NuMicro® Family

Arm® Cortex®-M0-based Microcontroller

NuMaker-DALI-NDA102SD2
User Manual

Evaluation Board for NuMicro® NDA102 Series

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

www.nuvoton.com

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1 OVERVIEW

The NuMaker-DALI-NDA102SD2 is an evaluation board for Nuvoton NuMicro NDA102SD2 microcontrollers. The NuMaker-DALI-NDA102SD2 consists of two parts: an NDA102SD2 target board and an on-board Nu-Link2-Me debugger and programmer. The NuMaker-DALI-NDA102SD2 is designed for DALI control gear and device project evaluation, prototype development and validation with power consumption monitoring function.

The NDA102SD2 target board is based on NuMicro NDA102SD2. For the development flexibility, the NDA102SD2 target board provides the extension connectors of NDA102SD2, the Arduino UNO compatible headers and multiple power supplies. Furthermore, the Nuvoton-designed ammeter connector can measure the power consumption instantly, which is essential for the prototype evaluation. For DALI application development and evaluation, the NuMicro NDA102SD2 supports one set of DALI interface and the NDA102SD2 target board has two DALI bus connectors on-board for users to connect the evaluation board with DALI application controller and other DALI devices. Nuvoton also offers an adapter board, NuMaker-DALI-Lighting, which can be connected to the Arduino UNO compatible headers and is able to demonstrate LED lighting control and color control.

In addition, 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 evaluation board and become a stand-alone mass production programmer.

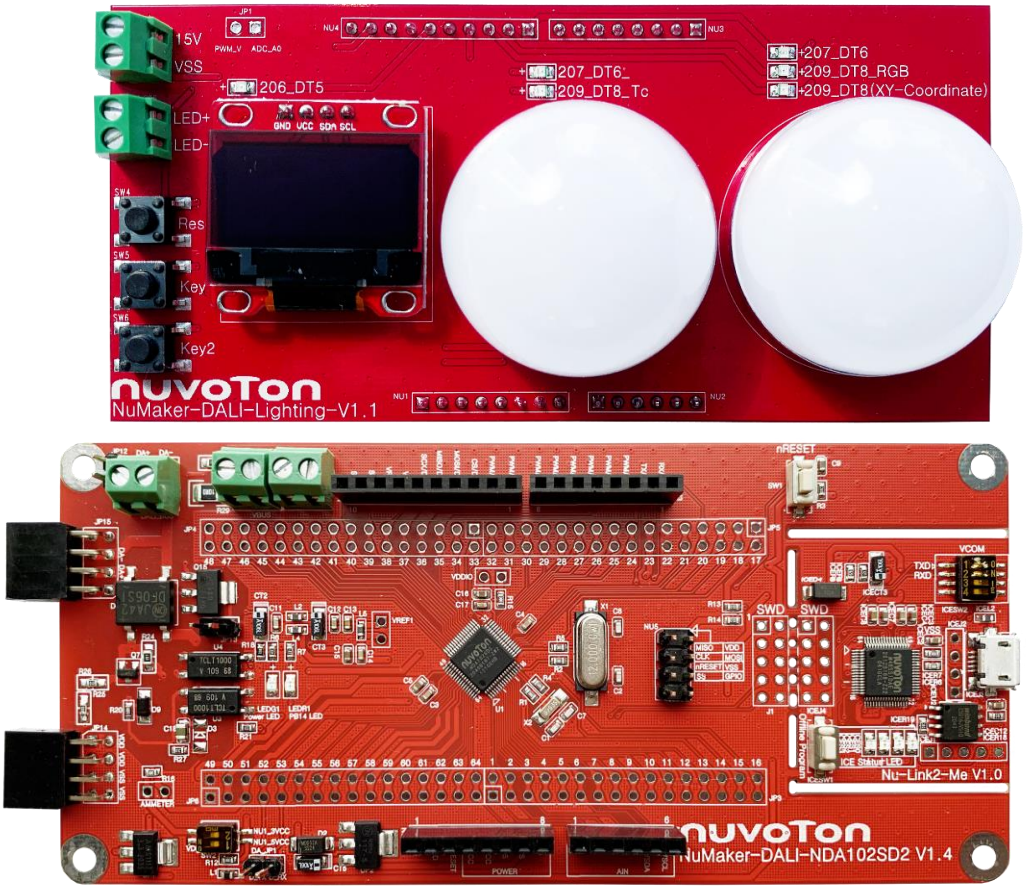

Figure 1-1 NuMaker-DALI-NDA102SD2 Evaluation Board

2 FEATURES

- NDA102SD2 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
  - ICE USB connector on Nu-Link2-Me
- On-board DALI bus connectors
- Plug-in adapter board to demonstrate
  - DT5 Lighting control
  - DT6 LED lighting control
  - DT8 Tc color control
- On-board Nu-Link2-Me debugger and programmer:
  - Debug through SWD interface
  - On-line/off-line programming
  - Virtual COM port function

3 NUMAKER-DALI-NDA102SD2 HARDWARE CONFIGURATION

3.1 Front View

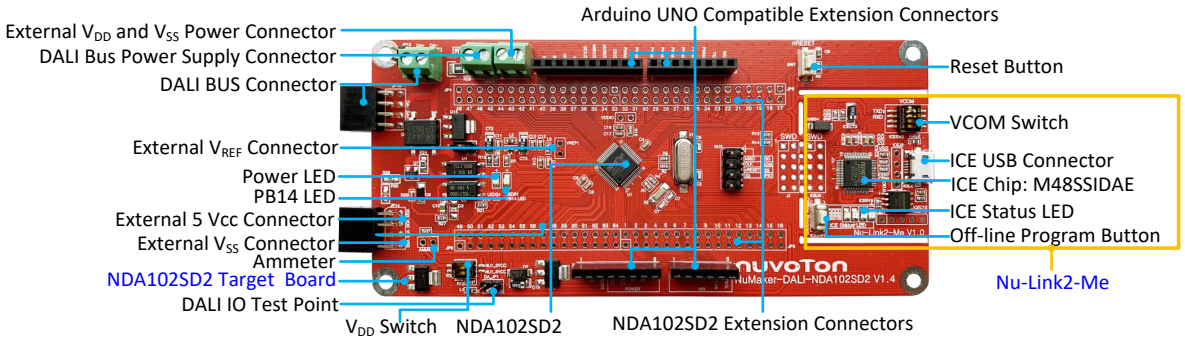

Figure 3-1 Front View of NuMaker-DALI-NDA102SD2

Figure 3-1 shows the main components and connectors from the front side of NuMaker-DALI-NDA102SD2. The following lists components and connectors from the front view:

- Target chip: NDA102SD2 (U1)
- Arduino UNO Compatible Extension Connectors (NU1, NU2, NU3, NU4)
- NDA102SD2 Extension Connectors (JP3, JP4, JP5 and JP6)
- External V_{DD} and V_{SS} Power Connector (JP14)
- External V_{REF} Connector (VREF1)
- V_{DD} Switch (SW2)
- Ammeter Connector (AMMETER)
- DALI Bus Connectors (JP15 and DALI_BUS)
- DALI IO Test Point (DA_JP1)
- External DALI Bus Power Connectors (VBUS, JP12 and JP13)
- Reset Button (SW1)
- Power LED and PB14 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-DALI-NDA102SD2.

The following lists components and connectors from the rear view:

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

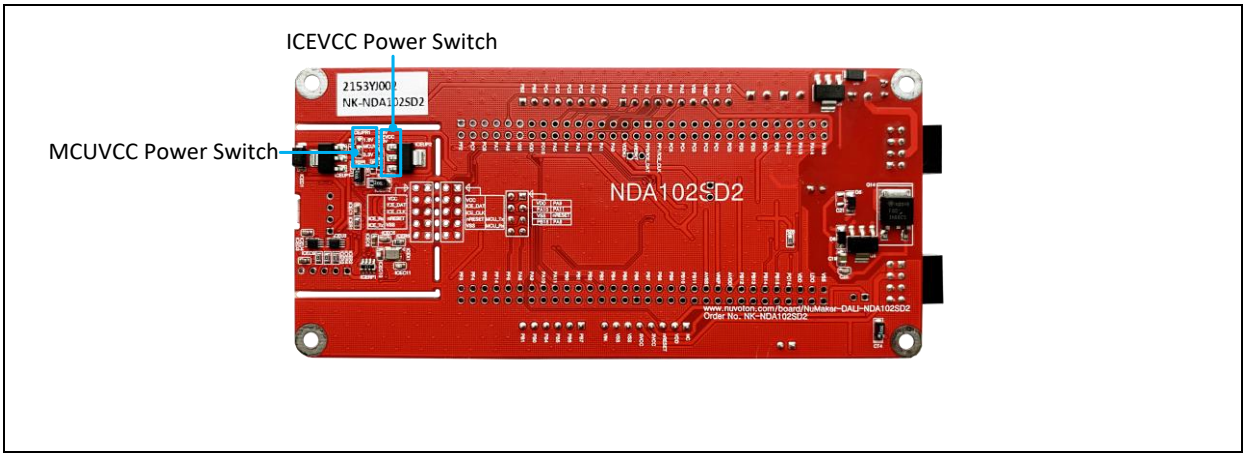

Figure 3-2 Rear View of NuMaker-DALI-NDA102SD2

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-DALI-NDA102SD2.
NU1, NU2, NU3 and NU4	Arduino UNO compatible pins on the NuMaker-DALI-NDA102SD2.

Table 3-1 Extension Connectors

3.3.1 Pin Assignment for Extension Connectors

The NuMaker-DALI-NDA102SD2 provides the NDA102SD2 onboard and extension connectors (JP3, JP4, JP5 and JP6). The Figure 3-3 shows the NDA102SD2 extension connectors.

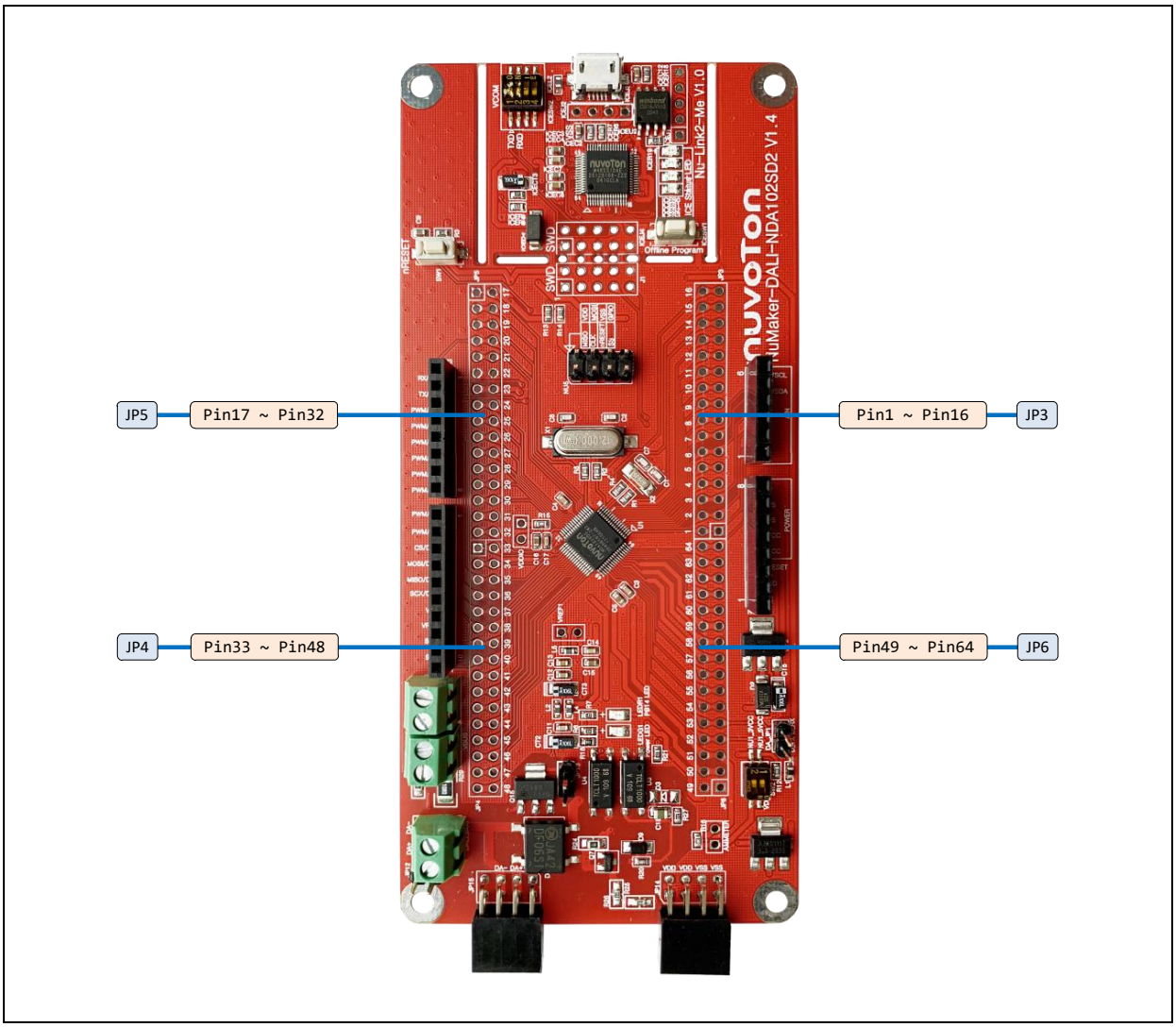

Figure 3-3 NDA102SD2 Extension Connectors

Header		NDA102SD2	
		Pin No.	Function
JP3	JP3.1	1	PB.6/EADC0_CH6/USCI1_DAT1/UART1_RXD/BPWM1_CH5/PWM1_BRAKE1/PWM1_CH5/INT4/ACMP1_O
	JP3.2	2	PB.5/EADC0_CH5/ACMP1_N/I2C0_SCL/USCI1_CTL0/SC0_CLK/PWM0_CH0/UART2_TXD/TM0/INT0
	JP3.3	3	PB.4/EADC0_CH4/ACMP1_P1/I2C0_SDA/USCI1_CTL1/SC0_DAT/PWM0_CH1/UART2_RXD/TM1/INT1
	JP3.4	4	PB.3/EADC0_CH3/ACMP0_N/I2C1_SCL/UART1_TXD/USCI1_DAT1/SC0_RST/PWM0_CH2/PWM0_BRAKE0/TM2/INT2
	JP3.5	5	PB.2/EADC0_CH2/ACMP0_P1/I2C1_SDA/UART1_RXD/USCI1_DAT0/SC0_PWR/PWM0_CH3/TM3/INT3
	JP3.6	6	PB.1/EADC0_CH1/UART2_TXD/USCI1_CLK/I2C1_SCL/QSPI0_MISO1/PWM0_CH4/PWM1_CH4/PWM0_BRAKE0
	JP3.7	7	PB.0/EADC0_CH0/UART2_RXD/SPI0_I2SMCLK/I2C1_SDA/QSPI0_MOSI1/PWM0_CH5/PWM1_CH5/PWM0_BRAKE1
	JP3.8	8	PA.11/ACMP0_P0/USCI0_CLK/BPWM0_CH0/TM0_EXT
	JP3.9	9	PA.10/ACMP1_P0/USCI0_DAT0/BPWM0_CH1/TM1_EXT
	JP3.10	10	PA.9/USCI0_DAT1/UART1_TXD/BPWM0_CH2/TM2_EXT
	JP3.11	11	PA.8/USCI0_CTL1/UART1_RXD/BPWM0_CH3/TM3_EXT/INT4
	JP3.12	12	PF.6/SC0_CLK/SPI0_MOSI/TAMPER0
	JP3.13	13	PF.14/PWM1_BRAKE0/PWM0_BRAKE0/PSIO0_CH3/PWM0_CH4/CLKO/TM3/INT5
	JP3.14	14	PF.5/UART2_RXD/UART2_nCTS/PWM0_CH0/BPWM0_CH4/X32_IN/EADC0_ST
	JP3.15	15	PF.4/UART2_TXD/UART2_nRTS/PWM0_CH1/BPWM0_CH5/X32_OUT
	JP3.16	16	PF.3/UART0_TXD/I2C0_SCL/XT1_IN/BPWM1_CH0
JP5	JP5.1	17	PF.2/UART0_RXD/I2C0_SDA/QSPI0_CLK/XT1_OUT/BPWM1_CH1
	JP5.2	18	PC.7/UART0_nCTS/I2C1_SMBAL/PWM1_CH2/BPWM1_CH0/TM0/INT3
	JP5.3	19	PC.6/UART0_nRTS/I2C1_SMBSUS/PWM1_CH3/BPWM1_CH1/TM1/INT2
	JP5.4	20	PA.7/UART0_TXD/I2C1_SCL/PWM1_CH4/BPWM1_CH2/ACMP0_WLAT/TM2/INT1
	JP5.5	21	PA.6/UART0_RXD/I2C1_SDA/PWM1_CH5/BPWM1_CH3/ACMP1_WLAT/TM3/INT0
	JP5.6	22	V_{SS}
	JP5.7	23	V_{DD}
	JP5.8	24	PD.15/PWM0_CH5/TM3/INT1
	JP5.9	25	PA.5/QSPI0_MISO1/UART0_nCTS/UART0_TXD/I2C0_SCL/BPWM0_CH5/PWM0_CH0
	JP5.10	26	PA.4/QSPI0_MOSI1/SPI0_I2SMCLK/SC0_nCD/UART0_nRTS/UART0_RXD/I2C0_SDA/BPWM0_CH4/PWM0_CH1
	JP5.11	27	PA.3/QSPI0_SS/SPI0_SS/SC0_PWR/I2C0_SMBAL/UART1_TXD/I2C1_SCL/BPWM0_CH3/PWM0_CH2/CLKO/PWM1_BRAKE1
	JP5.12	28	PA.2/QSPI0_CLK/SPI0_CLK/SC0_RST/I2C0_SMBSUS/UART1_RXD/I2C1_SDA/BPWM0_CH2/PWM0_CH3
	JP5.13	29	PA.1/QSPI0_MISO0/SPI0_MISO/SC0_DAT/UART0_TXD/UART1_nCTS/BPWM0_CH1/PWM0_CH4

Header		NDA102SD2	
		Pin No.	Function
	JP5.14	30	PA.0/QSPI0_MOSI0/SPI0_MOSI/SC0_CLK/UART0_RXD/UART1_nRTS/BPWM0_CH0/PWM0_CH5
	JP5.15	31	V_{DDIO}
	JP5.16	32	nRESET **Note:** It is recommended to use 10 kΩ pull-up resistor and 10 uF capacitor on nRESET pin.
JP4	JP4.1	33	PF.0/UART1_TXD/I2C1_SCL/UART0_TXD/BPWM1_CH0/ICE_DAT **Note:** It is recommended to use 100 kΩ pull-up resistor on ICE_DAT pin.
	JP4.2	34	PF.1/UART1_RXD/I2C1_SDA/UART0_RXD/BPWM1_CH1/ICE_CLK **Note:** It is recommended to use 100 kΩ pull-up resistor on ICE_CLK pin.
	JP4.3	35	PC.5/QSPI0_MISO1/UART2_TXD/I2C1_SCL/PWM1_CH0/PSIO0_CH0
	JP4.4	36	PC.4/QSPI0_MOSI1/UART2_RXD/I2C1_SDA/PWM1_CH1/PSIO0_CH1
	JP4.5	37	PC.3/QSPI0_SS/UART2_nRTS/I2C0_SMBAL/PWM1_CH2/PSIO0_CH2
	JP4.6	38	PC.2/QSPI0_CLK/UART2_nCTS/I2C0_SMBSUS/PWM1_CH3/PSIO0_CH3
	JP4.7	39	PC.1/QSPI0_MISO0/UART2_TXD/I2C0_SCL/PWM1_CH4/ACMP0_O
	JP4.8	40	PC.0/QSPI0_MOSI0/UART2_RXD/I2C0_SDA/PWM1_CH5/ACMP1_O
	JP4.9	41	PD.3/USCI0_CTL1/SPI0_SS/USCI1_CTL0/UART0_TXD
	JP4.10	42	PD.2/USCI0_DAT1/SPI0_CLK/UART0_RXD
	JP4.11	43	PD.1/USCI0_DAT0/SPI0_MISO
	JP4.12	44	PD.0/USCI0_CLK/SPI0_MOSI/TM2
	JP4.13	45	PA.12/I2C1_SCL/BPWM1_CH2
	JP4.14	46	PA.13/I2C1_SDA/BPWM1_CH3
	JP4.15	47	PA.14/UART0_TXD/BPWM1_CH4
	JP4.16	48	PA.15/UART0_RXD/BPWM1_CH5
JP6	JP6.1	49	V_{SS}
	JP6.2	50	LDO_CAP
	JP6.3	51	V_{DD}
	JP6.4	52	PC.14/SPI0_I2SMCLK/USCI0_CTL0/QSPI0_CLK/TM1
	JP6.5	53	PB.15/EADC0_CH15/SPI0_SS/USCI0_CTL1/UART0_nCTS/PSIO0_CH0/PWM1_CH0/TM0_EXT/PWM0_BRAKE1
	JP6.6	54	PB.14/EADC0_CH14/SPI0_CLK/USCI0_DAT1/UART0_nRTS/PSIO0_CH1/PWM1_CH1/TM1_EXT/CLKO
	JP6.7	55	PB.13/EADC0_CH13/ACMP0_P3/ACMP1_P3/SPI0_MISO/USCI0_DAT0/UART0_TXD/PSIO0_CH2/PWM1_CH2/TM2_EXT
	JP6.8	56	PB.12/EADC0_CH12/ACMP0_P2/ACMP1_P2/SPI0_MOSI/USCI0_CLK/UART0_RXD/PSIO0_CH3/PWM1_CH3/TM3_EXT
	JP6.9	57	AV_{DD}
	JP6.10	58	V_{REF}
	JP6.11	59	AV_{SS}
	JP6.12	60	PB.11/EADC0_CH11/UART0_nCTS/I2C1_SCL/SPI0_I2SMCLK/BPWM1_CH0

Header		NDA102SD2	
		Pin No.	Function
	JP6.13	61	PB.10/EADC0_CH10/USCI1_CTL0/UART0_nRTS/I2C1_SDA/BPWM1_CH1
	JP6.14	62	PB.9/EADC0_CH9/USCI1_CTL1/UART0_TXD/UART1_nCTS/I2C1_SMBAL/BPWM1_CH2
	JP6.15	63	PB.8/EADC0_CH8/USCI1_CLK/UART0_RXD/UART1_nRTS/I2C1_SMBSUS/BPWM1_CH3
	JP6.16	64	PB.7/EADC0_CH7/USCI1_DAT0/UART1_TXD/BPWM1_CH4/PWM1_BRAKE0/PWM1_CH4/INT5/ACMP0_O

Table 3-2 NDA102SD2 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.

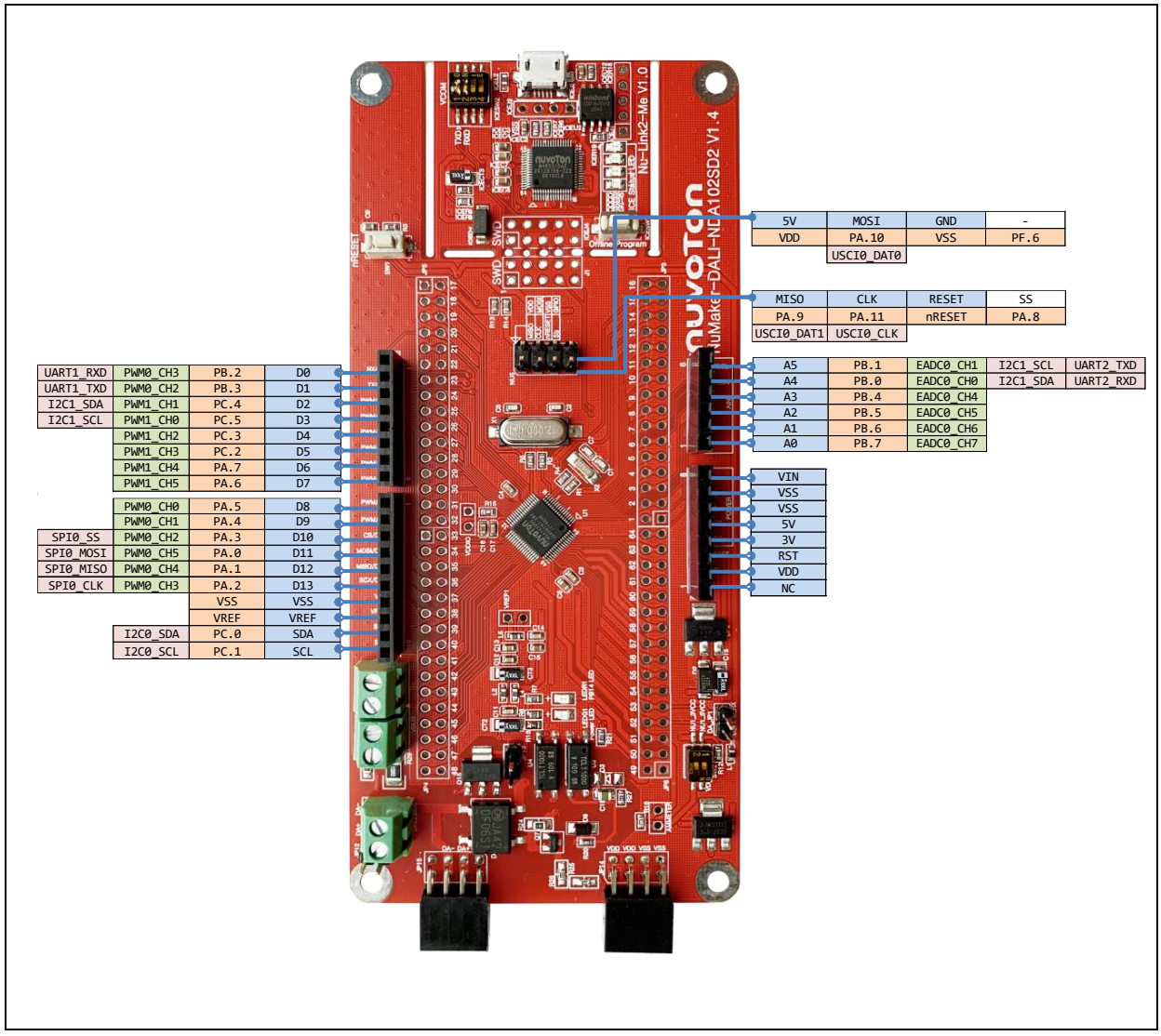

Figure 3-4 Arduino UNO Compatible Extension Connectors

Header		NuMaker-DALI-NDA102SD2		Header		NuMaker-DALI-NDA102SD2	
		Compatible to Arduino UNO	GPIO Pin of NDA102SD2			Compatible to Arduino UNO	GPIO Pin of NDA102SD2
NU3	NU3.1	D0	PB.2	NU2	NU2.6	A5	PB.1
	NU3.2	D1	PB.3		NU2.5	A4	PB.0
	NU3.3	D2	PC.4		NU2.4	A3	PB.4
	NU3.4	D3	PC.5		NU2.3	A2	PB.5
	NU3.5	D4	PC.3		NU2.2	A1	PB.6
	NU3.6	D5	PC.2		NU2.1	A0	PB.7
	NU3.7	D6	PA.7	NU1	NU1.8	VIN	-
	NU3.8	D7	PA.6		NU1.7	VSS	
NU4	NU4.1	D8	PA.5		NU1.6	VSS	
	NU4.2	D9	PA.4		NU1.5	5V	
	NU4.3	D10	PA.3		NU1.4	3V	
	NU4.4	D11	PA.0		NU1.3	RST	nRESET
	NU4.5	D12	PA.1		NU1.2	VDD	V_{DD}
	NU4.6	D13	PA.2		NU1.1	NC	-
	NU4.7	VSS	V_{SS}				
	NU4.8	VREF	V_{REF}				
	NU4.9	SDA	PC.0				
	NU4.10	SCL	PC.1				

Table 3-3 Arduino UNO Extension Connectors and NDA102SD2 Mapping GPIO List

3.4 Power Supply Configuration

The NuMaker-DALI-NDA102SD2 is able to adopt multiple power supplies. External power source includes NU1 Vin (7 V to 12 V), V_{DD} (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-DALI-NDA102SD2.

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 NDA102SD2 target board and Nu-Link2-Me.
JP14 pin1~pin4	NU1_5VCC	Connector on NuMaker-DALI-NDA102SD2 supplies 5 V power from external power supply such as DALI Master NUC029SEE board to NDA102SD2 target board and Nu-Link2-Me.
NU1 pin5	NU1_5VCC	ICEJ3, JP14 or NU1 pin8 supplies 5 V power to NU1 pin5. NU1 pin5 supplies 5 V power to target chip or Arduino adapter board.

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 NDA102SD2 target board or ICE chip.
UP1	NU1_3VCC	UP1 converts NU1_5VCC to 3.3 V and supplies 3.3 V to NDA102SD2 target board. **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 NDA102SD2 target board 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
JP12	The optional connector on the NuMaker-DALI-NDA102SD2 provides 9 to 22 V DC power to the DALI+ from an external power source, which only needs to be connected in the application of powering the host (DALI Part 103).
JP13	The optional connector on the NuMaker-DALI-NDA102SD2 connect DALI- to V_{SS}, which only needs to be connected in the application of powering the host (DALI Part 103).
JP14 pin1~pin4	Connector on NuMaker-DALI-NDA102SD2 supplies 5 V power from external power supply such as DALI Master NUC029SEE board to NDA102SD2 target board and Nu-Link2-Me.
JP14 pin5~pin8	V_{SS} connector on the NuMaker-DALI-NDA102SD2.
VBUS	Board external power source, with voltage range from 9 V to 22 V. The external input power supply needs to be used with JP12 and JP13, and it only needs to be provided when it is used as a host power supply application (DALI Part 103).

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.

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.
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.

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.

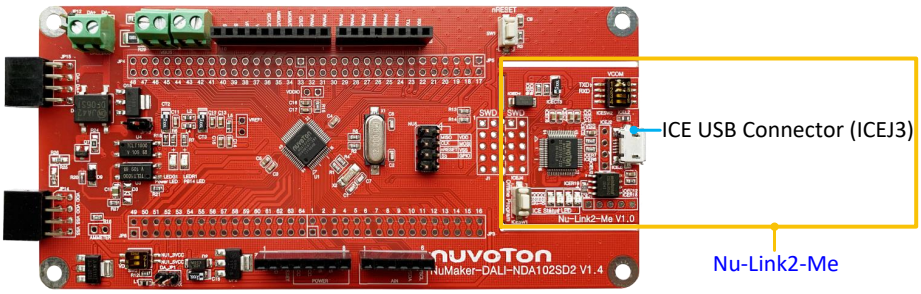

Figure 3-5 External Power Supply Sources on Nu-Link2-Me

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

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	Vin	JP1
1	1.8 V	Connect to PC	1.8 V	1.8 V	1.8 V	Off	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	3.3 V output
3	5 V	Connect to PC	5 V	3.3 V (default)	3.3 V	Off	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 NDA102SD2 Target Board to Target Chip

The external power supply sources on NDA102SD2 *target board* are shown in Figure 3-6.

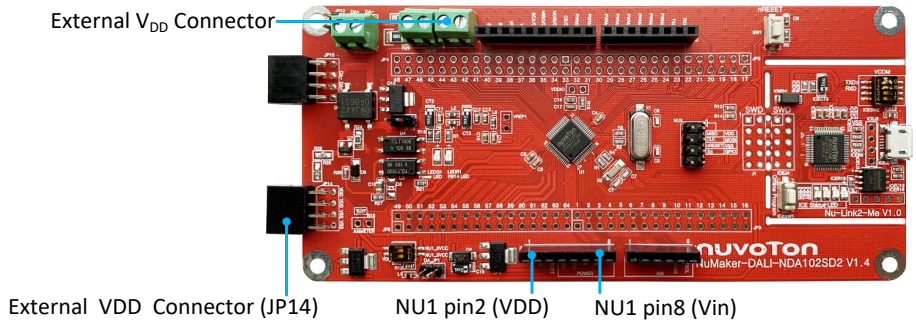

Figure 3-6 External Power Supply Sources on NDA102SD2 Target Board

To use Vin and JP14 as external power supply source, please follow the steps below:

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 ICEJ3 to PC.
5. Connect the external power supply to Vin and JP14.

To use V_{DD} as external power supply source with Nu-Link2-Me detached from NuMaker-DALI-NDA102SD2, please follow the steps below:

1. Switch the SW2 depends on the target chip operating voltage.
2. Detach the Nu-Link2-Me from NuMaker-DALI-NDA102SD2.

Connect the external power supply to V_{DD}.

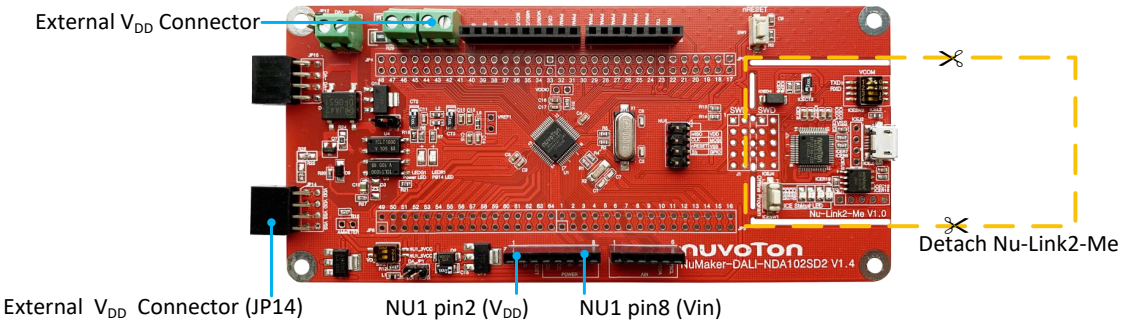

Figure 3-7 Detach the Nu-Link2-Me from NuMaker-DALI-NDA102SD2

Table 3-12 presents all power models when supplies external power through NDA102SD2 target board . The NDA102SD2 target board external power sources are highlighted in yellow.

Model	Target Chip Voltage	Vin [1], / DALI_VDD	J2[1]	JP14	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	X	NU1 3VCC	3.3 V output	Remove resistor	3.3 V	3.3 V
5	3.3 V	X	Connect to PC	X	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	X	NU1 5VCC	5 V output	Remove resistor	3.3 V	3.3 V
7	5 V	X	Connect to PC	X	X	NU1 5VCC	5 V output	Remove resistor	3.3 V	3.3 V
8	1.8 V ~ 5 V	X	X	X	Connect to PC	OFF	DC Input 1.8 V ~ 3.3 V	Remove resistor	1.8 V / 3.3 V	1.8 V / 3.3 V
9	1.8 V ~ 5 V	X	X	X	Nu-Link2-Me removed	OFF	DC Input 1.8 V ~ 5 V	X	X	X
10	3.3 V	X	X	5 V	Connect to PC	NU1 3VCC	3.3 V output	Remove resistor	1.8 V / 3.3 V	1.8 V / 3.3 V
11	5 V	X	X	5 V	Connect to PC	NU1 5VCC	5 V output	Remove resistor	1.8 V / 3.3 V	1.8 V / 3.3 V
12	3.3 V	X	X	5 V	Nu-Link2-Me removed	NU1 3VCC	3.3 V output	X	X	X
13	5 V	X	X	5 V	Nu-Link2-Me removed	NU1 5VCC	5 V output	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 NDA102SD2 Target Board

3.5 External Reference Voltage Connector

Table 3-14 presents the external reference voltage connector.

Connector	Description
VREF1	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

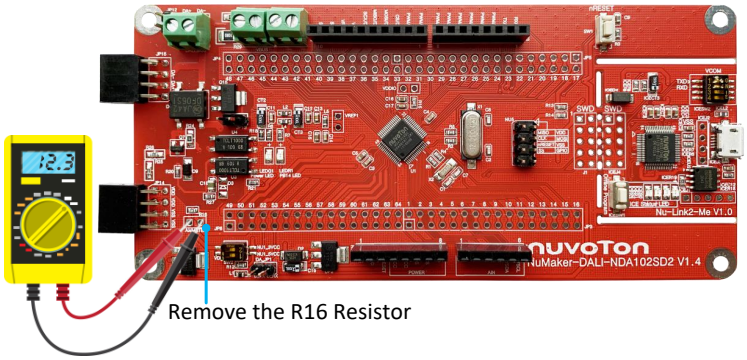

Figure 3-8 Wiring between Ammeter Connector and Ammeter

3.7 DALI Bus Connectors

Table 3-15 presents the DALI bus connectors and test pin.

Component	Description
JP15	Connector to wire to DALI bus.
DALI_BUS	Connector to wire to DALI bus.
JP12	Short pin 1 and pin 2 when using external power from VBUS.(Part 103)
JP13	Short pin 1 and pin 2 when using external power from VBUS.(Part 103)
DA_JP1	Connector for user to measure the target chip DALI TX and DALI_RX.

Table 3-15 DALI Bus Connectors

3.8 Push Buttons

Table 3-16 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 3-16 Push-Buttons

3.9 LEDs

Table 3-17 presents the LEDs.

Component	Description
Power LED	The power LED indicates that the NuMaker-DALI-NDA102SD2 is powered.
PB14 LED	The LED is connected to the target chip PB.14.
ICES0, ICES1, ICES2 and ICES3	Nu-Link2-Me status LED.

Table 3-17 LEDs

3.10 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 evaluation board and become a stand-alone mass production programmer. For more information about Nu-Link2-Me, please refer to *Nu-Link2-Pro Debugger and Programmer User Manual*.

3.10.1 VCOM Switches

Table 3-18 presents how to set the VCOM function by ICESW2.

ICESW2		
Pin	**Function**	**Description**
1	TXD	**On**: Connect target chip PB.13 (UART0_TXD) to Nu-Link2-Me. **Off**: Disconnect target chip PB.13 (UART0_TXD) to Nu-Link2-Me.
2	RXD	**On**: Connect target chip PB.12 (UART0_RXD) to Nu-Link2-Me. **Off**: Disconnect target chip PB.12 (UART0_RXD) to Nu-Link2-Me.
Note: Pin 3 and 4 is unused.		

Table 3-18 VCOM Function of Nu-Link2-Me

3.10.2 Status LEDs

Table 3-17 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 3-19 Operation Status LED Patterns

4 NUMAKER-DALI-LIGHTING HARDWARE CONFIGURATION

The NuMaker-DALI-Lighting is one of the adapter board of NuMaker-DALI-NDA102SD2. The NuMaker-DALI-Lighting is equipped with one RGB LED and one 2 in 1 cool and warm white LED for Part 207 and Part 209 demonstration, and one 1-10V/0-10V conversion circuit for Part 206 demonstration.

4.1 Front View

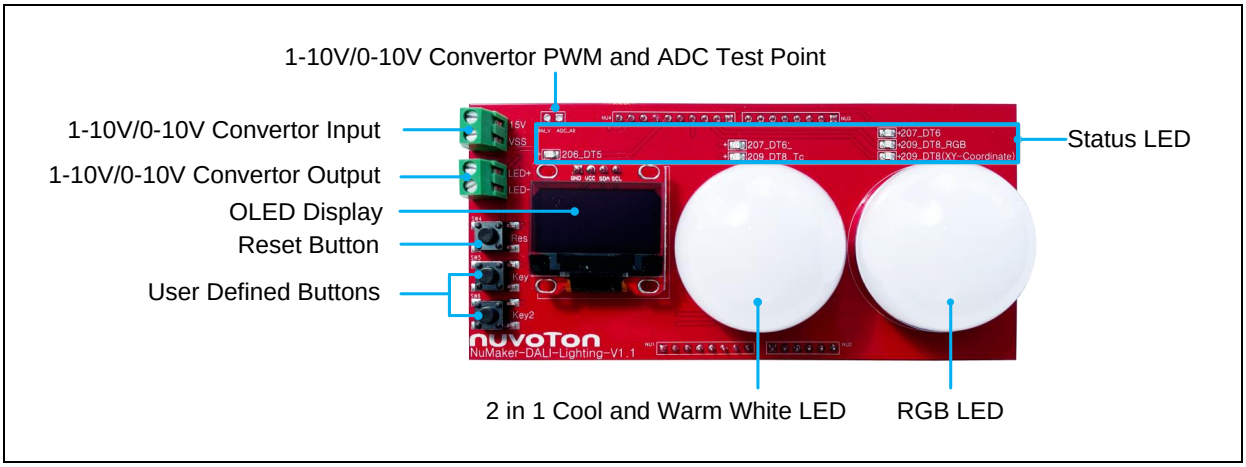

Figure 4-1 Front View of NuMaker-DALI-Lighting

Figure 4-1 shows the main components and connectors from the front side of NuMaker-DALI-Lighting. The following lists components and connectors from the front view:

- 2 in 1 Cool and Warm White LED (U5)
- RGB LED (U2)
- 1-10V/0-10V Convertor Output (DALI_206)
- 1-10V/0-10V Convertor Input (JP2)
- 1-10V/0-10V Convertor PWM and ADC Test Point (JP1)
- OLED Display (J2)
- Status LED (207_DT6, 209_DT8_RGB, 209_DT8_(XY-Coordinate), 209_DT8_Tc and 206_DT8_Tc)
- Reset Button (SW4)
- User Defined Button (SW5 and SW6)

4.2 Rear View

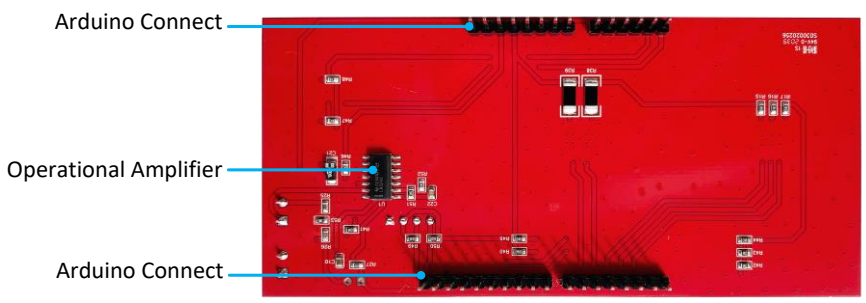

Figure 4-2 Rear View of NuMaker-DALI-Lighting

Figure 4-2 shows the main components and connectors from the rear side of NuMaker-DALI-NDA102SD2. The following lists components and connectors from the rear view:

- Operational Amplifier
- Arduino Connect

4.3 Extension Connectors

Figure 4-3 shows the pin assignment for extension connectors.

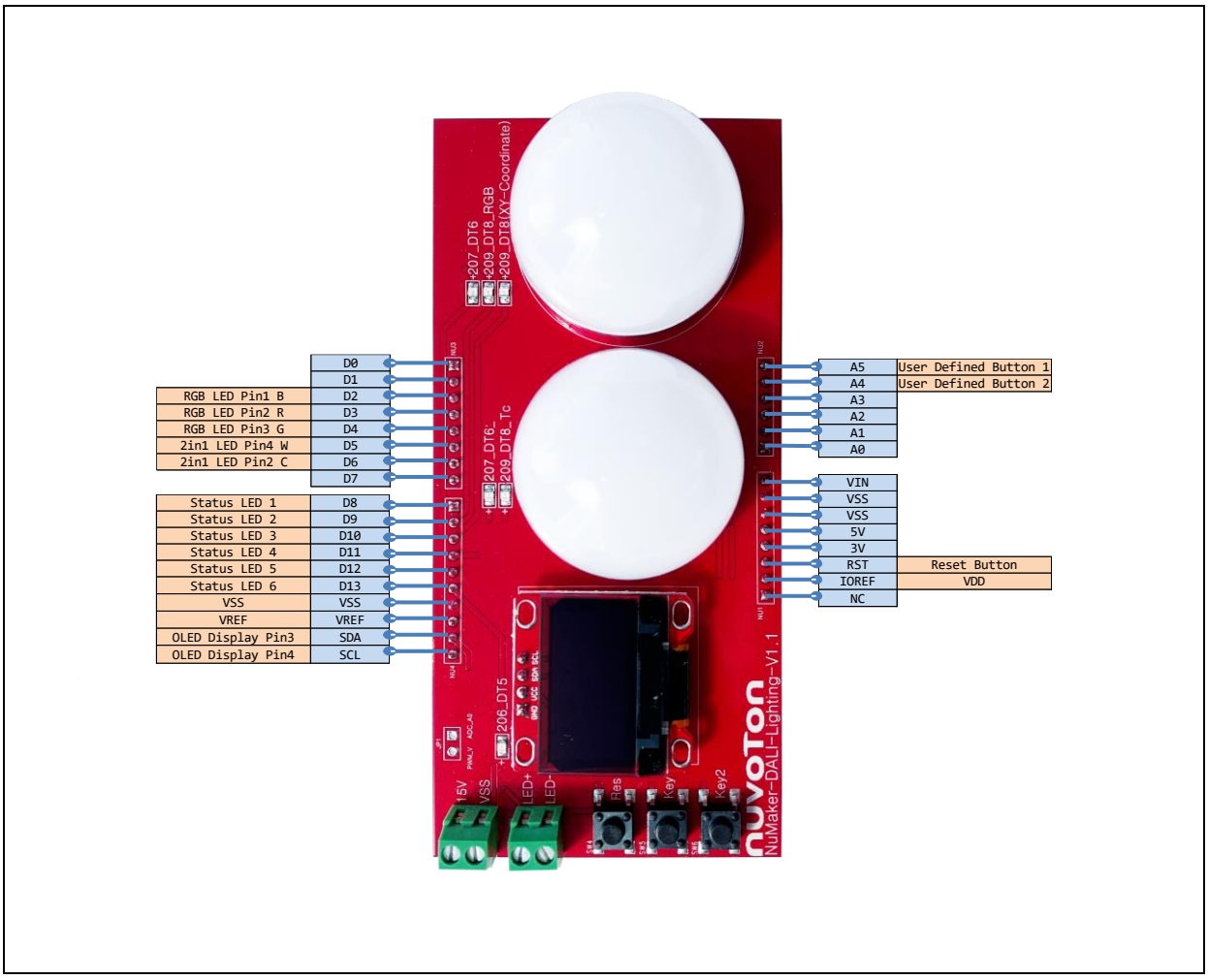

Figure 4-3 Extension Connectors of NuMaker-DALI-Lighting

4.4 2 in 1 Cool and Warm White LED

Table 4-1 presents the 2 in 1 cool and warm white LED (2n1 LED).

Component	Description
U5	2 in 1 cool and warm white LED. Working Voltage: 3.0 V~3.4 V Luminous flux: CW 20~24 lm, WW 20~22 lm Color Temperature: CW 6000~6500 K, WW 2800~3200 K

Pin Number	1	2	3	4	5	6
Function	CW+	CW-	WW+	WW-	GND	GND

Table 4-1 2 in 1 Cool and Warm White LED

4.5 RGB LED

Table 4-2 presents the RGB LED.

Component	Description
U2	RGB LED Working Voltage: 3.3 or 5 V Pin Number: 1 / 2 / 3 / 4 / 5 / 6 Function: B+ / B- / G+ / G- / R+ / R-

Table 4-2 RGB LED

4.6 1-10V/0-10V Convertor Connectors

Table 4-3 presents 1-10V/0-10V convertor connectors.

Connector	Description
JP2	1-10V/0-10V convertor external power source with 15 V input.
DALI_206	1-10V/0-10V convertor output. Output range from 1 V to10 V or 0 V to 10 V, depends on the Part 206 setting.
JP1	PWM and ADC test point.

Table 4-3 1-10V/0-10V Convertor Connectors

4.7 OLED Display Connector

Table 4-4 presents the OLED display connector.

Connector	Description
J2	The OLED display connector. Pin Number: 1 / 2 / 3 / 4 Function: GND / 3 V / I²C_SDA / I²C_SCL

Table 4-4 OLED Display Connector

4.8 Status LEDs

Table 4-5 presents the RGB LED.

Component	Header of Arduino UNO	GPIO Pin of NDA102SD2	Description
207_DT6	NU4.1	PA.5	**On**: Part 207 demo on RGB LED.
209_DT8_RGB	NU4.2	PA.4	**On**: Part 209 RGB demo on RGB LED.

209_DT8(XY-Coordinate)	NU4.3	PA.3	**On**: Part 209 xy-coordinate demo on RGB LED.
209_DT8_Tc	NU4.4	PA.0	**On**: Part 209 Tc control demo on 2n1 LED.
207_DT6_	NU4.5	PA.1	**On**: Part 207 demo on 2n1 LED.
206_DT5	NU4.6	PA.2	**On**: Part 206 demo on 0-10V/1-10V conversion circuit.

Table 4-5 Status LEDs on NuMaker-DALI-Lighting

4.9 Push Buttons

Table 4-6 presents the push buttons on NuMaker-DALI-Lighting.

Component	Description
SW4	Reset button to reset the target chip.
SW5	User defined button. Press to simulate lamp failure happened.
SW6	User defined button.

Table 4-6 Push-Buttons on NuMaker-DALI-Lighting

5 QUICK START

5.1 Toolchains Supporting

Install the Keil toolchain.

- KEIL MDK Nuvoton edition M0/M23

5.2 Nuvoton Nu-Link Driver Installation

Download and install the latest Nuvoton Nu-Link Driver.

- Download and install Nu-Link_Keil_Driver when using Keil MDK.

Please install the Nu-Link USB Driver as well at the end of the installation. The installation is presented in Figure 5-1 and Figure 5-2.

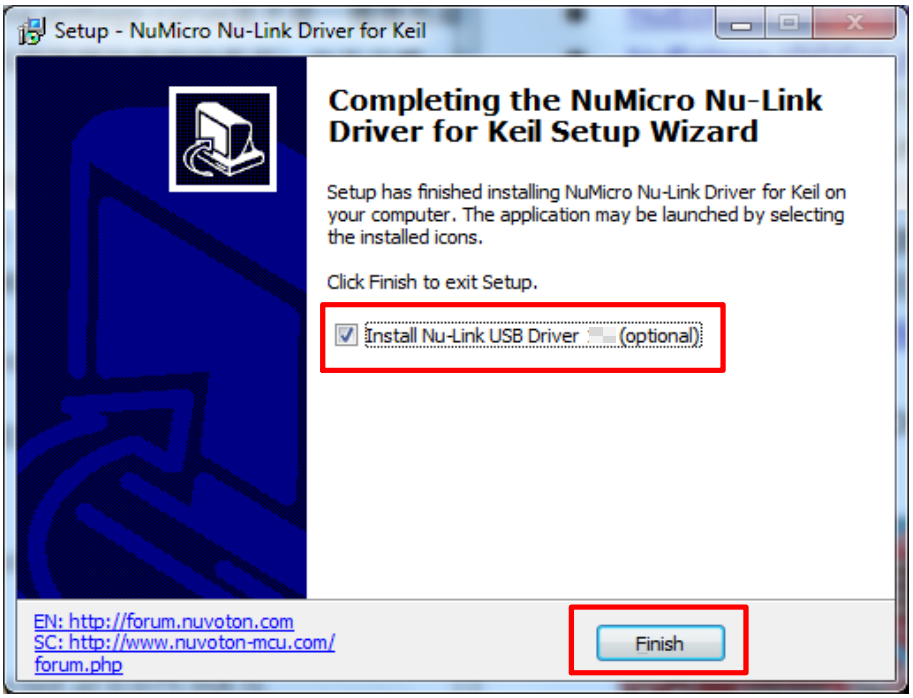

Figure 5-1 Nu-Link USB Driver Installation Setup

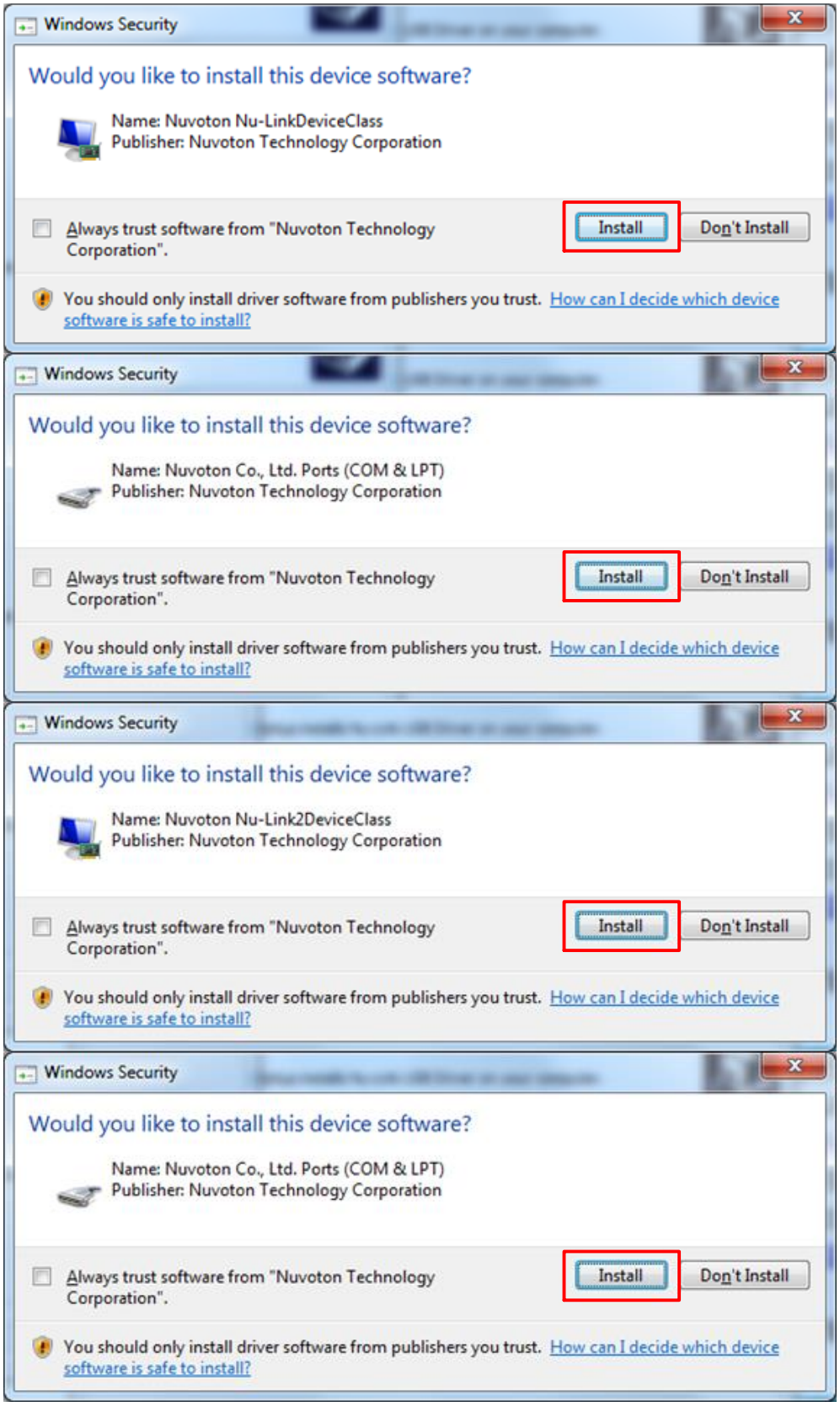

Figure 5-2 Nu-Link USB Driver Installation

5.3 Project Download

Please contact your local sales representative to have more information.

5.4 Project Structure

The project folders and files structure is shown in Figure 5-3.

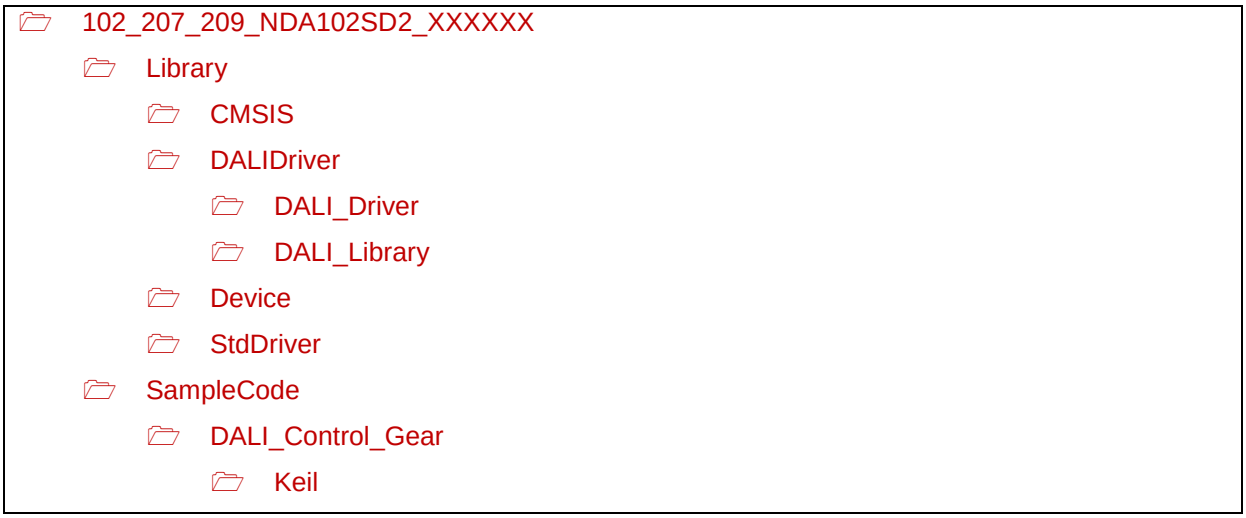

Figure 5-3 Project Folder Path

5.5 Execute the Project under Keil MDK

This section provides steps to beginners on how to run the project by using Keil MDK.

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

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

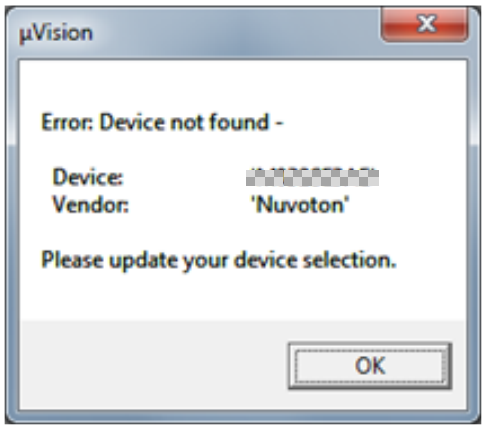

Figure 5-4 Warning Message of “Device not found”

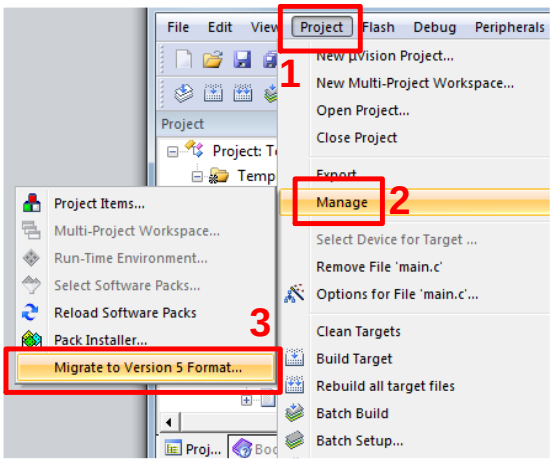

Figure 5-5 Project File Migrate to Version 5 Format

2. Make sure the “Options” settings are the same as Figure 5-6 and Figure 5-7.

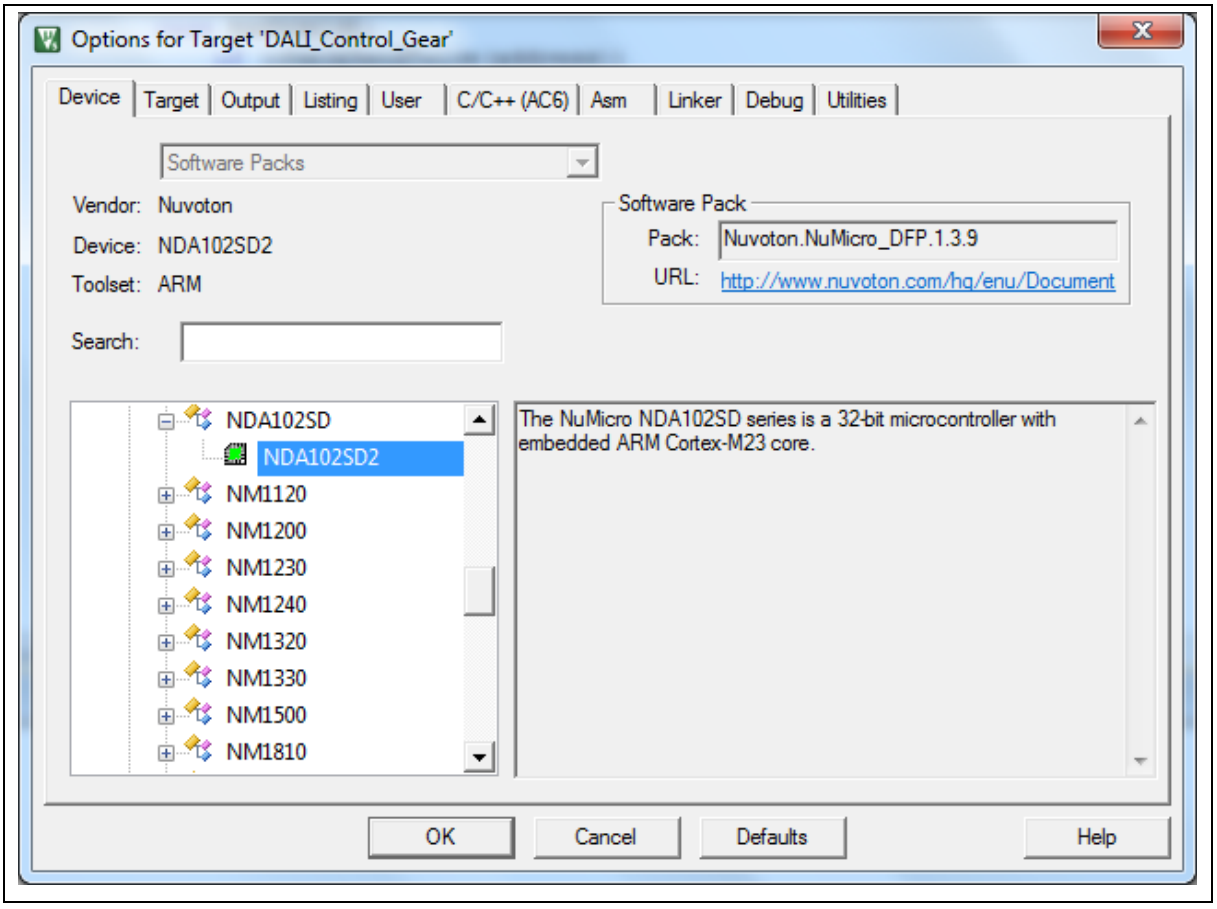

Figure 5-6 “Device” Setting in “Options” Window

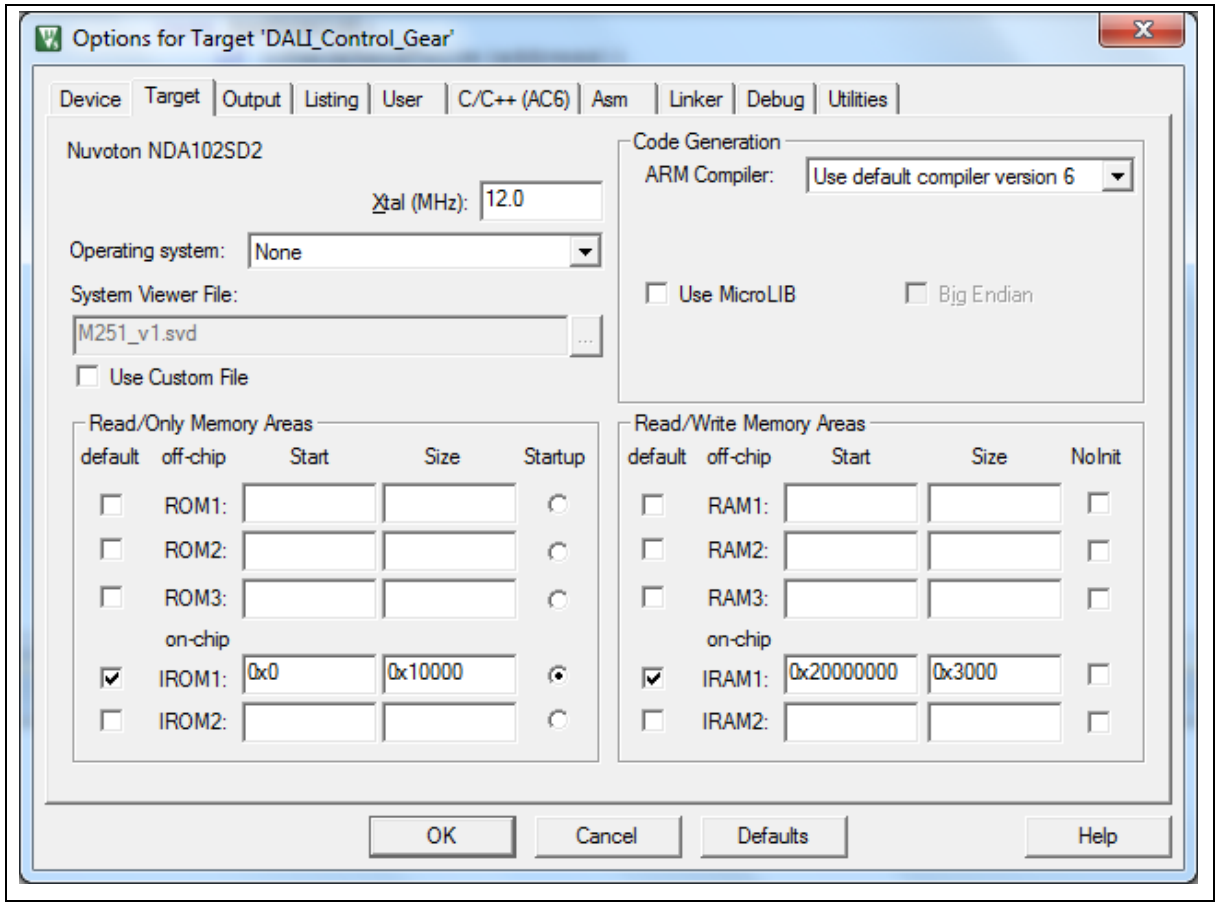

Figure 5-7 “Target” Setting in “Options” Window

3. Make sure the debugger is “Nuvoton Nu-Link Debugger” as shown in Figure 5-8 and Figure 5-9. And check the “Config” setting is the same as Figure 5-10.

   Note: If the dropdown menu in Figure 5-8 does not contain “Nuvoton Nu-Link Debugger” item, please rework section 5.2.

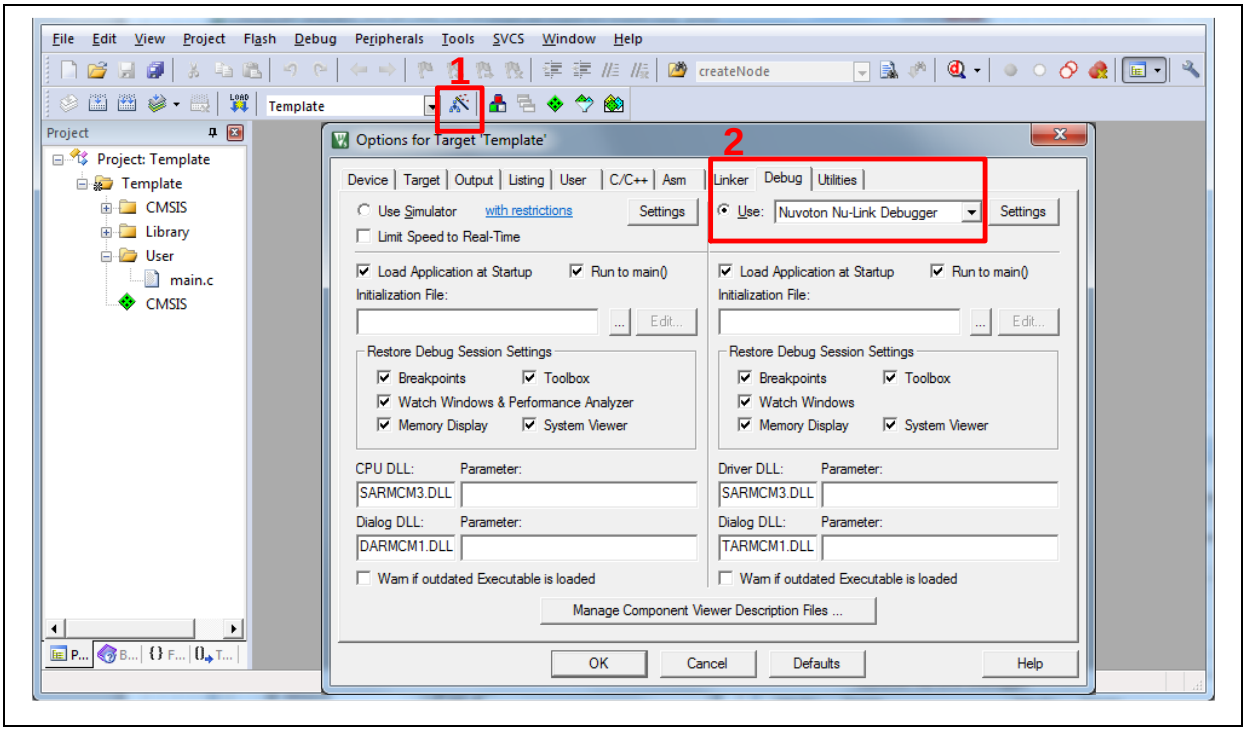

Figure 5-8 Debugger Setting in Options Window

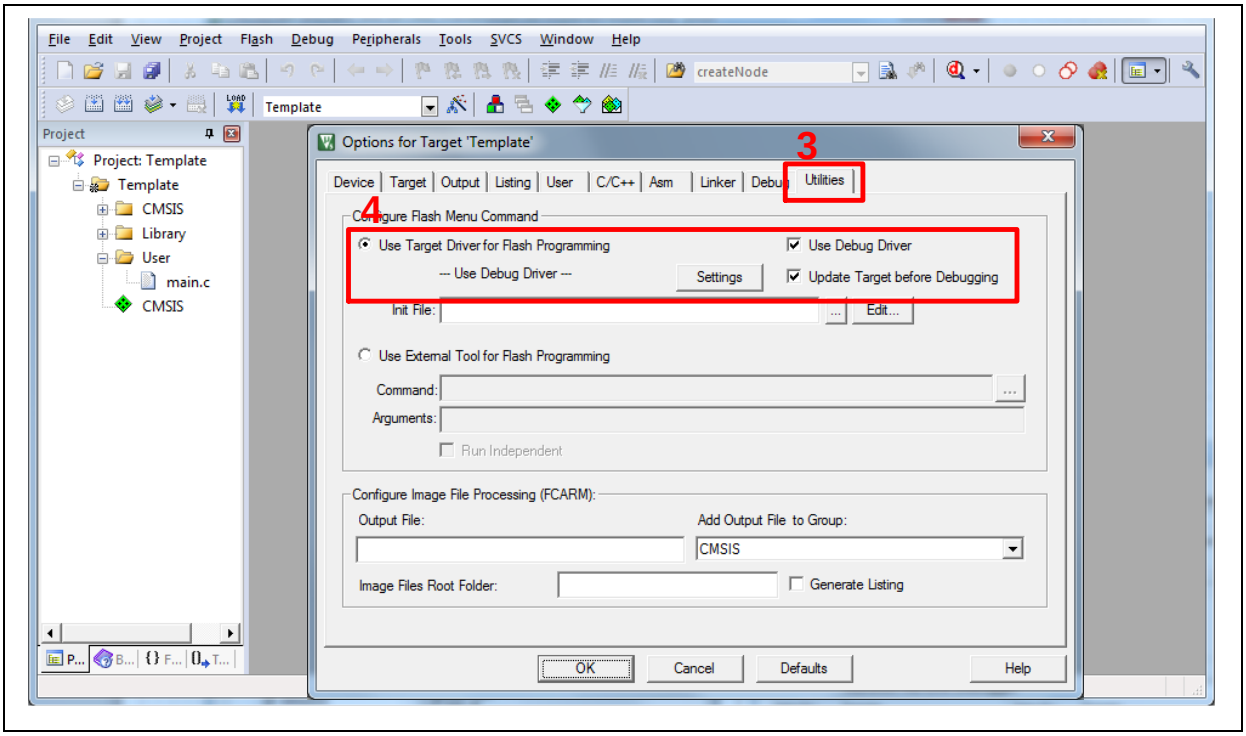

Figure 5-9 Programming Setting in Options Window

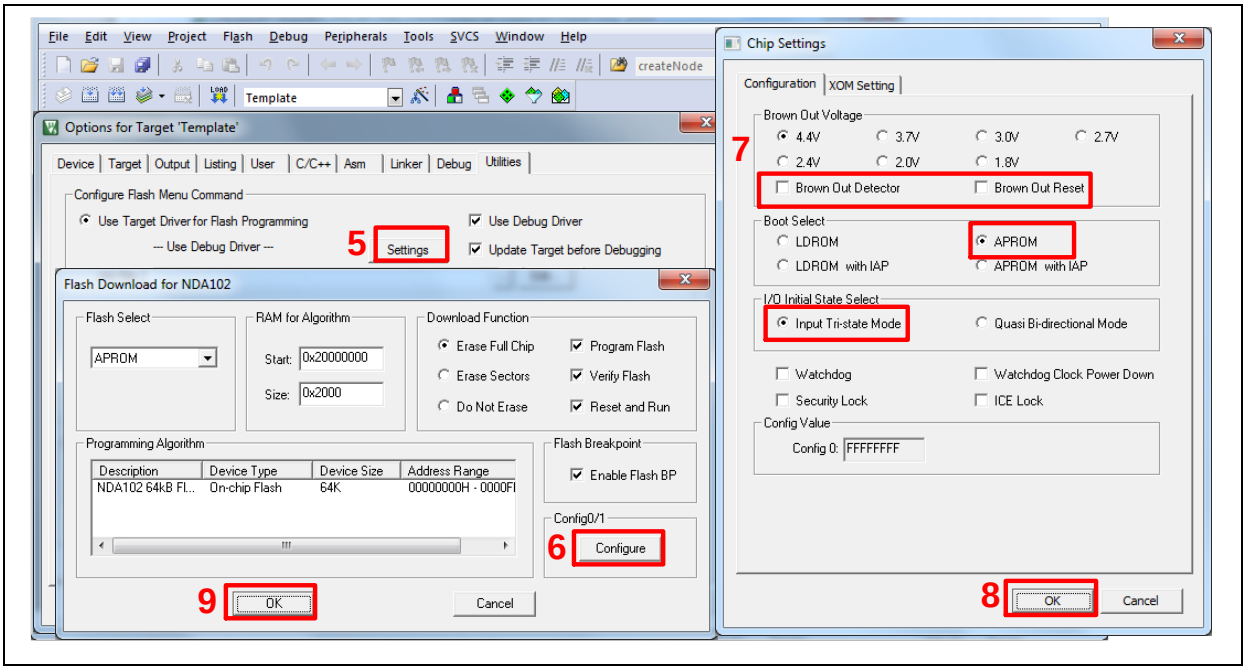

Figure 5-10 Default “Config” Setting in Options Window

4. 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.

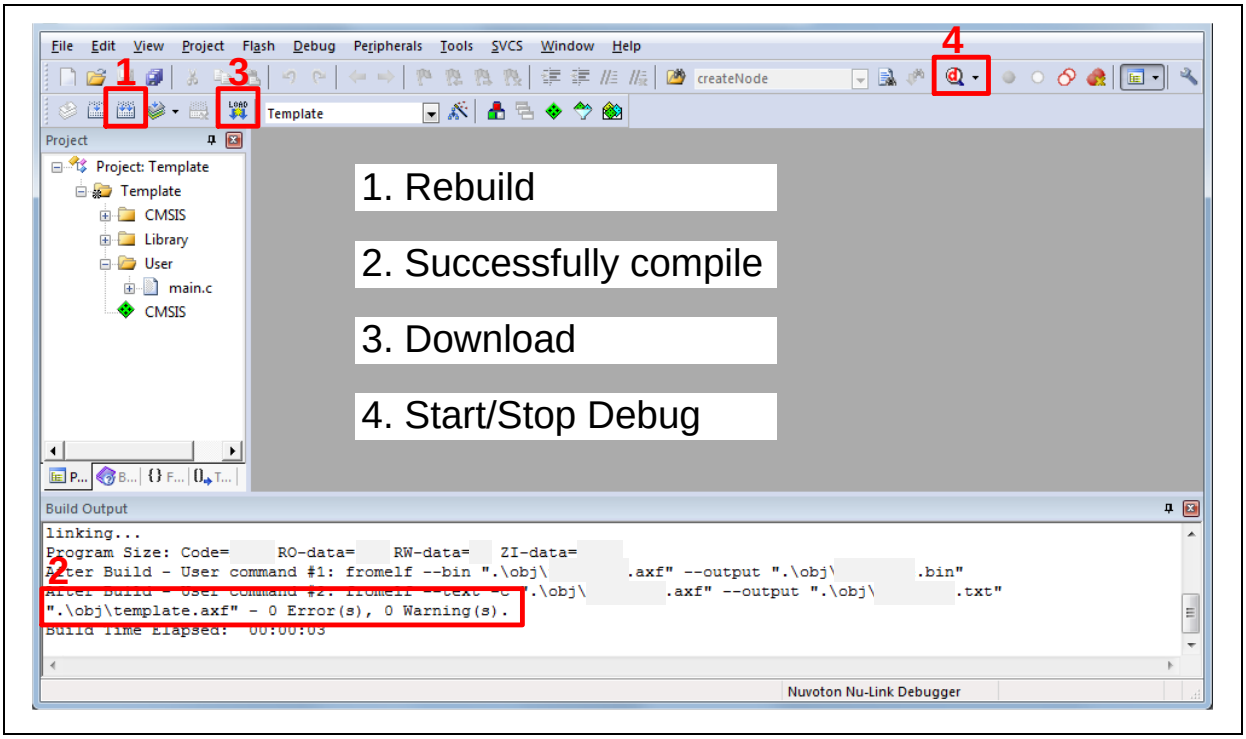

Figure 5-11 Compile and Download the Project

5. Figure 5-12 shows the debug mode under Keil MDK. User can debug the project under debug mode by checking source code, assembly language, peripherals’ registers, and setting breakpoint,

step run, value monitor, etc.

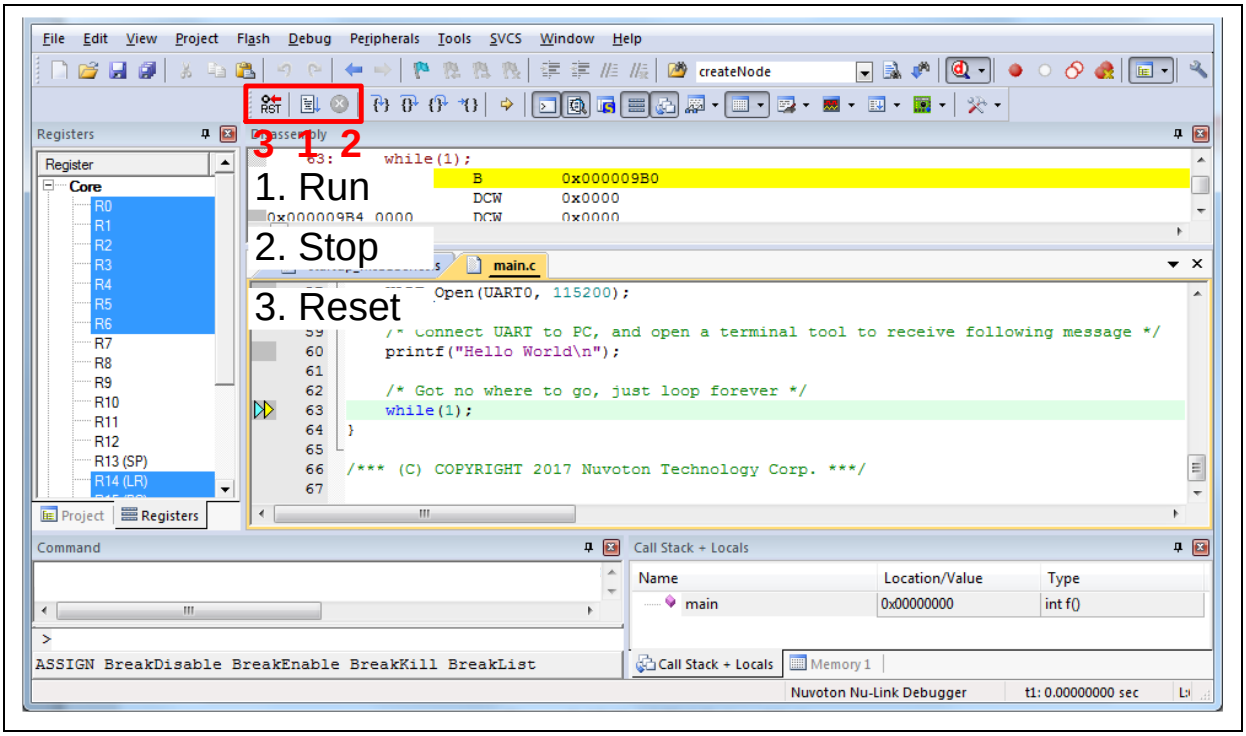

Figure 5-12 Keil MDK Debug Mode

5.6 Print Out Debug Message

1. Call function "`debugMegUART_Init()`" to enable UART debug port and then set the printf message. Rebuild and download the project to the NuMaker-DALI-NDA102SD2.
2. Open the virtual COM (VCOM) function by changing Nu-Link2-Me VCOM Switch No. 1 and 2 to ON.

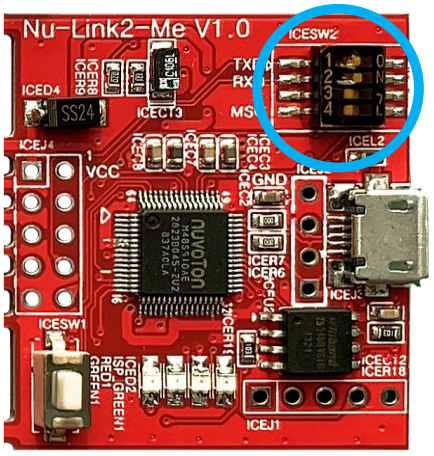

Figure 5-13 Open VCOM Function

3. Connect the ICE USB connector shown in Figure 5-14 to the PC USB port through USB cable.

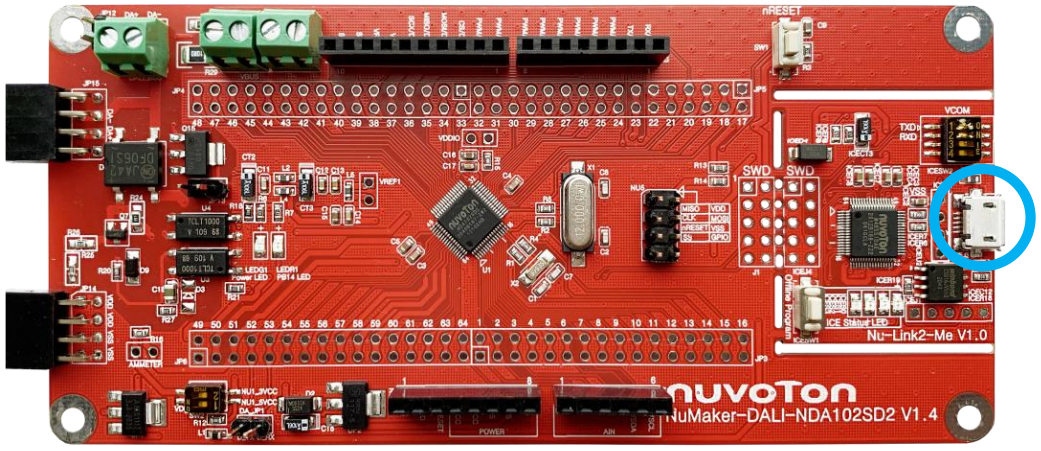

Figure 5-14 ICE USB Connector

4. Find the “Nuvoton Virtual COM Port” on the Device Manger as Figure 5-15.

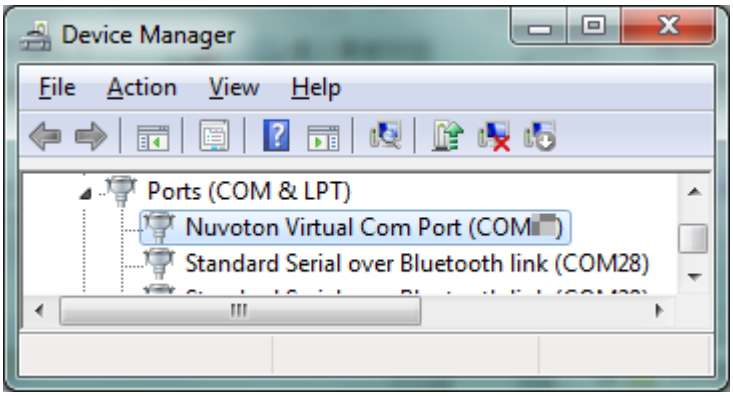

Figure 5-15 Device Manger

5. Open a serial port terminal, PuTTY for example, to print out debug message. Set the speed to 115200. Figure 5-16 presents the PuTTY session setting.

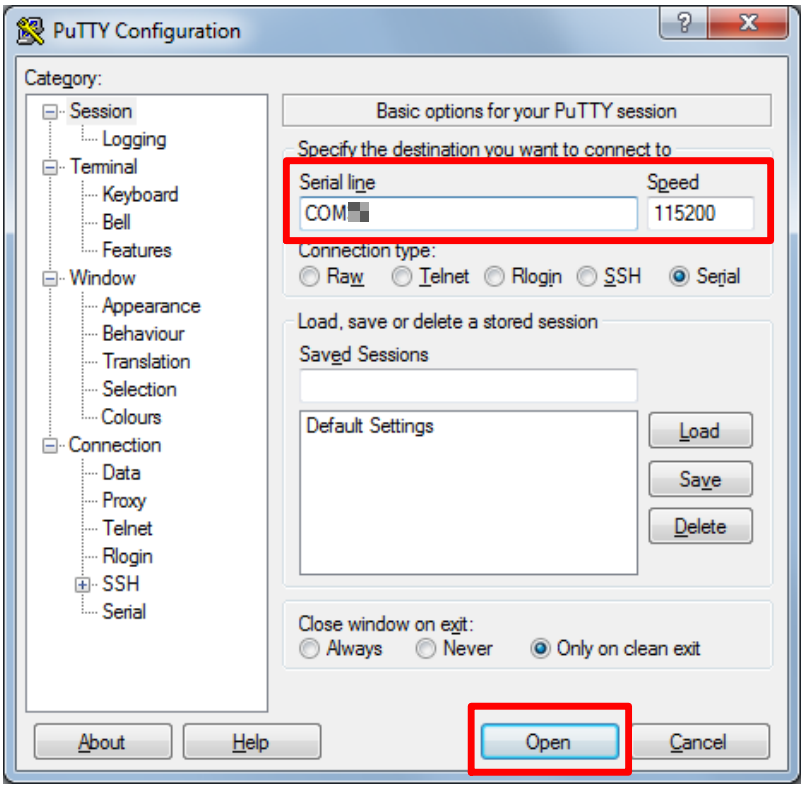

Figure 5-16 PuTTY Session Setting

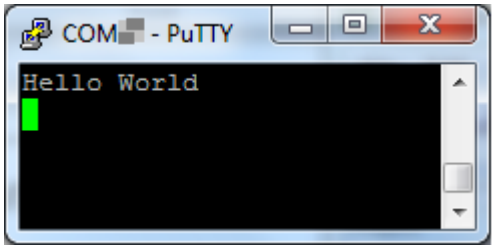

Figure 5-17 Debug Message on Serial Port Terminal Windows

5.7 Firmware Image File Download via ICP Programming Tool

This section list the operation steps of programming NuMaker-DALI-NDA102SD2 via Nuvoton NuMicro ICP Programming Tool. For more information about Nuvoton NuMicro ICP Programming Tool, please refer to Nuvoton NuMicro ICP Programmer User Guide.

5.7.1 Preparation

1. Download and install the latest Nuvoton NuMicro ICP Programming Tool.
2. Connect the ICE USB connector shown in Figure 5-14 to the PC USB port through USB cable.

5.7.2 Nuvoton NuMicro ICP Programming Tool Setting

1. Open the ICP Programming Tool and select the target chip.

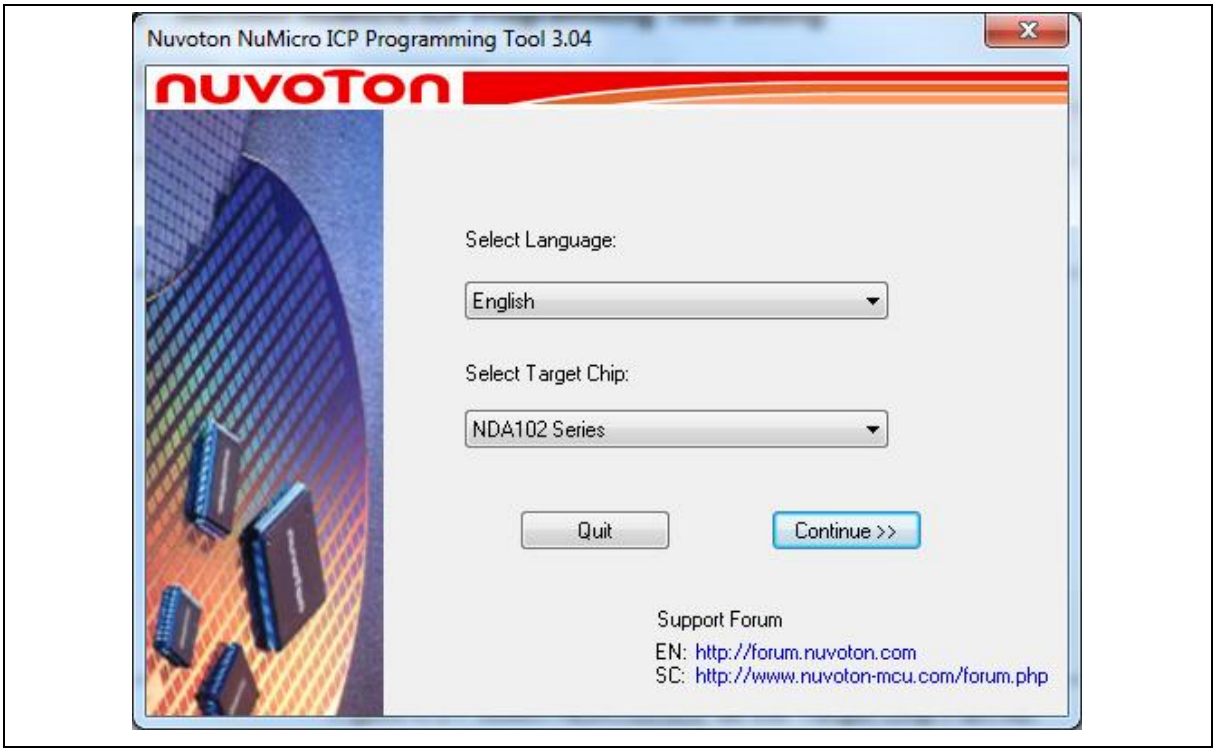

Figure 5-18 NDA102 Series Selection

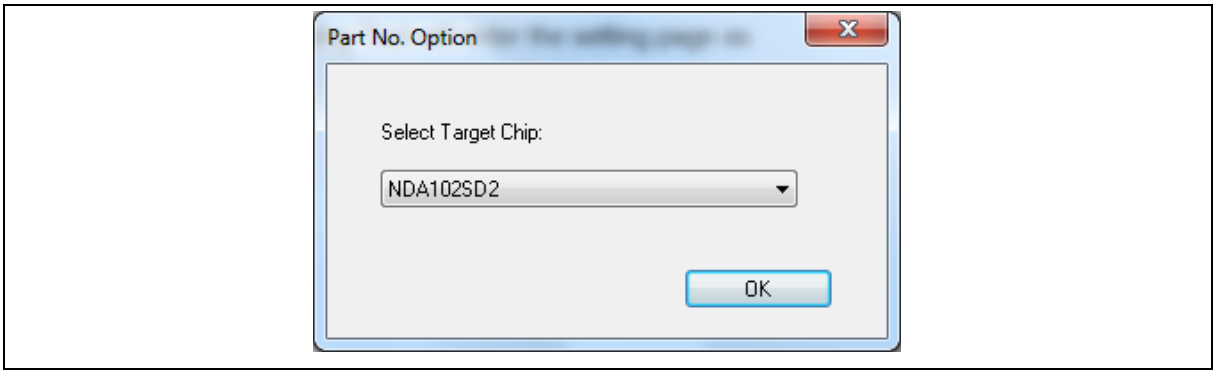

Figure 5-19 Select NDA102SD2 as the Target Chip Part No.

The ICP Programming Tool will enter the setting page. Click “Connect” to create the communication between target chip and ICP Programming Tool as Figure 5-20.

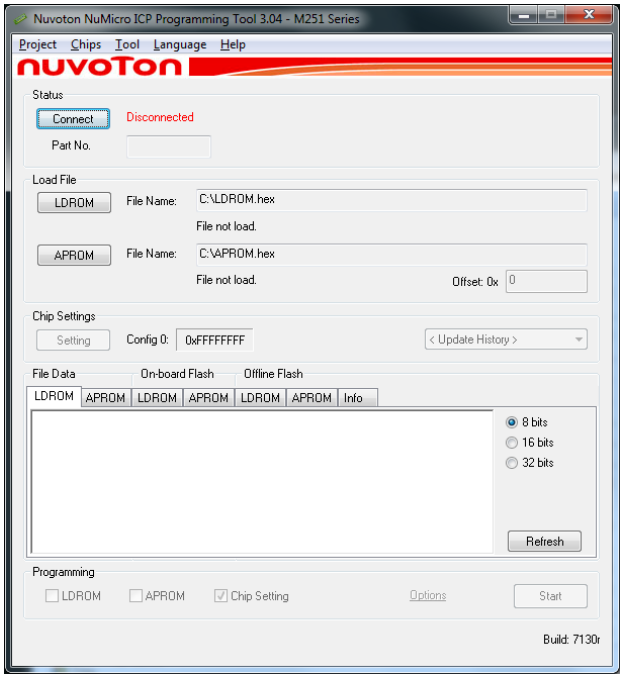

Figure 5-20 Nuvoton NuMicro ICP Programming Tool View

2. Select the project image file, and choose the “Programming” setting. The default setting for Nuvoton DALI project is shown as Figure 5-21.

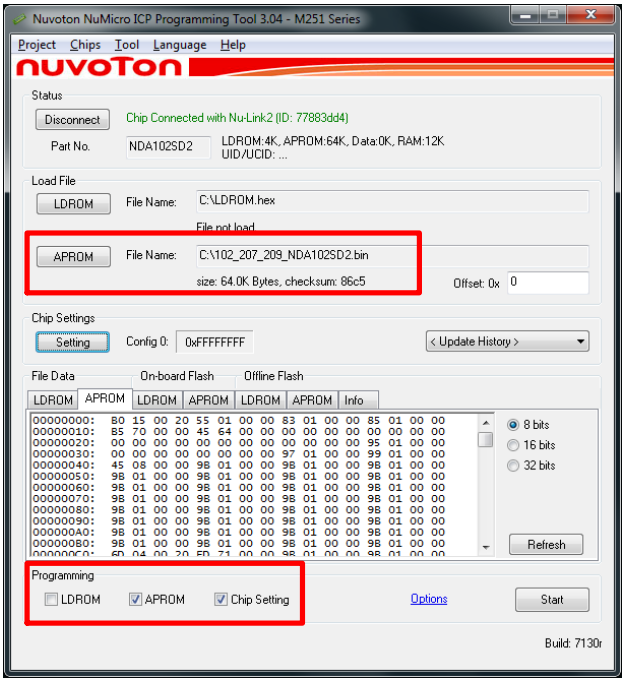

Figure 5-21 Default Project Image File Selection

3. Configure the “Chip Settings”. The default setting for Nuvoton DALI project is shown as Figure 5-22.

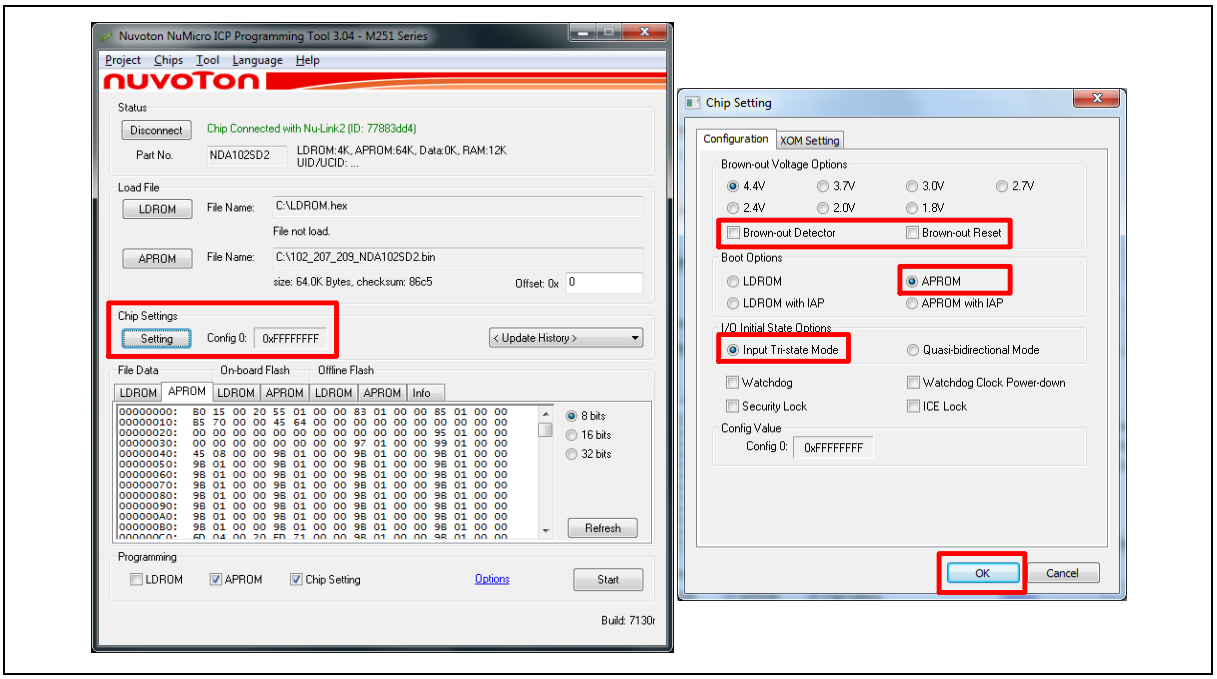

Figure 5-22 Default Chip Setting

4. Check the “Options” setting. The default setting for Nuvoton DALI project is shown as Figure 5-23.

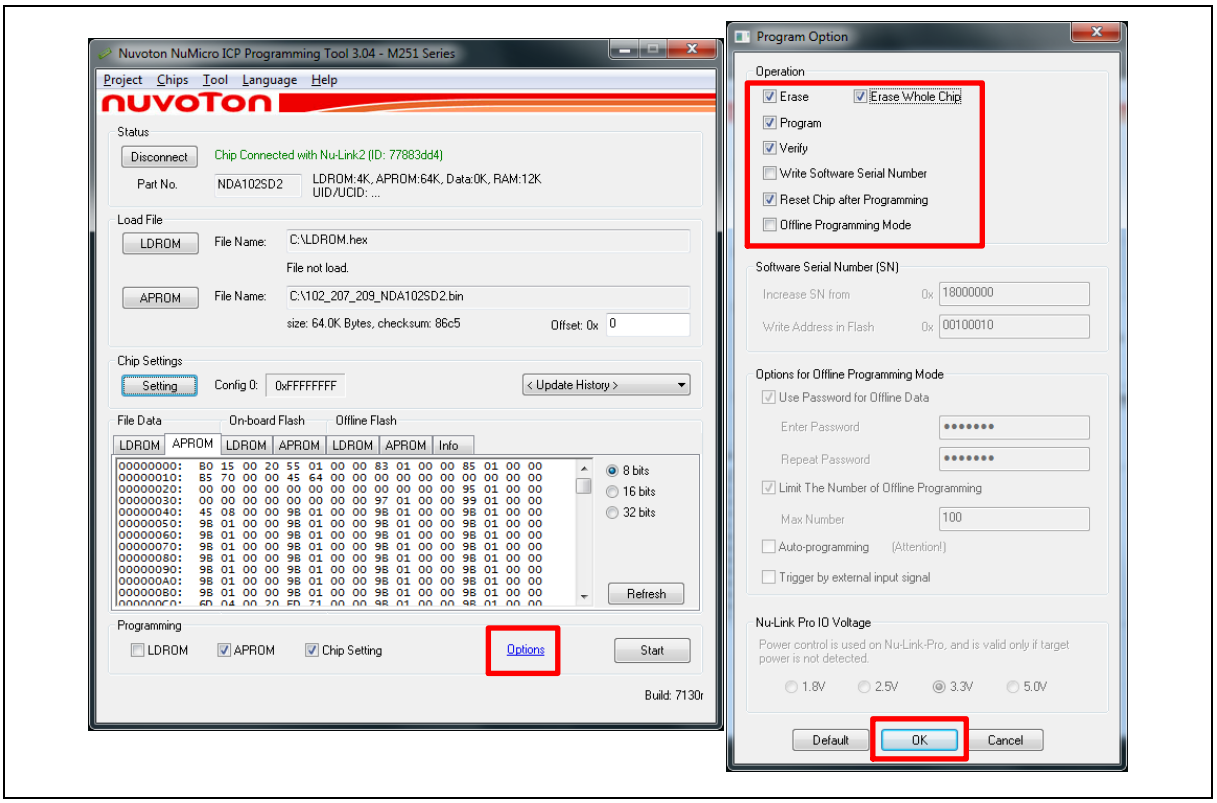

Figure 5-23 Default Options Setting

5. Click “Start” to program the target chip.

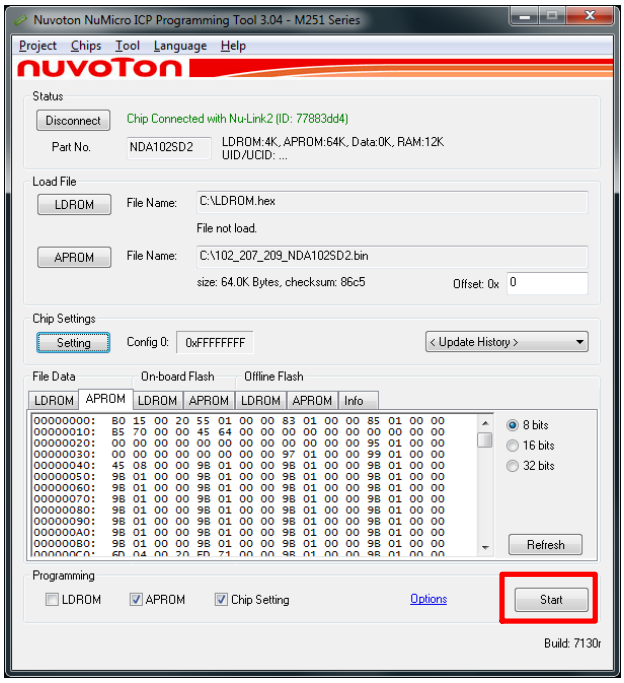

Figure 5-24 Start Programming the NuMaker-DALI-NDA102SD2

6 NUMAKER-DALI-NDA102SD2 TEST ENVIRONMENT SETUP

The NuMaker-DALI-NDA102SD2 needs to be connected to the ProbitLab2 machine during communication verification and testing. Figure 6-1 shows the connection diagram of NuMaker-DALI-NDA102SD2 and ProbitLab2. As there are more things to pay attention to when setting up, please follow the steps below to set up the DALI test environment.

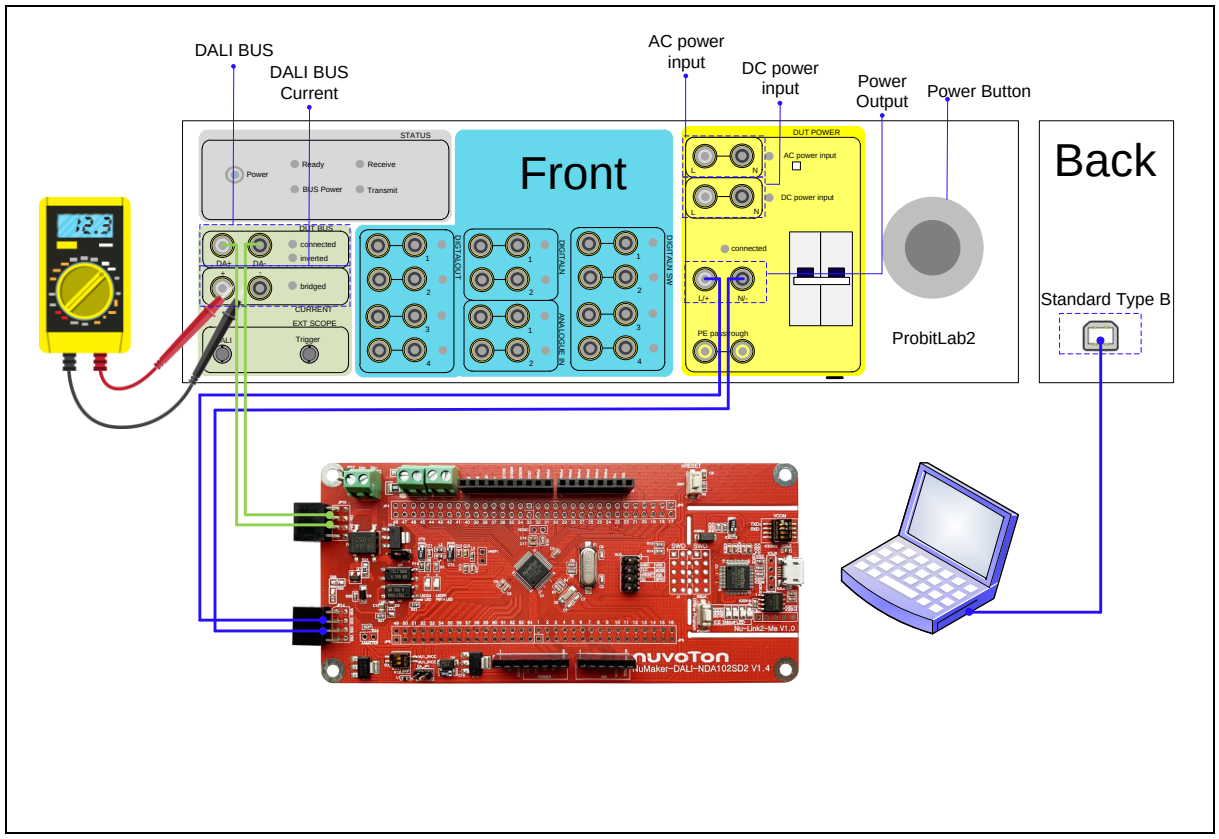

Figure 6-1 NuMaker-DALI-NDA102SD2 and ProbitLab2 Connection

6.1 Connection of NuMaker-DALI-NDA102SD2 with ProbitLab2

1. Input the DC power to be used into ProbitLab2, NuMaker-DALI-NDA102SD2 only supported voltage range is DC 3.3V to 5V, please do not input other voltage ranges or AC power.
2. Connect NuMaker-DALI-NDA102SD2 connector JP14 to ProbitLab2 Power Output L/+ and N/- respectively.
3. Connect NuMaker-DALI-NDA102SD2 connector JP15 to ProbitLab2 DALI BUS DA+ and DA- respectively.
4. Connect the current measuring instrument to the DALI BUS Current interface of ProbitLab2.
5. Connect the PC USB Port to the Standard Type B connector on the back of the ProbitLab2 machine. (The PC needs to install ProbitBench software, please refer to the ProbitBench user manual for details)
6. When testing, it is necessary to remove Nu-Link2-Me from the NuMaker-DALI-NDA102SD2 board to avoid related signal interference.

7 NUMAKER-DALI-NDA102SD2 SCHEMATICS

7.1 Nu-Link2-Me

Figure 7-1 shows the Nu-Link2-Me circuit.

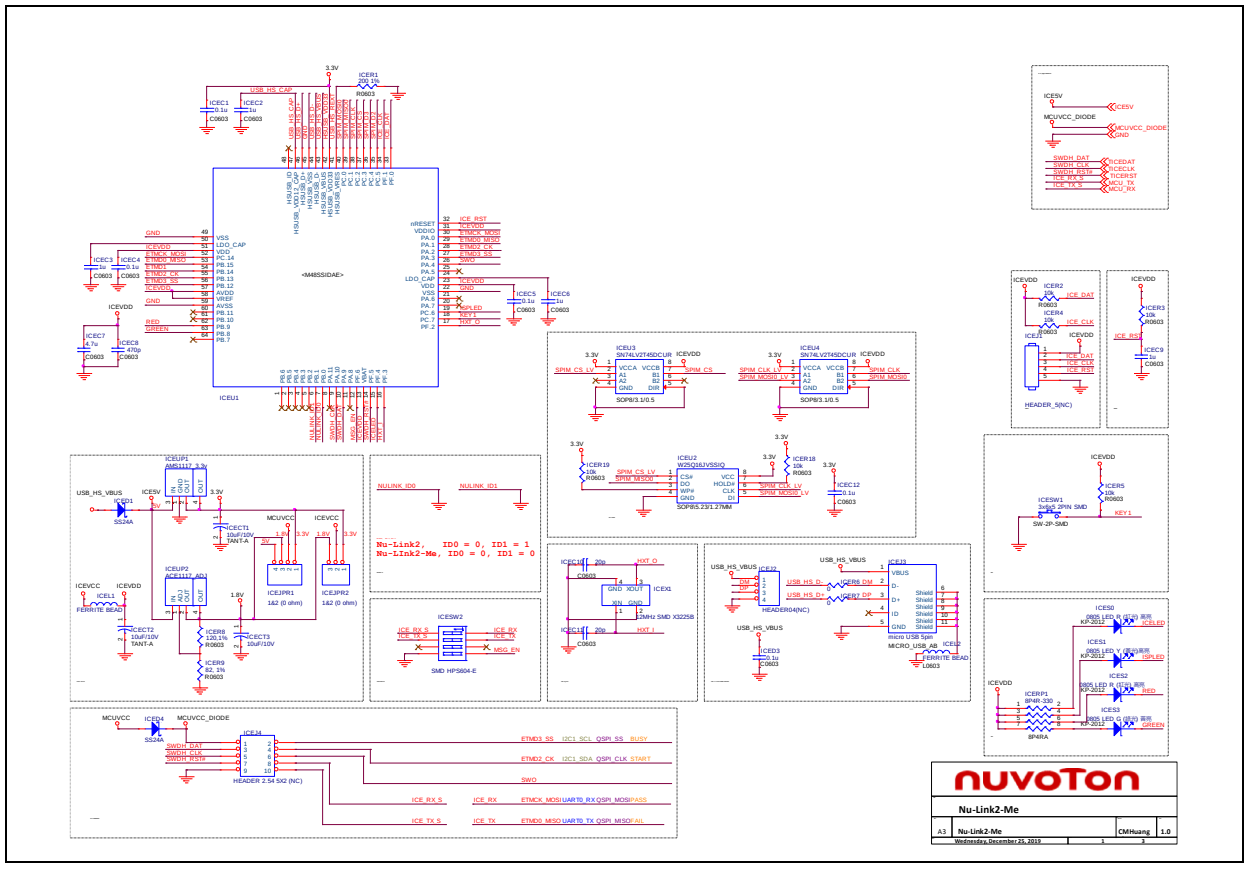

Figure 7-1 Nu-Link2-Me Circuit

7.2 NDA102SD2 Target Board

Figure 7-2 shows the NDA102SD2 target board circuit.

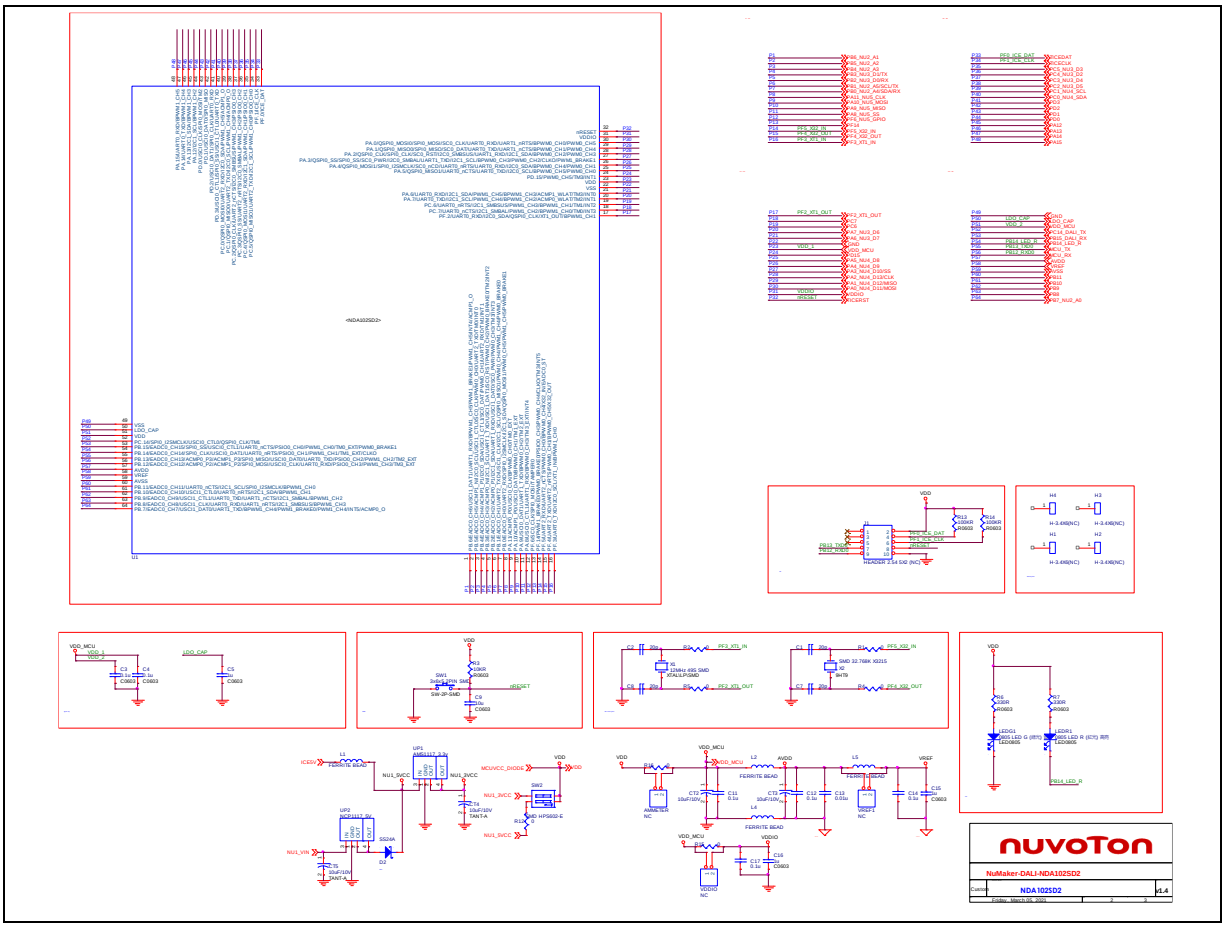

Figure 7-2 NDA102SD2 Target Board Circuit

7.3 Extension Connector

Figure 7-3 shows extension connectors of NuMaker-DALI-NDA102SD2.

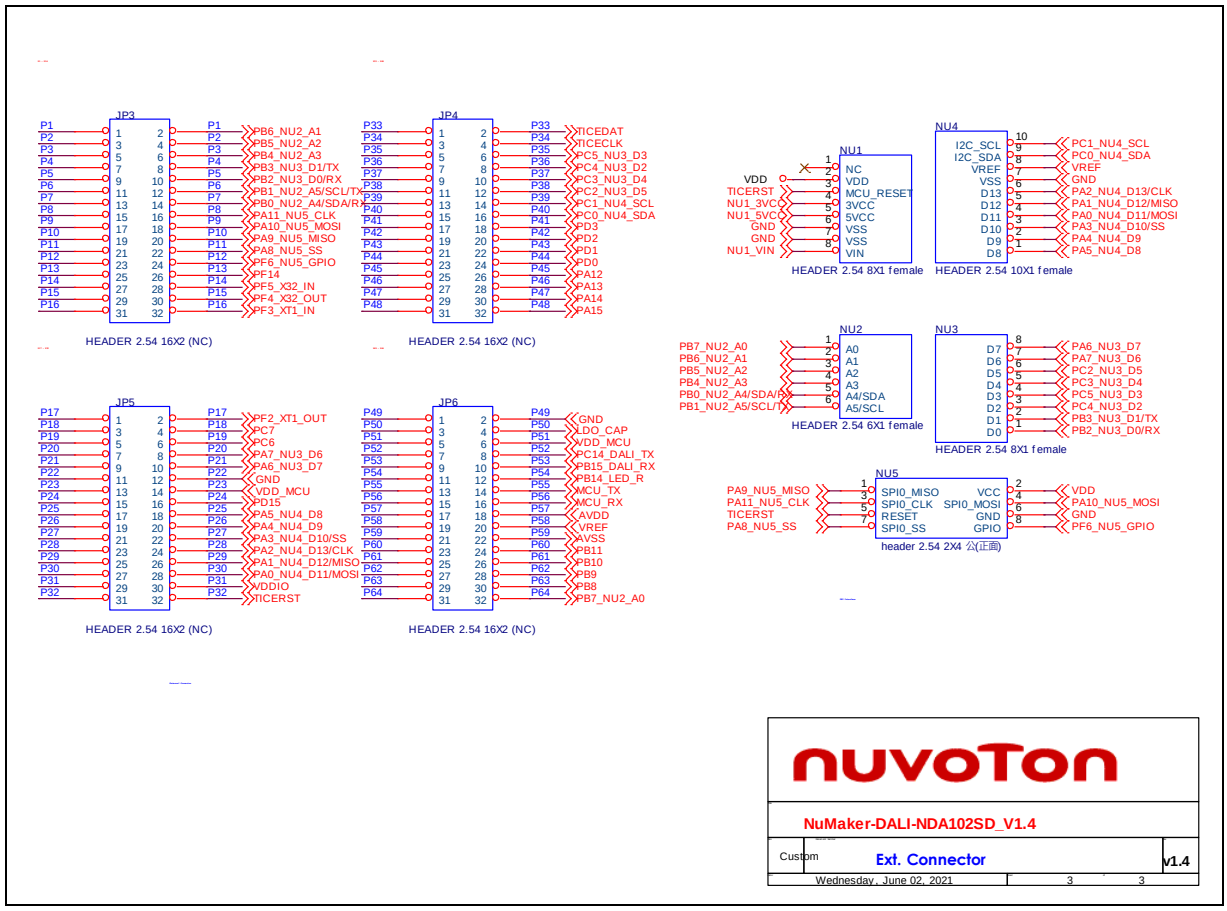

Figure 7-3 Extension Connectors Circuit

7.4 DALI Connector

Figure 7-4 shows the DALI application circuit.

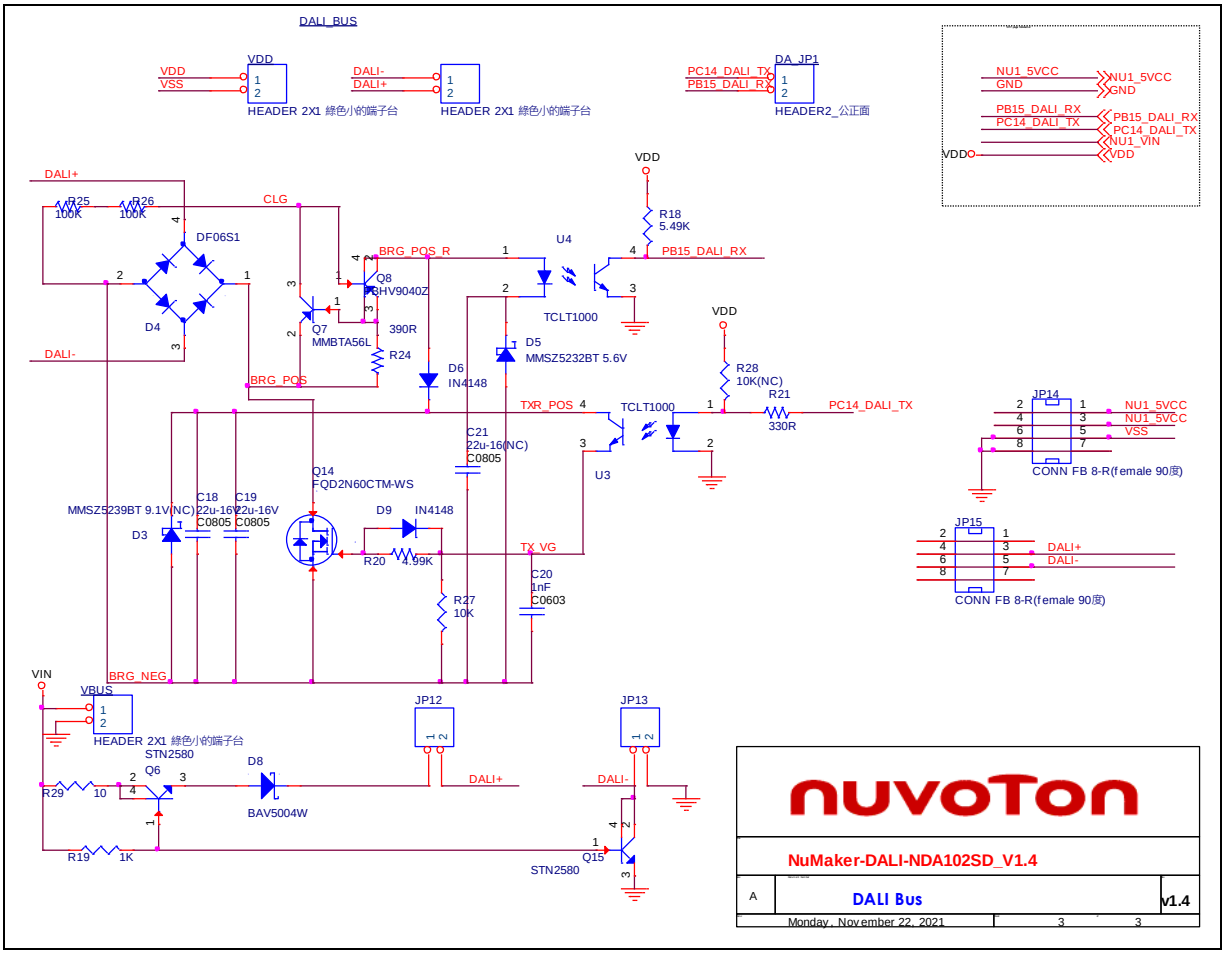

Figure 7-4 DALI Application Circuit

7.5 PCB Placement

Figure 7-5 and Figure 7-6 shows front and rear placement of NuMaker-DALI-NDA102SD2.

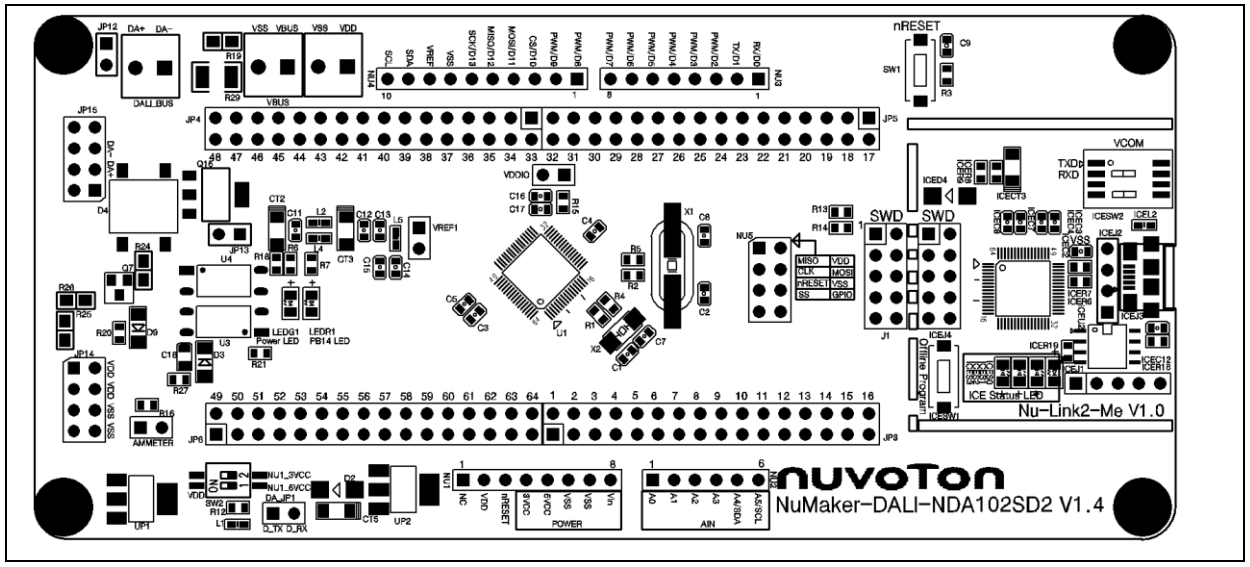

Figure 7-5 Front Placement of NuMaker-DALI-NDA102SD2

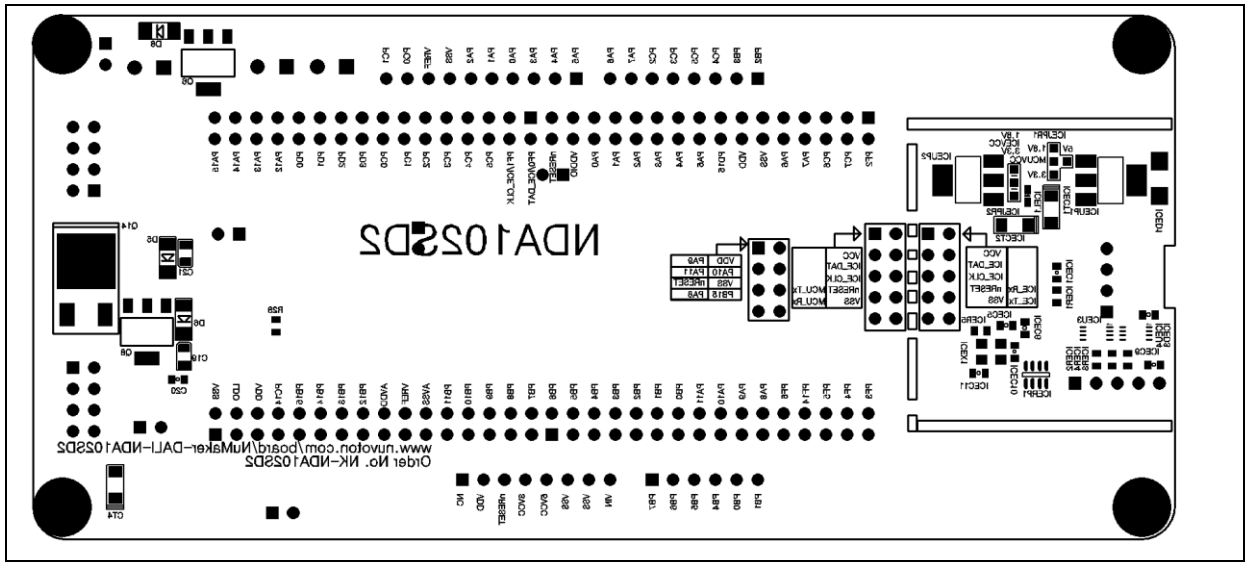

Figure 7-6 Rear Placement of NuMaker-DALI-NDA102SD2

8 NUMAKER-DALI-LIGHTING SCHEMATICS

8.1 LED Platform

Figure 8-1 shows the DALI lighting board circuit.

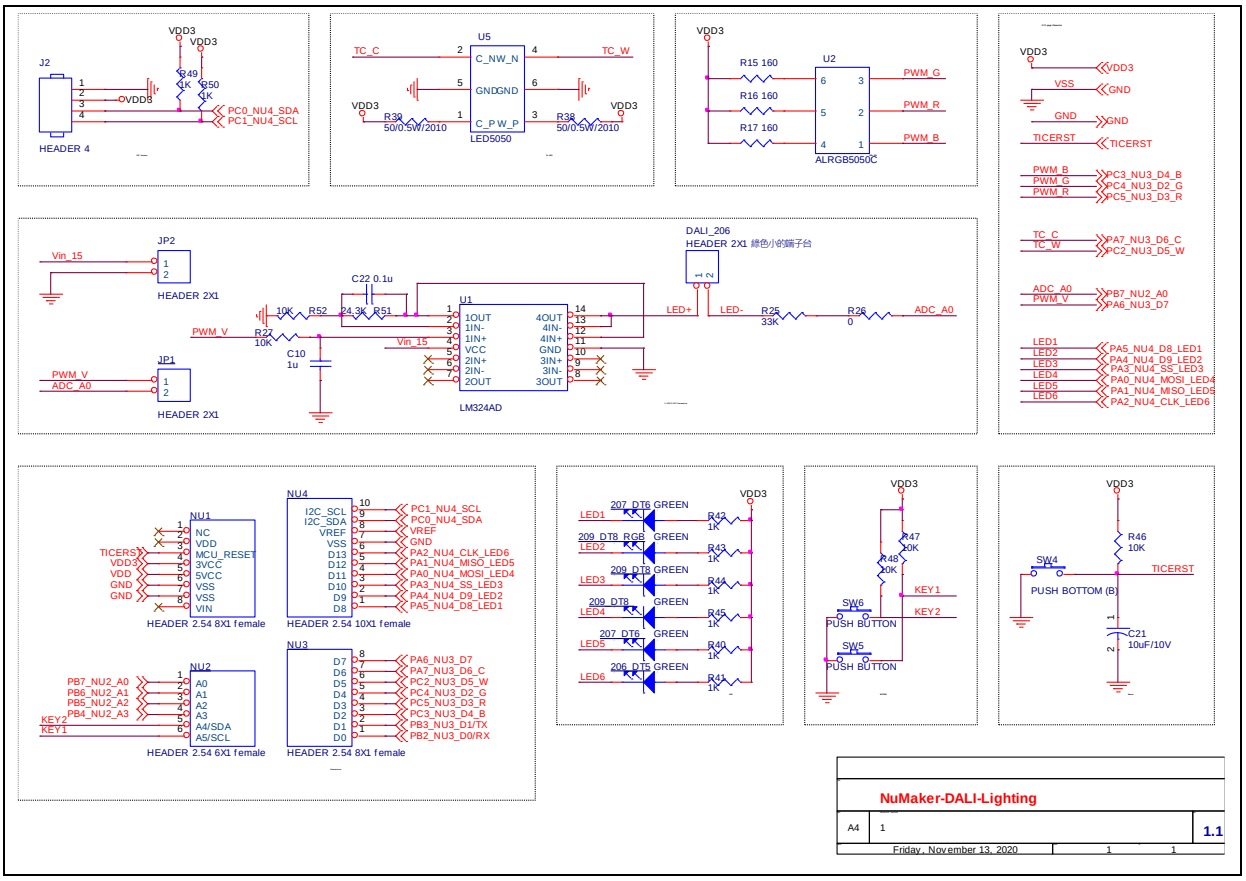

Figure 8-1 DALI Lighting Board Circuit.

8.2 PCB Placement

Figure 8-2 and Figure 8-3 shows front and rear placement of DALI lighting board.

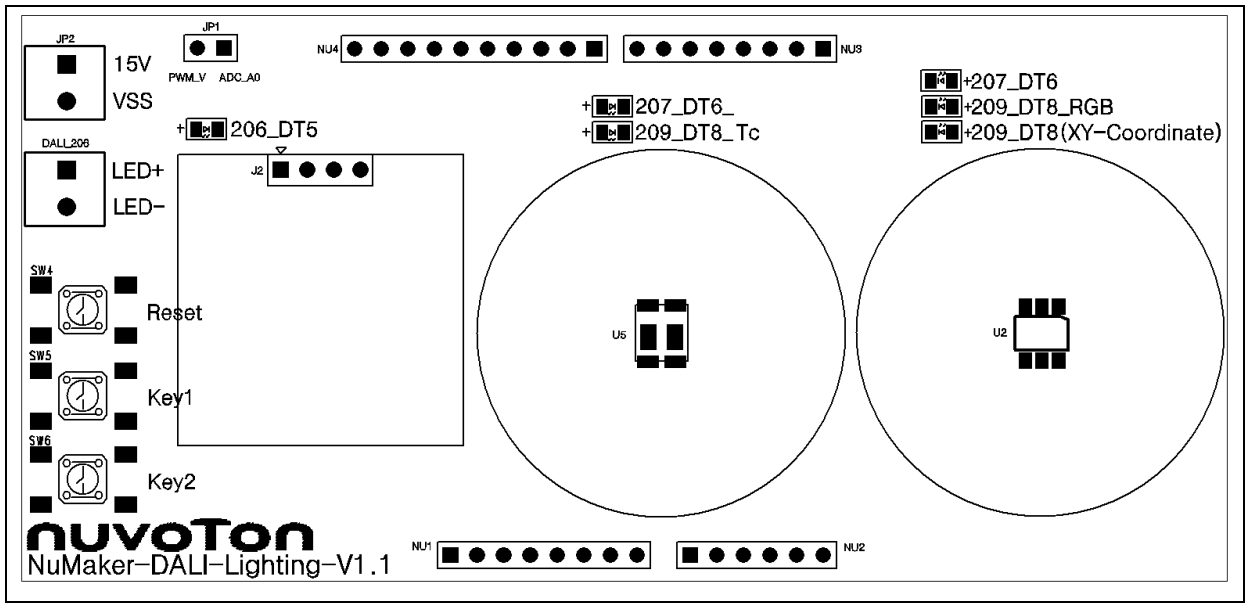

Figure 8-2 Front Placement of DALI Lighting Board

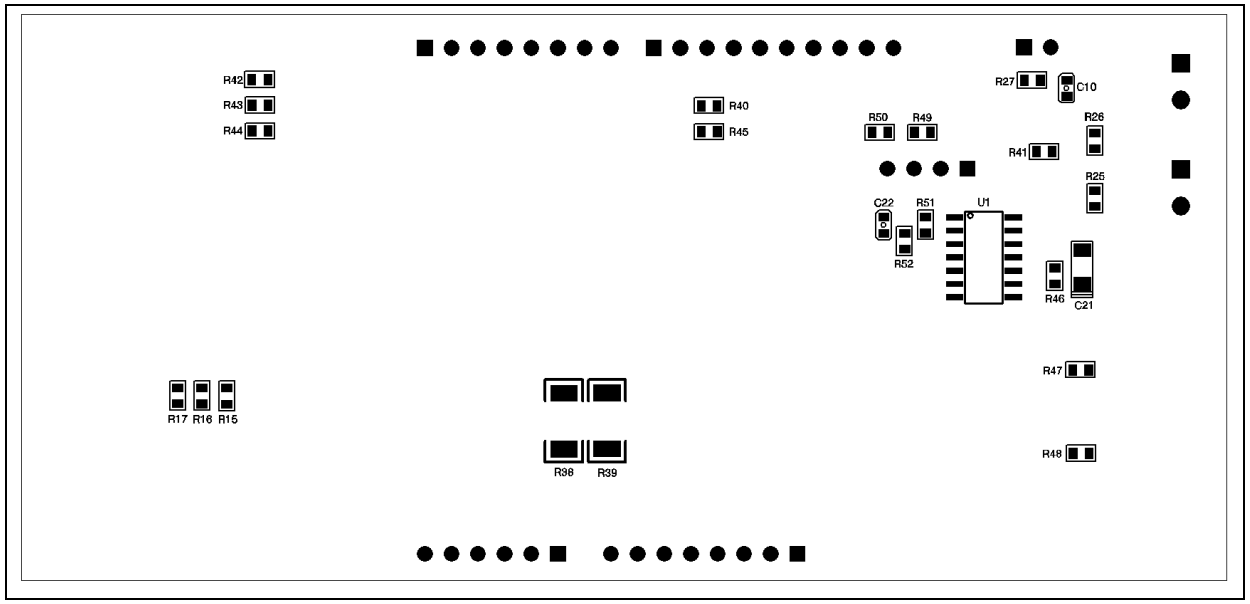

Figure 8-3 Rear Placement of DALI Lighting Board

9 REVISION HISTORY

Date	Revision	Description
2022.02.16	1.00	1. Initial version

Important Notice

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Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.