NuMicro® Family

Arm® Cortex®-M0-based Microcontroller

NuMaker-M032BTAI

User Manual

Evaluation Board for NuMicro® M032BT Series

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

www.nuvoton.com

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1 OVERVIEW

The NuMaker-M032BTAI is an evaluation board for Nuvoton NuMicro M032BT series microcontrollers. The M032BT series BLE MCU is compliant with the BLE 5.0 standard supporting data rates up to 2 Mbps, offering 2.4 GHz proprietary stacks to achieve more possibility for wireless connectivity and Over-the-Air (OTA) for firmware upgrade. The NuMaker-M032BTAI consists of two parts: an M032BTAI target board and an on-board Nu-Link2-Me debugger and programmer. The NuMaker-M032BTAI is designed for project evaluation, prototype development and validation with power consumption monitoring function.

The M032BTAI target board is based on NuMicro M032BTAIAAN. For the development flexibility, the M032BTAI 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.

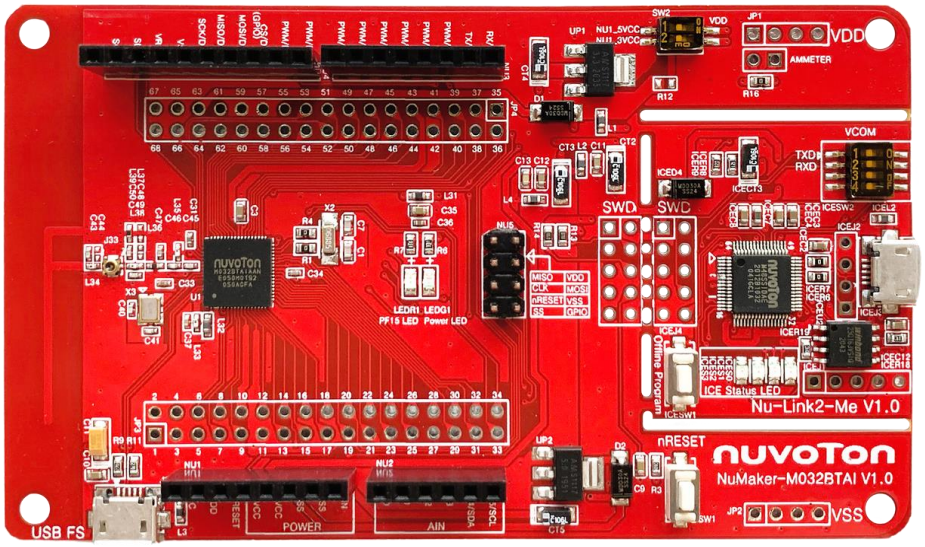

Figure 1-1 NuMaker-M032BTAI Evaluation Board

2 FEATURES

- NuMicro M032BTAIAAN used as main microcontroller with function compatible with:
  - M032BTAIAAN
  - M032BTAG8AN
- M032BTAIAAN full pins extension connectors
- Arduino UNO compatible extension connectors
- Ammeter connector for measuring the microcontroller's power consumption
- PCB antenna
- Microwave coaxial connector with switch for characteristics measurement
- Flexible board power supply:
  - External V_{DD} power connector
  - Arduino UNO compatible extension connector Vin
  - USB FS connector on M032BTAI 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

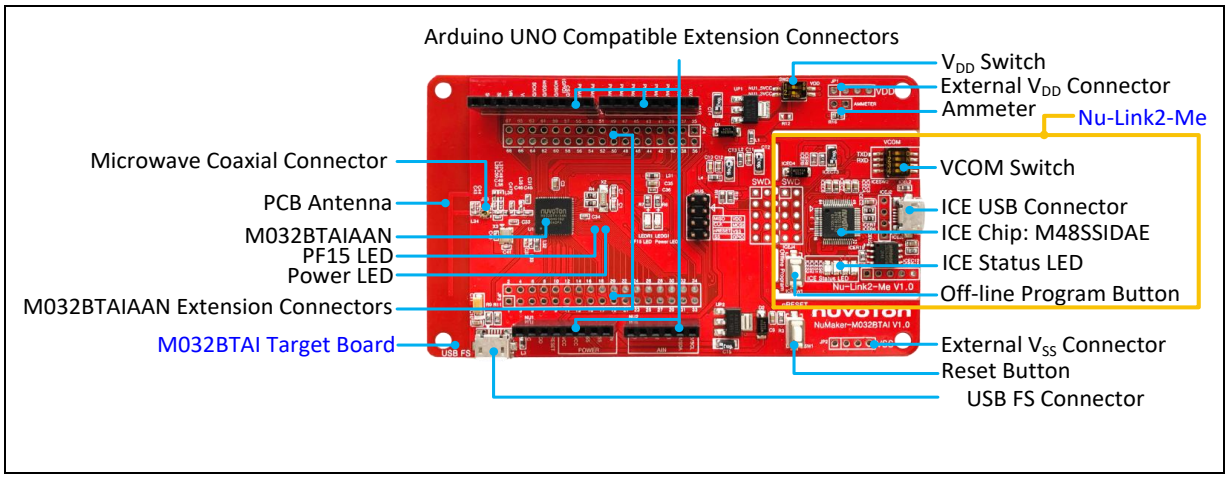

Figure 3-1 Front View of NuMaker-M032BTAI

Figure 3-1 shows the main components and connectors from the front side of NuMaker-M032BTAI. The following lists components and connectors from the front view:

- Target chip: M032BTAIAAN (U1)
- USB Full Speed Connector (J2)
- Arduino UNO Compatible Extension Connectors (NU1, NU2, NU3, NU4, NU5)
- M032BT Extension Connectors (JP3, JP4)
- External V_{DD} Power Connector (JP1)
- External V_{SS} Power Connector (JP2)
- V_{DD} Switch (SW2)
- Ammeter Connector (AMMETER)
- Reset Button (SW1)
- Power LED and PF15 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-M032BTAI.

The following lists components and connectors from the rear view:

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

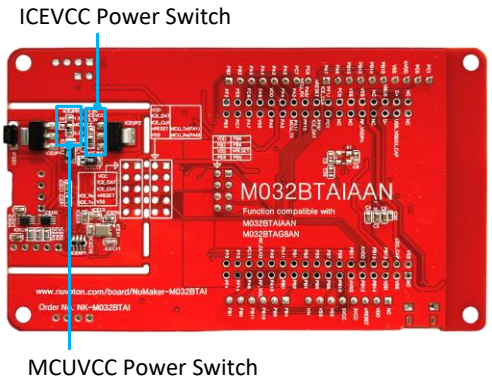

Figure 3-2 Rear View of NuMaker-M032BTAI

3.3 Extension Connectors

Table 3-1 presents the extension connectors.

Connector	Description
JP3, JP4	Full pins extension connectors on the NuMaker-M032BTAI.
NU1, NU2, NU3, NU4 and NU5	Arduino UNO compatible pins on the NuMaker-M032BTAI.

Table 3-1 Extension Connectors

3.3.1 Pin Assignment for Extension Connectors

The NuMaker-M032BTAI provides the M032BTAIAAN onboard and extension connectors (JP3, JP4). Figure 3-3 shows the M032BTAIAAN extension connectors.

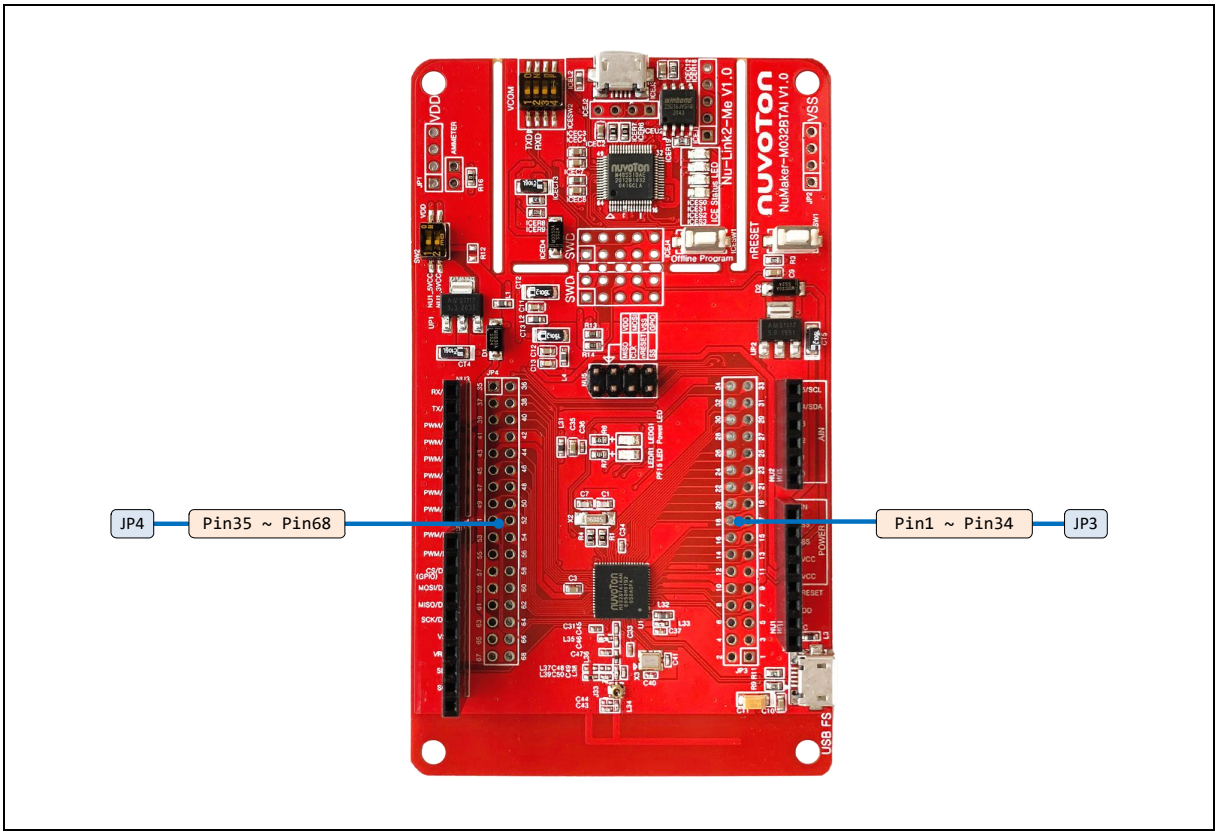

Figure 3-3 M032BTAIAAN Extension Connectors

Header		M032BTAIAAN	
		Pin No.	Function
JP3	JP3.1	1	RF_BUCK_OUT
	JP3.2	2	V_{SS}
	JP3.3	3	V_{SS}
	JP3.4	4	LDO_CAP
	JP3.5	5	V_{DD}
	JP3.6	6	PB.15 / ADC0_CH15 / USCI0_CTL1 / UART0_nCTS / UART3_TXD / PWM1_CH0 / TM0_EXT / PWM0_BRAKE1
	JP3.7	7	PB.14 / ADC0_CH14 / USCI0_DAT1 / UART0_nRTS / UART3_RXD / PWM1_CH1 / TM1_EXT / CLKO
	JP3.8	8	PB.13 / ADC0_CH13 / ACMP0_P3 / ACMP1_P3 / USCI0_DAT0 / UART0_TXD / UART3_nRTS / PWM1_CH2 / TM2_EXT
	JP3.9	9	PB.12 / ADC0_CH12 / ACMP0_P2 / ACMP1_P2 / USCI0_CLK / UART0_RXD / UART3_nCTS / PWM1_CH3 / TM3_EXT
	JP3.10	10	AV_{DD}
	JP3.11	11	AV_{SS}
	JP3.12	12	PB.11 / ADC0_CH11 / UART0_nCTS / UART4_TXD / I2C1_SCL / BPWM1_CH0
	JP3.13	13	PB.10 / ADC0_CH10 / USCI1_CTL0 / UART0_nRTS / UART4_RXD / I2C1_SDA / BPWM1_CH1
	JP3.14	14	PB.9 / ADC0_CH9 / USCI1_CTL1 / UART0_TXD / UART1_nCTS / BPWM1_CH2
	JP3.15	15	PB.8 / ADC0_CH8 / USCI1_CLK / UART0_RXD / UART1_nRTS / BPWM1_CH3
	JP3.16	16	PB.7 / ADC0_CH7 / USCI1_DAT0 / UART1_TXD / BPWM1_CH4 / PWM1_BRAKE0 / PWM1_CH4 / ACMP0_O
	JP3.17	17	PB.6 / ADC0_CH6 / USCI1_DAT1 / UART1_RXD / BPWM1_CH5 / PWM1_BRAKE1 / PWM1_CH5 / INT4 / ACMP1_O
	JP3.18	18	PB.5 / ADC0_CH5 / ACMP1_N / I2C0_SCL / UART5_TXD / USCI1_CTL0 / PWM0_CH0 / UART2_TXD / TM0 / INT0
	JP3.19	19	PB.4 / ADC0_CH4 / ACMP1_P1 / I2C0_SDA / UART5_RXD / USCI1_CTL1 / PWM0_CH1 / UART2_RXD / TM1 / INT1
	JP3.20	20	PB.3 / ADC0_CH3 / ACMP0_N / I2C1_SCL / UART1_TXD / UART5_nRTS / USCI1_DAT1 / PWM0_CH2 / PWM0_BRAKE0 / TM2 / INT2
	JP3.21	21	PB.2 / ADC0_CH2 / ACMP0_P1 / I2C1_SDA / UART1_RXD / UART5_nCTS / USCI1_DAT0 / PWM0_CH3 / TM3 / INT3
	JP3.22	22	PB.1 / ADC0_CH1 / UART2_TXD / USCI1_CLK / I2C1_SCL / QSPI0_MISO1 / PWM0_CH4 / PWM1_CH4 / PWM0_BRAKE0
	JP3.23	23	PB.0 / ADC0_CH0 / UART2_RXD / I2C1_SDA / QSPI0_MOSI1 / PWM0_CH5 / PWM1_CH5 / PWM0_BRAKE1
	JP3.24	24	PA.11 / ACMP0_P0 / USCI0_CLK / BPWM0_CH0 / TM0_EXT
	JP3.25	25	PA.10 / ACMP1_P0 / USCI0_DAT0 / BPWM0_CH1 / TM1_EXT
	JP3.26	26	PA.9 / USCI0_DAT1 / UART1_TXD / BPWM0_CH2 / TM2_EXT

Header		M032BTAIAAN	
		Pin No.	Function
	JP3.27	27	RF_VDD
	JP3.28	28	RF_CLKO
	JP3.29	29	PA.8 / USCI0_CTL1 / UART1_RXD / BPWM0_CH3 / TM3_EXT / INT4
	JP3.30	30	PC.13 / USCI0_CTL0 / UART2_TXD / BPWM0_CH4 / CLKO / ADC0_ST
	JP3.31	31	PF.14 / PWM1_BRAKE0 / PWM0_BRAKE0 / PWM0_CH4 / CLKO / TM3
	JP3.32	32	PF.5 / UART2_RXD / UART2_nCTS / PWM0_CH0 / BPWM0_CH4 / X32_IN / ADC0_ST
	JP3.33	33	PF.4 / UART2_TXD / UART2_nRTS / PWM0_CH1 / BPWM0_CH5 / X32_OUT
	JP3.34	34	PF.3 / UART0_TXD / I2C0_SCL / XT1_IN / BPWM1_CH0
JP4	JP4.1	35	PF.2 / UART0_RXD / I2C0_SDA / QSPI0_CLK / XT1_OUT / BPWM1_CH1
	JP4.2	36	PE.8 / USCI1_CTL1 / UART2_TXD / PWM0_CH0 / PWM0_BRAKE0
	JP4.3	37	PE.9 / USCI1_CTL0 / UART2_RXD / PWM0_CH1 / PWM0_BRAKE1
	JP4.4	38	PC.7 / UART4_TXD / UART0_nCTS / PWM1_CH2 / BPWM1_CH0 / TM0 / INT3
	JP4.5	39	PC.6 / UART4_RXD / UART0_nRTS / PWM1_CH3 / BPWM1_CH1 / TM1 / INT2
	JP4.6	40	PA.7 / UART0_TXD / I2C1_SCL / PWM1_CH4 / BPWM1_CH2 / ACMP0_WLAT / TM2 / INT1
	JP4.7	41	PA.6 / UART0_RXD / I2C1_SDA / PWM1_CH5 / BPWM1_CH3 / ACMP1_WLAT / TM3 / INT0
	JP4.8	42	V_{SS}
	JP4.9	43	V_{DD}
	JP4.10	44	PA.5 / QSPI0_MISO1 / UART0_nCTS / UART0_TXD / I2C0_SCL / UART5_TXD / BPWM0_CH5 / PWM0_CH0
	JP4.11	45	PA.4 / QSPI0_MOSI1 / UART0_nRTS / UART0_RXD / I2C0_SDA / UART5_RXD / BPWM0_CH4 / PWM0_CH1
	JP4.12	46	PA.3 / QSPI0_SS / UART4_TXD / I2C0_SMBAL / UART1_TXD / I2C1_SCL / BPWM0_CH3 / PWM0_CH2 / CLKO / PWM1_BRAKE1
	JP4.13	47	PA.2 / QSPI0_CLK / UART4_RXD / I2C0_SMBSUS / UART1_RXD / I2C1_SDA / BPWM0_CH2 / PWM0_CH3
	JP4.14	48	PA.1 / QSPI0_MISO0 / UART0_TXD / UART1_nCTS / BPWM0_CH1 / PWM0_CH4
	JP4.15	49	PA.0 / QSPI0_MOSI0 / UART0_RXD / UART1_nRTS / BPWM0_CH0 / PWM0_CH5
	JP4.16	50	PF.15 / PWM0_BRAKE0 / PWM0_CH1 / TM2 / CLKO / INT4
	JP4.17	51	nRESET
	JP4.18	52	PF.0 / UART1_TXD / I2C1_SCL / UART0_TXD / BPWM1_CH0 / ICE_DAT
	JP4.19	53	PF.1 / UART1_RXD / I2C1_SDA / UART0_RXD / BPWM1_CH1 / ICE_CLK
	JP4.20	54	PC.1 / QSPI0_MISO0 / UART2_TXD / I2C0_SCL / PWM1_CH4 / ACMP0_O / ADC0_ST
	JP4.21	55	PC.0 / QSPI0_MOSI0 / UART2_RXD / I2C0_SDA / PWM1_CH5 / ACMP1_O
	JP4.22	56	RF_AVDD_{1V2}
	JP4.23	57	V_{SS}

Header		M032BTAIAAN	
		Pin No.	Function
	JP4.24	58	RF_I/O
	JP4.25	59	V_{SS}
	JP4.26	60	RF_VDD_{PA}
	JP4.27	61	RF_XTAL_IN
	JP4.28	62	RF_XTAL_OUT
	JP4.29	63	USB_VBUS
	JP4.30	64	USB_D-
	JP4.31	65	USB_D+
	JP4.32	66	USB_VDD33_CAP
	JP4.33	67	RF_AVDD_{1V2}
	JP4.34	68	RF_BUCK_FB
-	-	69	EPAD(V_{SS})

Table 3-2 M032BTAIAAN 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.

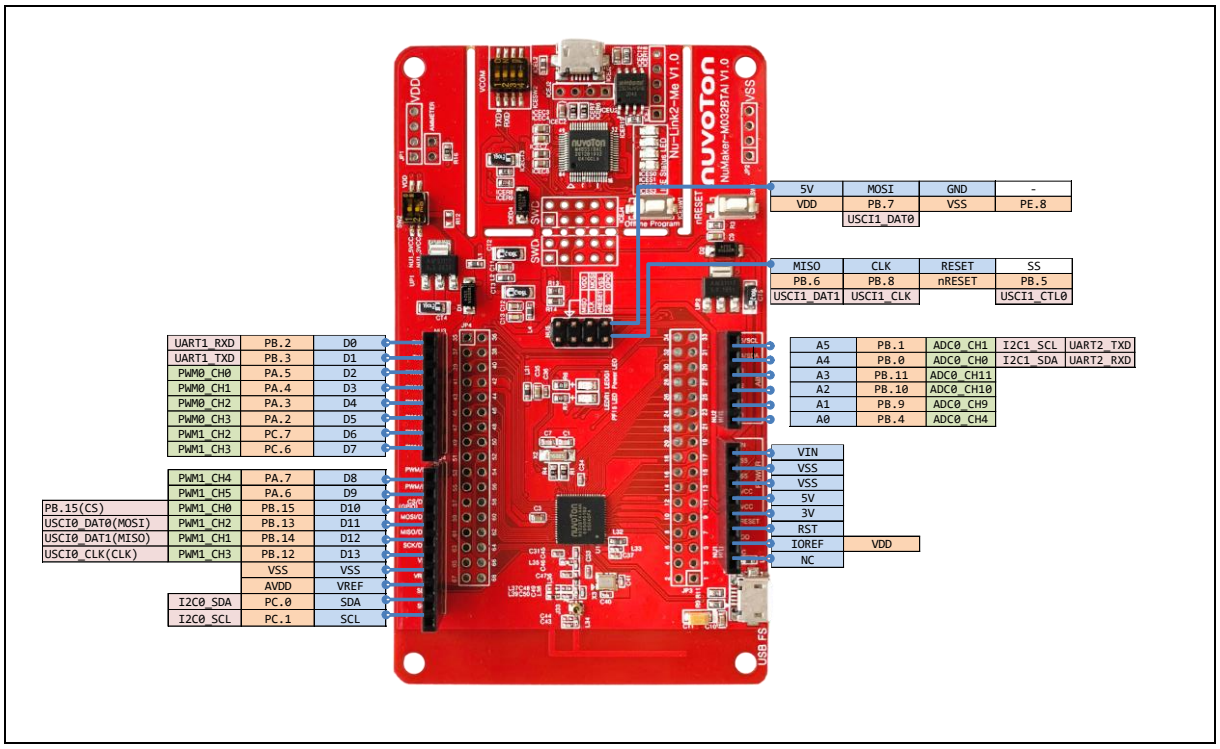

Figure 3-4 Arduino UNO Compatible Extension Connectors

Header		NuMaker-M032BTAI		Header		NuMaker-M032BTAI	
		Compatible to Arduino UNO	GPIO Pin of M032BT			Compatible to Arduino UNO	GPIO Pin of M032BT
NU5	NU5.1	MISO	PB.6	NU5	NU5.2	5V	V_{DD}
	NU5.3	CLK	PB.8		NU5.4	MOSI	PB.7
	NU5.5	RESET	nRESET		NU5.6	GND	V_{SS}
	NU5.7	-	PB.5		NU5.8	-	PE.8
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	PA.5		NU2.4	A3	PB.11
	NU3.4	D3	PA.4		NU2.3	A2	PB.10
	NU3.5	D4	PA.3		NU2.2	A1	PB.9
	NU3.6	D5	PA.2		NU2.1	A0	PB.4
	NU3.7	D6	PC.7	NU1	NU1.8	VIN	-
	NU3.8	D7	PC.6		NU1.7	V_{SS}	
NU4	NU4.1	D8	PA.7		NU1.6	V_{SS}	
	NU4.2	D9	PA.6		NU1.5	5V	
	NU4.3	D10	PB.15		NU1.4	3V	
	NU4.4	D11	PB.13		NU1.3	RST	nRESET
	NU4.5	D12	PB.14		NU1.2	IOREF	V_{DD}
	NU4.6	D13	PB.12		NU1.1	NC	-
	NU4.7	V_{SS}	V_{SS}				
	NU4.8	V_{REF}	AV_{DD}				
	NU4.9	SDA	PC.0				
	NU4.10	SCL	PC.1				

Table 3-3 Arduino UNO Extension Connectors and M032BTAIAAN Mapping GPIO List

3.4 Power Supply Configuration

The NuMaker-M032BTAI 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-M032BTAI.

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 M032BTAI target board and Nu-Link2-Me.
J2	USB_VBUS	USB connector on NuMaker-M032BTAI supplies 5 V power from PC to M032BTAI 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:** M032BT operating voltage range is from 1.8 V to 3.6 V. Do not switch SW2.1 (NU1 5VCC) to ON.

Table 3-5 5V 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 M032BTAI target board or ICE chip.
UP1	USB_VBUS	UP1 converts USB_VBUS to 3.3 V and supplies 3.3 V to M032BTAI 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 M032BTAI 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 M032BTAI 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-M032BTAI. **Note:** M032BT operating voltage range is from 1.8 V to 3.6 V.
JP2	V_{SS} connector on the NuMaker-M032BTAI.

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-M032BTAI 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:** M032BT 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:** M032BT 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.

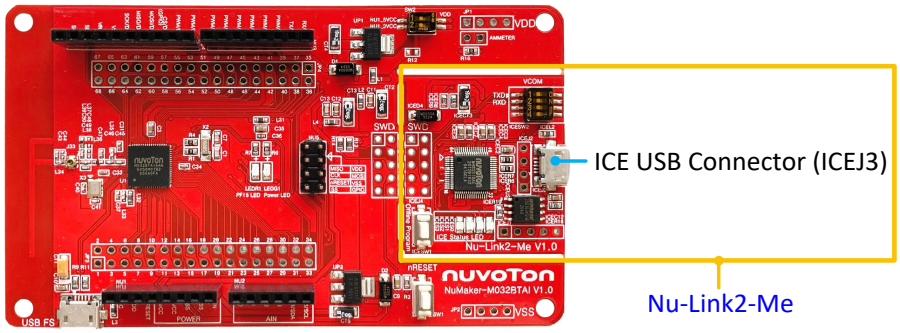

Figure 3-5 External Power Supply Sources on Nu-Link2-Me

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 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. -: Unused.

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

3.4.8.2 *External Power Supply through M032BTAI Target Board to Target Chip*

The external power supply sources on M032BTAI target board are shown in Figure 3-6.

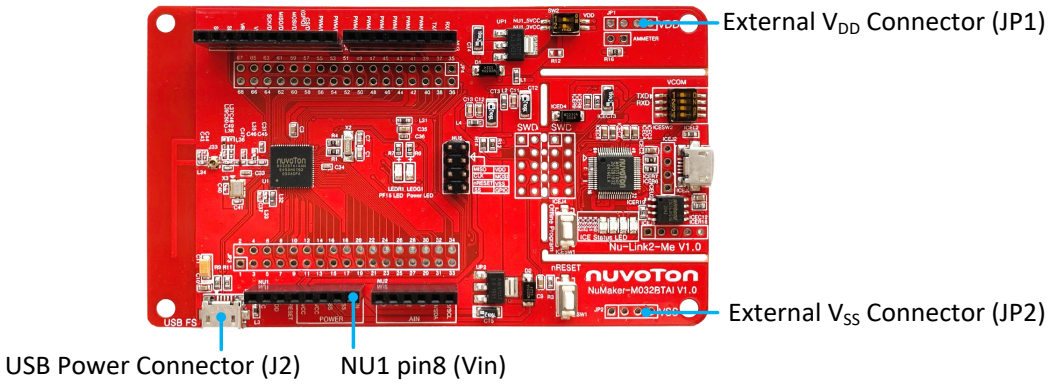

Figure 3-6 External Power Supply Sources on M032BTAI Target Board

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-M032BTAI, please follow the steps below:

1. Switch the SW2 depending on the target chip operating voltage.
2. Detach the Nu-Link2-Me from NuMaker-M032BTAI.
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-M032BTAI, please follow the steps below:

1. Switch the SW2 to OFF.
2. Detach the Nu-Link2-Me from NuMaker-M032BTAI.
3. Connect the external power supply to JP1.

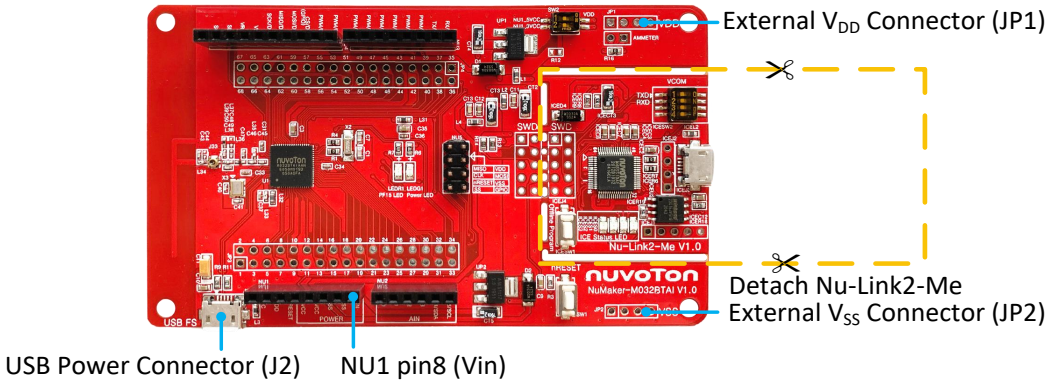

Figure 3-7 Detach the Nu-Link2-Me from NuMaker-M032BTAI

Table 3-12 presents all power models when supplies external power through M032BTAI target board. The M032BTAI 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 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. -: Unused

Table 3-12 Supply External Power for M032BTAI Target Board

3.5 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

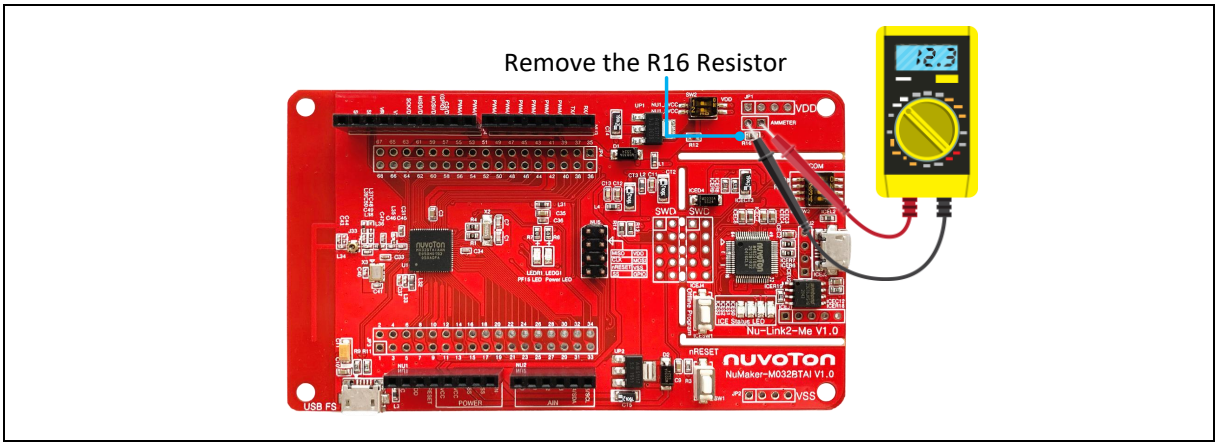

Figure 3-8 Wiring between Ammeter Connector and Ammeter

3.6 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.

Table 3-14 Push Buttons

3.7 LEDs

Table 3-15 presents the LEDs.

Component	Description
Power LED	The power LED indicates that the NuMaker-M032BTAI is powered.
PF15 LED	The LED is connected to the target chip PF.15.
ICES0, ICES1, ICES2 and ICES3	Nu-Link2-Me status LED.

Table 3-15 LEDs

3.8 HXT Clock Source Selection

If PF.2 and PF.3 are configured as external clock pins or external crystal pins, user needs to switch the clock source to external clock or external crystal oscillator by soldering resistors. Table 3-16 lists how to switch the clock source of HXT.

Clock Source	Description
External Crystal Oscillator	X1, C2, and C8 should be soldered, and the frequency depends on the user's application.
External clock (RF_CLKO)	C38 should be soldered with a 0 Ω resistor, and the input frequency of HXT is 16 MHz.

Table 3-16 Cock Sources of HXT

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

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

3.9.2 Status LEDs

Table 3-15 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 Toolchain Supporting

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

- KEIL MDK Nuvoton edition M0/M23

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.

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.

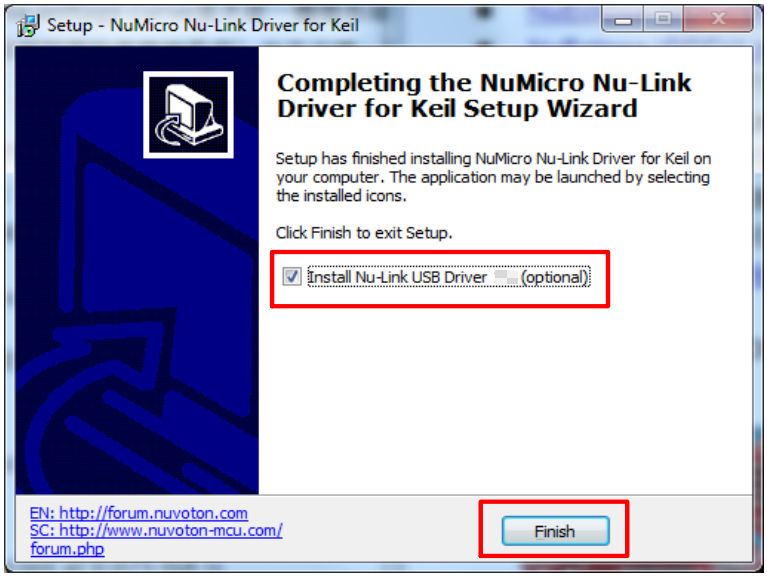

Figure 4-1 Nu-Link USB Driver Installation Setup

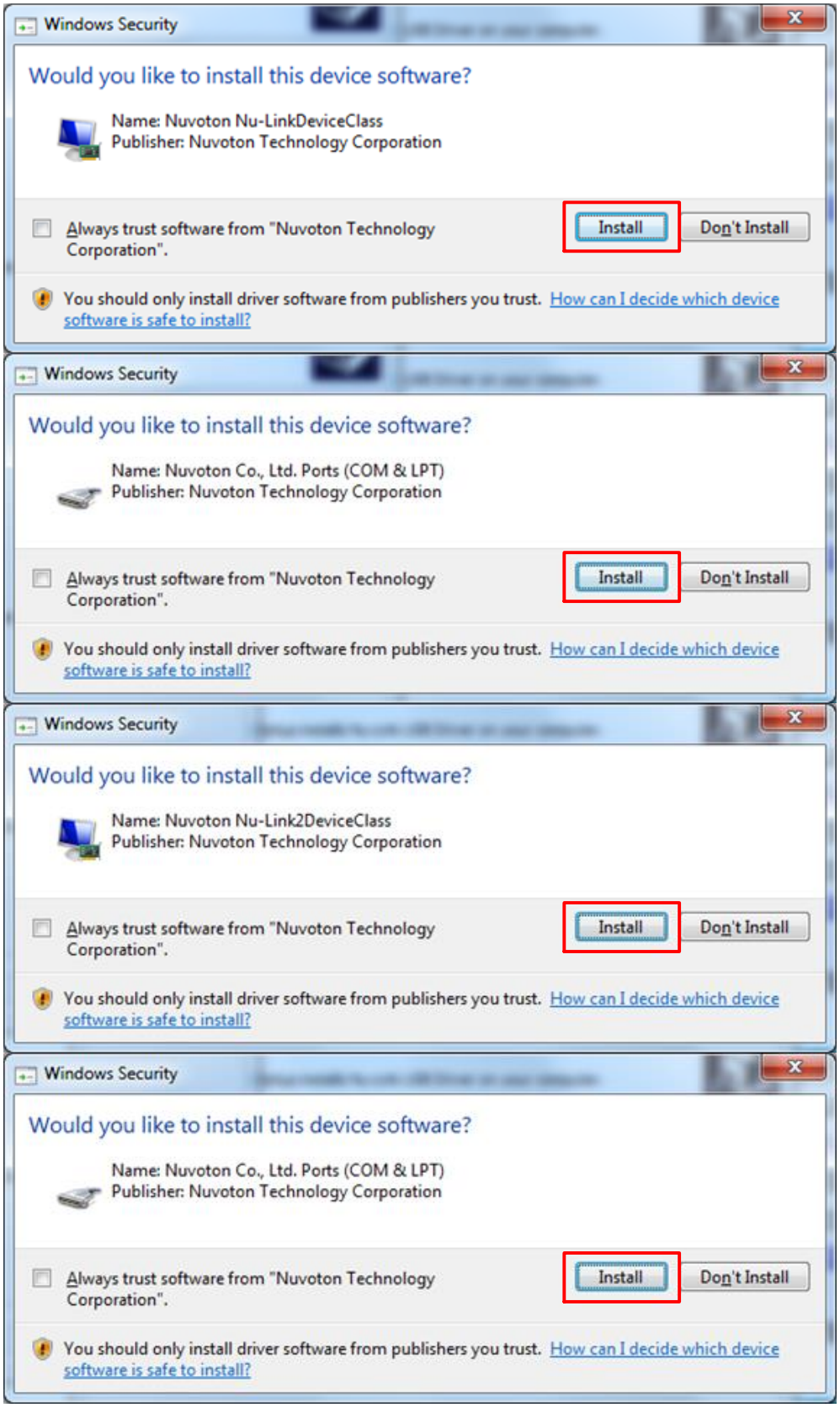

Figure 4-2 Nu-Link USB Driver Installation

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.

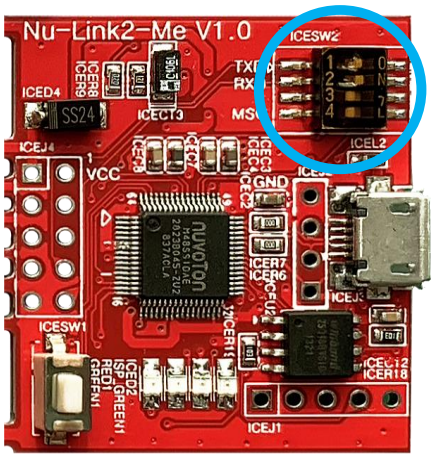

Figure 4-3 Open VCOM Function

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

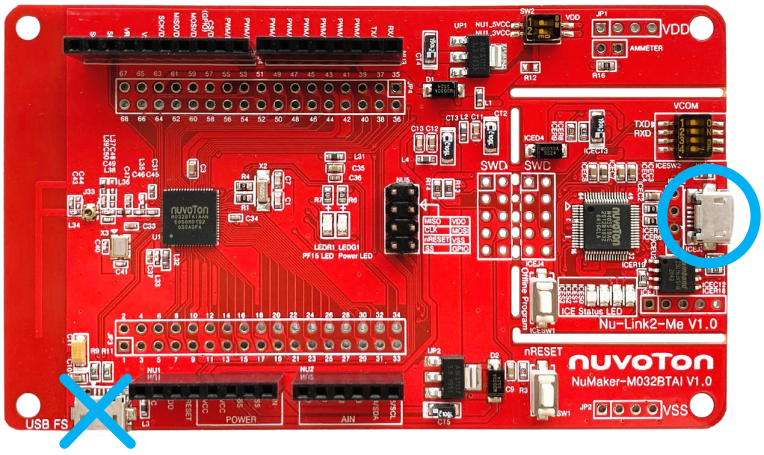

Figure 4-4 ICE USB Connector

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

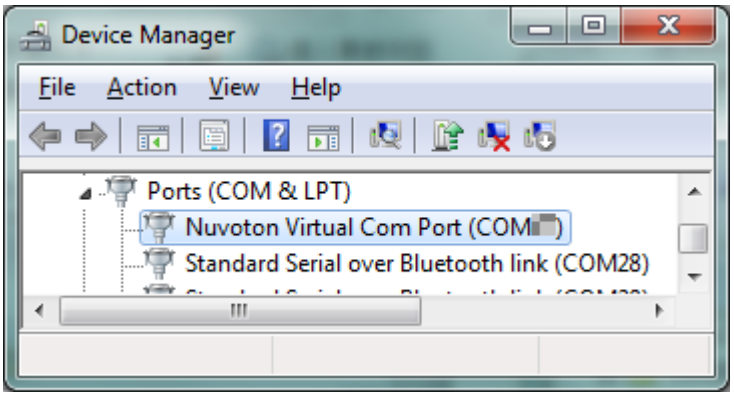

Figure 4-5 Device Manger

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.

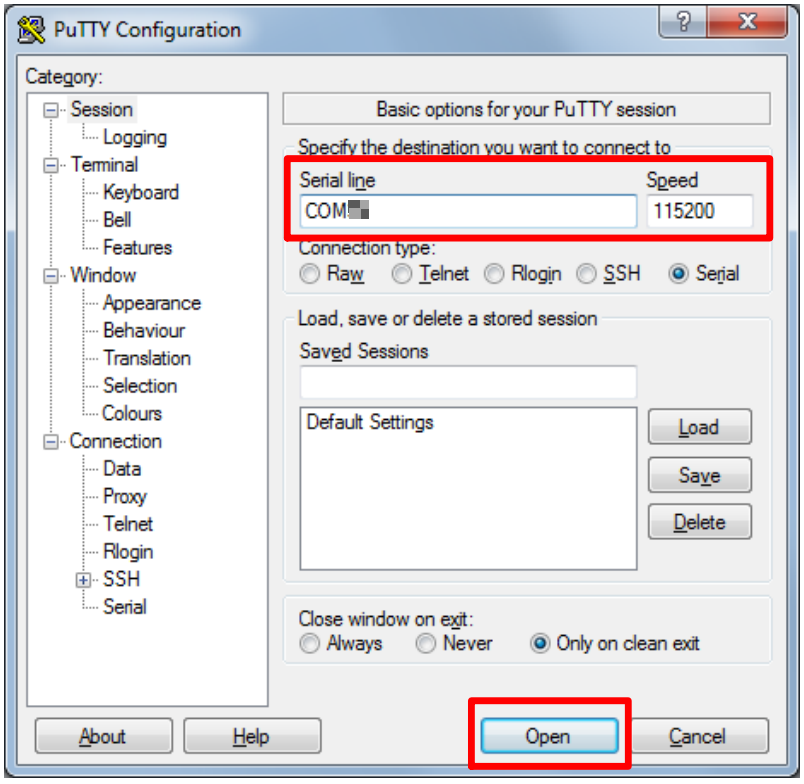

Figure 4-6 PuTTY Session Setting

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.

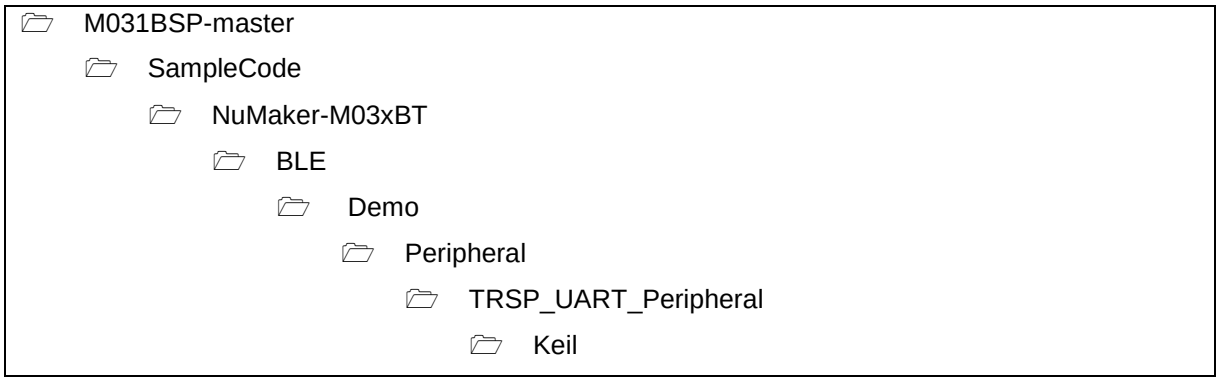

Figure 4-7 TRSP_UART_Peripheral Project Folder Path

4.6 Execute the Project under Toolchains

Open and execute the project under the toolchain. The section 4.6.1 describes the steps of executing project in Keil MDK.

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 “TRSP_UART_Peripheral.uvproj” to open the project.

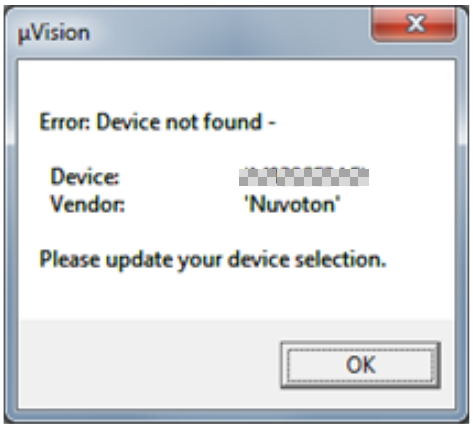

Figure 4-8 Warning Message of “Device not found”

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”.

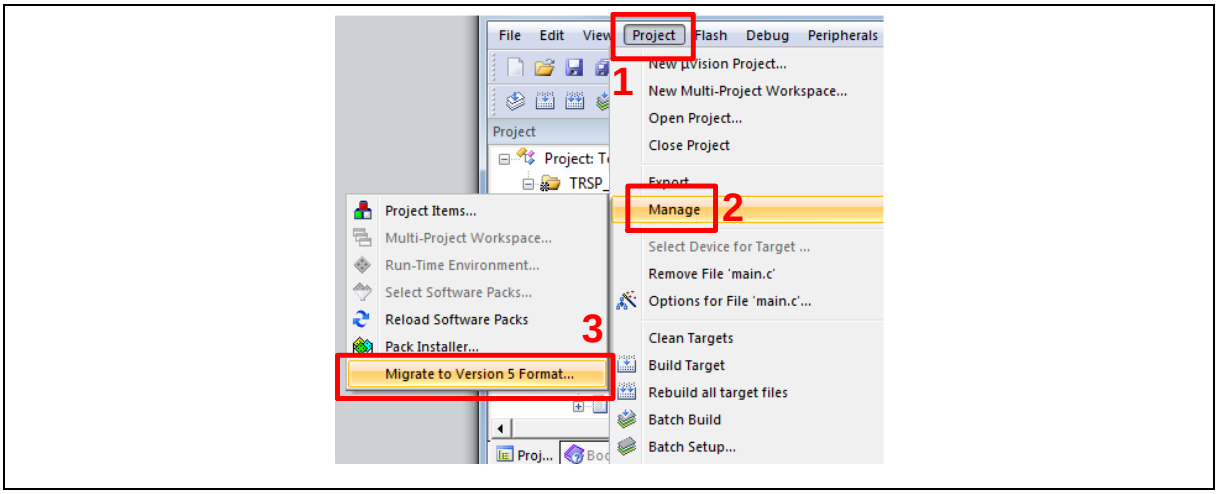

Figure 4-9 Project File Migrate to Version 5 Format

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

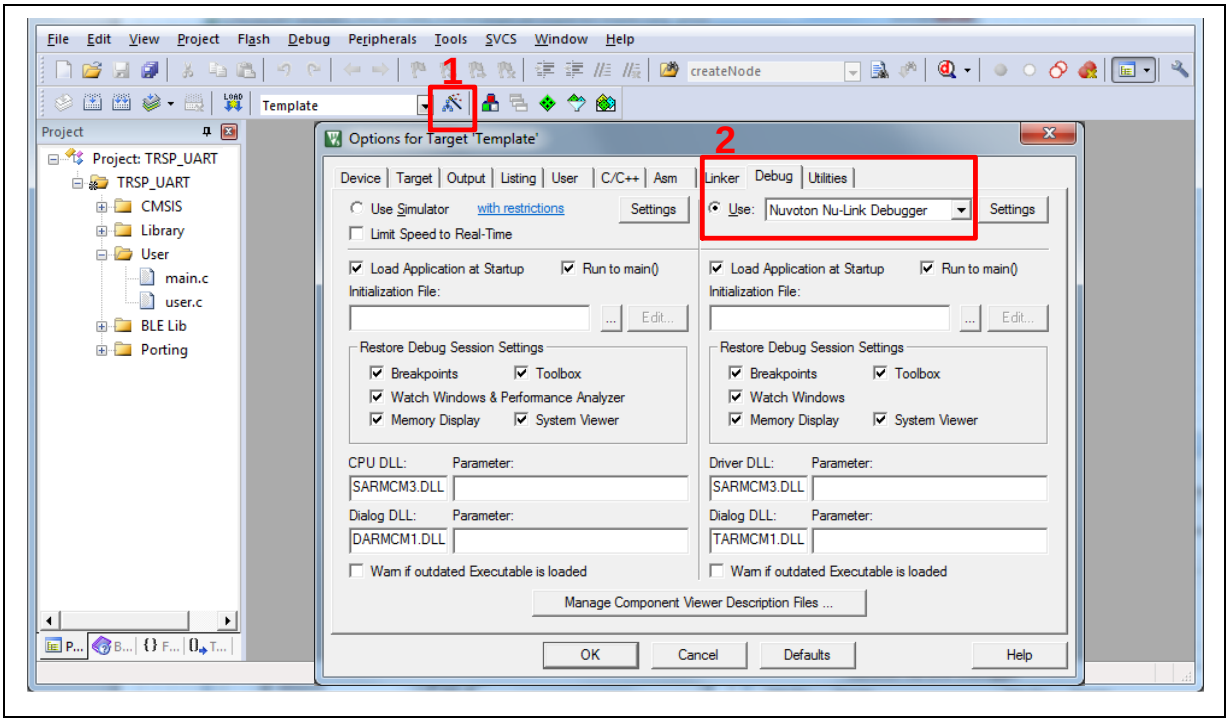

Figure 4-10 Debugger Setting in Options Window

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

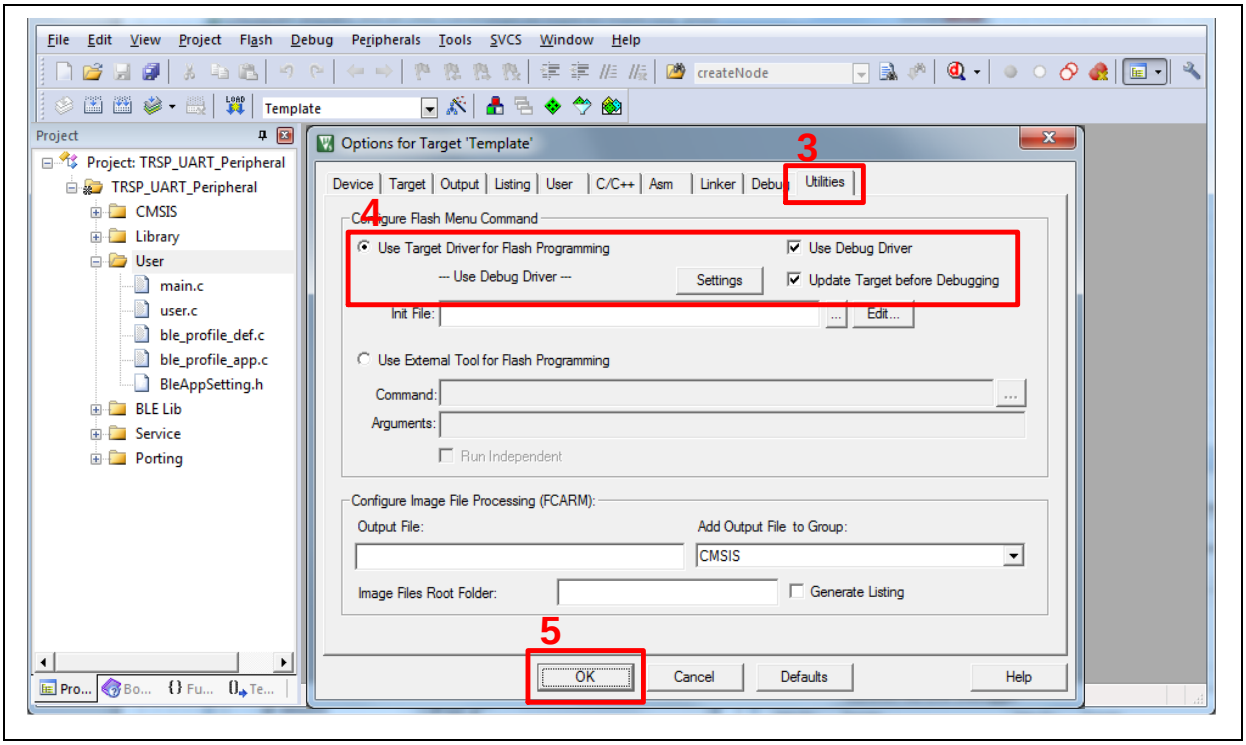

Figure 4-11 Programming Setting in Options Window

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.

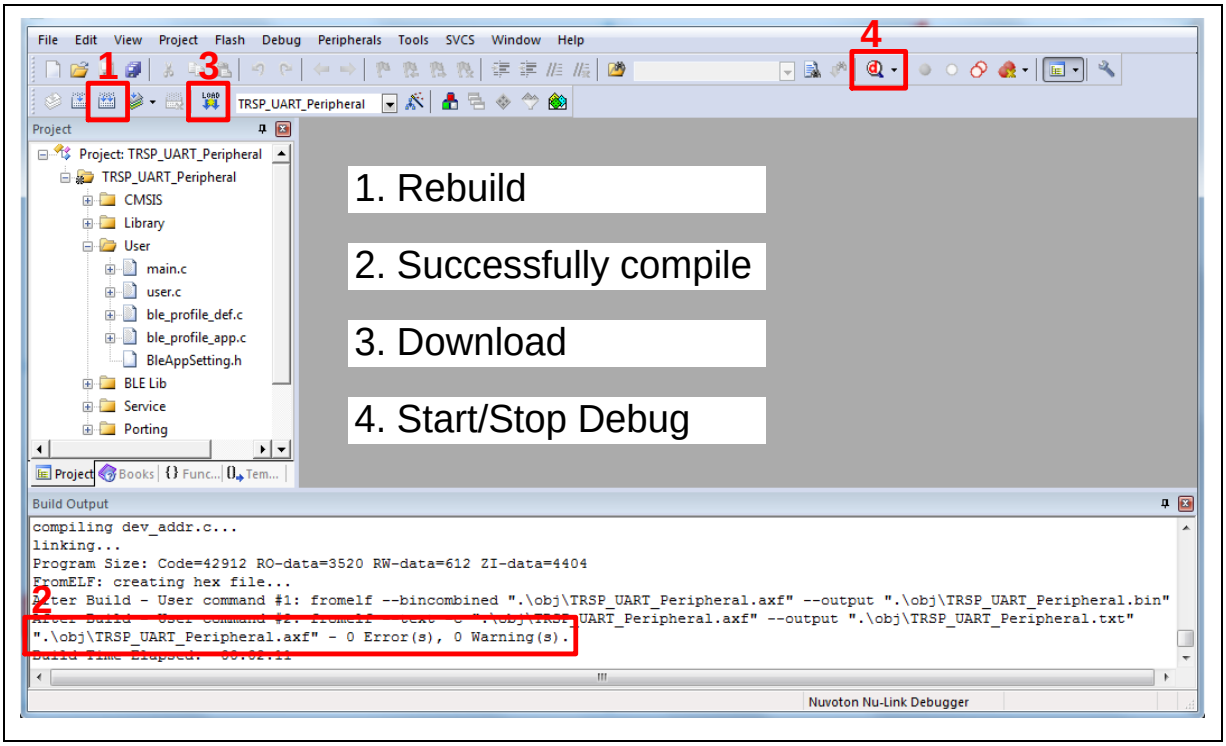

Figure 4-12 Compile and Download the Project

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.

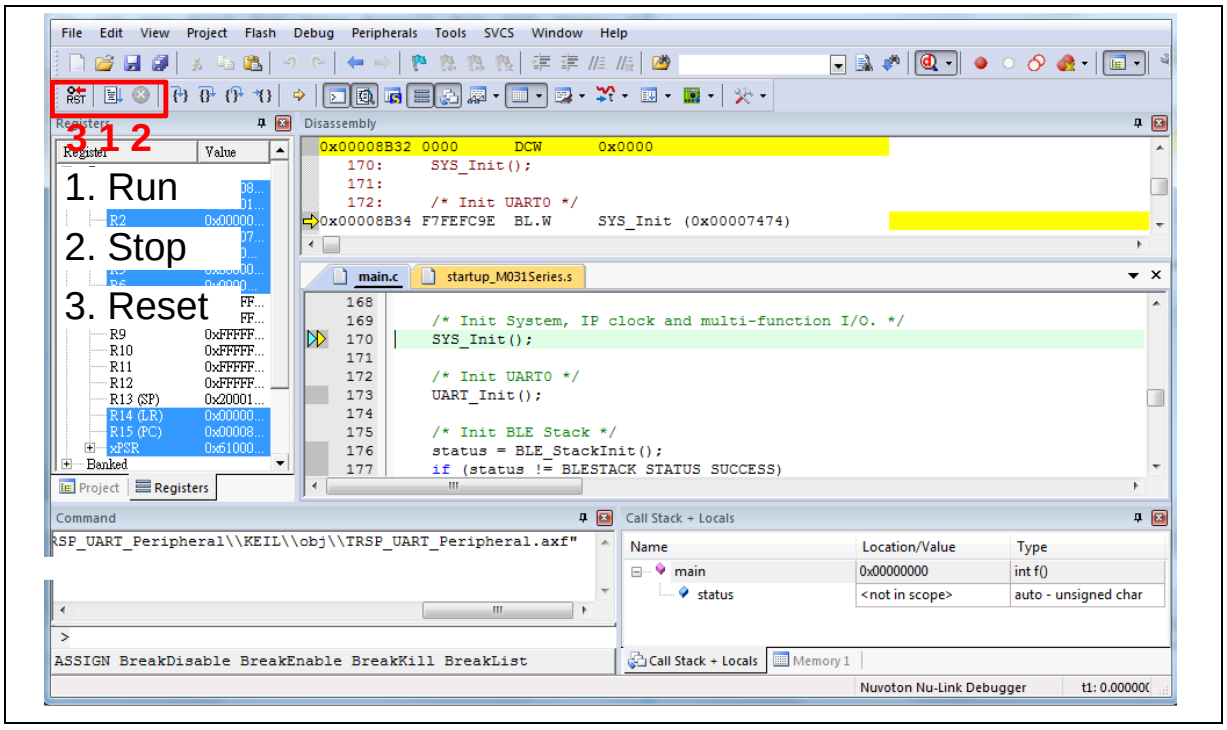

Figure 4-13 Keil MDK Debug Mode

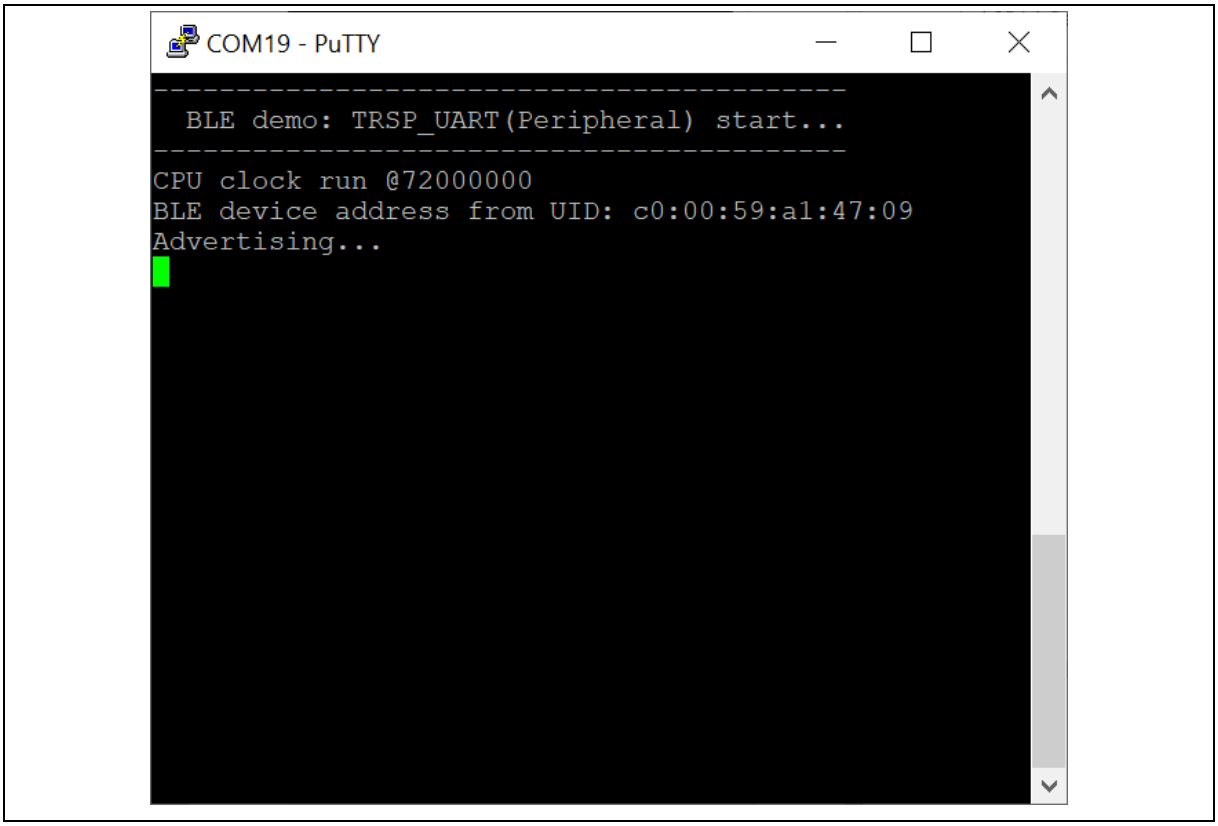

Figure 4-14 Debug Message on Serial Port Terminal Windows

5. User can download and install NuvotonBLE from Google Play Store (Android devices) or App Store (Apple devices).

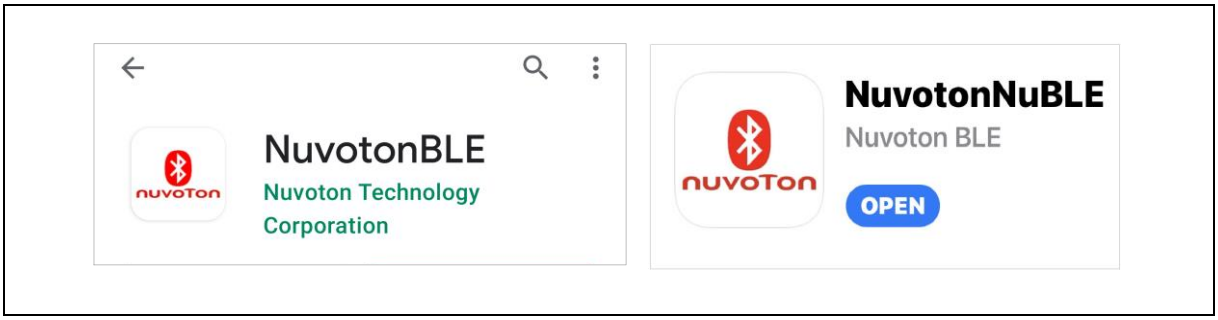

Figure 4-15 Search for NuvotonBLE on Google Play Store or App Store

6. Open the NuvotonBLE and turn on Bluetooth in settings of the mobile phone.

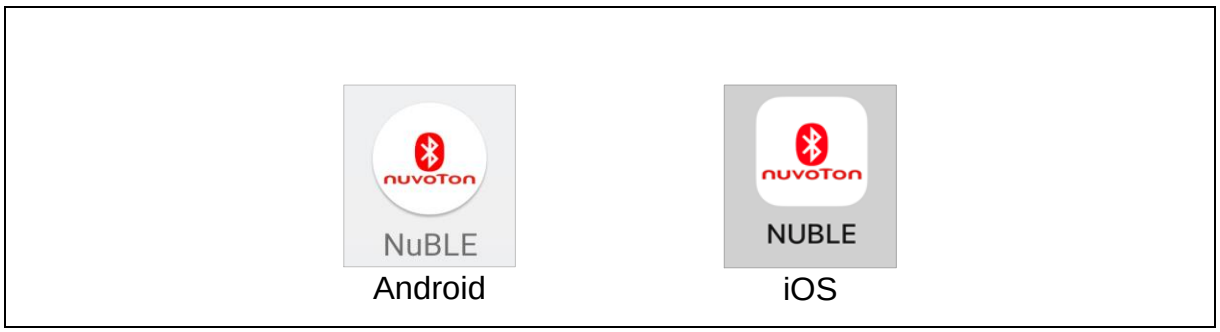

Figure 4-16 NuvotonBLE Icon

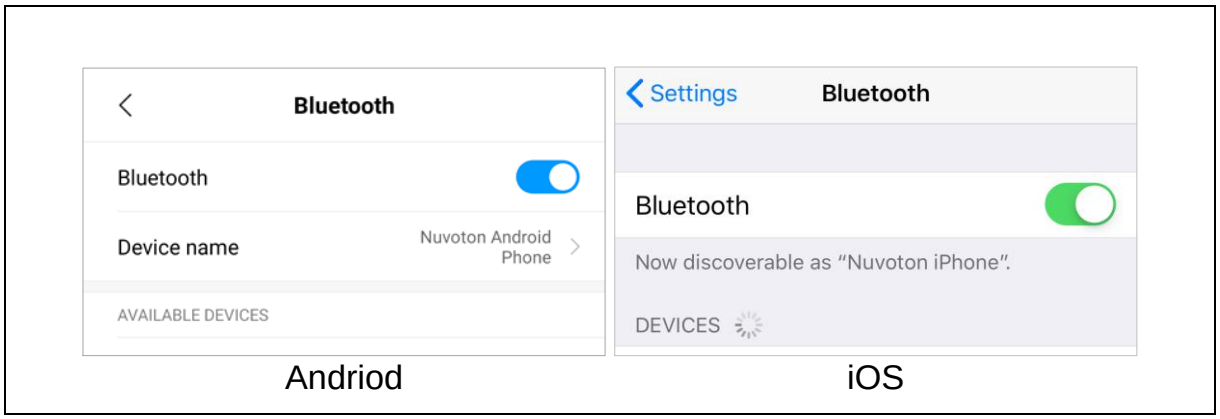

Figure 4-17 Turn on Bluetooth on Mobile Phone

7. After clicking "Scan", users can see many Bluetooth devices. Please click Nuvoton_TRSP_UART to connect.

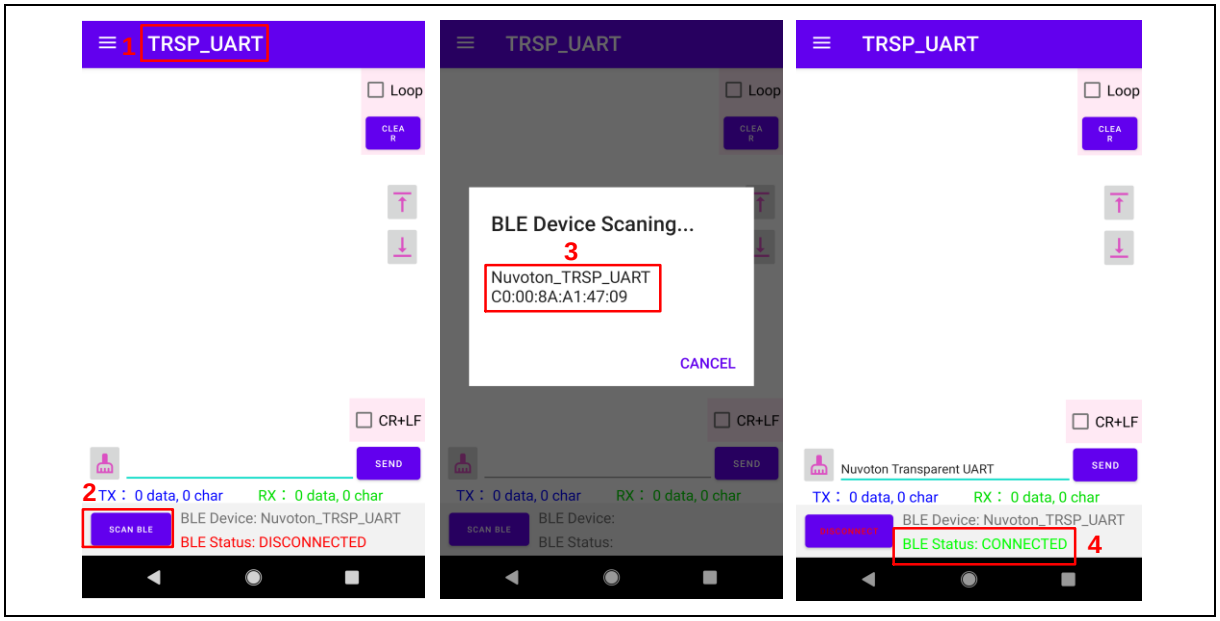

Figure 4-18 Connect to Nuvoton_TRSP_UART on Android Phone

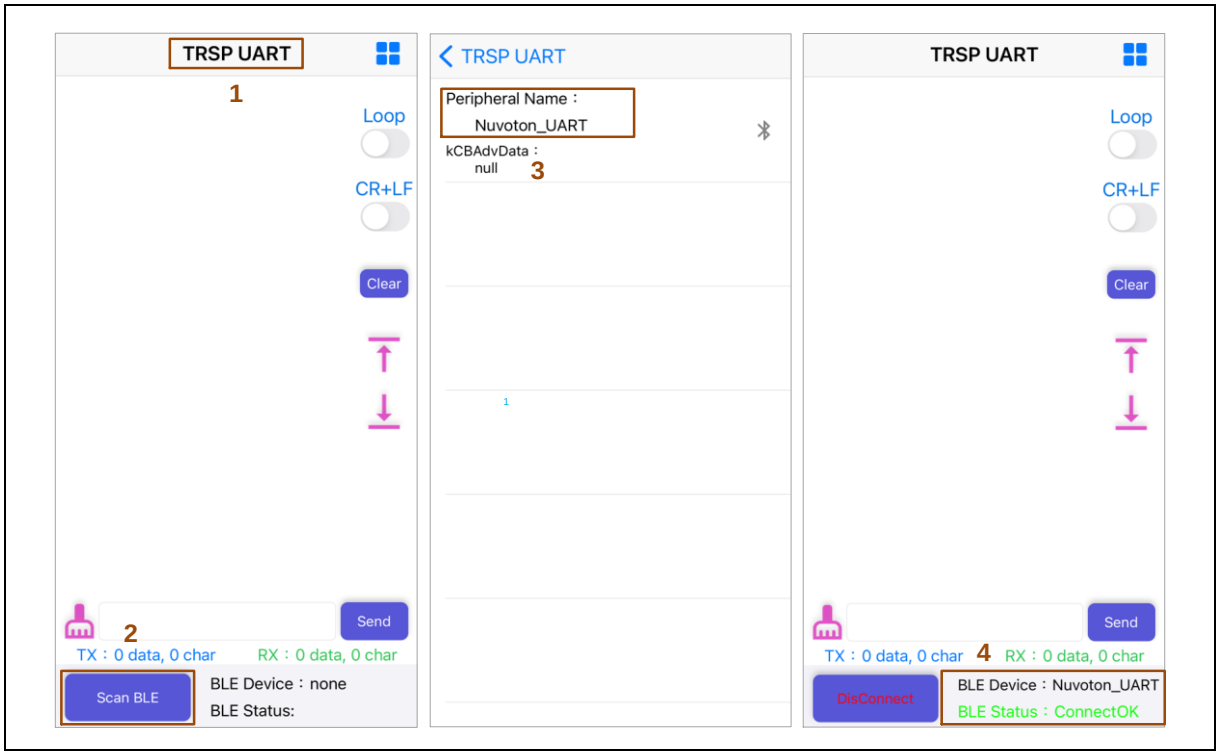

Figure 4-19 Connect to Nuvoton_TRSP_UART on iPhone

8. User can type a string in the NuvotonBLE text input field and click the SEND button, then the data can be transmitted from the mobile phone to M032BT through BLE, and finally sent to the PC through the M032BT UART and displayed on the terminal window.

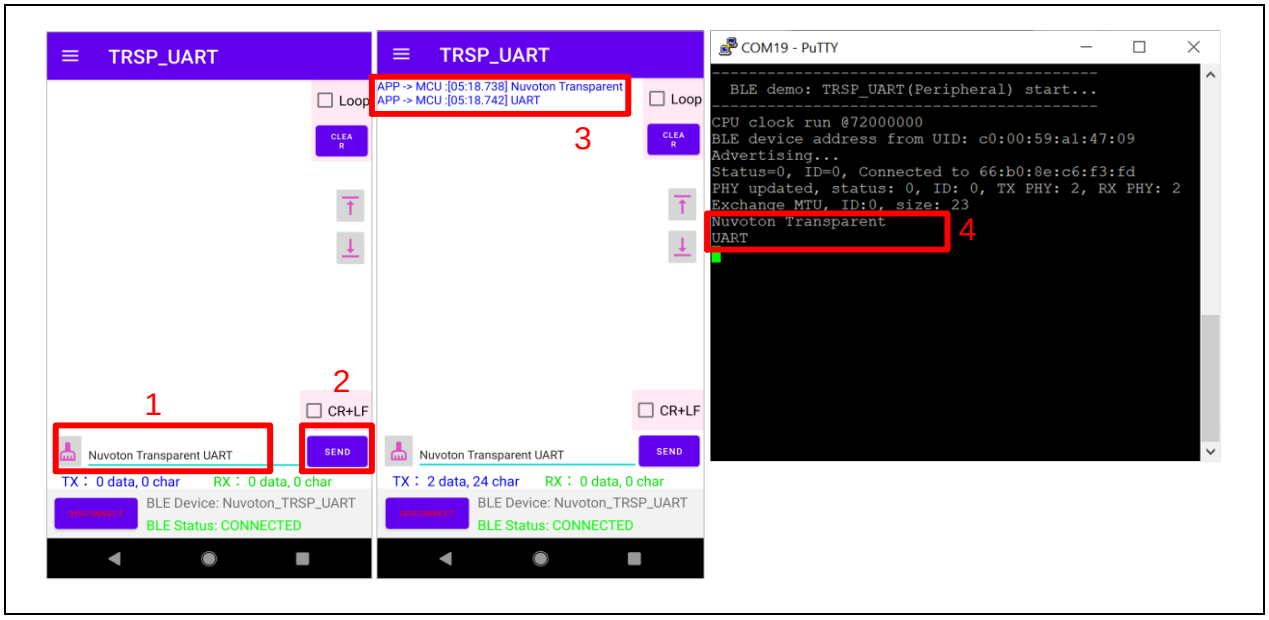

Figure 4-20 Transfer String from Android Phone to M032BT

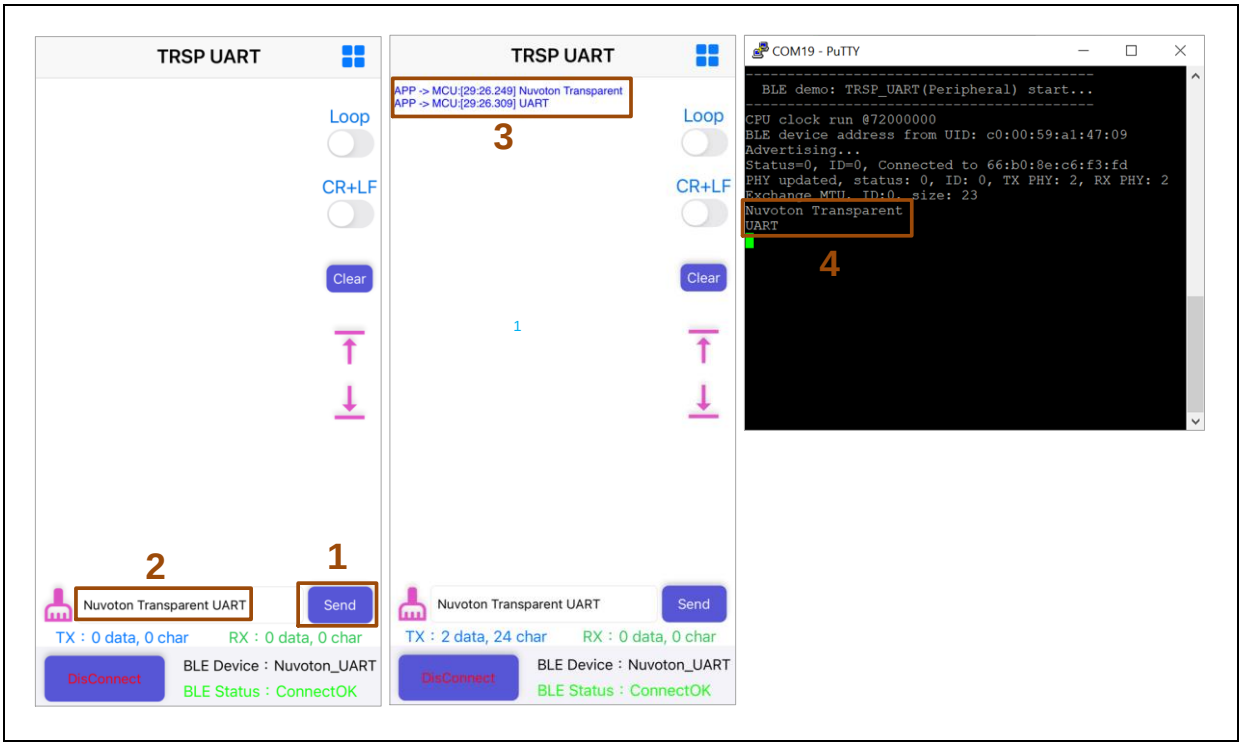

Figure 4-21 Transfer String from iPhone to M032BT

9. User can type a string in the terminal window and press enter "↵", then the data can be transmitted from M032BT to the mobile phone through BLE, and finally displayed on the NuvotonBLE main screen.

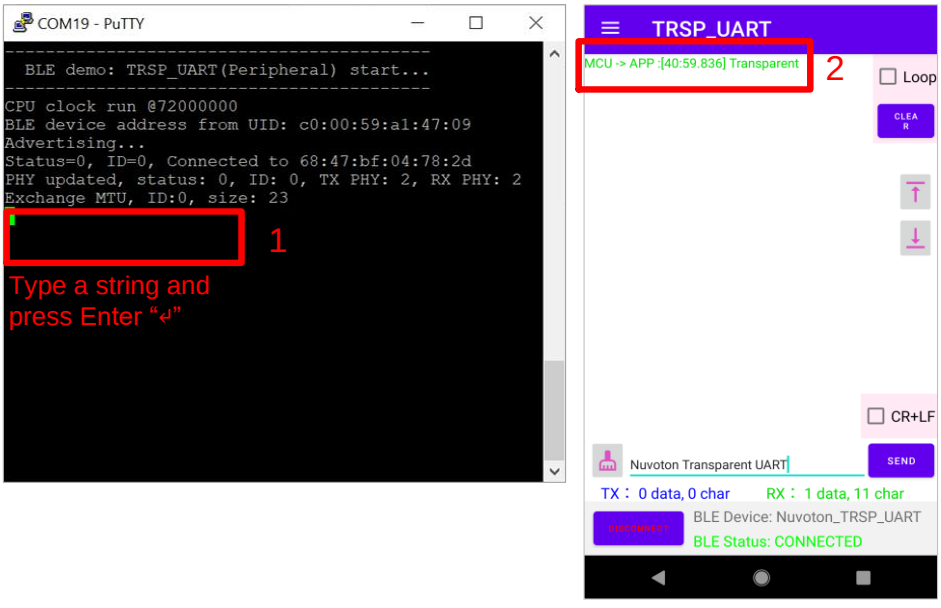

Figure 4-22 Transfer String from M032BT to Andriod Phone

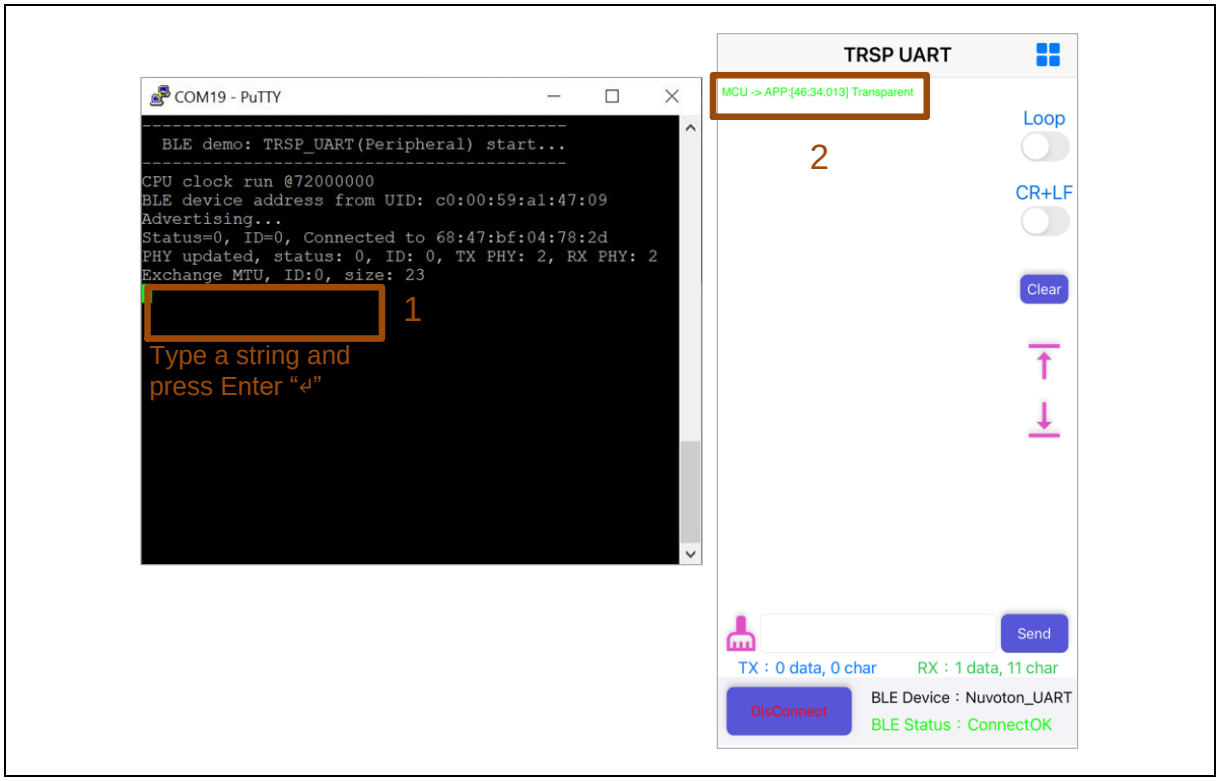

Figure 4-23 Transfer String from M032BT to iPhone

5 NUMAKER-M032BTAI SCHEMATICS

5.1 Nu-Link2-Me

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

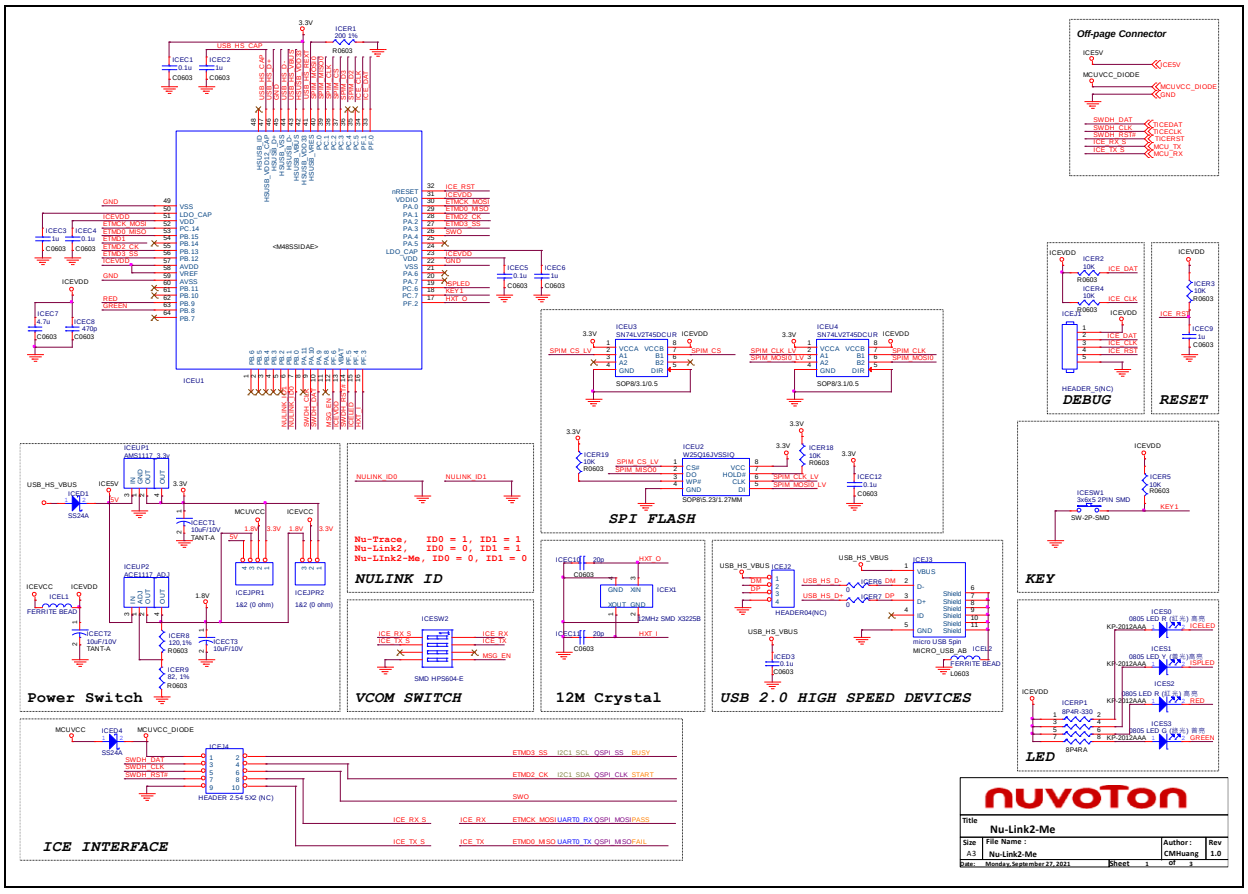

Figure 5-1 Nu-Link2-Me Circuit

5.2 M032BTAI Target Board

Figure 5-2 shows the M032BTAI target board circuit.

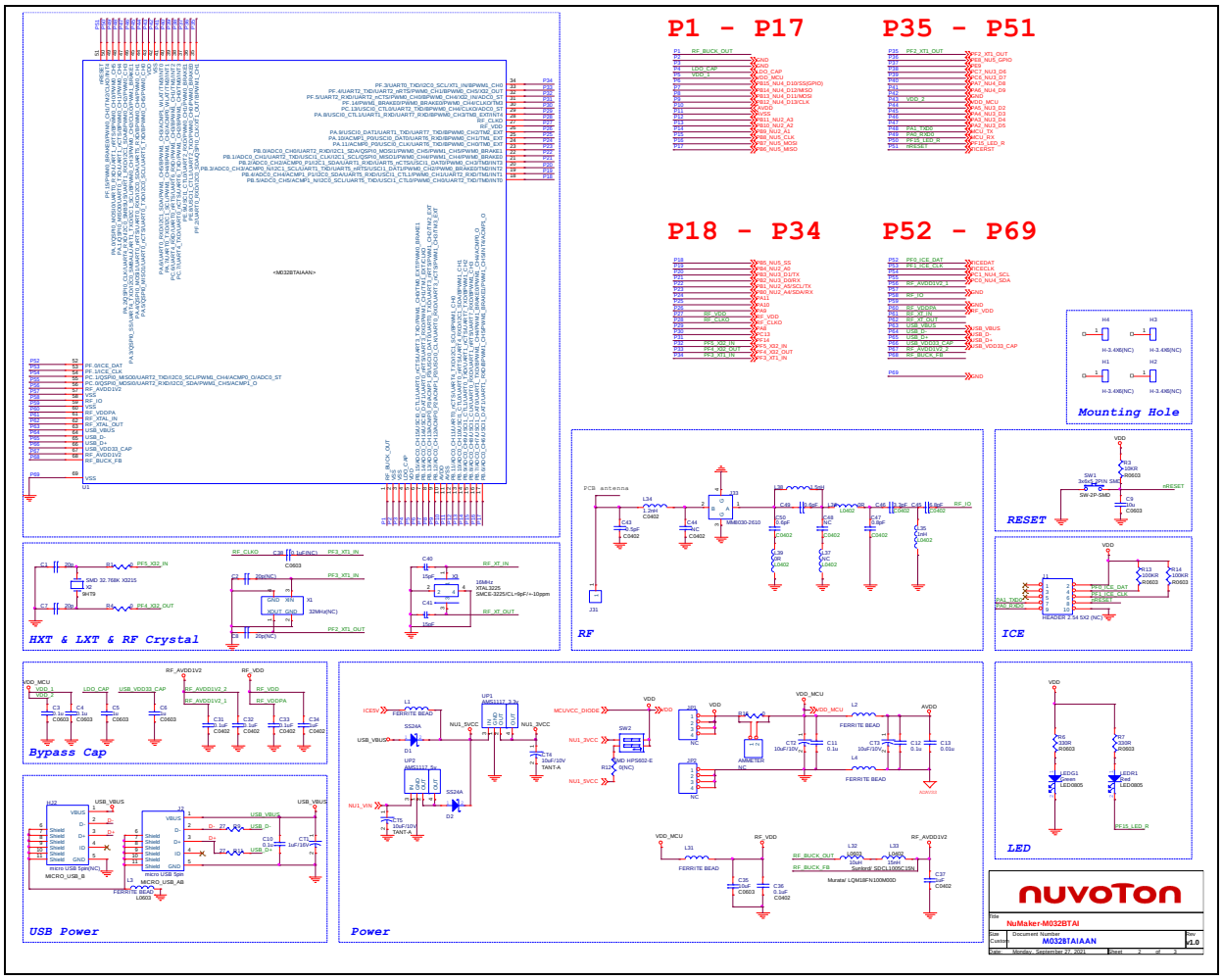

Figure 5-2 M032BTAI Target Board Circuit

5.3 Extension Connectors

Figure 5-3 shows extension connectors of NuMaker-M032BTAI.

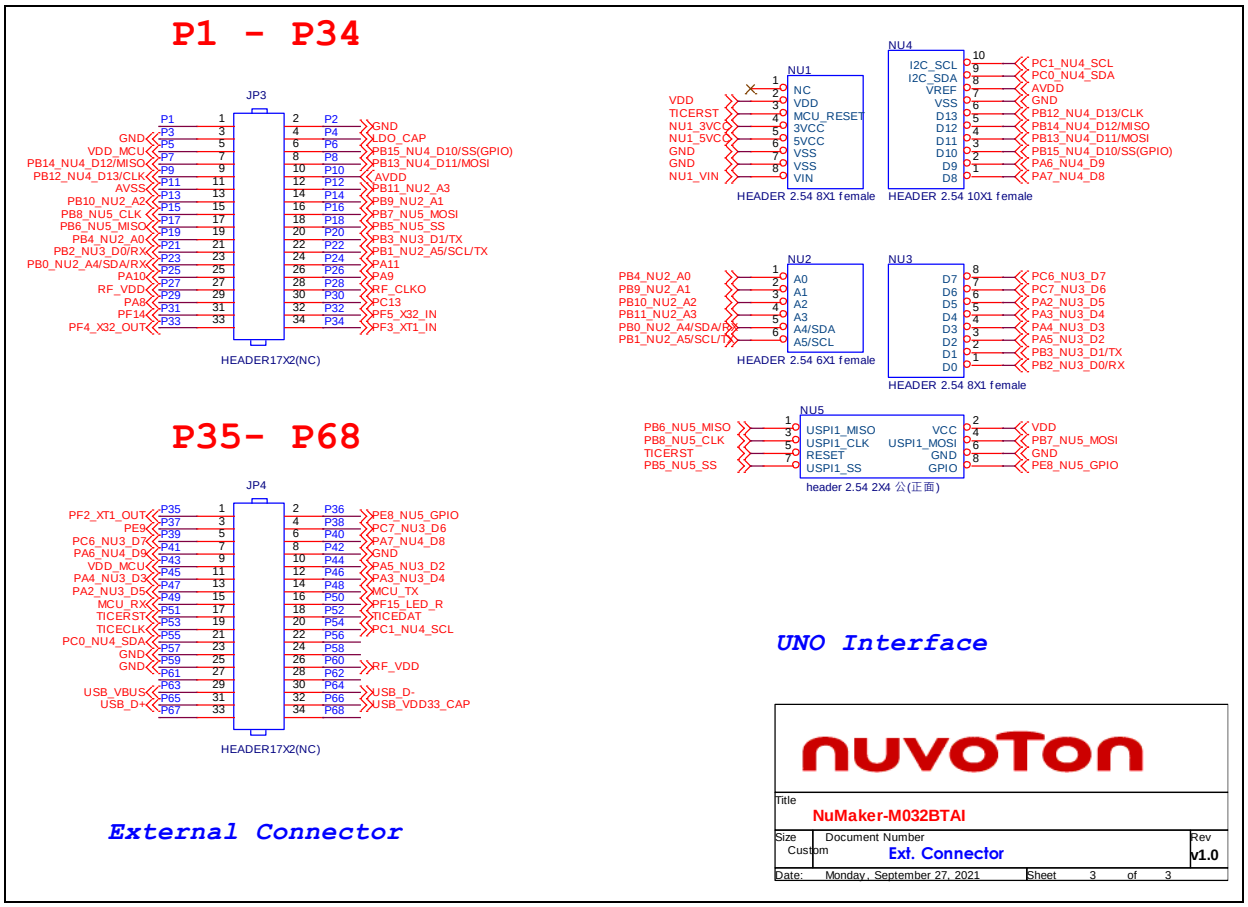

Figure 5-3 Extension Connectors Circuit

5.4 PCB Placement

Figure 5-4 and Figure 5-5 show the front and rear placement of NuMaker-M032BTAI.

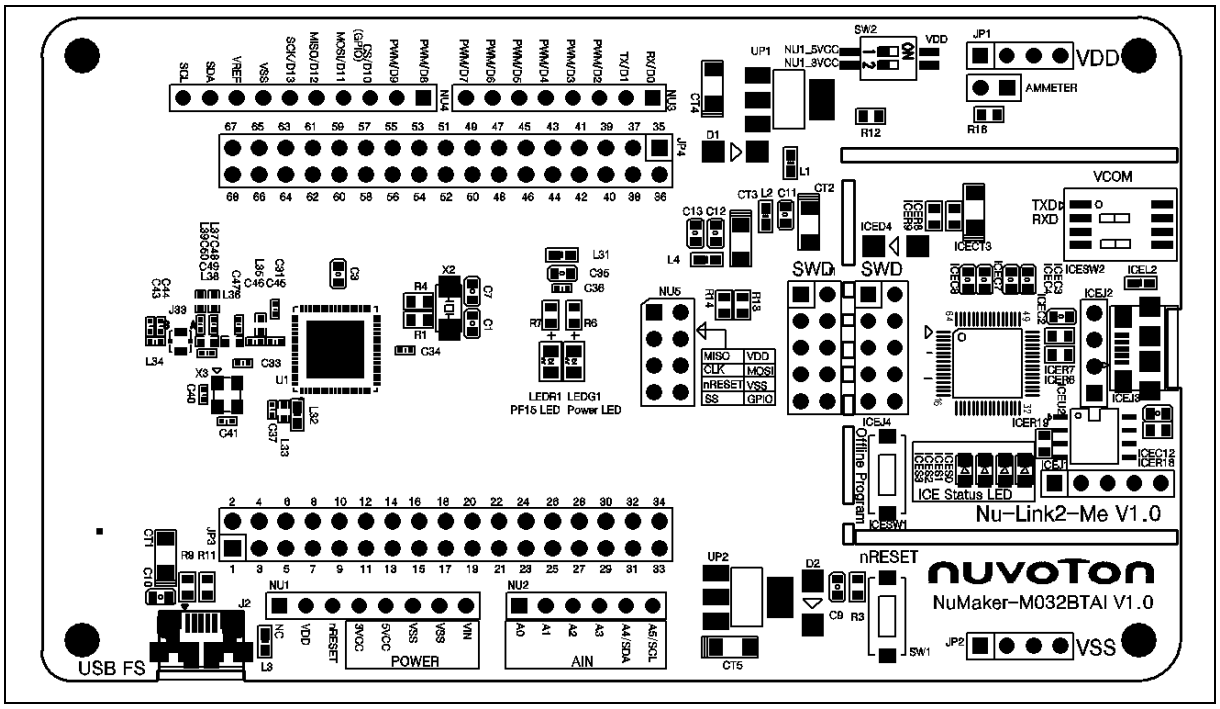

Figure 5-4 Front Placement

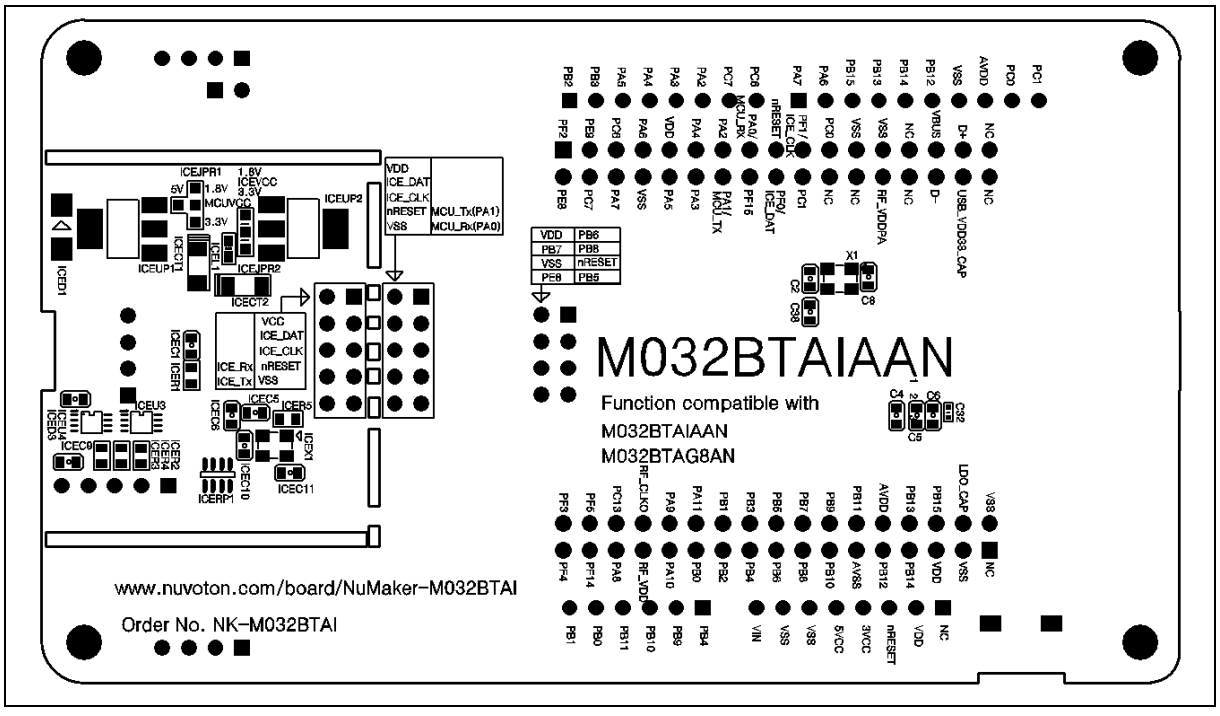

Figure 5-5 Rear Placement

6 REVISION HISTORY

Date	Revision	Description
2022.04.19	1.00	• Initial version

Important Notice

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