ARM® Cortex®-M

32-bit Microcontroller

NuMaker-PFM-NANO130 User Manual NuMicro® NANO100 Series

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NUMAKER-PFM-NANO130 USER MANUAL

Table of Contents

List of Figures

NUMAKER-PFM-NANO130 USER MANUAL

List of Tables

NUMAKER-PFM-NANO130 USER MANUAL

1 OVERVIEW

This user manual is aimed to give users a fast introduction to the use of ARM® mbed™ and NuMaker-PFM-NANO130 board.

1.1 Introduction to ARM® mbed™

The ARM® mbed™ IoT Device Platform provides the operating system, cloud services, tools and developer ecosystem to make the creation and deployment of commercial, standards-based IoT solutions possible.

The ARM® mbed™ allows IoT devices to collaborate and communicate with each other on the basis of transparency - otherwise each of the devices will not be able to talk to each other or to the cloud. For more detailed information about ARM® mbed™, user can visit the related ARM® mbed™ websites as the follows:

ARM® mbed™ homepage: www.mbed.com/en/

Software homepage: docs.mbed.com/docs/mbed-os-handbook/en/

Official C/C++ SDK: developer.mbed.org/users/mbed_official/code/mbed/

1.2 Introduction to NuMaker-PFM-NANO130 Board

The NuMaker-PFM-NANO130 is a development board based on an ARM® Cortex®-M0 microcontroller (MCU) – NANO100 series which has very rich peripherals.

This board is provided by Nuvoton and created specially to support the ARM® mbed™ IoT Device Platform, and let user easily to develop the IoT application program on this board. The NuMaker-PFM-NANO130 also provides user many useful and powerful learning materials for how to develop and verify the application programs through the peripherals and interfaces on MCU and this board.

Furthermore, this board also provides an Arduino UNO compatible interface for user to develop the specific function with any of Arduino modules or kits. Regarding to the Arduino, user can link directly to the Wikipedia website: en.wikipedia.org/wiki/Arduino to get more detailed introductions.

The NuMaker-PFM-NANO130 board consists of NANO130 Platform and Nu-Link-Me ICE Bridge. Figure 1-1 shows the NuMaker-PFM-NANO130 board.
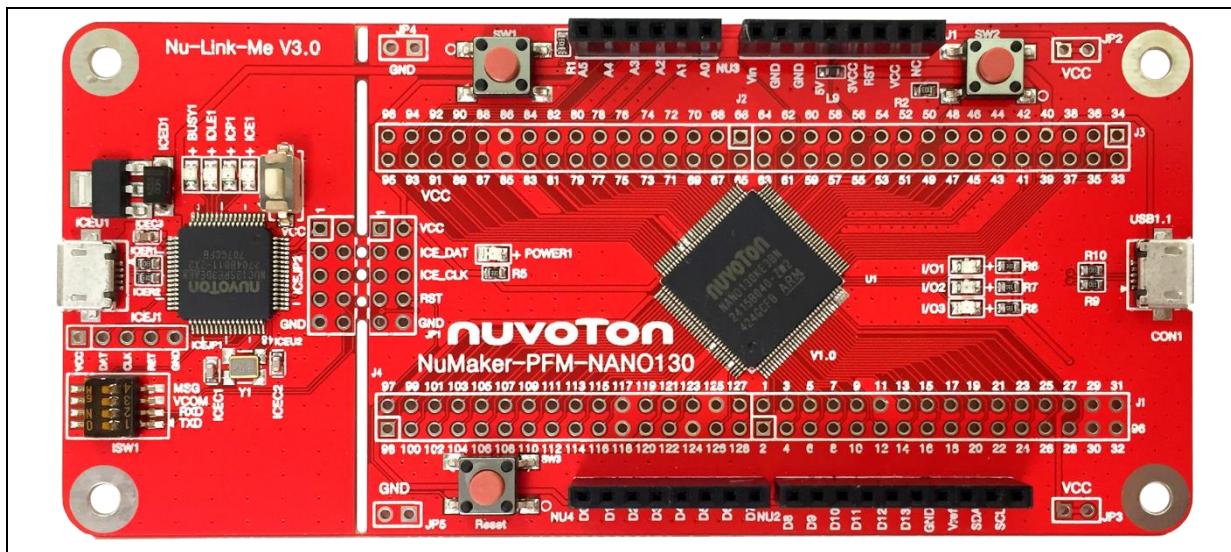

Figure 1-1 NuMaker-PFM-NANO130 Board

The right portion of this board is the NANO130 Platform that includes the target chip NANO130 MCU which embedded ARM® Cortex®-M0 core.

The left portion of this board is a Nu-Link-Me ICE Bridge based on the SWD (Serial Wire Debug) interface connected with the target chip, allowing user to program the application code to the flash of target chip through the USB port from PC Host.

For more information on the NuMaker-PFM-NANO130 board for the ARM® mbed™ Device Platform, please visit the ARM® mbed™ hardware board website:

https://developer.mbed.org/platforms/NUMAKER-PFM-NANO130/

1.3   NANO130 Series MCU Features

- NANO130KE3BN in LQFP128 package
- ARM® Cortex®-M0 core running up to 42 MHz
- Built-in 2.5 V/2.0 V/1.7 V LDO for wide operating voltage ranged operation
- 128 Kbytes Flash
- 16 Kbytes SRAM
- Peripheral DMA (PDMA)
- CRC
- GPIO
- 4 sets of 32-bit Timer
- WDT and WWDT
- RTC
- Up to 8 channel of 16-bit PWM outputs
- Up to 2 sets of 16-byte FIFO UART
- Up to 3 sets of SPI
- Up to 2 sets of I^2C
- 1 set of I^2S
- 12-bit SAR ADC up to 2Msps conversion rate
- 12-bit DAC monotonic output with 400K conversion rate
- Up to 3 ports of Smart Card (ISO-7816-3) Host Interface
- External Bus Interface (EBI)
- USB 2.0 Full-Speed Device
- LCD Driver for up to 4 COM x 40 SEG or 6 COM x 38 SEG

1.4   NuMaker-PFM-NANO130 Board Features

- On board Nu-Link-Me ICE Bridge (Mass storage as USB Disk drive) for drag and drop programming
- Arduino UNO compatible interface
- NANO130 extended interface connectors

- USB 2.0 Full-Speed Device

- Three push-buttons: one is for reset and the other two are for user-defined

- Four LEDs: one is for power indication and the other three are for user-defined

2 NUMAKER-PFM-NANO130 BOARD OVERVIEW

2.1 Board Overview

Figure 2-1 shows the main components and connectors from the front side of NuMaker-PFM-NANO130 board.

The following lists components and connectors from the front view:

- Target Chip: NANO130KE3BN (U1)
- Nu-Link-Me ICE Bridge: ICE Controller NUC12SRE3DE (ICEU2), USB connector (ICEJ1) to PC Host
- Arduino UNO compatible interface connectors (NU1, NU2, NU3 and NU4)
- NANO130 extended interface connectors (J1, J2, J3 and J4)
- USB 2.0 Full-Speed connector (CON1)
- Push Button (SW1 and SW2)
- Reset Button (SW3)
- I/O LED (I/O1, I/O2 and I/O3)
- Power LED (POWER1)
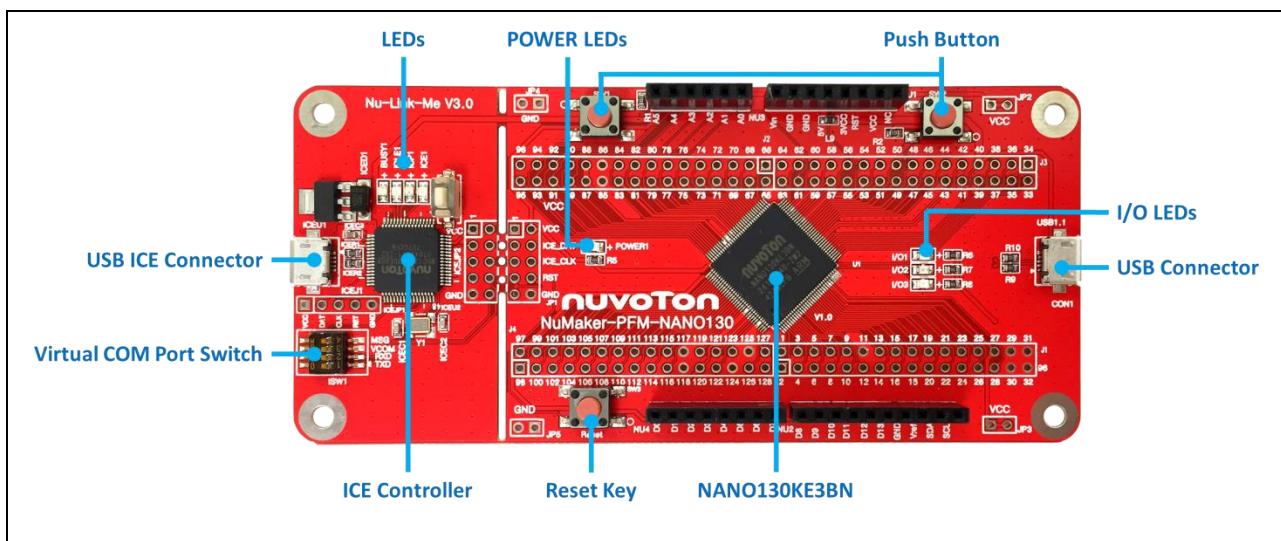
Figure 2-1 Front View of NuMaker-PFM-NANO130 Board

2.2 Arduino UNO Compatible Interface

Figure 2-2 shows the Arduino UNO compatible interface.
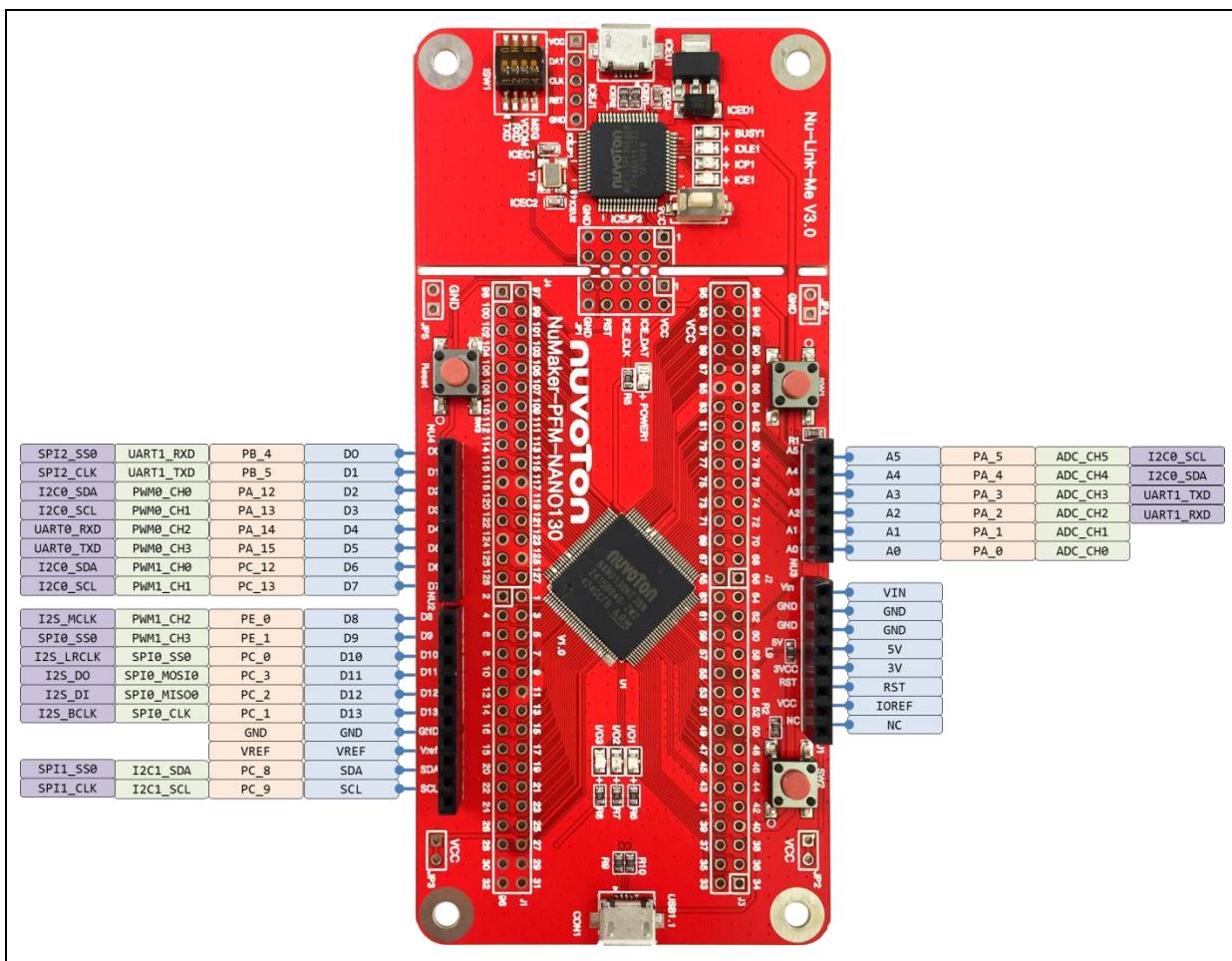
Figure 2-2 Arduino UNO Compatible Interface

Table 2-1 Arduino UNO Interface Mapping with NANO130KE3BN GPIO

Header		NuMaker-PFM-NANO130		Header		NuMaker-PFM-NANO130	
		Compatible to Arduino UNO	GPIO Pin of NANO130			Compatible to Arduino UNO	GPIO Pin of NANO130
N U 1	NU1.1	NC	-	**N U 2**	NU6.10	SCL	PC.9
	NU1.2	IOREF			NU6.9	SDA	PC.8
	NU1.3	RESET	RESET		NU6.8	VREF	-
	NU1.4	3VCC			NU6.7	GND	
	NU1.5	5VCC			NU6.6	D13	PC.1
	NU1.6	GND	-		NU6.5	D12	PC.2
	NU1.7	GND			NU6.4	D11	PC.3
	NU1.8	VIN			NU6.3	D10	PC.0
N U 3	NU2.1	A0	PA.0		NU6.2	D9	PE.1
	NU2.2	A1	PA.1		NU6.1	D8	PE.0
	NU2.3	A2	PA.2	**N U 4**	NU5.8	D7	PC.13
	NU2.4	A3	PA.3		NU5.7	D6	PC.12
	NU2.5	A4	PA.4		NU5.6	D5	PA.15
	NU2.6	A5	PA.5		NU5.5	D4	PA.14
					NU5.4	D3	PA.13
					NU5.3	D2	PA.12
					NU5.2	D1	PB.5
					NU5.1	D0	PB.4

2.3   Pin Assignment for Extended Connectors

The NuMaker-PFM-NANO130 provides the NANO130KE3BN target chip onboard and extended connectors (J1, J2, J3 and J4) for LQFP128-pin. The Figure 2-3 shows the NANO130KE3BN extended connectors.
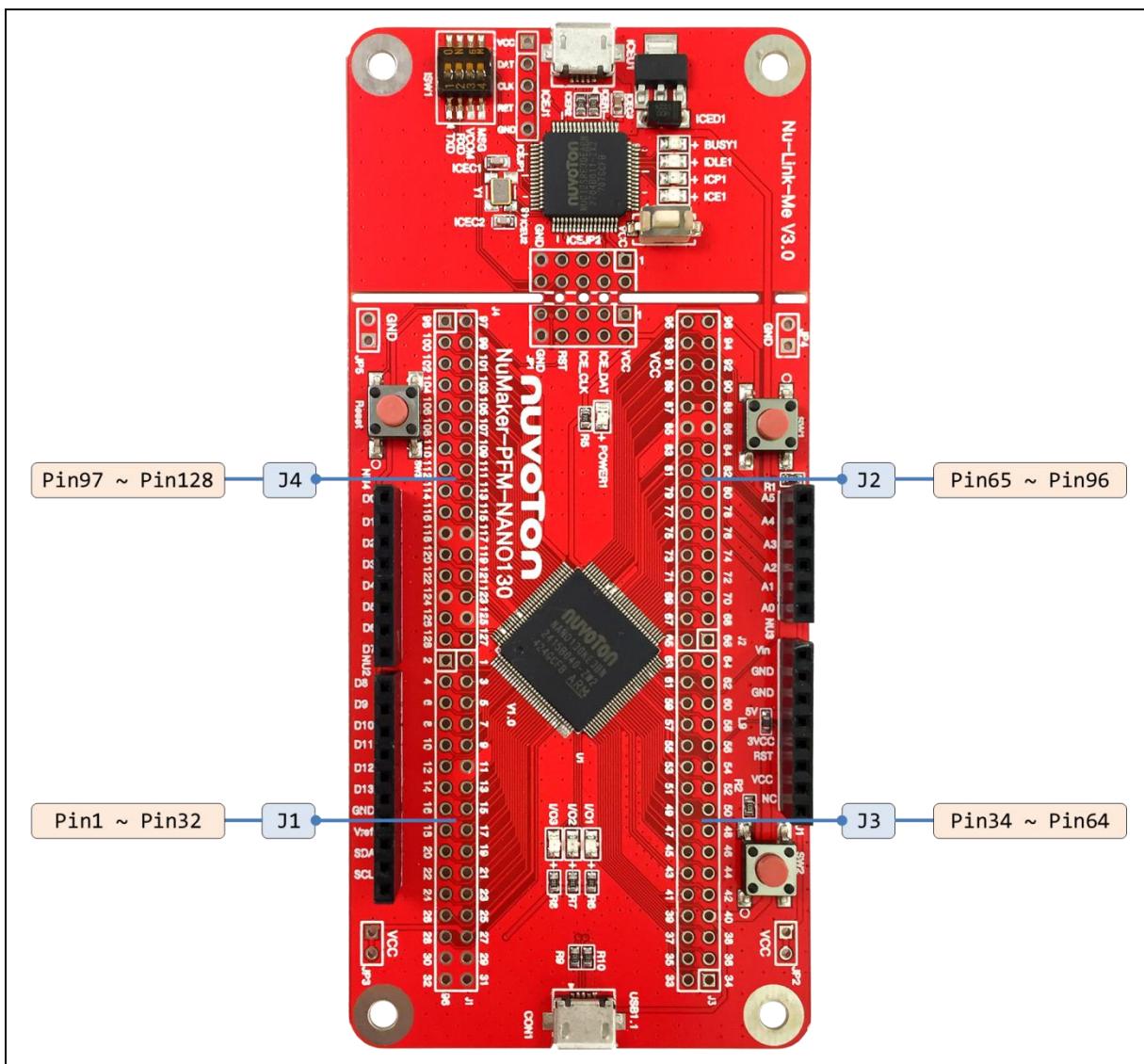

Figure 2-3 NANO130KE3BN Extended Connectors

Table 2-2 Extended Connector J1 Interface with NANO130KE3BN GPIO

Header		NANO130KE3BN		Header		NANO130KE3BN	
		Pin No.	Function			Pin No	Function
J1	J1.1	1	PE.13	J1	J1.2	2	PB.14
	J1.3	3	PB.13		J1.4	4	PB.12
	J1.5	5	NC		J1.6	6	XT32_OUT
	J1.7	7	XT32_IN		J1.8	8	NC
	J1.9	9	PA.11		J1.10	10	PA.10
	J1.11	11	PA.9		J1.12	12	PA.8
	J1.13	13	PD.8		J1.14	14	PD.9
	J1.15	15	PD.10		J1.16	16	PD.11
	J1.17	17	PD.12		J1.18	18	PD.13
	J1.19	19	PB.4		J1.20	20	PB.5
	J1.21	21	PB.6		J1.22	22	PB.7
	J1.23	23	NC		J1.24	24	LDO_CAP
	J1.25	25	NC		J1.26	26	NC
	J1.27	27	VDD		J1.28	28	NC
	J1.29	29	VSS		J1.30	30	VSS
	J1.31	31	VSS		J1.32	32	VSS

Table 2-3 Extended Connector J3 Interface with NANO130KE3BN GPIO

Header		NANO130KE3BN		Header		NANO130KE3BN	
		Pin No.	Function			Pin No	Function
J3	J3.1	33	PE.12	J3	J3.2	34	PE.11
	J3.3	35	PE.10		J3.4	36	PE.9
	J3.5	37	PE.8		J3.6	38	PE.7
	J3.7	39	NC		J3.8	40	USB_VBUS
	J3.9	41	USB_VDD33		J3.10	42	USB_D-
	J3.11	43	USB_D+		J3.12	44	PB.0 / UART0_RXD
	J3.13	45	PB.1 / UART0_TXD		J3.14	46	PB.2
	J3.15	47	PB.3		J3.16	48	PD.6
	J3.17	49	PD.7		J3.18	50	PD.14
	J3.19	51	PD.15		J3.20	52	PC.5
	J3.21	53	PC.4		J3.22	54	PC.3 / SPI0_MOSI0
	J3.23	55	PC.2 / SPI0_MISO0		J3.24	56	PC.1 / SPI0_CLK
	J3.25	57	PC.0 / SPI0_SS0		J3.26	58	PE.6
	J3.27	59	LCD_VLCD		J3.28	60	NC
	J3.29	61	PE.5		J3.30	62	PB.11
	J3.31	63	PB.10		J3.32	64	PB.9

Table 2-4 Extended Connector J2 Interface with NANO130KE3BN GPIO

Header		NANO130KE3BN		Header		NANO130KE3BN	
		Pin No.	Function			Pin No	Function
J2	J2.1	65	PE.4	**J2**	J2.2	66	PE.3
	J2.3	67	PE.2		J2.4	68	PE.1 / PWM1_CH3
	J2.5	69	PE.0 / PWM1_CH2		J2.6	70	PC.13 / PWM1_CH1
	J2.7	71	PC.12 / PWM1_CH0		J2.8	72	PC.11
	J2.9	73	PC.10		J2.10	74	PC.9 / I2C1_SCL
	J2.11	75	PC.8 / I2C1_SDA		J2.12	76	PA.15 / PWM0_CH3
	J2.13	77	PA.14 / PWM0_CH2		J2.14	78	PA.13 / PWM0_CH1
	J2.15	79	PA.12 / PWM0_CH0		J2.16	80	PF.0 / ICEDAT
	J2.17	81	PF.1 / ICECLK		J2.18	82	NC
	J2.19	83	VDD		J2.20	84	NC
	J2.21	85	VSS		J2.22	86	VSS
	J2.23	87	AVSS		J2.24	88	AVSS
	J2.25	89	PA0 / AD0		J2.26	90	PA.1 / AD1
	J2.27	91	PA.2 / AD2		J2.28	92	PA.3 / AD3
	J2.29	93	PA.4 / AD4		J2.30	94	PA.5 / AD5
	J2.31	95	PA.6		J2.32	96	PA.7

Table 2-5 Extended Connector J4 Interface with NANO130KE3BN GPIO

Header		NANO130KE3BN		Header		NANO130KE3BN	
		Pin No.	Pin Name			Pin No	Pin Name
J4	J4.1	97	VREF	J4	J4.2	98	NC
	J4.3	99	AVDD		J4.4	100	PD.0
	J4.5	101	PD.1		J4.6	102	PD.2
	J4.7	103	PD.3		J4.8	104	NC
	J4.9	105	PD.4		J4.10	106	PD.5
	J4.11	107	PC.7		J4.12	108	PC.6
	J4.13	109	PC.15		J4.14	110	PC.14
	J4.15	111	PB.15		J4.16	112	NC
	J4.17	113	PF.3 / XT1_IN		J4.18	114	PF.2 / XT1_OUT
	J4.19	115	NC		J4.20	116	nRESET
	J4.21	117	VSS		J4.22	118	VSS
	J4.23	119	NC		J4.24	120	VDD
	J4.25	121	NC		J4.26	122	PF.4
	J4.27	123	PF.5		J4.28	124	VSS
	J4.29	125	PVSS		J4.30	126	PB.8
	J4.31	127	PE.15		J4.32	128	PE.14

2.4 System Configuration

2.4.1 Power Source

- **ICEU1:** The voltage regular converts the 5V source to 3.3V and supplies it to NuMaker-PFM-NANO130 board.

Voltage Regular	Source	Comment
ICEU1	ICE_USB_VBUS	ICEU1 convert ICE_USB_VBUS to 3.3V and supplies it to NANO130 platform board. **Note:** L4 should be shorted 0ohm

2.4.2 USB Connectors

- **ICEU1:** USB connector (ICE) in Nu-Link-Me that connects to a PC's USB Host port to program code and supply power.
- **CON1:** USB 2.0 Full-Speed connector on NuMaker-PFM-NANO130 board for USB application use.

2.4.3 Arduino UNO Compatible Interface Connectors

- **NU1, NU2, NU3, and NU4:** Arduino UNO compatible pins on the NuMaker-PFM-NANO130 board.

2.4.4 Extended Connectors

- **J1, J2, J3 and J4:** Extended connectors interface pins on the NuMaker-PFM-NANO130 board.

2.4.5 Push-Buttons

- **RESET:** Reset button to reset the target chip on NuMaker-PFM-NANO130 board.
- **SW1, SW2:** Only for application use.

2.4.6 LEDs

- **POWER1:** The power LED indicates that the NuMaker-PFM-NANO130 board is powered.
- **I/O1, I/O2 and I/O3:** Only for application use.

2.4.7 Power Connectors

- **JP2, JP3:** 3VCC connectors on the NuMaker-PFM-NANO130 board.
- **JP4, JP6:** GND connectors on the NuMaker-PFM-NANO130 board.

2.5 Nu-Link-Me

NuMaker-PFM-NANO130 features a Nu-Link-Me ICE debugger and programmer, it provide user to program NANO130KE3BN and debug their application via SWD interface, or 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. Nu-link-Me can also emulate a virtual COM port, user can log or print debug message via it. Refer

Table 2-6 to enable or disable optional function of Nu-Link-Me.

Table 2-6 Optional Function of Nu-Link-Me

ISW1		
Pin	**Nu-Link-Me**	**Comment**
1	TXD	**On**: Connect PB.1 (UART0_TXD) of NANO130KE3BN to Nu-Link-Me. **Off**: Disconnect PB.1 (UART0_TXD) of NANO130KE3BN to Nu-Link-Me.
2	RXD	**On**: Connect PB.0 (UART0_RXD) of NANO130KE3BN to Nu-Link-Me. **Off**: Disconnect PB.0 (UART0_RXD) of NANO130KE3BN to Nu-Link-Me.
3	VCOM	**On**: Enable Nu-Link-Me virtual COM port function. **Off**: Disable Nu-Link-Me virtual COM port function.
4	MSG	**On**: Normal ICE mode, user can debugger and program via SWD interface. **Off**: Mass storage mode, user can update firmware by pulling bin file to pen driver.

2.6 PCB Placement

Figure 2-4 and Figure 2-5 show the front and rear placement of NuMaker-PFM-NANO130 board.
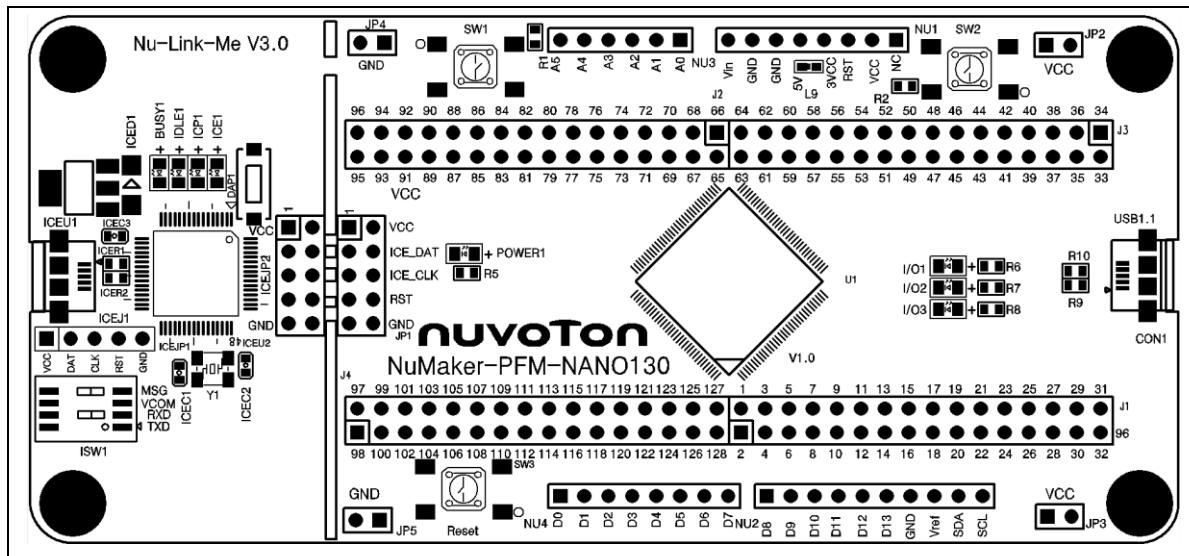

Figure 2-4 Front Placement
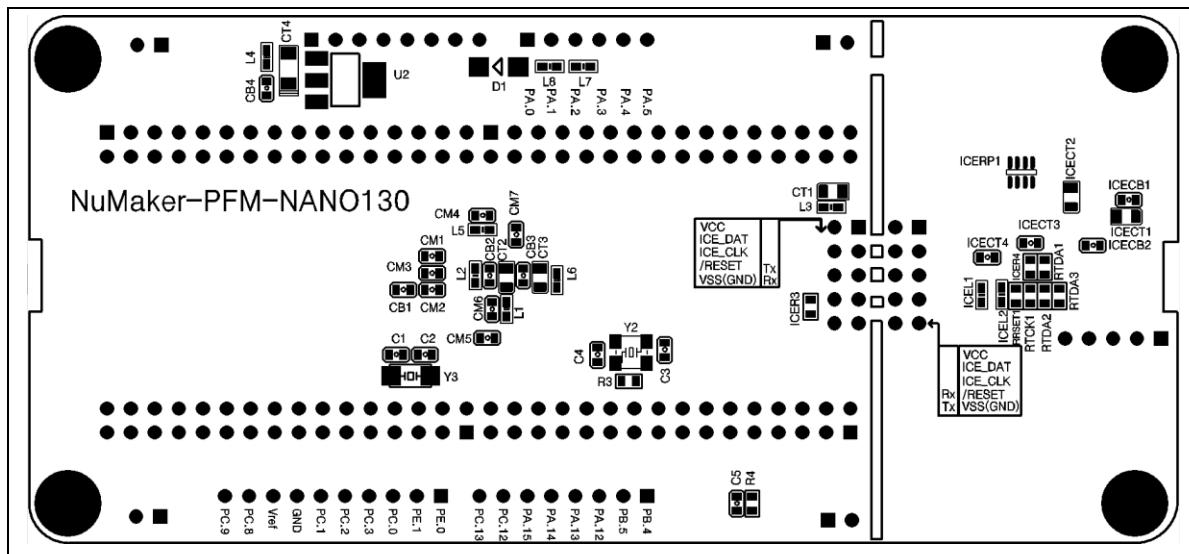
Figure 2-5 Rear Placement

3 NUMAKER-PFM-NANO130 SCHEMATICS

3.1 Nu-Link-Me

Figure 3-1 shows the Nu-Link-Me circuit, which is a USB-to-SWD bridge used to program code to the target chip.
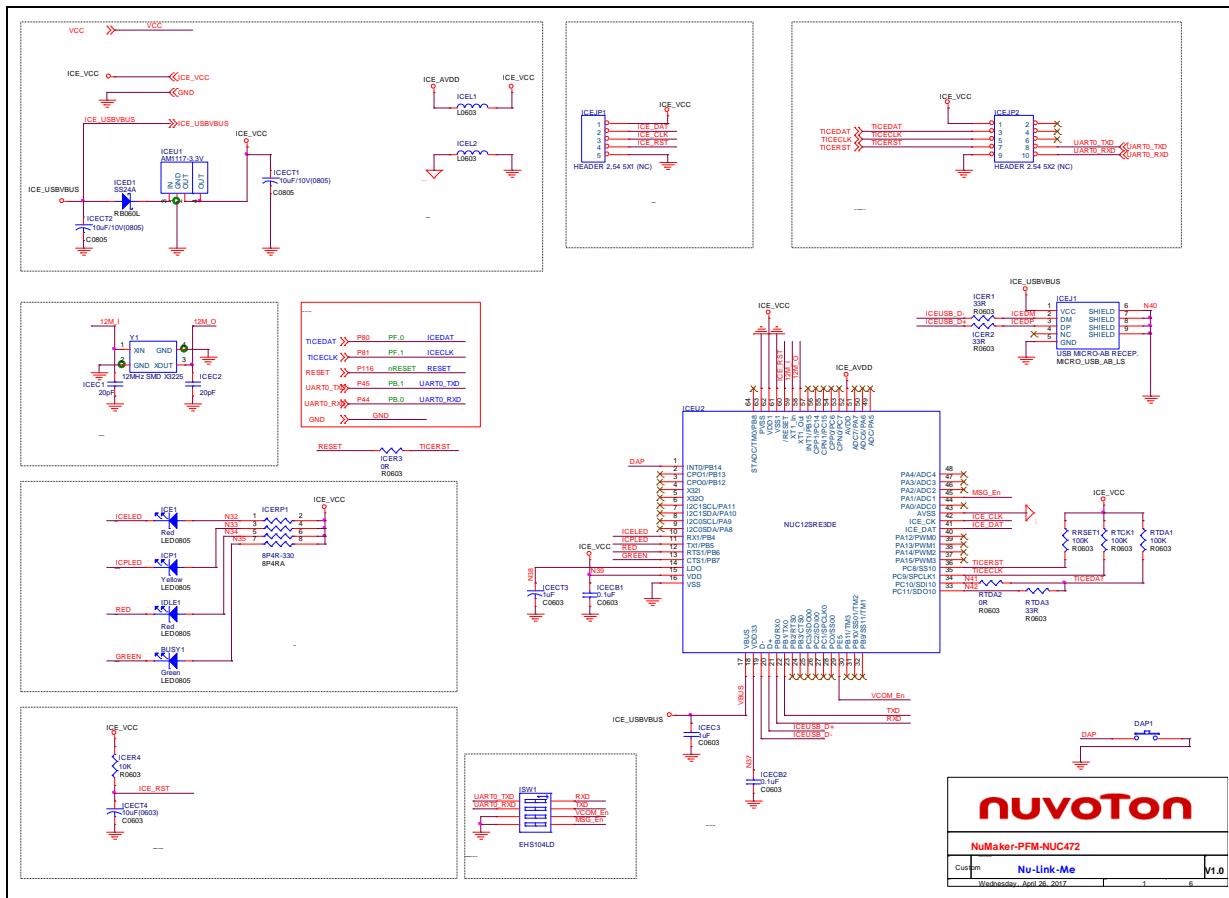

Figure 3-1 Nu-Link-Me Circuit

3.2 NANO130KE3BN

Figure 3-2 shows the pin assignment of the NANO130KE3BN.
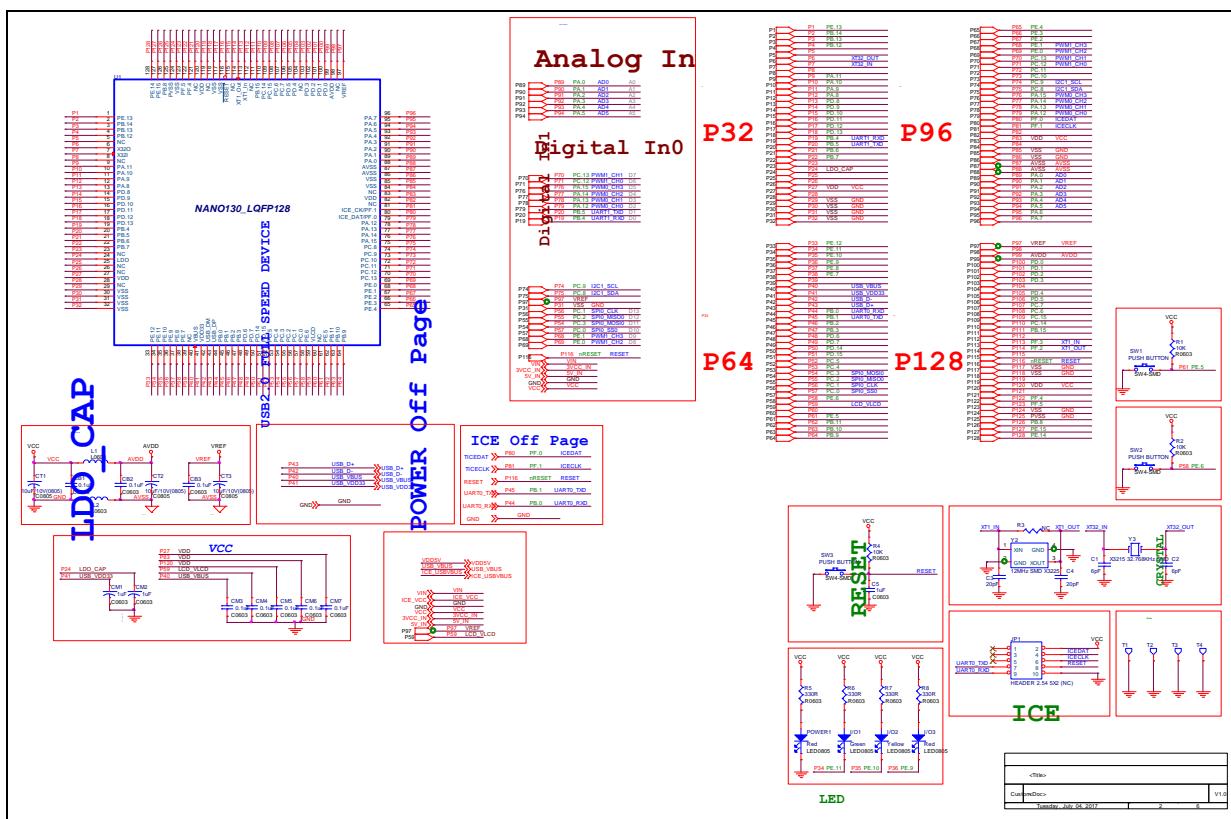
Figure 3-2 NANO130KE3BN Pin Assignment

3.3 Power Supply

Figure 3-3 shows power configurations of NuMaker-PFM-NANO130 board.
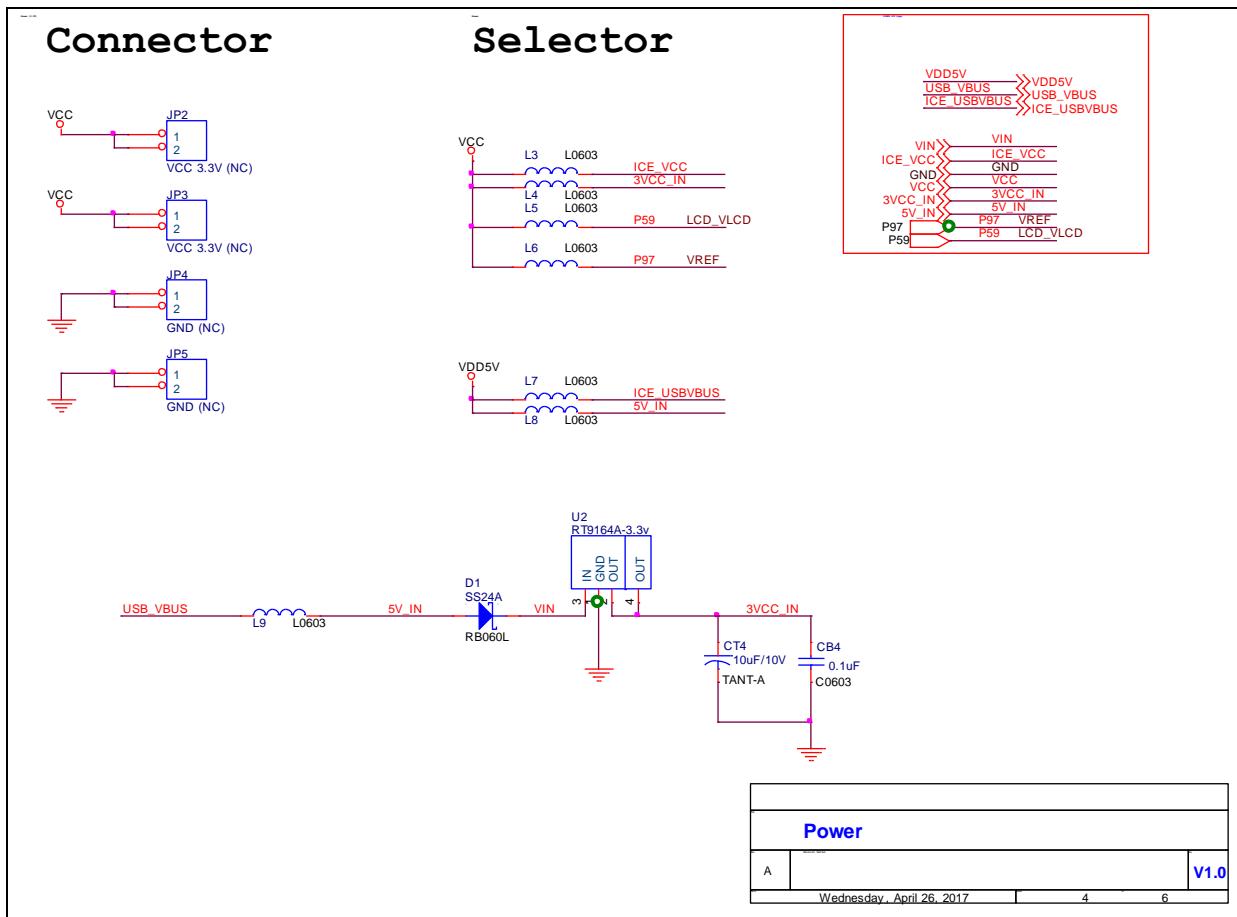

Figure 3-3 Power Circuit and Configurations

3.4 Arduino UNO Compatible Interface

Figure 3-4 shows the Arduino UNO compatible interface of NU1 to NU5 connectors.
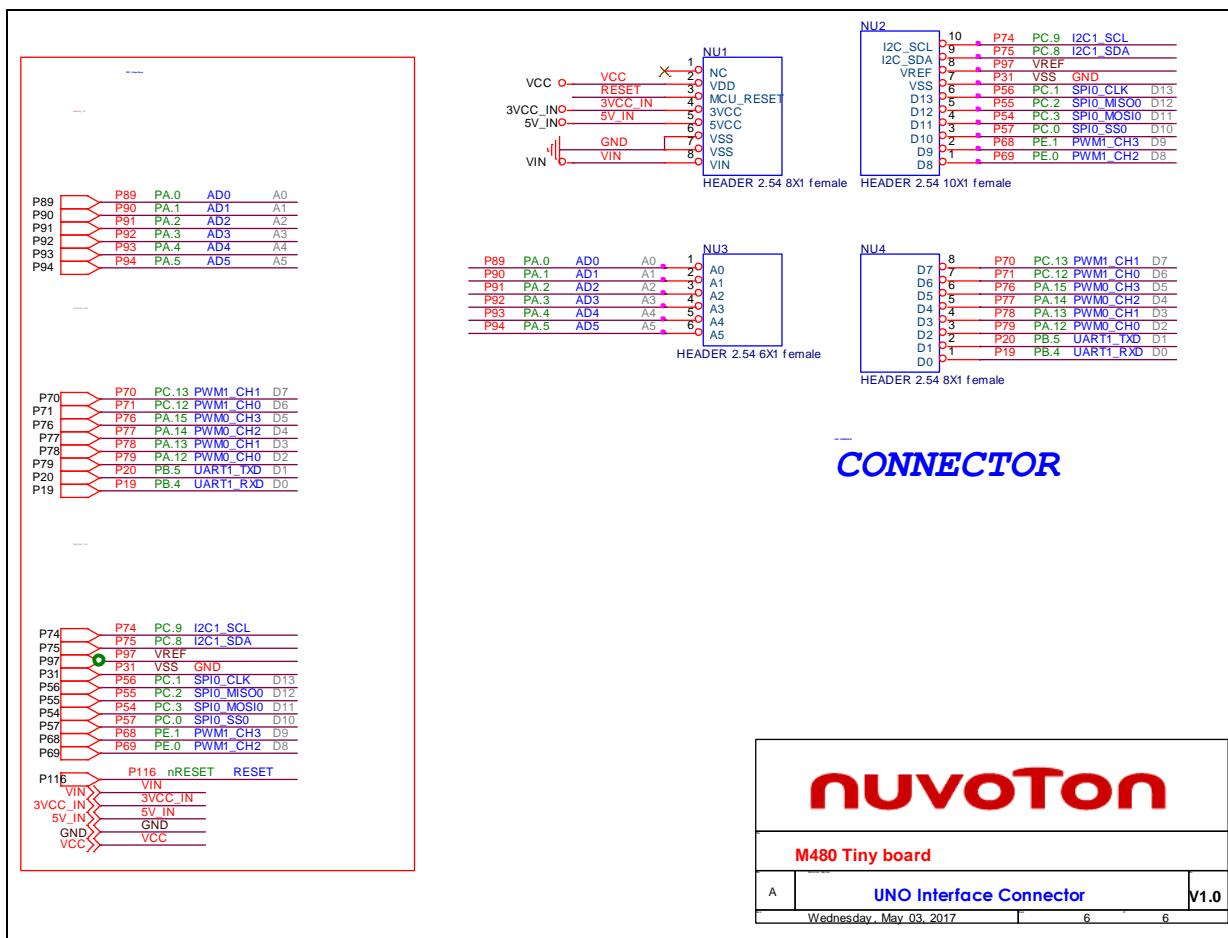

Figure 3-4 Arduino UNO Compatible Interface

3.5   USB 2.0 FS Device

Figure 3-5 shows the USB 2.0 FS device circuits on the NuMaker-PFM-NANO130 board.
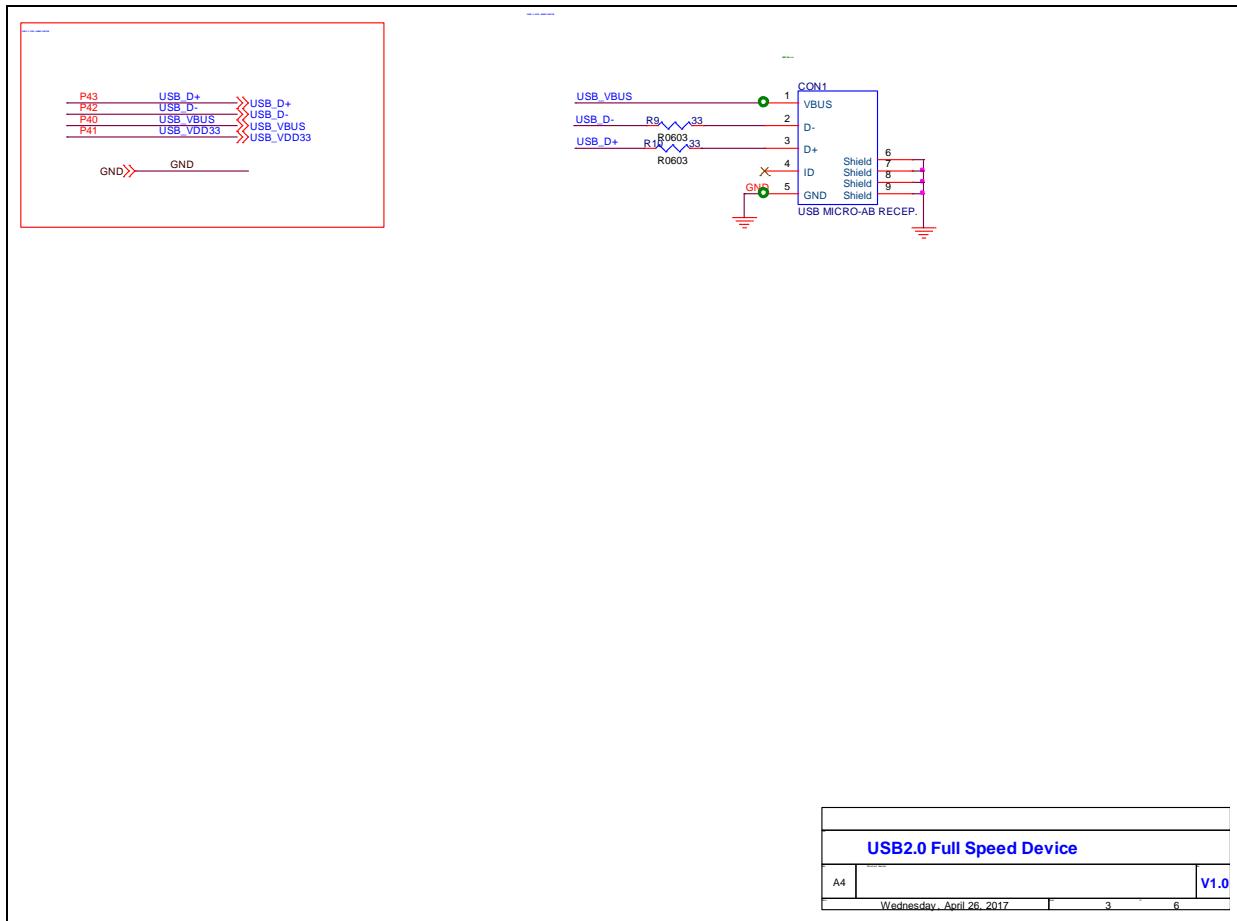
Figure 3-5 USB FS Device Circuits

3.6 Connector

Figure 3-6 shows the Connector circuits on the NuMaker-PFM-NANO130 board.
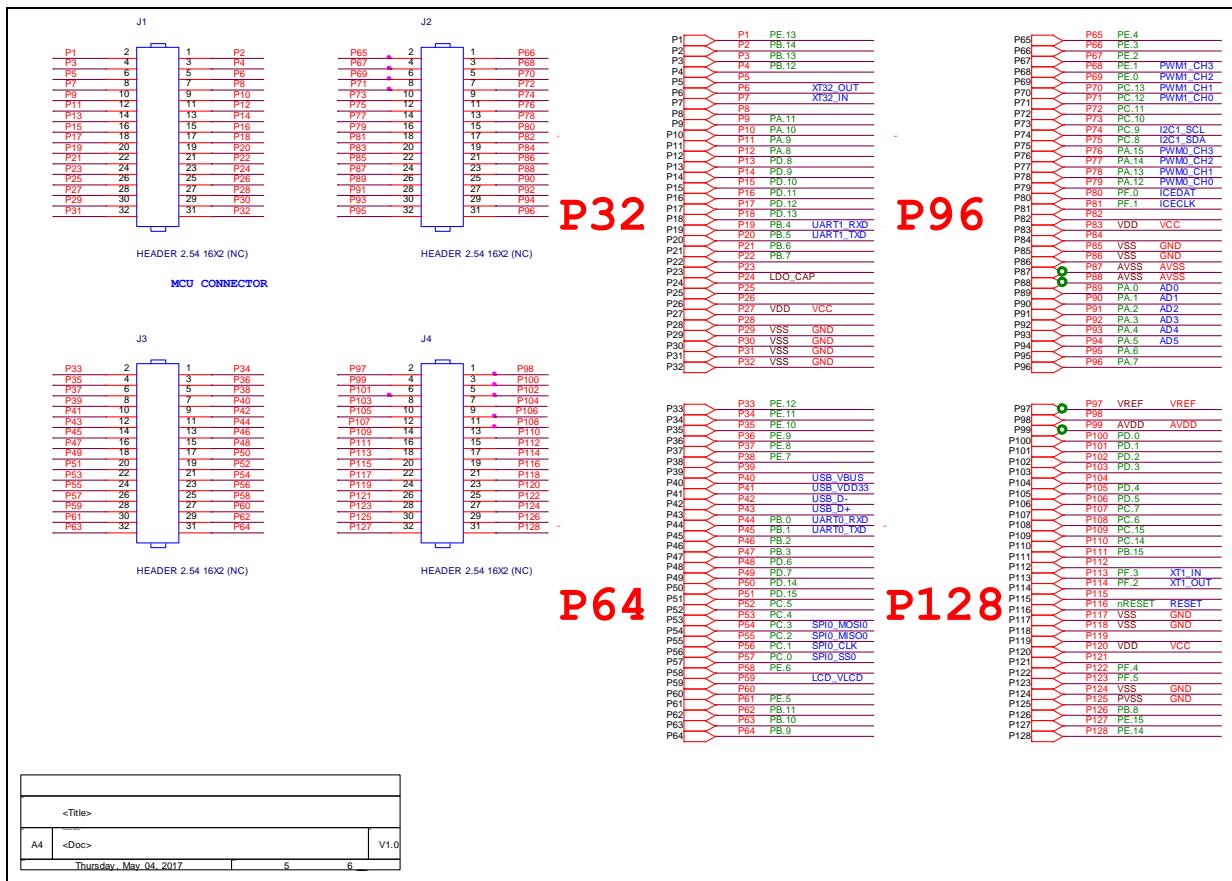
Figure 3-6 Connector Circuits

4   REVISION HISTORY

Date	Revision	Description
2018.07.10	1.00	1. Initially issued.

NUMAKER-PFM-NANO130 USER MANUAL

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