

NuMicro[®] NUC126 Series NuMaker-PFM-NUC126 Kit User Manual

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1 OVERVIEW

This user manual is aimed to give users a fast introduction for using the NuMaker-PFM-NUC126 kit. NuMaker-PFM-NUC126 kit includes three portions. Mother board called NuMaker-PFM-NUC126, debug adaptor called Nu-Link-Me and daughter board called NuTFT-SPI_320x240.

NuMaker-PFM-NUC126 mother board is the specific development tool for NuMicro® NUC126 series. Users can use NuMaker-PFM-NUC126 mother board to develop and verify the application program easily.

NuTFT-SPI_320x240 daughter board is equipped with touch screen, LCD panel, joystick and two push buttons for user develop and verify some special feature. Besides, the pin arrangement of NuTFT-SPI_320x240 daughter board is compatible with Arduino UNO. The driver IC of LCD panel is ILI9341, for the detailed information please refers to the ILI9341 datasheet.

By this platform, user does not need additional ICE or debug equipment for developing.

1.1 NuMaker-PFM-NUC126 Kit Introduction

NuMaker-PFM-NUC126 kit includes three portions. Mother board called NuMaker-PFM-NUC126, debug adaptor called Nu-Link-Me and daughter board called NuTFT-SPI_320x240.

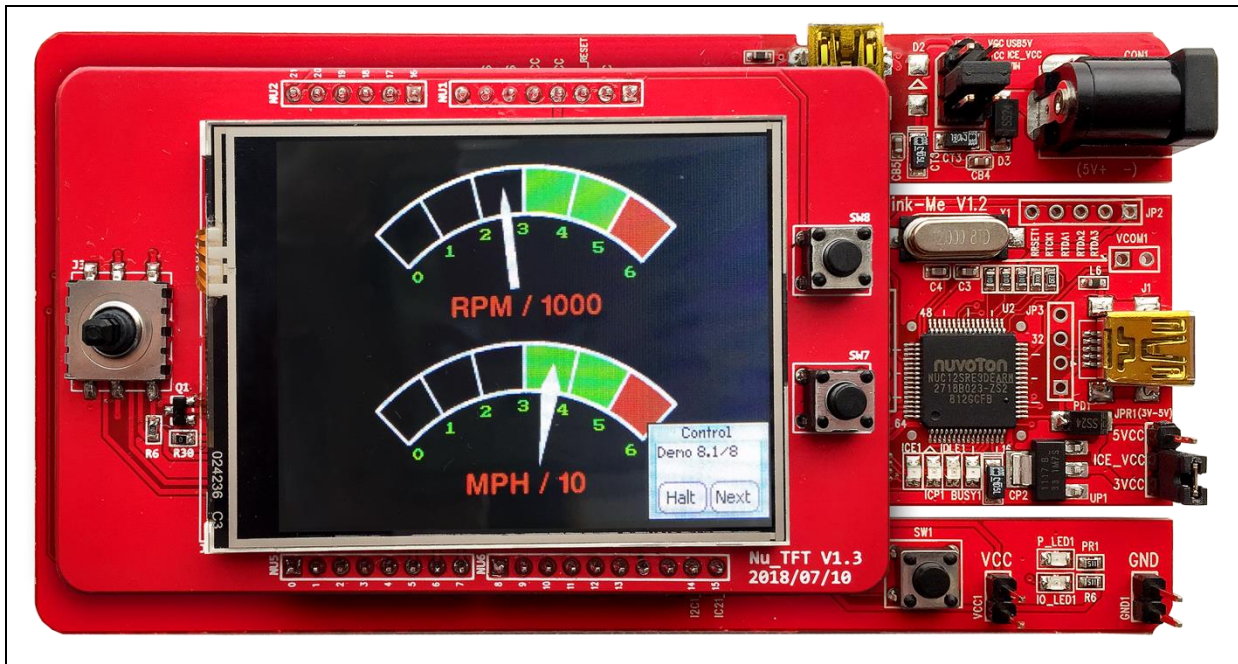


Figure 1-1 NuMaker-PFM-NUC126 Kit

1.2 NuMaker-PFM-NUC126 Mother Board Introduction

NuMaker-PFM-NUC126 mother board is equipped with NUC126VG4AE as target microcontroller. Figure 1-2 is NuMaker-PFM-NUC126 mother board. The left portion is called NuMaker-PFM-NUC126 and the right portion is debug adaptor called Nu-Link-Me.

Users can develop and verify applications to emulate the real behavior by NuMaker-PFM-NUC126 mother board. And the chip, NUC126VG4AE covers all of the features of NUC126 series. The NuMaker-PFM-NUC126 mother board can be a real system controller for designing target systems.

Nu-Link-Me is a debug adaptor. The Nu-Link-Me debug adaptor connects USB port of PC to the target system (via Serial Wired Debug Port) and allows to program and debug embedded programs on target hardware. To use Nu-Link-Me debug adaptor with IAR or Keil, please refer to “Nuvoton NuMicro® IAR ICE driver user manual” or Nuvoton NuMicro® Keil ICE driver user manual” in detail. When user installs each driver, these two documents will show in folder that user installed.

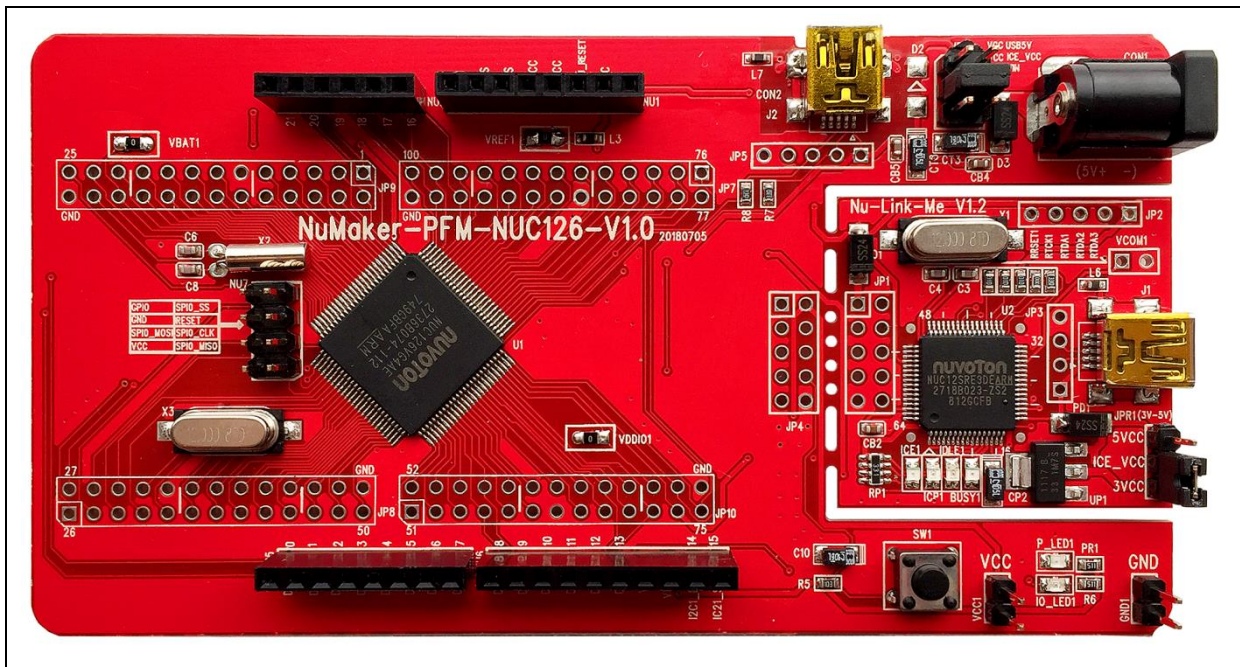


Figure 1-2 NuMaker-PFM-NUC126 Mother Board

1.3 NuTFT-SPI_320x240 Daughter Board Introduction

NuTFT-SPI_320x240 daughter board is equipped with touch screen, LCD panel, joystick and two push buttons for developing and verifying some special feature. Besides, the pin arrangement of NuTFT-SPI_320x240 daughter board is compatible with Arduino UNO.

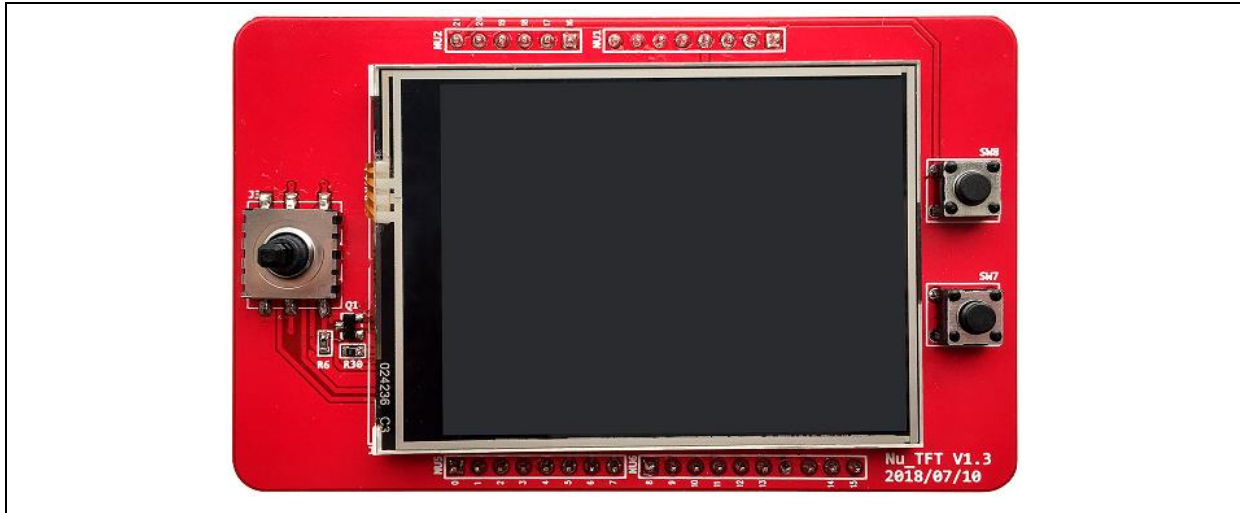


Figure 1-3 NuTFT-SPI_320x240 Daughter Board

1.4 NuMaker-PFM-NUC126 Kit Features

- 32-bit Cortex-M0 NUC126VG4AE
- CPU Speed up to 72 MHz
- 256KB Flash / 20KB SRAM
- 2.4" (320x240) SPI mode LCD Panel
- Five Direction Joystick
- 4-Wire ADC Touch Screen
- Arduino UNO Compatible Interface

2 NUMAKER-PFM-NUC126 MOTHER BOARD

2.1 NuMaker-PFM-NUC126 Mother Board Overview

Figure 2-1 shows the main components and connectors of NuMaker-PFM-NUC126 mother board.

The following lists components and connectors:

- Nu-Link-Me V1.2 (ICE debugger) :
 - ICE Controller NUC12SRE3DE (ICE_U2)
 - USB connector (ICEJ1) to PC Host
 - ICE power selector (JPR1) VCC 3.3V / 5V
- NuMaker-PFM-NUC126 :
 - Target Chip: NUC126VG4AE (U1)
 - Extended Interface Connectors (JP7, JP8, JP9 and JP10)
 - USB Connector (J2)
 - LEDs (P_LED1 and IO_LED1)
 - Power Jack (CON1)
 - Reset Key (SW1)
 - Arduino UNO Compatible Interface Connectors (NU1, NU2, NU5, NU6 and NU7)

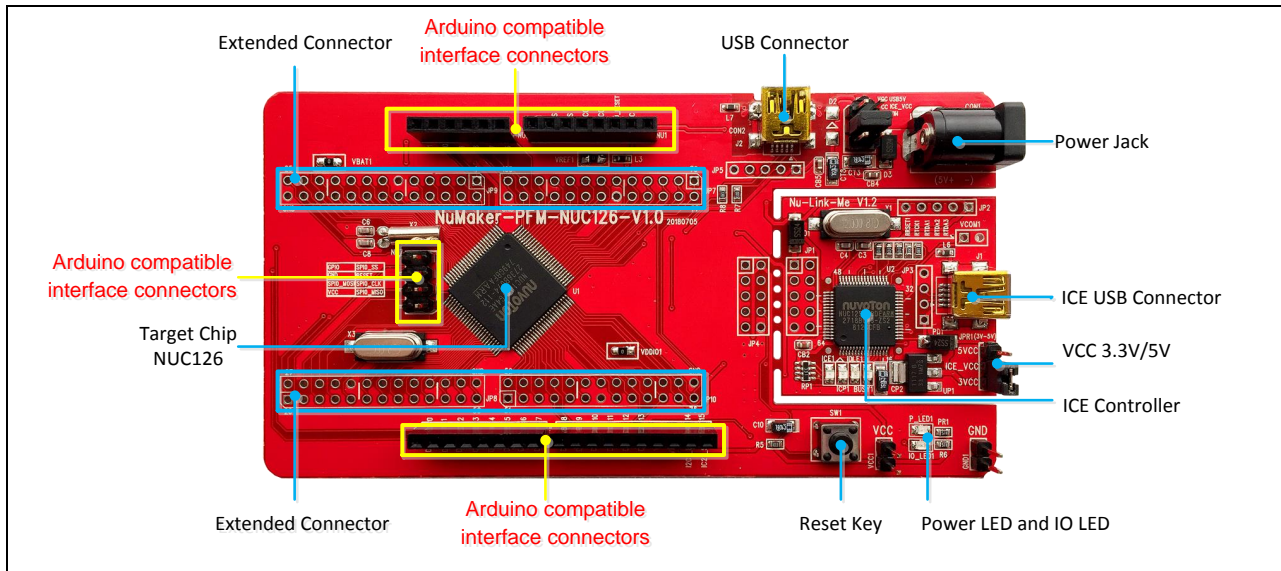


Figure 2-1 Front View of NuMaker-PFM-NUC126 Mother Board



2.2 Pin Assignment for Extended Connectors

The NuMaker-PFM-NUC126 mother board is equipped with the target chip, NUC126VG4AE and extended connectors (JP7, JP8, JP9 and JP10) for LQFP100-pin. The Figure 2-2 shows the NUC126VG4AE extended connectors.

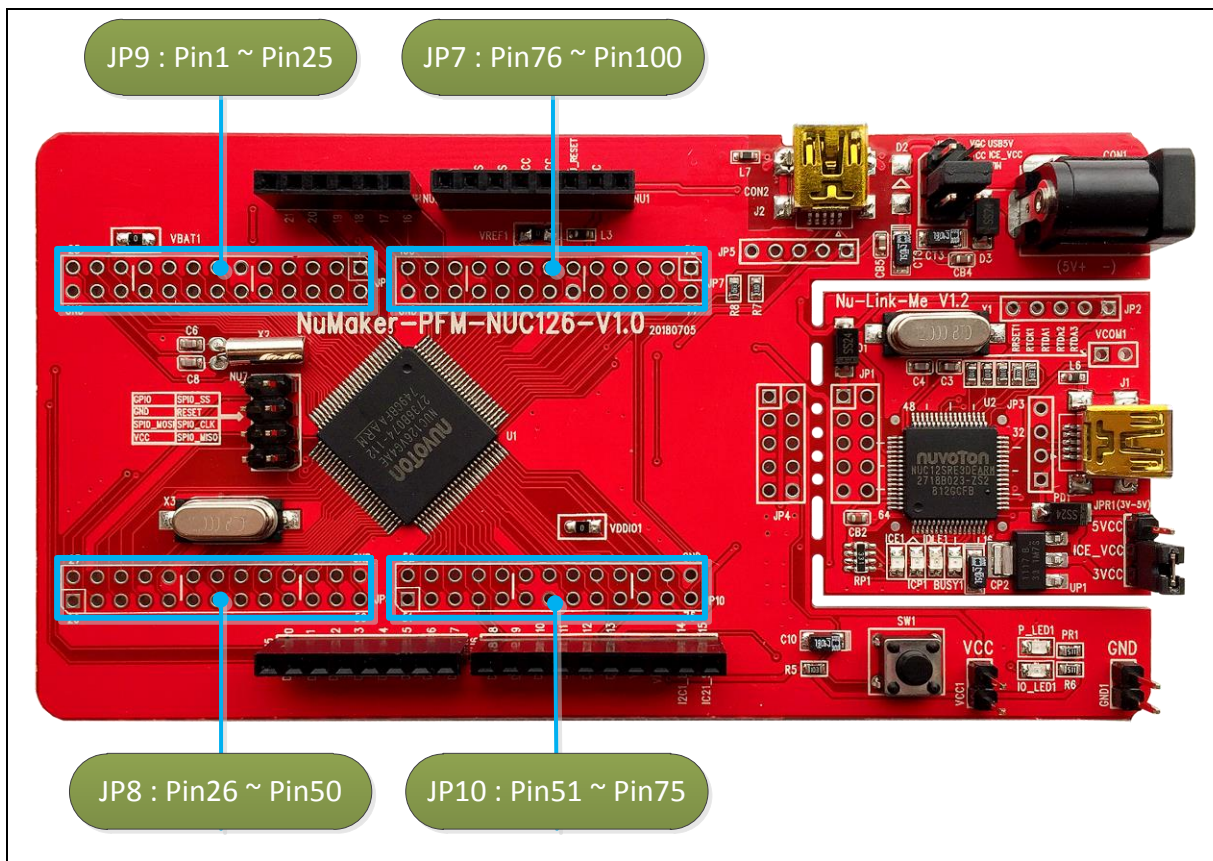


Figure 2-2 NuMaker-PFM-NUC126 Mother Board Extended Connectors

Table 2-1 Extended Connector JP9 Interface with NUC126VG4AE GPIO

Header	NUC126VG4AE		Header	NUC126VG4AE	
	Pin No.	Function		Pin No	Function
JP9	1	PB.13	JP9	14	PD.9
	2	PB.14		15	PD.1
	3	PB.15		16	PD.2
	4	PB.5		17	PD.3
	5	PB.6		18	PD.4
	6	PB.7		19	PD.5
	7	nRESET		20	PE.3
	8	PD.0		21	PD.6
	9	AV _{SS}		22	V _{BAT}
	10	V _{DD}		23	PF.0
	11	V _{SS}		24	PF.1
	12	PC.8		25	PF.2
	13	PD.8			

Table 2-2 Extended Connector JP8 Interface with NUC126VG4AE GPIO

Header	NUC126VG4AE		Header	NUC126VG4AE	
	Pin No.	Function		Pin No	Function
JP8	26	PD.10	JP8	39	PC.10
	27	PD.11		40	PC.11
	28	PD.12		41	PC.12
	29	PD.13		42	PC.13
	30	PD.14		43	PC.14
	31	PD.15		44	PC.0
	32	PD.7		45	PC.1
	33	PF.3		46	PC.2
	34	PF.4		47	PC.3
	35	V _{SS}		48	PC.4
	36	V _{DD}		49	PE.0
	37	LDO_CAP		50	PC.5
	38	PC.9			

Table 2-3 Extended Connector JP10 Interface with NUC126VG4AE GPIO

Header	NUC126VG4AE		Header	NUC126VG4AE	
	Pin No.	Function		Pin No	Function
JP10	51	PC.6	JP10	64	V _{DD}
	52	PC.7		65	PE.1
	53	PE.4		66	PE.8
	54	PE.5		67	PE.9
	55	ICE_CLK		68	PE.10
	56	ICE_DAT		69	PE.11
	57	PA.8		70	PE.12
	58	PA.9		71	PE.13
	59	PA.7		72	V _{DDIO}
	60	PA.6		73	USB_VBUS
	61	PA.5		74	USB_D-
	62	PA.4		75	USB_D+
	63	V _{SS}			

Table 2-4 Extended Connector JP7 Interface with NUC126VG4AE GPIO

Header	NUC126VG4AE		Header	NUC126VG4AE	
	Pin No.	Function		Pin No	Function
JP7	76	PF.7	JP7	89	AV _{DD}
	77	USB_VDD33_CAP		90	V _{REF}
	78	PB.12		91	PB.0
	79	PA.3		92	PB.1
	80	PA.2		93	PB.2
	81	PA.1		94	PB.3
	82	PA.0		95	PB.4
	83	PA.12		96	PB.8
	84	PA.13		97	PB.9
	85	PA.14		98	PB.10
	86	PA.15		99	PB.11
	87	V _{SS}		100	PE.2
	88	V _{DD}			

2.3 Arduino UNO Compatible Interface

Figure 2-3 shows the Arduino UNO compatible interface.

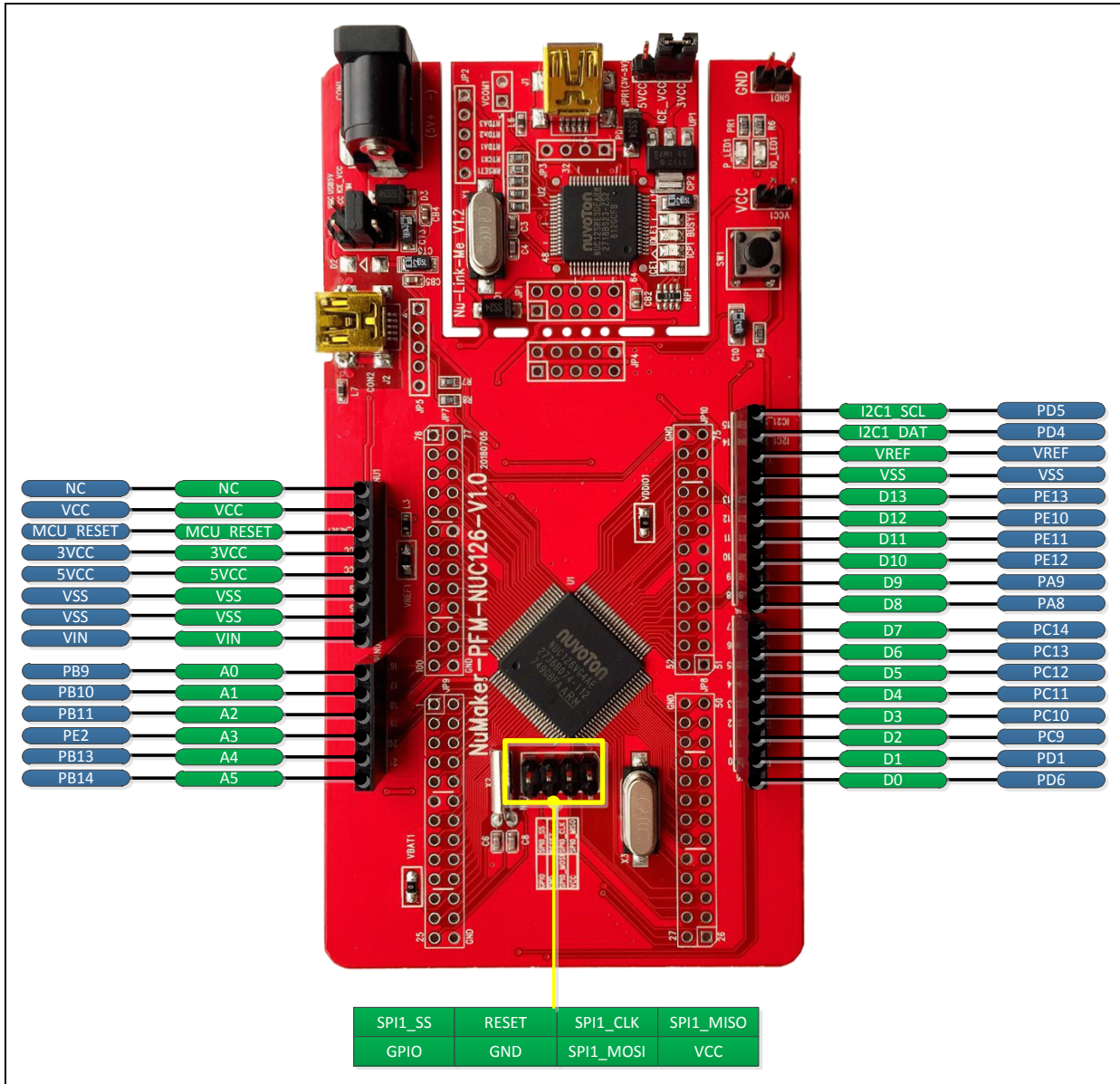


Figure 2-3 Arduino UNO Compatible Interface

Table 2-5 Arduino UNO Interface NU1 Mapping with NUC126VG4AE GPIO

Header	NuMaker-PFM-NUC126 Mother Board	
	Compatible to Arduino UNO	GPIO Pin of NUC126VG4AE
NU1	NC	-
	IOREF	
	RESET	RESET
	3VCC	-
	5VCC	
	GND	
	GND	
	VIN	

Table 2-6 Arduino UNO Interface NU2 Mapping with NUC126VG4AE GPIO

Header	NuMaker-PFM-NUC126 Mother Board			
	Compatible to Arduino UNO	GPIO Pin of NUC126VG4AE	Peripheral	
			ADC	PWM
NU2	A0	PB9	ADC0_CH6	
	A1	PB10	ADC0_CH7	
	A2	PB11	ADC0_CH8	
	A3	PE2	ADC0_CH9	PWM0_CH2
	A4	PB13	ADC0_CH10	
	A5	PB14	ADC0_CH11	

Table 2-7 Arduino UNO Interface NU5 Mapping with NUC126VG4AE GPIO

Header	NuMaker-PFM-NUC126 Mother Board						
	Compatible to Arduino UNO	GPIO Pin of NUC126VG4AE	Peripheral				
			PWM	SPI	UART	ADC	I ² C
NU5	D0	PD6	PWM0_CH5		UART0_RXD UART2_TXD		
	D1	PD1			UART0_TXD	ADC0_CH19	
	D2	PC9	PWM1_CH0				I2C1_SCL
	D3	PC10	PWM1_CH1	SPI0_MOSI			I2C1_SDA
	D4	PC11	PWM1_CH2	SPI0_MISO			
	D5	PC12	PWM1_CH3	SPI0_CLK			
	D6	PC13	PWM1_CH4	SPI0_SS			
	D7	PC14	PWM1_CH5				

Table 2-8 Arduino UNO Interface NU6 Mapping with NUC126VG4AE GPIO

Header	NuMaker-PFM-NUC126 Mother Board				
	Compatible to Arduino UNO	GPIO Pin of NUC126VG4AE	Peripheral		
			SPI	UART	I2C
NU6	D8	PA8	-	UART1_TXD	I2C1_SCL
	D9	PA9	-	UART1_RXD	I2C1_SDA
	D10	PE12	SPI1_SS SPI0_SS SPI1_MOSI	UART1_TXD	I2C0_SCL
	D11	PE11	SPI1_MOSI SPI0_MOSI SPI1_MISO	-	-
	D12	PE10	SPI1_MISO SPI0_MISO SPI1_CLK	-	-
	D13	PE13	SPI1_CLK SPI0_CLK SPI1_SS	UART1_RXD	I2C0_SDA
	VSS	-	-	-	-
	VREF	-	-	-	-

	I2C1_DAT	PD4	SPI1_CLK	-	I2C0_SDA
	I2C1_SCL	PD5	SPI1_MISO	-	I2C0_SCL

Table 2-9 Arduino UNO Interface NU7 Mapping with NUC126VG4AE GPIO

Header	NuMaker-PFM-NUC126 Mother Board		Header	NuMaker-PFM-NUC126 Mother Board	
	Compatible to Arduino UNO	GPIO Pin of NUC126VG4AE		Compatible to Arduino UNO	GPIO Pin of NUC126VG4AE
NU7	GPIO	PB12	NU7	GPIO_SS	PD12
	GND	GND		RESET	RESET
	SPI0_MOSI	PD13		SPI0_CLK	PD15
	VCC	VCC		SPI0_MISO	PD14

2.4 System Configuration

2.4.1 System Power Configure

There are six pins in JP6 and two power mode can be chosen.

Mode 1: Using jumper to short VCC and ICE_VCC.

VCC	USB5V
VCC	ICE_VCC
VCC	VIN

In mode 1, power source comes from J1 or CON2. User can plug the USB connector into J1 or CON2 to supply the power for NuMaker-PFM-NUC126 mother board.

Mode 2: Using jumper to short VCC and VIN.

VCC	USB5V
VCC	ICE_VCC
VCC	VIN

In mode 2, power source comes from CON1. User can plug the adaptor connector into CON1 to supply the power for NuMaker-PFM-NUC126 mother board.

Notice: There is no function when short VCC to USB5V, because the component, diode D2 is not place on NuMaker-PFM-NUC126 mother board.

2.4.2 5V Power Source

- **J1 (ICE):**
 - (1) Short the VCC to ICE_VCC on JP6
 - (2) Short the ICE_VCC to 5VCC on JPR1.
 - (3) Plug the USB connector into J1 to supply 5V power from PC host for NuMaker-PFM-NUC126 mother board.
- **CON2:**
 - (1) Short the VCC to ICE_VCC on JP6.
 - (2) Plug the USB connector into CON2 to supply 5V power from PC host for NuMaker-PFM-NUC126 mother board.
- **CON1(Power Jack):**
 - (1) Short the VCC to VIN on JP6.
 - (2) Plug the adaptor connector into CON1 to supply the power for NuMaker-PFM-NUC126 mother board.

Notice: Please do not short the ICE_VCC to 5VCC on JPR1 when you using the NUTFT-SPI_320X240 DAUGHTER BOARD.

The power of NUTFT-SPI_320X240 DAUGHTER BOARD comes from 3VCC and LCD panel is sourced by 3VCC. If user shorts the ICE_VCC to 5VCC on JPR1, the MCU will operate in 5V power domain. Hence, there is a short path between 3VCC and 5VCC from LCD panel to MCU. It will generate huge current in LCD panel and make its temperature increased quickly. Finally, the LCD panel will be chromatic polarization because of high temperature.

2.4.3 3.3V Power Source

- **J1 (ICE):**
 - (1) Short the VCC to ICE_VCC on JP6
 - (2) Short the ICE_VCC to 5VCC on JPR1.
 - (3) Plug the USB connector into J1 to supply 5V power from PC host for NuMaker-PFM-NUC126 mother board.
- **CON2:**
 - (1) Short the VCC to ICE_VCC on JP6.
 - (2) Plug the USB connector into CON2 to supply 5V power from PC host for NuMaker-PFM-NUC126 mother board.

2.4.4 USB Connectors

- **J1 (ICE):** Connect the USB connector (J1) to USB port of PC to program code, debug and supply power.
- **CON2:** USB connector on NuMaker-PFM-NUC126 mother board for USB application.

2.4.5 Arduino UNO Compatible Interface Connectors

- **NU1, NU2, NU5, NU6 and NU7:** Arduino UNO compatible pins on the NuMaker-PFM-NUC126 mother board.

2.4.6 Extended Connectors

- **JP7, JP8, JP9 and JP10:** Extended connectors interface pins on the NuMaker-PFM-NUC126 mother board.

2.4.7 Push-Buttons

- **SW1:** Reset button to reset the target chip on NuMaker-PFM-NUC126 mother board.

2.4.8 LEDs

- **POWER:** The power LED indicates that the NuMaker-PFM-NUC126 mother board is powered.
- **IO_LED1:** Only for application.

2.4.9 Power Connectors

- **CON1:** Power Jack connector on the NuMaker-PFM-NUC126 mother board.
- **VCC1:** V_{CC} connector on NuMaker-PFM-NUC126 mother board
- **GND1:** GND connector on NuMaker-PFM-NUC126 mother board

2.5 Nu-Link-Me

NuMaker-PFM-NUC126 mother board features a Nu-Link-Me ICE debugger and programmer, it supports user to program NUC126VG4AE and debug their application via SWD interface. Besides it can emulate a USB pen driver when connect to the PC, user can update their firmware by pulling bin file to the pen driver.

2.6 PCB Placement of NuMaker-PFM-NUC126 Mother Board

Figure 2-4 and Figure 2-5 show the front and back view placement of NuMaker-PFM-NUC126 mother board.

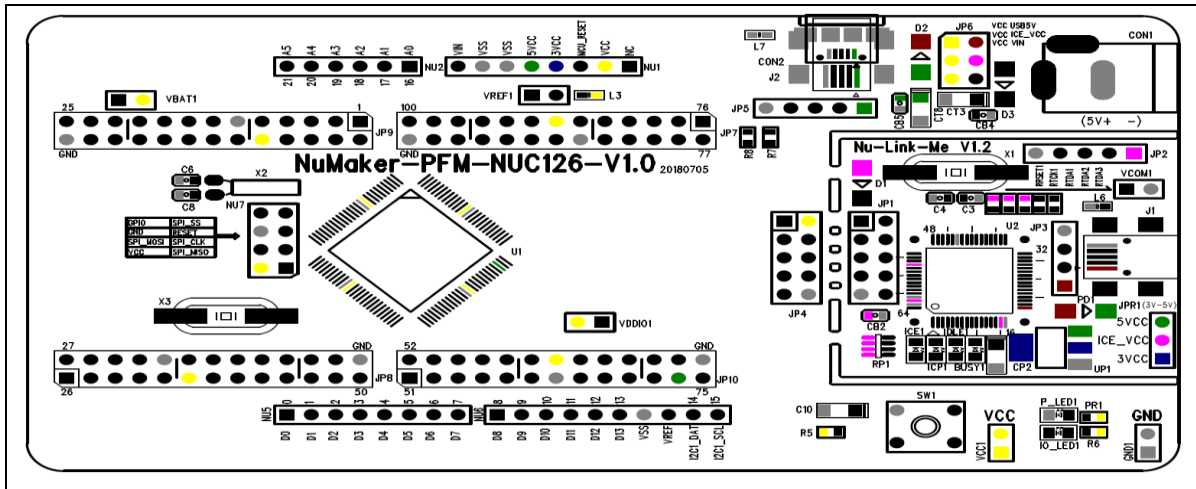


Figure 2-4 NuMaker-PFM-NUC126 Mother Board Placement - Front View

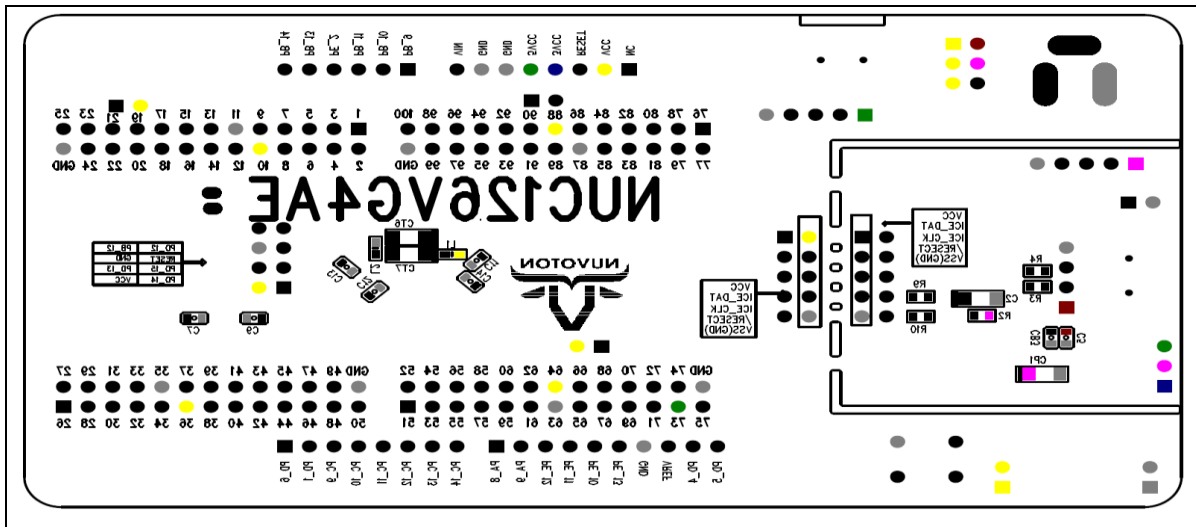


Figure 2-5 NuMaker-PFM-NUC126 Mother Board Placement - Back View

3 NUTFT-SPI_320X240 DAUGHTER BOARD

3.1 NuTFT-SPI_320x240 Daughter Board Overview

Figure 3-1 and Figure 3-2 shows the main components and connectors of NuTFT-SPI_320x240 daughter board.

The following lists components and connectors:

- Front View of NuTFT-SPI_320x240 Daughter Board :
 - Five Direction Joystick (J3)
 - Switch Button (SW7 and SW8)
 - TFT LCD and Touch Screen (J7)
 - Arduino Compatible Interface Connectors (NU1, NU2, NU5 and NU6)

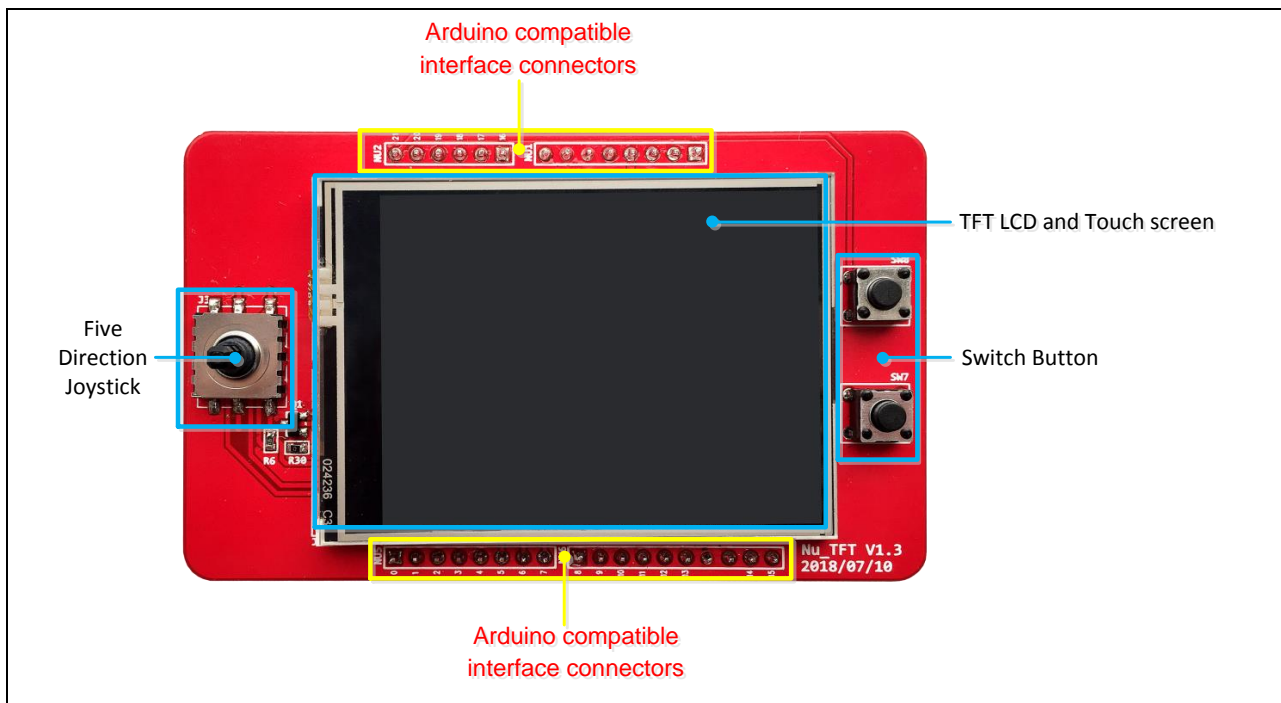


Figure 3-1 Front View of NuTFT-SPI_320x240 Daughter Board

- Back View of NuTFT-SPI_320x240 Daughter Board :
 - SPI Flash 16M-Bit (2 MBytes) (U1)
 - Arduino Compatible Interface Connectors (NU1, NU2, NU5, NU6 and NU7)

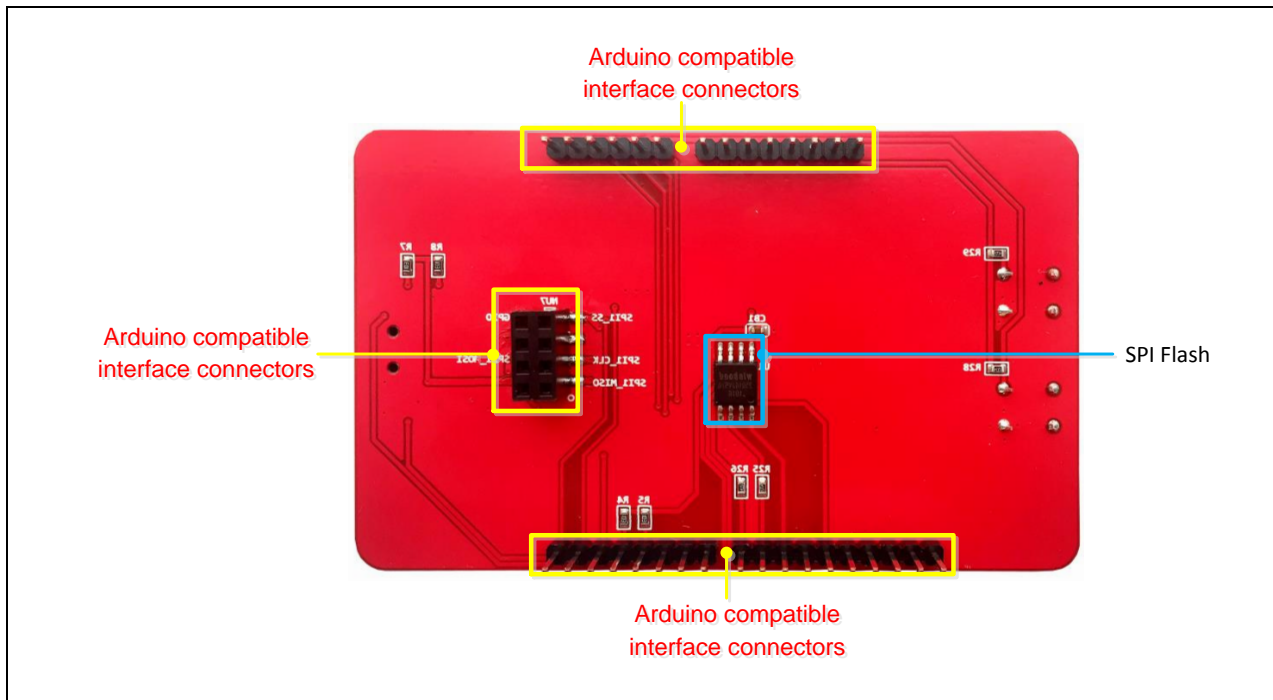


Figure 3-2 Back View of NuTFT-SPI_320x240 Daughter Board

3.2 Pin Assignment for NuTFT-SPI_320x240 Daughter Board

NuTFT-SPI_320x240 daughter board is equipped with touch screen, LCD panel, joystick and two push buttons for user developing and verifying some special feature. Besides, the pin arrangement of NuTFT-SPI_320x240 is compatible with Arduino UNO.

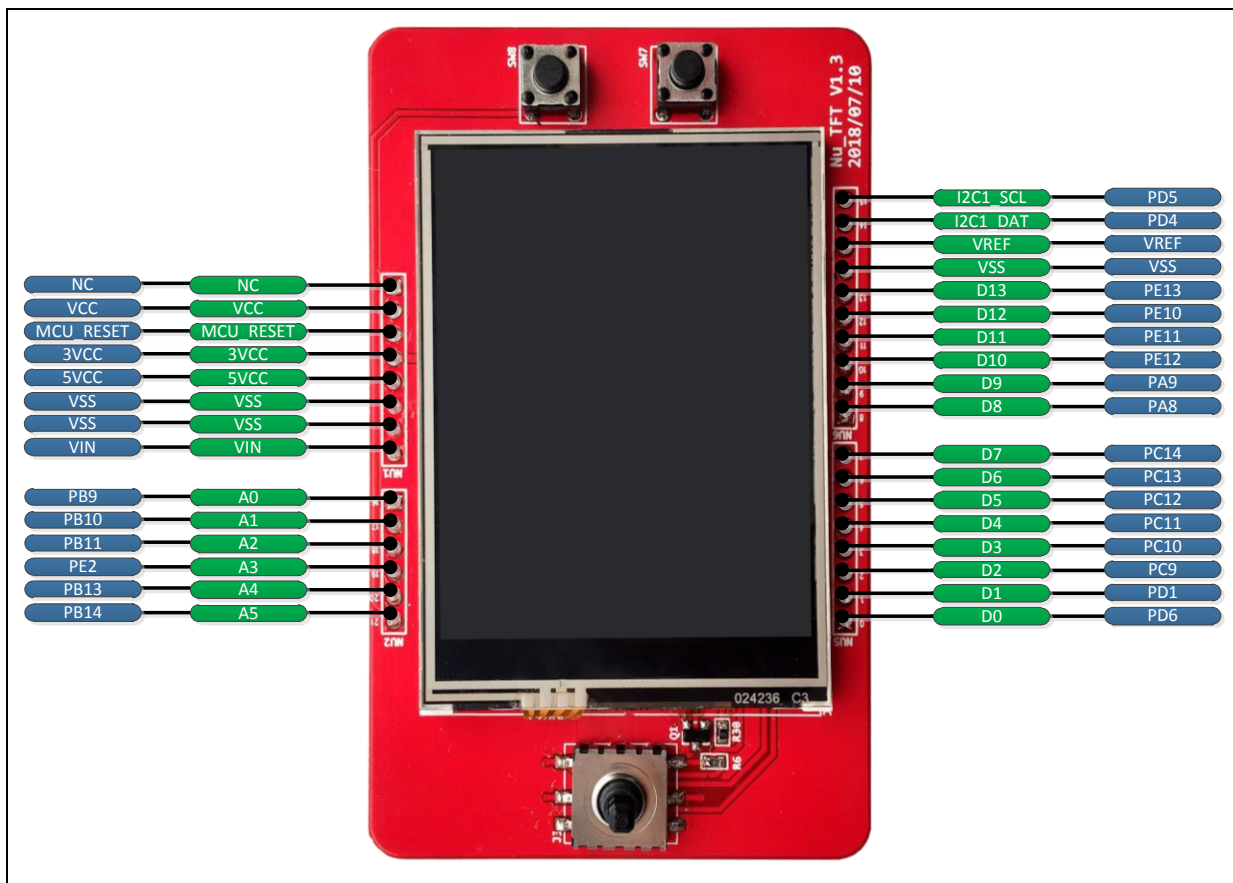


Figure 3-3 NuTFT-SPI_320x240 Daughter Board Connectors – Front View

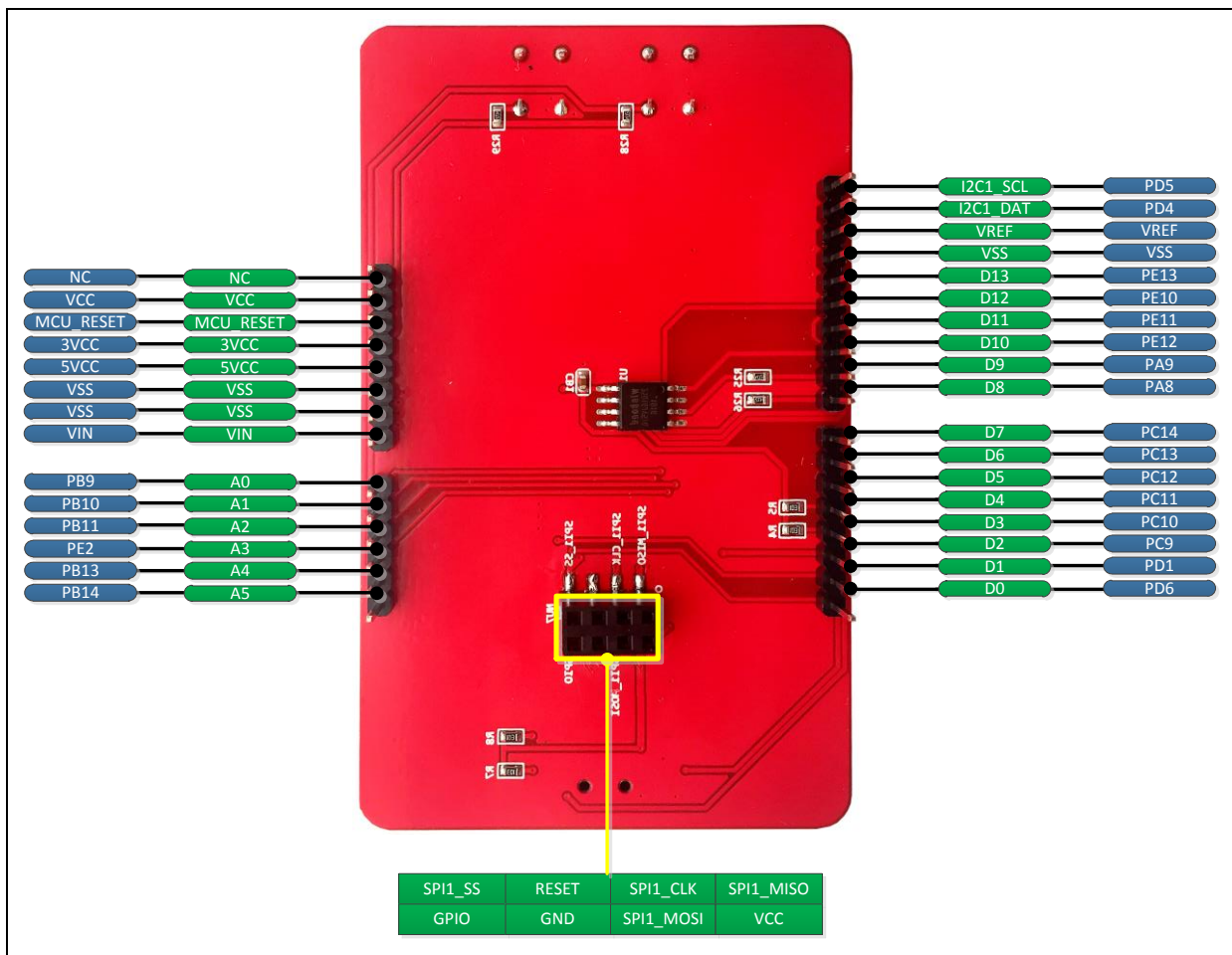


Figure 3-4 NuTFT-SPI_320x240 Daughter Board Connectors – Back View

Table 3-1 NuTFT-SPI_320x240 NU1 Daughter Board Mapping Table

Header	NuTFT-SPI_320x240 Daughter Board	
	Compatible to Arduino UNO	GPIO Pin of NUC126VG4AE
NU1	NC	-
	IOREF	
	RESET	RESET
	3VCC	
	5VCC	
	GND	
	GND	
	VIN	

Table 3-2 NuTFT-SPI_320x240 NU2, NU5 and NU6 Daughter Board Mapping Table

Header	NuTFT-SPI_320x240 Daughter Board		
	Compatible to Arduino UNO	GPIO Pin of NUC126VG4AE	NuTFT-SPI_320x240 Function
NU2	A0	PB9	4 wired ADC Touch Panel – YU
	A1	PB10	4 wired ADC Touch Panel – XL
	A2	PB11	4 wired ADC Touch Panel – YD
	A3	PE2	4 wired ADC Touch Panel – XR
	A4	PB13	SW7 Push Button
	A5	PB14	SW8 Push Button
NU5	D0	PD6	LCM_DC
	D1	PD1	LCM_RESET
	D2	PC9	Five direction joystick – Middle
	D3	PC10	Five direction joystick – Down
	D4	PC11	Five direction joystick – Left
	D5	PC12	Five direction joystick – Up
	D6	PC13	Five direction joystick – Right
	D7	PC14	LCM_LED
NU6	D8	PA8	SPI Flash – MISO1
	D9	PA9	SPI Flash – MOSI1
	D10	PE12	SPI Flash – SS
	D11	PE11	SPI Flash – MOSI0
	D12	PE10	SPI Flash – MISO0
	D13	PE13	SPI Flash – CLK
	VSS	VSS	-
	VREF	VREF	-
	I2C1_DAT	PD4	-
	I2C1_SCL	PD5	-

Table 3-3 NuTFT-SPI_320x240 NU7 Daughter Board Mapping Table

Header	NuTFT-SPI_320x240 Daughter Board		
	Compatible to Arduino UNO	GPIO Pin of NUC126VG4AE	NuTFT-SPI_320x240 Function
NU7	GPIO	PB12	-
	GND	GND	-
	SPI_MOSI	PD13	SPI_MOSI
	VCC	VCC	VCC
	SPI_SS	PD12	SPI_SS
	RESET	RESET	RESET
	SPI_CLK	PD15	SPI_CLK
	SPI_MISO	PD14	SPI_MISO

3.3 System Configuration

3.3.1 Arduino UNO Compatible Interface Connectors

- **NU1, NU2, NU5, NU6 and NU7:** Arduino UNO compatible pins on the NuTFT-SPI_320x240 daughter board.

3.3.2 Push-Buttons

- **SW7:** Push button controlled by A4, PB13 on NuMaker-PFM-NUC126 mother board.
- **SW8:** Push button controlled by A5, PB14 on NuMaker-PFM-NUC126 mother board.

3.3.3 Five-Direction Joystick

- There are five dimensions: up, down, left, right and middle in five direction joystick.

3.3.4 TFT LCD panel

- This touch panel is equipped with driver IC, ILI9341.
User can get the information detailed of this driver IC in ILI9341 datasheet.
- Interface : SPI
- Panel size is 2.4"
- Resolution : 320x240

3.3.5 Four-Wire ADC Touch Panel

- NuTFT-SPI_320x240 daughter board is equipped with four-wire ADC touch panel. User can get the touch point by ADC value.

3.4 PCB Placement of NuTFT-SPI_320x240 Daughter Board

Figure 3-5 and Figure 3-6 show the front and back view placement of NuTFT-SPI_320x240 daughter board.

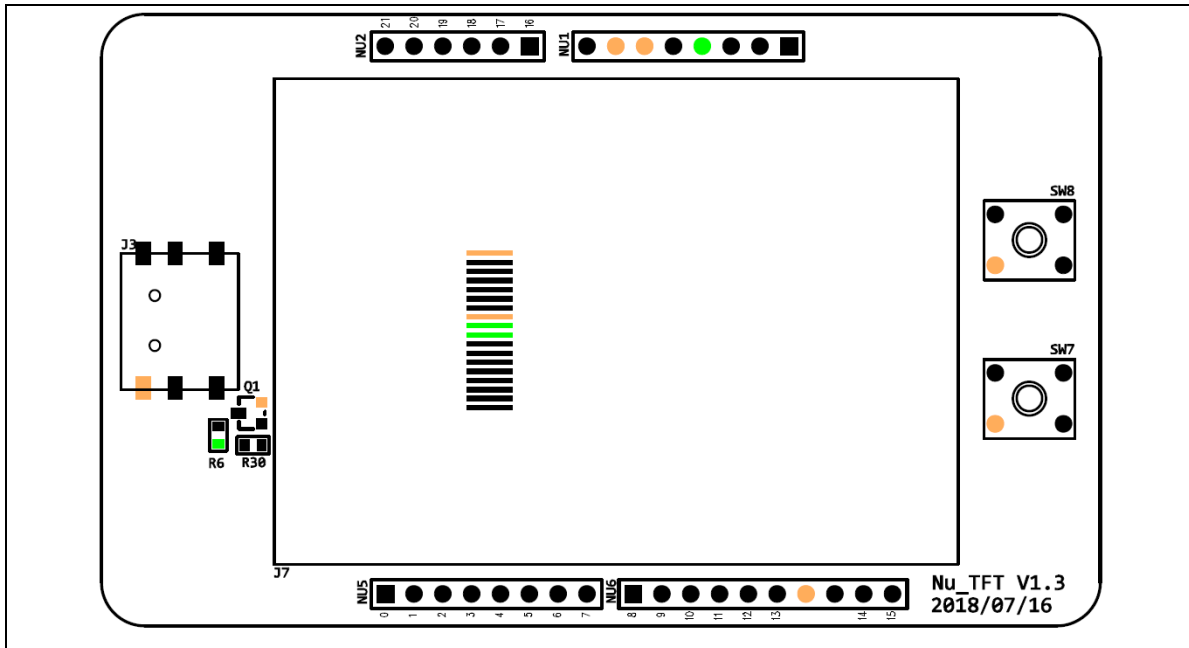


Figure 3-5 NuTFT-SPI_320x240 Daughter Board Placement - Front View

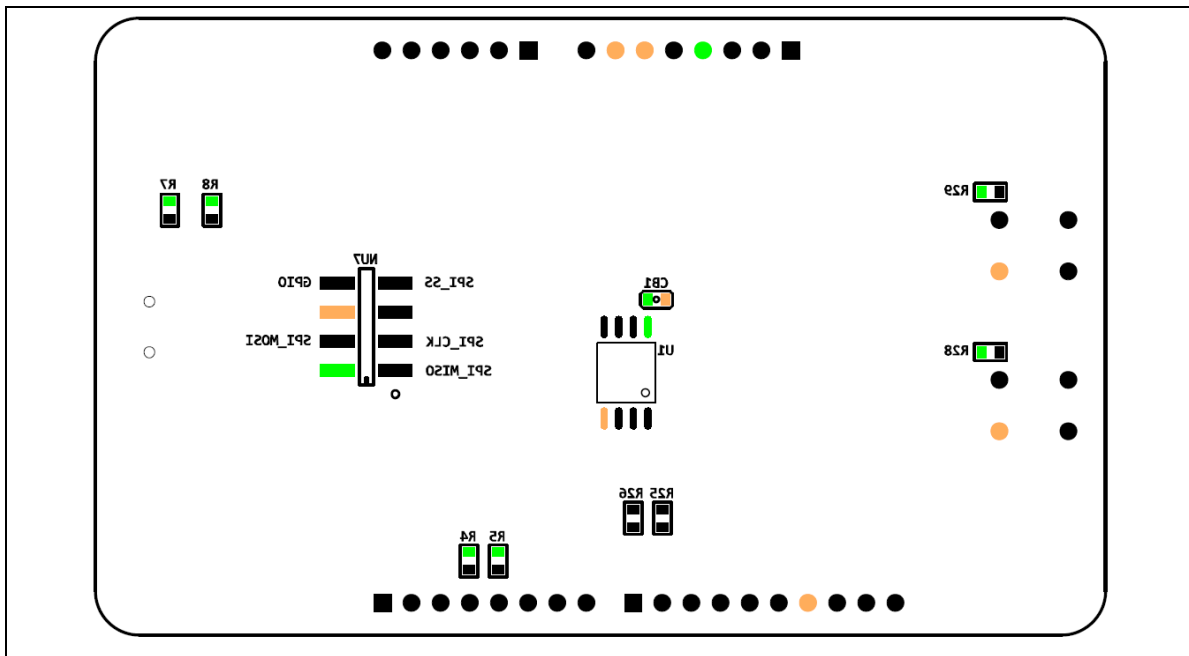


Figure 3-6 NuTFT-SPI_320x240 Daughter Board Placement - Back View

4 NUMAKER-PFM-NUC126 MOTHER BOARD SCHEMATICS

4.1 Nu-Link-Me

Figure 4-1 shows the Nu-Link-Me circuit, which is a USB-to-SWD bridge used to program code to the target chip.

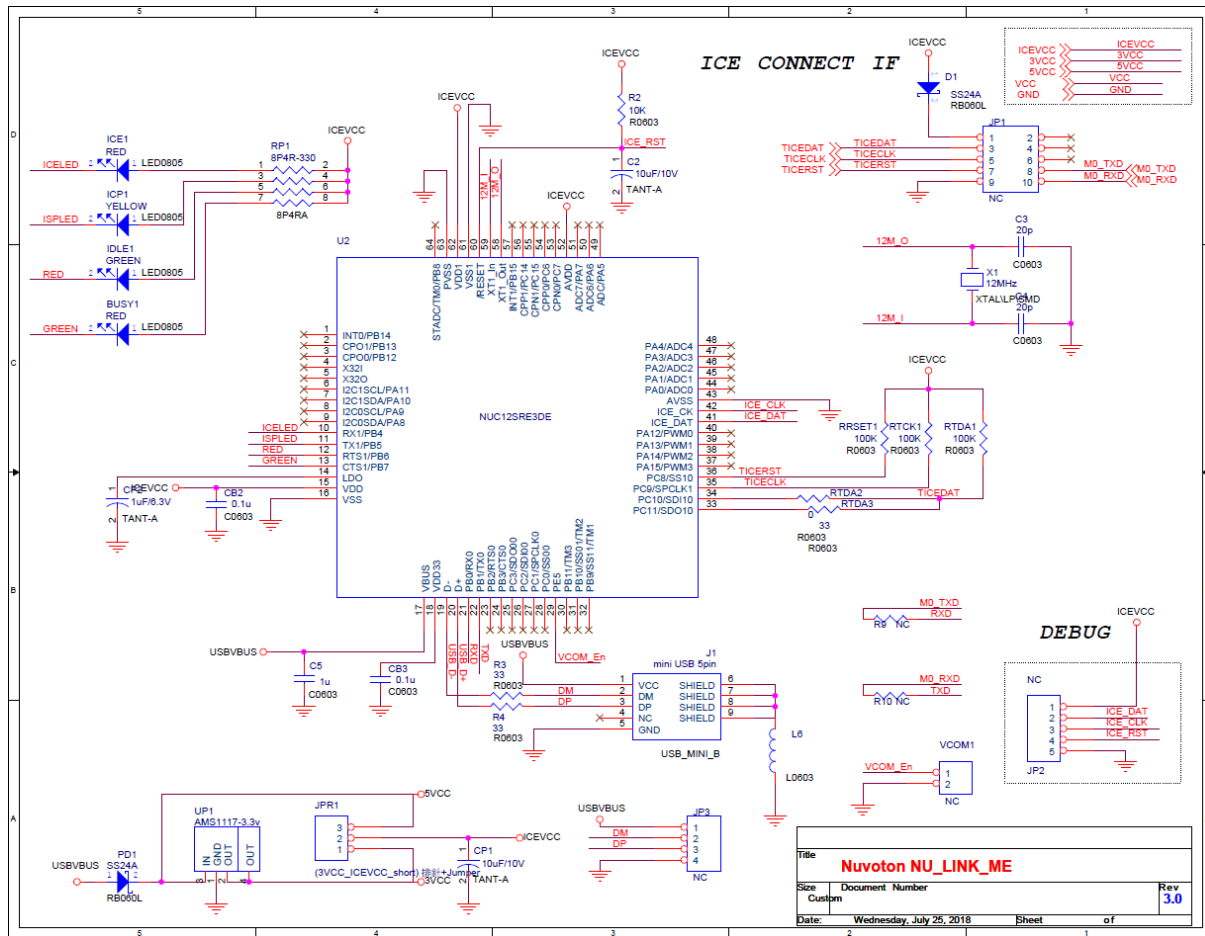


Figure 4-1 Nu-Link-Me Circuit

4.2 NUC126VG4AE Pin Assignment

Figure 4-2 shows the pin assignment of the NUC126VG4AE.

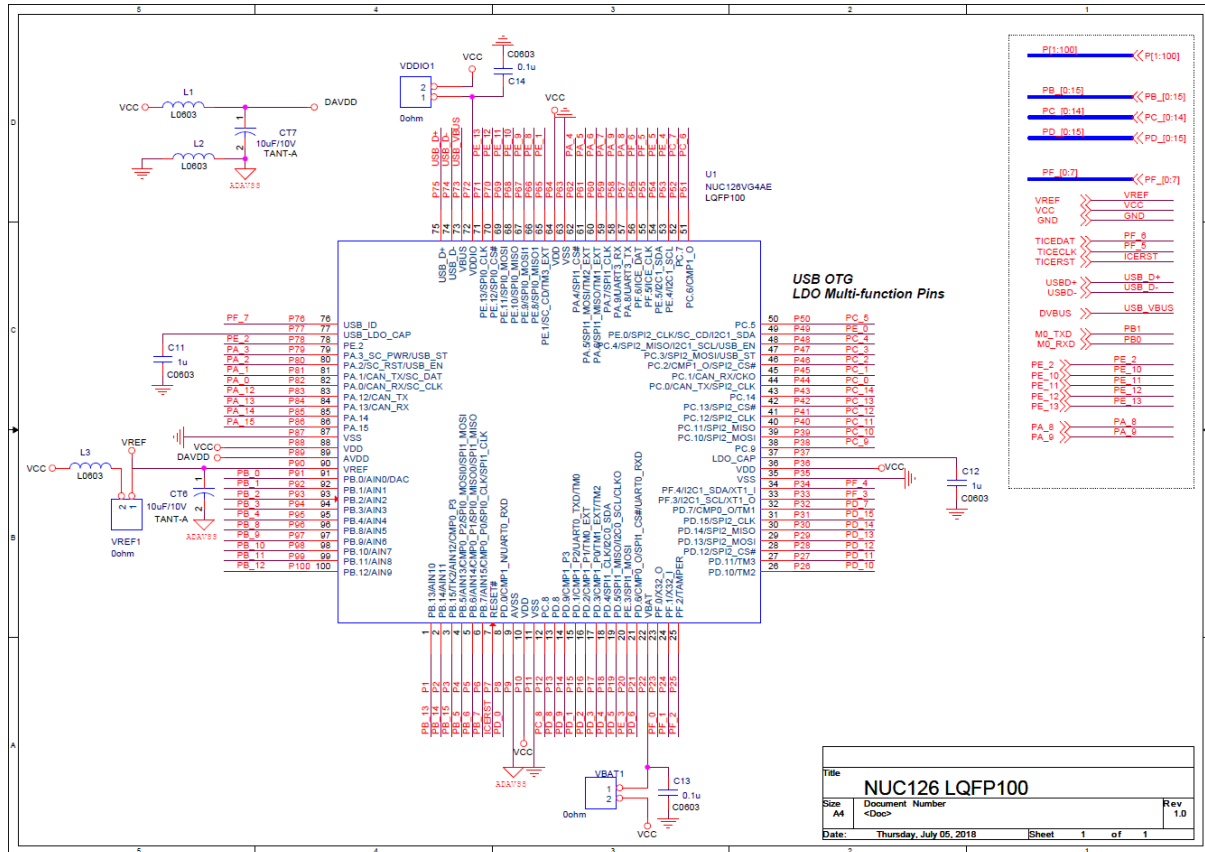


Figure 4-2 NUC126VG4AE Pin Assignment

4.3 Power Circuit

Figure 4-3 shows power configurations of NuMaker-PFM-NUC126 mother board.

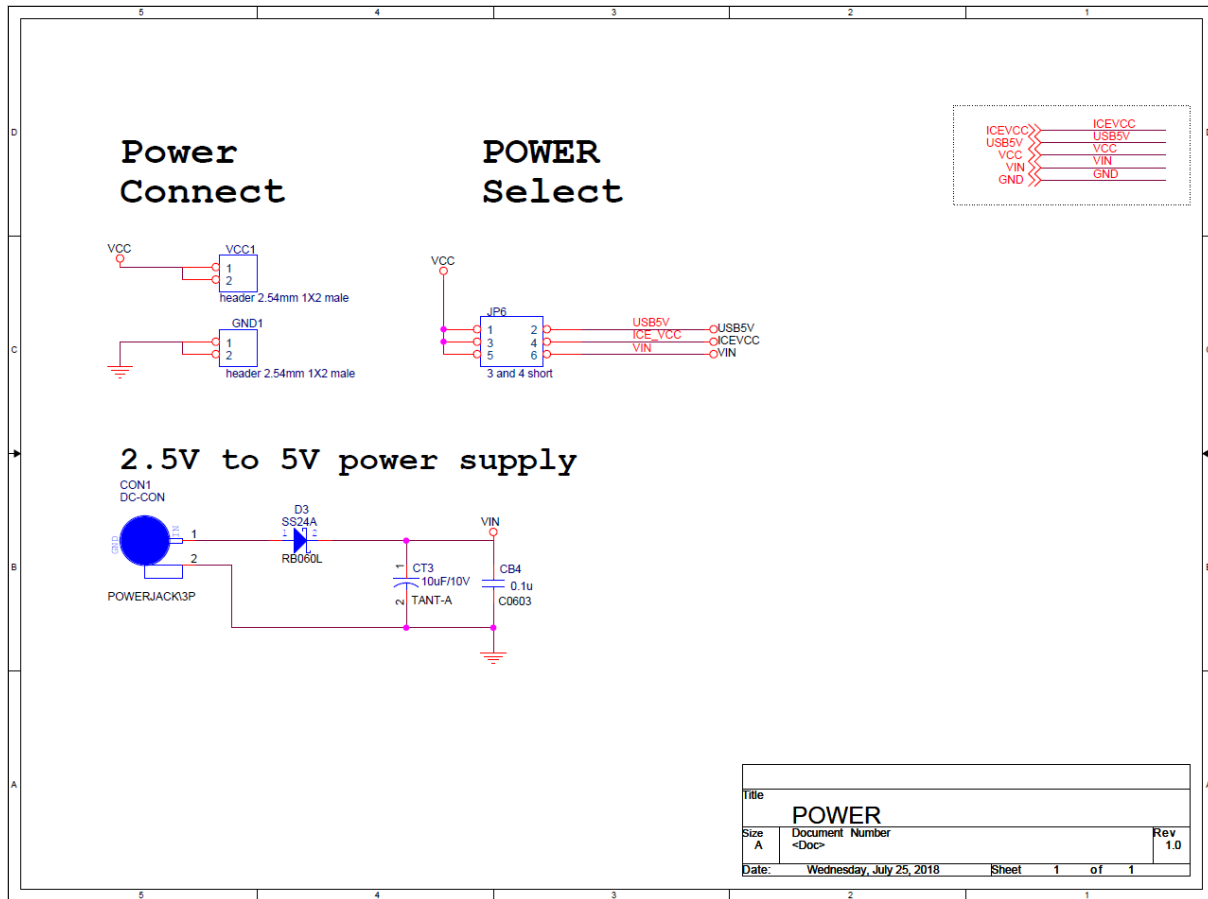


Figure 4-3 Power Circuit and Configurations

4.4 Arduino UNO Compatible Interface

Figure 4-4 shows the Arduino UNO compatible interface of NU1 to NU5 connectors.

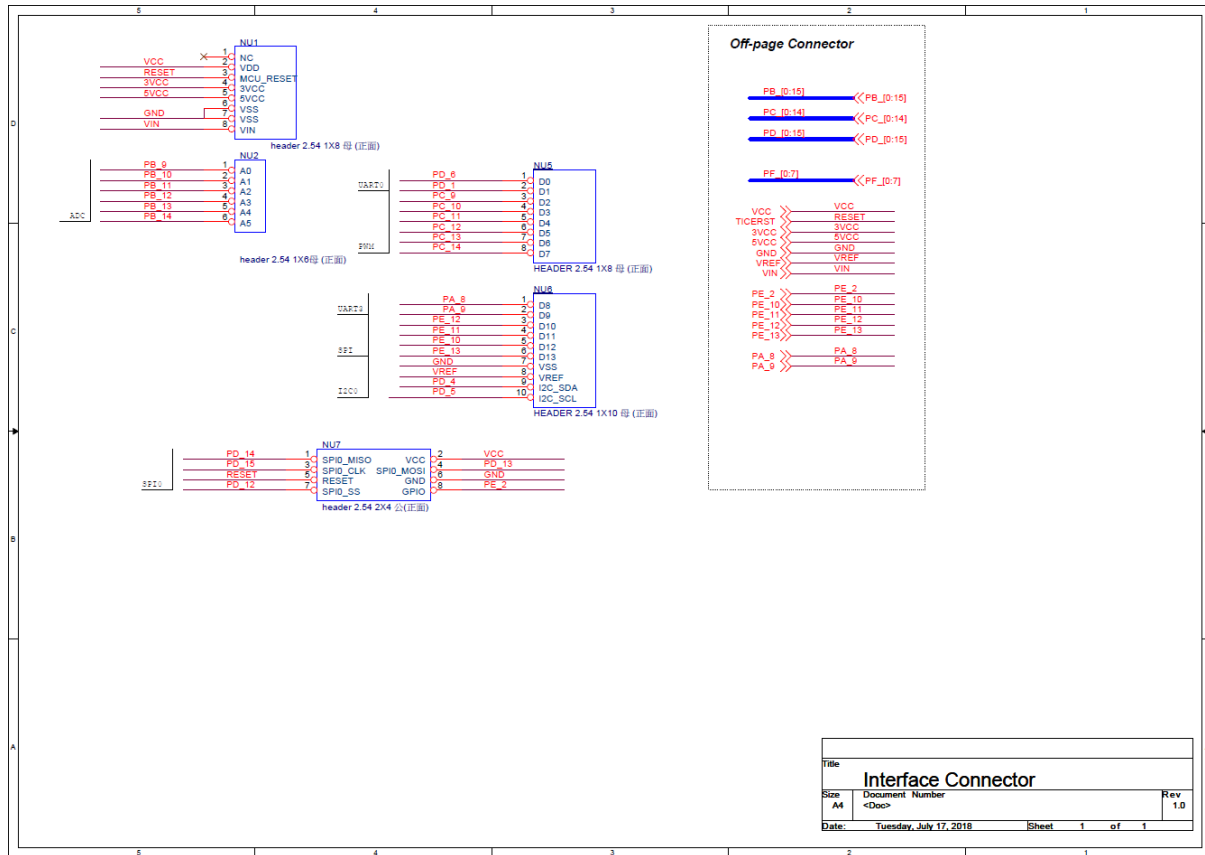


Figure 4-4 Arduino UNO Compatible Interface

4.5 Reset Circuit

Figure 4-5 shows the reset circuit of the NUC126VG4AE.

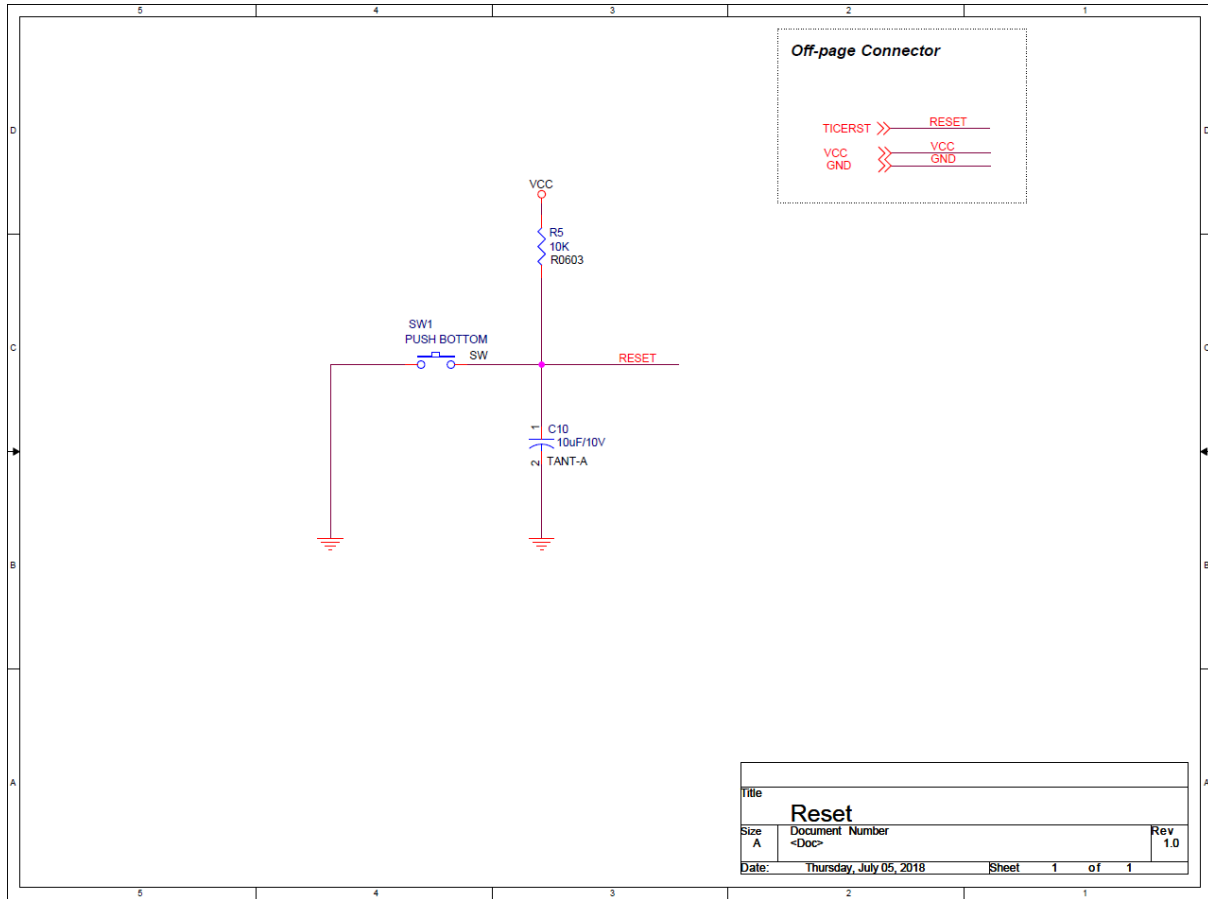


Figure 4-5 Reset Circuit

4.6 External Crystal Circuit

Figure 4-6 shows two external crystal circuits of the NUC126VG4AE.

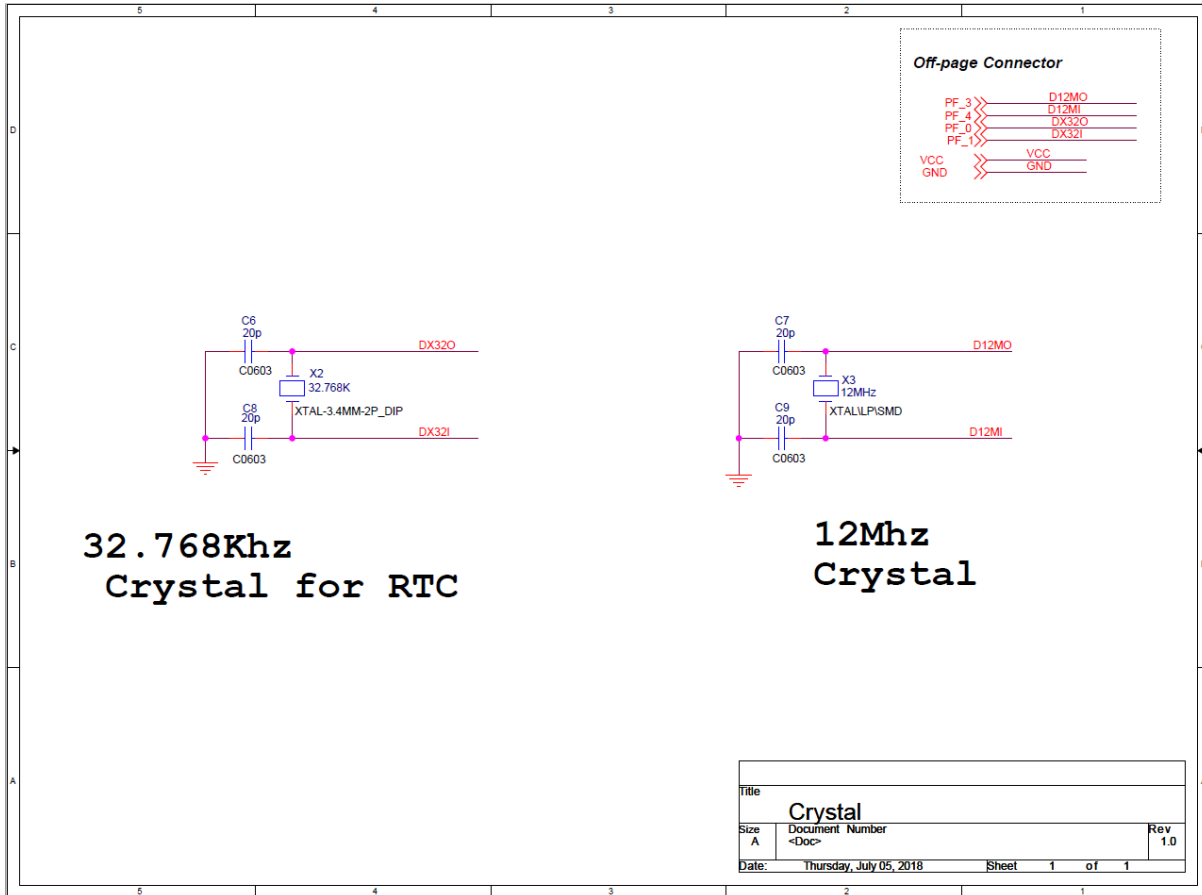


Figure 4-6 External Crystal Circuit

4.7 LED Circuit

Figure 4-7 shows the power LED and IO_LED circuit of the NUC126VG4AE. The IO_LED is controlled by PC_9.

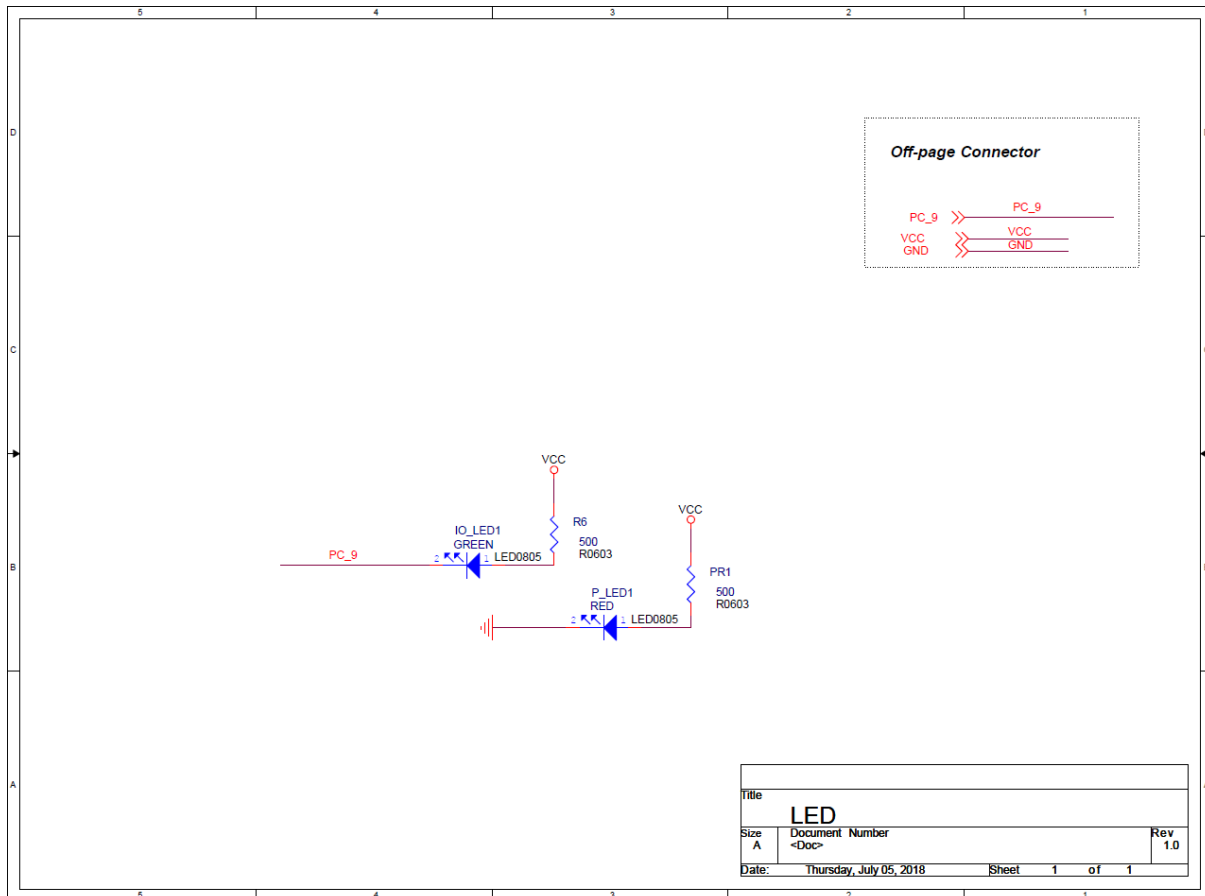


Figure 4-7 Power LED and IO LED Circuit

4.8 MCU I/O Connector

Figure 4-8 shows the MCU I/O connector circuit of the NuMaker-PFM-NUC126 mother board.

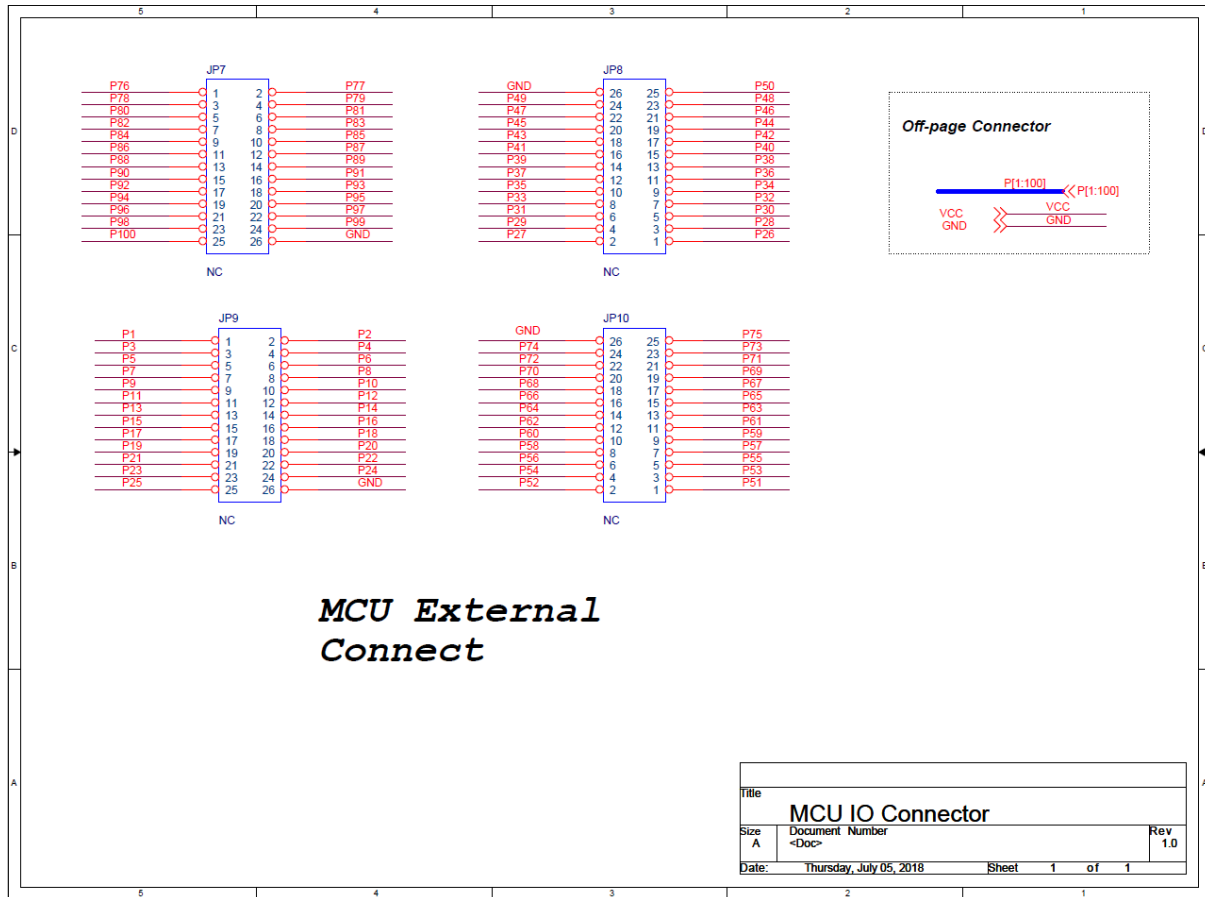


Figure 4-8 MCU I/O connector Circuit



4.9 USB Port

Figure 4-9 shows the USB circuit of the NuMaker-PFM-NUC126 mother board.

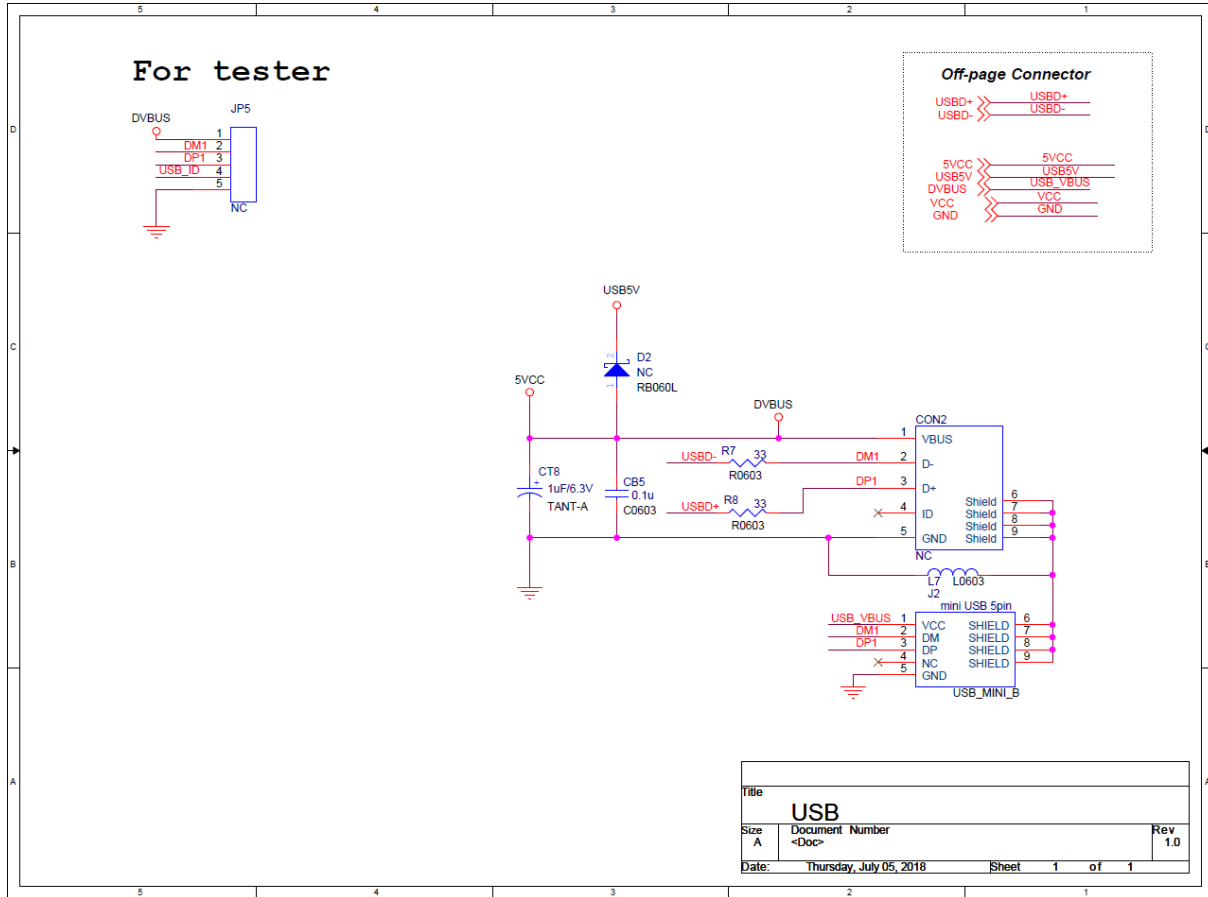


Figure 4-9 USB Circuit

4.10 ICE Interface Circuit

Figure 4-10 shows the ICE interface circuit of the NuMaker-PFM-NUC126 mother board.

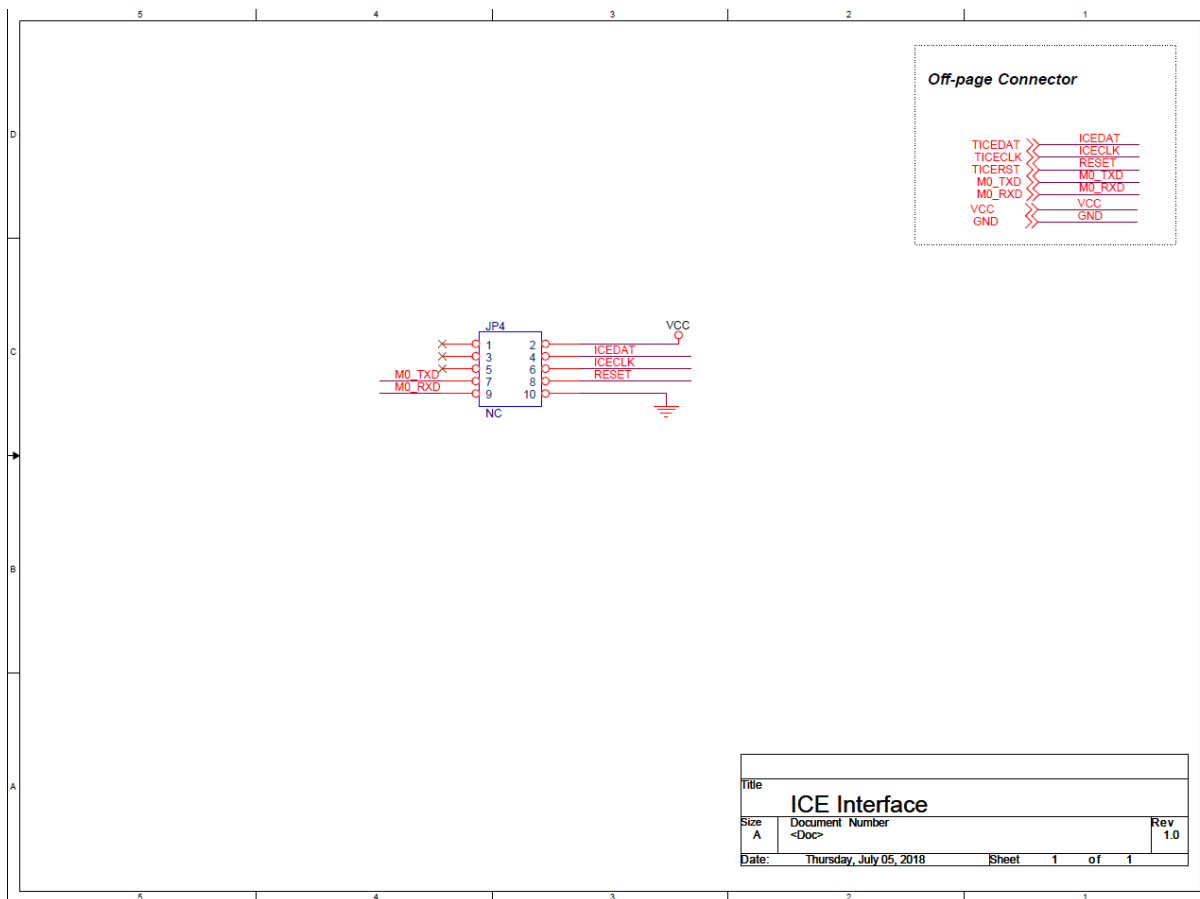


Figure 4-10 ICE Interface Circuit

5 NUTFT-SPI_320X240 DAUGHTER BOARD SCHEMATICS

5.1 Interface Connector

Figure 5-1 shows the Interface connector circuit of NuTFT-SPI_320x240 daughter board.



Figure 5-1 Interface Connector Circuit

5.2 SPI Flash Circuit

Figure 5-2 shows the SPI Flash circuit of NuTFT-SPI_320x240 daughter board.

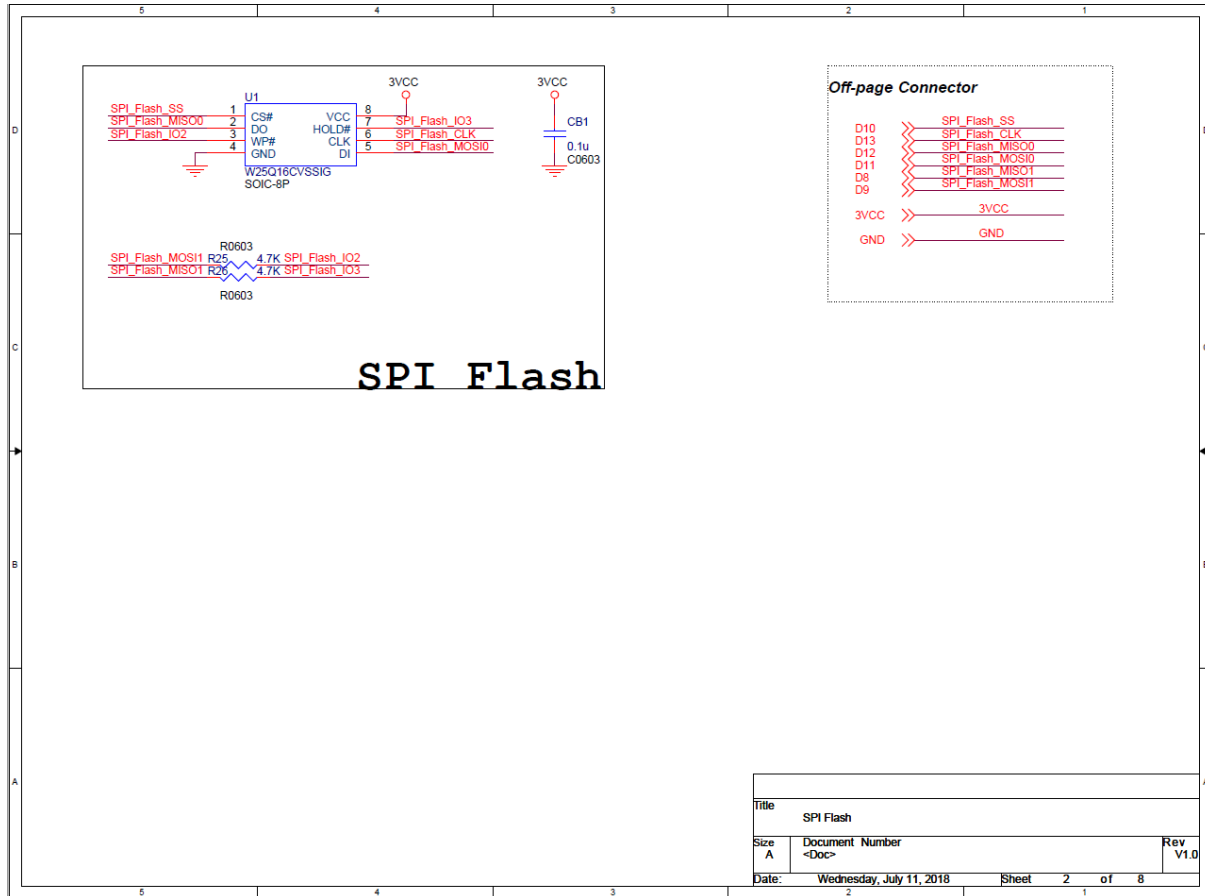


Figure 5-2 SPI Flash circuit

5.3 TFT LCD Circuit

Figure 5-3 shows the TFT LCD circuit of NuTFT-SPI_320x240 daughter board. YU, XL, YD and XR is using for 4-wire ADC touch panel. Others is using for TFT LCD panel.

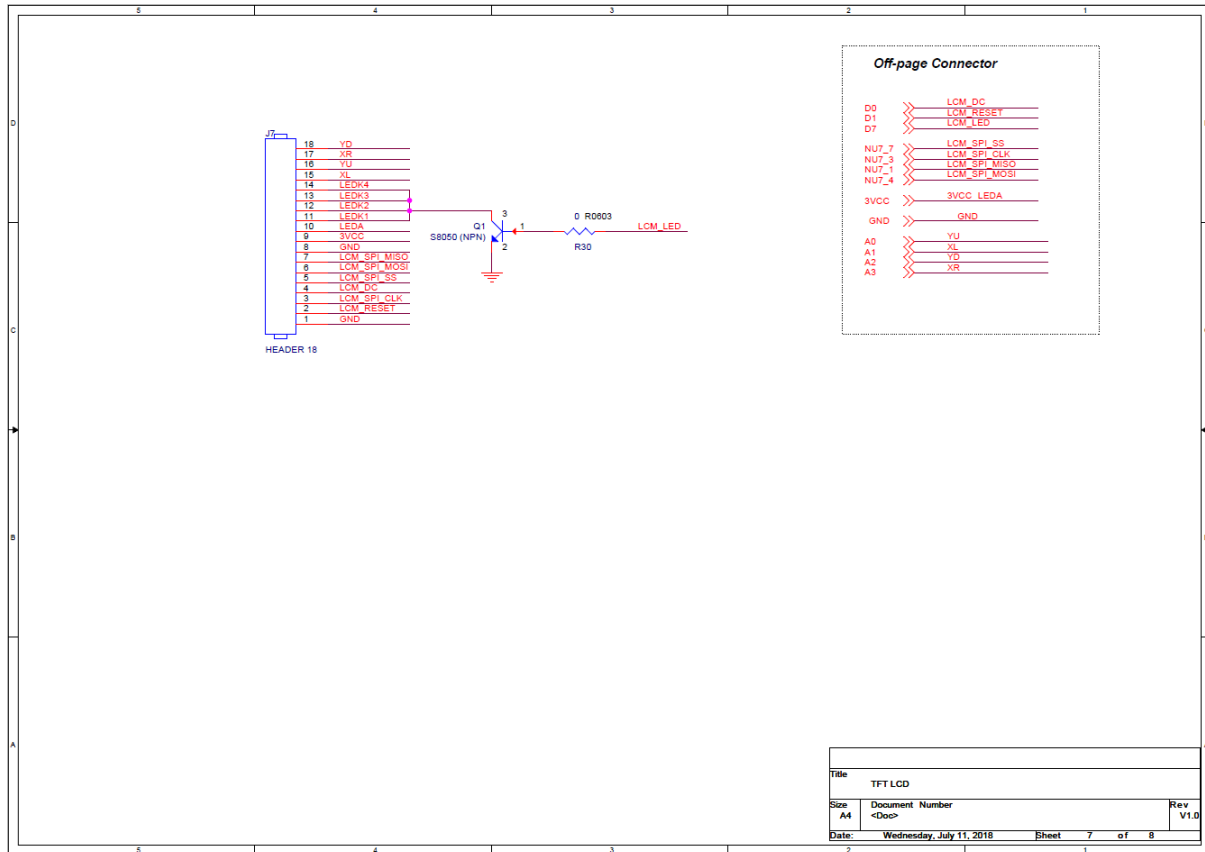


Figure 5-3 TFT LCD Circuit

5.4 Button Circuit

Figure 4-1 shows the Button circuit of NuTFT-SPI_320x240 daughter board. There are five-direction joystick and two push buttons.

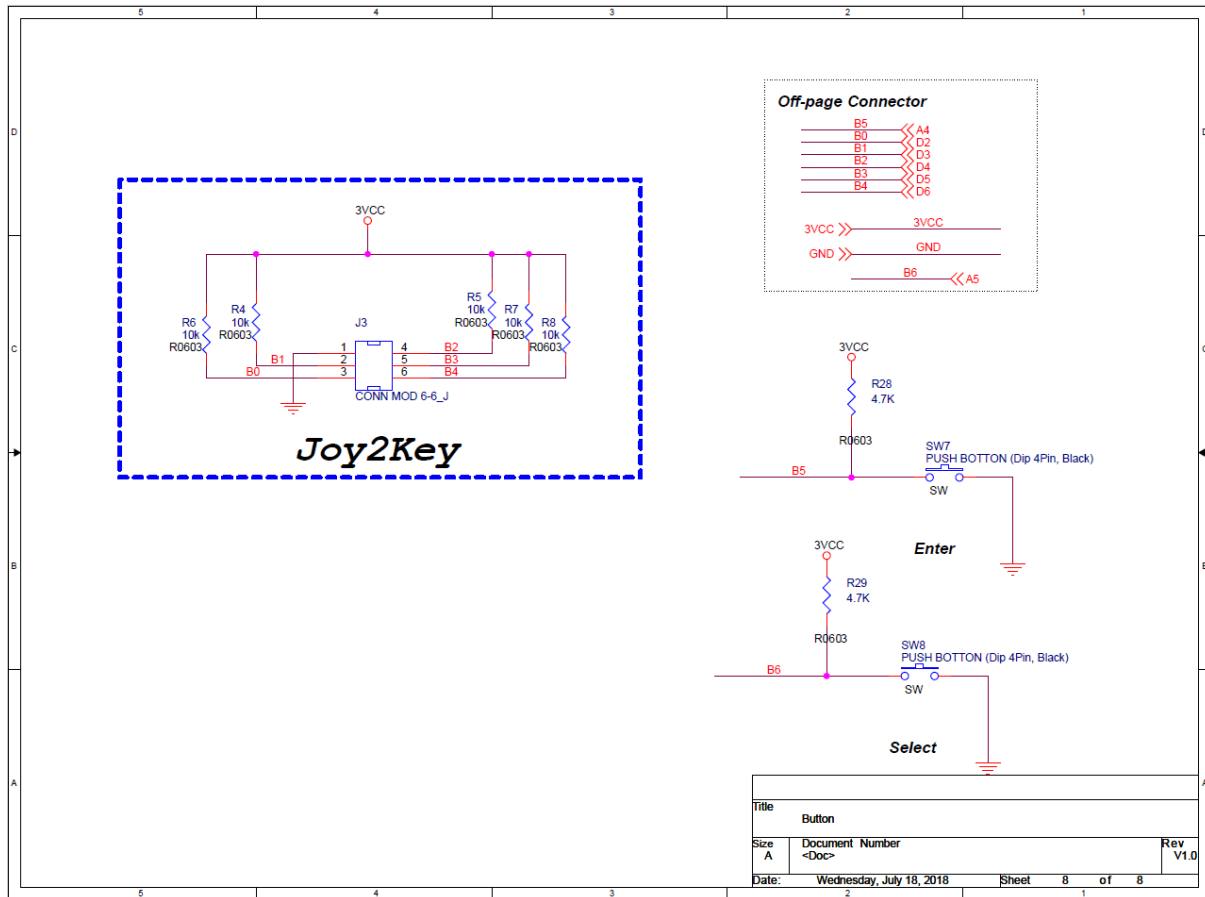


Figure 5-4 Button Circuit

6 REVISION HISTORY

Date	Revision	Description
2018. 07. 26	1.00	Initial version.
2018. 08. 15	1.01	1. To change figure on Figure 6-1 NuMaker-PFM-NUC126 Kit. 2. Add the notice in section 2.4.2 to warn user do not short the 5VCC to MCU when user is using the daughter board.

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