated every time the customer burns a new MCF831x target board.

2 Burning tool based on LP-MSPM0G3519 evaluation board

The burning tool is developed based on the MSPM0G3519 Launch Pad.

2.1 Profile of MSPM0G351x

MSPM0Gx51x MCU family is based on the enhanced Arm® Cortex®-M0+ core platform, operating at up to 80MHz. It features Flash memory ranging from 256KB to 512KB, built-in error correction code (ECC), and up to 128KB of SRAM. Flash is configured as a Dual Bank to support in-field firmware updates and enables address swapping between two Banks. Two simultaneous sampling 12-bit 4Msps ADC (supporting up to 27 external channels), on-chip voltage reference (1.4V or 2.5V), one 12-bit 1Msps DAC and three high-speed comparators (built-in 8-bit reference DAC, capable of operating in low-power and high-speed modes). Dual CAN-FD controllers, cybersecurity mechanism, and high-performance integrated analog, delivering excellent low-power performance over the entire operating temperature range.

MSPM0 MCU platform combines Arm Cortex-M0+ platform with a holistic ultra-low-power system architecture, enabling system designers to increase performance while reducing energy consumption.

One of the main factors in selecting MSPM0G3519 in this application is that MCF831x configuration file is in json format and there are certain requirements on the size of RAM when the json file is parsed inside the MCU. Once RAM capacity of MSPM0G3519 reaches 128KB, it can fully meet the requirements of json file parsing and provide some scalability to add other features in the future.

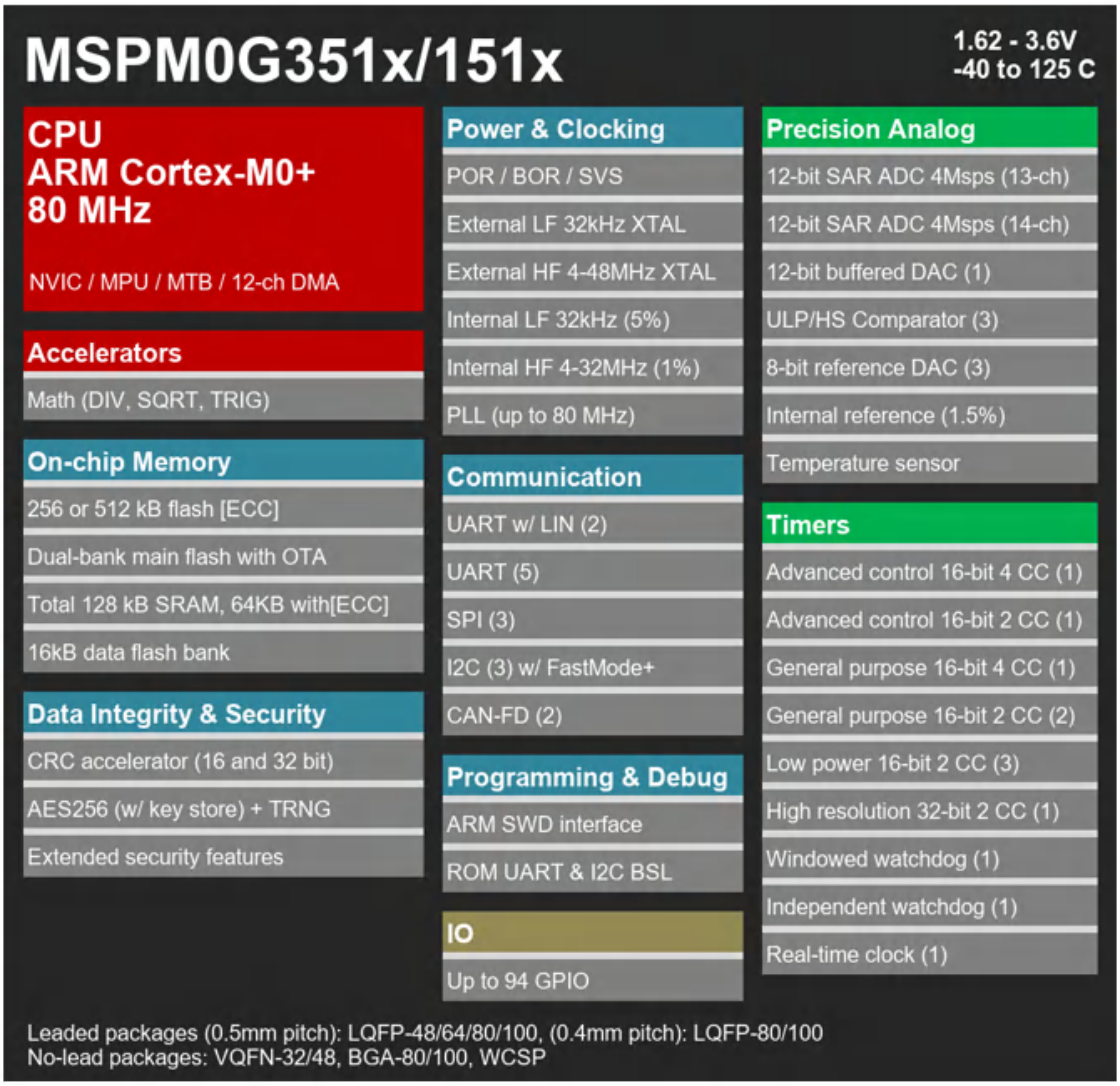


Figure 2-1. MSPM0G351x block diagram

2.2 Introduction of LP-MSPM0G3519 evaluation board

MSPM0G3519 LaunchPad™ development kit is an evaluation module for MSPM0G3519 microcontroller (MCU). LaunchPad kit contains everything needed to develop on the MSPM0Gx51x microcontroller platform, including an on-board debugger for programming, debugging, and EnergyTrace™ technology. The board contains three buttons, two LEDs (one is RGB LED), and 80+ pins. By reserving space on the board for ADC and DAC low-pass filters and utilizing the external reference input pins provided on the rear of the LaunchPad.

LP-MSPM0G3519 on-board resources:

- On-board XDS110 debug downloader
- USB to UART interface
- USB supplies power
- One reset button, two function buttons, 1 RGB LED, and 1 red LED
- External clock crystal

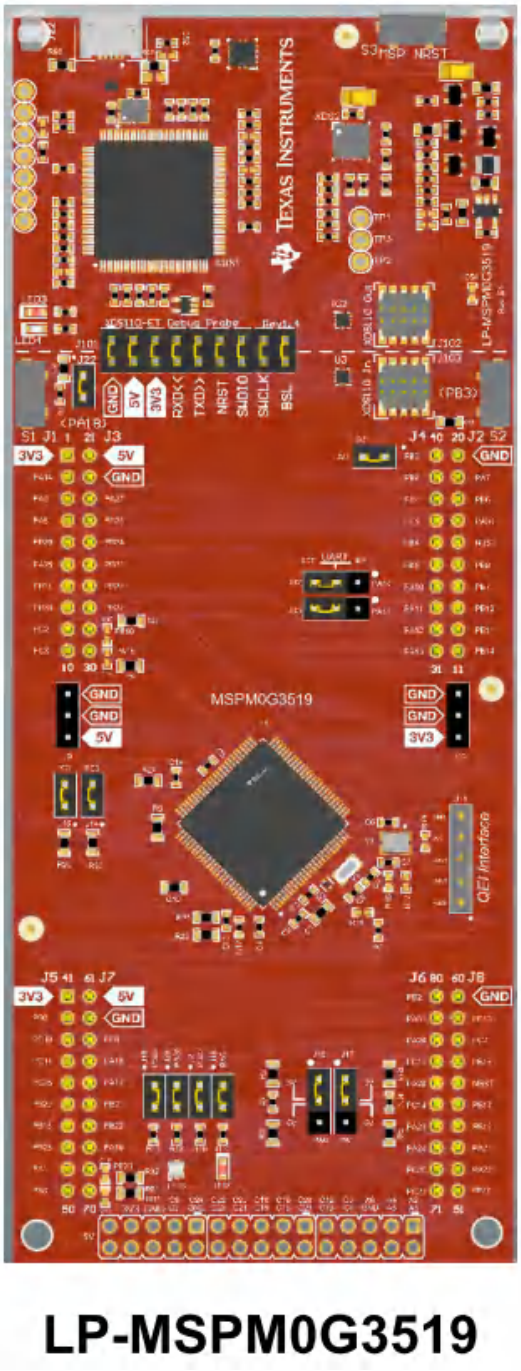


Figure 2-2. LP-MSPM0G3519 evaluation board

2.3 LP-MSPM0G3519 evaluation board burning tool hardware requirements and features

2.3.1 Burning platform hardware requirements

- One LP-MSPM0G3519 evaluation board;
- One micro USB to USB A cable;
- One target board for MCF831x;
- 12V/24V power supply (supply power to MCF831x target board)
- 3 DuPont wires;

2.3.2 Burning tool function

The tool has the following features:

- One-click burning of the DRV831x family chips
- Support standalone operation off-PC
- Automatic parse of Json file
- Auto-detection of I2C address
- Integrated burning verification
- Burning status, result LED indication, system status serial port real-time display

3 Procedure for using the burning tool

3.1 Hardware platform setup

1. Connect 12V/24V power supply to MCF831x evaluation board;
2. Remove the jumper caps for SCL, SDA on MCF831x evaluation board and connect SCL, SDA and GND to PC2 (SCL), PC3 (SDA) and GND on LP-MSPM0G3519 evaluation board through DuPont wire;
3. Connect LP-MSPM0G3519 evaluation board to PC end using micro USB.

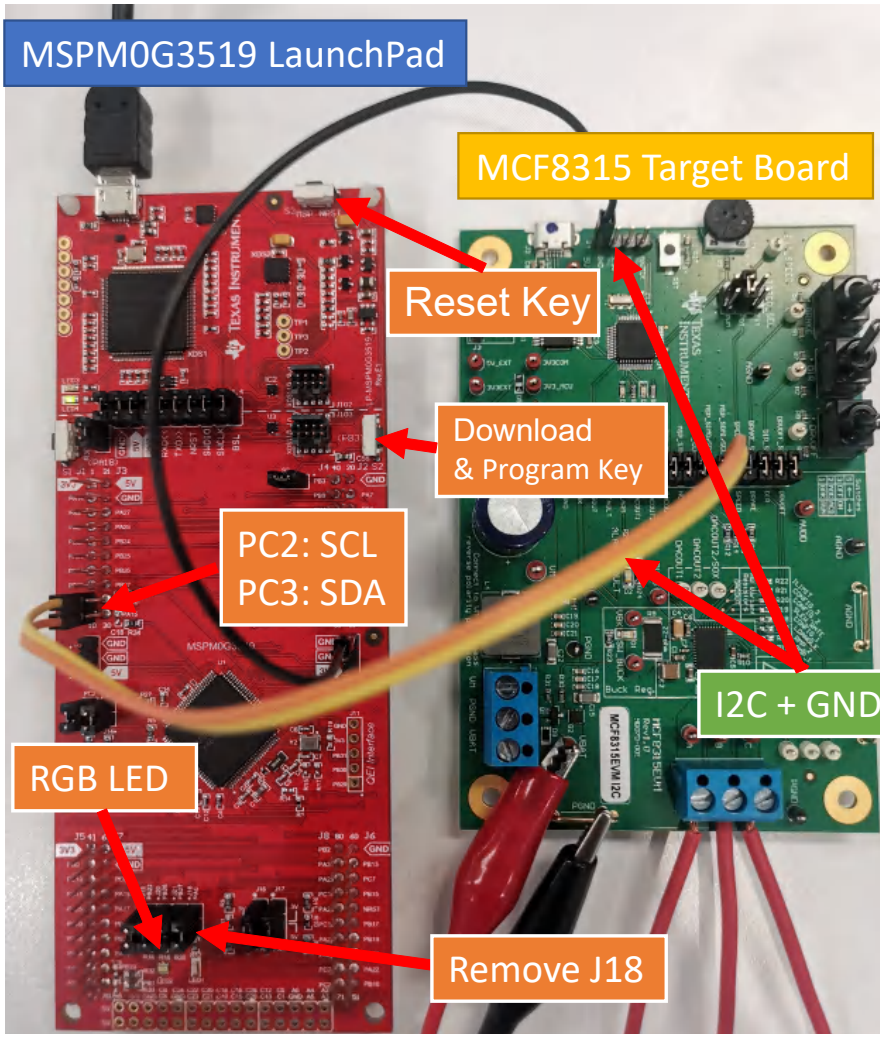
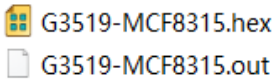


Figure 3-1. Diagram of burning tool hardware connection

3.2 Software Setup

3.2.1 Download and burn the firmware to LP-MSPM0G3519 using Uniflash



Once LP-MSPM0G3519 evaluation board is connected to the PC end, open the installed Uniflash software and automatically detect the board. When the screen shown below appears, click Start button to proceed to the next step.

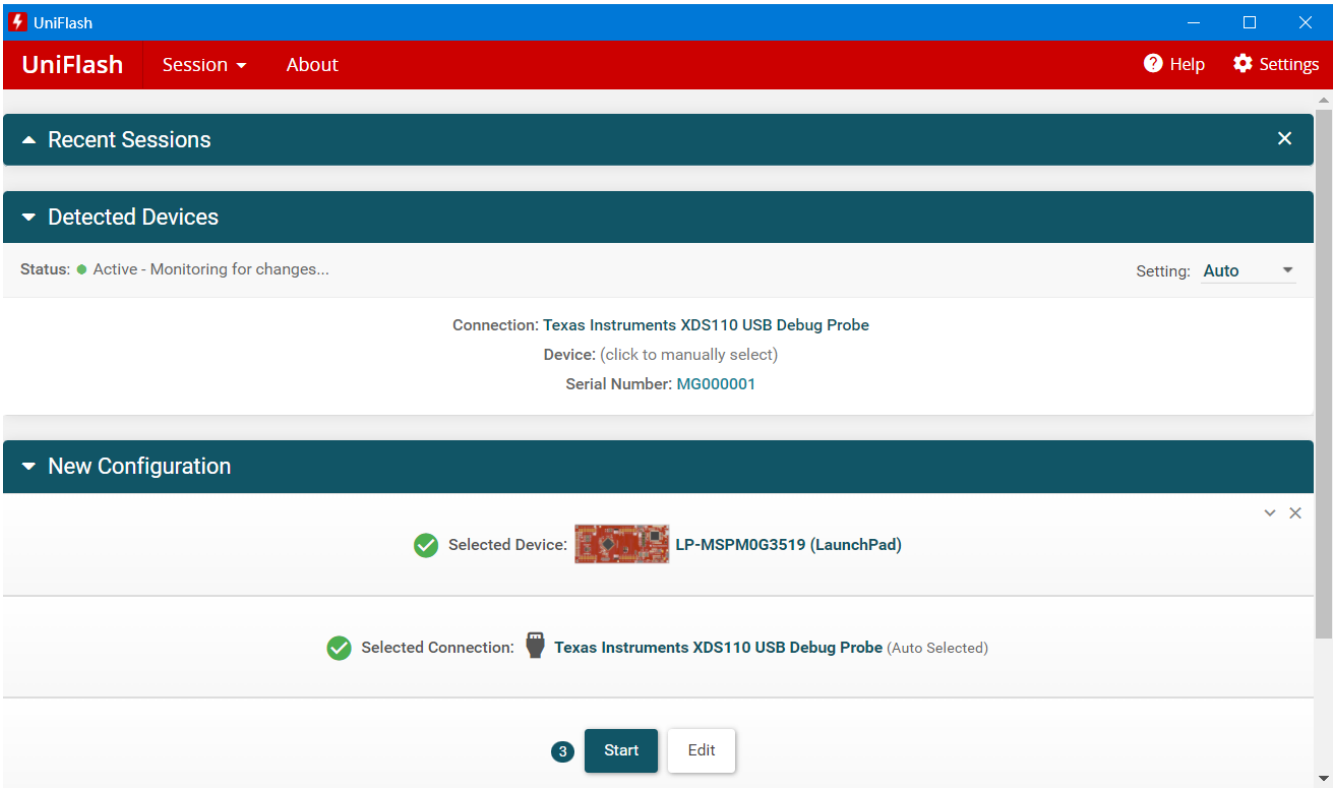
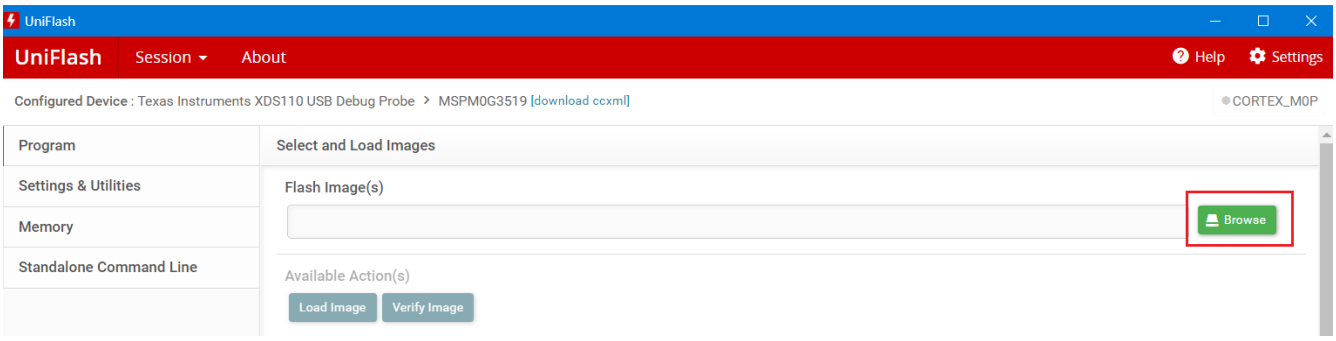


Figure 3-2. UniFlash burning Firmware project interface

Select the G3519-MCF8315.out file by clicking the Browse button on the screen below.



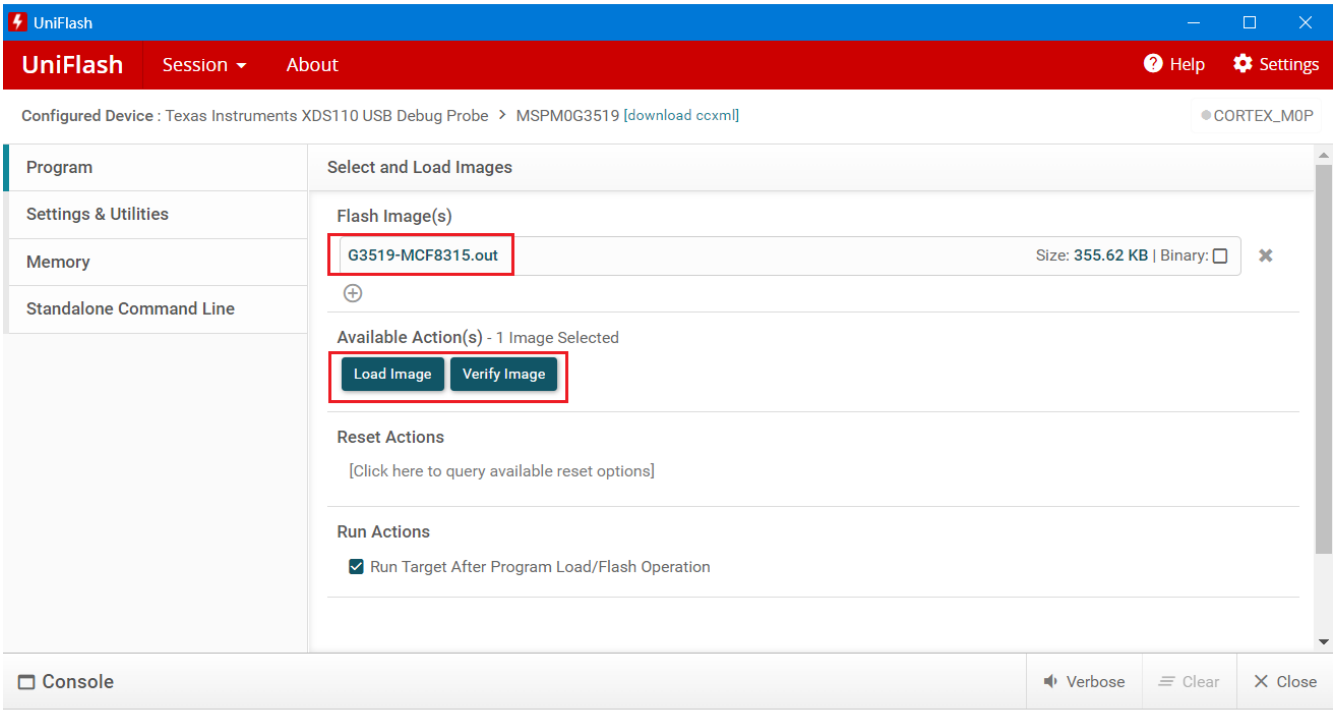


Figure 3-3. UniFlash loading Firmware burning

Click the Load Image button to start the software burning and the results of the successful burning can be seen in the Console window.

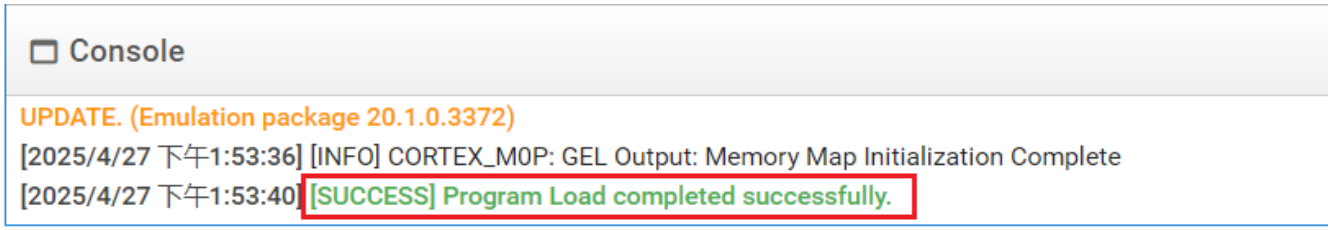


Figure 3-4. UniFlash burning completion prompt

3.2.2 Import MCF831x json configuration file to the burning platform

In order to import MCF831x json configuration file into the LP-MSPM0G3519 evaluation board, we need to use serial port software sscom, which is available at this address for this free software. http://www.daxia.com/download/sscom.rar

After connecting the LP-MSPM0G3519 evaluation board to the PC end using a micro USB, the serial port information can be seen in the device manager. Note that XDS110 Class Application/User UART (In COMxx, xx represents the actual number displayed by the user's computer) is used.

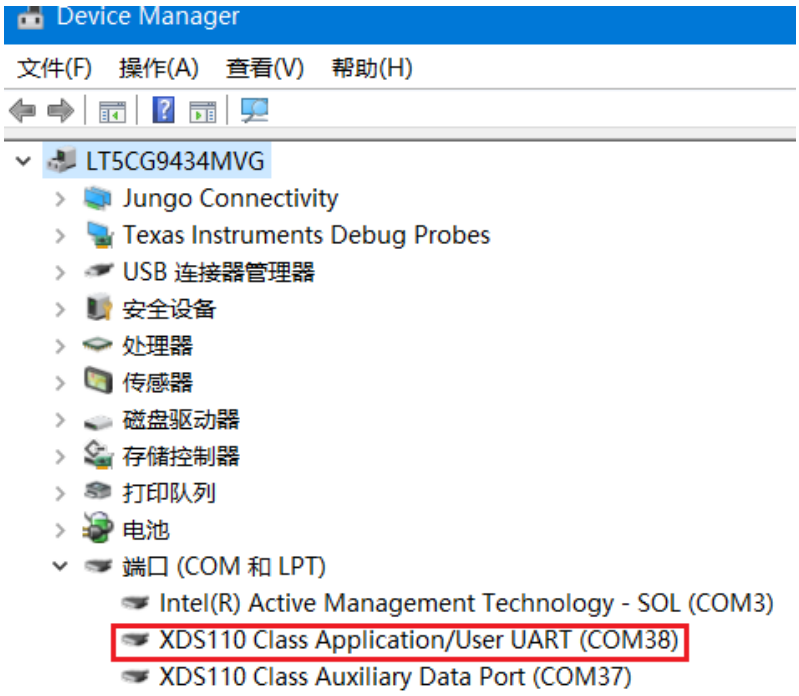


Figure 3-5. View port information of LP-MSPM0G3519 in Windows

Open sscom software and select the corresponding COMxx port in the ComNumber drop down menu and 115200 baud rate. Click OpenCom button, press S3 Reset button on LP-MSPM0G3519 evaluation board, and sscom will output the following information. We can see the release date of the software version.

Since no json configuration file is stored internally in MSPM0G3519, it will default to json file download mode, waiting for the user to initiate json file download operation.

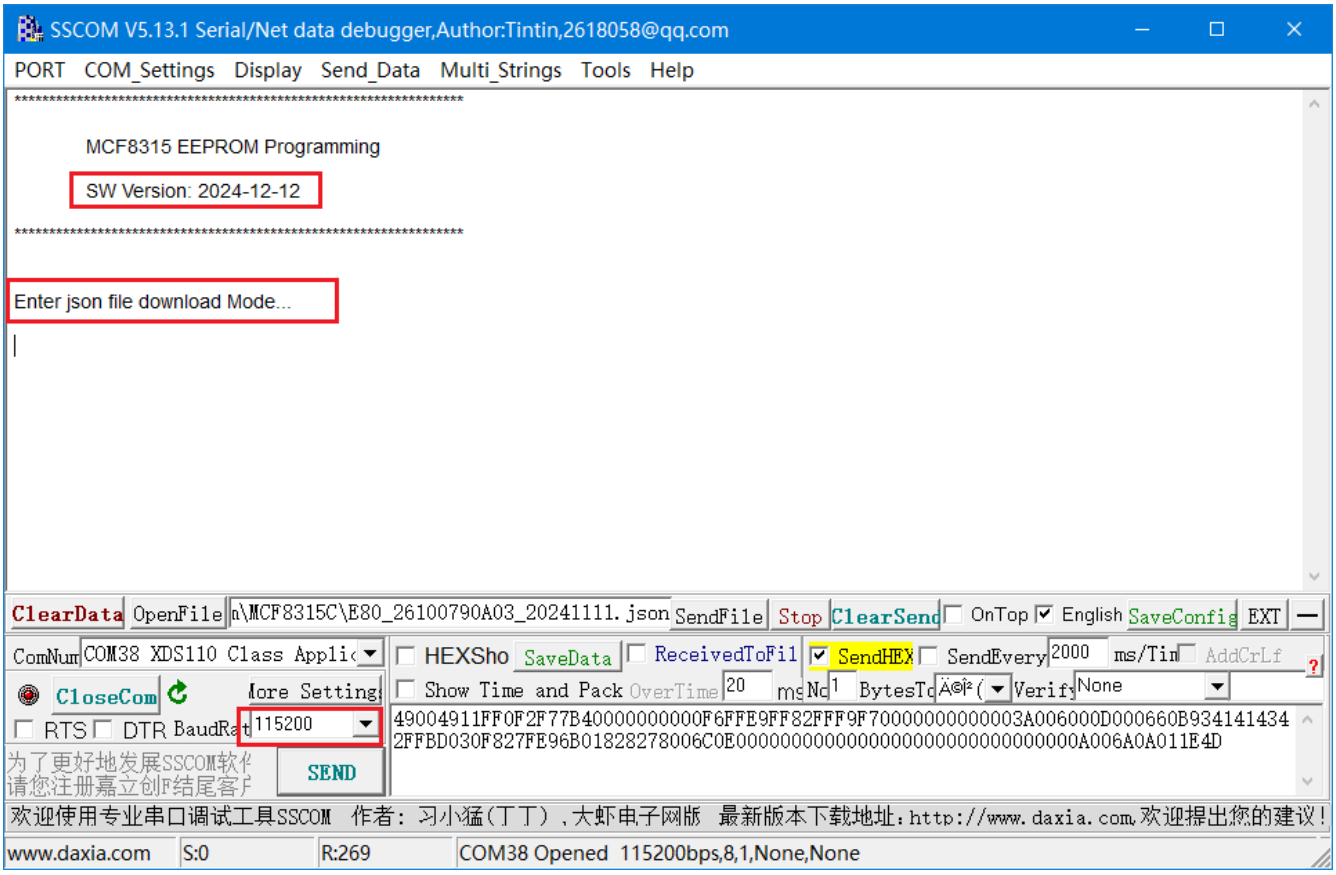


Figure 3-6. Burning tool output information interface

Click OpenFile button to select json file to download. When opened, the window displays the contents of the current json file. Click the Send button to start json file download process.

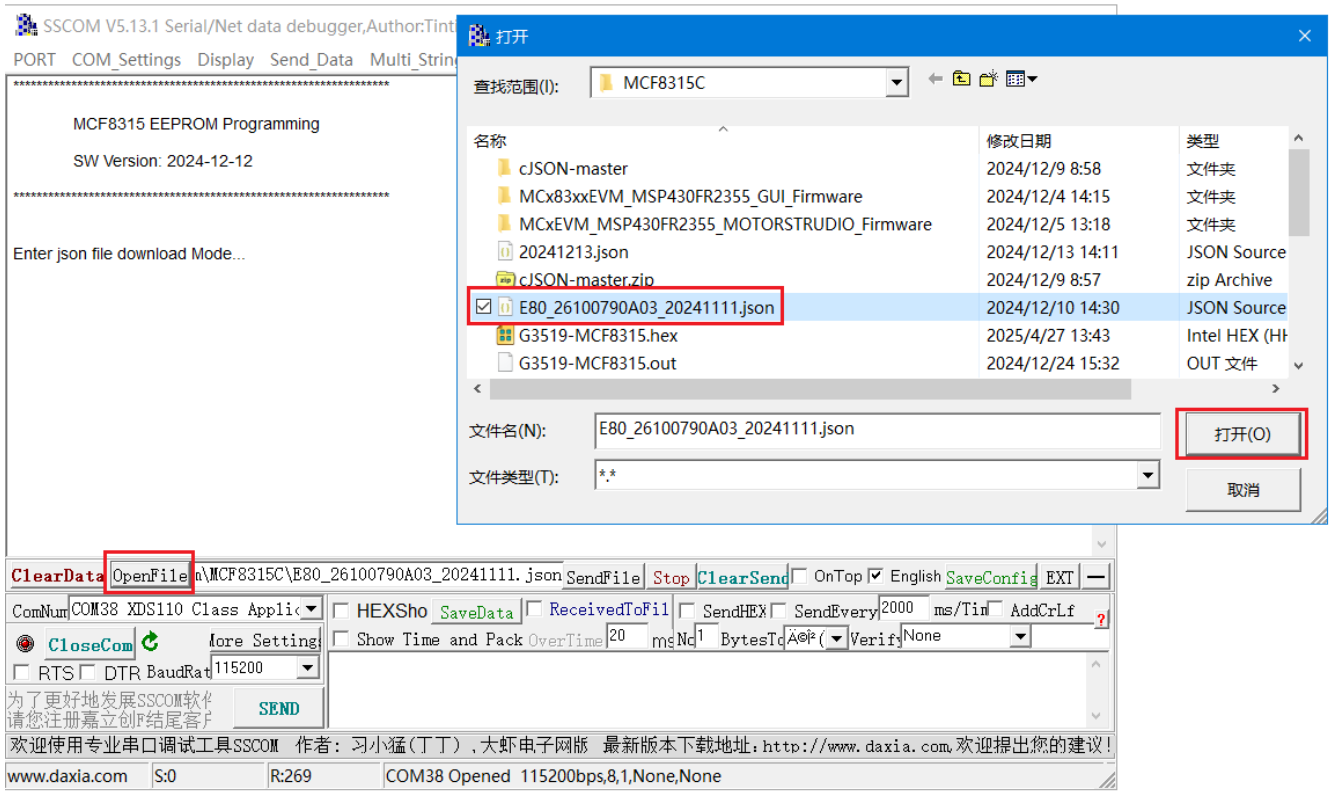


Figure 3-7. Select json file in sscom

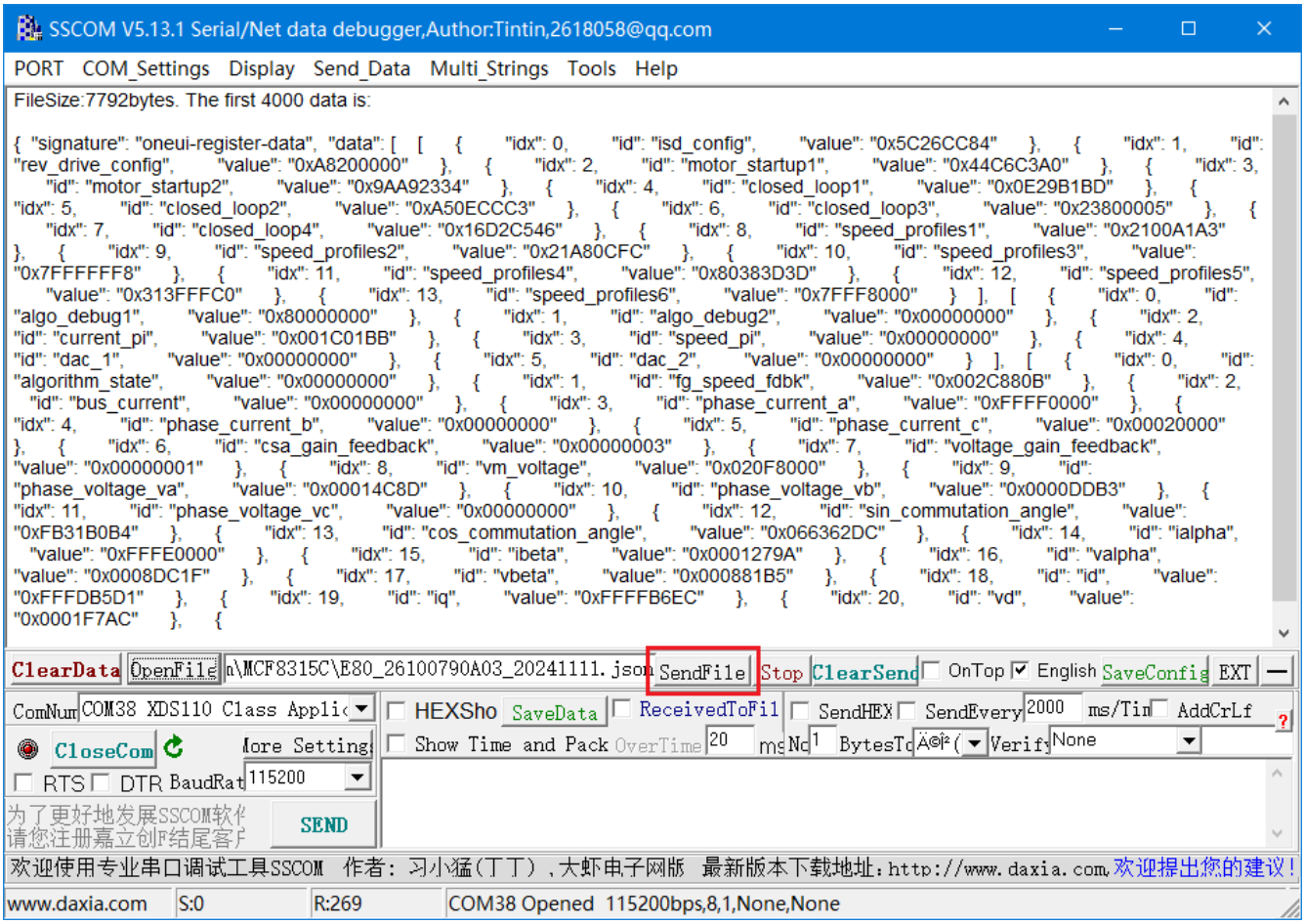


Figure 3-8. Burn json file in sscom

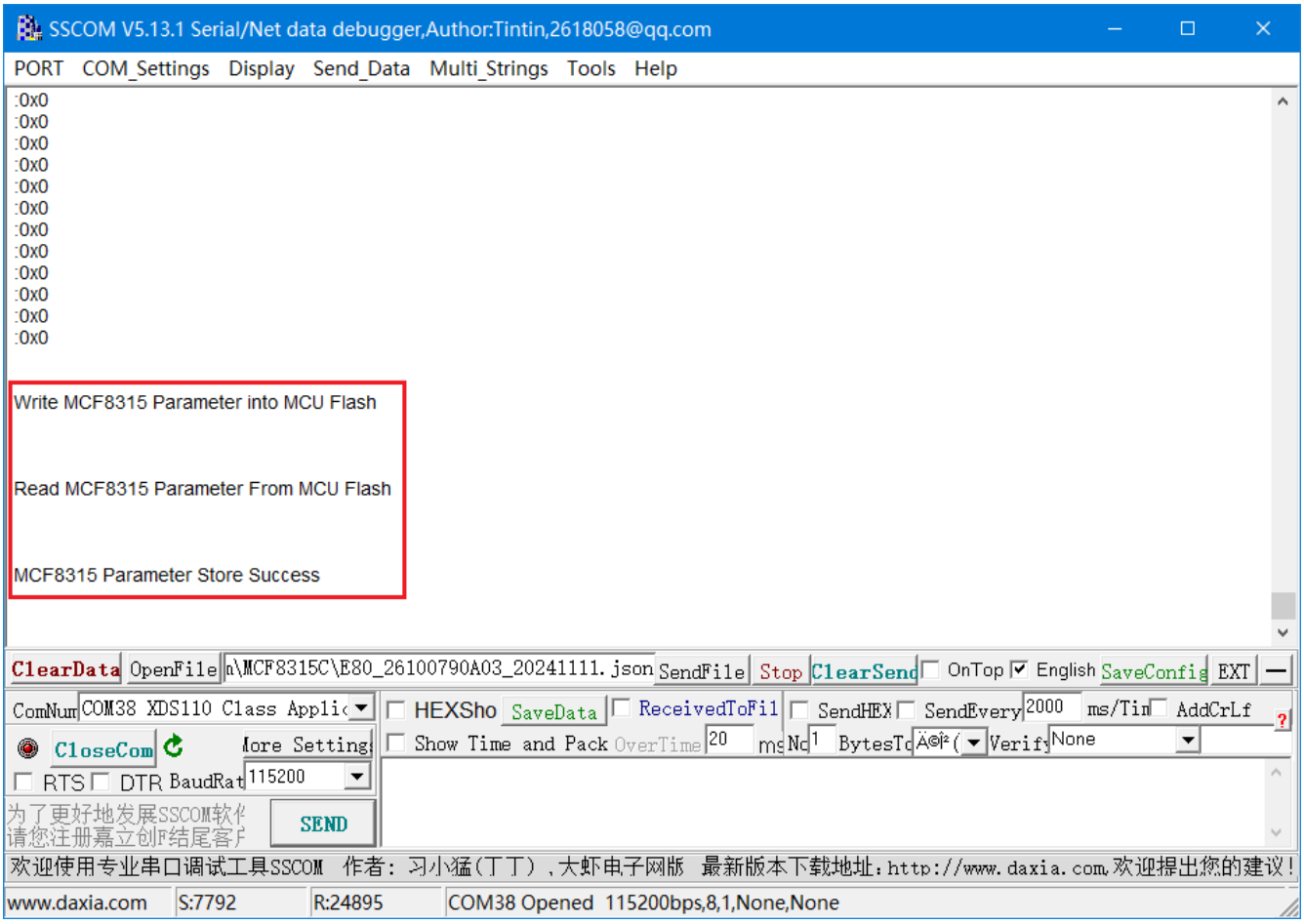


Figure 3-9. Json file burning success information

Upon successful burning of json file, the display will appear as shown in the diagram, and json file is checked automatically during this process to ensure that the burning is accurate. This is where all the preparation is done, proceeding to MCF831x burning phase.

3.3 Offline burning

After completing the hardware setup as described above, you can proceed to the burning stage.

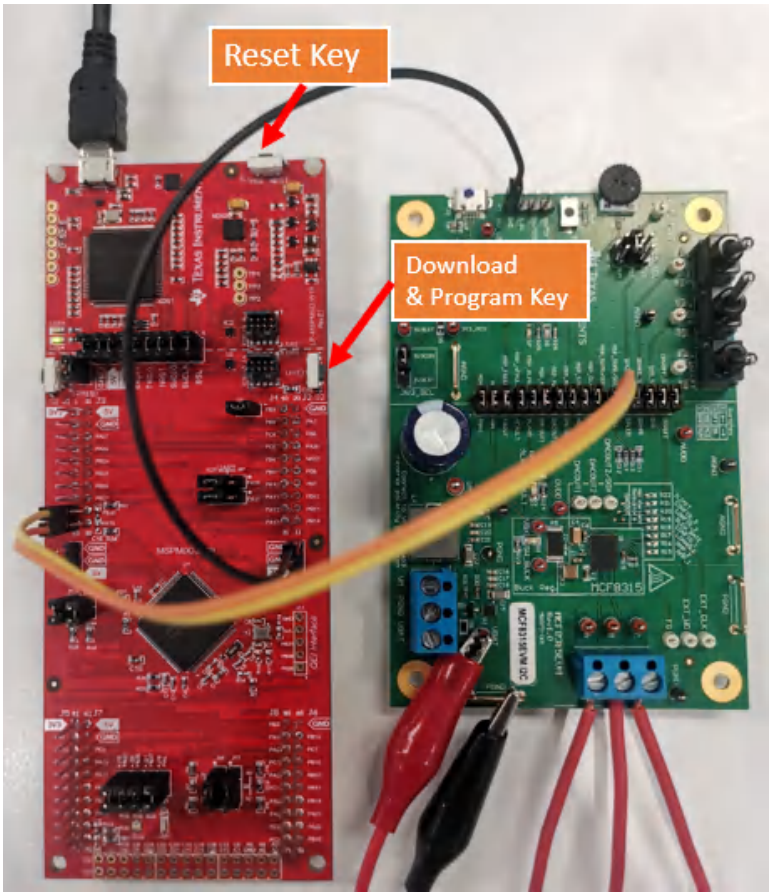


Figure 3-10. Burning connection diagram

After pressing LP-MSPM0G3519 evaluation board reset button, the following information appears in sscom with the blue LED remaining steadily lit.

```
 ********************************************************************
MCF8315 EEPROM Programming
SW Version: 2024-12-12
 ********************************************************************

Check MCF8315 I2C Address
Current MCF8315 I2C Address is: 0x0
Reading out MCF8315 EEPROM contents

Reg: 0x80 = 0x5c26cc84
Reg: 0x82 = 0xa8200000
Reg: 0x84 = 0x44c6c3a0
Reg: 0x86 = 0x9aa92334
Reg: 0x88 = 0xe29b1bd
Reg: 0x8a = 0xa50eccc3
Reg: 0x8c = 0x23800005
Reg: 0x8e = 0x16d2c546
Reg: 0x90 = 0x2dda0326
Reg: 0x92 = 0x7fd252d8
Reg: 0x94 = 0x2100a1a3
Reg: 0x96 = 0x21a80cfc
Reg: 0x98 = 0x7ffffff8
Reg: 0x9a = 0x80383d3d
Reg: 0x9c = 0x313fffc0
Reg: 0x9e = 0x7fff8000
Reg: 0xa0 = 0x3020f0
Reg: 0xa2 = 0x201
Reg: 0xa4 = 0x8000001
Reg: 0xa6 = 0x1
Reg: 0xa8 = 0x1f4f000
Reg: 0xaa = 0x2680200
Reg: 0xac = 0xc000104
```

```
Reg: 0xae = 0x1120000

Reading MCU Flash Contents for EEPROM Programming

0x5c26cc84
0xa8200000
0x44c6c3a0
0x9aa92334
0xe29b1bd
0xa50eccc3
0x23800005
0x16d2c546
0x2dda0326
0x7fd252d8
0x2100a1a3
0x21a80cfc
0x7ffffff8
0x80383d3d
0x313fffc0
0x7fff8000
0x3020f0
0x201
0x8000001
0x1
0x1f4f000
0x2680200
0xc000104
0x1120000

Waiting for Button pressed to write EEPROM
```

Simply press S2 button on LP-MSPM0G3519 evaluation board to enter the download process. The blue LED blinks during the download process and the green LED blinks rapidly when the download is complete, indicating a successful burning. If a flashing red LED appears, it indicates that the burning fails and then a failure indication occurs in sscom.

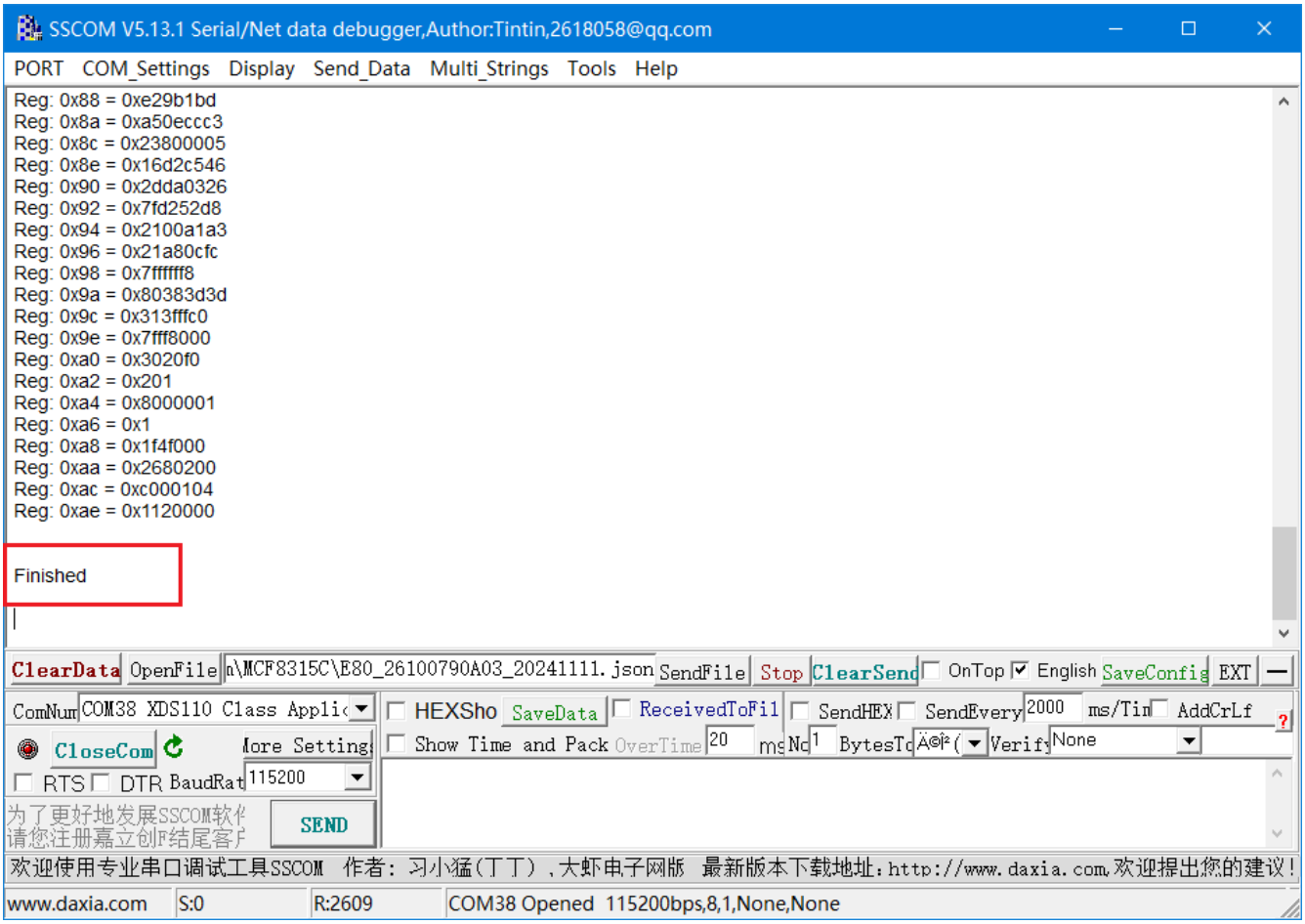


Figure 3-11. A prompt when burning and verification are complete

MCU will automatically check the contents of the EEPROM in the MCF831x after the burning is complete, so as to ensure that the burning is correct and consistent.

If you need to download a new json file to the LP-MSPM0G3519 evaluation board, just keep pressing S2 button and press the Reset button again, and then sscom will prompt you to enter json file download mode and the user can download the new json file.

4 Summary

This paper describes the challenges of using GUI to burn the MCF831x family, how to develop a burning tool in MCF831x family based on MSPM0 Launch Pad, the features of the tool and how to use it. This burning tool helps users improve development efficiency and reliability during the pre-sample production phase!

5 References

1. *MCF8315C-Q1 Sensorless Field Oriented Control (FOC) Integrated FET BLDC Driver dataset (Rev. A) (SLLSFV6A)*
2. *MCF83xx and MCT83xx EEPROM Read and Write Procedure (SLLA664)*
3. *MCF8316AEVM Evaluation Module User's Guide*
4. *UniFlash download address: https://www.ti.com/tool/UNIFLASH*
5. *LP-MSPM0G3519 — MSPM0G3519 LaunchPad™ development kit*

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