

NuMicro[®] Family**Based on Arm[®] Cortex[®]-M4**

NuMaker-M471R1

User Manual

Evaluation Board for NuMicro[®] M471M/R1/S Series

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Table of Contents

1 OVERVIEW	7
2 FEATURES	8
3 HARDWARE CONFIGURATION	9
3.1 Front View.....	9
3.2 Rear View	10
3.3 Extension Connectors.....	11
3.3.1 Pin Assignment for Extension Connectors	11
3.3.2 Arduino UNO Compatible Extension Connectors	17
3.4 Power Supply Configuration	19
3.4.1 VIN Power Source	19
3.4.2 5 V Power Sources	19
3.4.3 3.3 V Power Sources	20
3.4.4 1.8 V Power Sources	20
3.4.5 Power Connectors	20
3.4.6 USB Connectors	21
3.4.7 Power Switches	21
3.4.8 Power Supply Models	21
3.5 External Reference Voltage Connector.....	25
3.6 Ammeter Connector	25
3.7 Push Buttons	25
3.8 LEDs.....	26
3.9 Nu-Link2-Me.....	26
3.9.1 VCOM Switches.....	26
3.9.2 Status LEDs	27
4 QUICK START	28
4.1 Toolchains Supporting	28
4.2 Nuvoton Nu-Link Driver Installation	28
4.3 BSP Firmware Download	30
4.4 Hardware Setup.....	30
4.5 Find the Example Project	32
4.6 Execute the Project under Toolchains	32
4.6.1 Keil MDK.....	32
4.6.2 IAR EWARM.....	36
4.6.3 NuEclipse.....	38
5 NUMAKER-M471R1 SCHEMATICS.....	44
5.1 Nu-Link2-Me.....	44

5.2 M471R1 Target Board..... 45

5.3 Extension Connectors..... 46

5.4 PCB Placement 47

6 REVISION HISTORY 48

List of Figures

Figure 1-1 NuMaker-M471R1 Evaluation Board.....	7
Figure 3-1 Front View of NuMaker-M471R1	9
Figure 3-2 Rear View of NuMaker-M471R1	10
Figure 3-3 M471R1D6AE Extension Connectors	11
Figure 3-4 Arduino UNO Compatible Extension Connectors.....	17
Figure 3-5 External Power Supply Sources on Nu-Link2-Me	21
Figure 3-6 External Power Supply Sources on M471R1 Target Board	22
Figure 3-7 Detach the Nu-Link2-Me from NuMaker-M471R1.....	23
Figure 3-8 Wiring between Ammeter Connector and Ammeter.....	25
Figure 4-1 Nu-Link USB Driver Installation Setup.....	28
Figure 4-2 Nu-Link USB Driver Installation	29
Figure 4-3 Open VCOM Function	30
Figure 4-4 ICE USB Connector.....	30
Figure 4-5 Device Manger.....	31
Figure 4-6 PuTTY Session Setting.....	31
Figure 4-7 Template Project Folder Path.....	32
Figure 4-8 Warning Message of “Device not found”	32
Figure 4-9 Project File Migrate to Version 5 Format.....	33
Figure 4-10 Debugger Setting in Options Window.....	33
Figure 4-11 Programming Setting in Options Window.....	34
Figure 4-12 Compile and Download the Project	34
Figure 4-13 Keil MDK Debug Mode	35
Figure 4-14 Debug Message on Serial Port Terminal Windows.....	35
Figure 4-15 IAR EWARM Window	36
Figure 4-16 Compile and Download the Project	36
Figure 4-17 IAR EWARM Debug Mode	37
Figure 4-18 Debug Message on Serial Port Terminal Windows.....	37
Figure 4-19 Import the Project in NuEclipse	38
Figure 4-20 Import Projects Windows.....	38
Figure 4-21 Open Project Properties Window	39
Figure 4-22 Project Properties Settings	39
Figure 4-23 Build Project.....	40
Figure 4-24 Open Debug Configuration.....	40
Figure 4-25 Main Tab Configuration	41
Figure 4-26 Debugger Tab Configuration	41
Figure 4-27 Startup Tab Configuration	42

Figure 4-28 NuEclipse Debug Mode 43

Figure 4-29 Debug Message on Serial Port Terminal Windows..... 43

Figure 5-1 Nu-Link2-Me Circuit..... 44

Figure 5-2 M471R1 Target Board Circuit..... 45

Figure 5-3 Extension Connectors Circuit 46

Figure 5-4 Front Placement 47

Figure 5-5 Rear Placement..... 47

List of Tables

Table 3-1 Extension Connectors.....	11
Table 3-2 M471R1D6AE Full-pin Extension Connectors and GPIO Function List	16
Table 3-3 Arduino UNO Extension Connectors and M471R1D6AE Mapping GPIO List	18
Table 3-4 Vin Power Source	19
Table 3-5 5 V Power Sources	19
Table 3-6 3.3 V Power Sources	20
Table 3-7 1.8 V Power Sources	20
Table 3-8 Power Connectors	20
Table 3-9 USB Connectors	21
Table 3-10 Power Switches	21
Table 3-11 Supply External Power through Nu-Link2-Me	22
Table 3-12 Supply External Power for M471R1 Target Board	24
Table 3-13 External Reference Voltage Connector	25
Table 3-14 Ammeter Connector	25
Table 3-15 Push Buttons.....	25
Table 3-16 LEDs	26
Table 3-17 VCOM Function of Nu-Link2-Me.....	26
Table 3-18 Operation Status LED Patterns	27

1 OVERVIEW

The NuMaker-M471R1 is an evaluation board for Nuvoton NuMicro M471R1, M471MD, M471SD, and M471SE microcontrollers. The NuMaker-M471R1 consists of two parts: an M471R1 target board and an on-board Nu-Link2-Me debugger and programmer. The NuMaker-M471R1 is designed for project evaluation, prototype development and validation with power consumption monitoring function.

The M471R1 target board is based on NuMicro M471R1D6AE. For the development flexibility, the M471R1 target board provides the extension connectors, 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.

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.

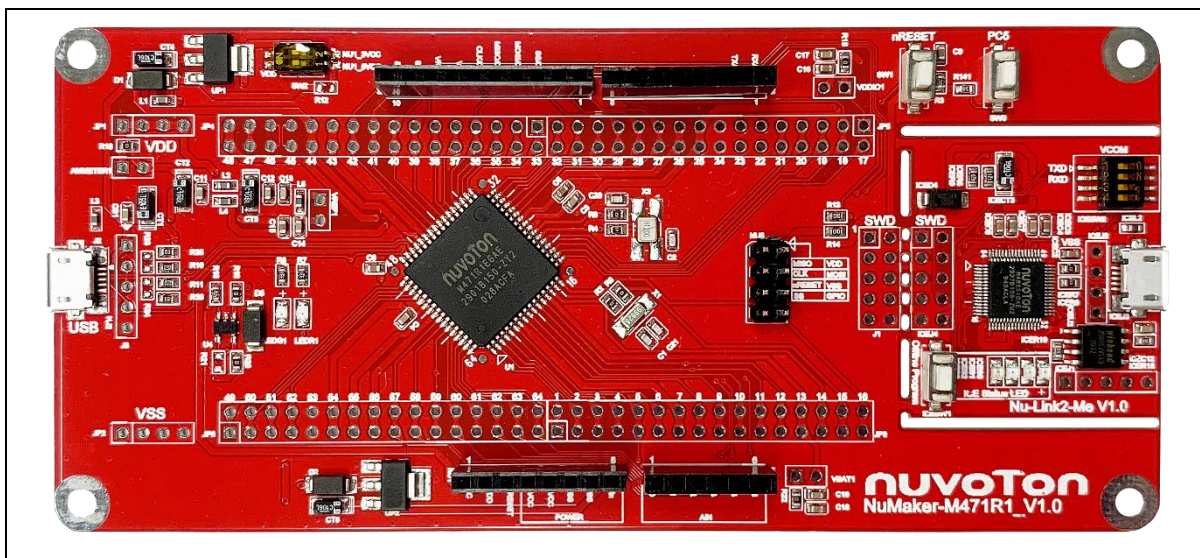


Figure 1-1 NuMaker-M471R1 Evaluation Board

2 FEATURES

- NuMicro M471R1D6AE microcontroller with function compatible with:
 - M471MD6AE
 - M471SD6AE
 - M471SE6AE
- M471R1D6AE 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 FS connector on M471R1 target board
 - ICE USB connector on Nu-Link2-Me
- On-board Nu-Link2-Me debugger and programmer:
 - Debug through SWD interface
 - Online/offline programming
 - Virtual COM port function

3 HARDWARE CONFIGURATION

3.1 Front View

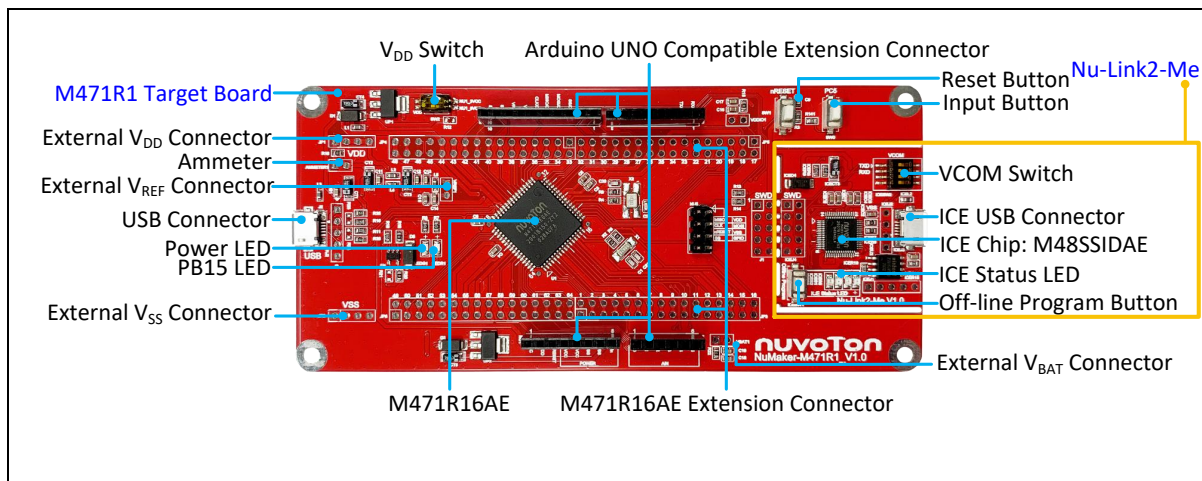


Figure 3-1 Front View of NuMaker-M471R1

Figure 3-1 shows the main components and connectors from the front side of NuMaker-M471R1. The following lists components and connectors from the front view:

- Target chip: M471R1D6AE (U1)
- USB PWR Connector (J2)
- Arduino UNO Compatible Extension Connectors (NU1, NU2, NU3, NU4)
- M471R1 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 (SW2)
- Ammeter Connector (AMMETER)
- Reset Button (SW1)
- Power LED and PB15 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-M471R1.

The following lists components and connectors from the rear view:

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

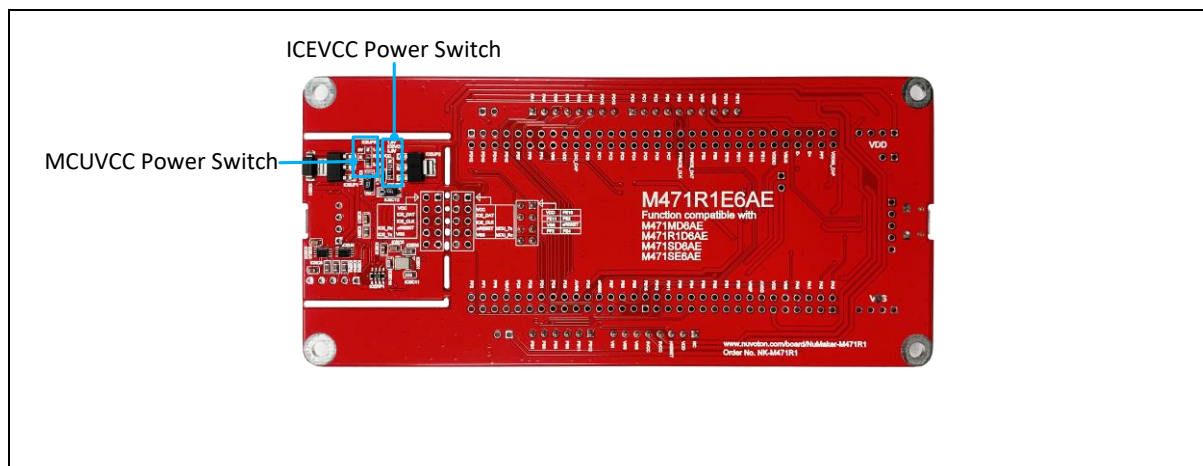


Figure 3-2 Rear View of NuMaker-M471R1

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-M471R1.
NU1, NU2, NU3 and NU4	Arduino UNO compatible pins on the NuMaker-M471R1.

Table 3-1 Extension Connectors

3.3.1 Pin Assignment for Extension Connectors

The NuMaker-M471R1 provides the M471R1D6AE onboard and extension connectors (JP3, JP4, JP5 and JP6). Figure 3-3 shows the M471R1D6AE extension connectors.

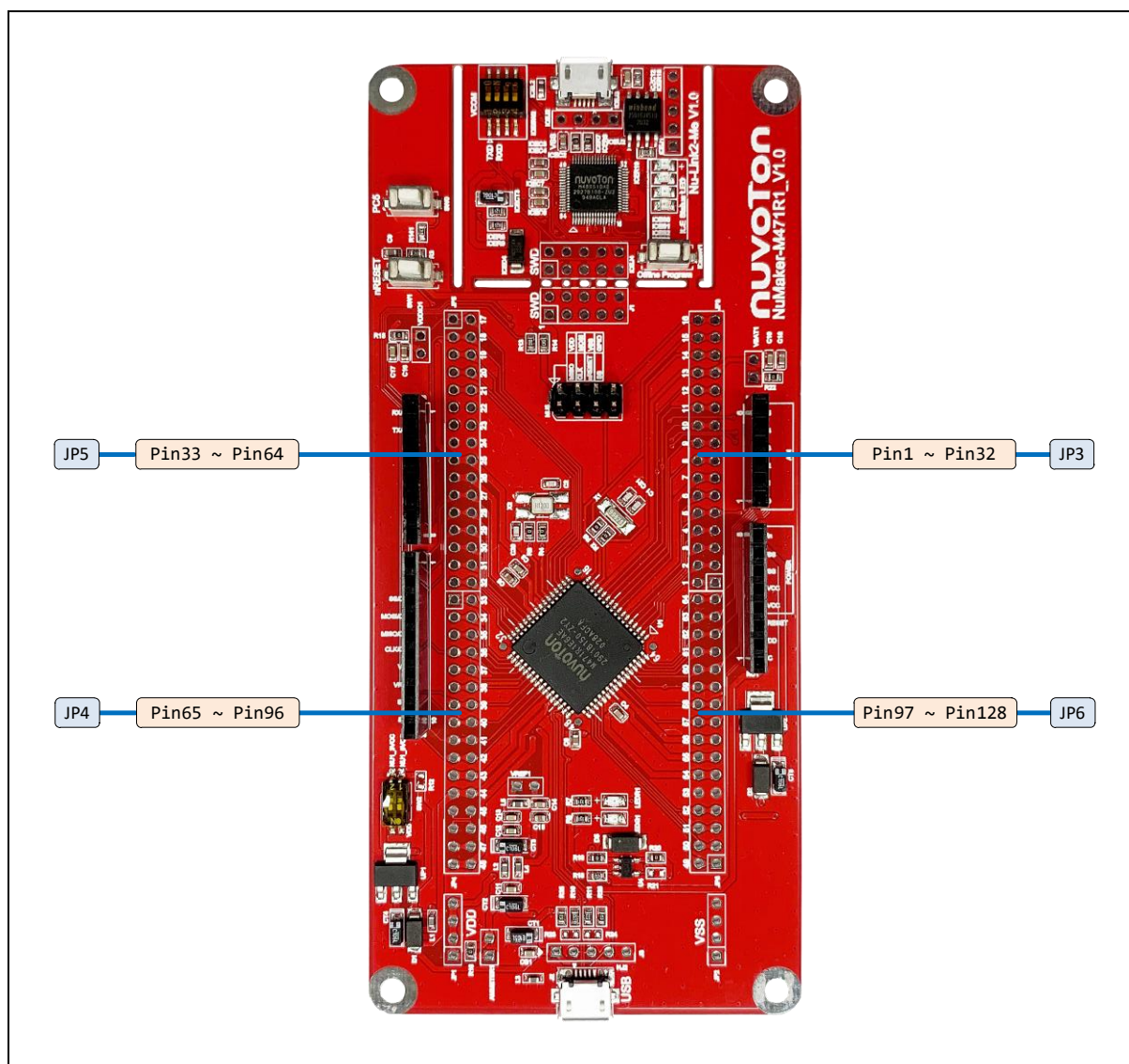


Figure 3-3 M471R1D6AE Extension Connectors

Header		M471R1D6AE	
		Pin No.	Function
JP3	JP3.1	1	PB.15 / EADC0_CH12 / EBI_nCS1
	JP3.2	2	PB.15 / EADC0_CH12 / EBI_nCS1
	JP3.3	3	PB.5 / EADC0_CH13 / SPI0_MOSI0 / SPI1_MOSI / EBI_AD6 / UART2_RXD
	JP3.4	4	PB.5 / EADC0_CH13 / SPI0_MOSI0 / SPI1_MOSI / EBI_AD6 / UART2_RXD
	JP3.5	5	PB.6 / EADC0_CH14 / SPI0_MISO0 / SPI1_MISO / EBI_AD5
	JP3.6	6	PB.6 / EADC0_CH14 / SPI0_MISO0 / SPI1_MISO / EBI_AD5
	JP3.7	7	PB.7 / EADC0_CH15 / SPI0_CLK / SPI1_CLK / EBI_AD4 / STADC
	JP3.8	8	PB.7 / EADC0_CH15 / SPI0_CLK / SPI1_CLK / EBI_AD4 / STADC
	JP3.9	9	nRESET
	JP3.10	10	nRESET
	JP3.11	11	PD.0 / EADC0_CH6 / SPI1_I2SMCLK / UART0_RXD / INT3 / TM3
	JP3.12	12	PD.0 / EADC0_CH6 / SPI1_I2SMCLK / UART0_RXD / INT3 / TM3
	JP3.13	13	AV _{ss}
	JP3.14	14	AV _{ss}
	JP3.15	15	PD.8 / EADC0_CH7 / EBI_nCS0
	JP3.16	16	PD.8 / EADC0_CH7 / EBI_nCS0
	JP3.17	17	PD.9 / EADC0_CH10 / EBI_ALE
	JP3.18	18	PD.9 / EADC0_CH10 / EBI_ALE
	JP3.19	19	PD.1 / EADC0_CH11 / PWM0_SYNC_IN / UART0_TXD / TM0 / EBI_nRD
	JP3.20	20	PD.1 / EADC0_CH11 / PWM0_SYNC_IN / UART0_TXD / TM0 / EBI_nRD
	JP3.21	21	PD.2 / STADC / TM0_EXT / PWM0_BRAKE0 / EBI_nWR / INT0
	JP3.22	22	PD.2 / STADC / TM0_EXT / PWM0_BRAKE0 / EBI_nWR / INT0
	JP3.23	23	PD.3 / TM2 / TM1_EXT / PWM0_BRAKE1 / EBI_MCLK / INT1
	JP3.24	24	PD.3 / TM2 / TM1_EXT / PWM0_BRAKE1 / EBI_MCLK / INT1
	JP3.25	25	V _{BAT}
	JP3.26	26	V _{BAT}
	JP3.27	27	PF.0 / X32_OUT / INT5
	JP3.28	28	PF.0 / X32_OUT / INT5
	JP3.29	29	PF.1 / X32_IN
	JP3.30	30	PF.1 / X32_IN
	JP3.31	31	PF.2 / TAMPER
	JP3.32	32	PF.2 / TAMPER

Header		M471R1D6AE	
		Pin No.	Function
JP5	JP5.1	33	PD.12 / UART3_TXD / PWM1_CH0 / EBI_ADR16
	JP5.2	34	PD.12 / UART3_TXD / PWM1_CH0 / EBI_ADR16
	JP5.3	35	PD.13 / UART3_RXD / PWM1_CH1 / EBI_ADR17
	JP5.4	36	PD.13 / UART3_RXD / PWM1_CH1 / EBI_ADR17
	JP5.5	37	PD.14 / UART3_nCTS / PWM1_CH2 / EBI_ADR18
	JP5.6	38	PD.14 / UART3_nCTS / PWM1_CH2 / EBI_ADR18
	JP5.7	39	PD.15 / UART3_nRTS / PWM1_CH3 / EBI_ADR19
	JP5.8	40	PD.15 / UART3_nRTS / PWM1_CH3 / EBI_ADR19
	JP5.9	41	PD.7 / PWM0_SYNC_IN / TM1 / PWM0_CH5 / EBI_nRD
	JP5.10	42	PD.7 / PWM0_SYNC_IN / TM1 / PWM0_CH5 / EBI_nRD
	JP5.11	43	PF.3 / XT1_OUT / I2C1_SCL
	JP5.12	44	PF.3 / XT1_OUT / I2C1_SCL
	JP5.13	45	PF.4 / XT1_IN / I2C1_SDA
	JP5.14	46	PF.4 / XT1_IN / I2C1_SDA
	JP5.15	47	V _{SS}
	JP5.16	48	V _{SS}
	JP5.17	49	V _{DD}
	JP5.18	50	V _{DD}
	JP5.19	51	LDO_CAP
	JP5.20	52	LDO_CAP
	JP5.21	53	PC.0 / SPI1_CLK / UART2_nCTS / PWM0_CH0 / EBI_AD8 / INT2 / UART3_TXD / TM3_EXT
	JP5.22	54	PC.0 / SPI1_CLK / UART2_nCTS / PWM0_CH0 / EBI_AD8 / INT2 / UART3_TXD / TM3_EXT
	JP5.23	55	PC.1 / CLK0 / UART2_nRTS / PWM0_CH1 / EBI_AD9 / UART3_RXD
	JP5.24	56	PC.1 / CLK0 / UART2_nRTS / PWM0_CH1 / EBI_AD9 / UART3_RXD
	JP5.25	57	PC.2 / SPI1_SS / UART2_TXD / PWM0_CH2 / EBI_AD10
	JP5.26	58	PC.2 / SPI1_SS / UART2_TXD / PWM0_CH2 / EBI_AD10
	JP5.27	59	PC.3 / SPI1_MOSI / UART2_RXD / PWM0_CH3 / EBI_AD11
	JP5.28	60	PC.3 / SPI1_MOSI / UART2_RXD / PWM0_CH3 / EBI_AD11
	JP5.29	61	PC.4 / SPI1_MISO / I2C1_SCL / PWM0_CH4 / EBI_AD12
	JP5.30	62	PC.4 / SPI1_MISO / I2C1_SCL / PWM0_CH4 / EBI_AD12
	JP5.31	63	PC.5 / PWM0_CH5 / EBI_AD13
	JP5.32	64	PC.5 / PWM0_CH5 / EBI_AD13

Header		M471R1D6AE	
		Pin No.	Function
JP4	JP4.1	65	PC.6 / I2C1_SMBAL / PWM1_CH0 / EBI_AD14 / UART0_TXD
	JP4.2	66	PC.6 / I2C1_SMBAL / PWM1_CH0 / EBI_AD14 / UART0_TXD
	JP4.3	67	PC.7 / I2C1_SMBSUS / PWM1_CH1 / EBI_AD15 / UART0_RXD
	JP4.4	68	PC.7 / I2C1_SMBSUS / PWM1_CH1 / EBI_AD15 / UART0_RXD
	JP4.5	69	PF.5 / ICE_CLK
	JP4.6	70	PF.5 / ICE_CLK
	JP4.7	71	PF.6 / ICE_DAT
	JP4.8	72	PF.6 / ICE_DAT
	JP4.9	73	PE.8 / UART1_TXD / SPI0_MISO1 / I2C1_SCL / SC0_PWR / CLKO / PWM0_BRAKE0 / TM1
	JP4.10	74	PE.8 / UART1_TXD / SPI0_MISO1 / I2C1_SCL / SC0_PWR / CLKO / PWM0_BRAKE0 / TM1
	JP4.11	75	PE.9 / UART1_RXD / SPI0_MOSI1 / I2C1_SDA / SC0_RST / SPI1_I2SMCLK / PWM1_BRAKE1 / TM2
	JP4.12	76	PE.9 / UART1_RXD / SPI0_MOSI1 / I2C1_SDA / SC0_RST / SPI1_I2SMCLK / PWM1_BRAKE1 / TM2
	JP4.13	77	PE.10 / SPI1_MISO / SPI0_MISO0 / UART1_nCTS / I2C0_SMBAL / SC0_DAT / UART3_TXD / I2C1_SCL
	JP4.14	78	PE.10 / SPI1_MISO / SPI0_MISO0 / UART1_nCTS / I2C0_SMBAL / SC0_DAT / UART3_TXD / I2C1_SCL
	JP4.15	79	PE.11 / SPI1_MOSI / SPI0_MOSI0 / UART1_nRTS / I2C0_SMBSUS / SC0_CLK / UART3_RXD / I2C1_SDA
	JP4.16	80	PE.11 / SPI1_MOSI / SPI0_MOSI0 / UART1_nRTS / I2C0_SMBSUS / SC0_CLK / UART3_RXD / I2C1_SDA
	JP4.17	81	PE.12 / SPI1_SS / SPI0_SS / UART1_TXD / I2C0_SCL
	JP4.18	82	PE.12 / SPI1_SS / SPI0_SS / UART1_TXD / I2C0_SCL
	JP4.19	83	PE.13 / SPI1_CLK / SPI0_CLK / UART1_RXD / I2C0_SDA
	JP4.20	84	PE.13 / SPI1_CLK / SPI0_CLK / UART1_RXD / I2C0_SDA
	JP4.21	85	V _{DDIO}
	JP4.22	86	V _{DDIO}
	JP4.23	87	USB_VBUS
	JP4.24	88	USB_VBUS
	JP4.25	89	USB_D-
	JP4.26	90	USB_D-
	JP4.27	91	USB_D+
	JP4.28	92	USB_D+
	JP4.29	93	PF.7
	JP4.30	94	PF.7
	JP4.31	95	USB_LDO33_CAP
	JP4.32	96	USB_LDO33_CAP

Header		M471R1D6AE	
		Pin No.	Function
JP6	JP6.1	97	PA.3 / UART0_RXD / UART0_nRTS / I2C0_SCL / SC0_PWR / PWM1_CH2 / EBI_AD3
	JP6.2	98	PA.3 / UART0_RXD / UART0_nRTS / I2C0_SCL / SC0_PWR / PWM1_CH2 / EBI_AD3
	JP6.3	99	PA.2 / UART0_TXD / UART0_nCTS / I2C0_SDA / SC0_RST / PWM1_CH3 / EBI_AD2
	JP6.4	100	PA.2 / UART0_TXD / UART0_nCTS / I2C0_SDA / SC0_RST / PWM1_CH3 / EBI_AD2
	JP6.5	101	PA.1 / UART1_nRTS / UART1_RXD / SC0_DAT / PWM1_CH4 / EBI_AD1 / STADC
	JP6.6	102	PA.1 / UART1_nRTS / UART1_RXD / SC0_DAT / PWM1_CH4 / EBI_AD1 / STADC
	JP6.7	103	PA.0 / UART1_nCTS / UART1_TXD / SC0_CLK / PWM1_CH5 / EBI_AD0 / INT0 / SPI1_I2SMCLK
	JP6.8	104	PA.0 / UART1_nCTS / UART1_TXD / SC0_CLK / PWM1_CH5 / EBI_AD0 / INT0 / SPI1_I2SMCLK
	JP6.9	105	V _{SS}
	JP6.10	106	V _{SS}
	JP6.11	107	V _{DD}
	JP6.12	108	V _{DD}
	JP6.13	109	AV _{DD}
	JP6.14	110	AV _{DD}
	JP6.15	111	V _{REF}
	JP6.16	112	V _{REF}
	JP6.17	113	PB.0 / EADC0_CH0 / SPI0_MOSI1 / UART2_RXD / TM2 / EBI_nWRL / INT1
	JP6.18	114	PB.0 / EADC0_CH0 / SPI0_MOSI1 / UART2_RXD / TM2 / EBI_nWRL / INT1
	JP6.19	115	PB.1 / EADC0_CH1 / SPI0_MISO1 / UART2_TXD / TM3 / SC0_RST / PWM0_SYNC_OUT / EBI_nWRH
	JP6.20	116	PB.1 / EADC0_CH1 / SPI0_MISO1 / UART2_TXD / TM3 / SC0_RST / PWM0_SYNC_OUT / EBI_nWRH
	JP6.21	117	PB.2 / EADC0_CH2 / SPI0_CLK / SPI1_CLK / UART1_RXD / SC0_nCD / UART3_RXD / TM2_EXT
	JP6.22	118	PB.2 / EADC0_CH2 / SPI0_CLK / SPI1_CLK / UART1_RXD / SC0_nCD / UART3_RXD / TM2_EXT
	JP6.23	119	PB.3 / EADC0_CH3 / SPI0_MISO0 / SPI1_MISO / UART1_TXD / EBI_ALE / UART3_TXD / TM0_EXT
	JP6.24	120	PB.3 / EADC0_CH3 / SPI0_MISO0 / SPI1_MISO / UART1_TXD / EBI_ALE / UART3_TXD / TM0_EXT
	JP6.25	121	PB.4 / EADC0_CH4 / SPI0_SS / SPI1_SS / UART1_nCTS / EBI_AD7 / UART2_TXD / TM1_EXT
	JP6.26	122	PB.4 / EADC0_CH4 / SPI0_SS / SPI1_SS / UART1_nCTS / EBI_AD7 / UART2_TXD / TM1_EXT
	JP6.27	123	PB.8 / EADC0_CH5 / UART1_nRTS / PWM0_CH2
	JP6.28	124	PB.8 / EADC0_CH5 / UART1_nRTS / PWM0_CH2
	JP6.29	125	PB.11 / EADC0_CH8
	JP6.30	126	PB.11 / EADC0_CH8
	JP6.31	127	PB.12 / EADC0_CH9
	JP6.32	128	PB.12 / EADC0_CH9

Table 3-2 M471R1D6AE 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.

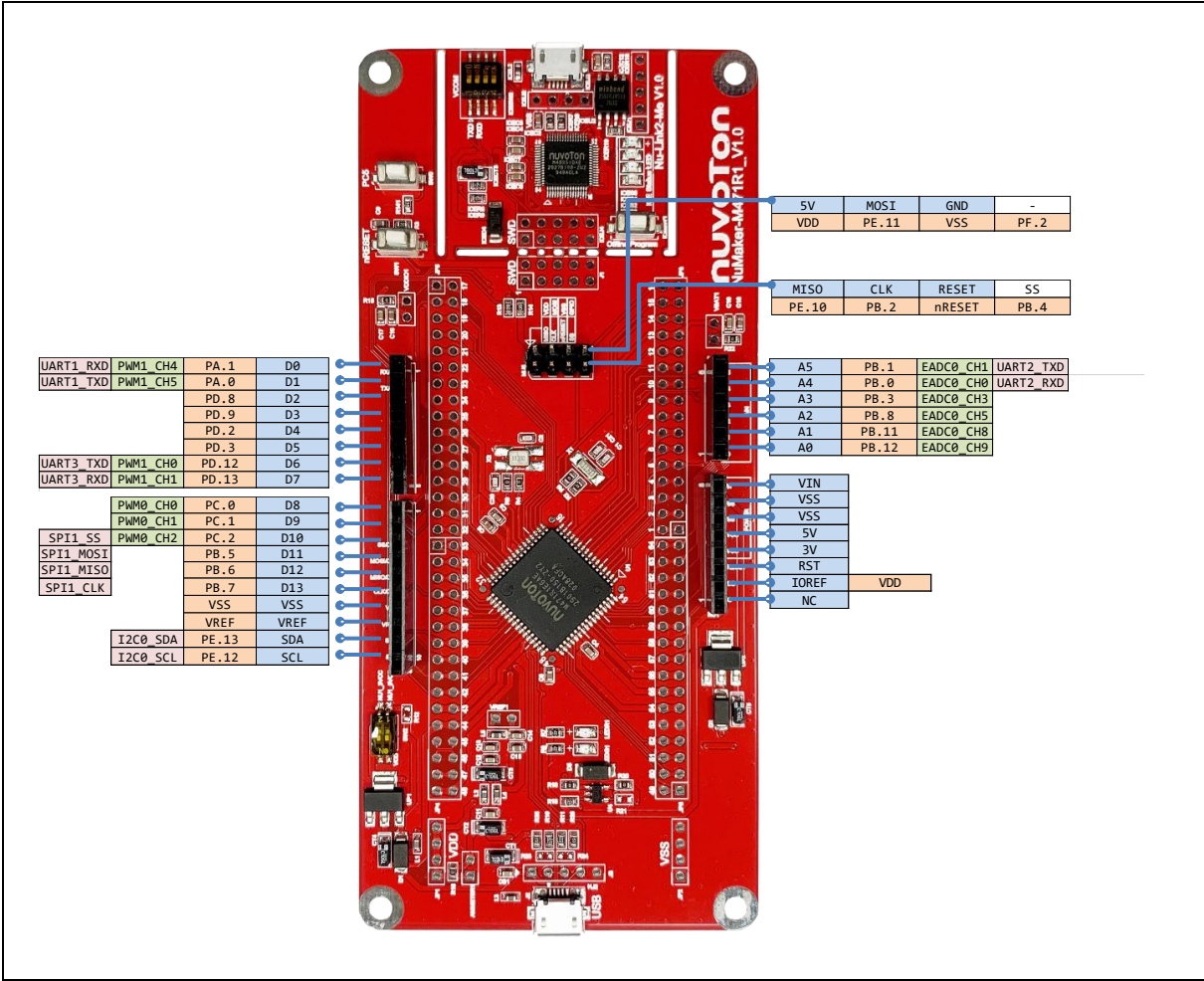


Figure 3-4 Arduino UNO Compatible Extension Connectors

Header		NuMaker-M471R1		Header		NuMaker-M471R1	
		Compatible to Arduino UNO	GPIO Pin of M471R1			Compatible to Arduino UNO	GPIO Pin of M471R1
NU3	NU3.1	D0	PA.1	NU2	NU2.6	A5	PB.1
	NU3.2	D1	PA.0		NU2.5	A4	PB.0
	NU3.3	D2	PD.8		NU2.4	A3	PB.3
	NU3.4	D3	PD.9		NU2.3	A2	PB.8
	NU3.5	D4	PD.2		NU2.2	A1	PB.11
	NU3.6	D5	PD.3		NU2.1	A0	PB.12
	NU3.7	D6	PD.12	NU1	NU1.8	VIN	-
	NU3.8	D7	PD.13		NU1.7	VSS	
NU4	NU4.1	D8	PC.0		NU1.6	VSS	
	NU4.2	D9	PC.1		NU1.5	5V	
	NU4.3	D10	PC.2		NU1.4	3V	nRESET
	NU4.4	D11	PB.5		NU1.3	RST	
	NU4.5	D12	PB.6		NU1.2	IOREF	V _{REF}
	NU4.6	D13	PB.7		NU1.1	NC	-
	NU4.7	VSS	V _{SS}				
	NU4.8	VREF	V _{REF}				
	NU4.9	SDA	PE.13				
	NU4.10	SCL	PE.12				

Table 3-3 Arduino UNO Extension Connectors and M471R1D6AE Mapping GPIO List

3.4 Power Supply Configuration

The NuMaker-M471R1 is able to adopt multiple power supplies. External power sources include NU1 Vin (7 V to 12 V), V_{DD} (depending on the target chip operating voltage), and PC through USB connector. By using switches and voltage regulator, multiple power domains can be created on the NuMaker-M471R1.

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 M471R1 target board and Nu-Link2-Me.
J2	USB_VBUS	USB connector on NuMaker-M471R1 supplies 5 V power from PC to M471R1 target board 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: M471R1 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 M471R1 target board or ICE chip.
UP1	USB_VBUS	UP1 converts USB_VBUS to 3.3 V and supplies 3.3 V to M471R1 target board. 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 M471R1 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 M471R1 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
JP1	V _{DD} connector on the NuMaker-M471R1. Note: M471R1 operating voltage range is from 1.8 V to 3.6 V.
JP2	V _{SS} connector on the NuMaker-M471R1.

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-M471R1 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: M471R1 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: M471R1 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.

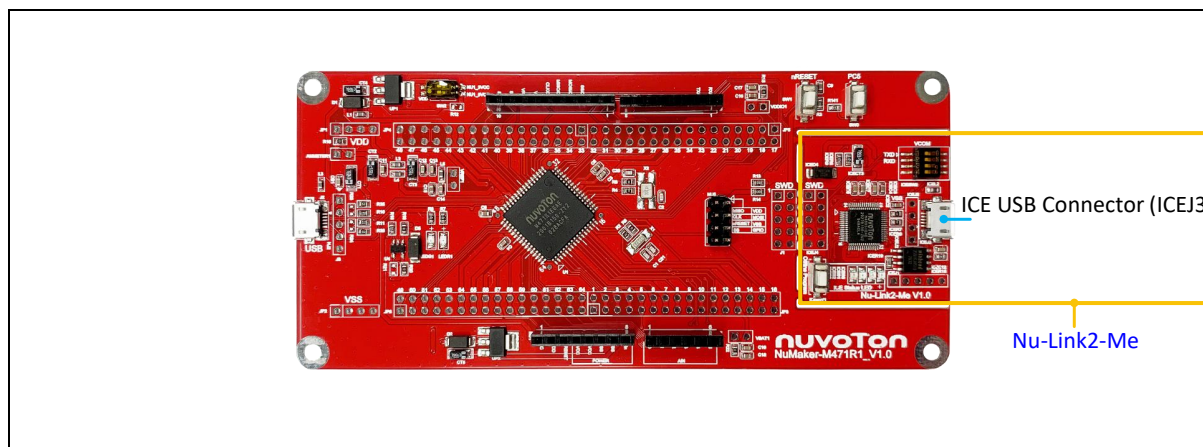


Figure 3-5 External Power Supply Sources on Nu-Link2-Me

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

1. Solder the resistor on ICEJPR1 (MCUVCC) depending on the target chip operating voltage.
2. Solder the resistor on ICEJPR2 (ICEVCC) depending 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 supplying 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	-	-	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
Note: 1. 0 Ω should be soldered between ICEJPR1's MCVCC 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. -: Unused.									

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

3.4.8.2 External Power Supply through M471R1 Target Board to Target Chip

The external power supply sources on M471R1 target board are shown in Figure 3-6.

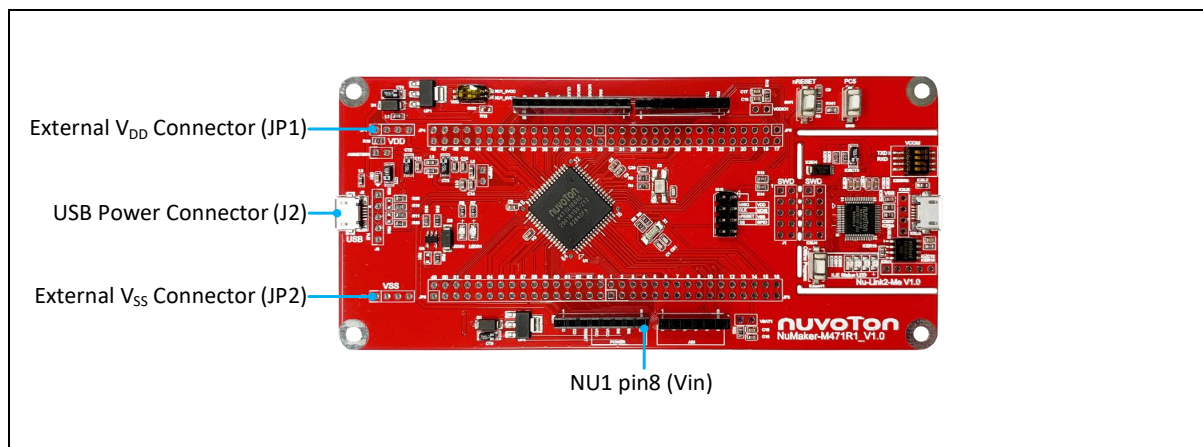


Figure 3-6 External Power Supply Sources on M471R1 Target Board

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

1. Switch the SW2 depending on the target chip operating voltage.
2. Remove the resistor on ICEJPR1 (MCUVCC).
3. Solder the resistor on ICEJPR2 (ICEVCC) depending 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 steps below:

1. Switch the SW2 to OFF.
2. Remove the resistor on ICEJPR1 (MCUVCC).
3. Solder the resistor on ICEJPR2 (ICEVCC) depending 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-M471R1, please follow the steps below:

1. Switch the SW2 depending on the target chip operating voltage.
2. Detach the Nu-Link2-Me from NuMaker-M471R1.
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-M471R1, please follow the steps below:

1. Switch the SW2 to OFF.
2. Detach the Nu-Link2-Me from NuMaker-M471R1.
3. Connect the external power supply to JP1.

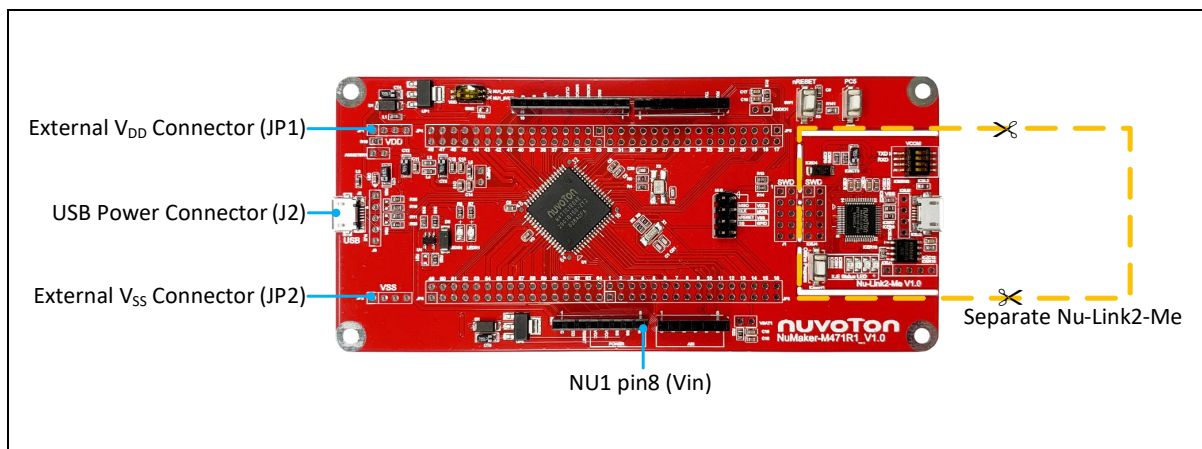


Figure 3-7 Detach the Nu-Link2-Me from NuMaker-M471R1

Table 3-12 presents all power models when supplies external power through M471R1 target board. The M471R1 target board 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	-	-	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:

1. The Vin input voltage will be converted by voltage regulator UP2 to 5 V. Supplying 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 MCVCC 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. -: Unused

Table 3-12 Supply External Power for M471R1 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

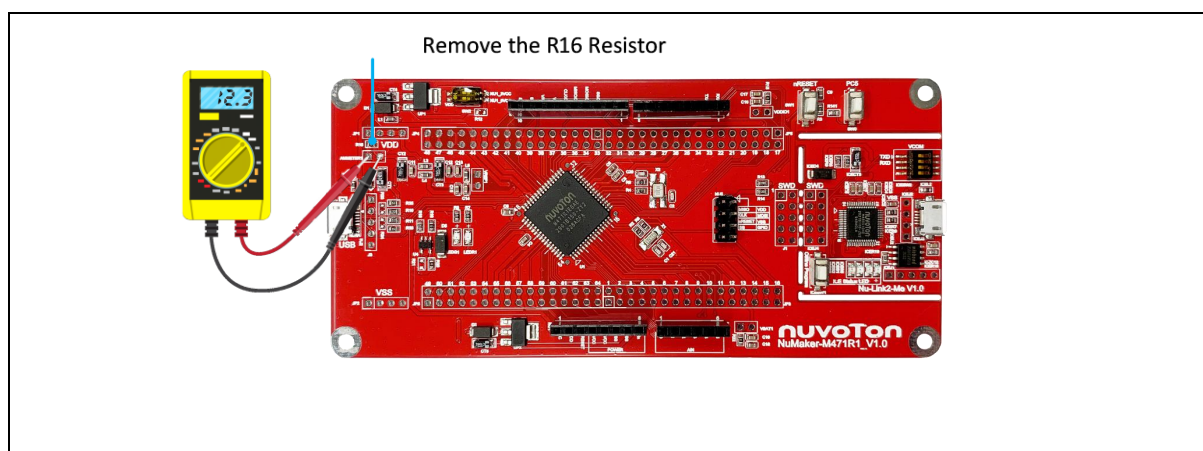


Figure 3-8 Wiring between Ammeter Connector and Ammeter

3.7 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-M471R1 is powered.
PB15 LED	The LED is connected to the target chip PB.15.
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 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*.

3.9.1 VCOM Switches

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

ICESW2		
Pin	Function	Description
1	TXD	On: Connect target chip 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 3-17 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
Boot	Flash x 3	Flash x 3	Flash x 3	Flash x 3
Idle	On	-	-	-
One Nu-Link2-Me is selected to connect	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	-	-
Note: "Online" means Nu-Link2-Me is connected to ICP Programming Tool, IDE or NuTool.				

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 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.

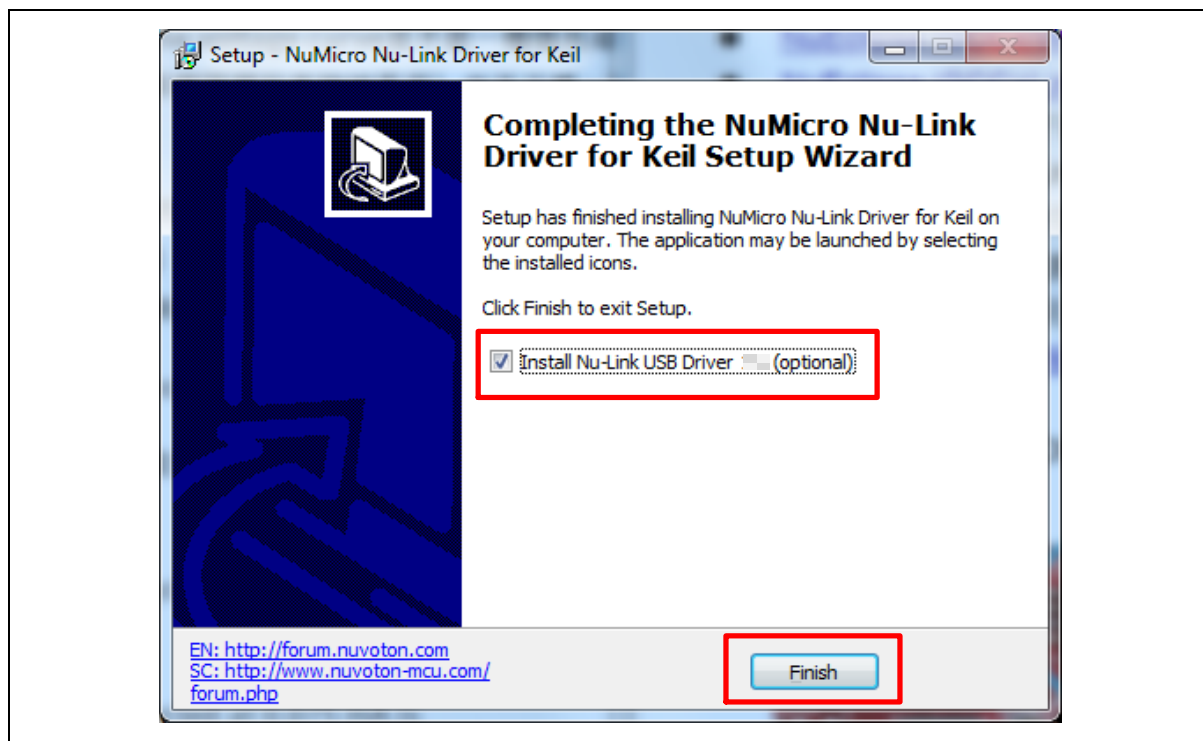


Figure 4-1 Nu-Link USB Driver Installation Setup

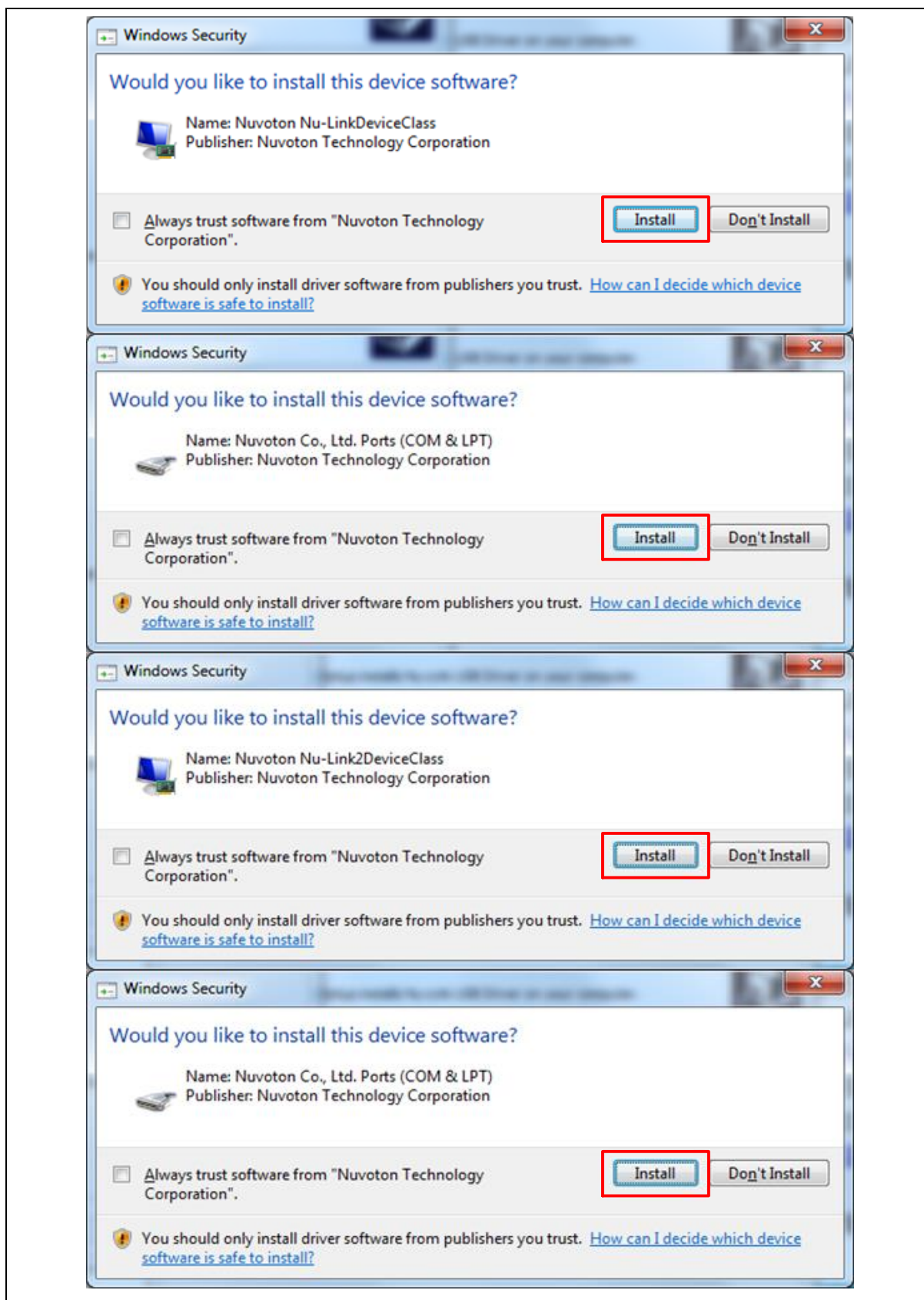


Figure 4-2 Nu-Link USB Driver Installation

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.

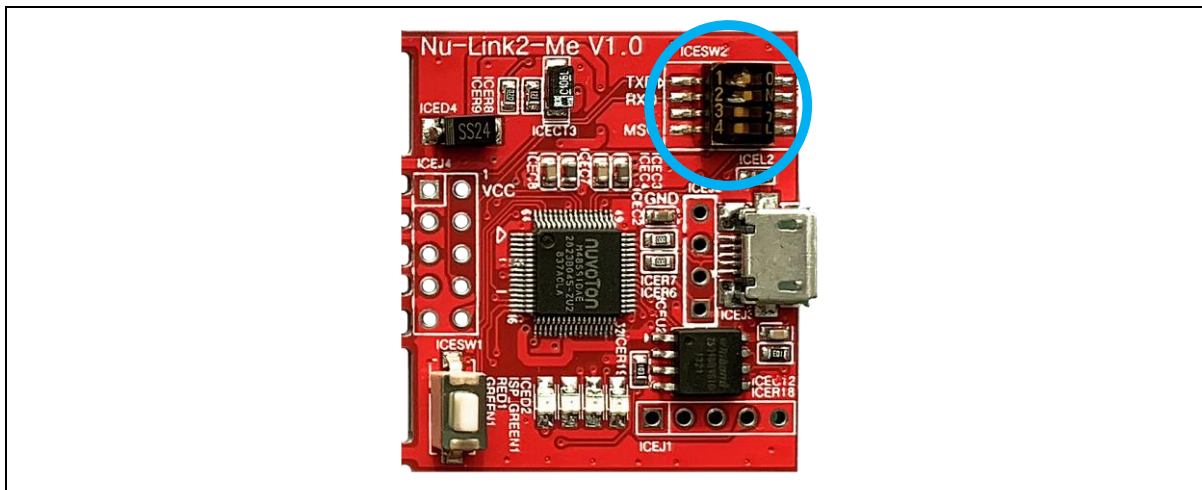


Figure 4-3 Open VCOM Function

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

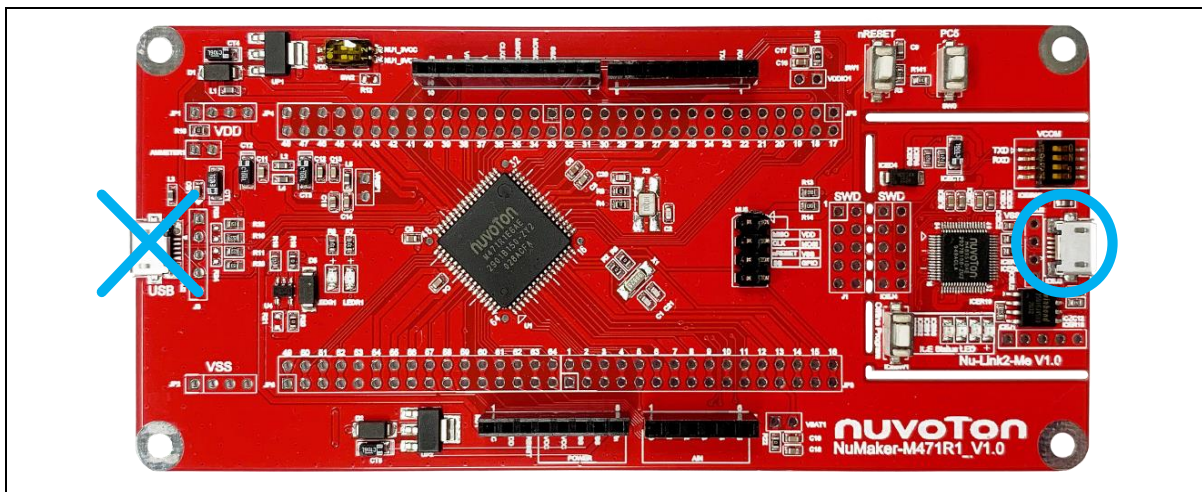


Figure 4-4 ICE USB Connector

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

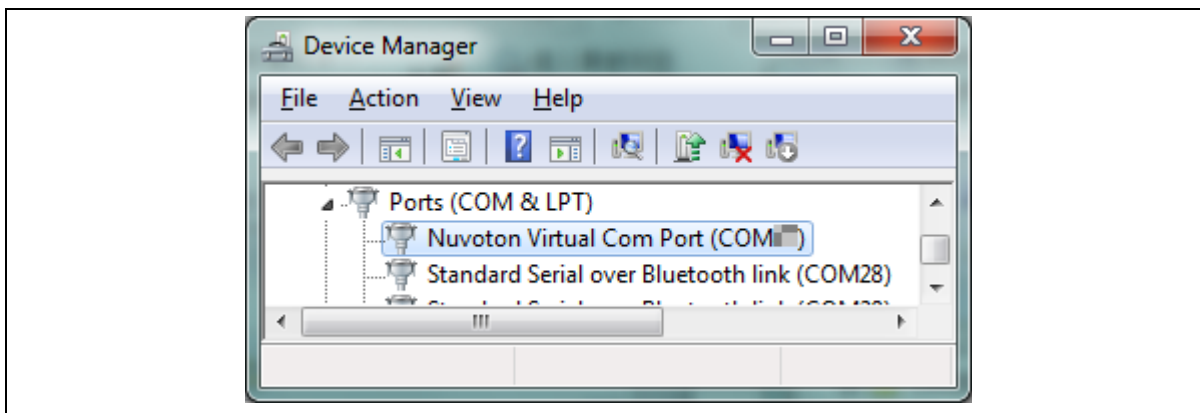


Figure 4-5 Device Manger

- 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.

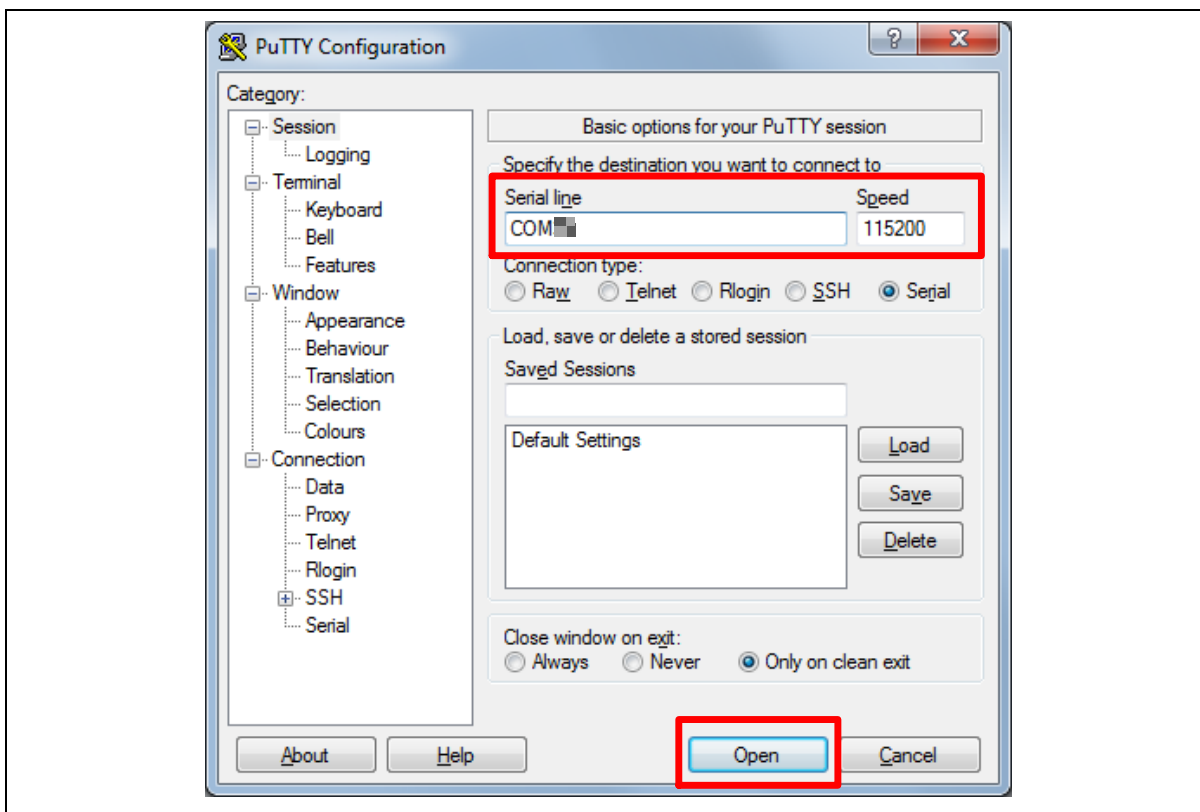


Figure 4-6 PuTTY Session Setting

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.

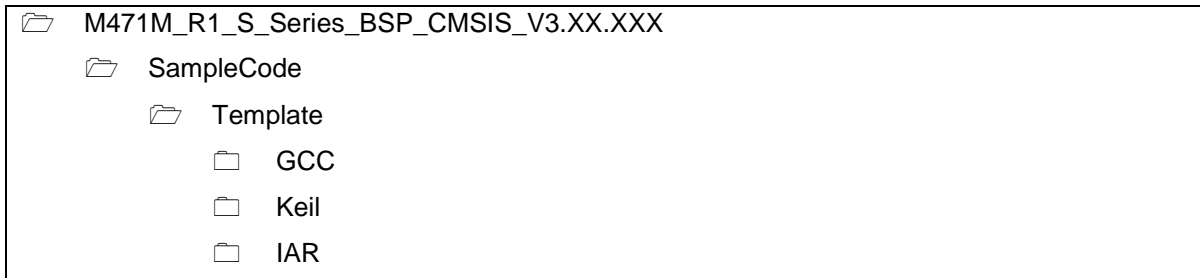


Figure 4-7 Template Project Folder Path

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.

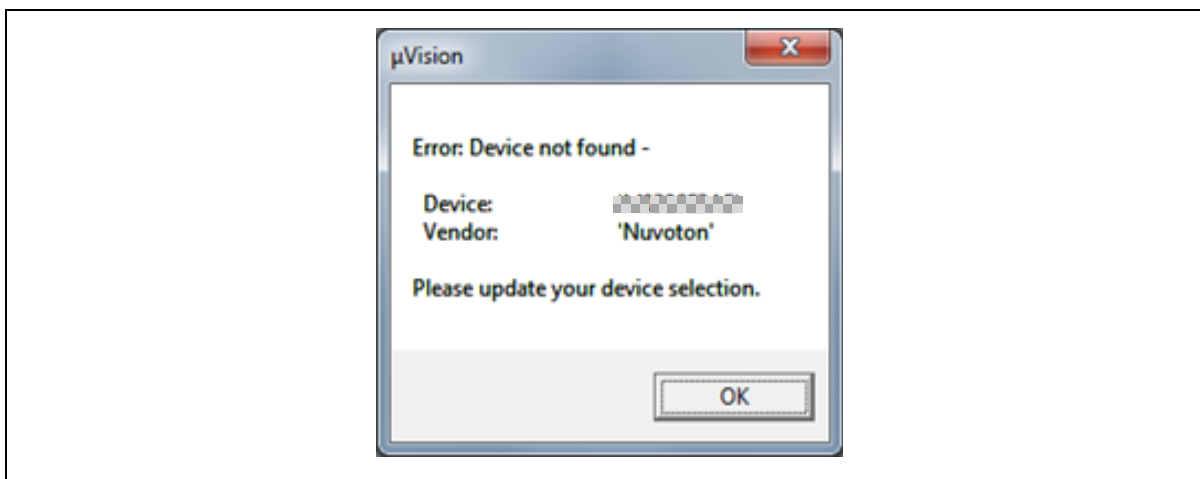


Figure 4-8 Warning Message of “Device not found”

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

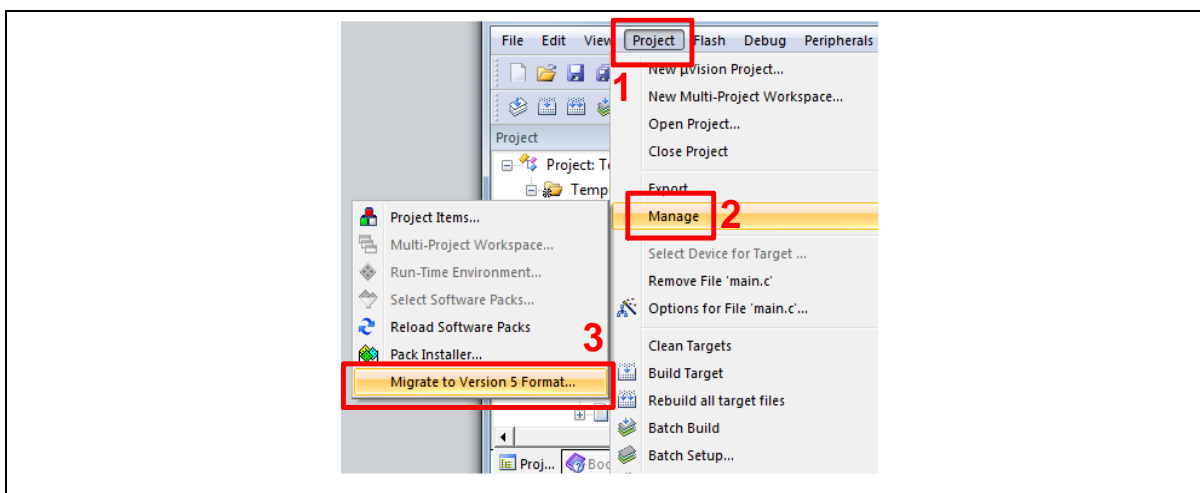


Figure 4-9 Project File Migrate to Version 5 Format

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

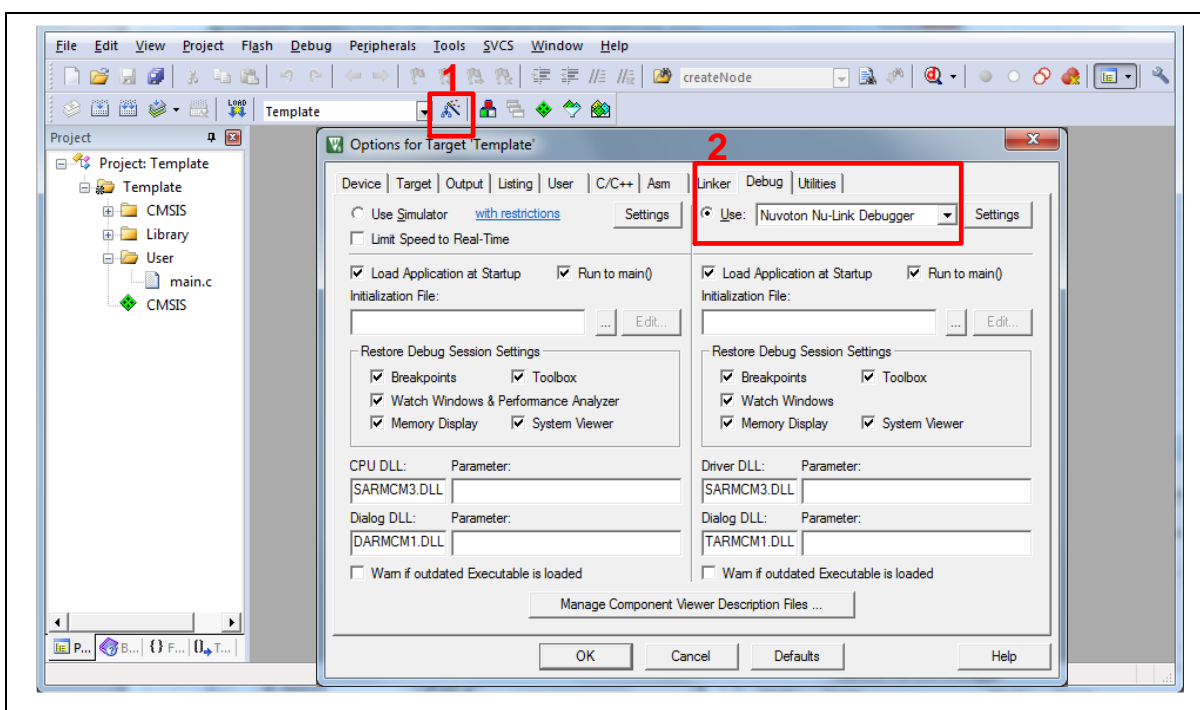


Figure 4-10 Debugger Setting in Options Window

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

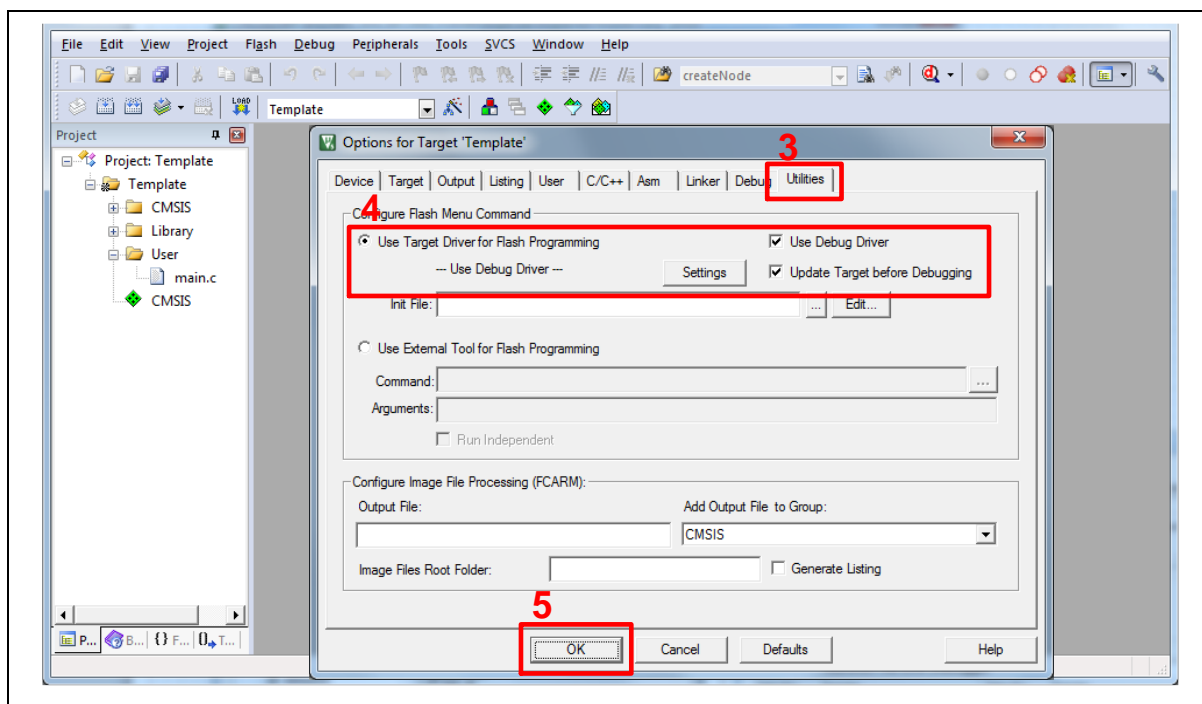


Figure 4-11 Programming Setting in Options Window

3. Rebuild all target files. After successfully compiling the project, download code to the Flash memory. Click **"Start/Stop Debug Section"** button to enter debug mode.

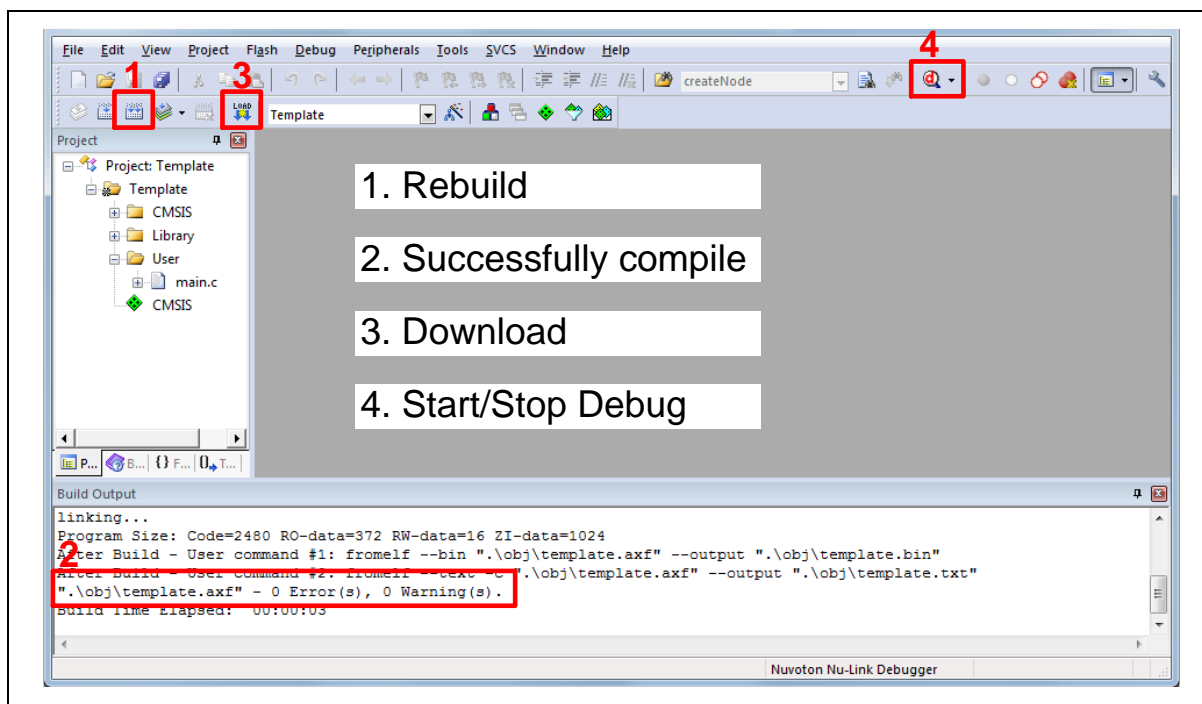


Figure 4-12 Compile and Download the Project

4. 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.

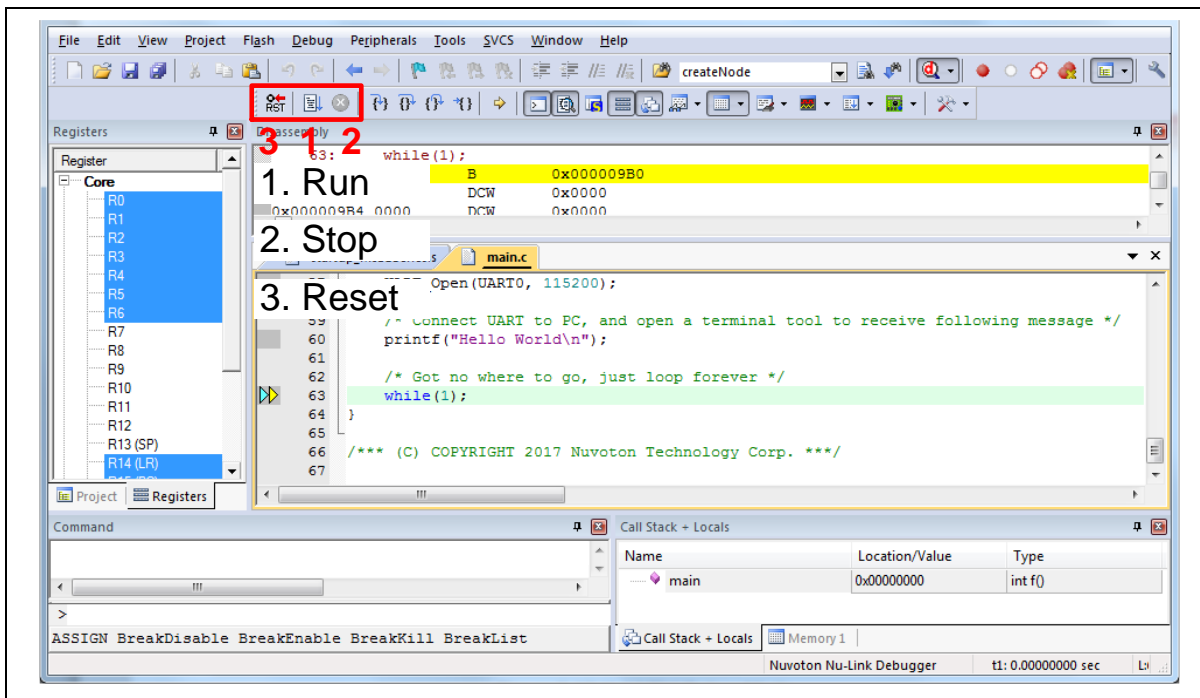


Figure 4-13 Keil MDK Debug Mode

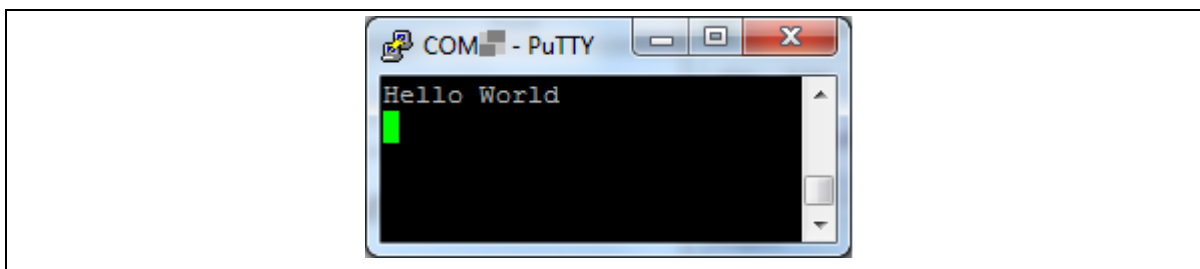


Figure 4-14 Debug Message on Serial Port Terminal Windows

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 contains “Nu-Link” item as shown in Figure 4-15.

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

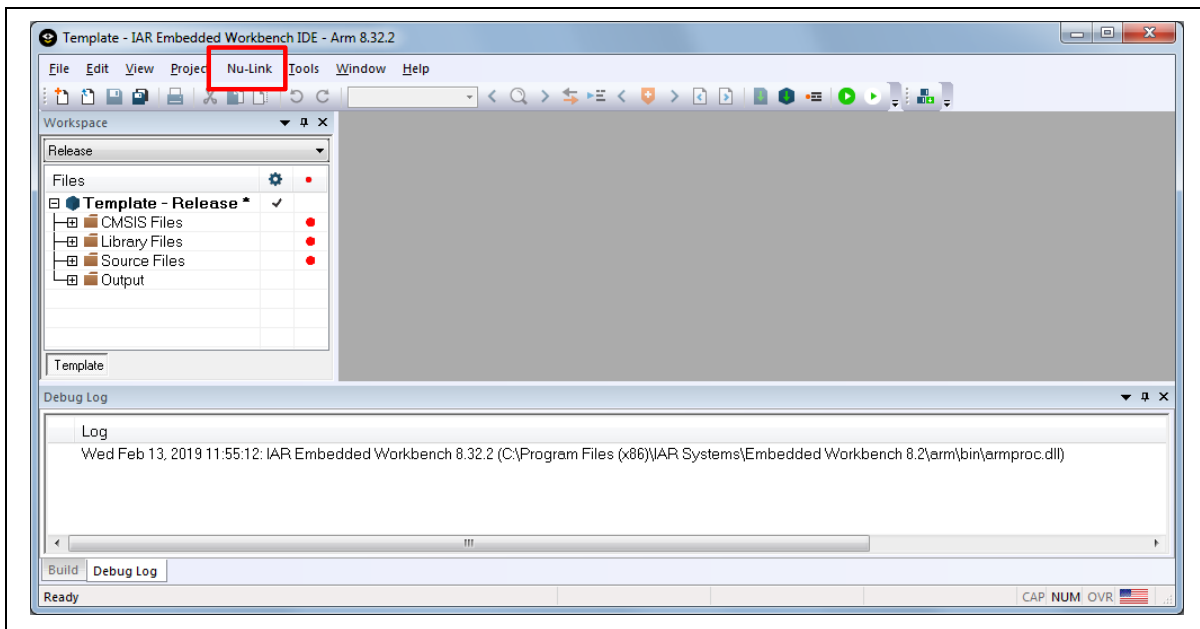


Figure 4-15 IAR EWARM Window

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

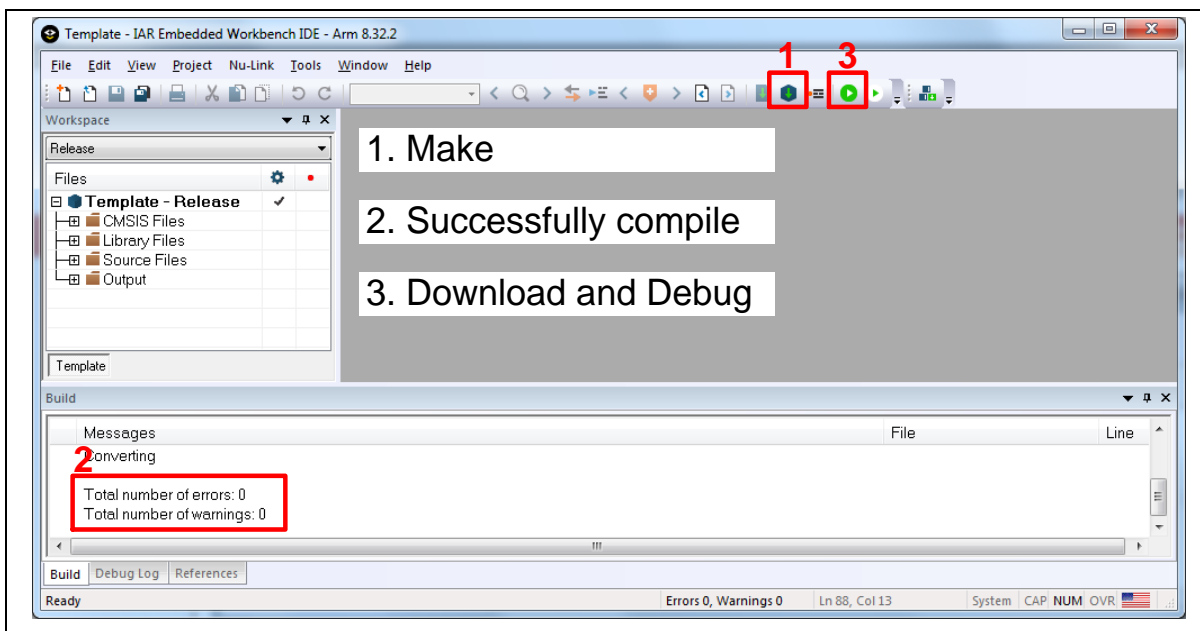


Figure 4-16 Compile and Download the Project

4. Figure 4-17 shows the debug mode under IAR 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.

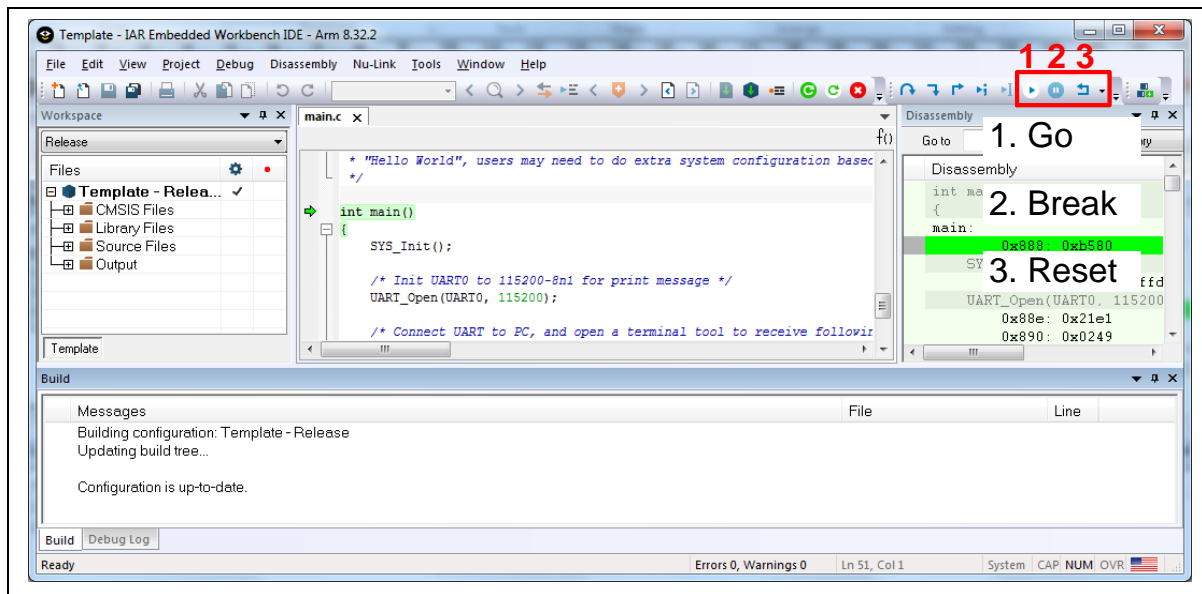


Figure 4-17 IAR EWARM Debug Mode

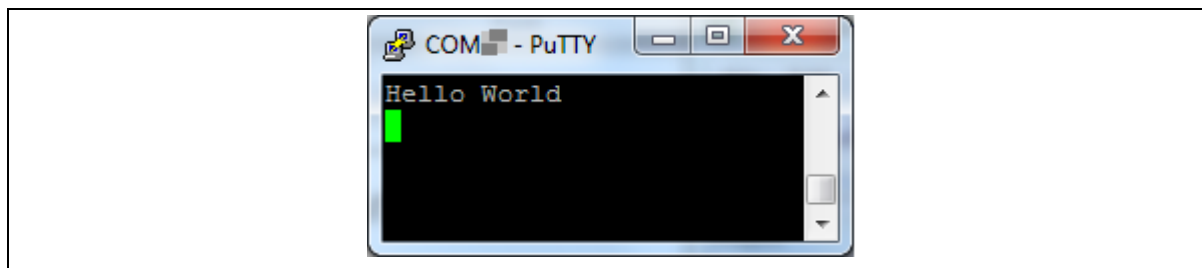


Figure 4-18 Debug Message on Serial Port Terminal Windows

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.

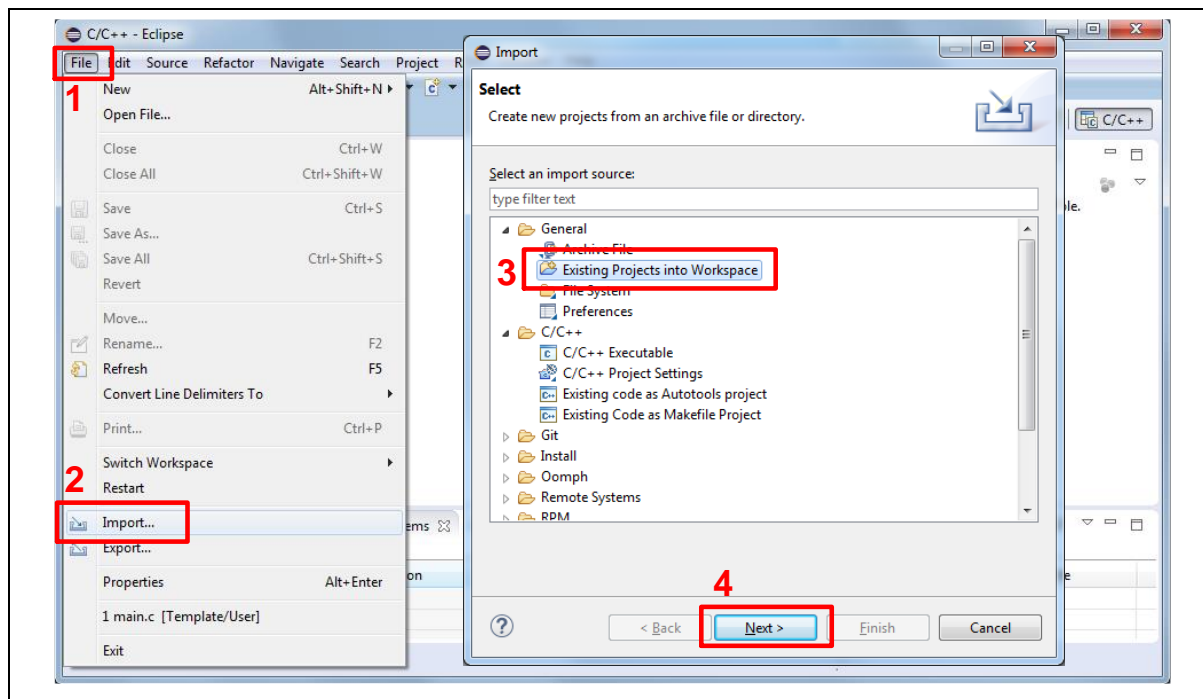


Figure 4-19 Import the Project in NuEclipse

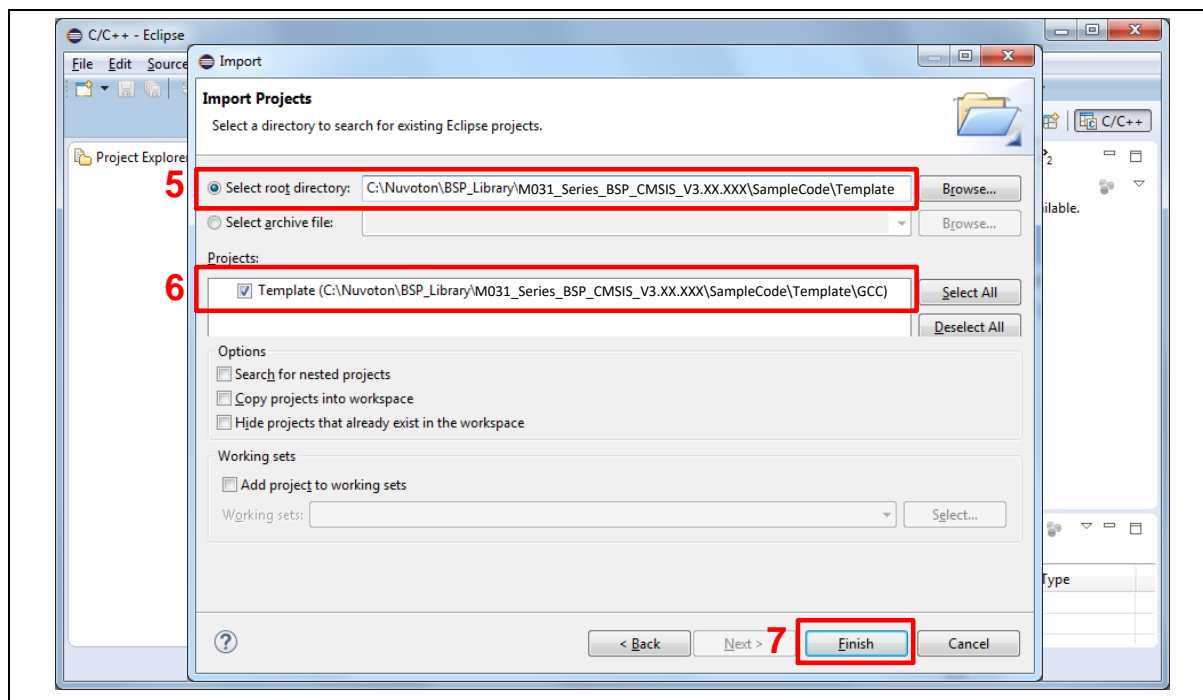


Figure 4-20 Import Projects Windows

- 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.

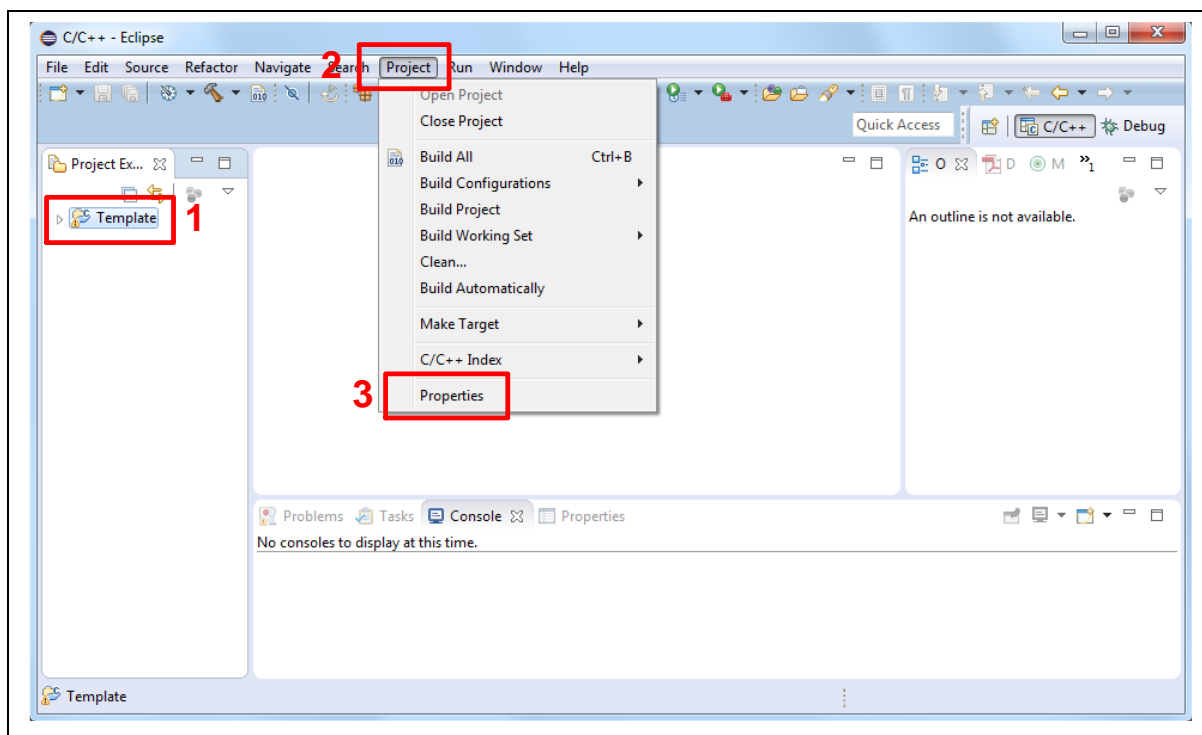


Figure 4-21 Open Project Properties Window

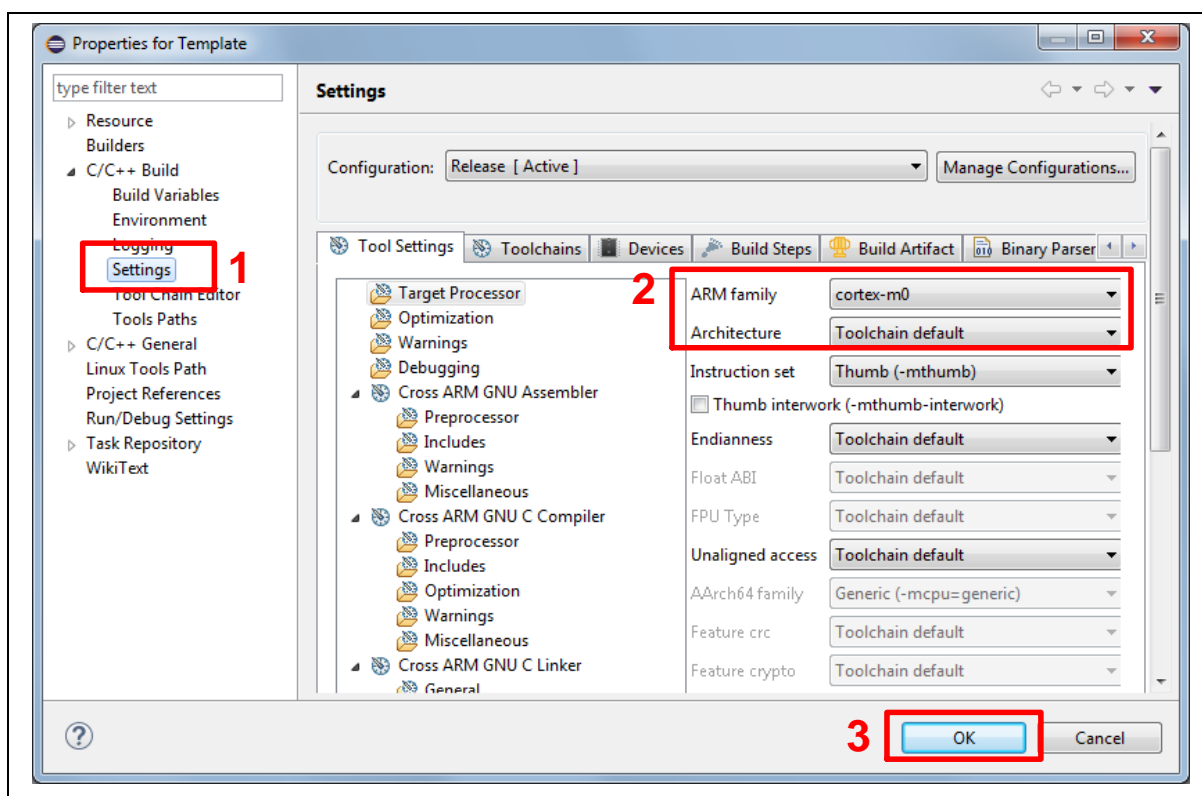


Figure 4-22 Project Properties Settings

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

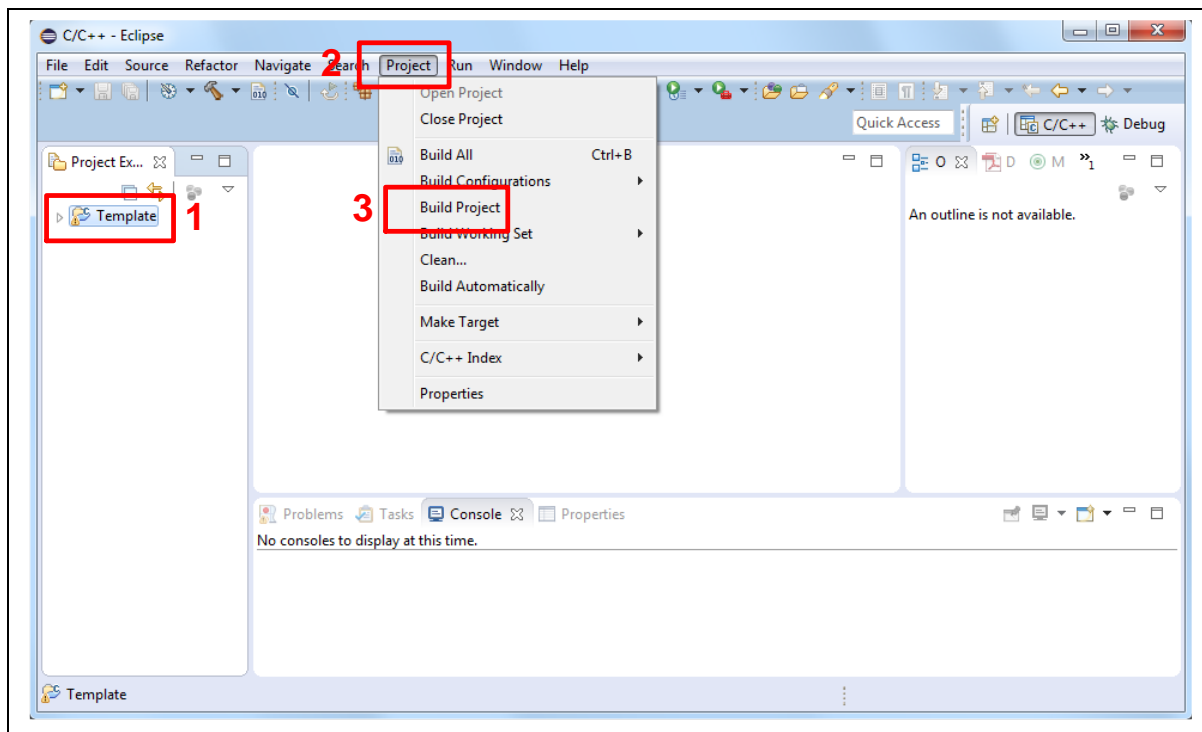


Figure 4-23 Build Project

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.

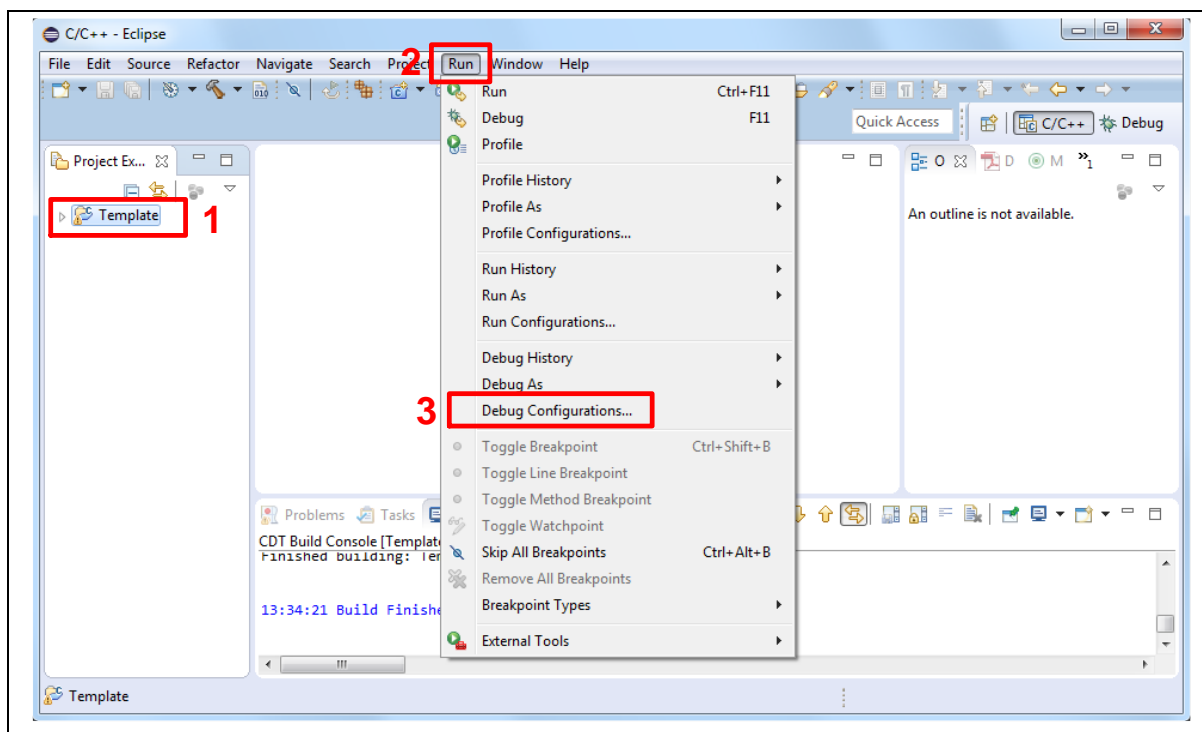
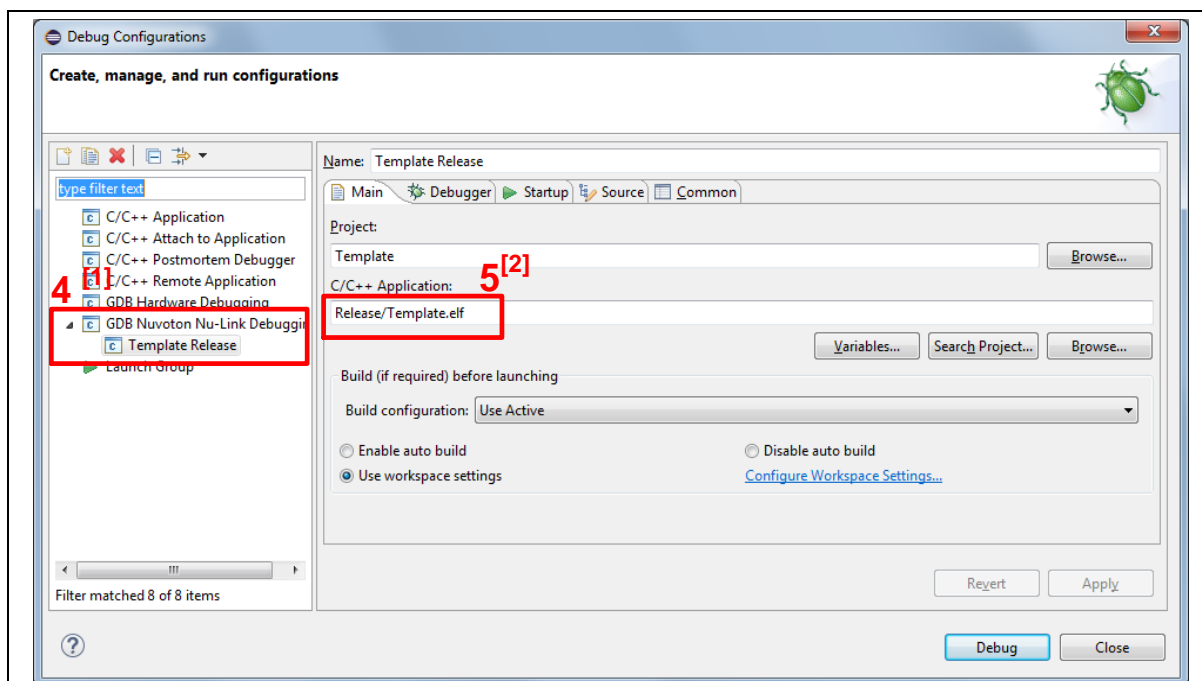


Figure 4-24 Open Debug Configuration



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

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

Figure 4-25 Main Tab Configuration

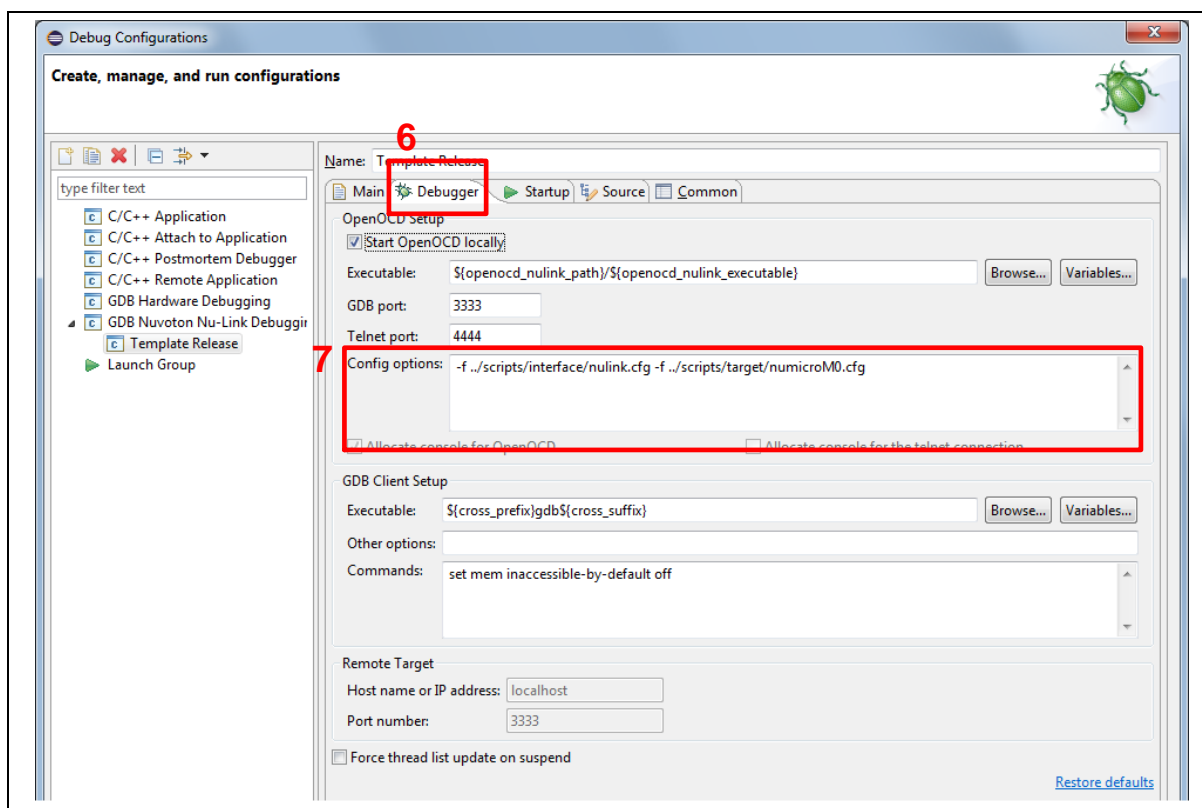


Figure 4-26 Debugger Tab Configuration

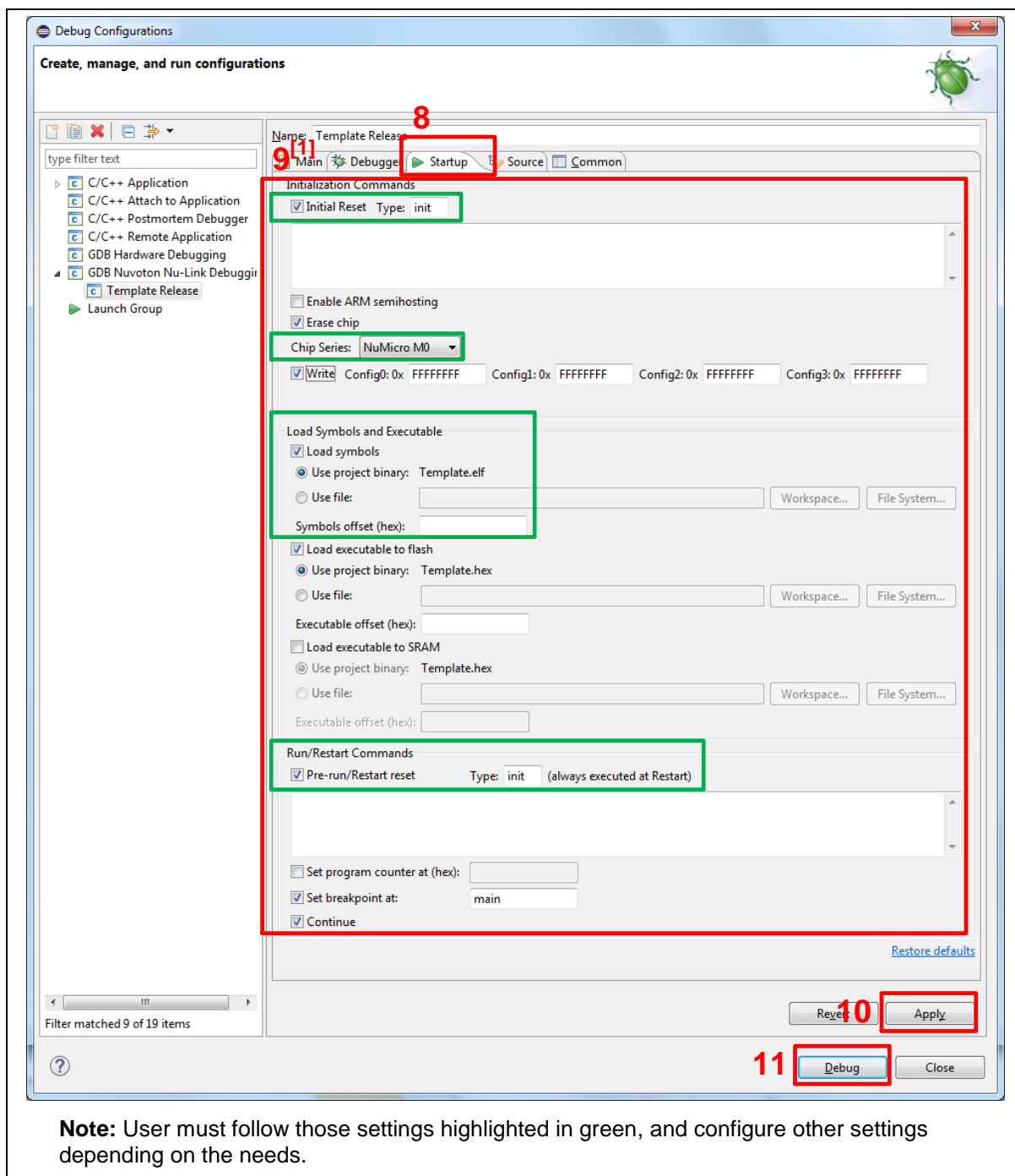


Figure 4-27 Startup Tab Configuration

6. 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*.

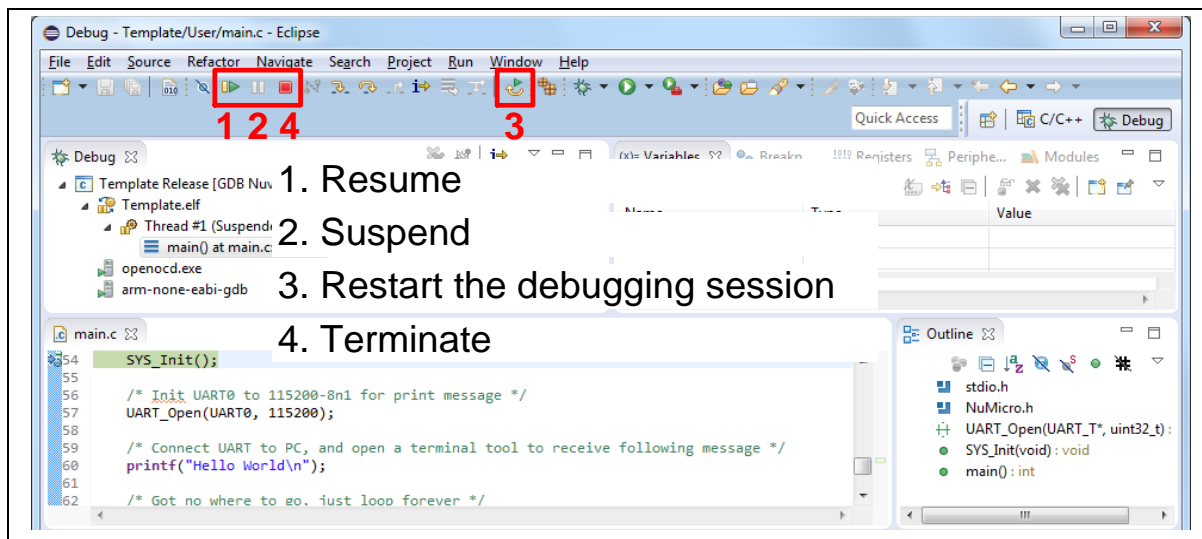


Figure 4-28 NuEclipse Debug Mode



Figure 4-29 Debug Message on Serial Port Terminal Windows

5 NUMAKER-M471R1 SCHEMATICS

5.1 Nu-Link2-Me

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

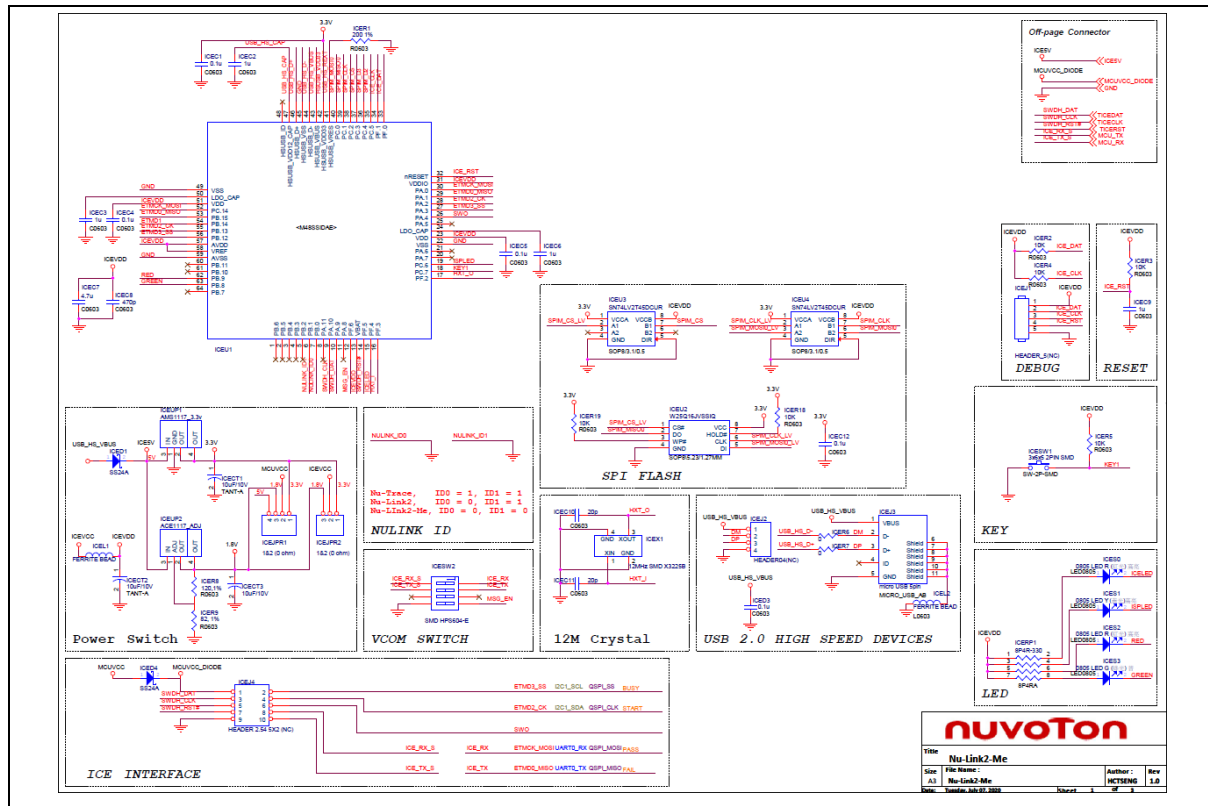


Figure 5-1 Nu-Link2-Me Circuit

5.2 M471R1 Target Board

Figure 5-2 shows the M471R1 target board circuit.

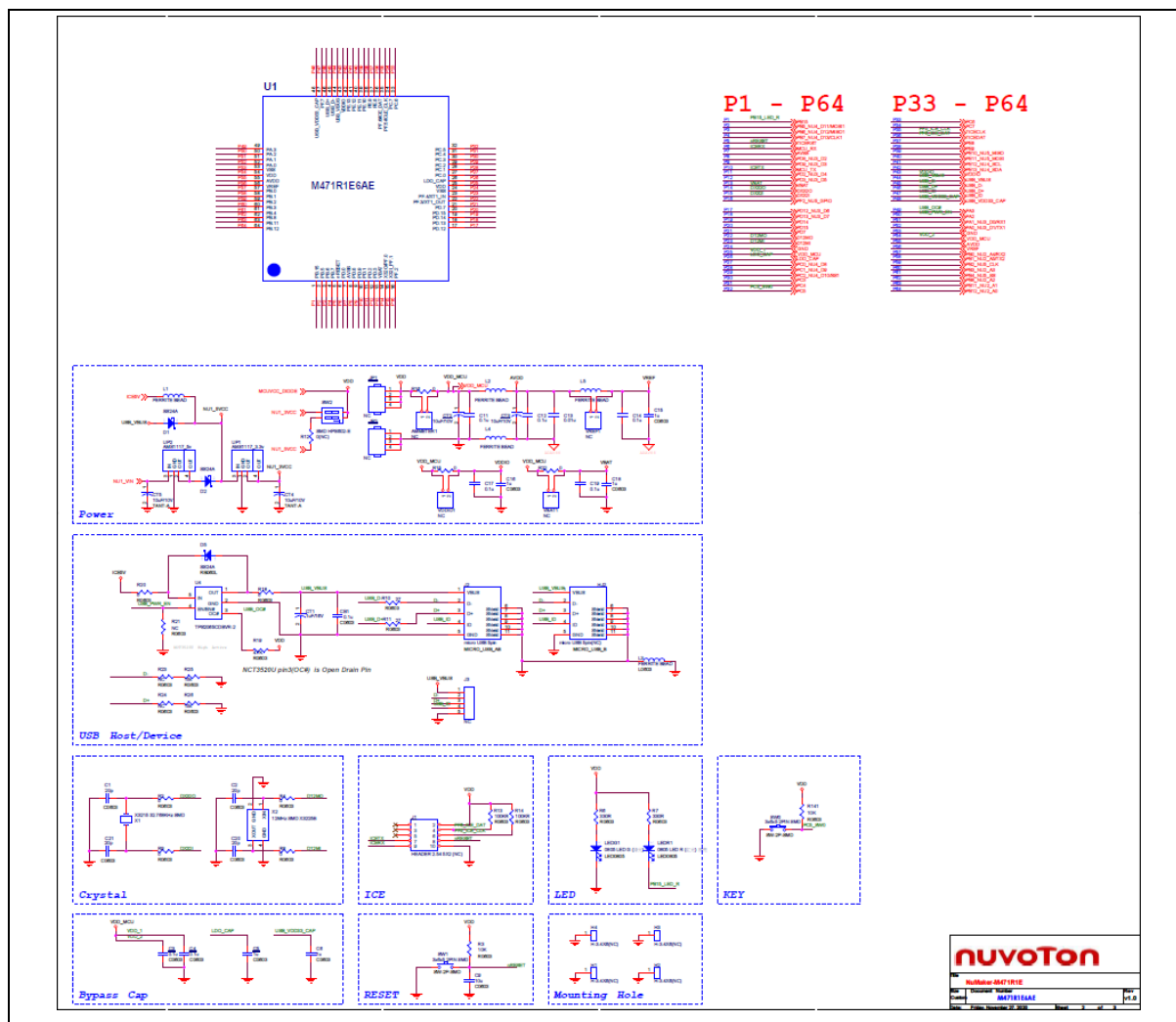


Figure 5-2 M471R1 Target Board Circuit

5.3 Extension Connectors

Figure 5-3 shows extension connectors of NuMaker-M471R1.

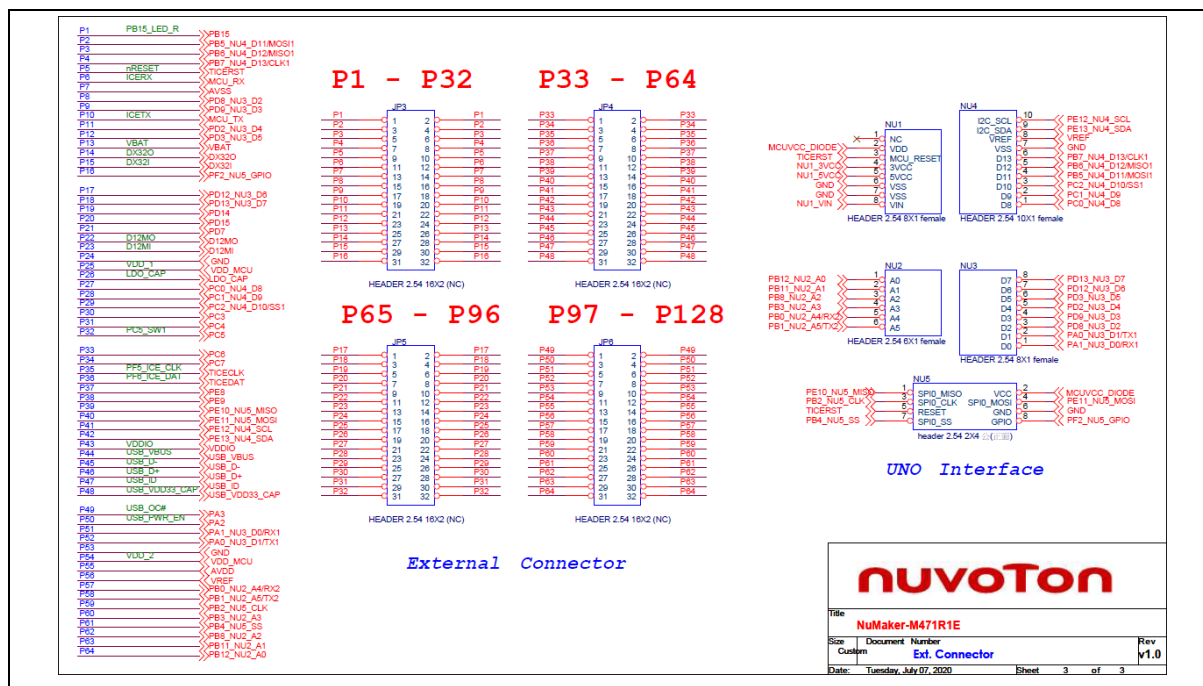


Figure 5-3 Extension Connectors Circuit

Figure 5-4 and Figure 5-5 show the front and rear placement of NuMaker-M471R1.



6 REVISION HISTORY

Date	Revision	Description
2021.04.20	1.00	• Initial version

Important Notice

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

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.

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