1T 8051

8-bit Microcontroller

NuMaker-ML51SD
User Manual
NuMicro® 8051 Series

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

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1 OVERVIEW

The NuMaker-ML51SD is a development board for Nuvoton NuMicro® ML51 series microcontrollers. The NuMaker-ML51SD consists of two parts: an ML51 platform and an on-board Nu-Link2-Me debugger and programmer. The NuMaker-ML51SD is designed for project evaluation, prototype development and validation with power consumption monitoring function.

The ML51 platform is based on NuMicro® ML51SD1AE. For the development flexibility, the ML51 platform provides the extension connectors of ML51SD1AE, the Arduino UNO compatible headers and able to adopt multiple power supply. Furthermore, the Nuvoton-designed ammeter connector can measure the power consumption instantly, which is essential for the prototype evaluation.

In addition to the ML51 platform, there is an attached on-board debugger and programmer “Nu-Link2-Me”. The Nu-Link2-Me supports on-chip debugging, online and offline ICP programming via SWD interface. The Nu-Link2-Me supports virtual COM (VCOM) port for printing debug messages on PC. Besides, the programming status could be shown on the built-in LEDs. Lastly, the Nu-Link2-Me could be detached from the development board and becoming a stand-alone mass production programmer.

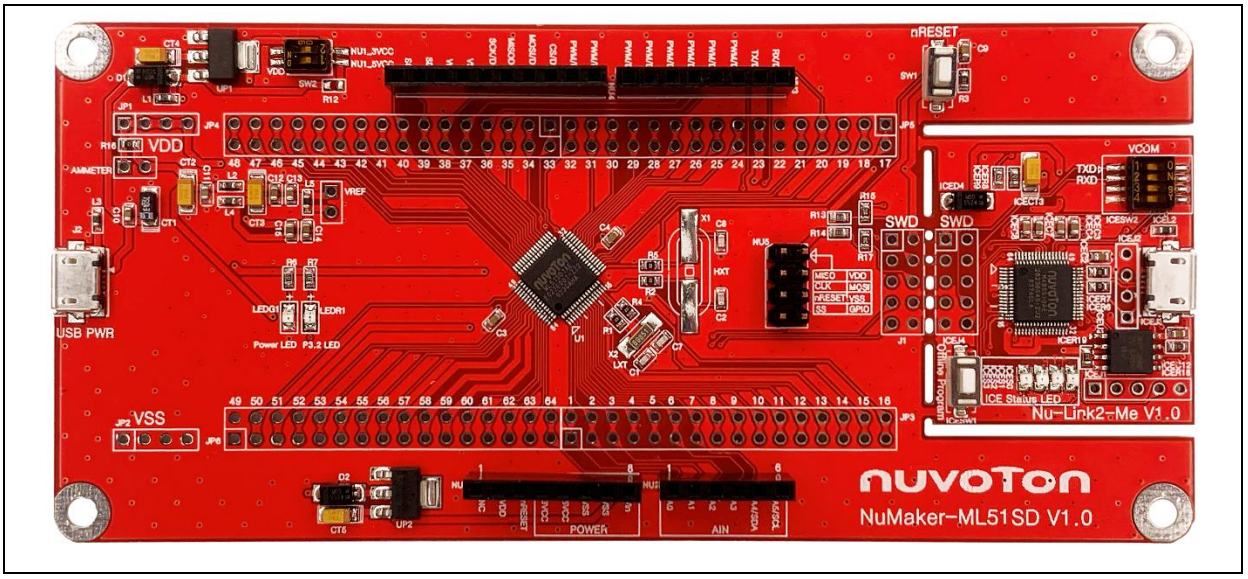


Figure 1-1 NuMaker-ML51SD Development Board

2 FEATURES

- NuMicro® ML51SD1AE microcontroller with function compatible with:
  - ML51TD1AE
  - ML51LD1AE
- ML51SD1AE extension connectors
- Arduino UNO compatible extension connectors
- Ammeter connector for measuring the microcontroller's power consumption
- Flexible board power supply:
  - External V_{DD} power connector
  - Arduino UNO compatible extension connector Vin
  - USB FS connector on ML51 platform
  - ICE USB connector on Nu-Link2-Me
- On-board Nu-Link2-Me debugger and programmer:
  - Debug through SWD interface
  - On-line/off-line programming
  - Virtual COM port function

3 HARDWARE CONFIGURATION

3.1 Front View

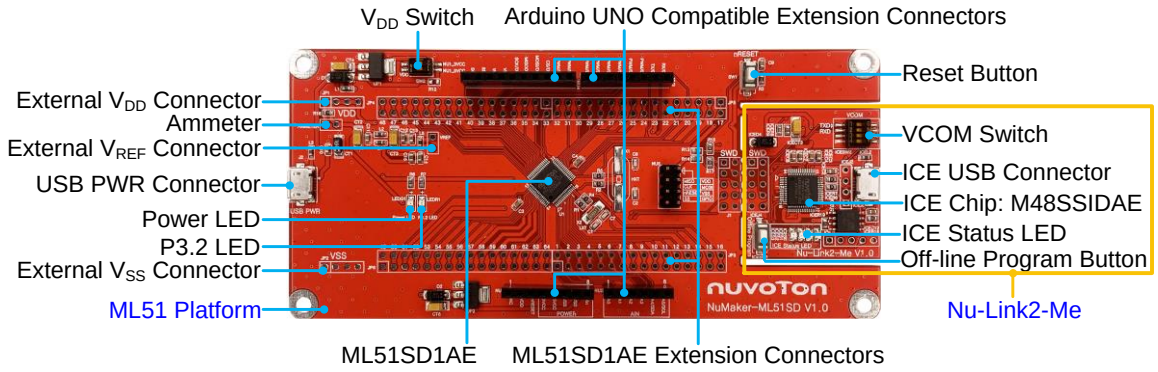


Figure 3-1 Front View of NuMaker-ML51SD

Figure 3-1 shows the main components and connectors from the front side of NuMaker-ML51SD. The following lists components and connectors from the front view:

- Target chip: ML51SD1AE (U1)
- USB PWR Connector (J2)
- Arduino UNO Compatible Extension Connectors (NU1, NU2, NU3, NU4)
- ML51 Extension Connectors (JP3, JP4, JP5 and JP6)
- External V_{DD} Power Connector (JP1)
- External V_{SS} Power Connector (JP2)
- External V_{REF} Connector (VREF)
- VDD Switch (SW2)
- Ammeter Connector (AMMETER)
- Reset Button (SW1)
- Power LED and P3.2 LED (LEDG1 and LEDR1)
- Nu-Link2-Me
  - VCOM Switch
  - ICE Chip: M48SSIDAE (ICEU2)
  - ICE USB Connector (ICEJ3)
  - ICE Status LED (ICES0, ICES1, ICES2, ICES3)
  - Off-line Program Button (ICESW1)

3.2 Rear View

Figure 3-2 shows the main components and connectors from the rear side of NuMaker-ML51SD.

The following lists components and connectors from the rear view:

- Nu-Link2-Me
  - MCUVCC Power Switch (ICEJPR1)
  - ICEVCC Power Switch (ICEJPR2)

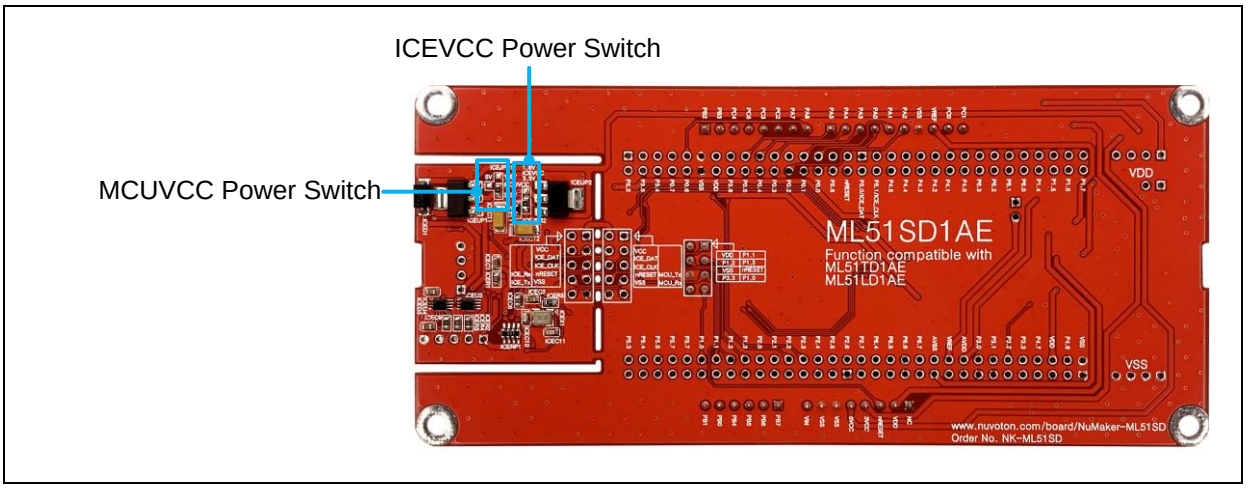


Figure 3-2 Rear View of NuMaker-ML51SD

3.3 Extension Connectors

Table 3-1 presents the extension connectors.

Connector	Description
JP3, JP4, JP5 and JP6	Full pins extension connectors on the NuMaker-ML51SD.
NU1, NU2, NU3 and NU4	Arduino UNO compatible pins on the NuMaker-ML51SD.

Table 3-1 Extension Connectors

3.3.1 Pin Assignment for Extension Connectors

The NuMaker-ML51SD provides the ML51SD1AE onboard and extension connectors (JP3, JP4, JP5 and JP6). The Figure 3-3 shows the ML51SD1AE extension connectors.

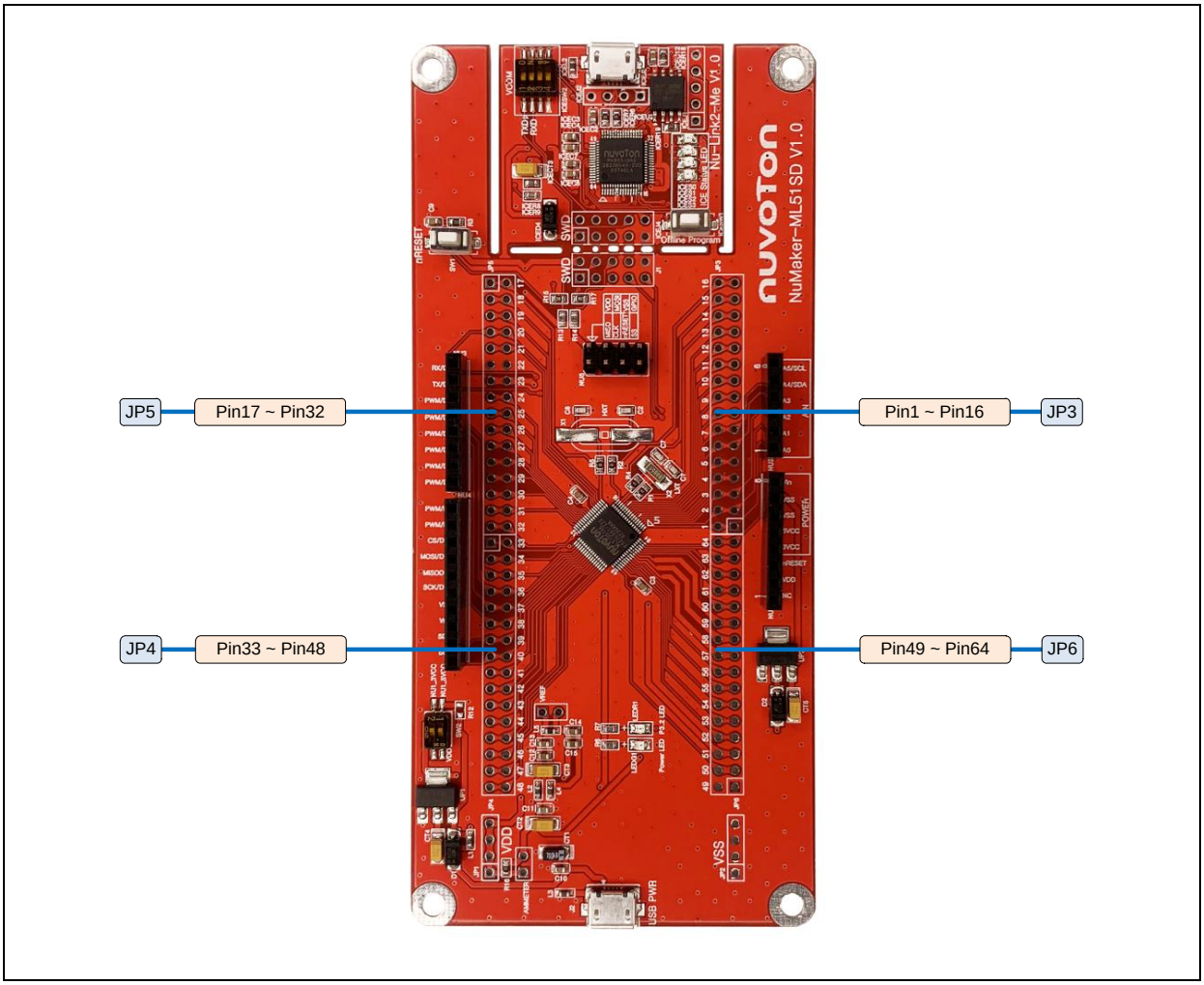


Figure 3-3 ML51SD1AE Extension Connectors

Header			ML51SD1AE	
			Pin No.	Function
JP3	JP3.1	JP3.2	1	P2.6 / UART1_RXD / PWM3_CH1 / ACMP1_O
	JP3.3	JP3.4	2	P2.5 / ADC_CH0 / ACMP0_P0 / ACMP1_P0 / I2C0_SCL / PWM0_CH0 / UART2_TXD / T0 / INT0
	JP3.5	JP3.6	3	P2.4 / ADC_CH1 / ACMP0_N0 / I2C0_SDA / PWM0_CH1 / UART2_RXD / T1 / INT1
	JP3.7	JP3.8	4	P2.3 / ADC_CH2 / ACMP0_P1 / ACMP1_P1 / I2C1_SCL / UART1_TXD / PWM0_CH2 / PWM0_BRAKE
	JP3.9	JP3.10	5	P2.2 / ADC_CH3 / ACMP1_N0 / I2C1_SDA / UART1_RXD / PWM0_CH3
	JP3.11	JP3.12	6	2.1 / ADC_CH4 / ACMP0_P2 / ACMP1_P2 / UART2_TXD / I2C1_SCL / PWM0_CH4 / PWM3_CH0 / PWM0_BRAKE
	JP3.13	JP3.14	7	P2.0 / ADC_CH5 / ACMP0_N1 / UART2_RXD / I2C1_SDA / PWM0_CH5 / PWM3_CH1 / PWM0_BRAKE
	JP3.15	JP3.16	8	P1.3 / IC0
	JP3.17	JP3.18	9	P1.2 / UART3_TXD / IC1
	JP3.19	JP3.20	10	P1.1 / UART3_RXD / UART1_TXD / IC2
	JP3.21	JP3.22	11	P1.0 / UART1_RXD / IC0
	JP3.23	JP3.24	12	P3.7 / SPI1_MOSI
	JP3.25	JP3.26	13	P5.7 / PWM0_BRAKE / PWM0_CH4 / CLKO
	JP3.27	JP3.28	14	P5.5 / UART2_RXD / PWM0_CH0 / X32_IN / STADC
	JP3.29	JP3.30	15	P5.4 / UART2_TXD / PWM0_CH1 / X32_OUT
	JP3.31	JP3.32	16	P5.3 / UART0_TXD / I2C0_SCL / XT1_IN
JP5	JP5.1	JP5.2	17	P5.2 / UART0_RXD / I2C0_SDA / XT1_OUT
	JP5.3	JP5.4	18	P3.5 / PWM2_CH0 / T0
	JP5.5	JP5.6	19	P3.4 / PWM2_CH1 / T1
	JP5.7	JP5.8	20	P0.7 / UART0_TXD / I2C1_SCL / PWM3_CH0 / INT1
	JP5.9	JP5.10	21	P0.6 / UART0_RXD / I2C1_SDA / PWM3_CH1 / INT0
	JP5.11	JP5.12	22	V_{SS}
	JP5.13	JP5.14	23	V_{DD}
	JP5.15	JP5.16	24	P3.6 / PWM0_CH5 / INT1
	JP5.17	JP5.18	25	P0.5 / UART0_TXD / I2C0_SCL / PWM0_CH0
	JP5.19	JP5.20	26	P0.4 / UART0_RXD / I2C0_SDA / PWM0_CH1
	JP5.21	JP5.22	27	P0.3 / SPI0_SS / SPI1_SS / UART1_TXD / I2C1_SCL / STADC / PWM0_CH2 / CLKO
	JP5.23	JP5.24	28	P0.2 / SPI0_CLK / SPI1_CLK / UART1_RXD / I2C1_SDA / PWM0_CH3
	JP5.25	JP5.26	29	P0.1 / SPI0_MISO / SPI1_MISO / UART2_RXD / UART0_TXD / PWM0_CH4
	JP5.27	JP5.28	30	P0.0 / SPI0_MOSI / SPI1_MOSI / UART2_TXD / UART0_RXD / PWM0_CH5
	JP5.29	JP5.30	31	P5.6 / PWM0_BRAKE / PWM0_CH1 / CLKO

	JP5.31	JP5.32	32	nRESET
JP4	JP4.1	JP4.2	33	P5.0 / UART1_TXD / I2C1_SCL / UART0_TXD / ICE_DAT
	JP4.3	JP4.4	34	P5.1 / UART1_RXD / I2C1_SDA / UART0_RXD / ICE_CLK
	JP4.5	JP4.6	35	P4.5 / UART2_TXD / I2C1_SCL / PWM1_CH0
	JP4.7	JP4.8	36	P4.4 / UART2_RXD / I2C1_SDA / PWM1_CH1
	JP4.9	JP4.10	37	P4.3 / PWM2_CH0
	JP4.11	JP4.12	38	P4.2 / PWM2_CH1
	JP4.13	JP4.14	39	P4.1 / UART2_TXD / I2C0_SCL / PWM3_CH0 / ACMP0_O
	JP4.15	JP4.16	40	P4.0 / UART2_RXD / I2C0_SDA / PWM3_CH1 / ACMP1_O / INT1
	JP4.17	JP4.18	41	P6.3 / SPI0_SS / UART0_TXD
	JP4.19	JP4.20	42	P6.2 / UART3_TXD / SPI0_CLK / UART0_RXD
	JP4.21	JP4.22	43	P6.1 / UART3_RXD / SPI0_MISO
	JP4.23	JP4.24	44	P6.0 / SPI0_MOSI
	JP4.25	JP4.26	45	P1.4 / I2C1_SCL
	JP4.27	JP4.28	46	P1.5 / I2C1_SDA
	JP4.29	JP4.30	47	P1.6 / UART0_TXD
	JP4.31	JP4.32	48	P1.7 / UART0_RXD
JP6	JP6.1	JP6.2	49	V_{SS}
	JP6.3	JP6.4	50	P4.6 / PWM0_CH0 / T0 / CLKO / INT0
	JP6.5	JP6.6	51	V_{DD}
	JP6.7	JP6.8	52	P4.7 / T1
	JP6.9	JP6.10	53	P3.3 / SPI1_SS / PWM1_CH0 / IC0 / PWM0_BRAKE
	JP6.11	JP6.12	54	P3.2 / ADC_CH7 / ACMP1_N1 / SPI1_CLK / UART3_RXD / PWM1_CH1 / IC1 / CLKO
	JP6.13	JP6.14	55	P3.1 / ADC_CH6 / ACMP0_P3 / ACMP1_P3 / SPI1_MISO / UART3_TXD / UART0_TXD / PWM2_CH0 / IC2
	JP6.15	JP6.16	56	P3.0 / ADC_CH10 / SPI1_MOSI / UART0_RXD / PWM2_CH1 / IC0
	JP6.17	JP6.18	57	AV_{DD}
	JP6.19	JP6.20	58	V_{REF}
	JP6.21	JP6.22	59	AV_{SS}
	JP6.23	JP6.24	60	P6.7 / ADC_CH11 / I2C1_SCL
	JP6.25	JP6.26	61	P6.6 / ADC_CH12 / I2C1_SDA
	JP6.27	JP6.28	62	P6.5 / ADC_CH13 / UART0_TXD
	JP6.29	JP6.30	63	P6.4 / ADC_CH14 / UART0_RXD
	JP6.31	JP6.32	64	P2.7 / ADC_CH15 / UART1_TXD / PWM3_CH0 / ACMP0_O

Table 3-2 ML51SD1AE Full-pin Extension Connectors and GPIO Function List

3.3.2 Arduino UNO Compatible Extension Connectors

Figure 3-4 shows the Arduino UNO compatible extension connectors.

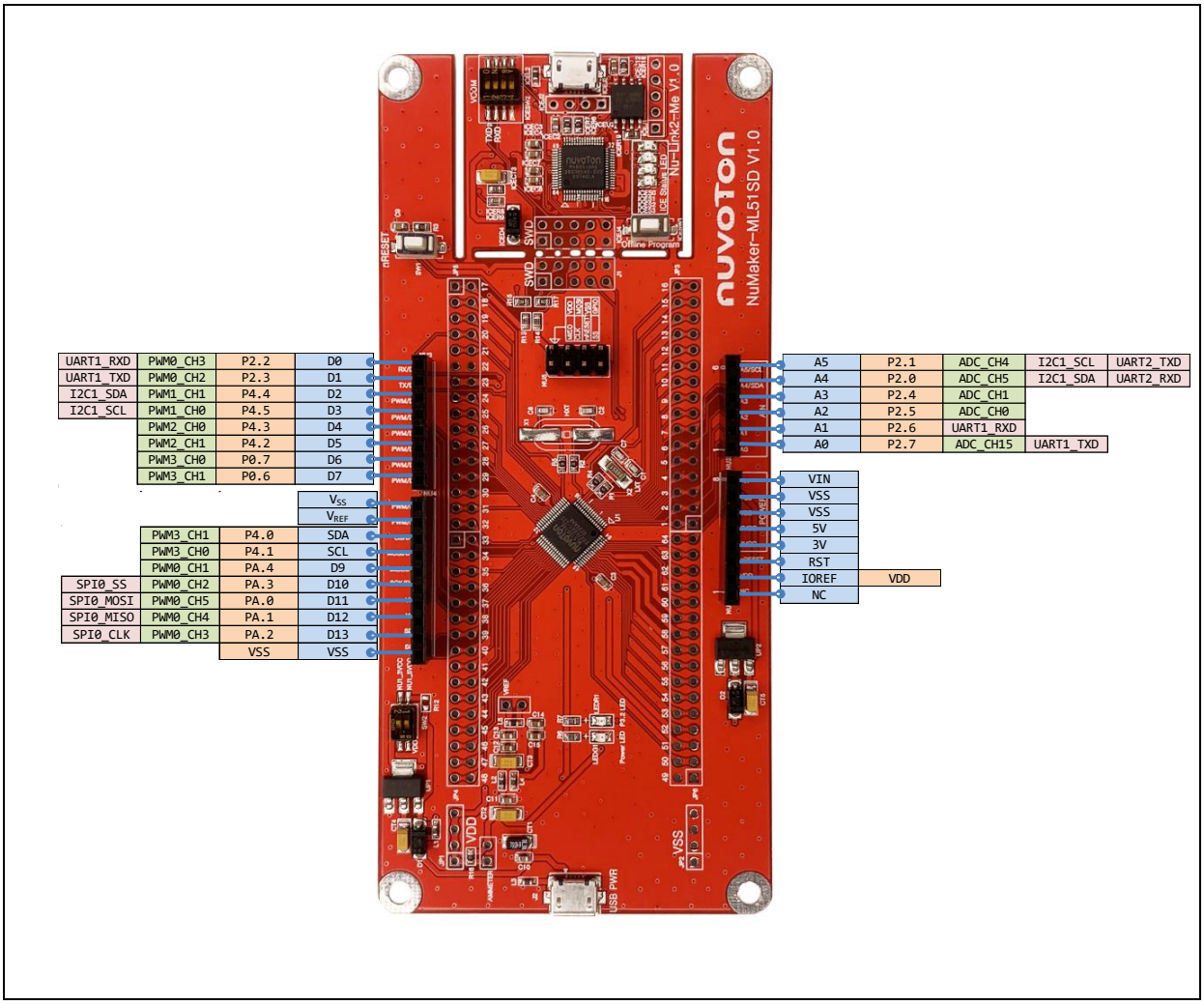


Figure 3-4 Arduino UNO Compatible Extension Connectors

Header		NuMaker-ML51SD		Header		NuMaker-ML51SD	
		Compatible to Arduino UNO	GPIO Pin of ML51			Compatible to Arduino UNO	GPIO Pin of ML51
NU3	NU3.1	D0	P2.2	NU2	NU2.6	A5	P2.1
	NU3.2	D1	P2.3		NU2.5	A4	P2.0
	NU3.3	D2	P4.4		NU2.4	A3	P2.4
	NU3.4	D3	P4.5		NU2.3	A2	P2.5
	NU3.5	D4	P4.3		NU2.2	A1	P2.6
	NU3.6	D5	P4.2		NU2.1	A0	P2.7
	NU3.7	D6	P0.7	NU1	NU1.8	VIN	-
	NU3.8	D7	P0.6		NU1.7	VSS	
NU4	NU4.1	D8	P0.5		NU1.6	VSS	
	NU4.2	D9	P0.4		NU1.5	5V	
	NU4.3	D10	P0.3		NU1.4	3V	
	NU4.4	D11	P0.0		NU1.3	RST	nRESET
	NU4.5	D12	P0.1		NU1.2	IOREF	V_{DD}
	NU4.6	D13	P0.2		NU1.1	NC	-
	NU4.7	VSS	V_{SS}				
	NU4.8	VREF	V_{REF}				
	NU4.9	SDA	P4.0				
	NU4.10	SCL	P4.1				

Table 3-3 Arduino UNO Extension Connectors and ML51SD1AE Mapping GPIO List

3.4 Power Supply Configuration

The NuMaker-ML51SD is able to adopt multiple power supply. External power source include NU1 Vin (7 V to 12 V), VDD (depends on target chip operating voltage), and PC through USB connector. By using switches and voltage regulator, multiple power domains can be created on the NuMaker-ML51SD.

3.4.1 VIN Power Source

Table 3-4 presents the Vin power source.

Connector	Net Name in Schematic	Description
NU1 pin8	NU1_VIN	Board external power source, with voltage range from 7 V to 12 V. The voltage regulator UP2 converts the NU1 pin8 input voltage to 5 V and supplies it to NU1_5VCC.

Table 3-4 Vin Power Source

3.4.2 5 V Power Sources

Table 3-5 presents the 5 V power sources.

Connector	Net Name in Schematic	Description
ICEJ3	USB_HS_VBUS	ICE USB connector supplies 5 V power from PC to ML51 platform and Nu-Link2-Me.
J2	USB_VBUS	USB connector on NuMaker-ML51SD supplies 5 V power from PC to ML51 platform and Nu-Link2-Me.
NU1 pin5	NU1_5VCC	ICEJ3, J2 or NU1 pin8 supplies 5 V power to NU1 pin5. NU1 pin5 supplies 5 V power to target chip or Arduino adapter board. **Note:** ML51 operating voltage range is from 1.8 V to 3.6 V. Do not switch SW2.1 (NU1 5VCC) to ON.

Table 3-5 5 V Power Sources

3.4.3 3.3 V Power Sources

Table 3-6 presents the 3.3 V power sources.

Voltage Regulator	5 V Source	Description
ICEUP1	USB_HS_VBUS	ICEUP1 converts USB_HS_VBUS to 3.3 V and supplies 3.3 V to ML51 platform or ICE chip.
UP1	USB_VBUS	UP1 converts USB_VBUS to 3.3 V and supplies 3.3 V to ML51 platform. **Note:** SW2.2 (NU1 3VCC) should be switched to ON.
UP1	NU1_5VCC	UP1 converts NU1_5VCC to 3.3 V and supplies 3.3 V to ML51 platform. **Note:** SW2.2 (NU1 3VCC) should be switched to ON.

Table 3-6 3.3 V Power Sources

3.4.4 1.8 V Power Sources

Table 3-7 presents the 1.8 V power source.

Voltage Regular	5V Source	Description
ICEUP2	USB_HS_VBUS	ICEUP2 converts USB_HS_VBUS to 1.8 V and supplies 1.8 V to ML51 platform or ICE chip.

Table 3-7 1.8 V Power Sources

3.4.5 Power Connectors

Table 3-8 presents the power connectors.

Connector	Description
JP1	V_{DD} connector on the NuMaker-ML51SD. **Note:** ML51SD1AE operating voltage range is from 1.8 V to 3.6 V.
JP2	V_{SS} connector on the NuMaker-ML51SD.

Table 3-8 Power Connectors

3.4.6 USB Connectors

Table 3-9 presents the USB connectors.

Connector	Description
ICEJ3	ICE USB connector on Nu-Link2-Me for power supply, debugging and programming from PC.
J2	USB FS connector on NuMaker-ML51SD for power supply.

Table 3-9 USB Connectors

3.4.7 Power Switches

Table 3-10 presents the power switches.

Switch	Description
ICEJPR1	Configures the target chip operating voltage at 1.8 V / 3.3 V / 5 V. **Note:** ML51SD1AE operating voltage range is from 1.8 V to 3.6 V. Do not switch ICEJPR1 (MCUVCC) to 5 V.
ICEJPR2	Configures the ICE chip operating voltage at 1.8 V / 3.3 V.
SW2	Configures the target chip operating voltage at 3.3 V / 5 V. **Note:** ML51SD1AE operating voltage range is from 1.8 V to 3.6 V. Do not switch SW2.1 (NU1 5VCC) to ON.

Table 3-10 Power Switches

3.4.8 Power Supply Models

3.4.8.1 External Power Supply through Nu-Link2-Me to Target Chip

The external power supply source on Nu-Link2-Me is shown in Figure 3-5.

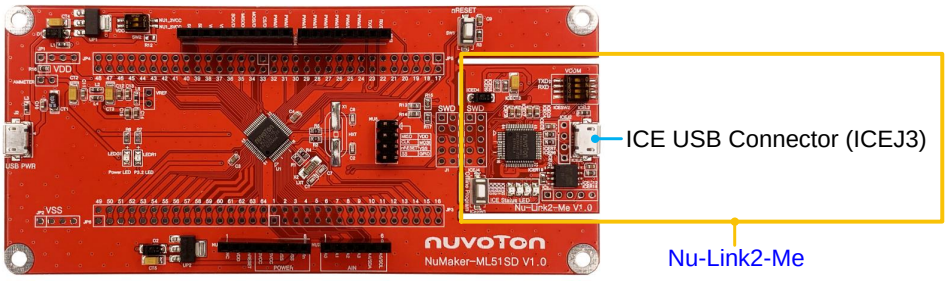


Figure 3-5 External Power Supply Sources on Nu-Link2-Me

To use ICEJ3 as external power supply source with Nu-Link2-Me, please follow the below steps:

1. Solder the resistor on ICEJPR1 (MCUVCC) depends on the target chip operating voltage.
2. Solder the resistor on ICEJPR2 (ICEVCC) depends on the ICE chip operating voltage.
3. Switch the SW2 to OFF.
4. Connect the external power supply to ICEJ3.

Table 3-11 presents all power models when supplies external power through Nu-Link2-Me. The Nu-Link2-Me external power sources are highlighted in yellow.

Model	Target Chip Voltage	ICEJ3	ICEJPR1 (MCUVCC) Selection [1]	ICEJPR2 (ICEVCC) Selection [2]	ICE Chip Voltage	SW2 Selection	J2	Vin	JP1
1	1.8 V	Connect to PC	1.8 V	1.8 V	1.8 V	Off	X	X	1.8 V output
2	3.3 V	Connect to PC	3.3 V (default)	3.3 V (default)	3.3 V	Off	X	X	3.3 V output
3	5 V	Connect to PC	5 V	3.3 V (default)	3.3 V	Off	X	X	5 V output
	Note: 1. 0 Ω should be soldered between ICEJPR1's MCUVCC and 1.8 V / 3.3 V / 5 V. 2. 0 Ω should be soldered between ICEJPR2's ICEVCC and 1.8 V / 3.3 V. 3. X: Unused.								

Table 3-11 Supply External Power through Nu-Link2-Me

3.4.8.2 External Power Supply through ML51 platform to Target Chip

The external power supply sources on ML51 platform are shown in Figure 3-6.

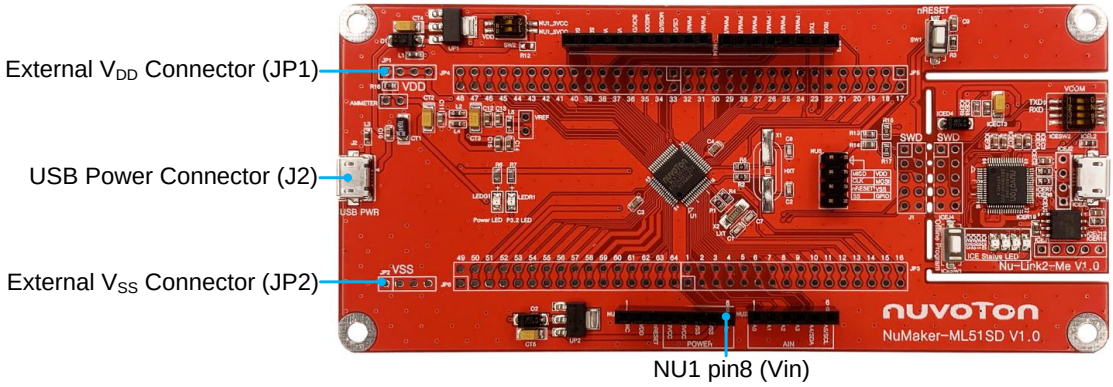


Figure 3-6 External Power Supply Sources on ML51 platform

To use Vin or J2 as external power supply source, please follow the below steps:

1. Switch the SW2 depends on the target chip operating voltage.
2. Remove the resistor on ICEJPR1 (MCUVCC).
3. Solder the resistor on ICEJPR2 (ICEVCC) depends on the ICE chip operating voltage.
4. Connect the external power supply to Vin or J2.

To use JP1 as external power supply source, please follow the below steps:

1. Switch the SW2 to OFF.
2. Remove the resistor on ICEJPR1 (MCUVCC).
3. Solder the resistor on ICEJPR2 (ICEVCC) depends on the ICE chip operating voltage.
4. Connect ICEJ3 to PC.
5. Connect the external power supply to JP1.

To use Vin or J2 as external power supply source with Nu-Link2-Me detached from NuMaker-ML51SD, please follow the below steps:

1. Switch the SW2 depends on the target chip operating voltage.
2. Detach the Nu-Link2-Me from NuMaker-ML51SD.
3. Connect the external power supply to Vin or J2.

To use JP1 as external power supply source with Nu-Link2-Me detached from NuMaker-ML51SD, please follow the below steps:

1. Switch the SW2 to OFF.
2. Detach the Nu-Link2-Me from NuMaker-ML51SD.
3. Connect the external power supply to JP1.

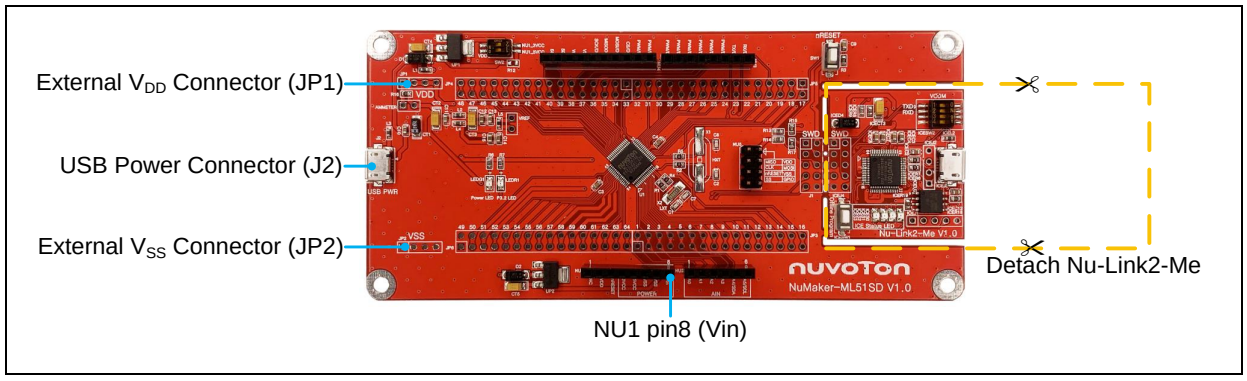


Figure 3-7 Detach the Nu-Link2-Me from NuMaker-ML51SD

Table 3-12 presents all power models when supplies external power through ML51 platform. The ML51 platform external power sources are highlighted in yellow.

Model	Target Chip Voltage	Vin [1]	J2[1]	ICEJ3	SW2 Selection	JP1[2]	ICEJPR1 (MCUVCC) Selection [3]	ICEJPR2 (ICEVCC) Selection [4]	ICE Chip Voltage [5]
4	3.3 V	7 V ~ 12 V Input	X	X	NU1 3VCC	3.3 V output	Remove resistor	3.3 V	3.3 V
5	3.3 V	X	Connect to PC	X	NU1 3VCC	3.3 V output	Remove resistor	3.3 V	3.3 V
6	5 V	7 V ~ 12 V Input	X	X	NU1 5VCC	5 V output	Remove resistor	3.3 V	3.3 V
7	5 V	X	Connect to PC	X	NU1 5VCC	5 V output	Remove resistor	3.3 V	3.3 V
8	1.8 V ~ 3.6 V	X	X	Connect to PC	OFF	DC Input 1.8 V ~ 3.6 V	Remove resistor	1.8 V / 3.3 V	1.8 V / 3.3 V
9	1.8 V ~ 3.6 V	X	X	Nu-Link2-Me removed	OFF	DC Input 1.8 V ~ 3.6 V	X	X	X

Note:

1. The Vin input voltage will be converted by voltage regulator UP2 to 5 V. Supply external power to Vin or J2 can provide 5 V to NU1 pin5 (5V) and 3.3 V to NU1 pin4 (3VCC).
2. JP1 external power input only provides voltage to target chip.
3. 0 Ω should be removed from ICEJPR1's MCUVCC and 1.8 V / 3.3 V / 5 V.
4. 0 Ω should be soldered between ICEJPR2's ICEVCC and 1.8 V / 3.3 V.
5. The ICE chip voltage should be close to the target chip voltage.
6. X: Unused

Table 3-12 Supply External Power for ML51 platform

3.5 External Reference Voltage Connector

Table 3-14 presents the external reference voltage connector.

Connector	Description
VREF	Connector for user to connect to the external reference voltage pin of the target chip. User needs to remove the L5 ferrite bead.

Table 3-13 External Reference Voltage Connector

3.6 Ammeter Connector

Table 3-14 presents the ammeter connector.

Connector	Description
AMMETER	Connector for user to measure the target chip power consumption easily. User needs to remove the R16 resistor.

Table 3-14 Ammeter Connector

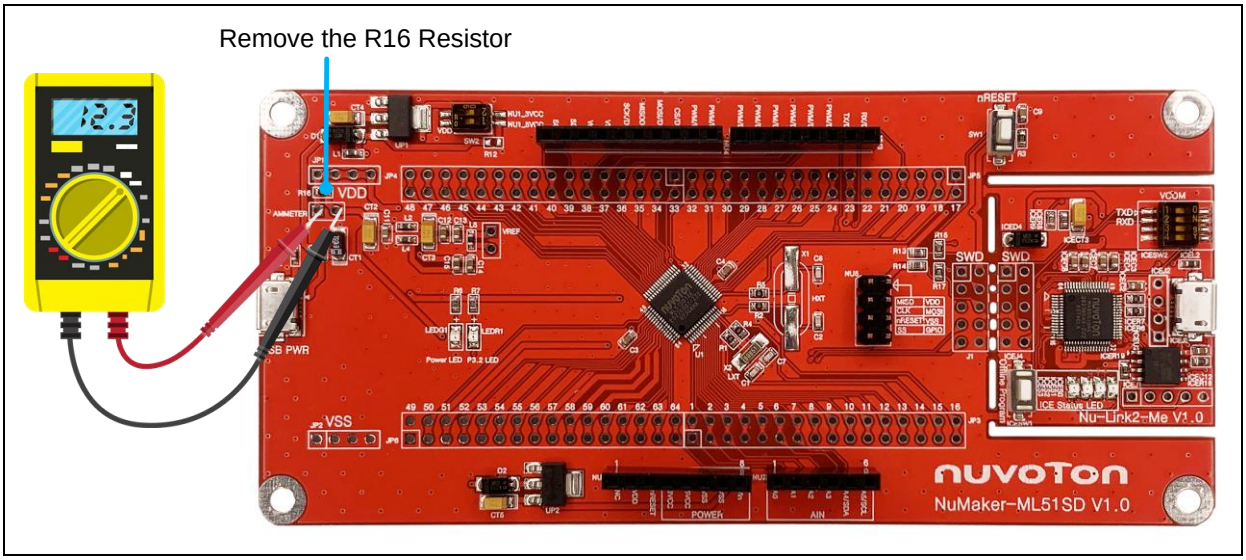


Figure 3-8 Wiring between Ammeter Connector and Ammeter

3.7 Push Buttons

Table 3-15 presents the push buttons.

Component	Description
ICESW1	Offline program button to start offline ICP programming the target chip.
SW1	Reset button to reset the target chip.

Table 3-15 Push-Buttons

3.8 LEDs

Table 3-16 presents the LEDs.

Component	Description
Power LED	The power LED indicates that the NuMaker-ML51SD is powered.
P3.2 LED	The LED is connected to the target chip P3.2.
ICES0, ICES1, ICES2 and ICES3	Nu-Link2-Me status LED.

Table 3-16 LEDs

3.9 Nu-Link2-Me

The Nu-Link2-Me is an attached on-board debugger and programmer. The Nu-Link2-Me supports on-chip debugging, online and offline ICP programming through SWD interface. The Nu-Link2-Me also supports virtual COM port (VCOM) for printing debug messages on PC. Besides, the programming status could be shown on the built-in LEDs. Lastly, the Nu-Link2-Me could be detached from the development board and becoming a stand-alone mass production programmer. For more information about Nu-Link2-Me, please refer to Nu-Link2-Pro Debugger and Programmer User Manual.

3.9.1 VCOM Switches

Table 3-17 presents how to set the VCOM function by ICESW2.

ICESW2		
Pin	**Function**	**Description**
1	TXD	**On**: Connect target chip P3.1 (UART0_TXD) to Nu-Link2-Me. **Off**: Disconnect target chip P3.1 (UART0_TXD) to Nu-Link2-Me.
2	RXD	**On**: Connect target chip P3.0 (UART0_RXD) to Nu-Link2-Me. **Off**: Disconnect target chip P3.0 (UART0_RXD) to Nu-Link2-Me.
Note: Pin 3 and 4 is unused.		

Table 3-17 VCOM Function of Nu-Link2-Me

3.9.2 Status LEDs

Table 3-16 presents the status LEDs patterns for different operation on Nu-Link2-Me.

Operation Status	**Status LED**			
	ICES0	**ICES1**	**ICES2**	**ICES3**
Power on	Flash x 3	Flash x 3	Flash x 3	Flash x 3
Connected to IDE/NuTool	Flash x 3	Flash x 3	Flash x 3	On
ICE online (Not connected to a target chip)	On	-	Flash x 3	Flash x 3
ICE online (Connected to a target chip)	On	-	-	On
ICE online (Failed to connect to a target chip)	On	Any	Flash	On
During Offline Programming	-	On	-	Flash
Offline Programming Completed	On	-	-	-
Offline Programming Completed (Auto mode)	On	On	-	-
Offline Programming Failed	On	Flash	-	-

Table 3-18 Operation Status LED Patterns

4 QUICK START

4.1 Toolchains Supporting

Install the preferred toolchain. Please make sure at least one of the toolchains has been installed.

- KEIL C51
- IAR EW8051

4.2 Nuvoton Nu-Link Driver Installation

Download and install the latest Nuvoton Nu-Link Driver.

- Download and install Nu-Link_Keil_Driver when using Keil C51.
- Download and install Nu-Link_IAR_Driver when using IAR EW8051.

Please install the Nu-Link USB Driver as well at the end of the installation. The installation is presented in Figure 4-1 and Figure 4-2.

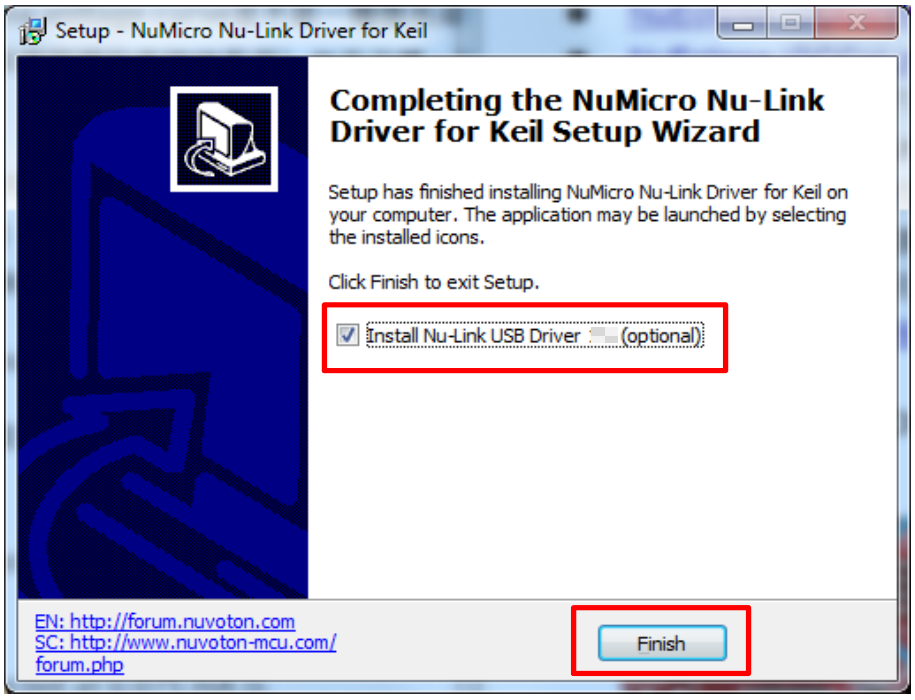


Figure 4-1 Nu-Link USB Driver Installation Setup

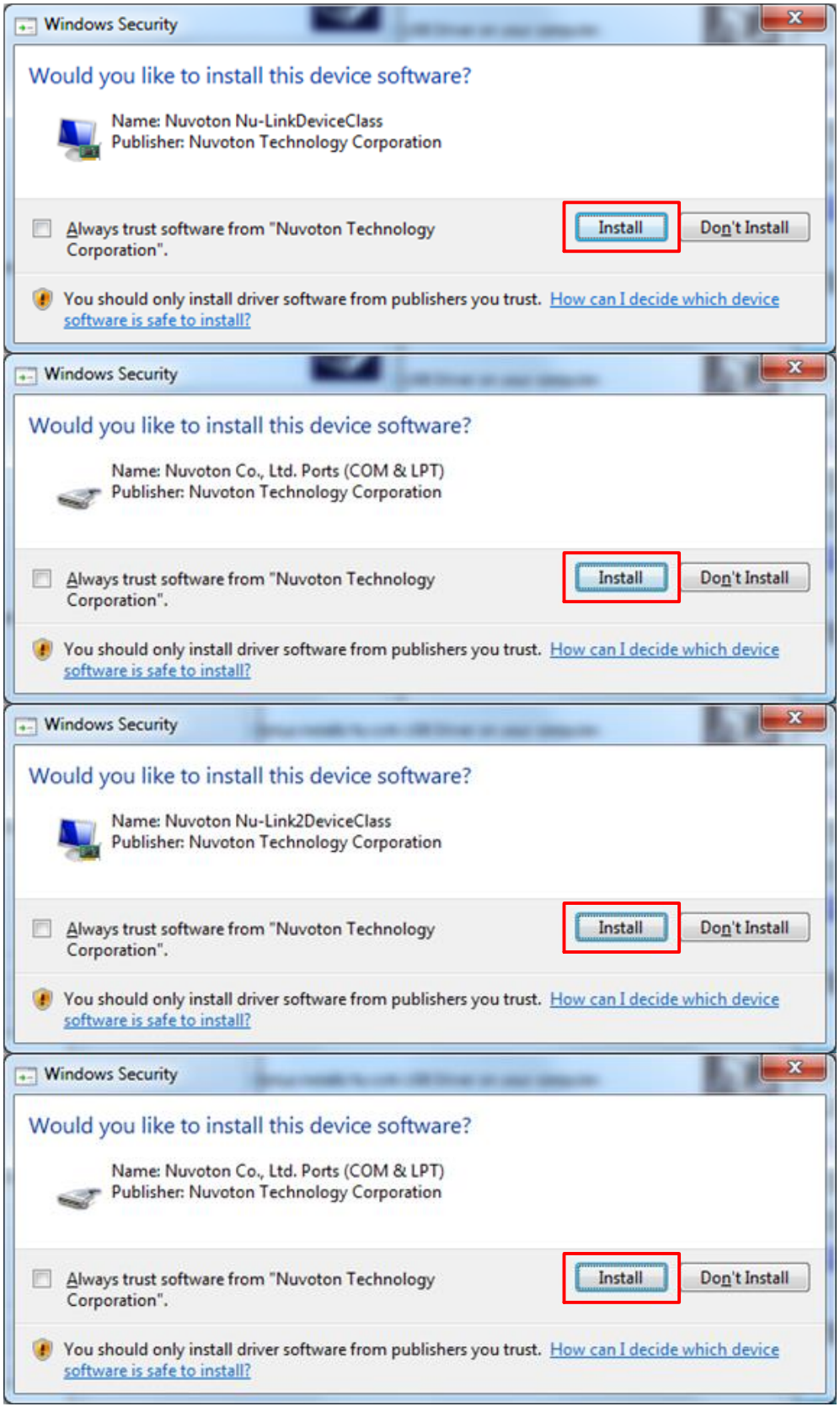


Figure 4-2 Nu-Link USB Driver Installation

4.3 BSP Firmware Download

Download and unzip the Board Support Package (BSP).

4.4 Hardware Setup

1. Open the virtual COM (VCOM) function by changing Nu-Link2-Me VCOM Switch No. 1 and 2 to ON.

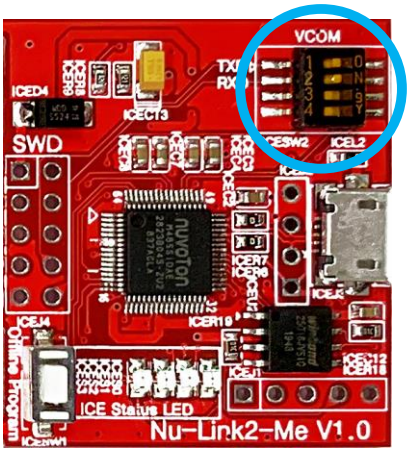


Figure 4-3 Open VCOM Function

2. Connect the ICE USB connector shown in Figure 4-4 to the PC USB port through USB cable.

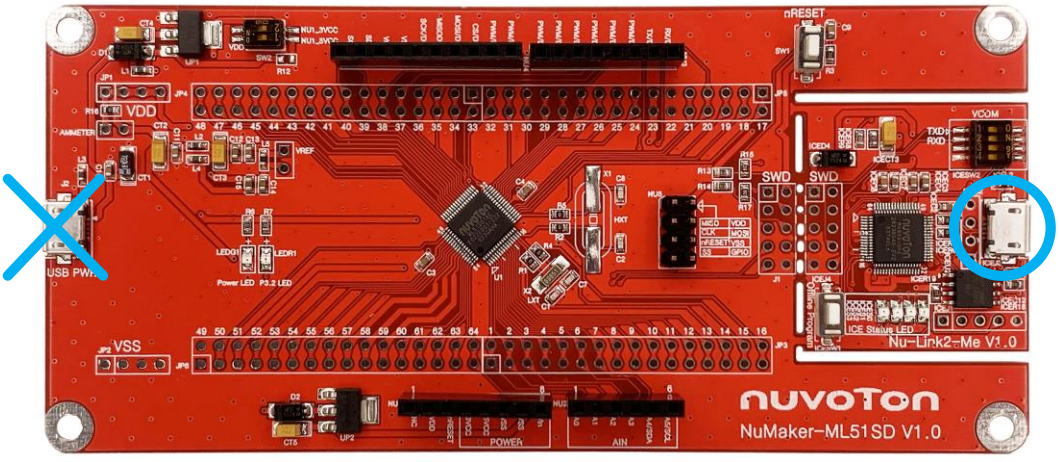


Figure 4-4 ICE USB Connector

3. Find the “Nuvoton Virtual COM Port” on the Device Manger as Figure 4-5.

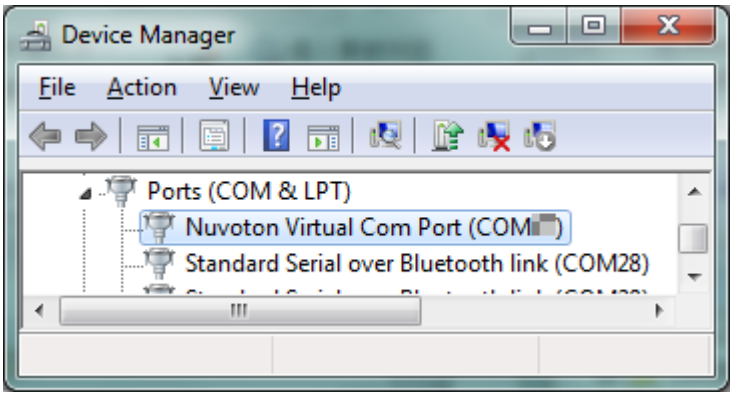


Figure 4-5 Device Manger

4. Open a serial port terminal, PuTTY for example, to print out debug message. Set the speed to 115200. Figure 4-6 presents the PuTTY session setting.

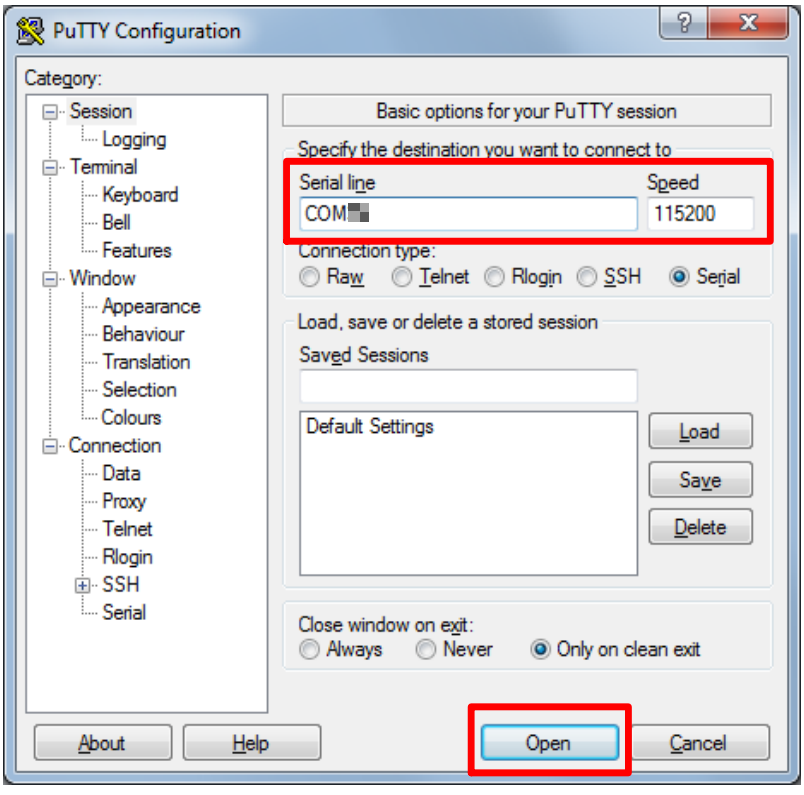


Figure 4-6 PuTTY Session Setting

4.5 Find the Example Project

Use the “Template” project as an example. The project can be found under the BSP folder as shown in Figure 4-7.

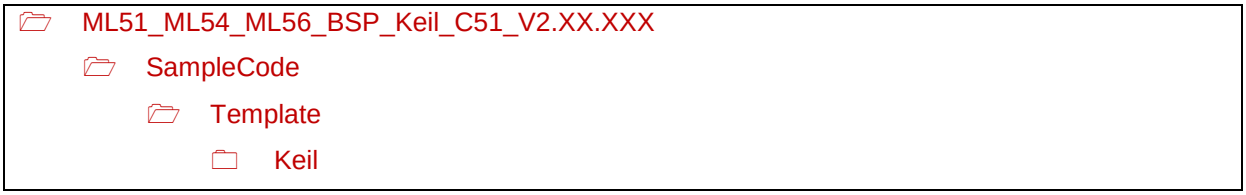


Figure 4-7 Template Project Folder Path

4.6 Execute the Project under Toolchains

Open and execute the project under the toolchain. The section 4.6.1 and 4.6.2 describe the steps of executing project in Keil C51, IAR EW8051 , respectively.

4.6.1 Keil C51

This section provides steps to beginners on how to run a project by using Keil C51.

1. Double click the “Template.uvproj” to open the project.

   Note: If Figure 4-8 warning message jumps out, please migrate to version 5 formats as shown in Figure 4-9. The “.uvproj” filename extension will change to “.uvprojx”.

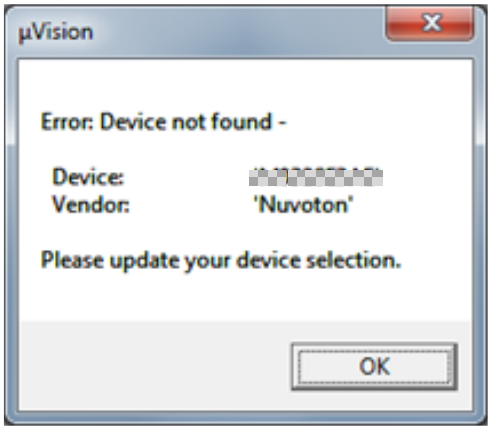


Figure 4-8 Warning Message of “Device not found”

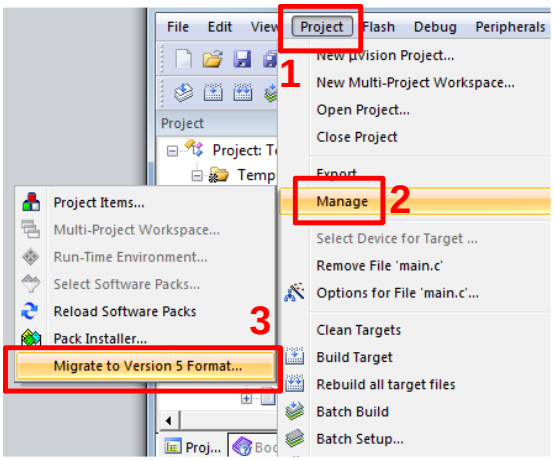


Figure 4-9 Project File Migrate to Version 5 Format

2. Make sure the debugger is “Nuvoton Nu-Link Debugger” as shown in Figure 4-10 and Figure 4-11.

   Note: If the dropdown menu in Figure 4-10 does not contain “Nuvoton Nu-Link Debugger” item, please rework section 4.2.

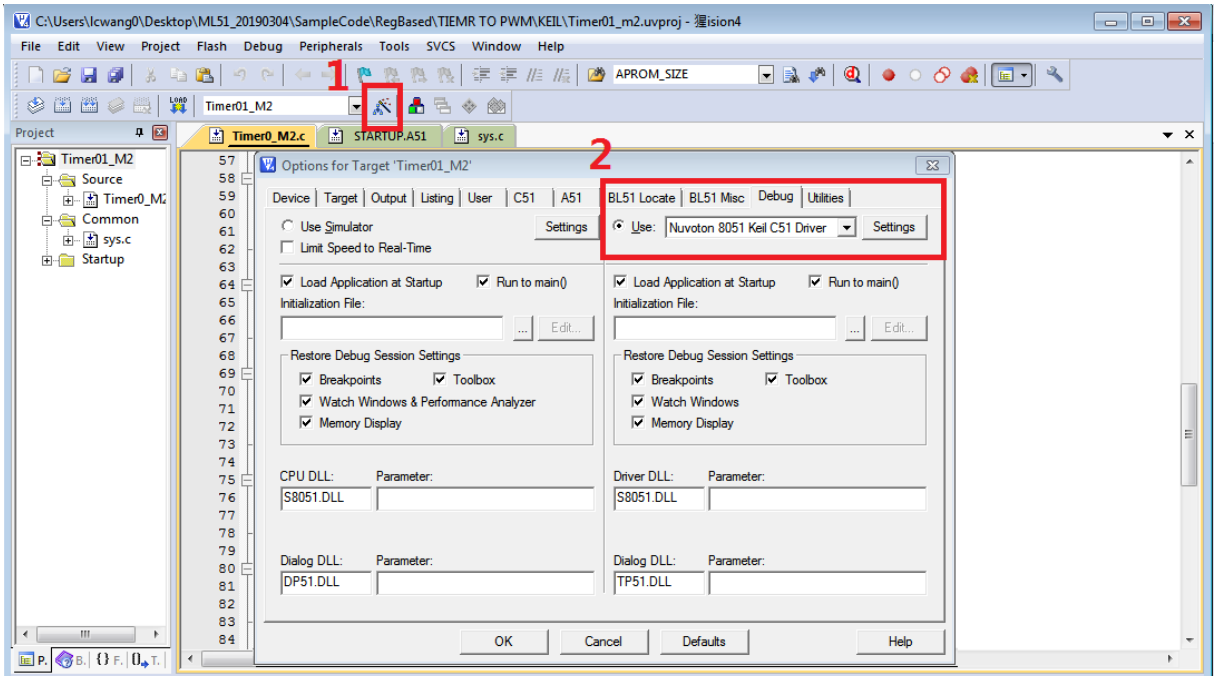


Figure 4-10 Debugger Setting in Options Window

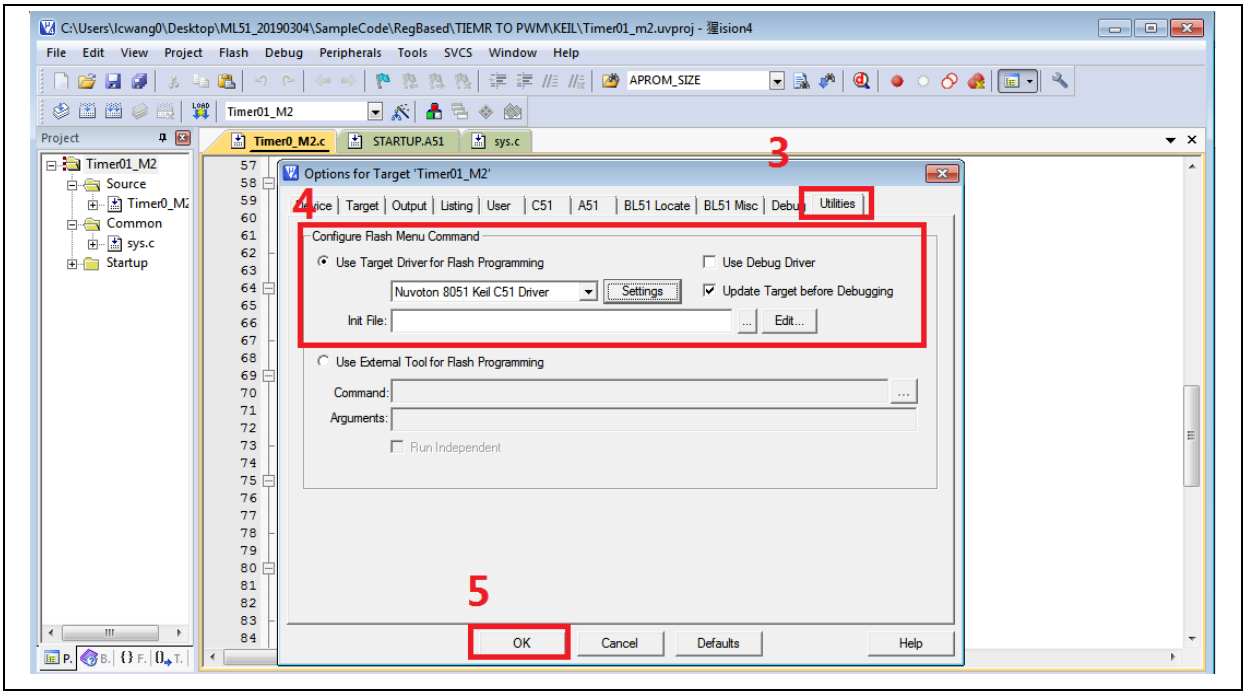


Figure 4-11 Programming Setting in Options Window

3. Rebuild all target files. After successfully compile the project, download code to the flash memory. Click “Start/Stop Debug Section” button can enter debug mode.

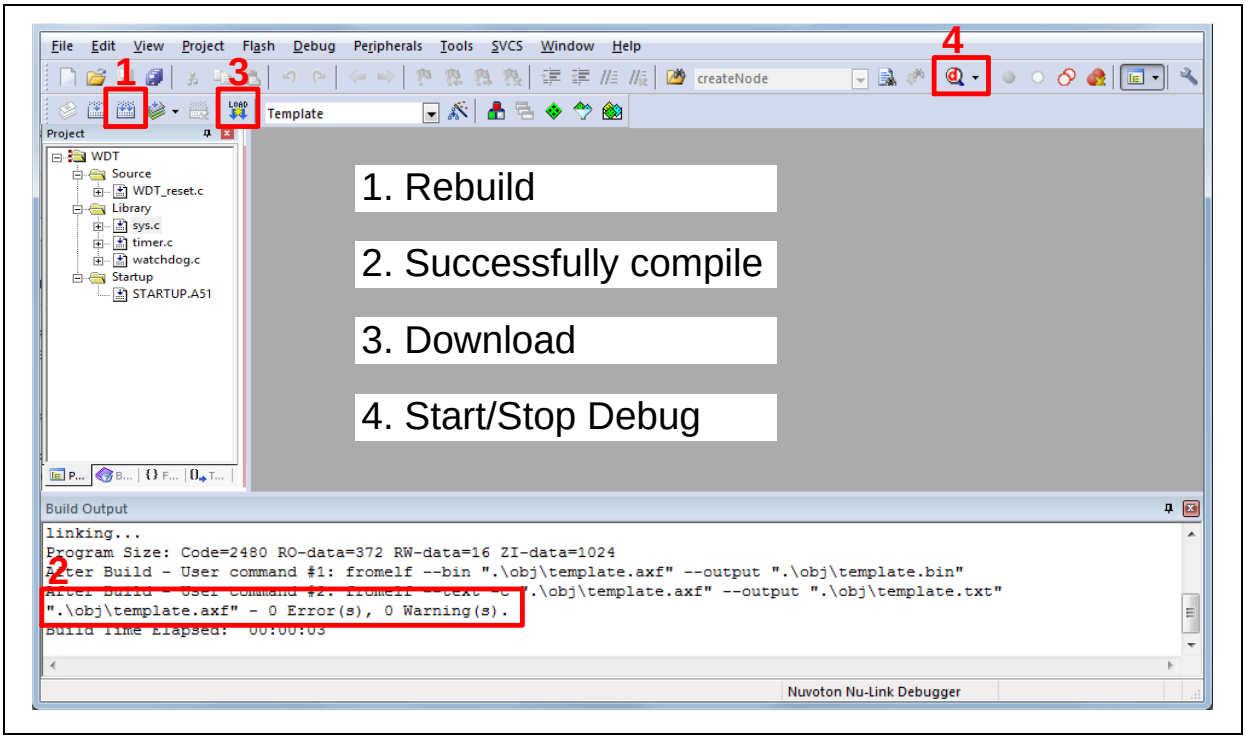


Figure 4-12 Compile and Download the Project

4. Figure 4-13 shows the debug mode under Keil C51. Click “Run” and the debug message will be

printed out as shown in Figure 4-14. User can debug the project under debug mode by checking source code, assembly language, peripherals' registers, and setting breakpoint, step run, value monitor, etc.

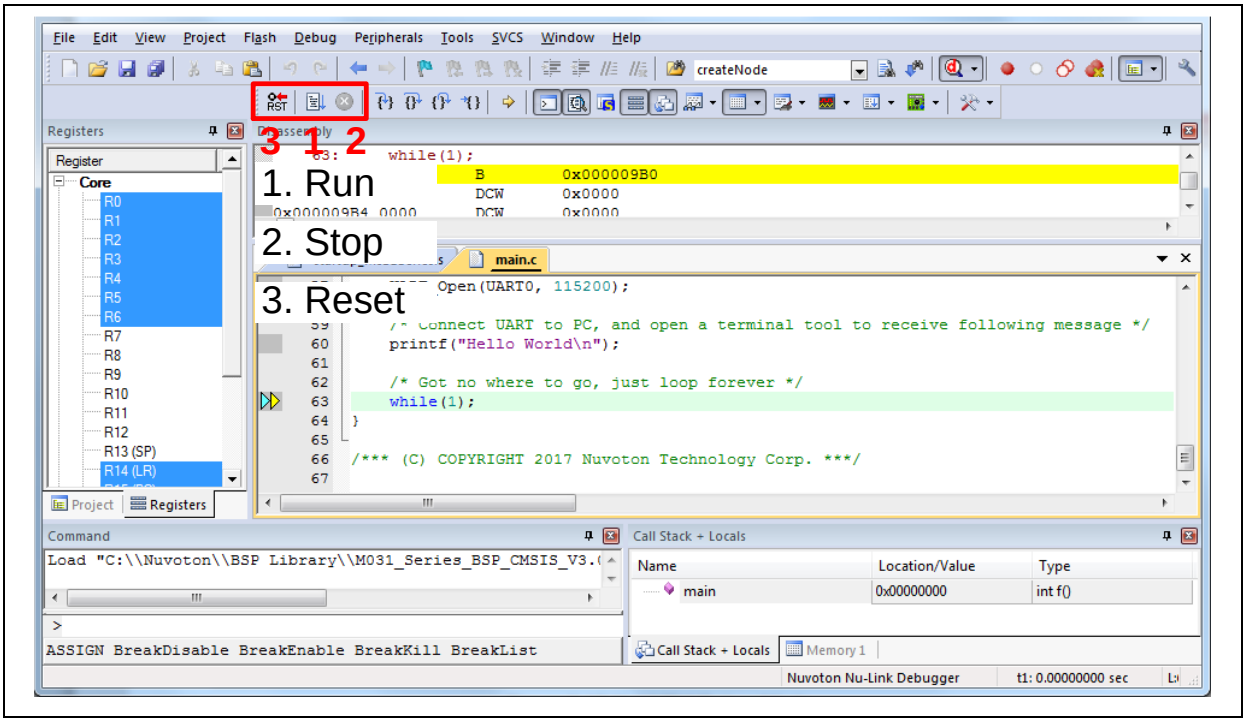


Figure 4-13 Keil C51 Debug Mode

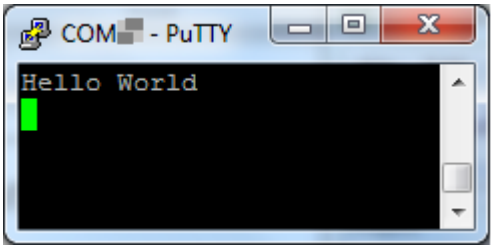


Figure 4-14 Debug Message on Serial Port Terminal Windows

4.6.2 IAR EW8051

This section provides steps to beginners on how to run a project by using IAR EW8051.

1. Double click the “Template.eww” to open the project.
2. Make sure the toolbar contain “Nu-Link” item as shown in Figure 4-15.

   Note: If the toolbar does not contain “Nu-Link” item, please rework section 4.2.

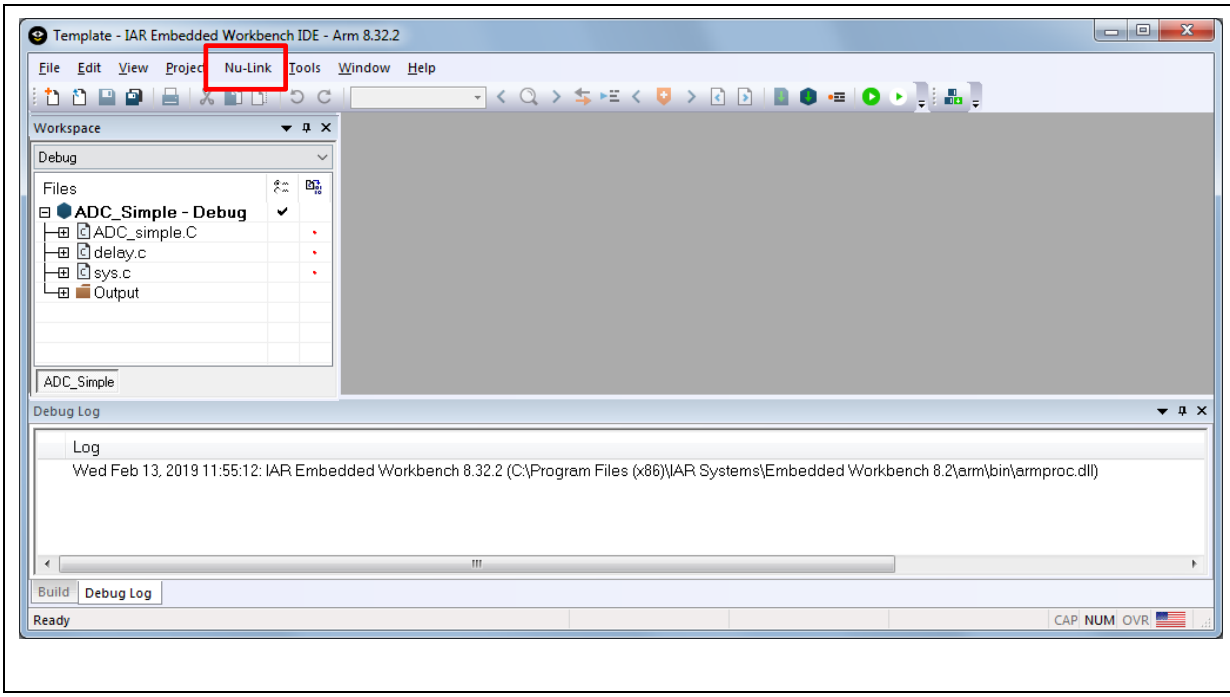


Figure 4-15 IAR EW8051 Window

3. Make target file as presented in Figure 4-16. After successfully compile the project, download code to the flash memory and enter debug mode.

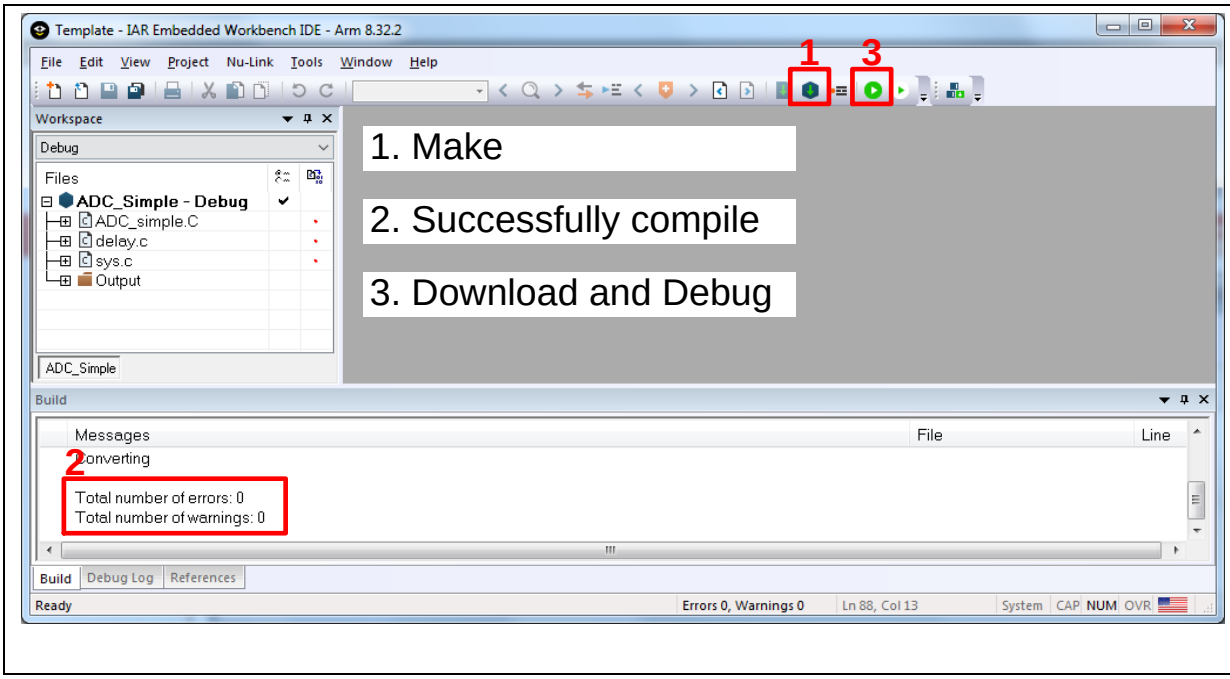


Figure 4-16 Compile and Download the Project

4. Figure 4-17 shows the debug mode under IAR EW8051. Click “Go” and the debug message will be printed out as shown in Figure 5-1. User can debug the project under debug mode by checking source code, assembly language, peripherals’ registers, and setting breakpoint, step run, value monitor, etc.

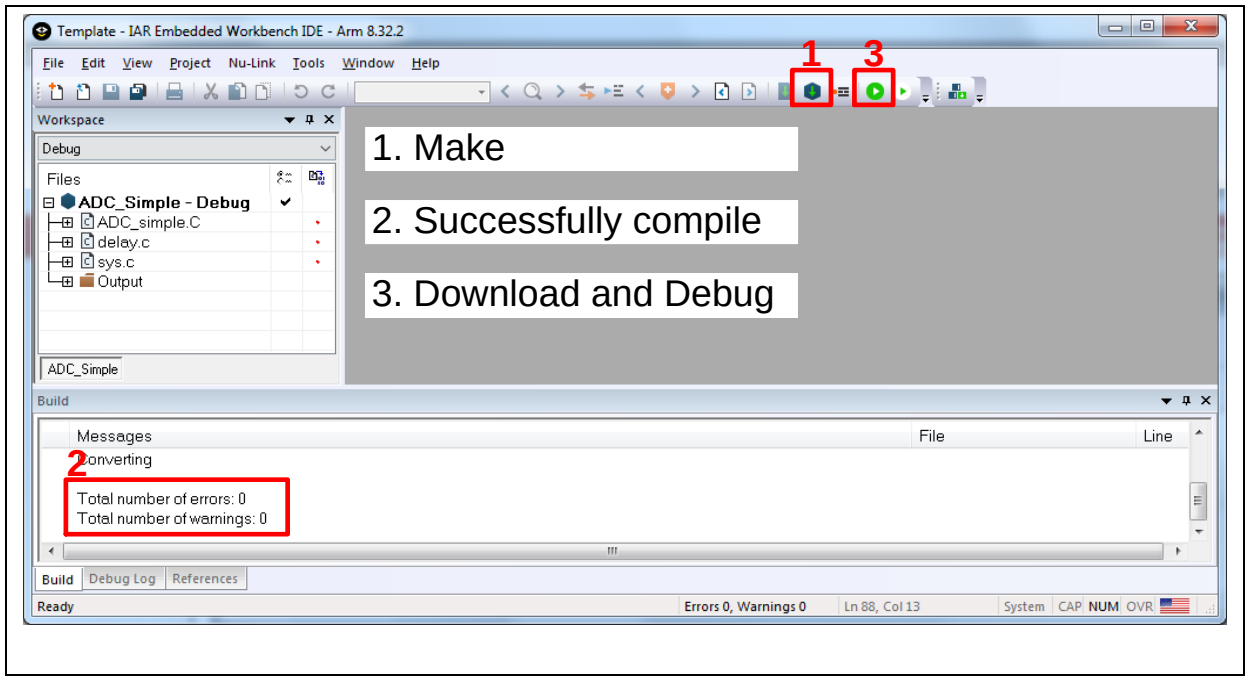
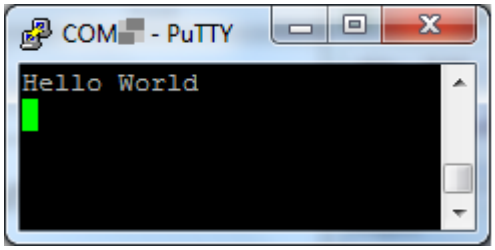


Figure 4-17 IAR EW8051 Debug Mode



5 FIGURE 5-1 DEBUG MESSAGE ON SERIAL PORT TERMINAL WINDOWSNUMAKER-ML51SD SCHEMATICS

5.1 Nu-Link2-Me

Figure 5-2 shows the Nu-Link2-Me circuit.

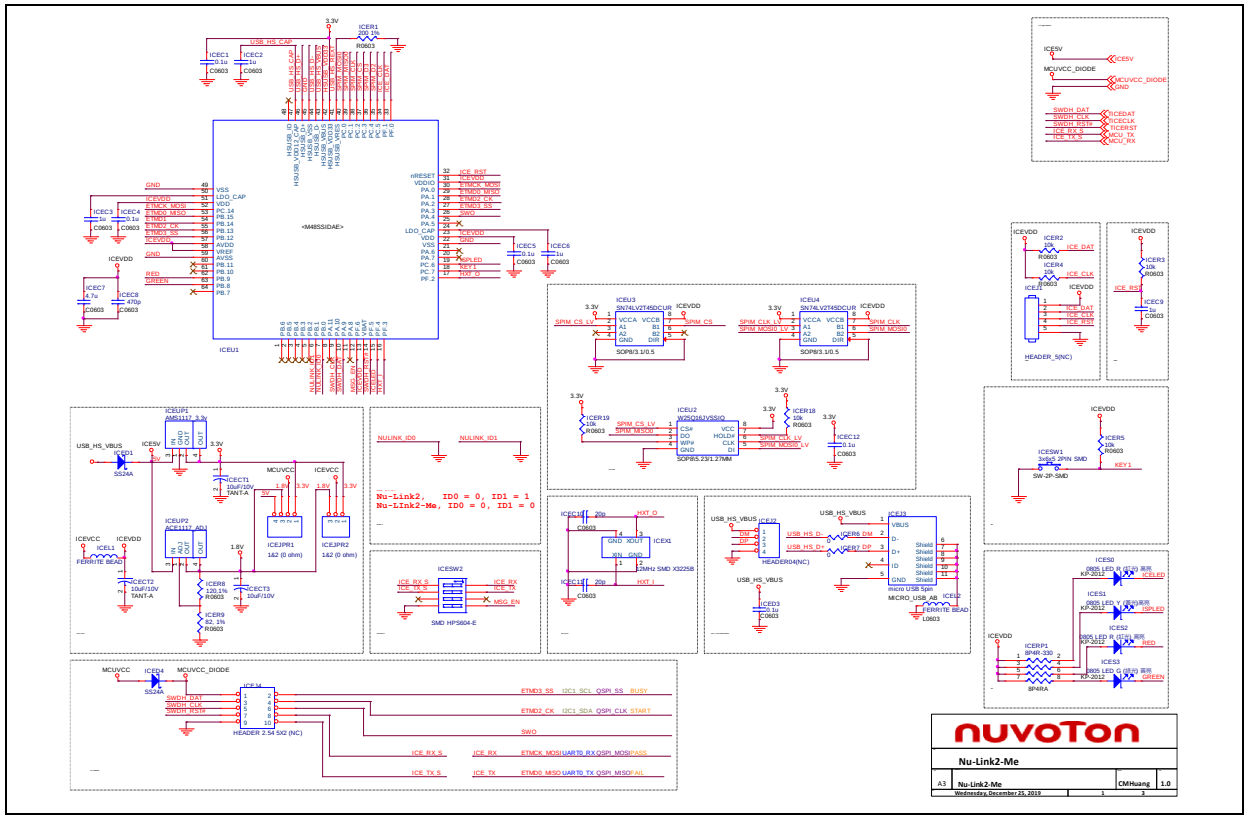


Figure 5-2 Nu-Link2-Me Circuit

5.2 ML51 platform

Figure 5-3 shows the ML51 platform circuit.

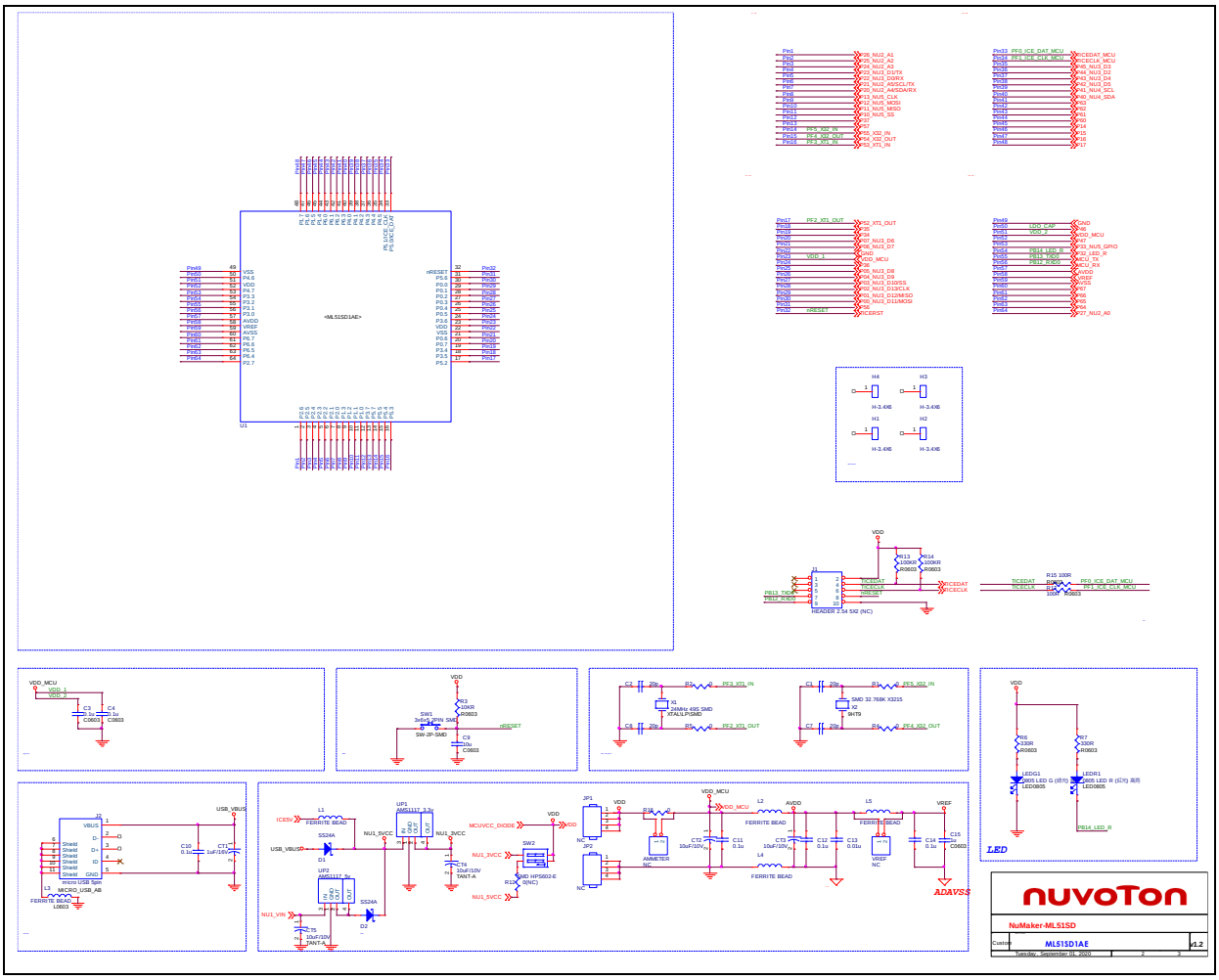


Figure 5-3 ML51 platform Circuit

5.3 Extension Connector

Figure 5-4 shows extension connectors of NuMaker-ML51SD.

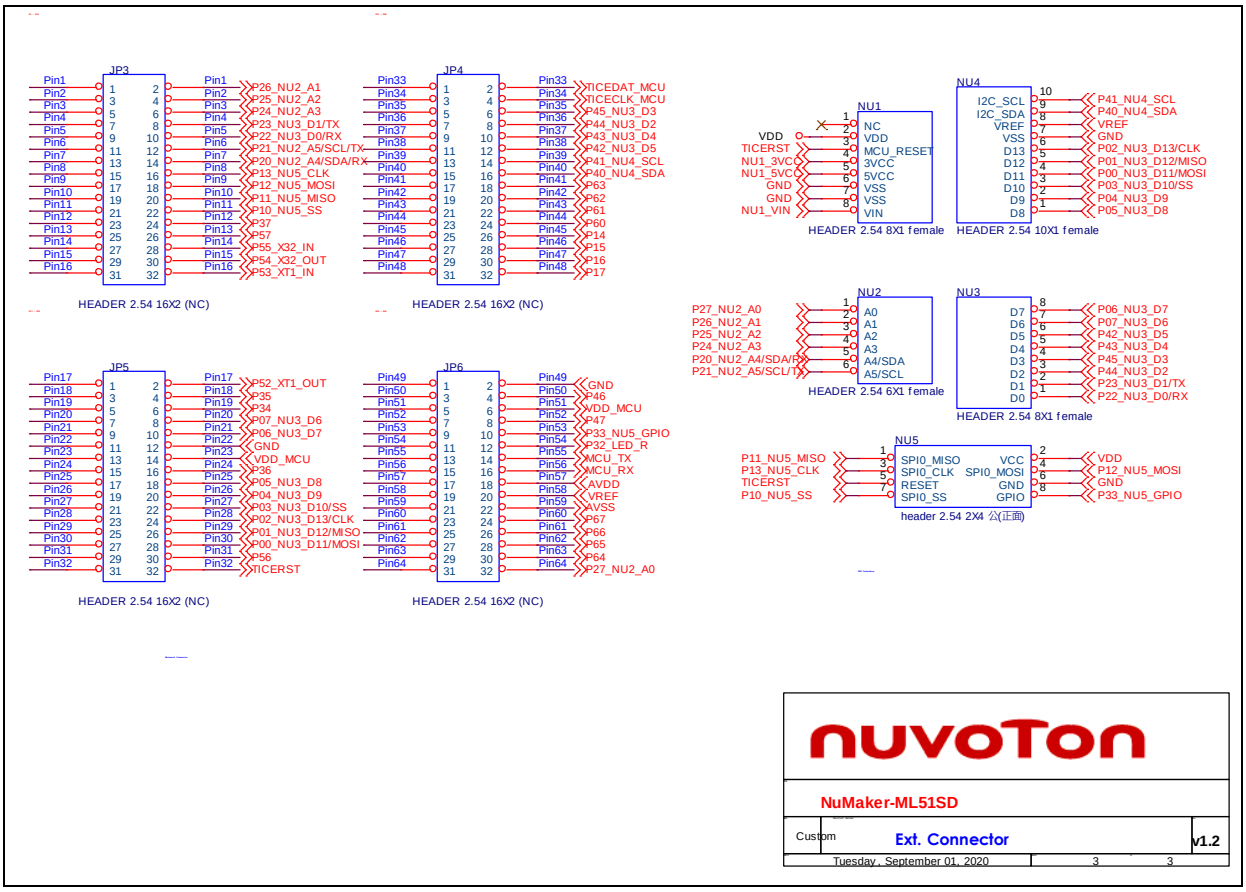


Figure 5-4 Extension Connectors Circuit

5.4 PCB Placement

Figure 5-5 and Figure 5-6 show the front and rear placement of NuMaker-ML51SD.

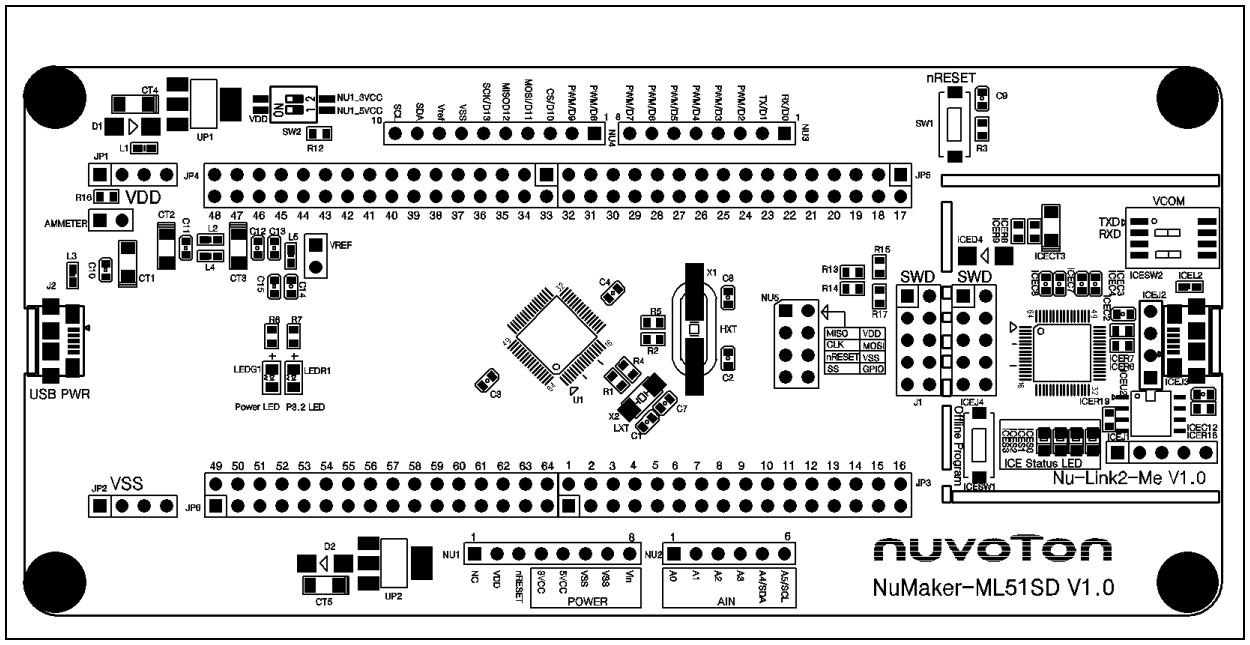


Figure 5-5 Front Placement

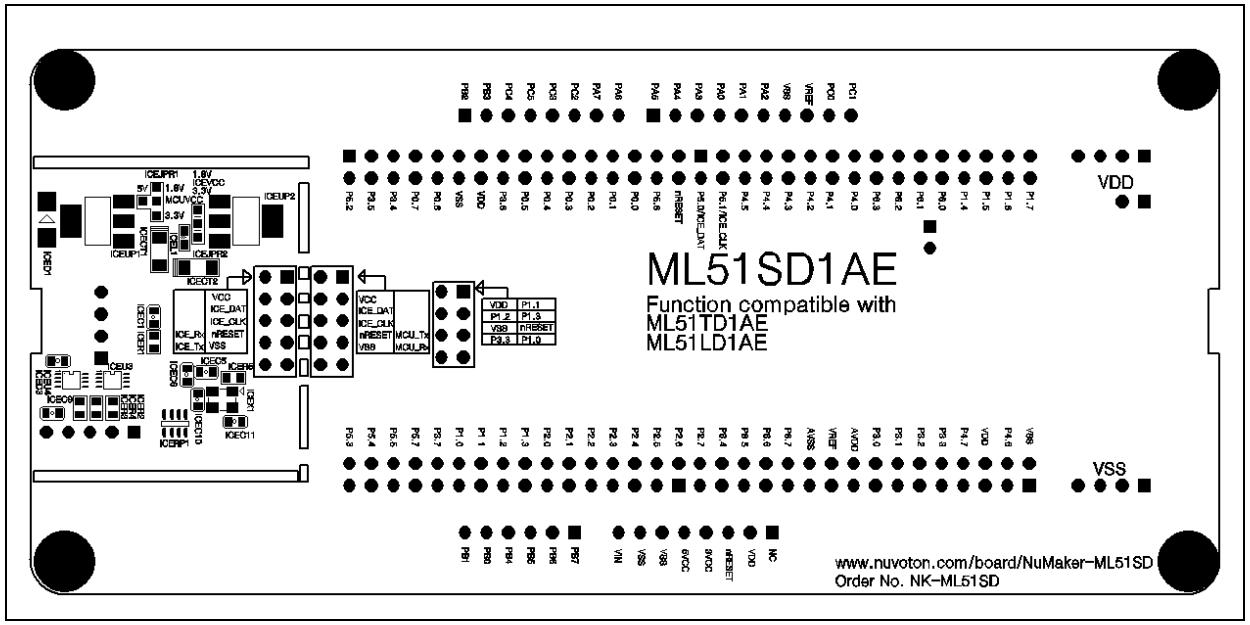


Figure 5-6 Rear Placement

6 REVISION HISTORY

Date	Revision	Description
2020.08.21	1.00	1. Initial version
2021.03.08	1.01	2. Modified the Figure 4-11, Figure 4-12 and 4-13.

Important Notice

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