

**ARM<sup>®</sup> Cortex<sup>®</sup>-M  
32-bit Microcontroller**

**NuMaker-M471KI  
User Manual  
NuMicro<sup>®</sup> M471 Series**

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## 1 OVERVIEW

The NuMaker-M471KI is a development board for Nuvoton NuMicro M471KI, M471VI, and M471VG microcontrollers. The NuMaker-M471KI consists of two parts: an M471 target board and an on-board Nu-Link2-Me debugger and programmer. The NuMaker-M471KI is designed for project evaluation, prototype development and validation with power consumption monitoring function.

The M471 target board is based on NuMicro® M471KI8AE. For the development flexibility, the M471 target board provides the extension connectors of M471KI8AE, the Arduino UNO compatible headers and the capability of adopting multiple power supplies. Furthermore, the Nuvoton-designed ammeter connector can measure the power consumption instantly, which is essential for the prototype evaluation. The M471 target board includes the Embedded Trace Macrocell (ETM) to trace instructions, the embedded hardware IR Receiver to do pattern matching and decoding for a remote controller. A reserved ceramic resonator footprint on the development board can be applied for the 4~24 MHz high-speed external (HXT) clock.

In addition to the M471 target board, 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 become a stand-alone mass production programmer.

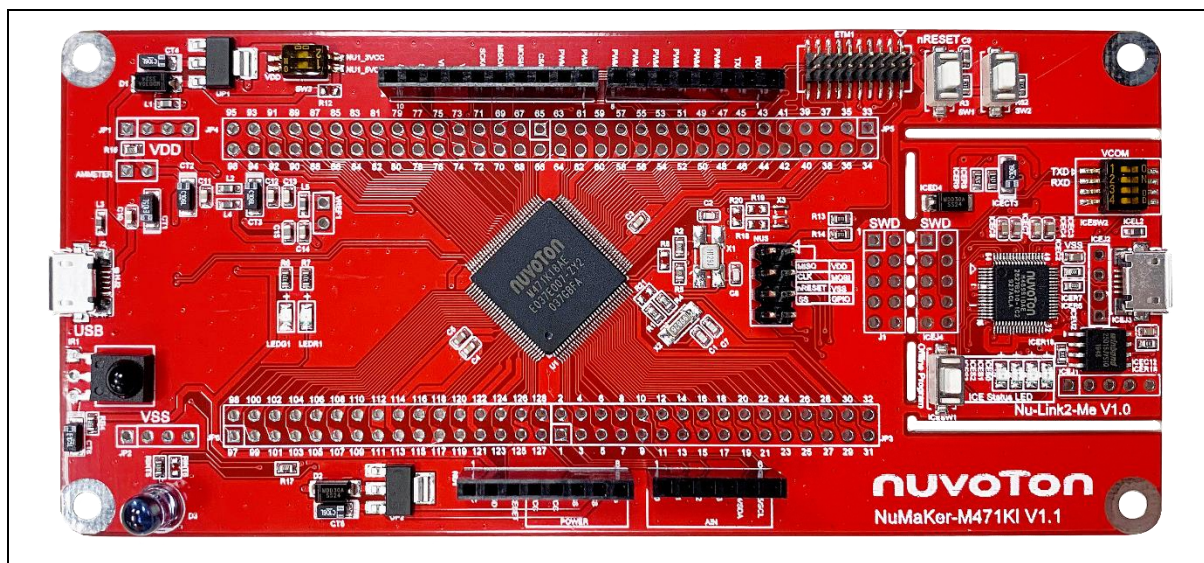


Figure 1-1 NuMaker-M471KI Development Board

## 2 FEATURES

- NuMicro® M471KI8AE microcontroller with function compatible with:
  - ◆ M471VI8AE
  - ◆ M471VG7AE
- M471KI8AE 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  $V_{in}$
  - ◆ USB connector on M471 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

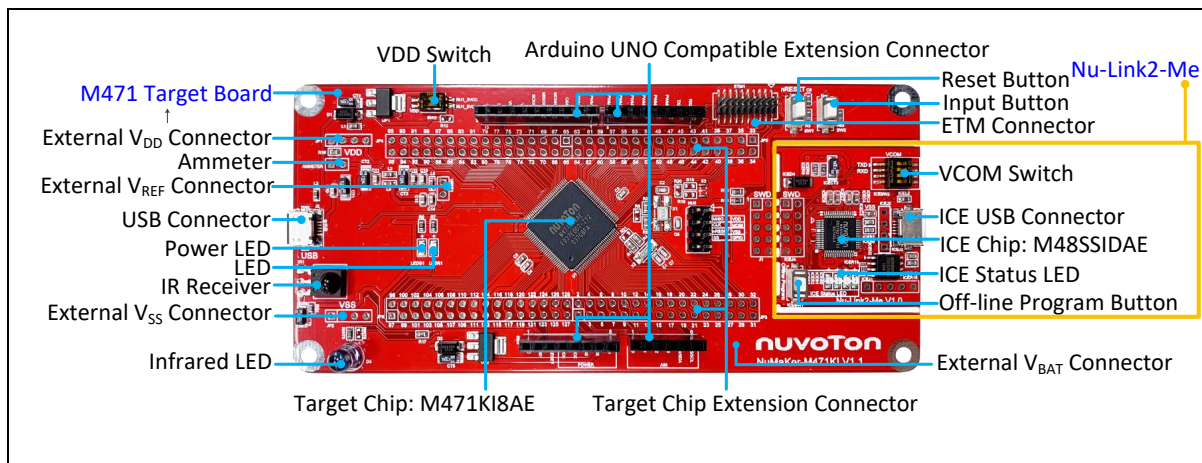


Figure 3-1 Front View of NuMaker-M471KI

Figure 3-1 shows the main components and connectors from the front side of NuMaker-M471KI. The following lists components and connectors from the front view:

- Target chip: M471KI8AE (U1)
- USB PWR Connector (J2)
- Arduino UNO Compatible Extension Connectors (NU1, NU2, NU3, NU4)
- M471 Extension Connectors (JP3, JP4, JP5 and JP6)
- External  $V_{DD}$  Power Connector (JP1)
- External  $V_{SS}$  Power Connector (JP2)
- External  $V_{REF}$  Connector (VREF1)
- $V_{DD}$  Switch (SW3)
- ETM Connector (ETM1)
- IR Receiver (IR1)
- Infrared LED (D3)
- Ammeter Connector (AMMETER)
- Reset Button (SW1)
- Input Button (SW2)
- 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-M471KI.

The following lists components and connectors from the rear view:

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

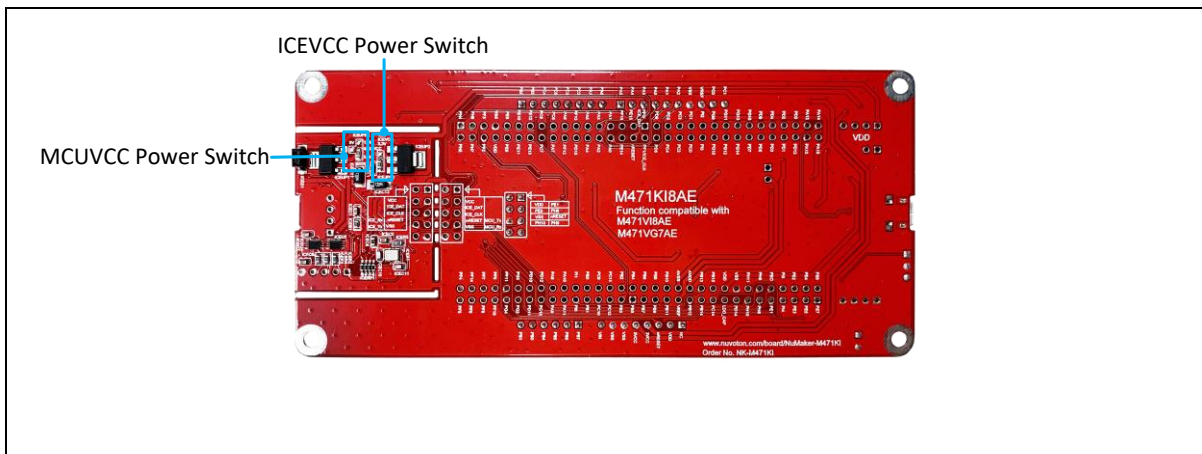


Figure 3-2 Rear View of NuMaker-M471KI

### 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-M471KI.
NU1, NU2, NU3 and NU4	Arduino UNO compatible pins on the NuMaker-M471KI.

Table 3-1 Extension Connectors

#### 3.3.1 Pin Assignment for Extension Connectors

The NuMaker-M471KI provides the M471KI8AE onboard and extension connectors (JP3, JP4, JP5 and JP6). The Figure 3-3 shows the M471KI8AE extension connectors.

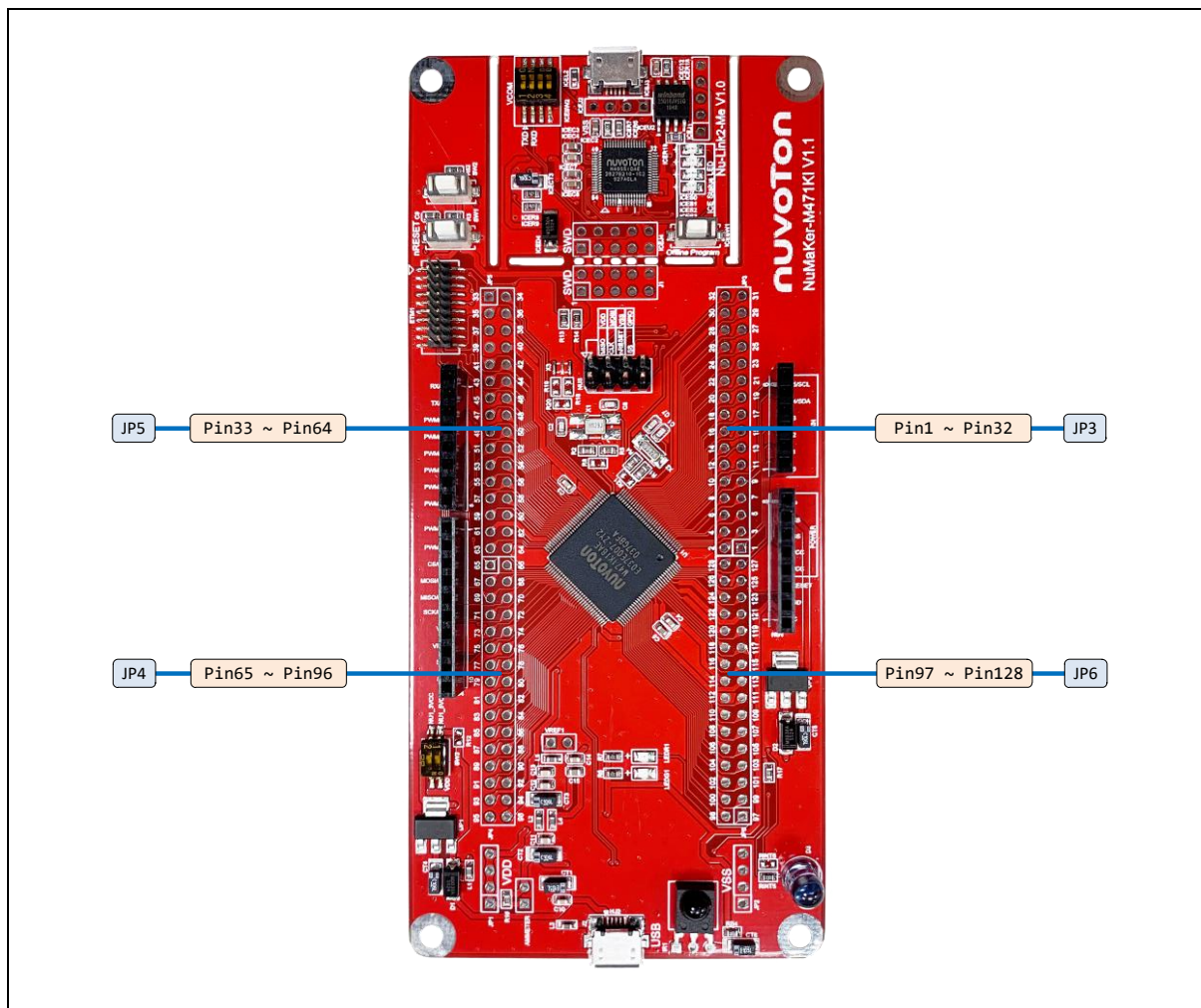


Figure 3-3 M471KI8AE Extension Connectors

Header		M471KI8AE	
		Pin No.	Function
JP3	JP3.1	1	PB.5/EADC0_CH5/ACMP1_N/SPI1_MISO/I2C0_SCL/UART5_TXD/EPWM0_CH0/UART2_TXD/TM0/INT0
	JP3.2	2	PB.4/EADC0_CH4/ACMP1_P1/SPI1_MOSI/I2C0_SDA/UART5_RXD/EPWM0_CH1/UART2_RXD/TM1/INT1
	JP3.3	3	PB.3/EADC0_CH3/ACMP0_N/SPI1_CLK/UART1_TXD/UART5_nRTS/EPWM0_CH2/I2C1_SCL/EPWM0_BRAKE0/TM2/INT2
	JP3.4	4	PB.2/EADC0_CH2/ACMP0_P1/SPI1_SS/UART1_RXD/UART5_nCTS/EPWM0_CH3/I2C1_SDA/TM3/INT3
	JP3.5	5	PC.12/UART0_TXD/I2C0_SCL/EPWM1_CH0/ACMP0_O
	JP3.6	6	PC.11/UART0_RXD/I2C0_SDA/EPWM1_CH1/ACMP1_O
	JP3.7	7	PC.10/UART3_TXD/EPWM1_CH2
	JP3.8	8	PC.9/UART3_RXD/EPWM1_CH3
	JP3.9	9	PB.1/EADC0_CH1/SPI1_I2SMCLK/UART2_TXD/I2C1_SCL/EPWM0_CH4/EPWM1_CH4/EPWM0_BRAKE0
	JP3.10	10	PB.0/EADC0_CH0/UART2_RXD/SPI0_I2SMCLK/I2C1_SDA/EPWM0_CH5/EPWM1_CH5/EPWM0_BRAKE1
	JP3.11	11	PI.0/UART0_TXD/I2C0_SCL/UART5_TXD/UART2_TXD/I2C1_SCL/EPWM0_CH4/EPWM1_CH0/ACMP0_O
	JP3.12	12	PI.1/UART0_RXD/I2C0_SDA/UART5_RXD/UART2_RXD/I2C1_SDA/EPWM0_CH5/EPWM1_CH1/ACMP1_O
	JP3.13	13	PA.11/EADC0_CH23/ACMP0_P0/BPWM0_CH0/EPWM0_SYNC_OUT/TM0_EXT
	JP3.14	14	PA.10/EADC0_CH22/ACMP1_P0/BPWM0_CH1/TM1_EXT/DAC0_ST
	JP3.15	15	PA.9/EADC0_CH21/UART1_TXD/BPWM0_CH2/TM2_EXT
	JP3.16	16	PA.8/EADC0_CH20/UART1_RXD/BPWM0_CH3/TM3_EXT/INT4
	JP3.17	17	PC.13/EADC0_CH19/UART2_TXD/BPWM0_CH4/CLKO/EADC0_ST
	JP3.18	18	PD.12/EADC0_CH18/UART2_RXD/BPWM0_CH5/CLKO/EADC0_ST/INT5
	JP3.19	19	PD.11/EADC0_CH17/UART1_TXD/INT6
	JP3.20	20	PD.10/EADC0_CH16/UART1_RXD/INT7
	JP3.21	21	PG.2/I2C0_SMBAL/I2C1_SCL/TM0
	JP3.22	22	PG.3/I2C0_SMBUS/I2C1_SDA/TM1
	JP3.23	23	PG.4/TM2
	JP3.24	24	PF.11/UART5_TXD/TM3
	JP3.25	25	PF.10/SPI0_I2SMCLK/UART5_RXD
	JP3.26	26	PF.9/SPI0_SS/UART5_nRTS
	JP3.27	27	PF.8/SPI0_CLK/UART5_nCTS
	JP3.28	28	PF.7/SPI0_MISO/UART4_TXD
	JP3.29	29	PF.6/SPI0_MOSI/UART4_RXD
	JP3.30	30	PF.14/EPWM1_BRAKE0/EPWM0_BRAKE0/EPWM0_CH4/CLKO/TM3/INT5
	JP3.31	31	PF.5/UART2_RXD/UART2_nCTS/EPWM0_CH0/BPWM0_CH4/EPWM0_SYNC_OUT/X32_IN/EADC0_ST
	JP3.32	32	PF.4/UART2_TXD/UART2_nRTS/EPWM0_CH1/BPWM0_CH5/X32_OUT

Header		M471KI8AE	
		Pin No.	Function
JP5	JP5.1	33	PH.4/SPI1_MISO
	JP5.2	34	PH.5/SPI1_MOSI
	JP5.3	35	PH.6/SPI1_CLK
	JP5.4	36	PH.7/SPI1_SS
	JP5.5	37	PF.3/UART0_TXD/I2C0_SCL/XT1_IN/BPWM1_CH0
	JP5.6	38	PF.2/UART0_RXD/I2C0_SDA/XT1_OUT/BPWM1_CH1
	JP5.7	39	V <sub>SS</sub>
	JP5.8	40	V <sub>DD</sub>
	JP5.9	41	PE.8/UART2_TXD/EPWM0_CH0/EPWM0_BRAKE0/TRACE_DATA3
	JP5.10	42	PE.9/UART2_RXD/EPWM0_CH1/EPWM0_BRAKE1/TRACE_DATA2
	JP5.11	43	PE.10/UART3_TXD/EPWM0_CH2/EPWM1_BRAKE0/TRACE_DATA1
	JP5.12	44	PE.11/UART3_RXD/UART1_nCTS/EPWM0_CH3/EPWM1_BRAKE1/TRACE_DATA0
	JP5.13	45	PE.12/UART1_nRTS/EPWM0_CH4/TRACE_CLK
	JP5.14	46	PE.13/I2C0_SCL/UART4_nRTS/UART1_TXD/EPWM0_CH5/EPWM1_CH0/BPWM1_CH5
	JP5.15	47	PC.8/I2C0_SDA/UART4_nCTS/UART1_RXD/EPWM1_CH1/BPWM1_CH4
	JP5.16	48	PC.7/SPI1_MISO/UART4_TXD/UART0_nCTS/I2C1_SMBAL/EPWM1_CH2/BPWM1_CH0/TRACE_DATA3/TM0/INT3
	JP5.17	49	PC.6/SPI1_MOSI/UART4_RXD/UART0_nRTS/I2C1_SMBSUS/EPWM1_CH3/BPWM1_CH1/TRACE_DATA2/TM1/INT2
	JP5.18	50	PA.7/SPI1_CLK/UART0_TXD/I2C1_SCL/EPWM1_CH4/BPWM1_CH2/ACMP0_WLAT/TM2/INT1
	JP5.19	51	PA.6/SPI1_SS/UART0_RXD/I2C1_SDA/EPWM1_CH5/BPWM1_CH3/ACMP1_WLAT/TM3/INT0
	JP5.20	52	PF.12/I2C0_SCL/UART5_TXD/UART3_TXD/UART1_TXD/I2C1_SCL/EPWM0_CH2/BPWM0_CH0/TRACE_DATA1/CIR0_RXD
	JP5.21	53	PF.13/I2C0_SDA/UART5_RXD/UART3_RXD/UART1_RXD/I2C1_SDA/EPWM0_CH3/BPWM0_CH1/TRACE_DATA0
	JP5.22	54	PD.15/EPWM0_CH5/TRACE_CLK/TM3/INT1
	JP5.23	55	PA.5/SPI1_I2SMCLK/UART0_nCTS/UART5_TXD/I2C0_SCL/UART0_TXD/BPWM0_CH5/EPWM0_CH0
	JP5.24	56	PA.4/SPI0_I2SMCLK/UART0_nRTS/UART5_RXD/I2C0_SDA/UART0_RXD/BPWM0_CH4/EPWM0_CH1
	JP5.25	57	PA.3/SPI0_SS/UART4_TXD/UART1_TXD/I2C1_SCL/I2C0_SMBAL/CLKO/BPWM0_CH3/EPWM0_CH2/EPWM1_BRAKE1
	JP5.26	58	PA.2/SPI0_CLK/UART4_RXD/UART1_RXD/I2C1_SDA/I2C0_SMBSUS/BPWM0_CH2/EPWM0_CH3/CIR0_RXD
	JP5.27	59	PA.1/SPI0_MISO/UART0_TXD/UART1_nCTS/BPWM0_CH1/EPWM0_CH4
	JP5.28	60	PA.0/SPI0_MOSI/UART0_RXD/UART1_nRTS/BPWM0_CH0/EPWM0_CH5/DAC0_ST
	JP5.29	61	PF.15/EPWM0_BRAKE0/EPWM0_CH1/TM2/CLKO/INT4
	JP5.30	62	PE.14/UART2_TXD
	JP5.31	63	PE.15/UART2_RXD
	JP5.32	64	nRESET
JP4	JP4.1	65	PF.0/ICE_DAT

Header	M471KI8AE		
	Pin No.	Function	
JP4.2	66	PF.1/ICE_CLK	
JP4.3	67	PD.9/UART2_nCTS	
JP4.4	68	PD.8/UART2_nRTS	
JP4.5	69	PC.5/UART2_TXD/I2C1_SCL/UART4_TXD/EPWM1_CH0	
JP4.6	70	PC.4/SPI1_I2SMCLK/UART2_RXD/I2C1_SDA/UART4_RXD/EPWM1_CH1	
JP4.7	71	PC.3/SPI1_MISO/UART2_nRTS/I2C0_SMBAL/UART3_TXD/EPWM1_CH2	
JP4.8	72	PC.2/SPI1_MOSI/UART2_nCTS/I2C0_SMBUS/UART3_RXD/EPWM1_CH3	
JP4.9	73	PC.1/SPI1_CLK/UART2_TXD/I2C0_SCL/EPWM1_CH4/ACMP0_O/EADC0_ST	
JP4.10	74	PC.0/SPI1_SS/UART2_RXD/I2C0_SDA/EPWM1_CH5/ACMP1_O	
JP4.11	75	PI.2/UART1_TXD/I2C0_SCL/UART5_TXD/I2C1_SCL/UART4_TXD/BPWM0_CH5/EADC0_ST	
JP4.12	76	PI.3/UART1_RXD/I2C0_SDA/UART5_RXD/I2C1_SDA/UART4_RXD/BPWM0_CH4	
JP4.13	77	PG.9/BPWM0_CH5	
JP4.14	78	PG.10/BPWM0_CH4	
JP4.15	79	PG.11/BPWM0_CH3	
JP4.16	80	PG.12/BPWM0_CH2	
JP4.17	81	PG.13/BPWM0_CH1	
JP4.18	82	PG.14/BPWM0_CH0	
JP4.19	83	PG.15/CLKO/EADC0_ST	
JP4.20	84	PD.7/UART1_TXD/I2C0_SCL/SPI1_MISO	
JP4.21	85	PD.6/UART1_RXD/I2C0_SDA/SPI1_MOSI	
JP4.22	86	PD.5/I2C1_SCL/SPI1_CLK	
JP4.23	87	PD.4/I2C1_SDA/SPI1_SS	
JP4.24	88	PD.3/SPI0_SS/UART3_nRTS/UART0_TXD	
JP4.25	89	PD.2/SPI0_CLK/UART3_nCTS/UART0_RXD	
JP4.26	90	PD.1/SPI0_MISO/UART3_TXD	
JP4.27	91	PD.0/SPI0_MOSI/UART3_RXD/TM2	
JP4.28	92	PD.13/SPI0_I2SMCLK/SPI1_I2SMCLK	
JP4.29	93	PA.12/UART4_TXD/I2C1_SCL/BPWM1_CH2	
JP4.30	94	PA.13/UART4_RXD/I2C1_SDA/BPWM1_CH3	
JP4.31	95	PA.14/UART0_TXD/BPWM1_CH4	
JP4.32	96	PA.15/UART0_RXD/BPWM1_CH5/EPWM0_SYNC_IN	
JP6	JP6.1	97	PE.7/UART5_TXD/EPWM0_CH0/BPWM0_CH5
	JP6.2	98	PE.6/UART5_RXD/EPWM0_CH1/BPWM0_CH4
	JP6.3	99	PE.5/EPWM0_CH2/BPWM0_CH3
	JP6.4	100	PE.4/EPWM0_CH3/BPWM0_CH2

Header	M471KI8AE	
	Pin No.	Function
JP6.5	101	PE.3/EPWM0_CH4/BPWM0_CH1
JP6.6	102	PE.2/EPWM0_CH5/BPWM0_CH0
JP6.7	103	PI.4/UART4_TXD/UART0_TXD/UART1_TXD/EPWM0_CH5/CIR0_RXD/ACMP0_O
JP6.8	104	PI.5/UART4_RXD/UART0_RXD/UART1_RXD/EPWM0_CH4/ACMP1_O
JP6.9	105	PE.1/SPI1_MISO/UART3_TXD/I2C1_SCL/UART4_nCTS
JP6.10	106	PE.0/SPI1_MOSI/UART3_RXD/I2C1_SDA/UART4_nRTS
JP6.11	107	PH.8/SPI1_CLK/UART3_nRTS/I2C1_SMBAL/UART1_TXD
JP6.12	108	PH.9/SPI1_SS/UART3_nCTS/I2C1_SMBSUS/UART1_RXD
JP6.13	109	PH.10/SPI1_I2SMCLK/UART4_TXD/UART0_TXD
JP6.14	110	PH.11/UART4_RXD/UART0_RXD/EPWM0_CH5
JP6.15	111	PD.14/SPI0_I2SMCLK/EPWM0_CH4
JP6.16	112	V <sub>SS</sub>
JP6.17	113	LDO_CAP
JP6.18	114	V <sub>DD</sub>
JP6.19	115	PC.14/SPI0_I2SMCLK/CIR0_RXD/EPWM0_SYNC_IN/TM1
JP6.20	116	PB.15/EADC0_CH15/SPI0_SS/UART0_nCTS/UART3_TXD/EPWM0_BRAKE1/EPWM1_CH0/TM0_EXT
JP6.21	117	PB.14/EADC0_CH14/SPI0_CLK/UART0_nRTS/UART3_RXD/EPWM1_CH1/TM1_EXT/CLKO
JP6.22	118	PB.13/EADC0_CH13/ACMP0_P3/ACMP1_P3/SPI0_MISO/UART0_TXD/UART3_nRTS/EPWM1_CH2/TM2_EXT
JP6.23	119	PB.12/EADC0_CH12/DAC0_OUT/ACMP0_P2/ACMP1_P2/SPI0_MOSI/UART0_RXD/UART3_nCTS/EPWM1_CH3/TM3_EXT
JP6.24	120	AV <sub>DD</sub>
JP6.25	121	V <sub>REF</sub>
JP6.26	122	AV <sub>SS</sub>
JP6.27	123	PB.11/EADC0_CH11/UART0_nCTS/UART4_TXD/I2C1_SCL/SPI0_I2SMCLK/BPWM1_CH0
JP6.28	124	PB.10/EADC0_CH10/UART0_nRTS/UART4_RXD/I2C1_SDA/BPWM1_CH1
JP6.29	125	PB.9/EADC0_CH9/UART0_TXD/UART1_nCTS/I2C1_SMBAL/I2C0_SCL/BPWM1_CH2/INT7
JP6.30	126	PB.8/EADC0_CH8/UART0_RXD/UART1_nRTS/I2C1_SMBSUS/I2C0_SDA/BPWM1_CH3/INT6
JP6.31	127	PB.7/EADC0_CH7/UART1_TXD/BPWM1_CH4/EPWM1_BRAKE0/EPWM1_CH4/INT5/ACMP0_O
JP6.32	128	PB.6/EADC0_CH6/UART1_RXD/BPWM1_CH5/EPWM1_BRAKE1/EPWM1_CH5/INT4/ACMP1_O

Table 3-2 M471KI8AE 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.

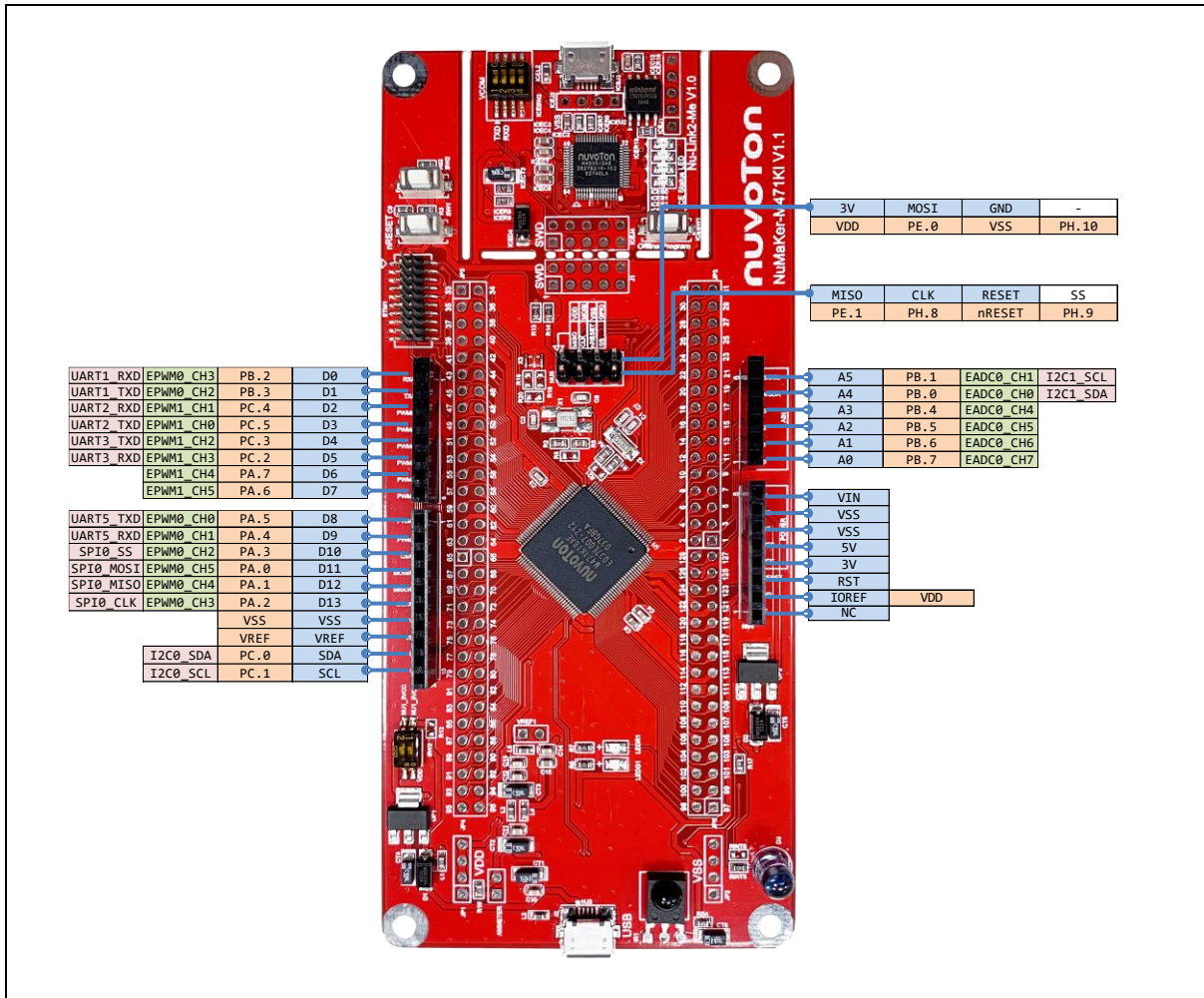


Figure 3-4 Arduino UNO Compatible Extension Connectors



Header		NuMaker-M471KI		Header		NuMaker-M471KI	
		Compatible to Arduino UNO	GPIO Pin of M471			Compatible to Arduino UNO	GPIO Pin of M471
N U 3	NU3.1	D0	PB.2	N U 2	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	N U 1	NU1.8	VIN	-
	NU3.8	D7	PA.6		NU1.7	VSS	
N U 4	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	IOREF	V <sub>REF</sub>
	NU4.6	D13	PA.2	NU1.1	NC	-	
	NU4.7	VSS	V <sub>SS</sub>				
	NU4.8	VREF	V <sub>REF</sub>				
	NU4.9	SDA	PC.0				
	NU4.10	SCL	PC.1				

Table 3-3 Arduino UNO Extension Connectors and M471KI8AE Mapping GPIO List

### 3.4 Power Supply Configuration

The NuMaker-M471KI is able to adopt multiple power supply. External power sources include NU1 Vin (7 V to 12 V), V<sub>DD</sub> (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-M471KI.

#### 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 M471 platform and Nu-Link2-Me.
J2	USB_VBUS	USB connector on NuMaker-M471KI supplies 5 V power from PC to M471 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. <b>Note:</b> SW3.1(NU1 5VCC) should be switched 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 M471 platform or ICE chip.
UP1	USB_VBUS	UP1 converts USB_VBUS to 3.3 V and supplies 3.3 V to M471 platform. <b>Note:</b> SW3.2 (NU1 3VCC) should be switched to ON.
UP1	NU1_5VCC	UP1 converts NU1_5VCC to 3.3 V and supplies 3.3 V to M471 platform. <b>Note:</b> SW3.2 (NU1 3VCC) should be switched to ON.

Table 3-6 3.3 V Power Sources

### 3.4.4 Power Connectors

Table 3-7 presents the power connectors.

Connector	Description
JP1	V <sub>DD</sub> connector on the NuMaker-M471KI. <b>Note:</b> M471 operating voltage range is from 2.5 V to 5.5 V.
JP2	V <sub>SS</sub> connector on the NuMaker-M471KI.

Table 3-7 Power Connectors

### 3.4.5 USB Connectors

Table 3-8 presents the USB connectors.

Connector	Description
ICEJ3	ICE USB connector on Nu-Link2-Me for power supply, debugging and programming from PC.
J2	USB connector on NuMaker-M471KI for power supply.

Table 3-8 USB Connectors

### 3.4.6 Power Switches

Table 3-9 presents the power switches.

Switch	Description
ICEJPR1	Configures the target chip operating voltage at 1.8 V / 3.3 V / 5 V. <b>Note:</b> M471 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.
SW3	Configures the target chip operating voltage at 3.3 V / 5 V. <b>Note:</b> M471 operating voltage range is from 2.5 V to 5.5 V.

Table 3-9 Power Switches

### 3.4.7 Power Supply Models

#### 3.4.7.1 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.

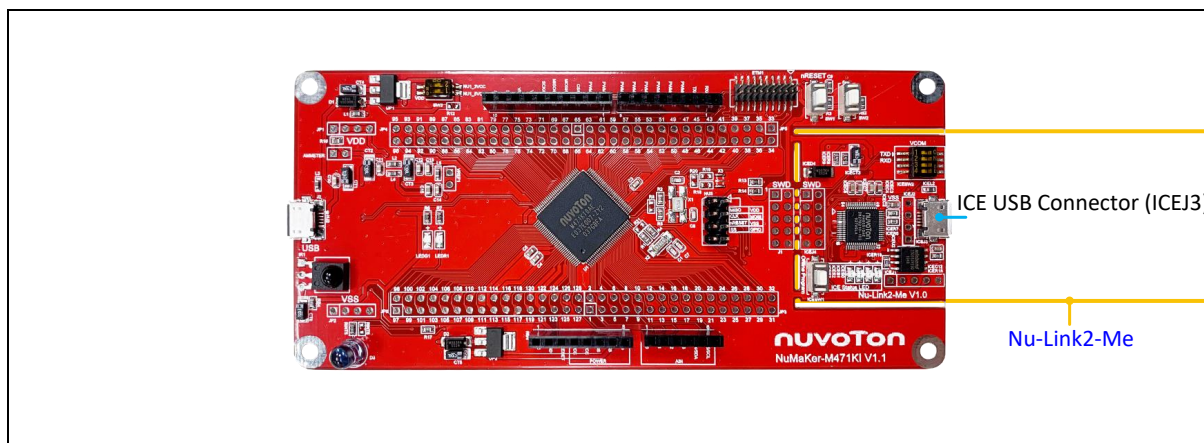


Figure 3-5 External Power Supply Sources on Nu-Link2-Me

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 SW3 to OFF.
4. Connect the external power supply to ICEJ3.

Table 3-10 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 <sup>[1]</sup>	ICEJPR2 (ICEVCC) Selection <sup>[2]</sup>	ICE Chip Voltage	SW3 Selection	J2	Vin	JP1
1	1.8 V	Connect to PC	1.8 V	1.8 V	1.8 V	Off	-	-	1.8 V output
2	3.3 V	Connect to PC	3.3 V (default)	3.3 V (default)	3.3 V	Off	-	-	3.3 V output
3	5 V	Connect to PC	5 V	3.3 V (default)	3.3 V	Off	-	-	5 V output
<p><b>Note:</b></p> <ol style="list-style-type: none"> <li>1. 0 Ω should be soldered between ICEJPR1's MCVCC and 1.8 V / 3.3 V / 5 V.</li> <li>2. 0 Ω should be soldered between ICEJPR2's ICEVCC and 1.8 V / 3.3 V.</li> <li>3. X: Unused.</li> </ol>									

Table 3-10 Supply External Power through Nu-Link2-Me

### 3.4.7.2 External Power Supply through M471 platform to Target Chip

The external power supply sources on M471 platform are shown in Figure 3-6.

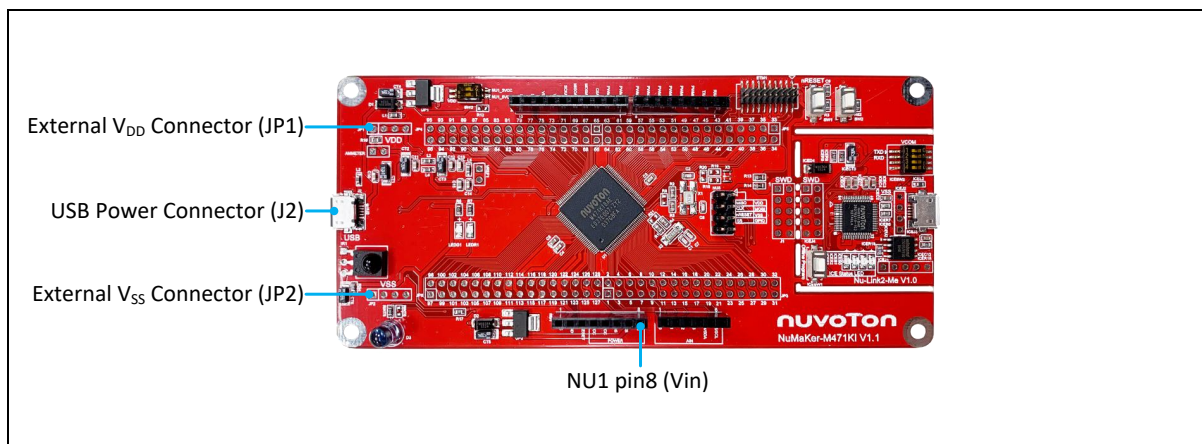


Figure 3-6 External Power Supply Sources on M471 platform

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

1. Switch the SW3 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 SW3 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-M471KI, please follow the below steps:

1. Switch the SW3 depends on the target chip operating voltage.
2. Detach the Nu-Link2-Me from NuMaker-M471KI.
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-M471KI, please follow the below steps:

1. Switch the SW3 to OFF.
2. Detach the Nu-Link2-Me from NuMaker-M471KI.
3. Connect the external power supply to JP1.

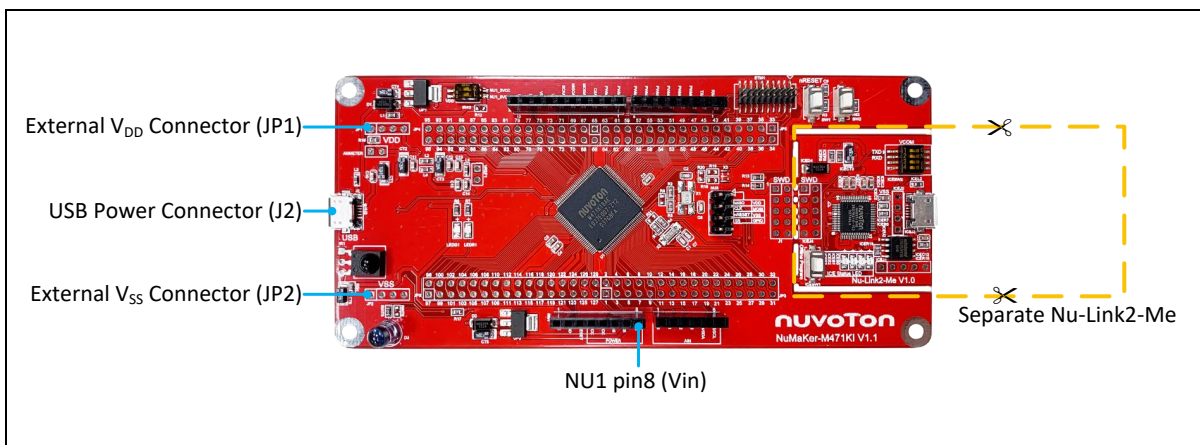


Figure 3-7 Detach the Nu-Link2-Me from NuMaker-M471KI

Table 3-11 presents all power models when supplies external power through M471 platform. The M471 platform external power sources are highlighted in yellow.

Model	Target Chip Voltage	Vin <sup>[1]</sup>	J2 <sup>[1]</sup>	ICEJ3	SW3 Selection	JP1 <sup>[2]</sup>	ICEJPR1 (MCUVCC) Selection <sup>[3]</sup>	ICEJPR2 (ICEVCC) Selection <sup>[4]</sup>	ICE Chip Voltage <sup>[5]</sup>
4	3.3 V	7 V ~ 12 V Input	-	-	NU1 3VCC	3.3 V output	Remove resistor	3.3 V	3.3 V
5	3.3 V	-	Connect to PC	-	NU1 3VCC	3.3 V output	Remove resistor	3.3 V	3.3 V
6	5 V	7 V ~ 12 V Input	-	-	NU1 5VCC	5 V output	Remove resistor	3.3 V	3.3 V
7	5 V	-	Connect to PC	-	NU1 5VCC	5 V output	Remove resistor	3.3 V	3.3 V
8	1.8 V ~ 3.6 V	-	-	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	-	-	Nu-Link2-Me removed	OFF	DC Input 1.8 V ~ 3.6 V	-	-	-

**Note:**

- 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).
- JP1 external power input only provides voltage to target chip.
- 0 Ω should be removed from ICEJPR1's MCVCC and 1.8 V / 3.3 V / 5 V.
- 0 Ω should be soldered between ICEJPR2's ICEVCC and 1.8 V / 3.3 V.
- The ICE chip voltage should be close to the target chip voltage.
- X: Unused

Table 3-11 Supply External Power for M471 platform

### 3.5 External Reference Voltage Connector

Table 3-13 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 3-12 External Reference Voltage Connector

### 3.6 Ammeter Connector

Table 3-13 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 3-13 Ammeter Connector

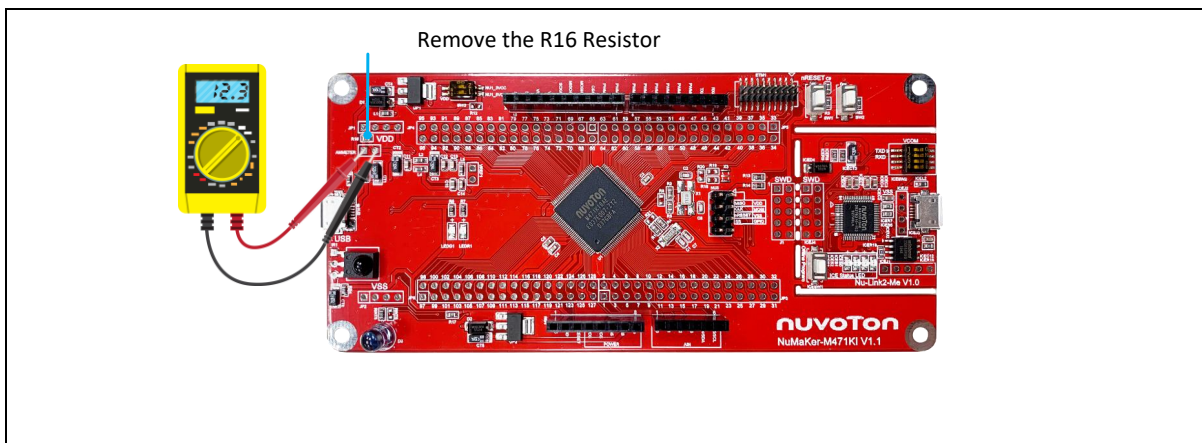


Figure 3-8 Wiring between Ammeter Connector and Ammeter

### 3.7 Push Buttons

Table 3-14 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.
SW2	GPIO input button for PH.4.

Table 3-14 Push-Buttons

### 3.8 LEDs

Table 3-15 presents the LEDs.

Component	Description
Power LED	The power LED indicates that the NuMaker-M471KI 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 3-15 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 3-16 presents how to set the VCOM function by ICESW2.

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

Table 3-16 VCOM Function of Nu-Link2-Me

### 3.9.2 Status LEDs

Table 3-15 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 3-17 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 MDK Nuvoton edition M0/M23](#)
- [IAR EWARM](#)
- [NuEclipse GCC \(for Windows\)](#)
- [NuEclipse GCC \(for Linux\)](#)

### 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 MDK.
- Download and install [Nu-Link IAR Driver](#) when using IAR EWARM.
- Skip this step when using NuEclipse.

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.

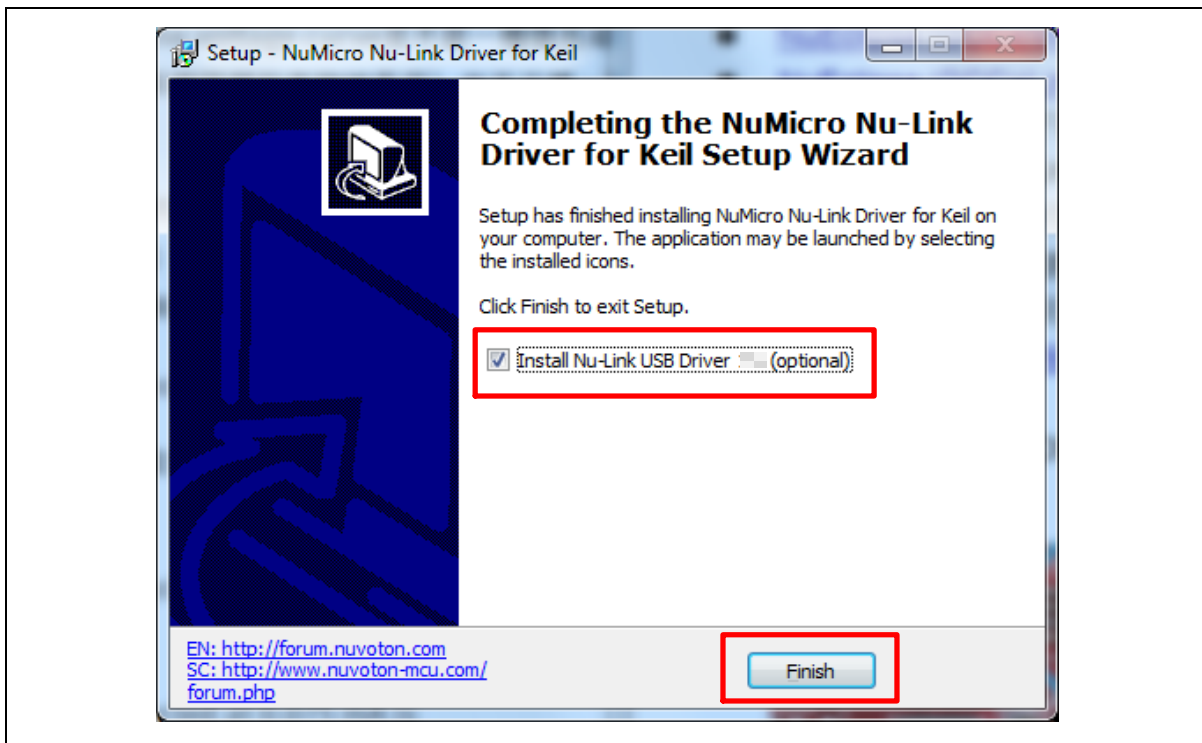


Figure 4-1 Nu-Link USB Driver Installation Setup

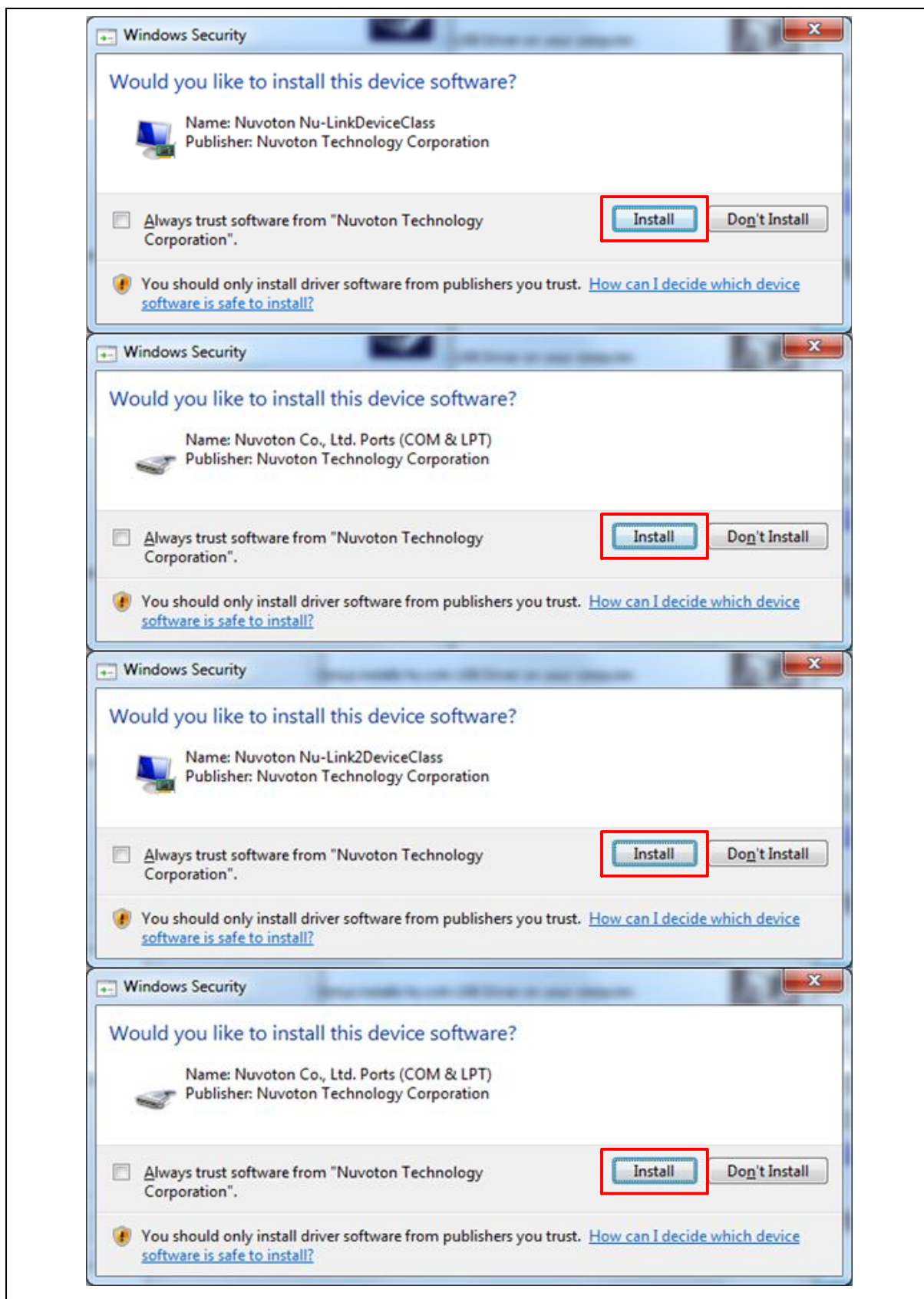


Figure 4-2 Nu-Link USB Driver Installation

### 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.

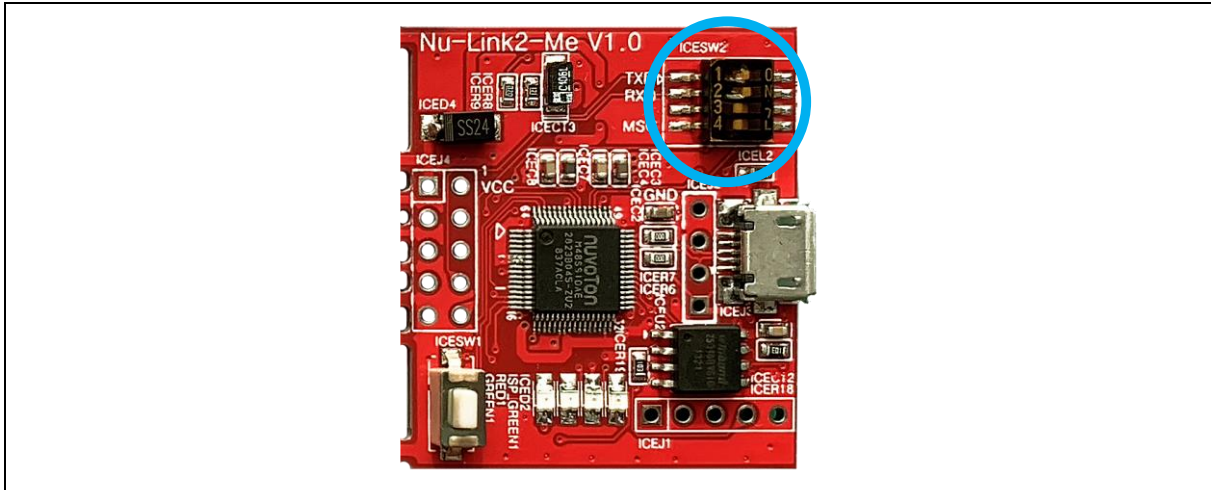


Figure 4-3 Open VCOM Function

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

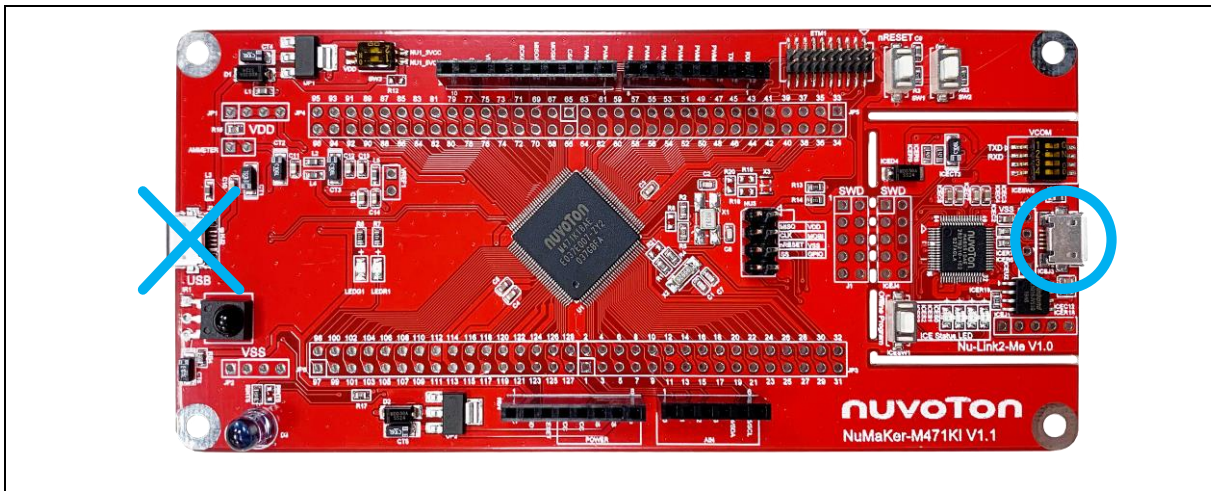


Figure 4-4 ICE USB Connector

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

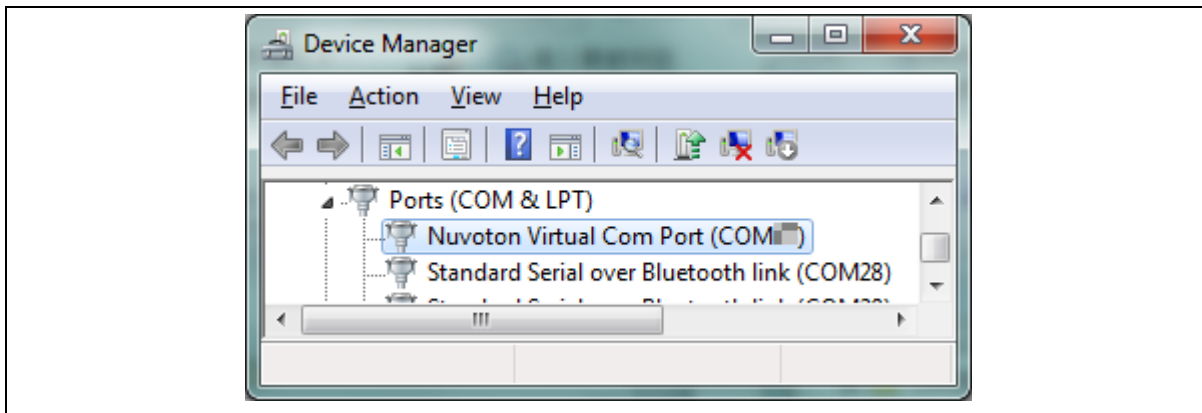


Figure 4-5 Device Manger

- 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.

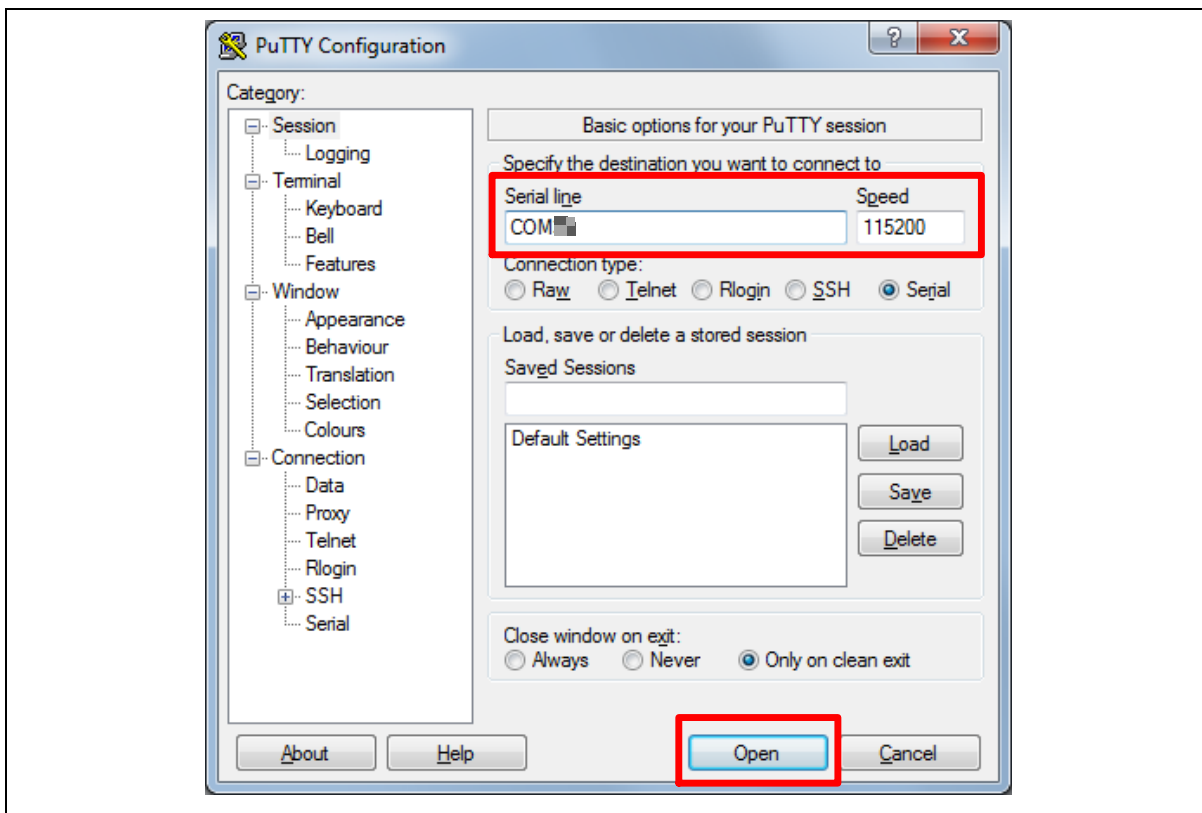


Figure 4-6 PuTTY Session Setting

### 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.

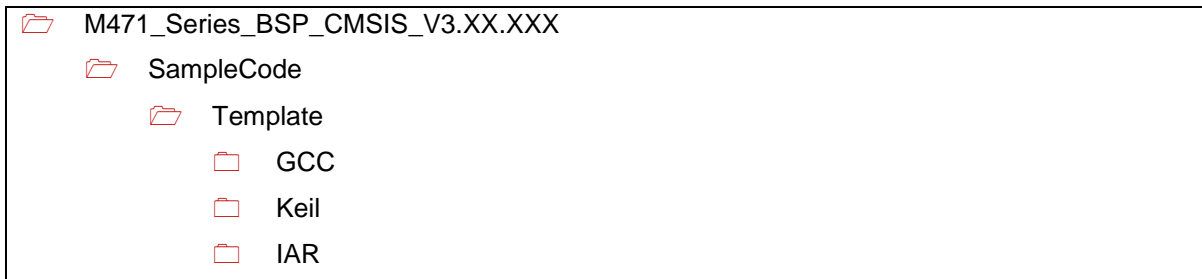


Figure 4-7 Template Project Folder Path

### 4.6 Execute the Project under Toolchains

Open and execute the project under the toolchain. The section 4.6.1, 4.6.2, and 4.6.3 describe the steps of executing project in Keil MDK, IAR EWARM and NuEclipse, respectively.

#### 4.6.1 Keil MDK

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

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”.

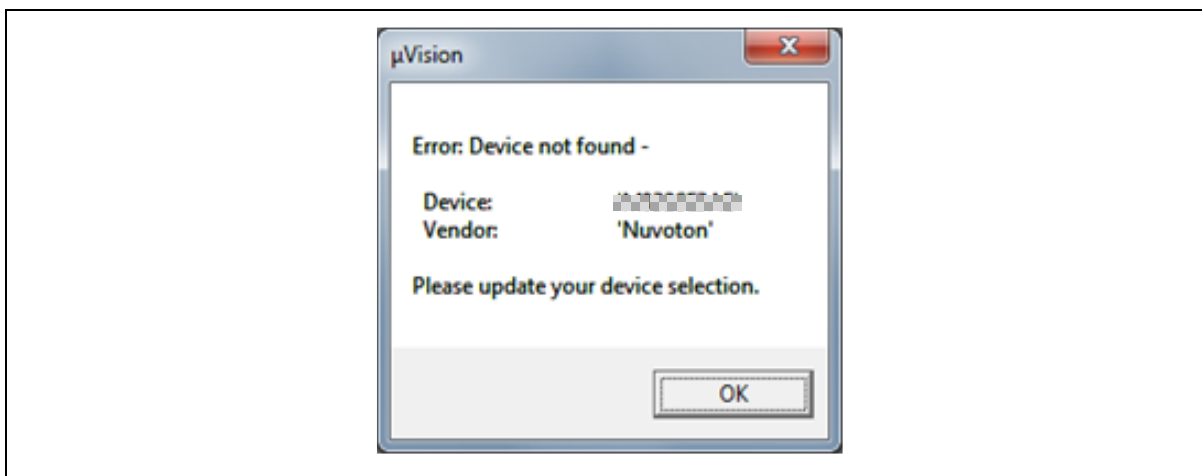


Figure 4-8 Warning Message of “Device not found”

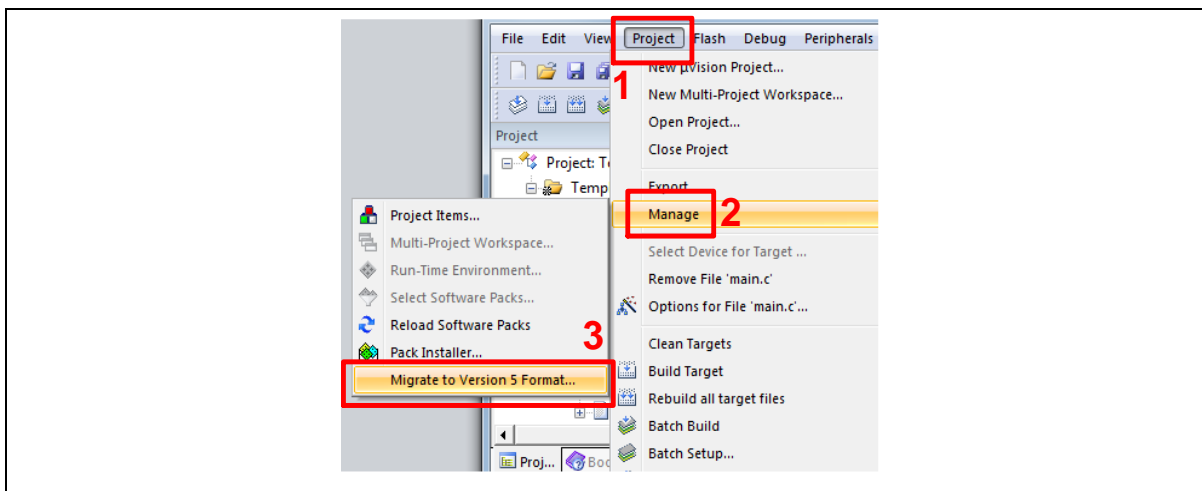


Figure 4-9 Project File Migrate to Version 5 Format

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.

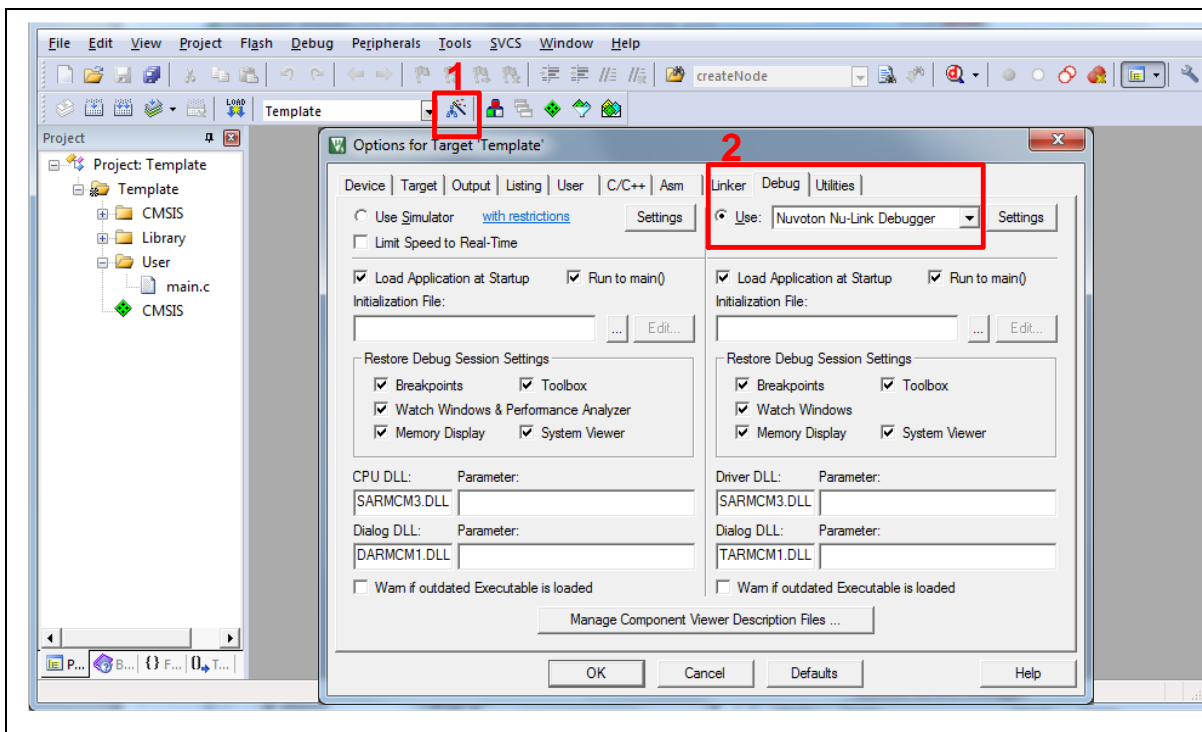


Figure 4-10 Debugger Setting in Options Window

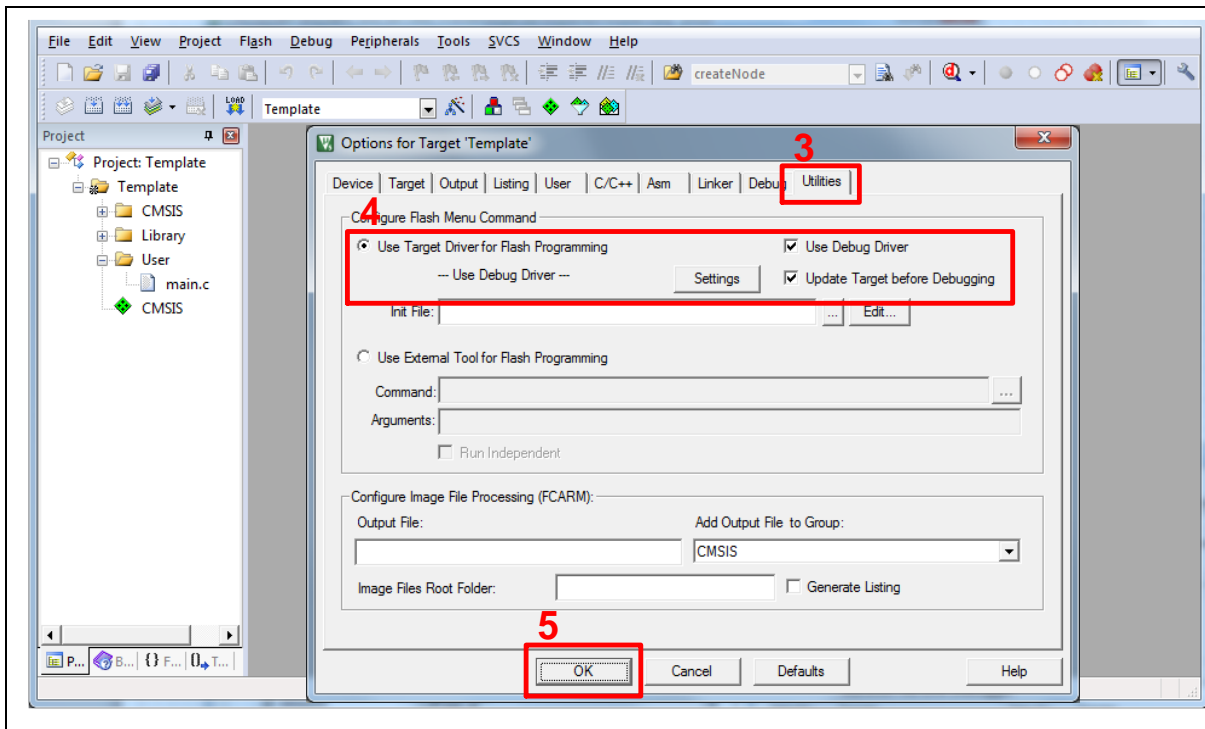


Figure 4-11 Programming Setting in Options Window

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.

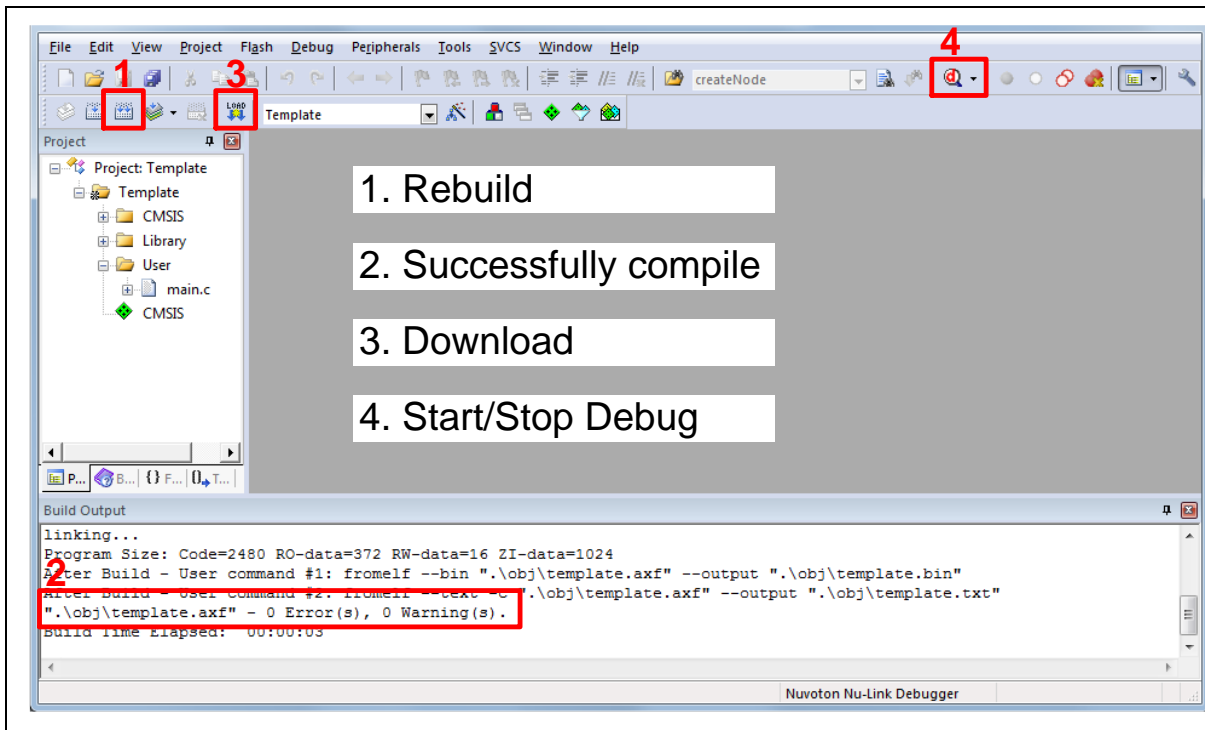


Figure 4-12 Compile and Download the Project



- Figure 4-13 shows the debug mode under Keil MDK. 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.

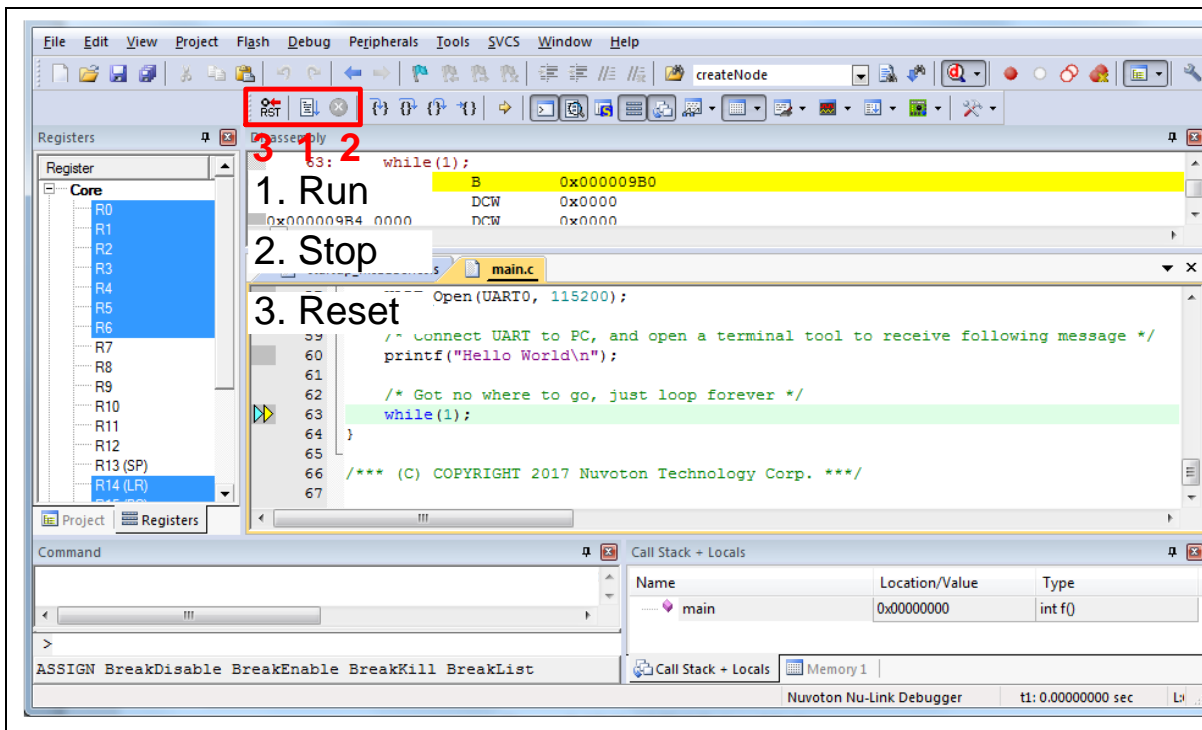


Figure 4-13 Keil MDK Debug Mode

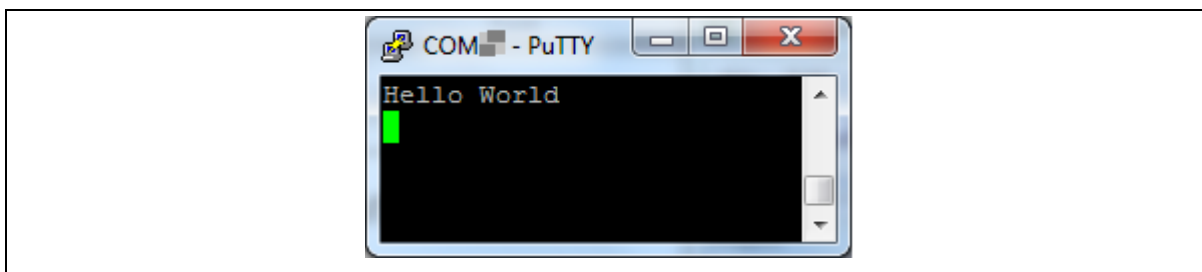


Figure 4-14 Debug Message on Serial Port Terminal Windows

### 4.6.2 IAR EWARM

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

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.

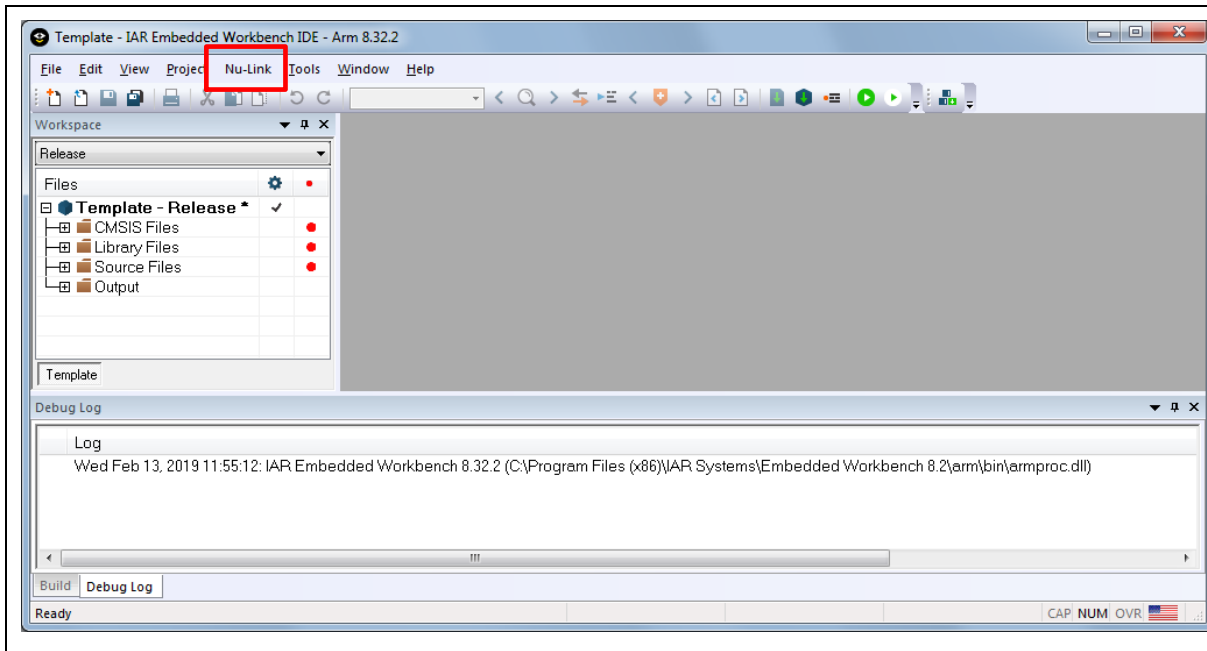


Figure 4-15 IAR EWARM Window

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.

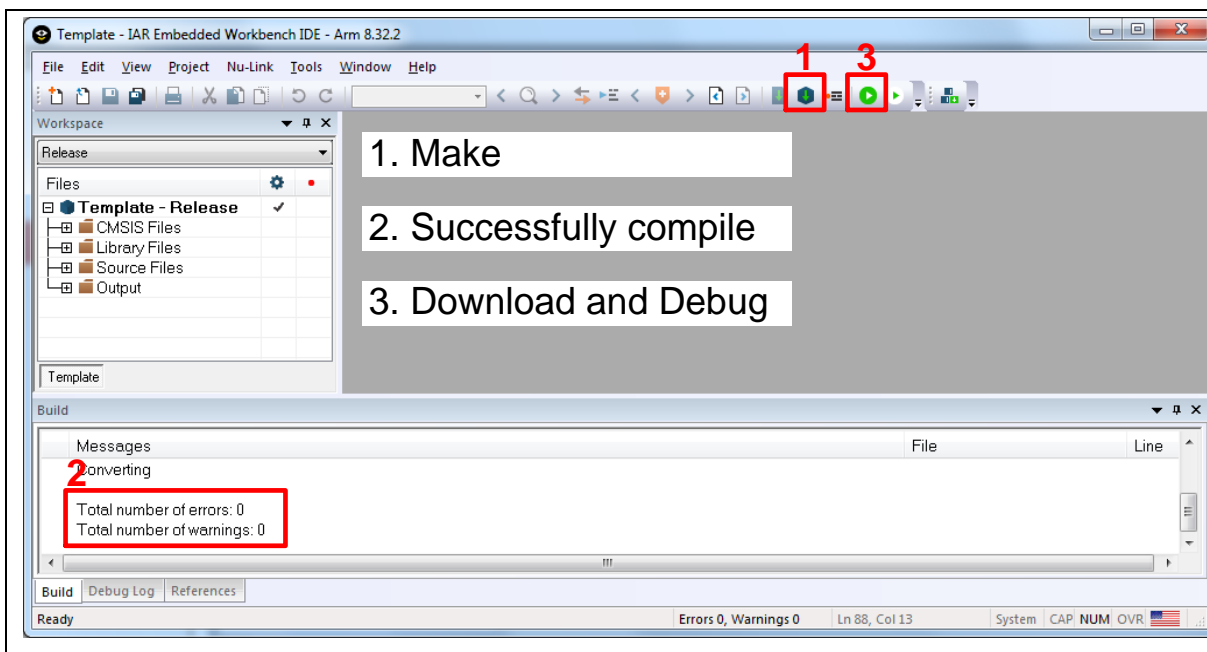


Figure 4-16 Compile and Download the Project

- Figure 4-17 shows the debug mode under IAR EWARN. Click “Go” and the debug message will be printed out as shown in Figure 4-18. User can debug the project under debug mode by checking source code, assembly language, peripherals’ registers, and setting breakpoint, step run, value monitor, etc.

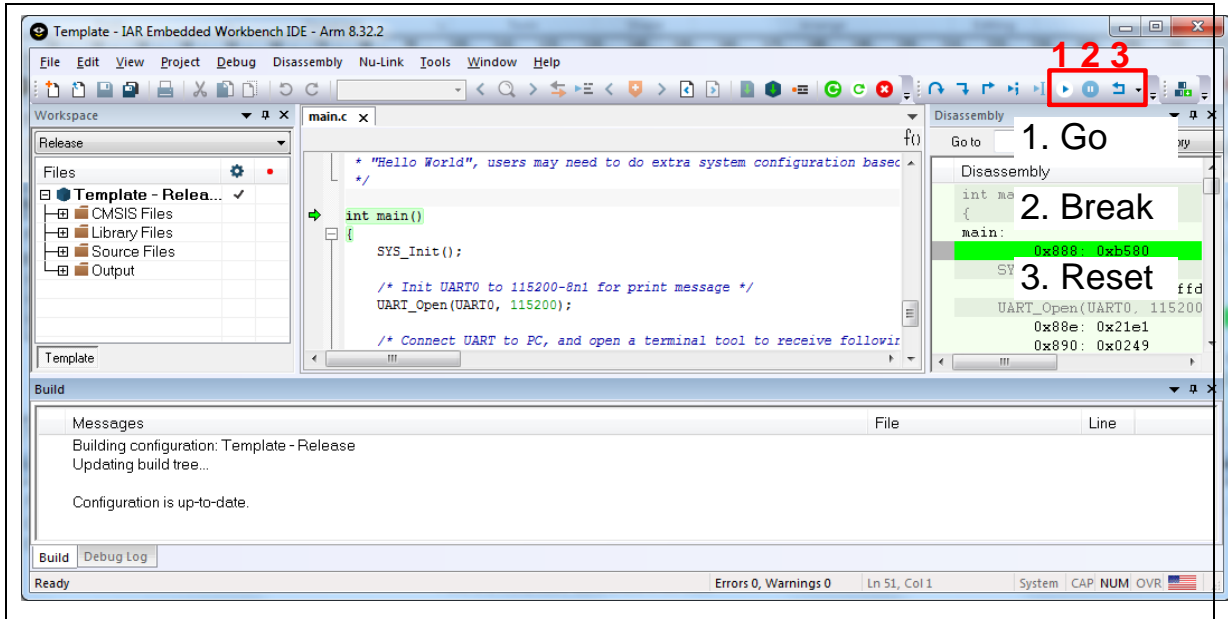


Figure 4-17 IAR EWARM Debug Mode

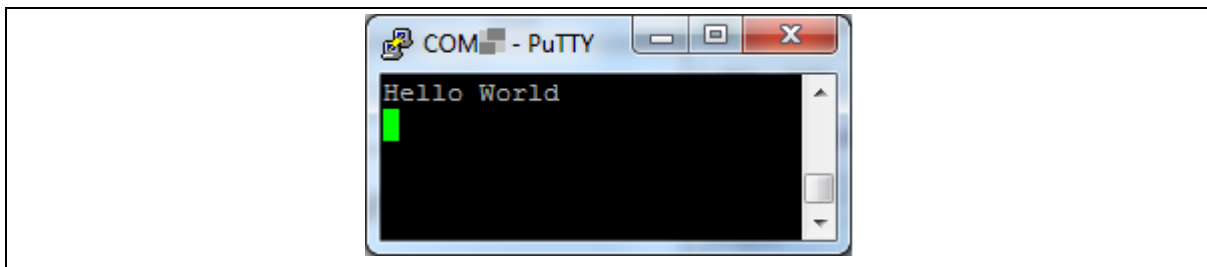


Figure 4-18 Debug Message on Serial Port Terminal Windows

### 4.6.3 NuEclipse

This section provides steps to beginners on how to run a project by using NuEclipse. Please make sure the filenames and project folder path contain neither invalid character nor space.

1. Double-click NuEclipse.exe to open the toolchain.
2. Import the "Template" project by following the steps presented in Figure 4-19 and Figure 4-20.

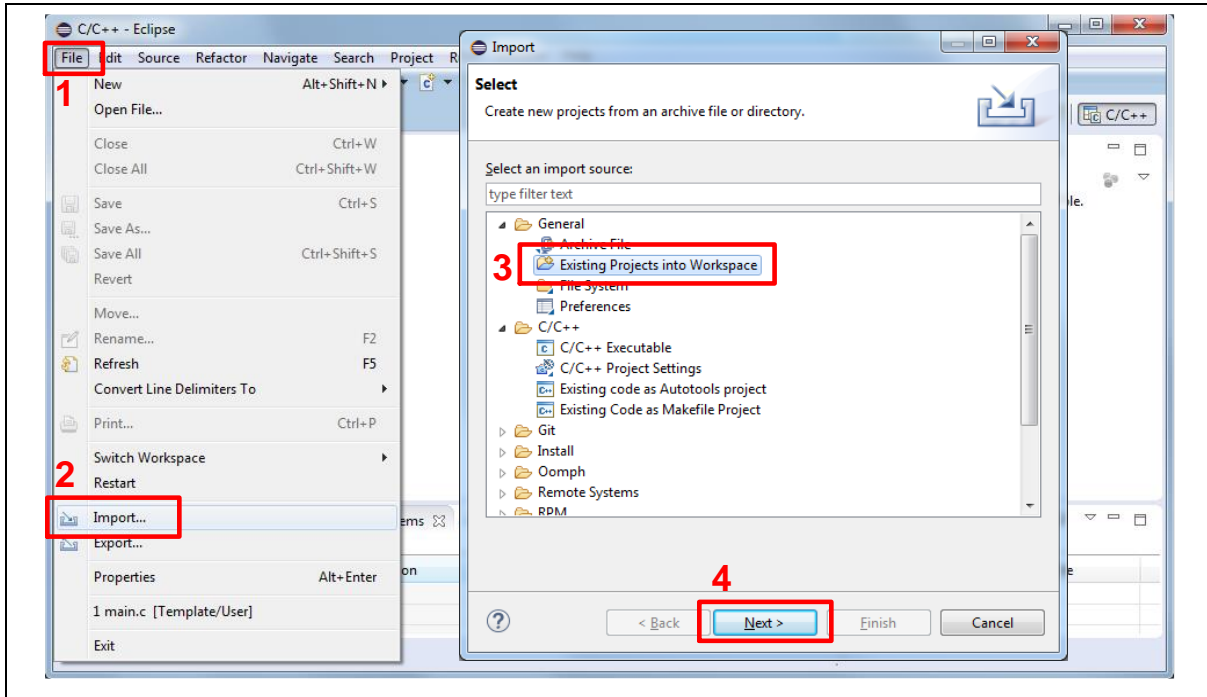


Figure 4-19 Import the Project in NuEclipse

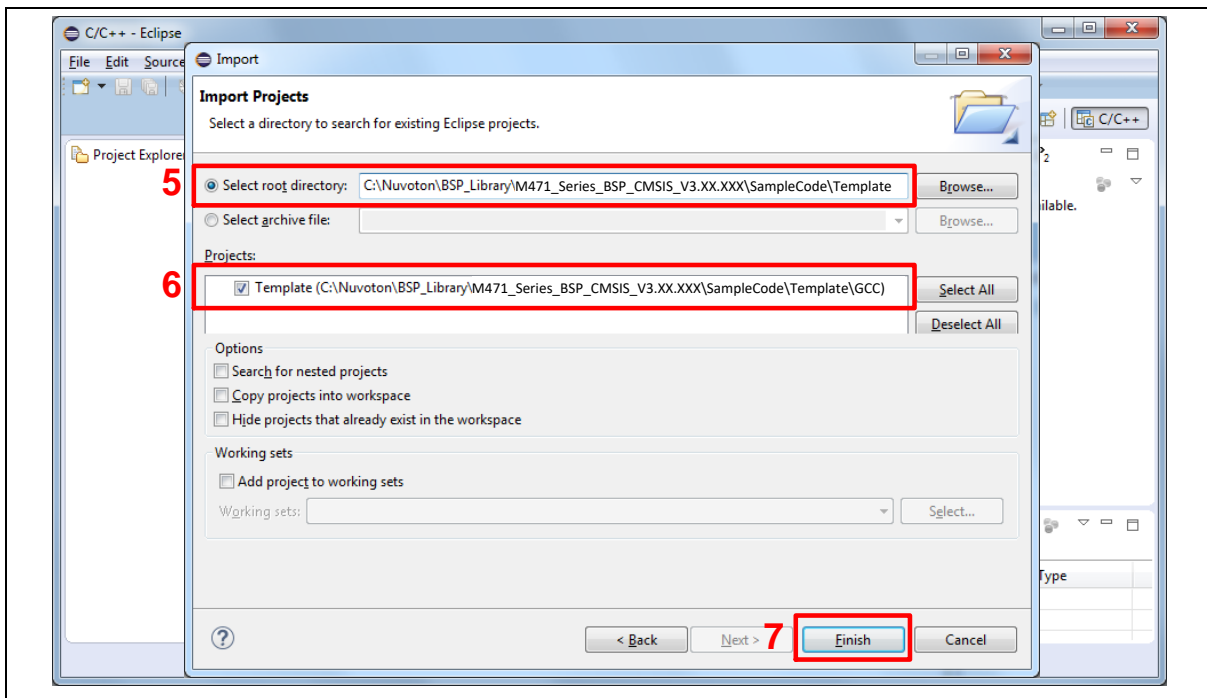


Figure 4-20 Import Projects Windows

- 3. Click the “Template” project and find the project properties as shown in Figure 4-21. Make sure the settings are the same as settings in Figure 4-22.

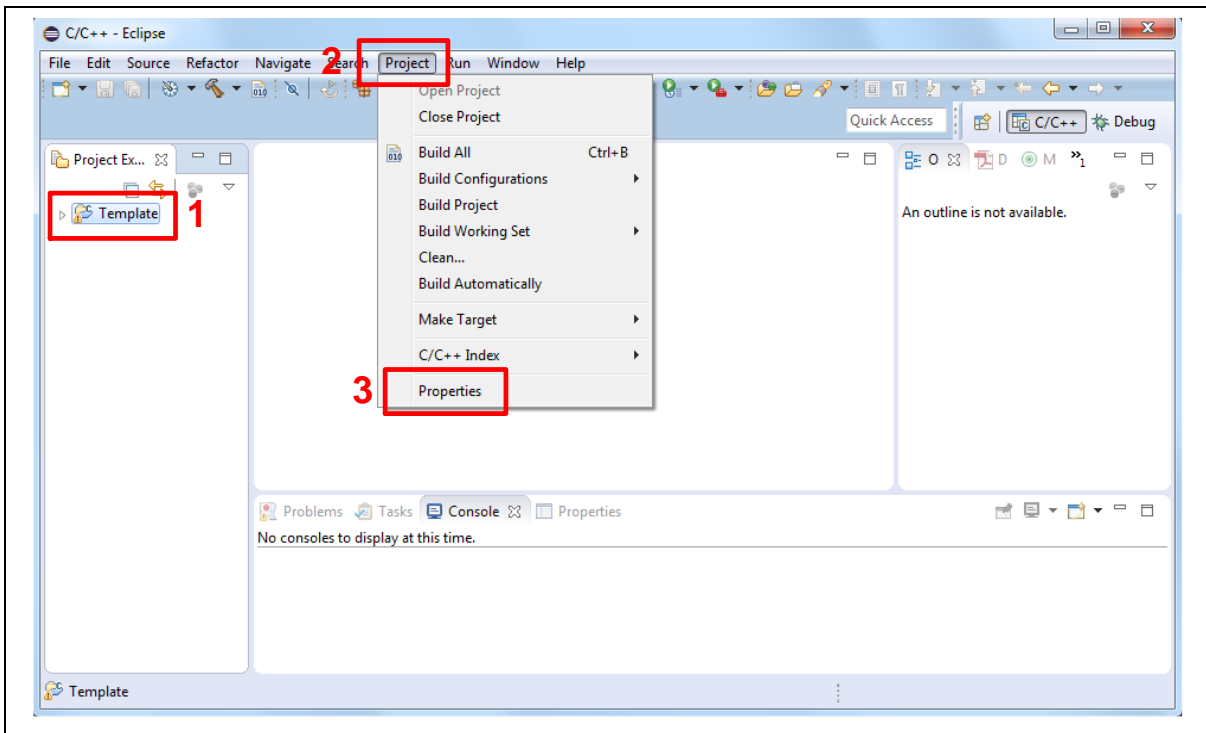


Figure 4-21 Open Project Properties Window

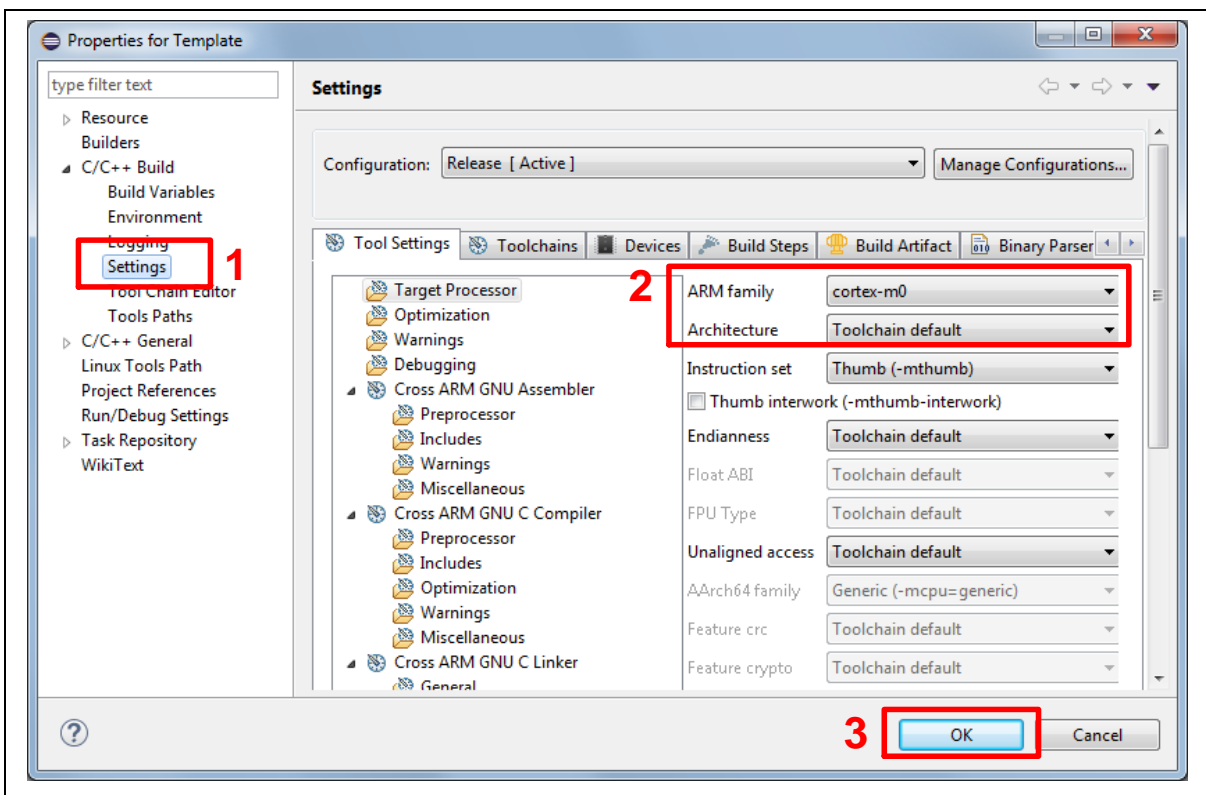


Figure 4-22 Project Properties Settings

- 4. Click the “Template” project and build the project.

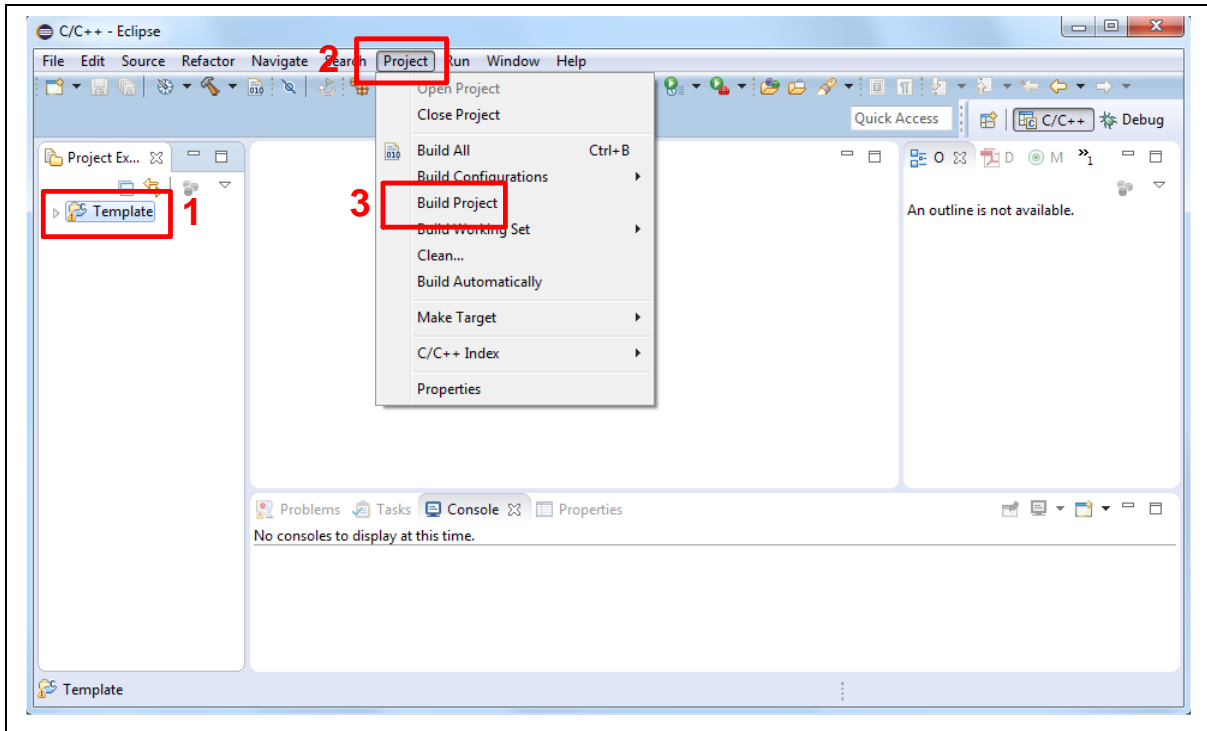


Figure 4-23 Build Project

- 5. After the project is built, click the “Template” project and set the “Debug Configuration” as shown in Figure 4-24. Follow the settings presented in Figure 4-25, Figure 4-26 and Figure 4-27 to enter debug mode.

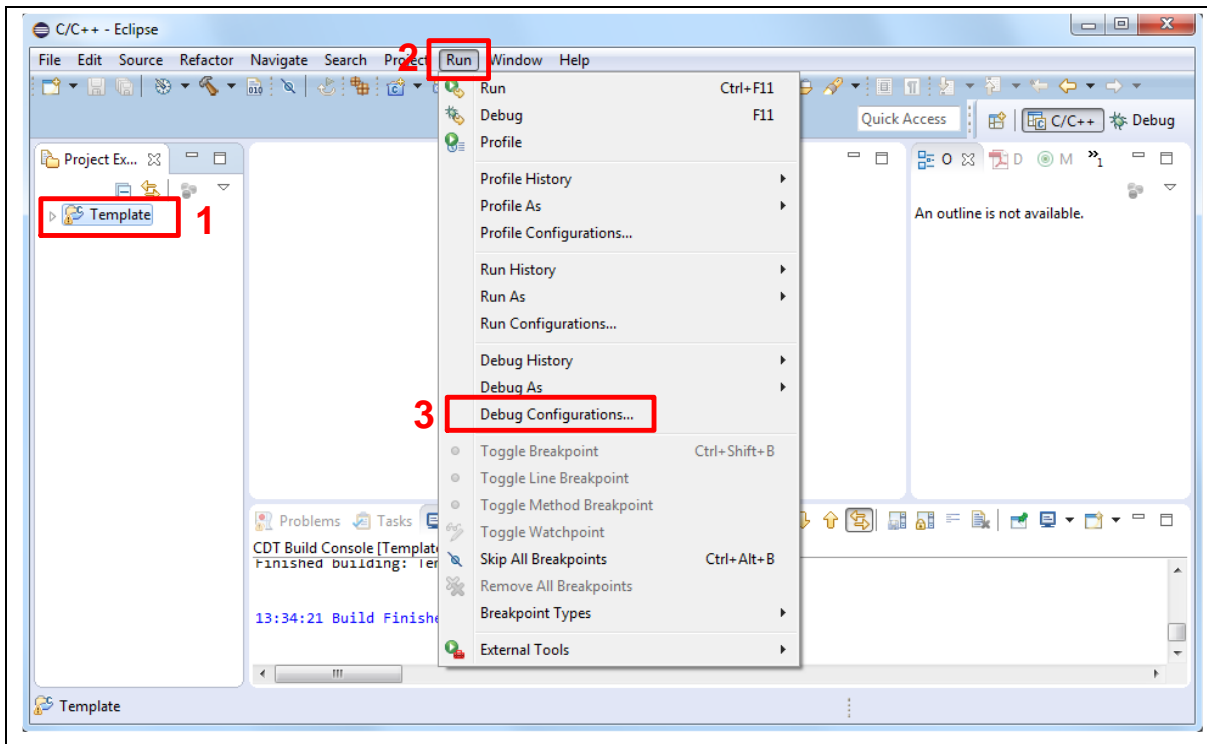
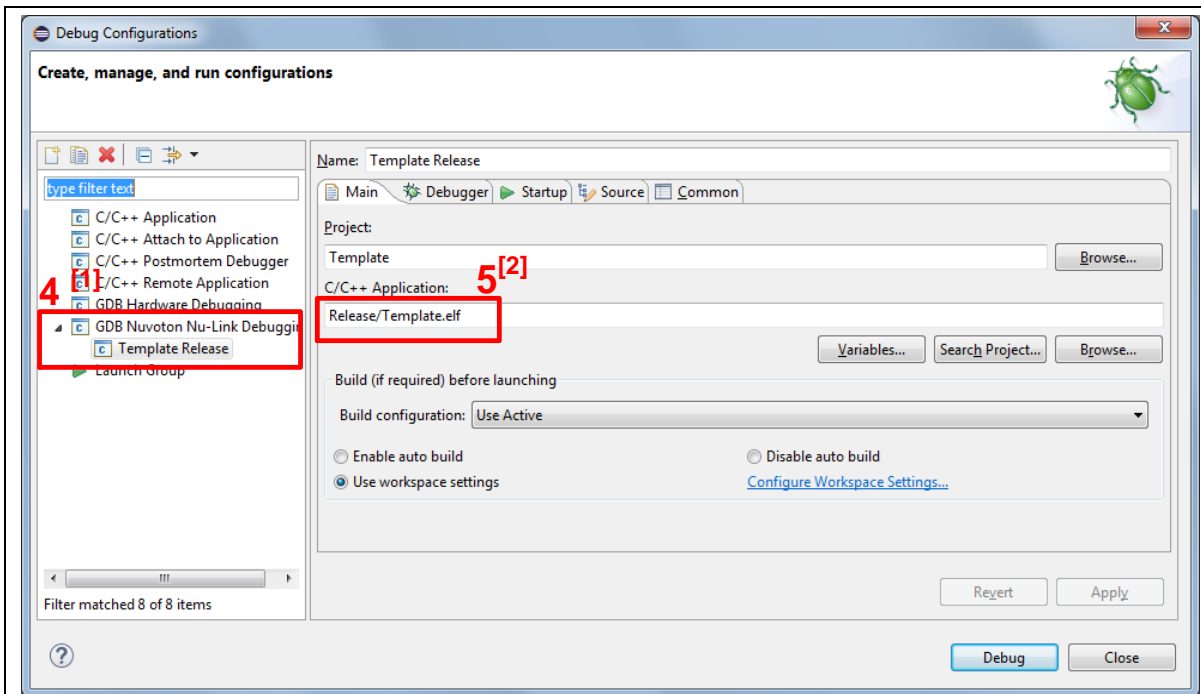


Figure 4-24 Open Debug Configuration



**Note 1:** Double click the “GDB Nuvoton Nu-Link Debugging” to create the subitem.

**Note 2:** After the project is built, the “\*.elf” file will be shown in “C/C++ Application” frame.

Figure 4-25 Main Tab Configuration

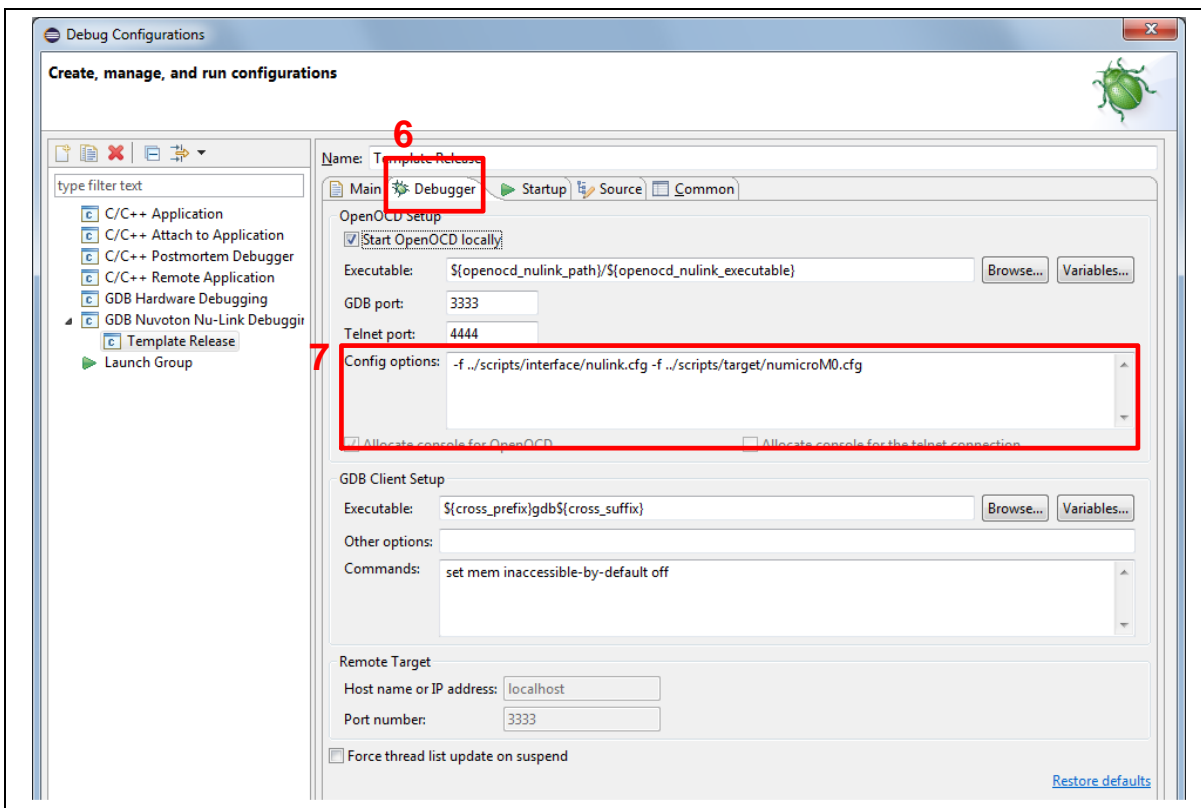
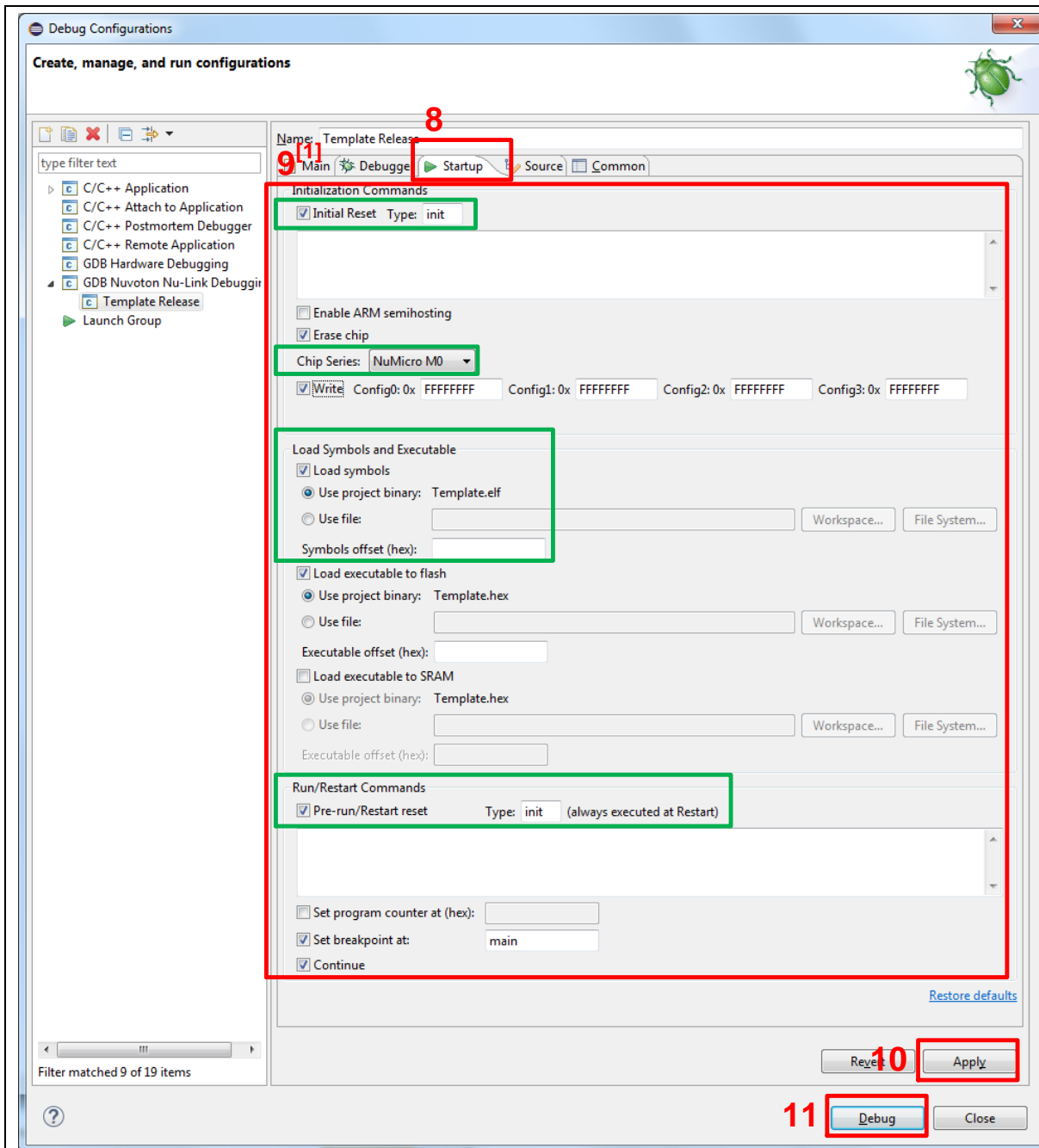


Figure 4-26 Debugger Tab Configuration



**Note 1:** User must follow those settings highlighted in green, and can configure other settings depend on the needs.

Figure 4-27 Startup Tab Configuration



- Figure 4-28 shows the debug mode under NuEclipse. Click “Resume” and the debug message will be printed out as shown in Figure 4-29. User can debug the project under debug mode by checking source code, assembly language, peripherals’ registers, and setting breakpoint, step run, value monitor, etc. For more information about how to use NuEclipse, please refer to the NuEclipse User Manual.

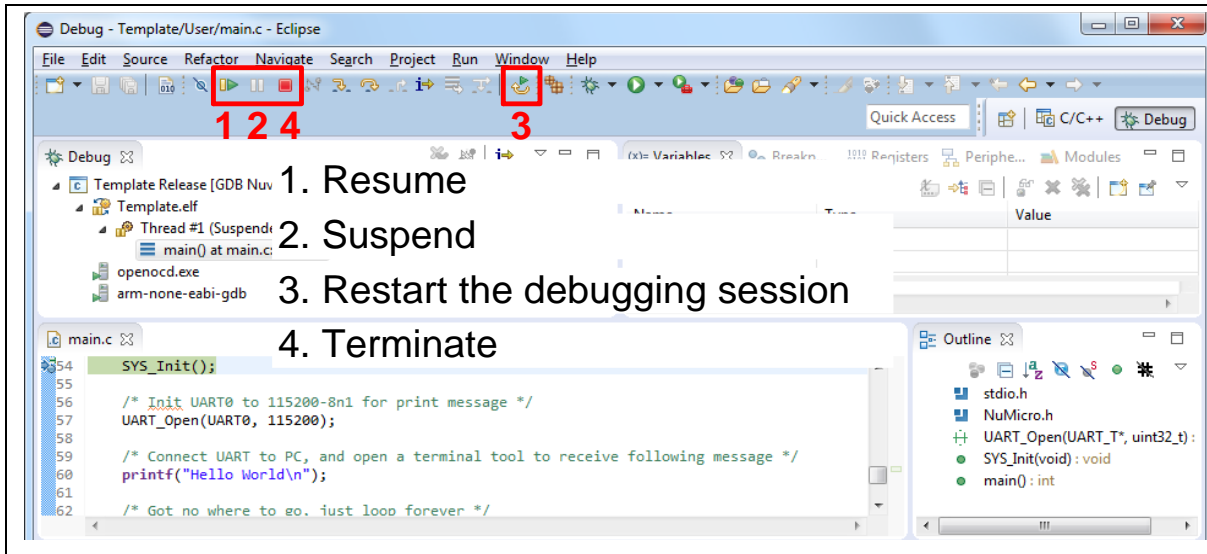


Figure 4-28 NuEclipse Debug Mode

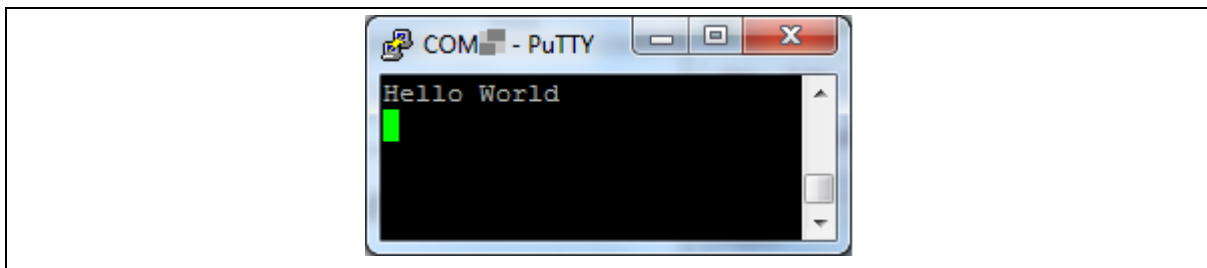


Figure 4-29 Debug Message on Serial Port Terminal Windows

## 5 NUMAKER-M471KI SCHEMATICS

### 5.1 Nu-Link2-Me

Figure 5-1 shows the Nu-Link2-Me circuit.

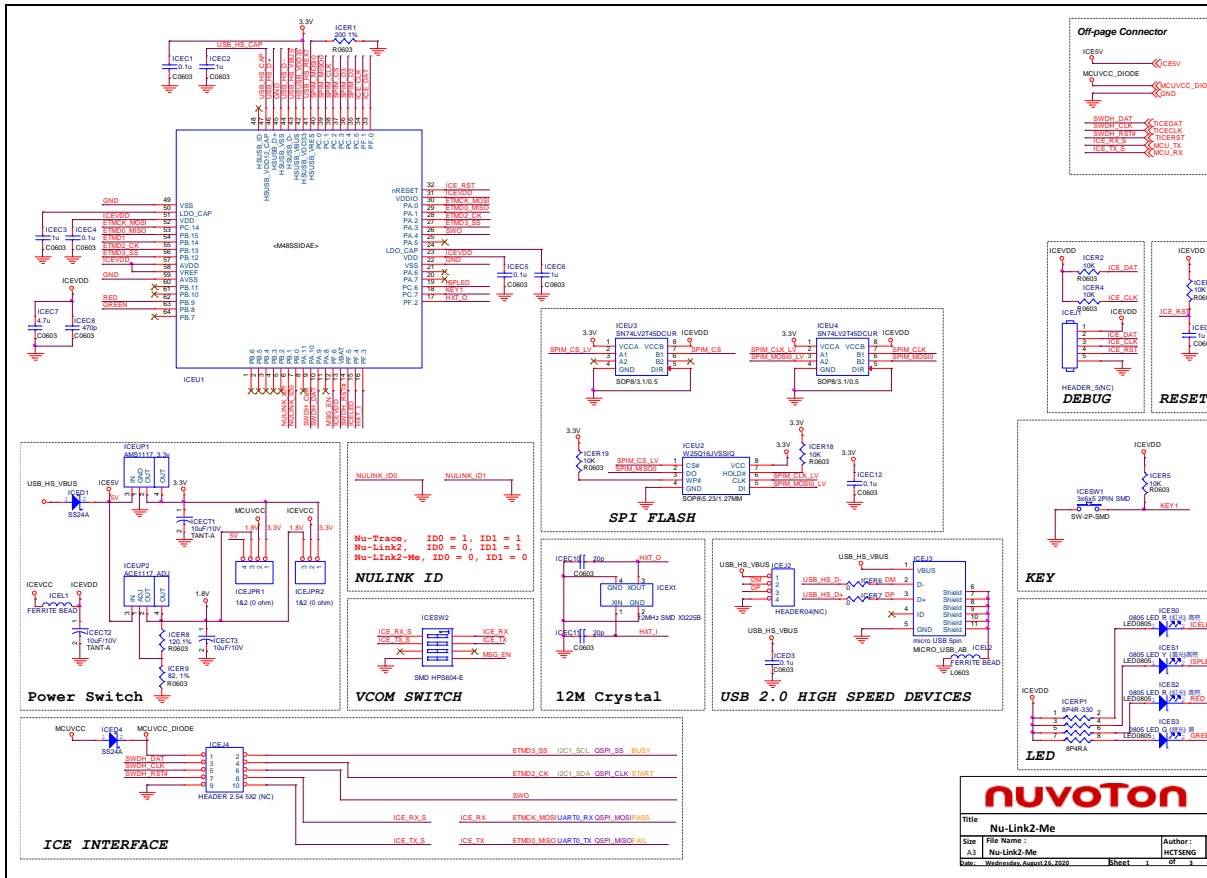


Figure 5-1 Nu-Link2-Me Circuit

### 5.2 M471 platform

Figure 5-2 shows the M471 platform circuit.

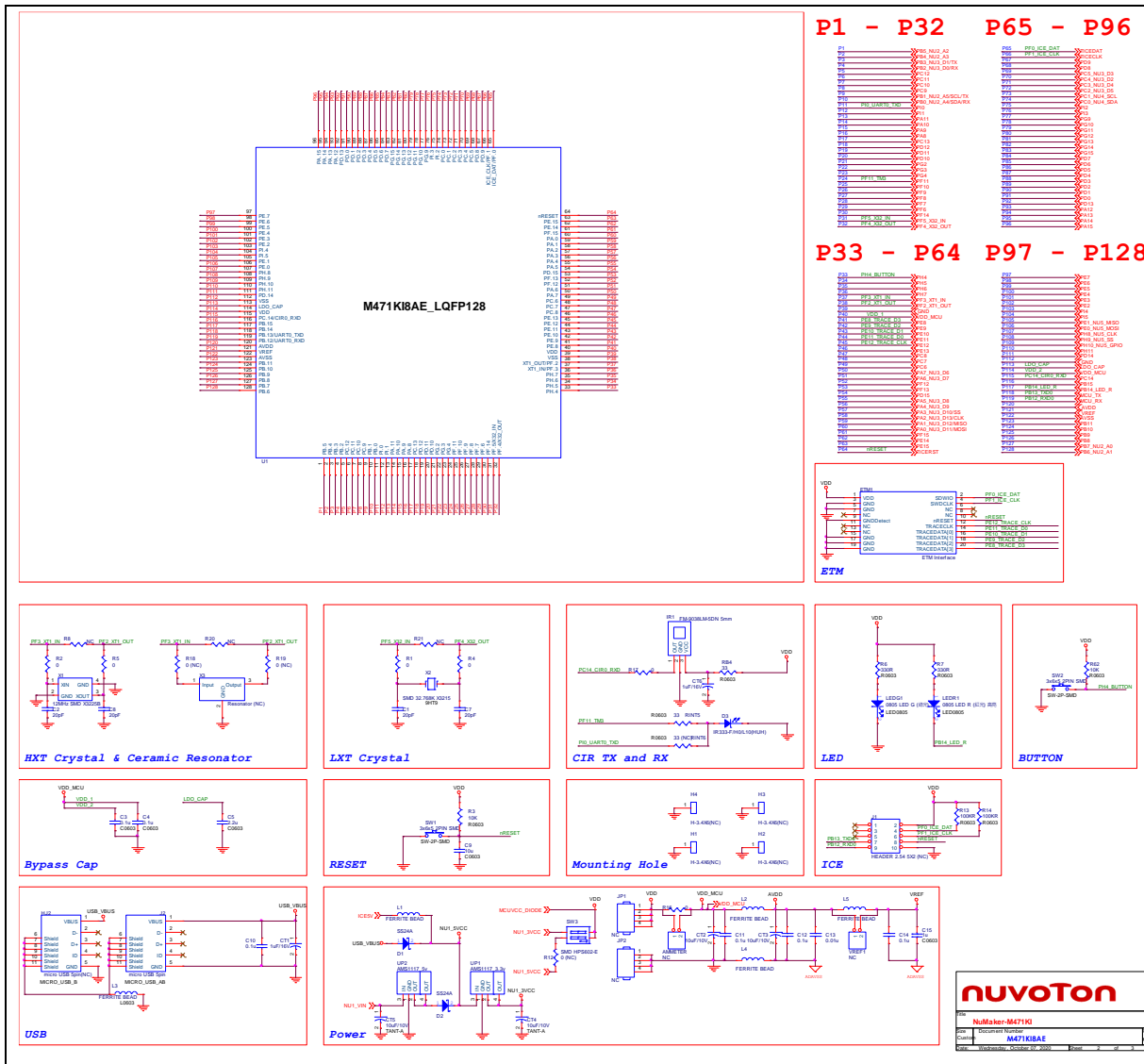


Figure 5-2 M471 platform Circuit

### 5.3 Extension Connector

Figure 5-3 shows extension connectors of NuMaker-M471KI.

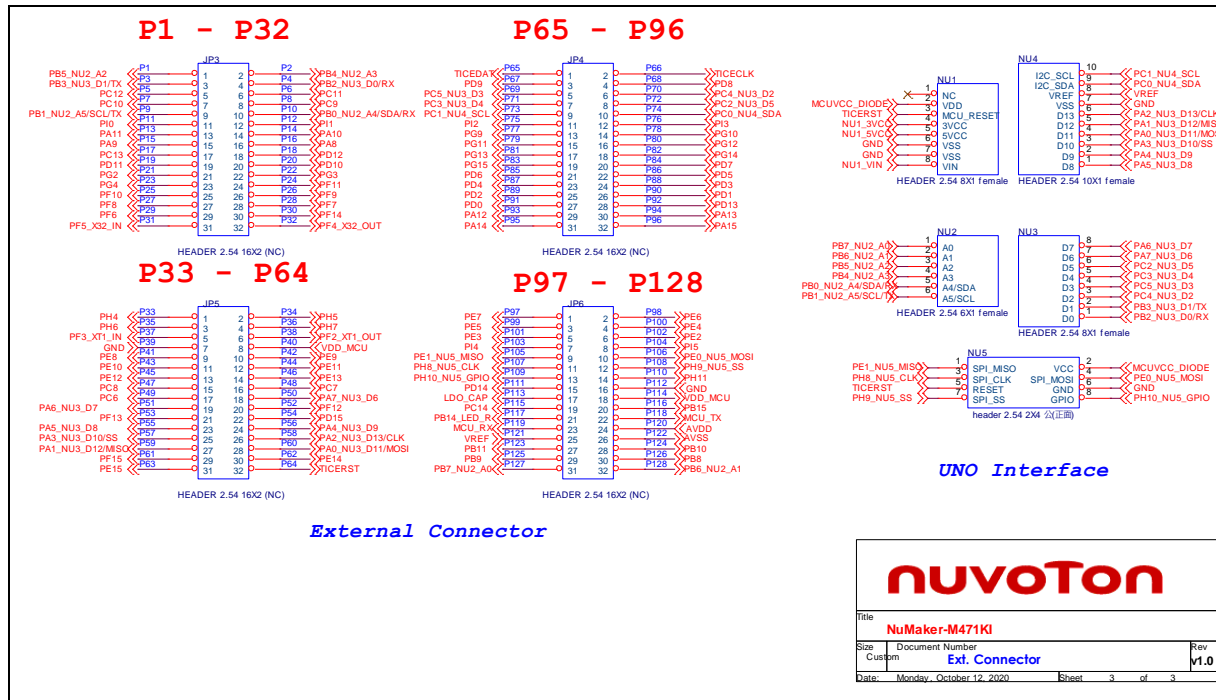


Figure 5-3 Extension Connectors Circuit

### 5.4 PCB Placement

Figure 5-4 and Figure 5-5 show the front and rear placement of NuMaker-M471KI.

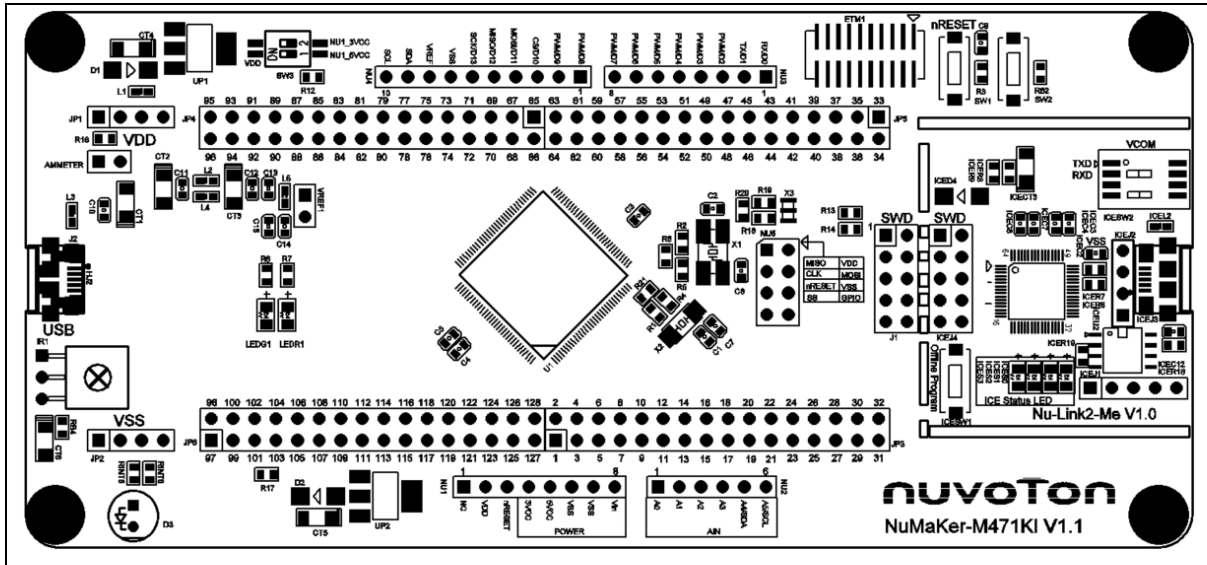


Figure 5-4 Front Placement

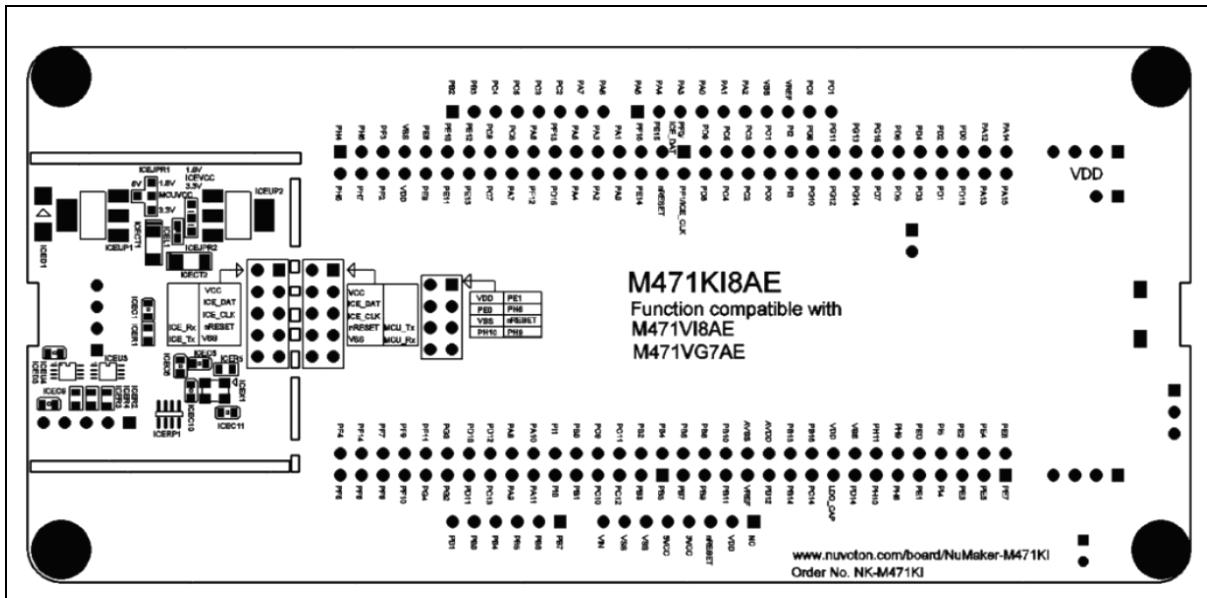


Figure 5-5 Rear Placement

NUMAKER-M71KI USER MANUAL

**6 REVISION HISTORY**

Date	Revision	Description
2020.11.4	1.00	1. Initial version

### Important Notice

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