Application Notes on Using NX1 EF Series ICs with SPI Flash

Description: Recommended Power Configuration and Wiring Instructions for Using SPI Flash with NX1 EF Series ICs.

Reason：

1. Power configuration

In common applications, the input power source is 3 or 2 batteries, corresponding to voltages of 4.5V and 3V respectively. When using 3 batteries, the NX12FS / NX13FS series ICs can be directly powered by the batteries, with the suggested configuration shown in Figure 1. The NX11FS2x series, however, requires an external LDO (Low Dropout Regulator) device to provide stable system power, with the suggested configuration shown in Figure 1-1. When using 2 batteries, power can be supplied directly to the system, with the suggested configurations shown in Figures 2 and 2-1. Compared to the NX12FS / NX13FS series, the NX11FS2x series does not have a built-in SPI LDO power supply. Therefore, when using SPI Flash, power cannot be supplied through the SPI LDO and must be provided directly by an external LDO device or external power source, with the suggested configurations shown in Figures 1-1 and 2-1. Furthermore, to save system cost in 3-battery applications, the power for the NX11FS2x can be directly input from the batteries, and the power for the SPI Flash can be supplied by stepping down the battery output through a diode with a higher VF (approximately 0.6V) to avoid potential reliability issues caused by high voltage. The suggested configuration for this is shown in Figure 3.

2. External SPI Flash circuity configuration

According to the settings in NYIDE / Q-Code, the NX1 EF series IC will automatically determine whether the power supply for SPI0 and SPI1 communication ports is provided by SPI0_VDD or VDD. External circuitry needs to be adjusted accordingly to avoid hardware abnormalities caused by potential mismatch.

Please refer to Table 1 for the SPI0 configuration in NYIDE / Q-Code, and Table 6 for the SPI1 configuration.

The recommended power configurations

[Configuration 1]

In 3-battery applications, power is supplied by using an external LDO power supply shared by the entire system.

NX12FS / NX13FS series-- IC VDD: VDD; SPI Flash VDD: SPI0 VDD.

NX11FS2x series-- IC VDD: LDO; SPI Flash VDD: LDO.

3-battery applications	
NX12FS / NX13FS series	NX11FS2x series

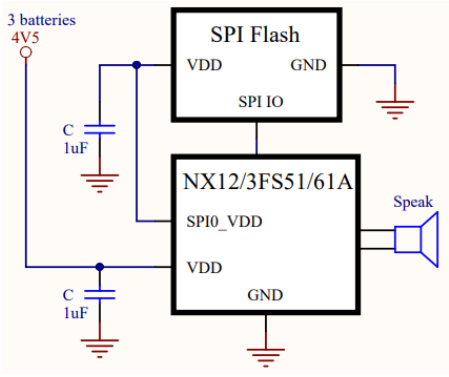
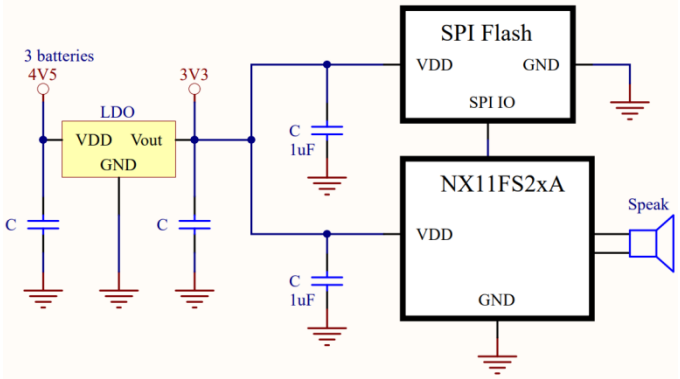

	

Figure 1	Figure 1-1

[Configuration 2]

2-battery applications can be directly powered by batteries -

NX12FS / NX13FS series-- IC VDD: VDD; SPI Flash VDD: SPI0 VDD。

NX11FS2x series -- IC VDD: VDD; SPI Flash VDD: VDD。

2-battery applications	
NX12FS / NX13FS series	NX11FS2x series

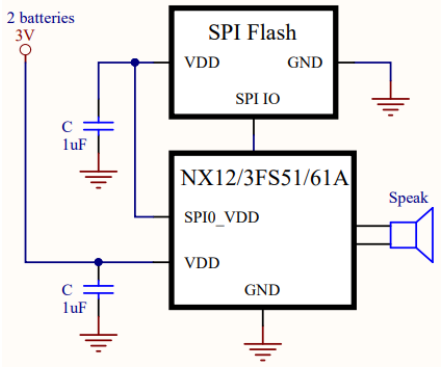
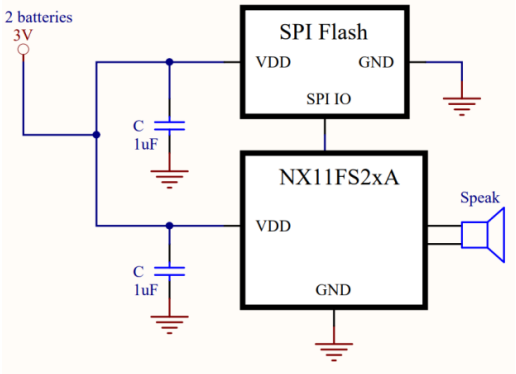

	

Figure 2	Figure 2-1

[Configuration 3]

To save power from the LDO, in a 3-battery application, the NX11FS2x can be directly powered by these batteries. However, an additional diode with a higher VF (approximately 0.6V) needs to be selected to step down the battery output voltage to supply the SPI Flash, thus avoiding potential reliability issues caused by high voltage. This method still may not fully comply with the SPI Flash specifications, and users need to make their own judgment and bear the possible risks. Furthermore, due to the voltage difference between the NX11FS2x and the SPI Flash, there might be transmission concerns caused by level shifting and potential leakage current during communication. These factors must also be considered during use.

NX11FS2x series-- IC VDD: VDD; SPI Flash VDD: VDD-1Diode.

3-battery application with diode
NX11FS2x series

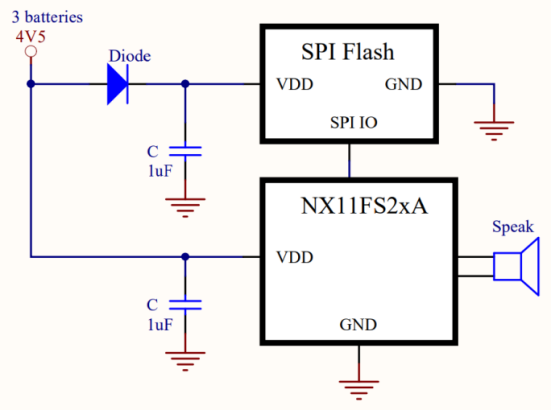
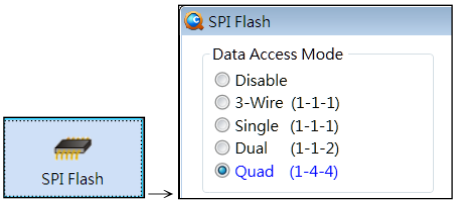



Figure 3

External SPI Flash Configuration:

[NYIDE / Q-Code SPI0 Configuration]

Depending on the chosen settings, the SPI Flash wiring method can be categorized into three-wire communication / Single / Dual / Quad mode.

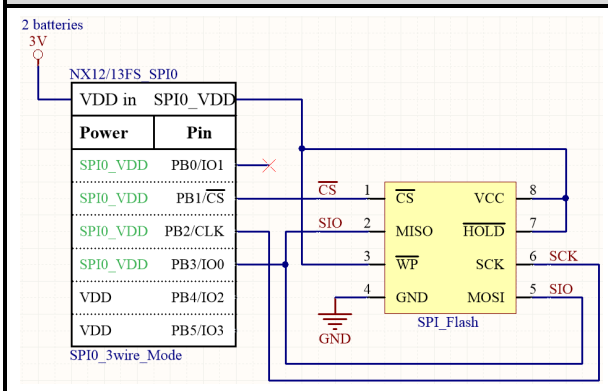
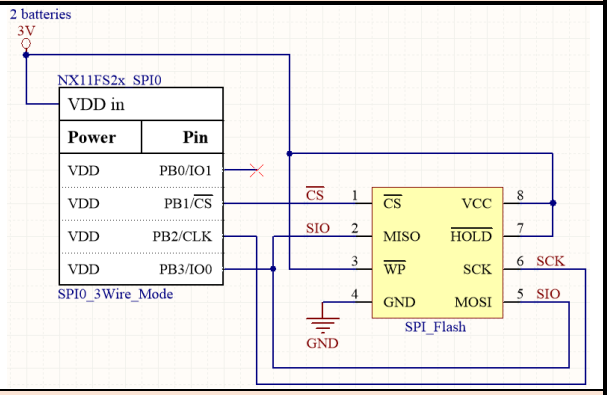
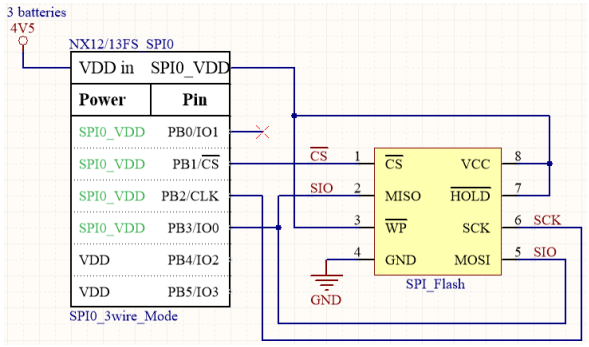
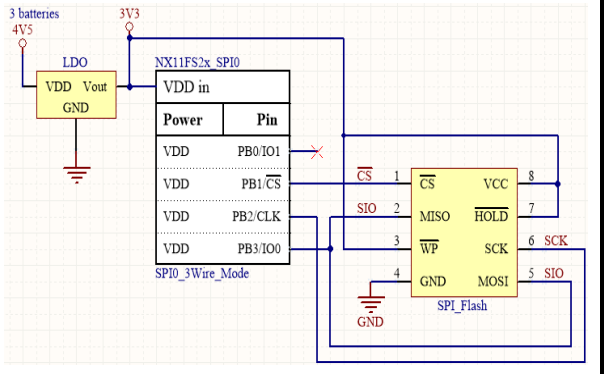
<table>
<tr><td>Table 1</td><td colspan="4">SPI0 Setting</td></tr>
<tr><td rowspan="3">Setup</td><td colspan="2">NYIDE</td><td colspan="2">Q-Code</td></tr>
<tr><td colspan="2">Project path)…\src\nx1_config.h
674 #define _SPI_MODULE ENABLE
675 #if _EF_SERIES
676 #define _SPI_ACCESS_MODE SPI_1_4_4_MODE
677 #else</td><td colspan="2">Option → SPI Flash → Data Access Mode
  </td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td rowspan="2">SPI0
Mode</td><td colspan="2">_SPI_MODULE</td><td colspan="2">Data Access Mode</td></tr>
<tr><td>DISABLE</td><td>ENABLE</td><td>DISABLE</td><td>ENABLE</td></tr>
</table>

setting	**_SPI_ACCESS_MODE**		
	Disable	**_SPI_ACCESS_MODE** options: SPI_1_1_1_MODE_3WIRE: three-wire communication SPI_1_1_1_MODE: Single mode SPI_1_1_2_MODE: Dual mode SPI_1_2_2_MODE: Dual mode SPI_1_4_4_MODE: Quad mode	Disable	**Data Access Mode** options: 3-Wire (1-1-1): three-wire communication Single (1-1-1): Single mode Dual (1-1-2): Dual mode Quad(1-4-4): Quad mode
	The SPI0 communication port will automatically adjust the voltage source based on **_SPI_MODULE** and **_SPI_ACCESS_MODE**.		Q-Code will automatically adjust the voltage source of the SPI0 communication port based on the **Data Access Mode** setting.

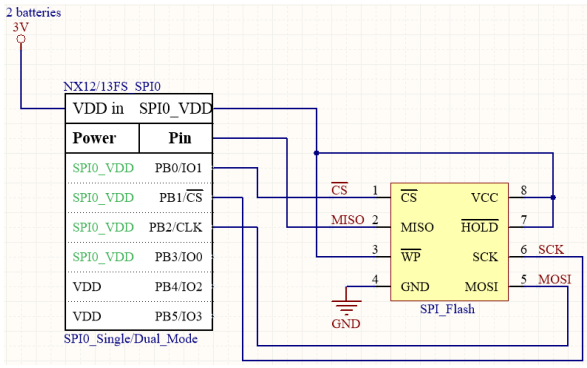
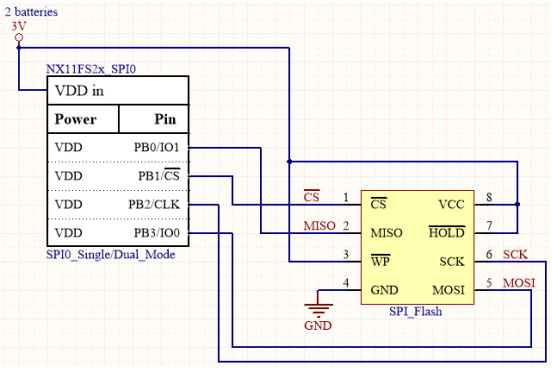
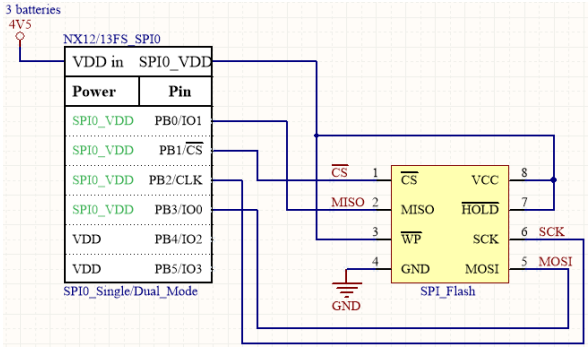
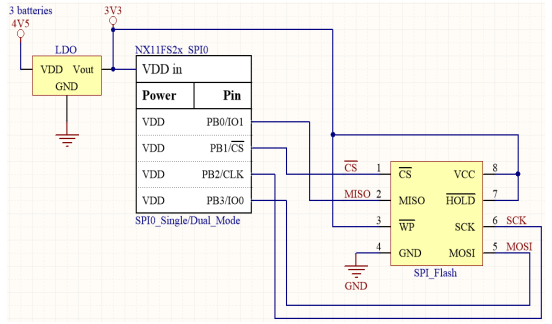
[SPI0 Disable Device]

Table 2	**SPI0 Disable**	
	NX12FS / NX13FS series	NX11FS2x series
SPI0 Flash 接線配置	NX12/13FS_SPI0 VDD in SPI0_VDD **Power** / **Pin** VDD PB0/IO1 VDD PB1/$\overline{CS}$ VDD PB2/CLK VDD PB3/IO0 VDD PB4/IO2 VDD PB5/IO3	NX11FS2x_SPI0 VDD in **Power** / **Pin** VDD PB0/IO1 VDD PB1/$\overline{CS}$ VDD PB2/CLK VDD PB3/IO0
Remarks	※PB0 ~ PB5 are powered by SPI0_VDD and can be converted as GPIO.	NX11FS2x series doesn't have a SPI0 LDO.

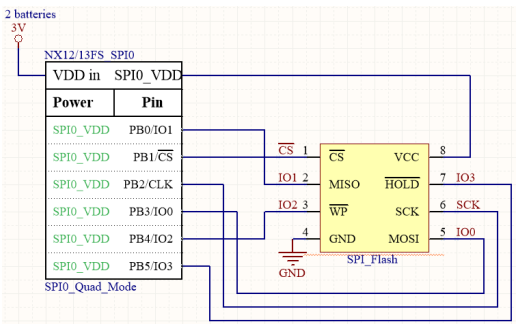
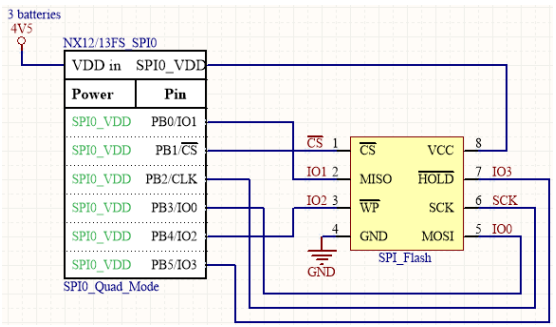
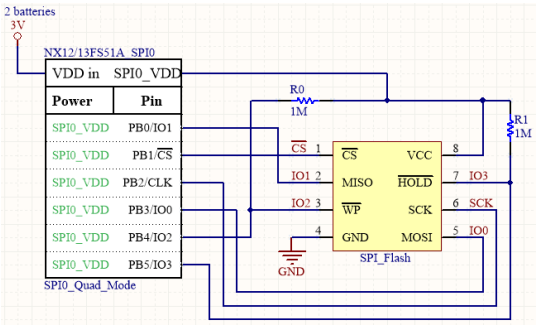
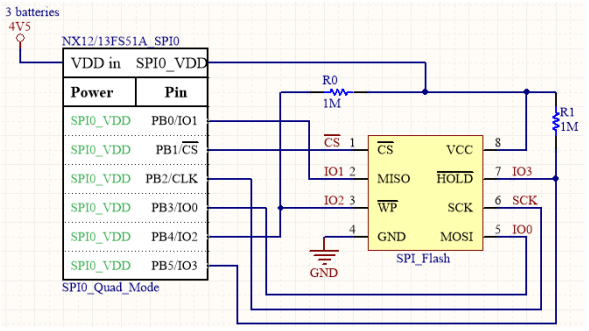
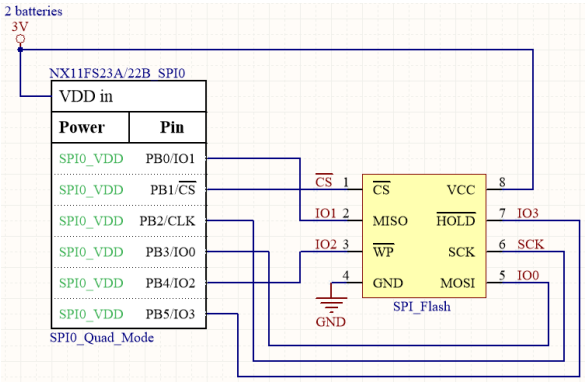
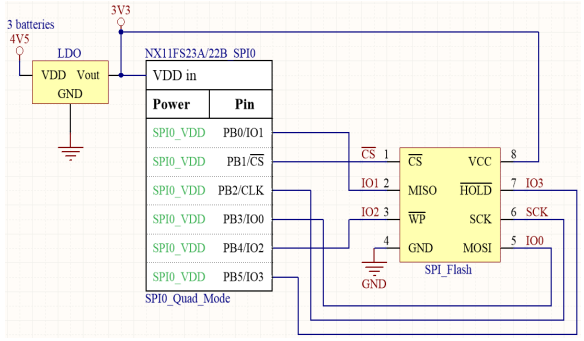
[SPI0 3-wire communication setup]

<table>
<tr><th>Table 3</th><th colspan="2">SPI0 3-wire communication</th></tr>
<tr><td rowspan="4">SPI0 Flash Configuration</td><td>NX12FS / NX13FS series-VDD=3V</td><td>NX11FS2x series -VDD=3V</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>NX12FS / NX13FS series -VDD=4.5V</td><td>NX11FS2x series -VDD=4.5V</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Remarks</td><td>※PB0 ~ PB3 are powered by SPI0_VDD.
※Note the voltage level when using PB0, it is recommended to reserve this pin and not use it:
1. If set as Input, the internal pull-up resistor will be ineffective, and PB0 cannot be used to wake up the IC during sleep.
2. If set as Output, in addition to noting the potential, the output will also stop during IC sleep.
※PB4 / PB5 are powered by VDD and can be converted as GPIO.</td><td>The NX11FS2x series does not have an SPI LDO power supply; PB0~PB3 are powered by VDD.</td></tr>
</table>

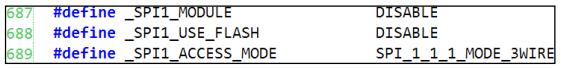
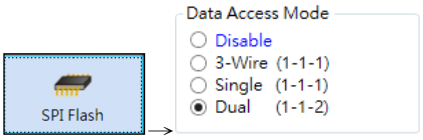
[SPI0 Single/Dual mode setup]

Table 4	SPI0 Single/Dual mode communication	
SPI0 Flash Configuration	NX12FS / NX13FS series -VDD=3V	NX11FS2x series -VDD=3V
		
	NX12FS / NX13FS series-VDD=4.5V	NX11FS2x series-VDD=4.5V
		
Remarks	※PB0 ~ PB3 are powered by SPI0_VDD. ※PB4 / PB5 is powered by VDD and can be converted as GPIO.	NX11FS2x series doesn't have a SPI LDO, PB0~PB3 are powered by VDD.

[SPI0 Quad mode setup]

<table>
<tr><th>Table 5</th><th colspan="2">SPI0 Quad mode</th></tr>
<tr><td rowspan="2">SPI0 Flash Configuration</td><td>NX12FS / NX13FS series-VDD=3V</td><td>NX12FS / NX13FS series -VDD=4.5V</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Remarks</td><td colspan="2">※PB0 ~ PB5 are powered by SPI0_VDD.</td></tr>
<tr><td rowspan="2">SPI0 Flash Configuration</td><td>NX12FS / NX13FS51A series -VDD=3V</td><td>NX12FS / NX13FS51A series -VDD=4.5V</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Remarks</td><td colspan="2">※For proper writing mode operation with NX12FS51A and NX13FS51A, PB4 and PB5 must have pull-up resistors. Refer to AP-27 for details.
※PB0 ~ PB5 are powered by SPI0_VDD.</td></tr>
<tr><td rowspan="2">SPI0 Flash Configuration</td><td>NX11FS23A/22B series -VDD=3V</td><td>NX11FS23A/22B series -VDD=4.5V</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Remarks</td><td colspan="2">※PB0 ~ PB5 are powered by SPI0_VDD.
※NX11FS20/21/2HA doesn’t have PB4&PB5 and Quad mode.</td></tr>
</table>

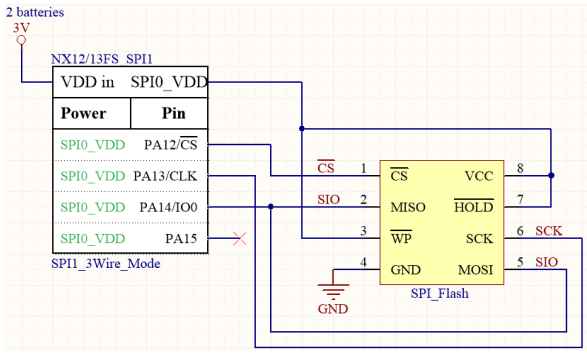
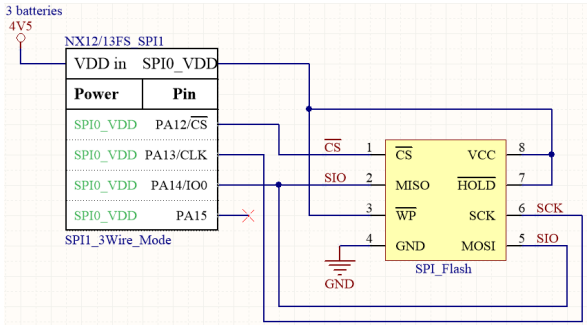
[NYIDE / Q-Code SPI1 setup] Depending on the user's selected settings, the SPI Flash wiring method can be configured for 3-wire communication, Single mode, or Dual mode.

<table>
<tr><th>Table 6</th><th colspan="3">SPI1 Setup</th></tr>
<tr><td>Setup</td><td>NYIDE</td><td colspan="2">Q-Code</td></tr>
<tr><td rowspan="5">SPI1 Mode Setting</td><td>專案路徑)…\src\nx1_config.h
 
</td><td colspan="2">Option → SPI Flash → Data Access Mode
 
</td></tr>
<tr><td>_SPI_MODULE</td><td colspan="2">Data Access Mode</td></tr>
<tr><td>DISABLE ENABLE
_SPI_ACCESS_MODE</td><td>DISABLE</td><td>ENABLE</td></tr>
<tr><td>Disable</td><td>_SPI_ACCESS_MODE options:
SPI_1_1_1_MODE_3WIRE: 3-wire communication
SPI_1_1_1_MODE: Single mode
SPI_1_1_2_MODE: Dual mode
SPI_1_2_2_MODE: Dual mode</td><td>Disable</td><td>Data Access Mode options:
3-Wire (1-1-1) : 3-wire communication
Single (1-1-1): Single mode
Dual (1-1-2): Dual mode</td></tr>
<tr><td>The SPI0 communication port will automatically adjust the voltage source based on _SPI_MODULE and _SPI_ACCESS_MODE.</td><td colspan="2">Q-Code will automatically adjust the voltage source of the SPI0 communication port based on the Data Access Mode setting.</td></tr>
</table>

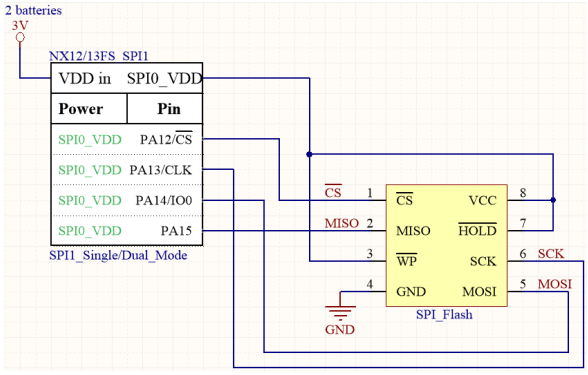
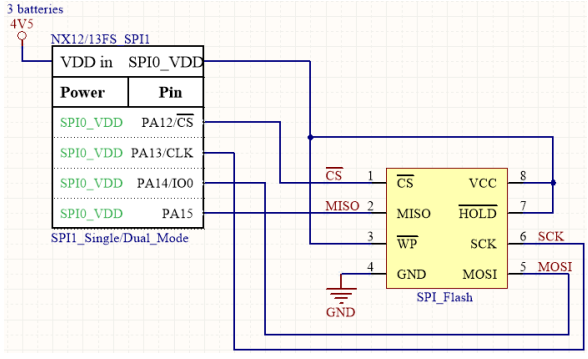
[SPI1 disable setup]

<table>
<tr><th>Table 7</th><th colspan="2">SPI1 Disable</th></tr>
<tr><td rowspan="2">SPI1 Flash Configuration</td><td>NX12FS / NX13FS series</td><td>NX11FS2x series</td></tr>
<tr><td>NX12/13FS SPI1
VDD in SPI0_VDD
Power | Pin
VDD | PA12/$\overline{CS}$
VDD | PA13/CLK
VDD | PA14/IO0
VDD | PA15</td><td>N/A</td></tr>
<tr><td>Remarks</td><td>※PA12 ~ PA15 are powered by VDD and can be converted as GPIO.</td><td>NX11FS2x series doesn't have the SPI communication function.</td></tr>
</table>

[SPI1 3-wire communication setup]

Table8	SPI1 3-wire communication	
	NX12FS / NX13FS series -VDD=3V	NX12FS / NX13FS series -VDD=4.5V
SPI1 Flash Configuration		
Remarks	※PA12 ~ PA15 are powered by SPI0_VDD. ※When using PA15, pay attention to the voltage level. It is recommended to leave it as a reserved pin and not use it 1. If configured as Input, the internal pull-up resistor will be disabled, and PA15 cannot be used for wake-up during IC sleep. 2. If configured as Output, in addition to paying attention to the voltage level, the output will also stop during IC sleep.	

[SPI1 Single/Dual mode setup]

Table 9	SPI1 Single/Dual mode	
	NX12FS / NX13FS series -VDD=3V	NX12FS / NX13FS series VDD=4.5V
SPI1 Flash Configuration		
Remarks	※PA12 ~ PA15 are powered by SPI0_VDD.	