



# SF100/SF600/SF600Plus/SF600Plus-G2/SF700 In-system Programming for SPI NOR Flash Chip

## Application Note



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## I. Name Interpretation

1. **SPI NOR Flash:** Also known as Serial NOR Flash, BIOS, ROM, Chip, IC.
2. **Programmer:** DediProg's SF series programmer, include SF100, SF600, SF600Plus, SF600Plus-G2, SF700.
3. **Chipset:** Include all the application controllers who drive the Serial Flash: Southbridge, Super I/O, Embedded Controller, and MCU (Microcontroller), etc.
4. **SPI Bus:** Serial Peripheral Interface (SPI) is a de facto standard (with many variants) for synchronous serial communication. In short, the programmer communicates with the SPI NOR Flash chip through the 4 SPI Bus I/O pins (CS, MOSI, MISO, CLK). For more detailed SPI Bus description, please check Wikipedia or use Google to search for the keyword "SPI Bus".
5. **PCB:** A printed circuit board (PCB), also called printed wiring board (PWB), is a medium used to connect or "wire" components to one another in a circuit.

## II. What is In-system programming (ISP)?

In-system programming (ISP), also called in-circuit serial programming (ICSP), is the ability of some programmable logic devices, microcontrollers, chipsets and other embedded devices to be programmed while installed in a complete system, rather than requiring the chip to be programmed prior to installing it into the system.

### III. PCB Design Note

1. Whether In-system programming (ISP) can be successfully programmed has a lot to do with the circuit design of the PCB. Please refer to the application file AN0103 to confirm the circuit design of the PCB:  
<https://www.DediProg.com/download/save/617.pdf>
2. It is recommended that the length of the cable/flying wire between the writer and PCB should not exceed 10cm, and try not to use flying wires (jumpers). Possible problems with using long cables and flying leads (jumpers):
  - (1) Inductive effect: slender cables and wires have a large inductance, which will cause the signal load capacitance to become larger, and the signal may degrade and become worse, resulting in errors.
  - (2) Using flying leads, there may be problems of mutual interference of signals.
3. When the programmer is programming the SPI NOR Flash on the PCB, the "Chipset" on the PCB cannot use the SPI Bus at the same time.
4. If the "Chipset" has a reset/enable pin, please connect this pin to the IO3/RESET Pin of the programmer. During programming, IO3/RESET will send a low level signal to stop the "Chipset" from working to avoid the "Chipset" also using the SPI Bus at the same time.
5. After the "Chipset" is reset, release the SPI Bus with high impedance.
6. When the system is in standby mode (powered but not turned on), when powering the "Chipset" and SPI NOR Flash, the "Chipset" needs to release the SPI bus with high impedance.
7. After the system startup is completed, if the programmer needs to program the SPI NOR Flash on the PCB, the "Chipset" must release the SPI Bus with high impedance.
8. WP Pin of SPI NOR Flash (write protection pin). This pin must be pulled high (connect a resistor in series to VCC) and set it to high level (logic H).
9. HOLD Pin of SPI NOR Flash. This pin must be pulled high (connect a resistor in series to VCC) and set it to high level (logic H).
10. Consider the issue of selective powering: is it possible to power the SPI NOR Flash without powering up the rest of the system? If you power the SPI NOR Flash, it means you are powering the "Chipset" it is connected to, and you cannot prevent that "Chipset" from communicating with the SPI NOR Flash using the SPI Bus you are connecting to, then this will not work. Essentially, if the SPI NOR Flash and "Chipset" are running from the same power supply, and the "Chipset" does not have an externally accessible reset/enable pin, it will be difficult to work. And, what happens if the same power source powers other components?

## IV. Problems and Solutions

When the programmer programs the SPI NOR Flash on the PCB, the problems usually encountered are as follows:

1. Unable to automatically detect SPI NOR Flash.
2. Timeout messages, failure messages or other error messages appear during erasing/programming/verification.

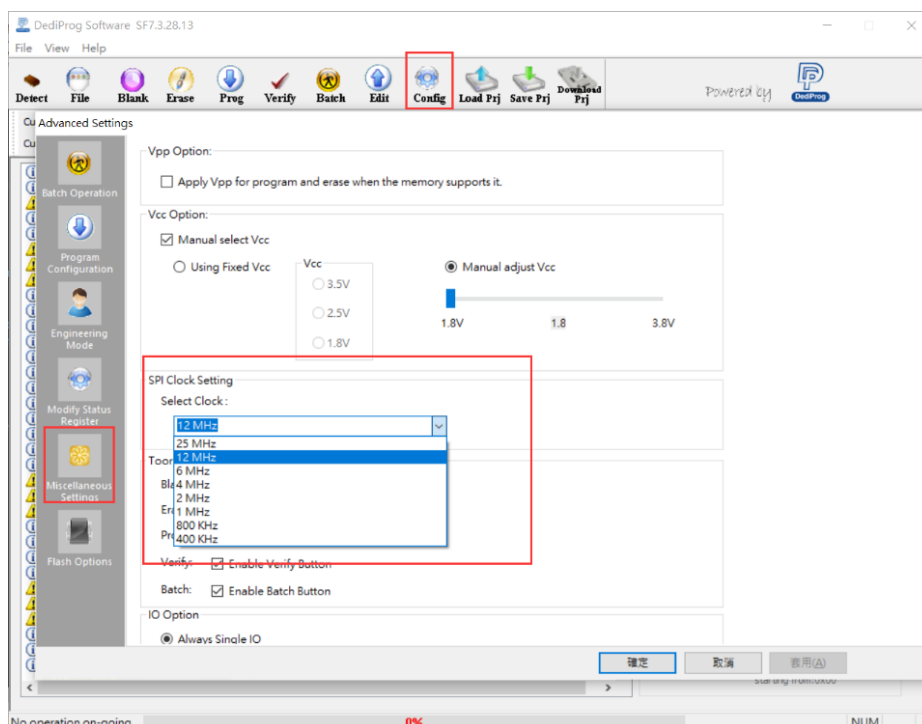
The possible causes of the problem are as follows:

1. The programmer has hardware damage.
2. There is a problem with the programmer software.
3. The "Chipset" interference problem on the PCB: The "Chipset" on the PCB is connected to the SPI NOR Flash. When the programmer programs the SPI NOR Flash on the PCB, the "Chipset" will interfere with the programmer's SPI Bus.

Please follow the steps below to analyze and try to solve the problem:

### 1. Update the latest software and firmware

If the problem of updating software and firmware still exists, please try to lower the clock frequency and observe at which frequency the SPI NOR Flash can be successfully detected? At which frequency can the programming and verification be successful?



### 2. Use off-line programming to program SPI NOR Flash, and check whether the programmer, software and SPI NOR Flash chip are normal.

Off-line programming means to program SPI NOR Flash in an environment without PCB, eliminating any interference factors that will affect the SPI Bus of the programmer. Off-line programming is to clarify whether the "Chipset" on the PCB will interfere with the programmer's SPI Bus.

**Please follow these steps to test off-line programming:**

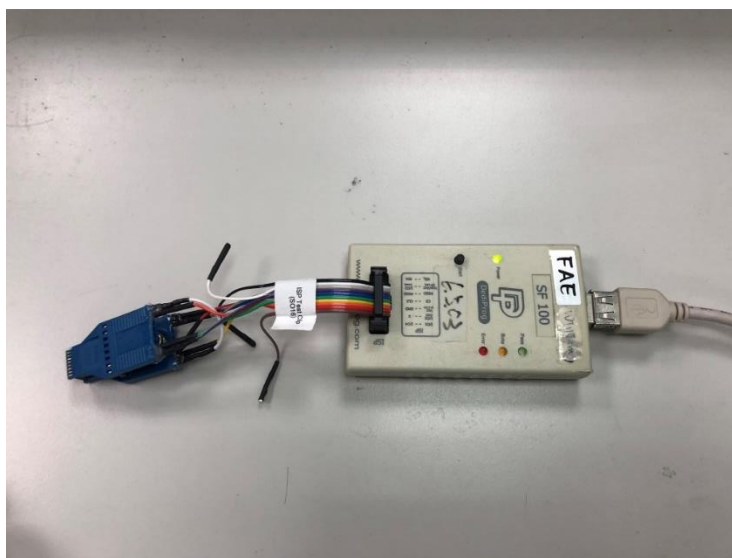
2.1 Desolder the SPI NOR Flash chip from the PCB.

2.2 The SPI NOR Flash chip is connected to the programmer. You can connect the SPI NOR Flash chip to the programmer through the programmer accessories sold by DediProg. If you do not have the programmer accessories sold by DediProg, please find a way to connect the desoldered SPI NOR Flash chip to the programmer yourself.

2.2.1 SF100:

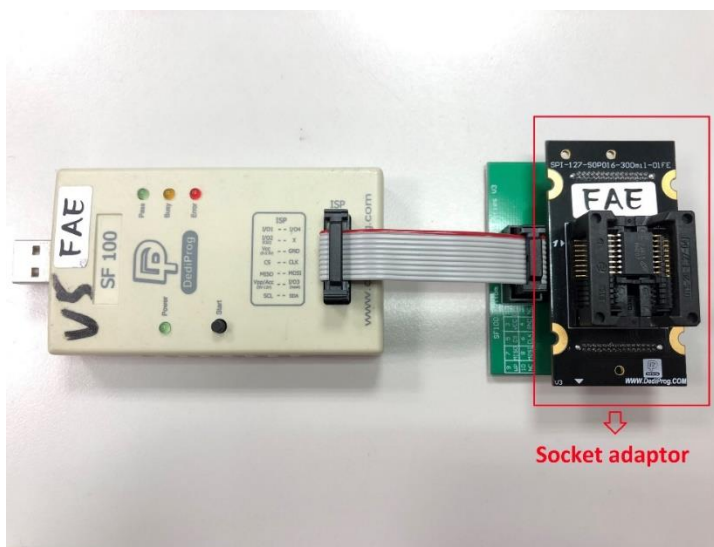
(1) Using IC test clips:

- <https://www.DediProg.com/product/ISP-TC-16>
- <https://www.DediProg.com/product/ISP-TC-8>
- The test clips currently sold only support ICs with package SO8N (150mils), SO8W (200/207/208 mils), and SO16W (300 mils).
- Connection diagram using IC test clip.



- (2) Use the **SF100 Bottom Board** and the corresponding IC package socket adaptor, and place the SPI NOR Flash into the socket adaptor to program. If you don't know which socket adaptor to use, please provide the SPI NOR Flash part number you are using.

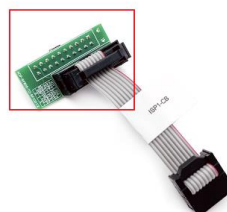
- SF100 Bottom Board + socket adaptor connection diagram



## 2.2.2 SF600/SF600Plus:

### (1) Using IC test clips:

- <https://www.DediProg.com/product/ISP-TC-16 + Universal Adaptor>
- <https://www.DediProg.com/product/ISP-TC-8 + Universal Adaptor>
- <https://www.DediProg.com/product/EM-TC-16>
- <https://www.DediProg.com/product/EM-TC-8>
- The test clips currently sold only support ICs with package SO8N (150mils), SO8W (200/207/208 mils), and SO16W (300 mils).
- The Universal Adapter is the small green adapter in the picture. This accessory will be included when purchasing SF600/SF600Plus. Using this adapter, you can use the accessories of SF100.





- Connection diagram using IC test clip



### 2.2.3 SF700:

(1) Using IC test clips:

- <https://www.DediProg.com/product/ISP-TC-16 + ISP-SPI-SF14 adaptor>
- <https://www.DediProg.com/product/ISP-TC-8 + ISP-SPI-SF14 adaptor>
- <https://www.DediProg.com/product/EM-TC-16 + ISP-SPI-SF20 adaptor>
- <https://www.DediProg.com/product/EM-TC-8 + ISP-SPI-SF20 adaptor>
- The test clips currently sold only support ICs with package SO8N (150mils), SO8W (200/207/208 mils), and SO16W (300 mils).
- Connection diagram using IC test clip



- (2) Use the corresponding IC package socket adaptor and put the SPI NOR Flash into the socket adaptor to program. If you don't know which socket adaptor to use, please provide the SPI NOR Flash part number you are using.



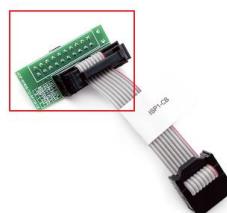
- Socket adaptor connection diagram



#### 2.2.4 SF600Plus-G2:

(1) Using IC test clips:

- <https://www.DediProg.com/product/ISP-TC-16 + Universal Adaptor>
- <https://www.DediProg.com/product/ISP-TC-8 + Universal Adaptor>
- <https://www.DediProg.com/product/EM-TC-16>
- <https://www.DediProg.com/product/EM-TC-8>
- The test clips currently sold only support ICs with package SO8N (150mils), SO8W (200/207/208 mils), and SO16W (300 mils).
- The Universal Adapter is the small green adapter in the picture. This accessory will be included when purchasing SF600Plus-G2. Using this adapter, you can use the accessories of SF100.



- Connection diagram using IC test clip



- (2) Using the **ProgMaster Socket Bottom Board** and the corresponding IC package socket adaptor, place the SPI NOR Flash into the socket adaptor to program. If you don't know which socket adaptor to use, please provide the SPI NOR Flash part number you are using.

- ProgMaster Socket Bottom Board + socket adaptor connection diagram



2.3 Can the SPI NOR Flash be successfully detected  ?

2.4 Can Program  and Verify  be successful after loading the programming file?

2.5 If off-line programming can successfully detect SPI NOR Flash, and there are no problems with Program and Verify, it means that there are no problems with the software, programmer, and SPI NOR Flash.

2.6 Solder the SPI NOR Flash back to the PCB.

If you use off-line programming to program SPI NOR Flash, the programmer software can detect the SPI NOR Flash normally, and there are no problems with Program and Verify. However, the programmer cannot successfully program the SPI NOR Flash on the PCB. Detect, Program and Verify, the obvious possible reason is that when the programmer communicates with the SPI NOR Flash on the PCB, the "Chipset" on the PCB will use the SPI Bus at the same time, causing interference to the SPI Bus of the programmer.

If you are unable to desolder the SPI NOR Flash from the PCB or cannot perform off-line programming testing, please send the programmer and related connection cable back to us for testing.

### 3. Analyze and find out the reasons why the "Chipset" on the PCB will interfere with the SPI Bus of the programmer.

**Please consider the following possible interference factors:**

3.1 Is the length of the cable/flying wire between the programmer and the board too long? Try not to exceed 10cm.

3.2 While the programmer is programming the SPI NOR Flash on the PCB, will the "(Chipset)" on the PCB also work? If "Chipset" also works, will "Chipset" interfere with the programmer's SPI Bus?

3.3 Does "Chipset" have a reset/enable pin? If so, please connect this pin to the IO3/RESET Pin of the programmer. During programming, IO3/RESET will send a low level signal to stop "Chipset" from working to avoid "Chipset" also using the SPI Bus at the same time.

3.4 Does the WP Pin (write protection pin) of the SPI NOR Flash on the PCB have a pull high (connect a resistor in series to VCC) and set it to high level (logic H)?

3.5 Does the HOLD Pin of the SPI NOR Flash on the PCB have a pull high (connect a resistor in series to VCC) and set it to high level (logic H)?

3.6 When "Chipset" is reset, is the SPI Bus in a high impedance state?

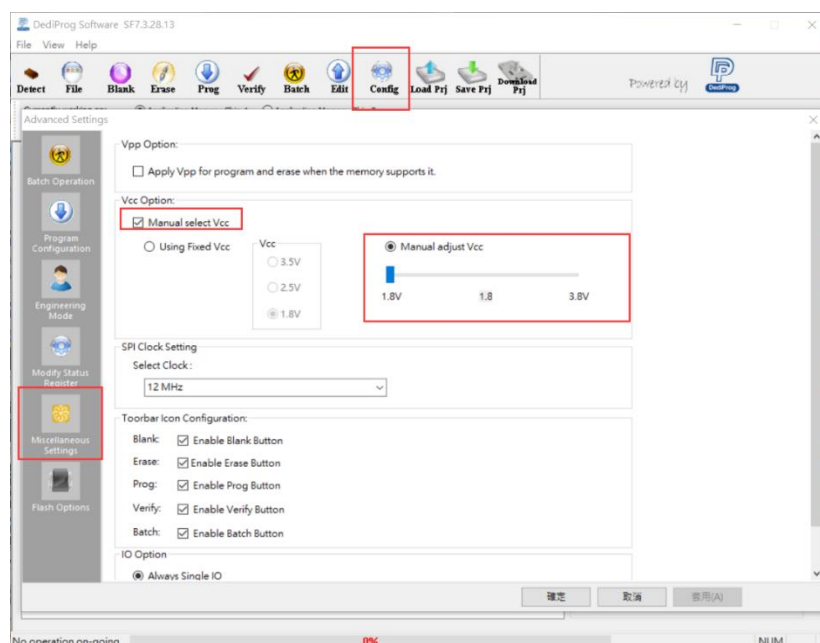
3.7 When the system startup is completed, does "Chipset" release the SPI Bus with high impedance?

**Please use an oscilloscope to measure the SPI Bus to see if there are any problems with the waveform:**

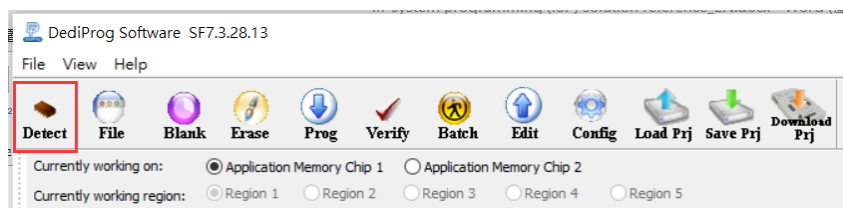
**Note:** The following uses Winbond W25Q16FW as a demonstration. The clock frequency is the default 12Mh.

3.8 Use an oscilloscope to measure whether the voltage of the SPI NOR Flash VCC Pin is normal during Detect.

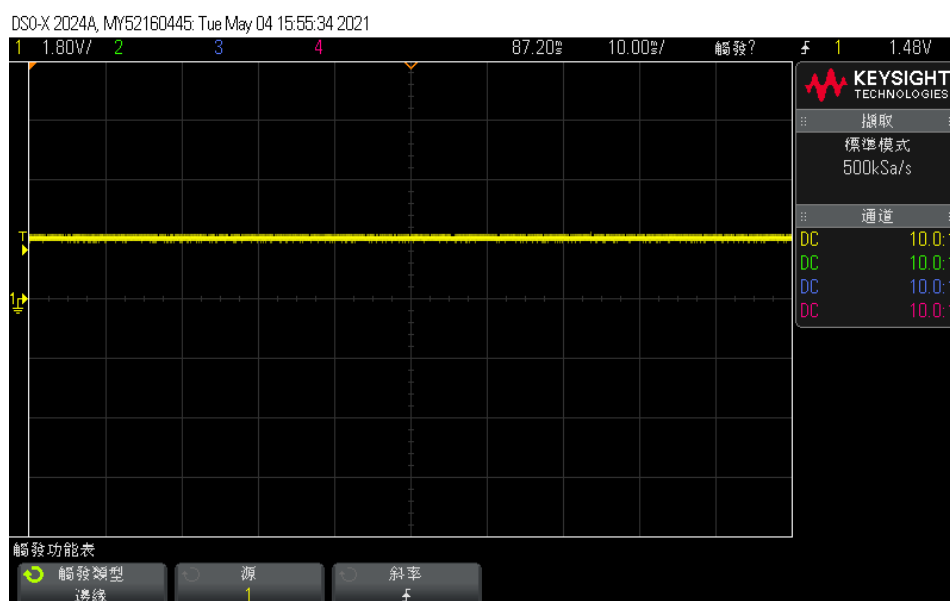
3.8.1 Click the Config button → Click the Miscellaneous Setting button → Click the Manual select Vcc button → Click the Manual adjust Vcc button to adjust the voltage supported by SPI NOR Flash. The voltage used by W25Q16FW is 1.8V.



### 3.8.2 Run Detect



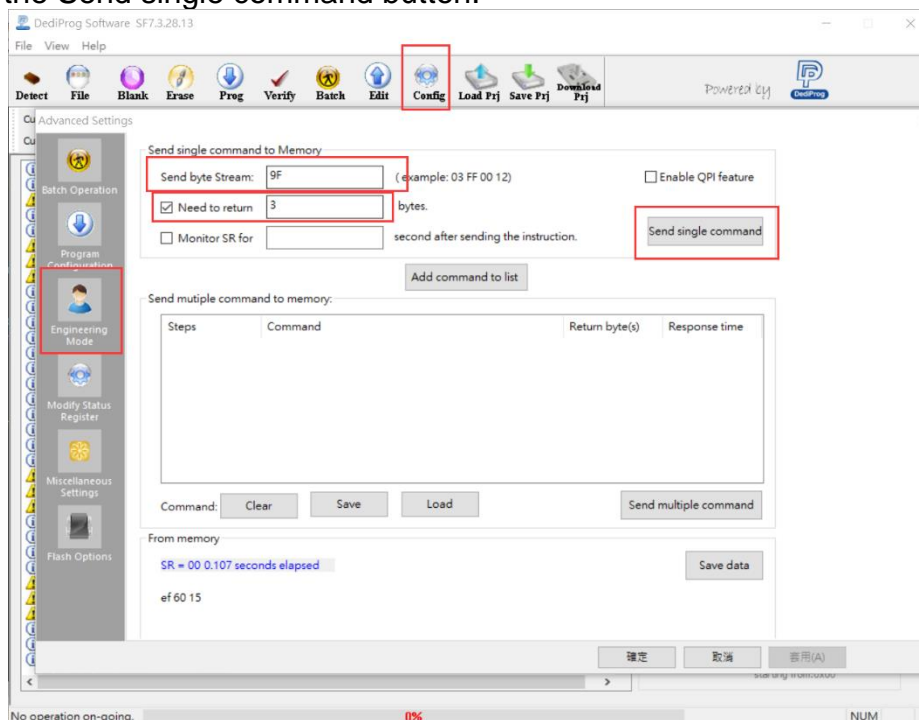
3.8.3 Observe the oscilloscope to measure whether the voltage of the VCC Pin of the SPI NOR Flash is normal during Detect Chip.



Above: The oscilloscope measures the SPI NOR Flash VCC Pin to be 1.8V, and the voltage is output normally.

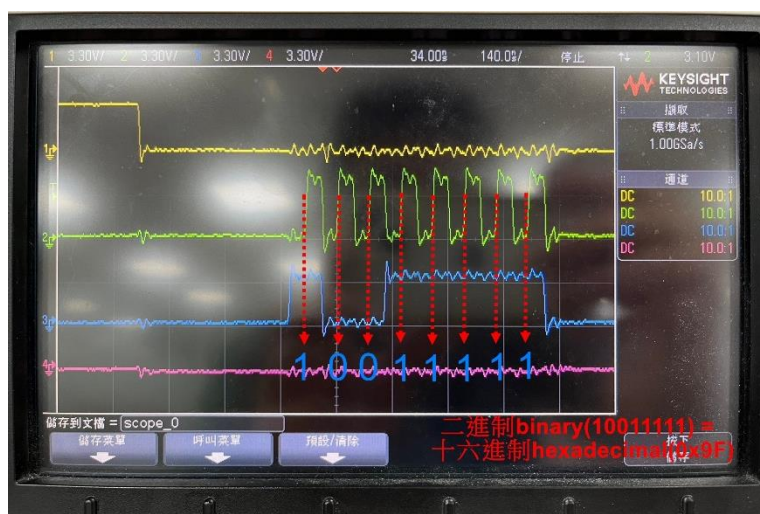
3.9 Use an oscilloscope to measure whether the waveforms of the I/O Pins CS, CLK, MOSI, and MISO of the SPI NOR Flash SPI Bus are normal when sending Read ID Command (9F).

3.9.1 Click the Config button→ Click the Engineering Mode button→ Send byte Stream: Enter Read ID Command (9F)→ Check Need to return and fill in the number 3→ Click the Send single command button.



3.9.2 Use the oscilloscope with edge triggering on MOSI crossing, trigger on the first MSOI output, and observe the following points:

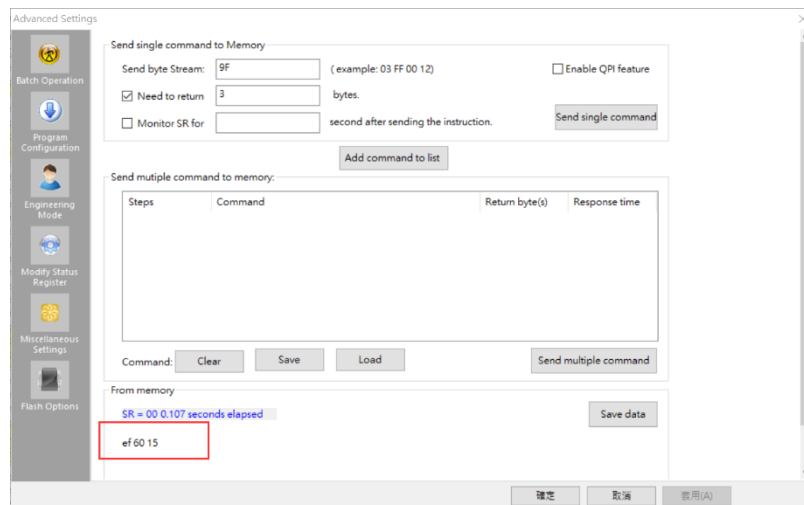
- (1) Is CS pulled low to 0V?
- (2) Are the CLK waveform and voltage normal?
- (3) Is the Read ID Command (9F) waveform output by MOSI correct?



Above: The oscilloscope measures the Read ID Command of the MOSI output as 9F, and the waveform is correct.

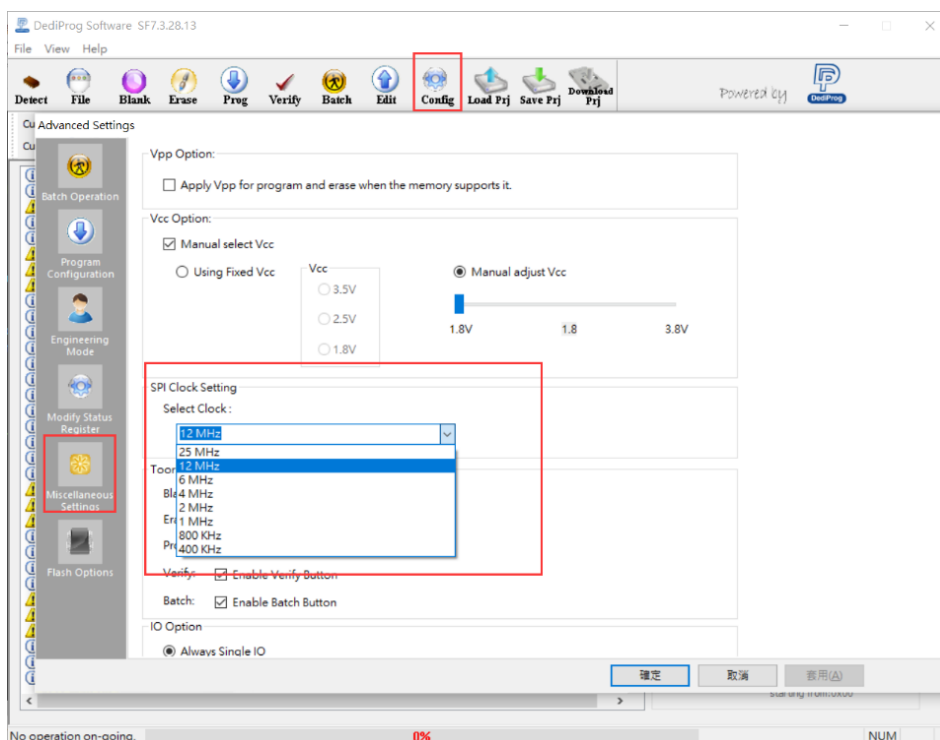


### 3.9.3 Is the ID retrieved by the software correct?



**Note:** The ID of Winbond W25Q16FW is EF 60 15. Please check the Datasheet of the IC you are using to find out the ID.

3.9.4 If the ID retrieval fails, try lowering the frequency step by step until you find the setting that allows successful ID reading.



## V. Provide Information to DediProg

If you need help, please provide the following information to DediProg.

1. Please provide a complete or partial circuit diagram of the board. Part of the circuit diagram should include:
  - (1) "Chipset" circuit diagram connected to SPI NOR Flash.
  - (2) Circuit diagram of the SPI NOR Flash.
  - (3) Circuit diagram of the header on the PCB.
2. How long is the cable/flying wire between the programmer and PCB?
3. Which connection method is used between the programmer and the PCB? Please describe the connection method and take a photo for reference.  
For example: SF600 → SF600 ISP Cable → The SPI NOR Flash on PCB
4. Please describe the pin assignment between the programmer and the PCB.
5. Is the "Chipset" on the PCB isolated to protect the programmer's SPI Bus from interference?
6. See "Updating Methods" in application document AN0103. Which method do you use to update the SPI NOR Flash on the board?
7. Does the "Chipset" have a reset/enable pin?
8. While the programmer is programming the SPI NOR Flash on the PCB, will the "Chipset" on the PCB also work? If "Chipset" also works, will "Chipset" interfere with the SPI Bus of the writer?
9. Is the power source of SPI NOR Flash powered by PCB or programmer?
10. Using off-line programming to program SPI NOR Flash, can the SPI NOR Flash be successfully detected? Or can the SPI NOR Flash be successfully programmed and verified?
11. Use an oscilloscope to measure the voltage of the VCC Pin of the SPI NOR Flash during Detect Chip. Is it normal? Please provide the measured waveform diagram.
12. Use an oscilloscope to measure the I/O pins of CS, CLK, MOSI, and MISO of the SPI NOR Flash SPI Bus. Are the waveforms normal when sending Read ID Command (9F)? Please provide the measured waveform diagram.
13. Can you provide us with programming files for testing?



## VI. Revision History

Date	Version	Description
2021/08/24	1.0	Initial release.
2022/05/04	1.1	Added the first chapter "Name Interpretation ". Adjusted the text and sequence of steps in Chapter 3 "In-system programming (ISP) Solution Reference".
2022/07/18	1.2	Modified the second description in chapter II.
2023/11/23	1.3	Added new chapters and optimized arrangement order.

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