ARM® Cortex®-M

32-bit Microcontroller

NuMicro® Family
NuMaker Uni
User Manual

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

www.nuvoton.com

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1 OVERVIEW

NuMaker Uni is an IoT or wearable application development board based on NuMicro® NANO100NE3BN. The start kit enables quick development, prototype evaluation, and creation of innovative designs for users. The kit also includes complete source-code examples, which helps users to build target C code applications quickly.

The NuMaker Uni has built in many components such as a Gyro sensor, a Wi-Fi Module, and a Bluetooth Module. By these components, developers can create new applications and working prototypes easily. It also allows users to extend its hardware, like servo motor, LED and EEPROM. The NuMaker Uni is suitable for a variety of IoT or wearable applications. Developers can implement applications for IoT such as home security, gas leak warning, smart remote controller, humidity and temperature monitor, and self-balancing scooter, multicopter. Developers can also implement applications for wearables such as pedometer, oximeter, heart rate monitor, electrocardiography (ECG), and smartband.

The NANO100NE3BN is an ultra-low power 32-bit microcontroller embedded with ARM® Cortex®-M0 core operated at a wide voltage range from 1.8V to 3.6V and runs up to 42 MHz frequency.

1.1 Features

The NuMaker Uni offers the following features:

- IR Transmitter
- IR Receiver
- 3-axis accelerometer and 3-axis Gyro sensor (MPU6500)
- Temperature-Humidity sensor (HTU21D)
- ESP-03 – 802.11b/g/n Wi-Fi Module
- BB2710-29 – Dual Mode Bluetooth Module
- R/G/B LED
- Extension pins provide SPI, I^2C, PWM, and ADC interfaces

2 INTRODUCTION TO NUMAKER UNI

The NuMaker Uni uses the NANO100NE3BN as the target microcontroller. Figure 2-1 shows the NuMaker Uni board.

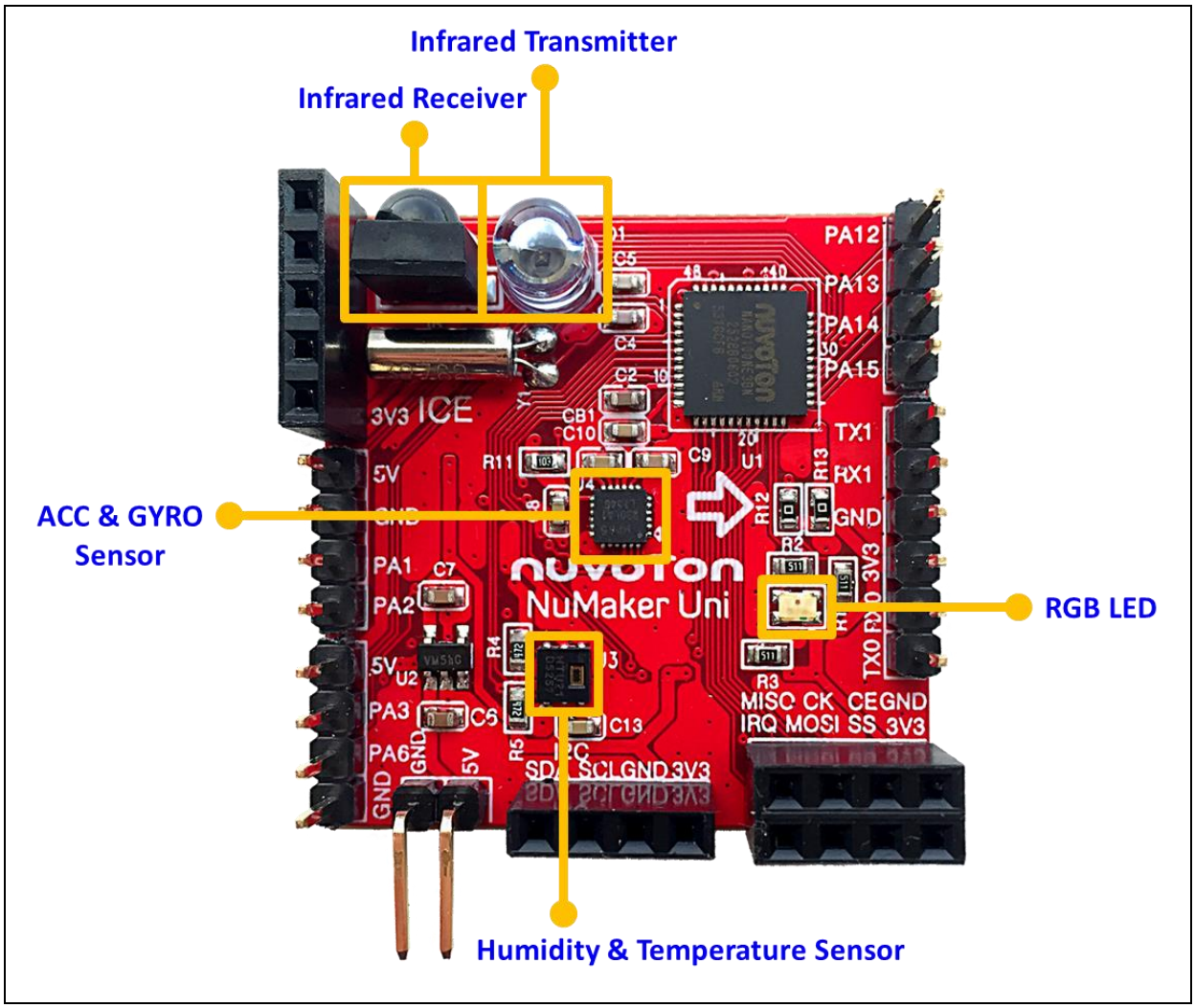


Figure 2-1 NuMaker Uni Board

The NuMaker Uni supports the Nu-Link ICE Adaptor, and uses In-Circuit Programming (ICP) mode based on the SWD interface. The uvNuMicro® ICP Programming Tool can be used for developers to develop their software and program the MCU. The NuMaker Uni also supports third party development tools, such as Keil RVMDK, and IAR EWARM.

The NANO100NE3BN used by the NuMaker Uni can run up to 42MHz, and support 3.7V to 5V DC connector for 3.7V Lithium battery or 5V power supply. It includes Red/Geen/Blue LED, an Infrared transmitter and infrared receiver, 3-axis accelerometer & 3-axis gyroscope (MPU6500), a temperature & humidity sensor (HTU21D), a 802.11b/g/n Wi-Fi module (ESP-03) which supports TCP, UDP server & client, AP or Station mode, and AT command, and a dual mode Bluetooth 3.0 module (BB2710-29) which supports SPP and GATT profile, and AT command.

3 INTRODUCTION TO NU-LINK MINI

The Nu-Link Mini is a Debug Adaptor which connects the USB port of your PC to your target system (via Serial Wired Debug Port) and allows you to program and debug embedded programs on the target hardware. To use the Nu-Link Mini Debug adaptor with Keil or IAR, please refer to “Nuvoton NuMicro® IAR ICE Driver User Manual” or Nuvoton NuMicro® Keil ICE Driver User Manual” for details. Figure 3-1 shows the Nu-Link Mini board.

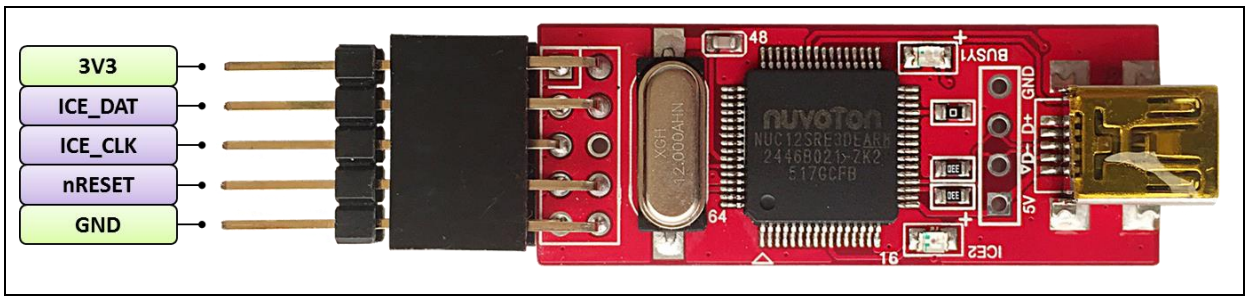


Figure 3-1 Nu-Link Mini Board

4 HARDWARE INTRODUCTION

- MCU
  - Cortex®-M0 NANO100NE3BN - 32-bit MCU
  - Max speed of 42 MHz
  - 128 KB Flash and 16 KB SRAM
  - Power-down current <1uA
  - Support SPI, I²C, UART, ADC, PWM, GPIO
- Sensor
  - IR Transmitter
  - IR Receiver
  - 3-axis accelerometer and 3-axis Gyro sensor (MPU6500)
  - Temperature-Humidity sensor (HTU21D)
- Wireless Module
  - ESP-03 – 802.11b/g/n Wi-Fi Module
    - Support TCP, UDP Server & Client
    - Support AP, Station mode
    - Support AT Command
  - BB2710-29 – Dual Mode Bluetooth Module
    - Support SPP and GATT profile
    - Support UART AT Command

4.1 On-Board Devices Interface

Device Name	Component Name	MCU Interface Name
Infrared Receiver	FM-9038	PWM capture: PA13/PWM0_CH1
Infrared Transmitter	IR diode	PWM output : PA12/PWM0_CH0
Inertial Measurement Unit	MPU6500	I²C1: PA11/I²C1-SCL & PA10/I²C1-SDA
Temperature & Humidity	HTU21D	I²C1: PA11/I²C1-SCL & PA10/I²C1-SDA
Wi-Fi module	ESP-03	UART1
Bluetooth module	BB2710-29	UART0

4.2 Board Extension Interfaces

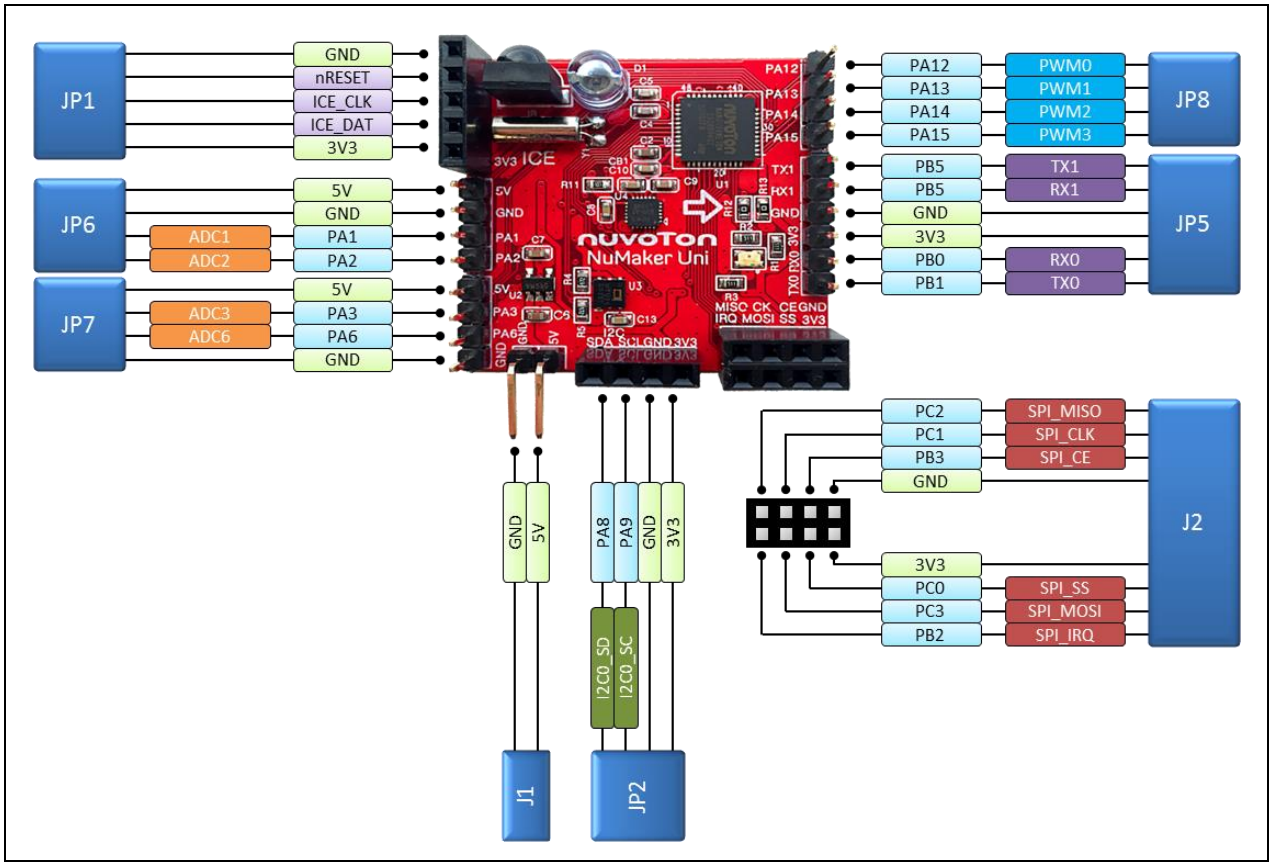


Figure 4-1 NuMaker Uni Pin Diagram

- JP1 – ICE interface for Nu-Link Mini

JP1	Interface Signal Name	MCU Pin Assignment
Pin 1	VCC	VCC3
Pin 2	ICE_DAT	ICE_DAT
Pin 3	ICE_CLK	ICE_CK
Pin 4	RESET	nRESET
Pin 5	GND	GND

- JP2 – I^2C interface (pin assignment matched with the 0.96" I^2C OLED module)

JP2	Interface Signal Name	MCU Pin Assignment
Pin 1	VCC	VCC
Pin 2	GND	GND
Pin 3	SCL	I^2C0_SCL / PA9
Pin 4	SDA	I^2C0_SDA / PA8

- JP5 – UART interface

JP5	Interface Signal Name	MCU Pin Assignment
Pin 1	UART0_TX	UART0_TX / PB1
Pin 2	UART0_RX	UART0_RX / PB0
Pin 3	VCC3	VCC3
Pin 4	GND	GND
Pin 5	UART1_RX	UART1_RX / PB4
Pin 6	UART1_TX	UART1_TX / PB5

- JP6 – ADC interface (pin assignment match gas sensor module MQ-2)

JP6	Interface Signal Name	MCU Pin Assignment
Pin 1	ADC_MQ	PA2 / ADC2
Pin 2	ADC_DO	PA1 / ADC1
Pin 3	GND	GND
Pin 4	+5V	+5V

- JP7 – TimerCapture interface (pin assignment matched with the ultrasonic sensor module HC-SR04)

JP7	Interface Signal Name	MCU Pin Assignment
Pin 1	GND	GND
Pin 2	ECHO	PA6 / TC3
Pin 3	TRIG	PA3
Pin 4	+5V	+5V

- JP8 – PWM interface

JP8	Interface Signal Name	MCU Pin Assignment
Pin 1	PA15	PA15 / PWM0_CH3
Pin 2	PA14	PA14 / PWM0_CH2
Pin 3	PA13	PA13 / PWM0_CH1
Pin 4	PA12	PA12 / PWM0_CH0

- J2 – SPI interface (pin assignment matched with the RF module nRF24L01)

J2	Interface Signal Name	MCU Pin Assignment
Pin 1	GND	GND
Pin 2	VCC3	VCC3

Pin 3	SPI_CE	PB3
Pin 4	SPI_CS	PC0 / SPI0_SS0
Pin 5	SPI_CLK	PC1 / SPI0_CLK
Pin 6	SPI_MOSI	PC3 / SPI0_MOSI0
Pin 7	SPI_MISO	PC2 / SPI0_MISO0
Pin 8	SPI_IRQ	PB2

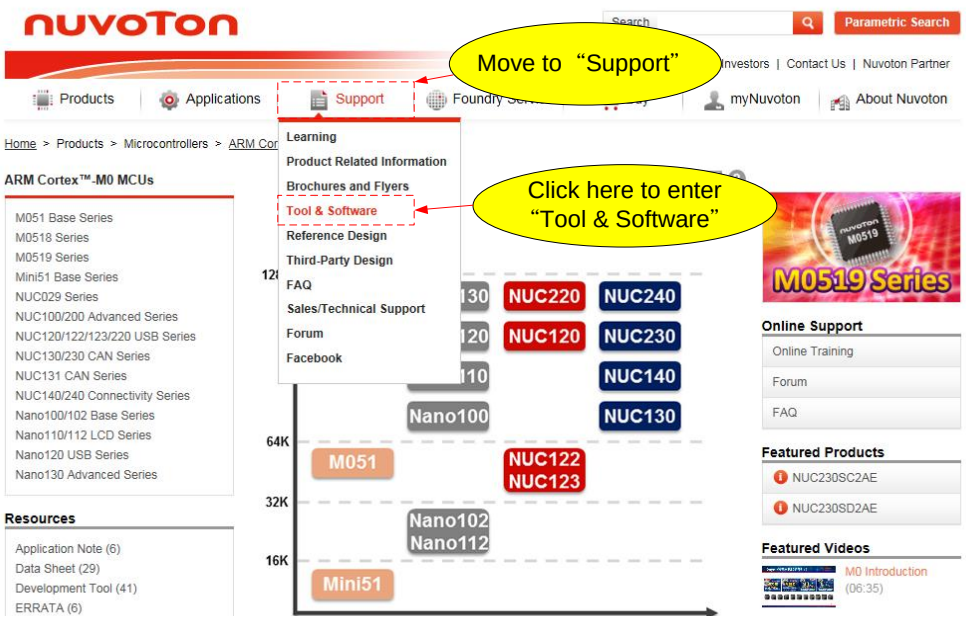
5 HOW TO START NUMAKER UNI ON IDE

5.1 Supported IDE Software

- IAR Embedded Workbench
- Keil µVision® IDE

5.2 Nuvoton Nu-Link Driver Download and Installation

Please visit the Nuvoton company NuMicro® website (http://www.nuvoton.com/NuMicro) to download "NuMicro® Keil µVision® IDE driver" or "NuMicro® IAR Embedded Workbench driver" file. When the Nu-Link driver has been downloaded, please unzip the file and execute the "Nu-Link_Keil_Driver.exe" or "Nu-Link_IAR_Driver.exe" to install the driver.

Step1	**Visit The Nuvoton NuMicro® Website: HTTP://WWW.NUVOTON.COM/NUMICRO.**
Step2	

Step3

Step4

Programmer Software Tools Package

File name	Description	Version	Date
ICP Programming Tool V1.31.6535.zip Revision History	NuMicro ICP tool & user manual	V1.31.6535	2016-2-24
ISP Programming Tool V1.47.zip Revision History	NuMicro ISP Programming Tool & user manual	V1.47	2015-7-28
NuGang Programmer V7.02.zip Revision History	& user manual	V7.02	2015-11-27

Click here to download the file.

Nu-Link Driver

File name	Description	Version	Date
Nu-Link Driver for Keil RVMDK V1.31.6535.zip Revision History	This driver is to support Nu-Link to work under Keil RVMDK Development Environment for all NuMicro Family Devices.	V1.31.6535	2016-2-24
Nu-Link Driver for IAR EWARM V1.31.6535.zip Revision History	This driver is to support Nu-Link to work under IAR EWARM Development Environment for all NuMicro Family Devices.	V1.31.6535	2016-2-24

Step5

Download the NuMicro® µVision® IDE driver or NuMicro® IAR Embedded Workbench driver.

5.3 Hardware Setup

The hardware setup is shown as Figure 5-1.

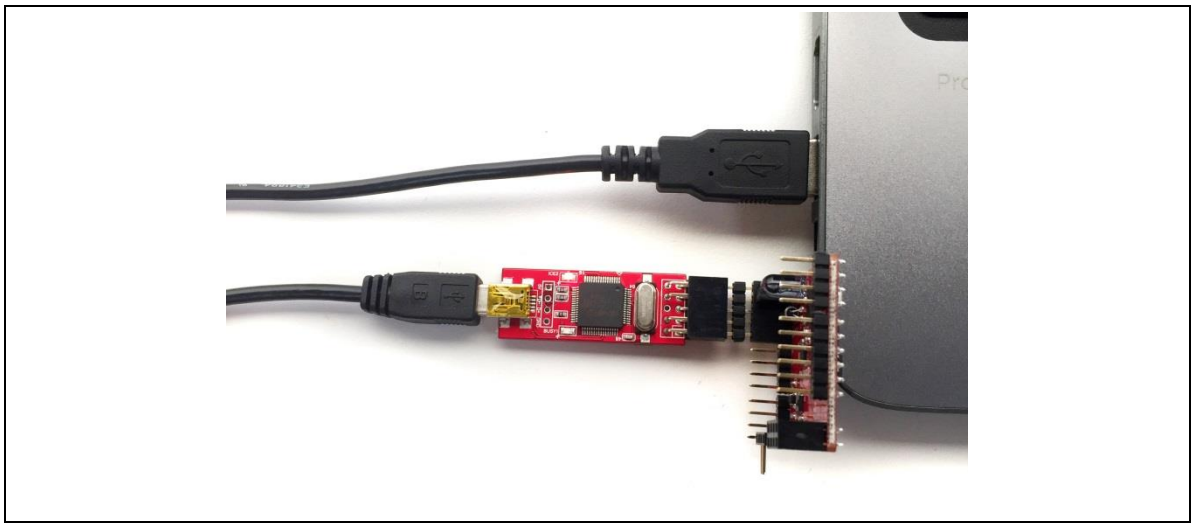


Figure 5-1 NuMaker Uni Hardware Setup

5.4 Starting to Use NuMaker Uni

1. Connect Nu-Link Mini to NuMaker Uni on its ICE port (J2) as of Figure 5-2.

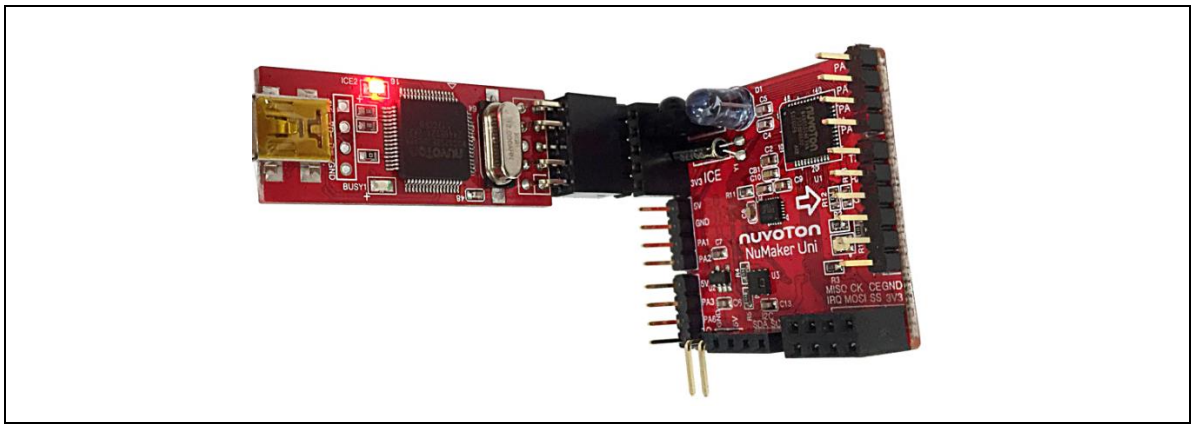


Figure 5-2 NuMaker Uni and Nu-Link Mini Connection

2. Connect Nu-Link Mini to PC through the USB cable as Figure 5-3.

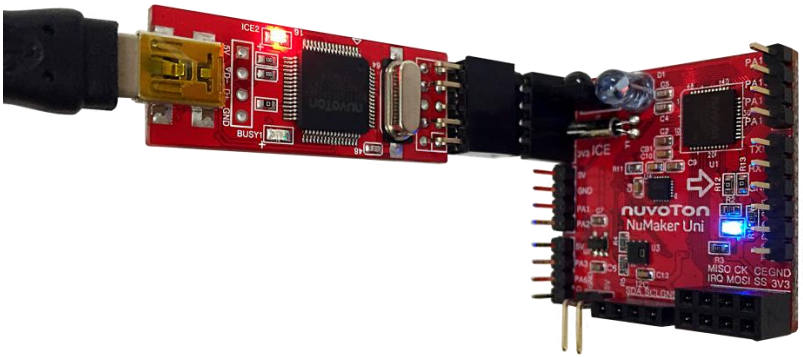


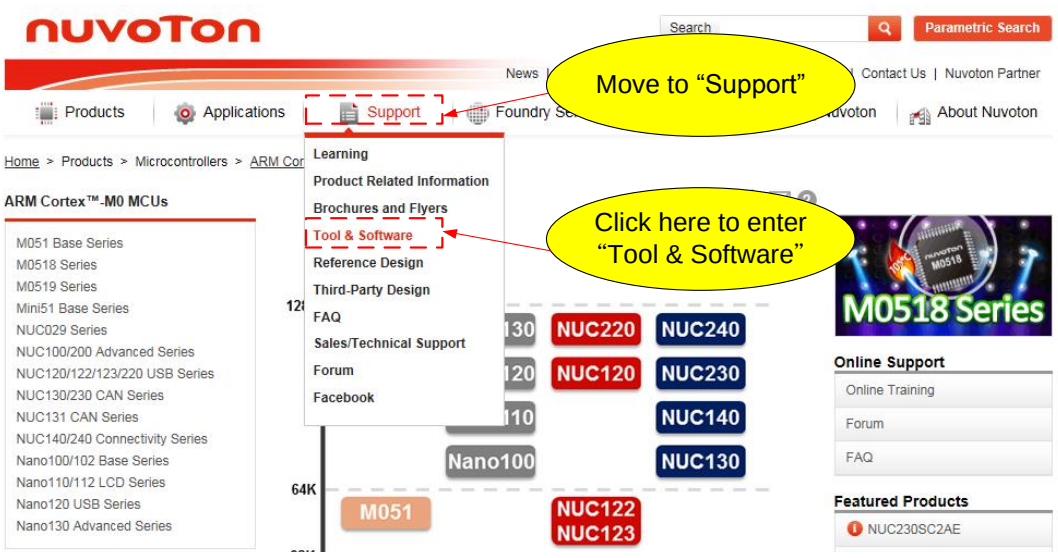
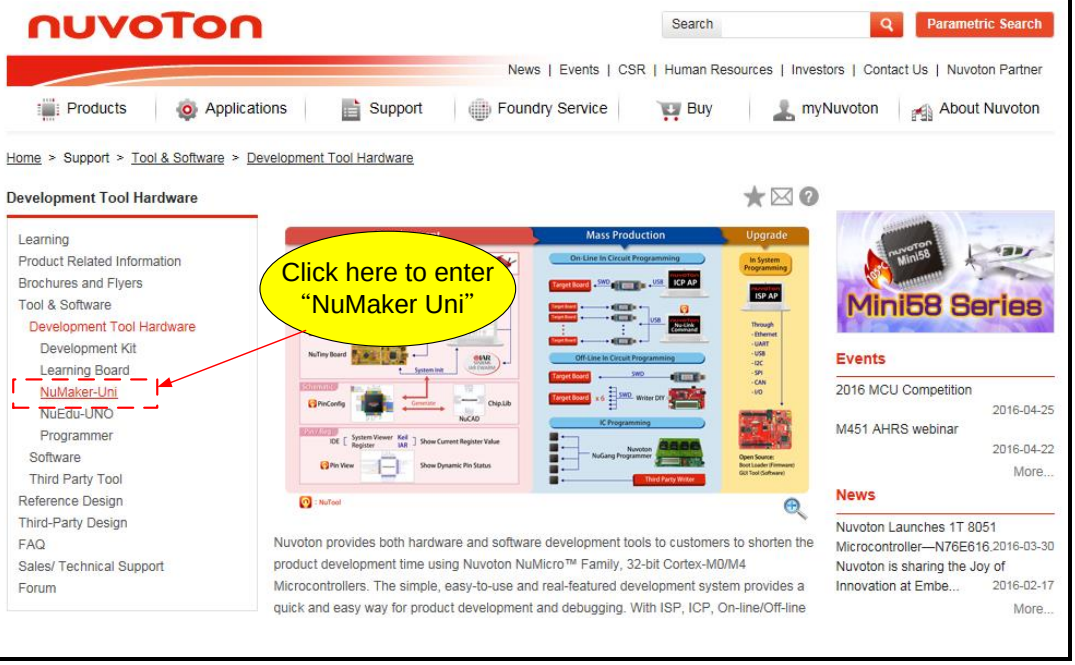
Figure 5-3 Blue LED Turns On

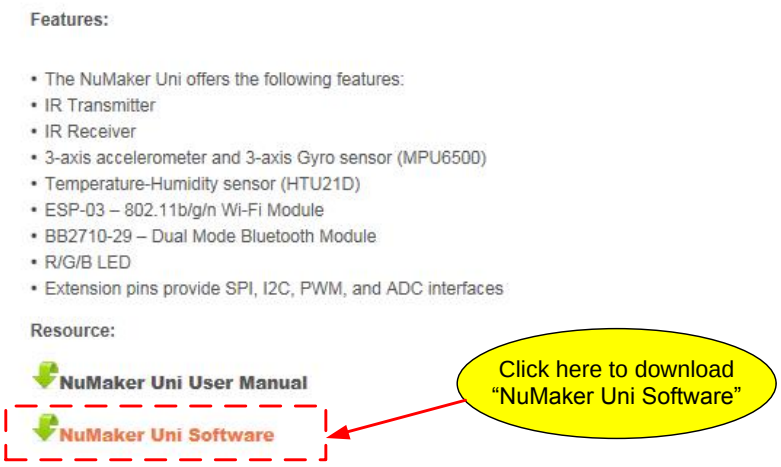
After the Nu-Link Mini is connected to PC, PC will start searching USB device, and it will be recognized as USB ICE shown in the peripheral device window of control panel. Also, the Nu-Link Mini LED will turn on to indicate the power is supplied from PC.

The Blue LED turns on as shown in Figure 5-3 after the connection from NuMaker Uni to PC through Nu-Link Mini. It means the R/G/B LED, the Bluetooth Module, the Wi-Fi Module, and the I^2C module is ready to use. For more detail please refer to 6.1.1.

5.5 Software Download

Please visit the Nuvoton NuMicro® website (http://www.nuvoton.com/NuMicro) to download NuMaker Uni sample code. The following steps demonstrate how to download sample code of NuMaker Uni.

Step1	**Visit The Nuvoton NuMicro® Website: HTTP://WWW.NUVOTON.COM/NUMICRO.**
Step2	
Step3	

Step4	
Step5	Download the SW_MuMaker_Uni_V1.0 Software.

5.6 Folder Structure

The example demonstrates compiling, downloading and executing sample code on a NuMaker Uni board. Figure 5-4 lists the NuMaker Uni software (SW_NuMaker_Uni_v1.0.zip) downloaded from Nuvoton NuMicro® website.

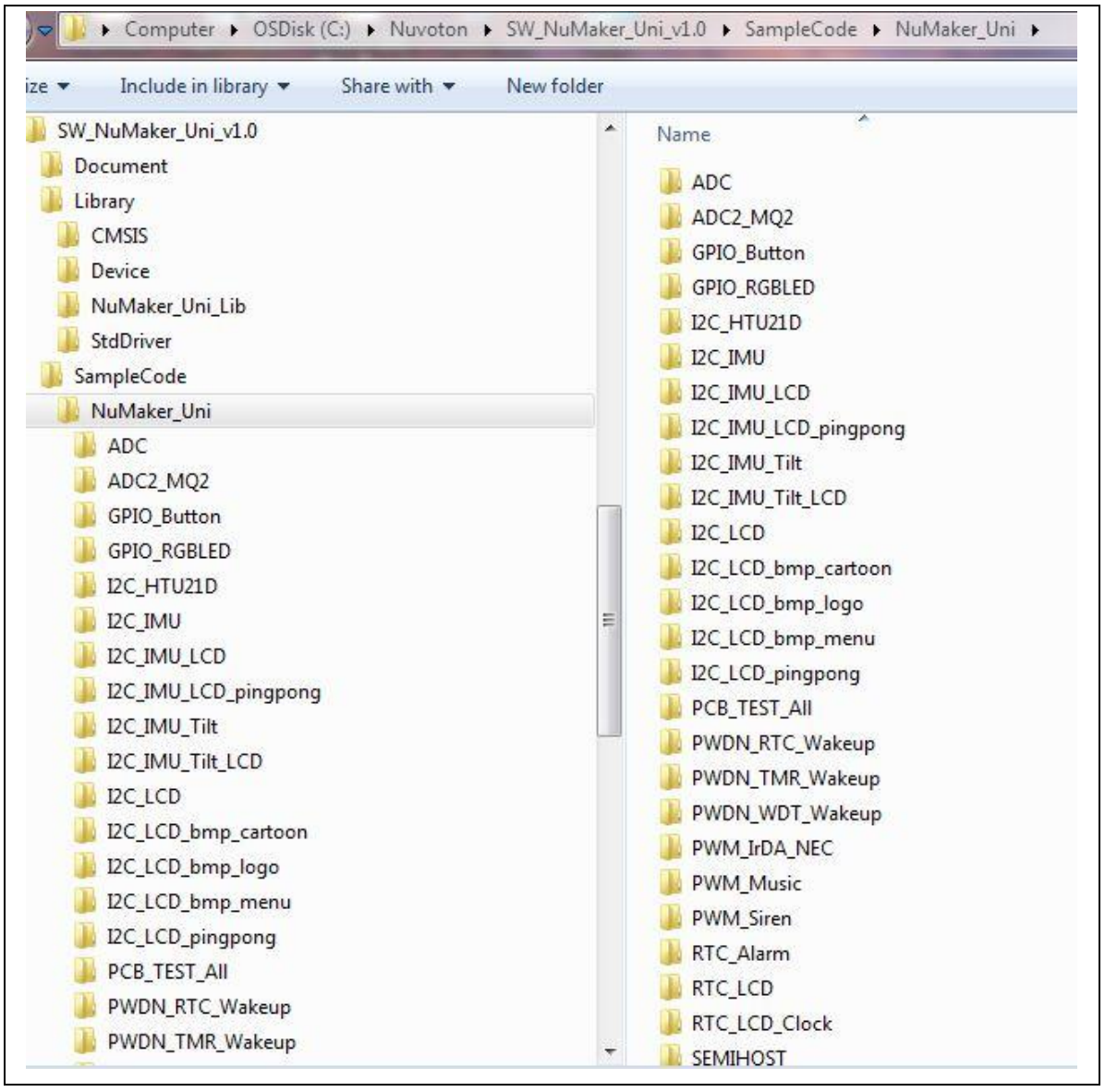


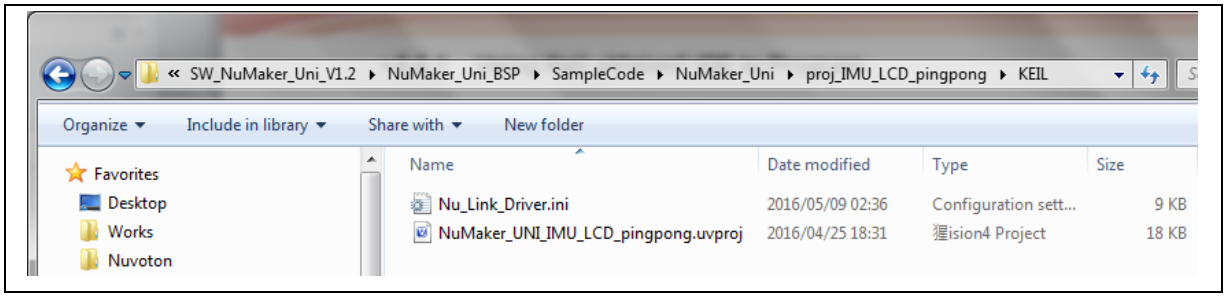
Figure 5-4 Sample Code Directory

5.6.1 Using Keil µVision® IDE to Program

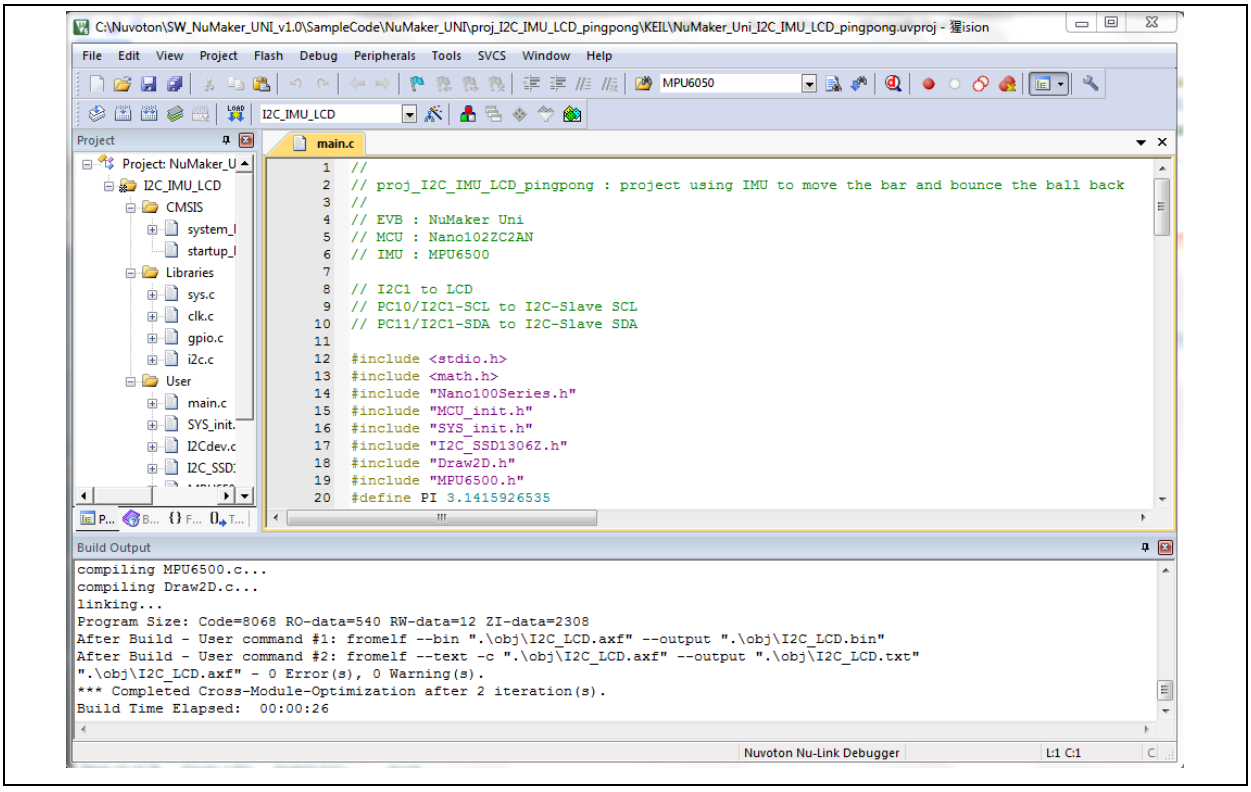
The example demonstrates how to download and debug an application on NuMaker Uni board.

1. The example file can be found in the directory list shown in the following figure.

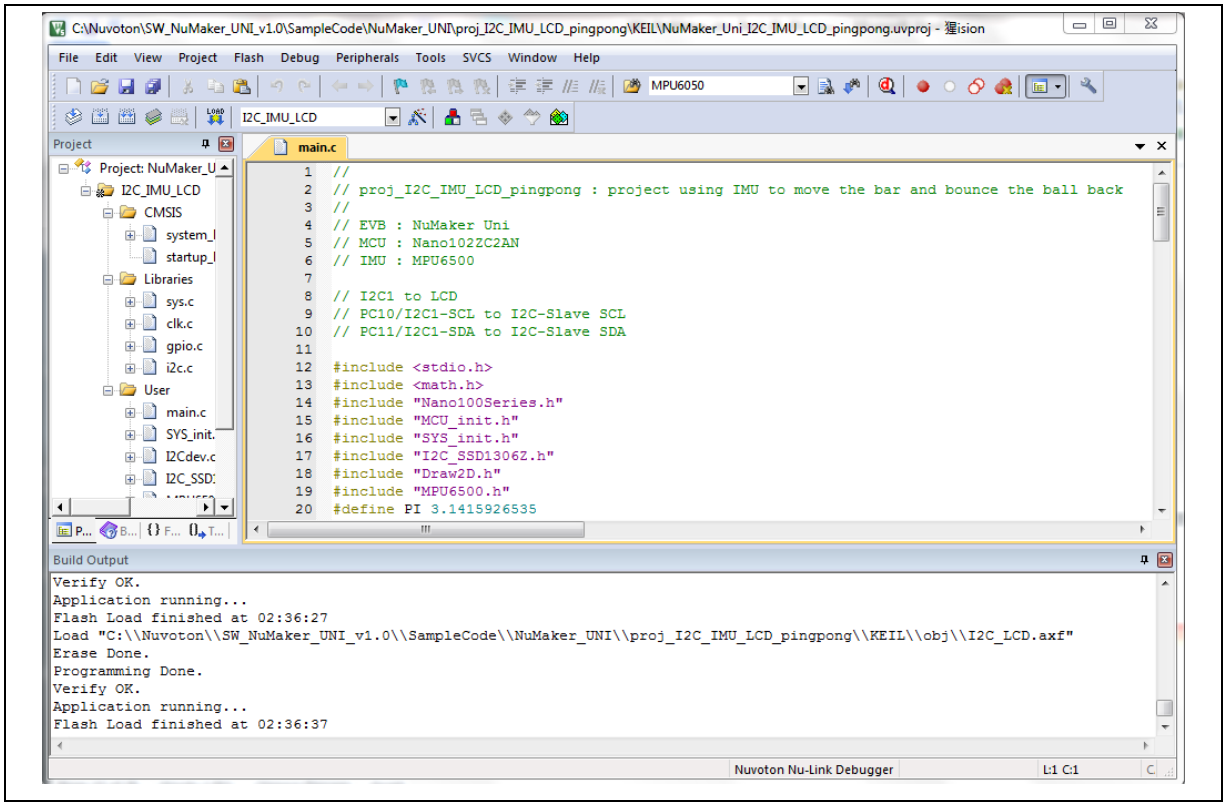
(Default:\SW_NuMaker_Uni_V1.2\NuMaker_Uni_BSP\SampleCode\NuMaker_Uni\proj_IMU_LCD_pingpong\KEIL)



2. Click  "Build" to compile the sample code.



3. Click  “Download” to download binary code to NuMaker Uni.



4. After download, MCU should be up and running. If not, please reconnect USB cable to power it up again. In this sample code, it is using IMU to detect motion for controlling the bar to bounce the ball back, as shown in Figure 5-5.

   Note that the start kit does not include the Li-battery and the LCD module.

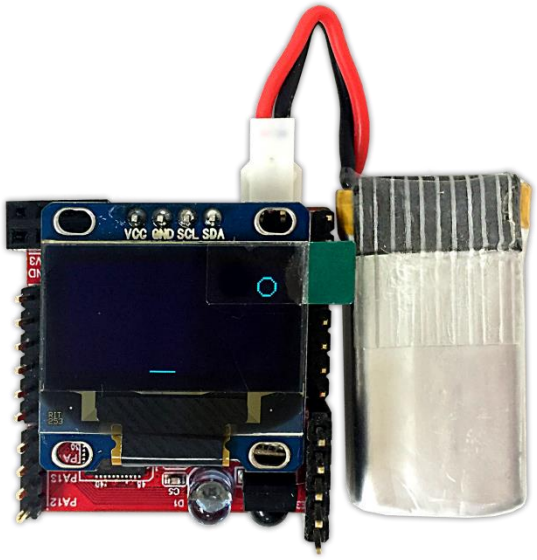


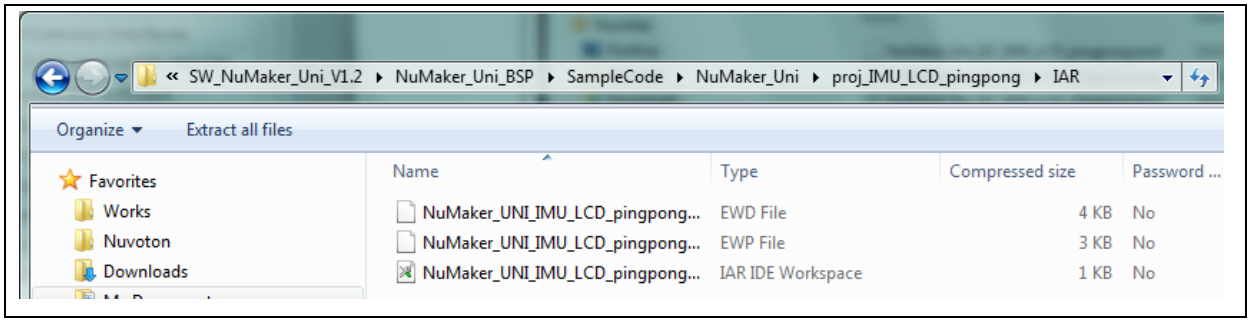
Figure 5-5 NuMaker Uni Sample Code Running

5.6.2 Using IAR Embedded Workbench to Program

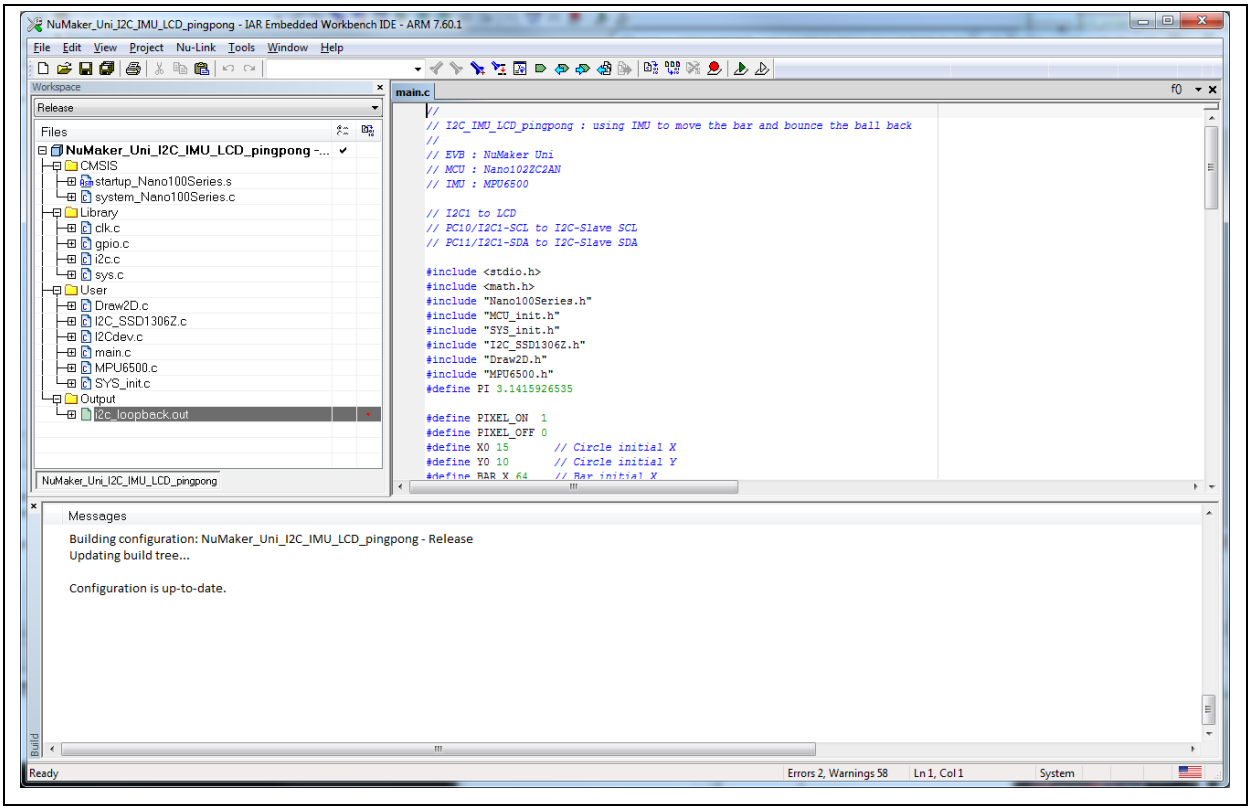
The example demonstrates how to download and debug an application on NuMaker Uni board.

1. The example file can be found in the directory list shown in the following figure.

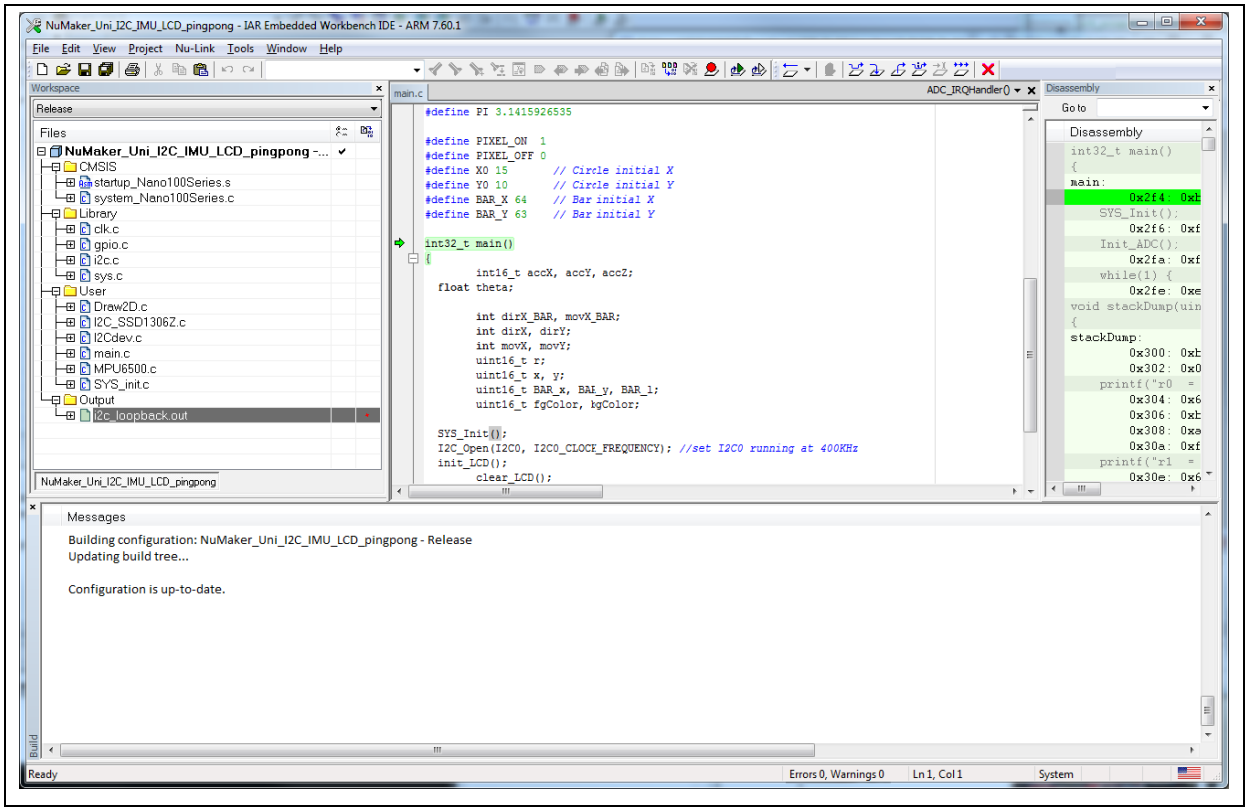
(Default:\SW_NuMaker_Uni_V1.2\NuMaker_Uni_BSP\SampleCode\NuMaker_Uni\proj_IMU_LCD_pingpong\IAR\)



2. Click “Make” to compile the sample code.



3. Click  “Download and Debug” to download binary code to NuMaker Uni.



4. After download, MCU should be up and running. If not, please reconnect the USB cable to power it up again. In this sample code, it is using IMU to detect motion for controlling the bar to bounce the ball back, as shown in Figure 5-5.

6 SAMPLE CODE DESCRIPTION

File path: \SW_NuMaker_Uni_V1.2\NuMaker_Uni_BSP\SampleCode\NuMaker_Uni

Category	Sample Code Name	Description
Project	proj_IMU_LCD_pingpong	Using IMU to move the bar and bounce the ball back
Project	proj_BT_Humidity	Using Bluetooth to report humidity to Smartphone
Project	proj_BT_Remote	Using Smartphone to control MCU to output IR code
ADC	ADC	Using Analog-to-Digital Converter to read sensor
ADC	ADC2_MQ2	Using Analog-to-Digital Converter to read Gas sensor
GPIO	GPIO_IRQ	GPIO interrupt triggered by buttons
GPIO	GPIO_RGBLED	GPIOs control R/G/B LEDs
I2C	I2C_HTU21D	Using I^2C to read humidity and transparency
IMU	I2C_IMU	Using I^2C to read IMU and display on Debug Session of Keil MDK
IMU	I2C_IMU_LCD	Using I^2C to read IMU and display on LCD
IMU	IMU_Tilt	Read Accelerometer to calculate title angles and print on Debug Session of Keil MDK
IMU	IMU_Tilt_LCD	Read Accelerometer to calculate title angles and print on LCD
LCD	I2C_LCD	Display 4 lines of text on LCD
LCD	I2C_LCD_bmp_cartoon	Draw and display multiple cartoons' bitmap on LCD
LCD	I2C_LCD_bmp_logo	Draw a bitmap of logo on LCD
LCD	I2C_LCD_bmp_menu	Display a menu bitmap on LCD
LCD	I2C_LCD_pingpong	Draw a bar and ball to emulate pingpong on LCD
PCB Test	PCB_All_Test	Testing All components and pins on PCB and display pass/fail status on LED
PWDN	PWDN_RTC_Wakeup	RTC time-out to wake up MCU from Power-down mode
PWDN	PWDN_TMR_Wakeup	Timer time-out to wake up MCU from Power-down mode
PWDN	PWDN _WDT_Wakeup	Watchdog Timer time-out to wake up MCU from Power-down mode
PWM	PWM_IrDA_NEC	IR emitter to transmit and IR receiver to receive NEC code
PWM	PWM_Music	PWM output tone to Buzzer to play music "Fur Elise"
PWM	PWM_Siren	PWM output dual frequency to buzzer
RTC	RTC_Alarm	RTC alarm in 5 seconds (printf onto display)
RTC	RTC_LCD	Display RTC Date & Time on LCD (without Power-down mode)
RTC	RTC_LCD_Clock	Draw a Clock & draw clock pointer every RTC tick
ICE	SEMIHOST	Using Keil MDK Debug Session
SPI	SPI_Loopback	SPI MOSI connected to MISO
SPI	SPI_NRF24L01	nRF24L01 Transmitter & Receiver Testing

SPI	SPI_RFID_RC522	RFID Reader RC522 reading RFID Tag
TMR	TMR1	Timer1 counting
TMR	TMR1_LED	Timer1 controlled (no water) to target board
TMR	TMR3_Capture_SR04	Timer3 capture Ultrasonic sensor ranger
UART0	UART0_BT_RX_LCD	Bluetooth Receive & display on LCD
UART0	UART0_BT_TEST_LCD	Returning Universal donative contract
UART1	UART1_WiFi_TCPclient	ESP8266 run as TCP client
UART1	UART1_WiFi_TCPserver	ESP8266 run as TCP server
UART1	UART1_WiFi_LCD	ESP8266 run as a TCP with LCD display
UART1	UART1_WiFi_Test_LCD	Test ESP8266 AT Command OK
WDT	WDT_Interrupt	Watchdog Timer time-out to interrupt MCU
WDT	WDT_Reset	Watchdog Timer time-out to reset MCU

6.1 Application Project Examples

6.1.1 NuMaker Uni Components and Socket Pins Test

File Name	Default Directory
NuMaker_Uni_PCB_Test_All.uvproj	\SW_NuMaker_Uni_V1.2\NuMaker_Uni_BSP\SampleCode\NuMaker_Uni\PCB_TEST_All\KEIL

NuMaker_Uni_PCB_Test_All.uvproj allows users to check all components and socket pins on NuMaker Uni. This project is already downloaded into NuMaker Uni. The NuMaker Uni has passed this test before product delivery. Here is the list of all tests:

1. R/G/B LED
2. Bluetooth module
3. Wi-Fi module
4. GPIO
5. Temperature-Humidity sensor
6. Extension pins provide SPI, I^2C, PWM, and ADC interfaces

Please follow the below steps to download and execute the sample project.

1. To execute this sample project, some extension pins need to be short on NuMaker Uni. The hardware setting as shown in Figure 6-1.

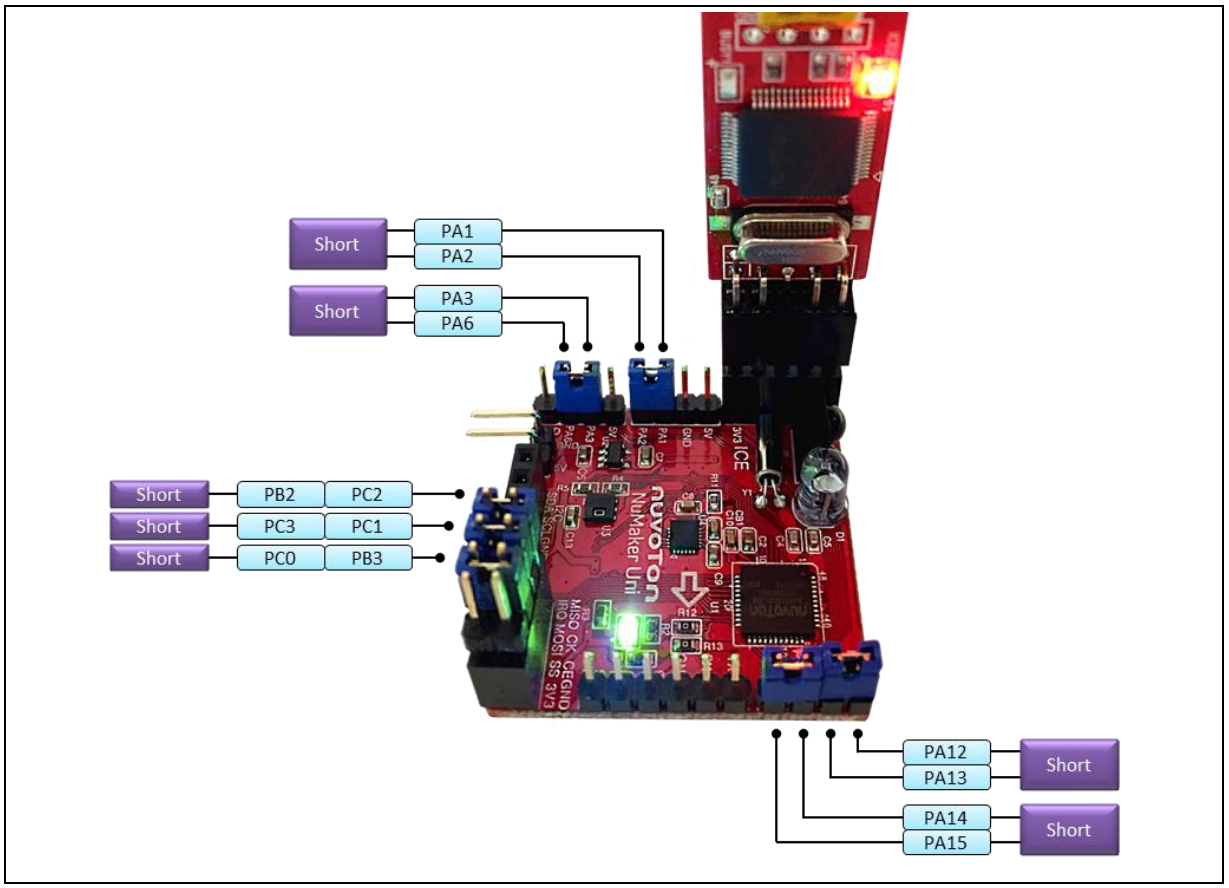


Figure 6-1 NuMaker Uni Hardware Setup

2. Download the demo firmware to NuMaker Uni, click  "Start Debug Session", and click  "Run".
3. The Blue LED turns on means the R/G/B LED, the Bluetooth Module, the Wi-Fi Module, and the I^2C module is ready to use.
4. After finishing all the tests, LED will turn on depend on the tests result. The Green LED turns on means all tests pass, as shown in Figure 6-2. The Red LED turns on means at least one test fails.

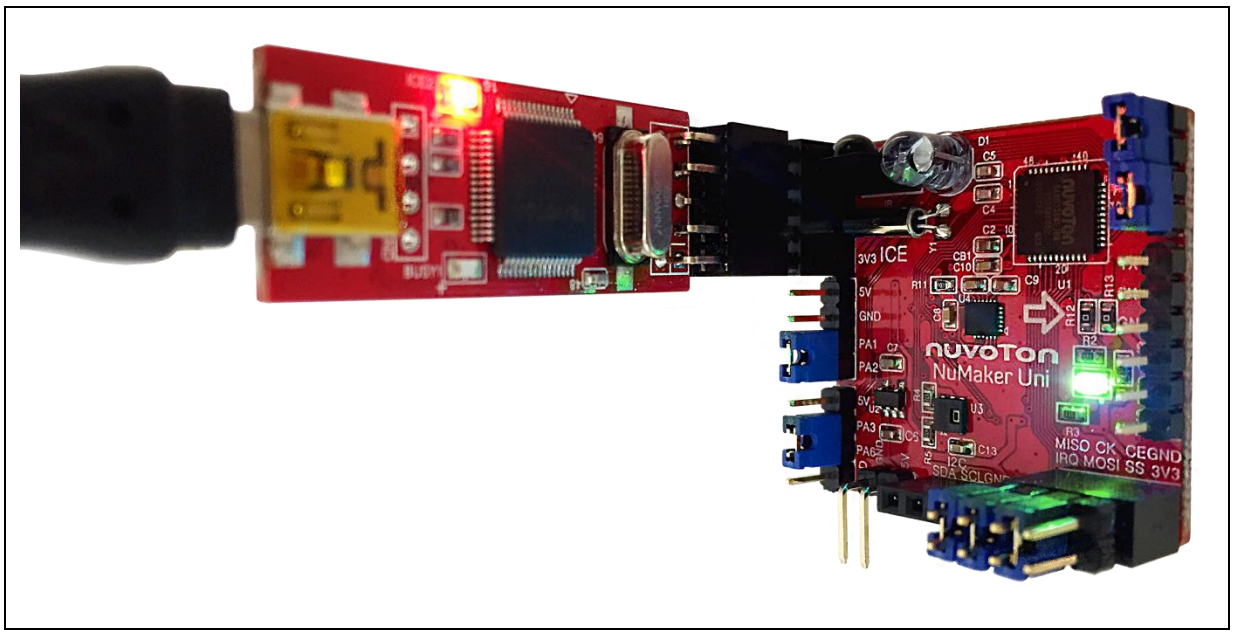


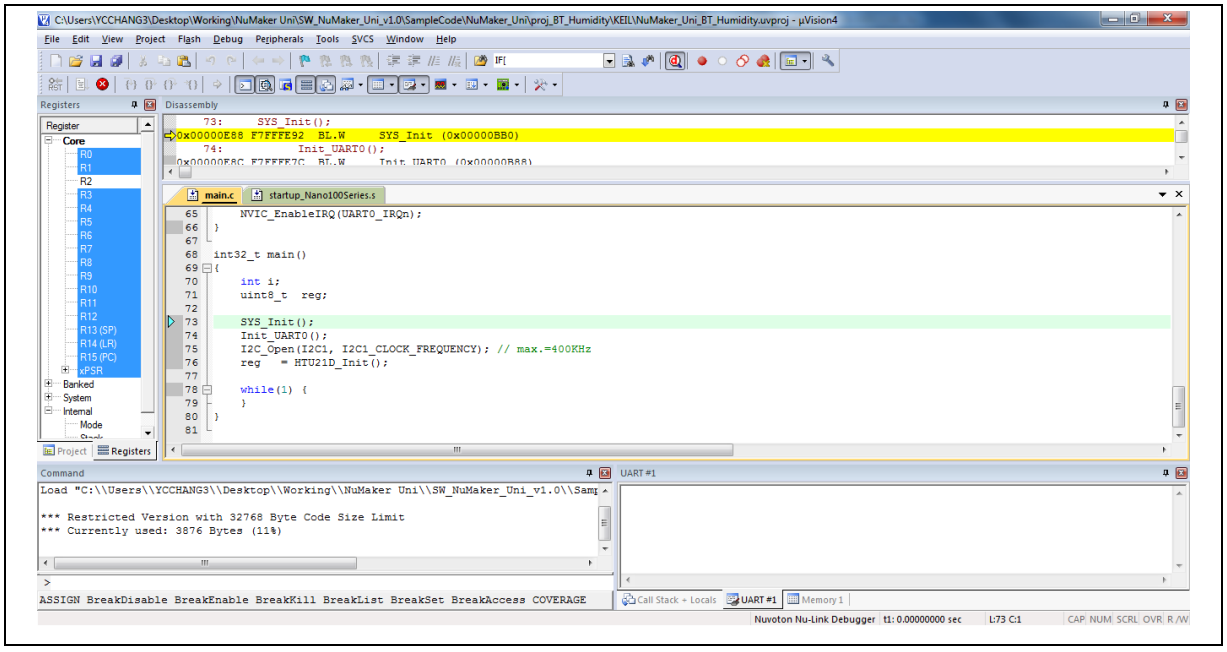
Figure 6-2 Green LED Turns On

6.1.2 Using NuMaker Uni to Detect Temperature and Humidity

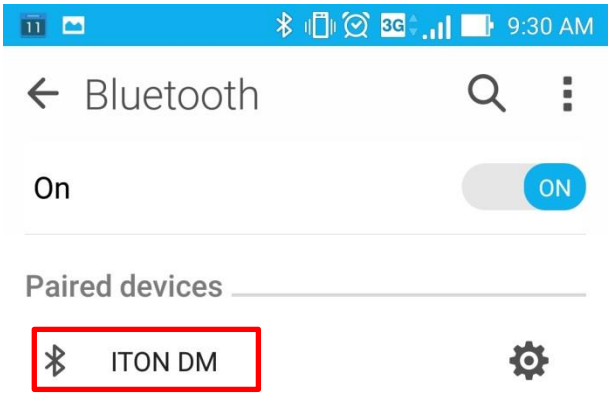
File Name	Default Directory
NuMaker_Uni_BT_Humidity.uvproj	\SW_NuMaker_Uni_V1.2\NuMaker_Uni_BSP\SampleCode\NuMaker_Uni\proj_BT_Humidity\KEIL
NuMaker_Uni_BT_Humidity.apk	\SW_NuMaker_Uni_V1.2\NuMaker_Uni_APP\Android

The NuMaker Uni BT Humidity APP allows the android phone or tablet to connect with NuMaker Uni. The proj_BT_Humidity project allows NuMaker Uni to detect environment temperature and humidity and send these information to the android phone or tablet. Please follow the below steps to install and execute the application project.

1. Connect the NuMaker Uni board to a computer through a Mini USB cable, and place the NuMaker Uni board on a flat surface.
2. Download the demo firmware to NuMaker Uni, click  "Start Debug Session", and click  "Run".

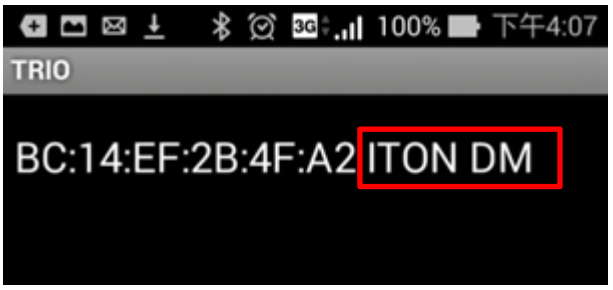


3. Install NuMaker_Uni_BT_Humidity.apk on an android phone or tablet.
4. Set up your phone with Bluetooth on. Search for Bluetooth device “ITON DM” and pair with your phone.



5. Open NuMaker Uni BT Humidity APP.

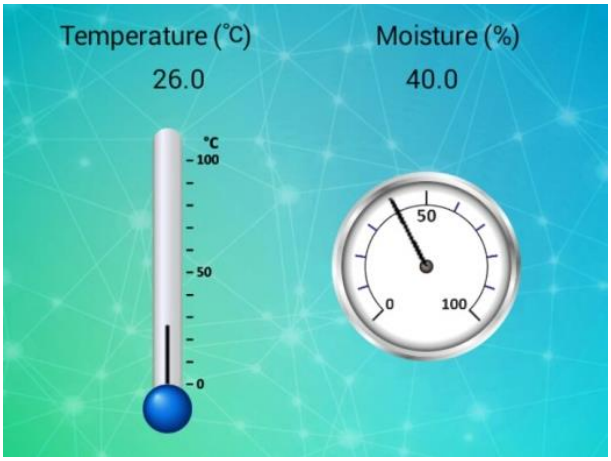
6. Tap “Connect” and select the Bluetooth device “ITOM DM”.



7. After connected, a new page will appear on NuMaker Uni BT Humidity APP.

8. Select Temperature/Humidity Meter.

9. Temperature and humidity visual indicators show.



6.1.3 Using NuMaker Uni to Receive Information from NuMaker Uni APP

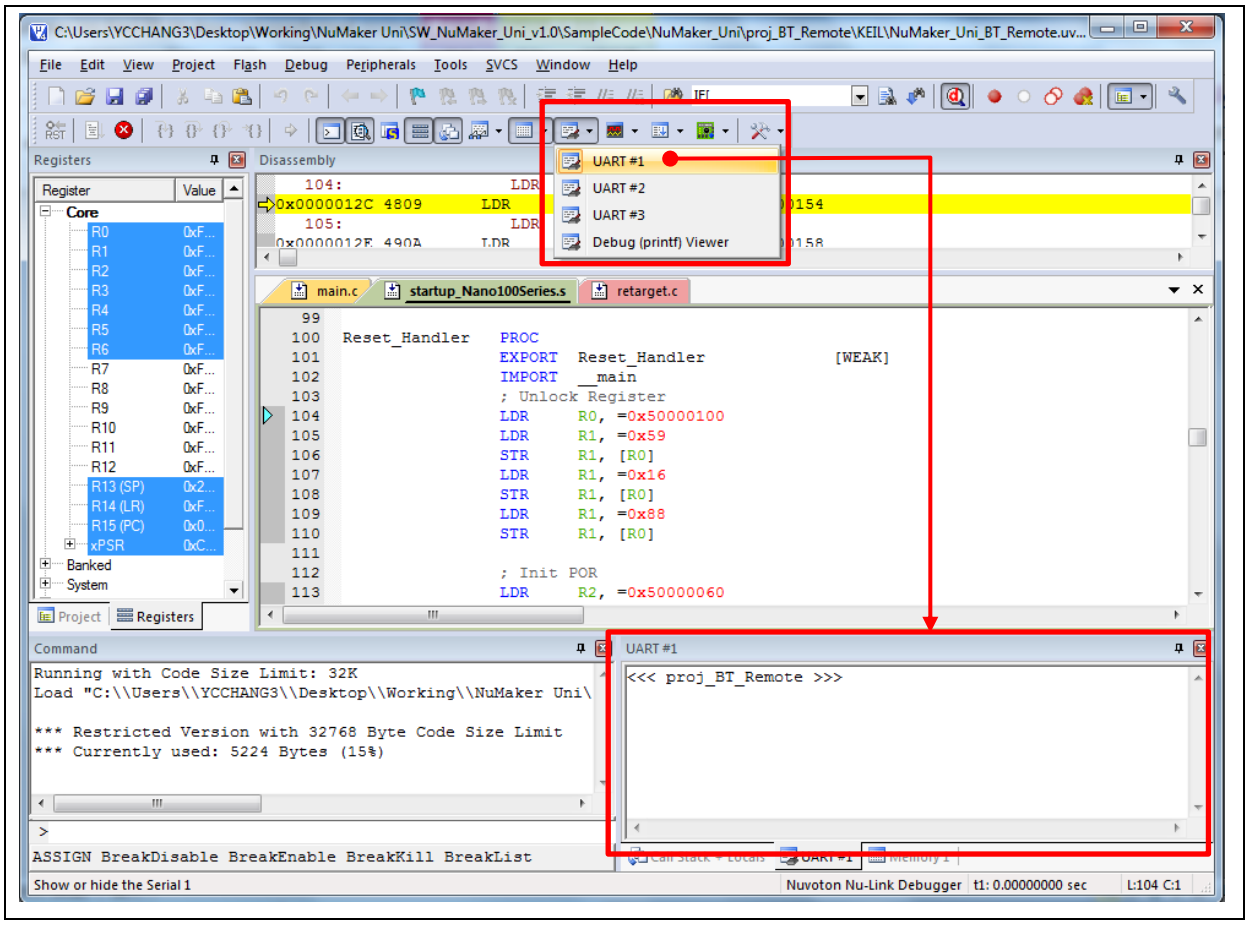
File Name	Default Directory
NuMaker_Uni_BT_Remote.uvproj	\SW_NuMaker_Uni_V1.2\NuMaker_Uni_BSP\SampleCode\NuMaker_Uni\proj_BT_Remote\ KEIL
NuMaker_Uni_BT_Remote.apk	\SW_NuMaker_Uni_V1.2\NuMaker_Uni_APP\Android

The NuMaker Uni BT Remote APP allows users to use the android phone or tablet as remote control. The proj_BT_Remote project allows NuMaker Uni to work as a receiver. Please follow the steps below to install and execute the application project.

1. Connect the NuMaker Uni board to a computer through a Mini USB cable, and place the NuMaker Uni board on a flat surface.

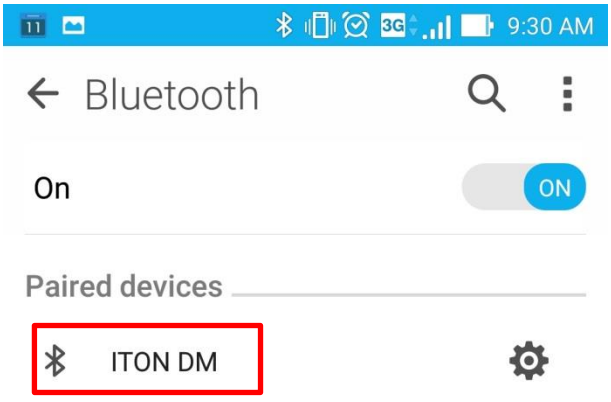
2. Download the demo firmware to NuMaker Uni, click  “Start Debug Session”, and click  “Run”.

3. Click “Serial Windows” and select “UART #1”. The UART #1 windows will appear.

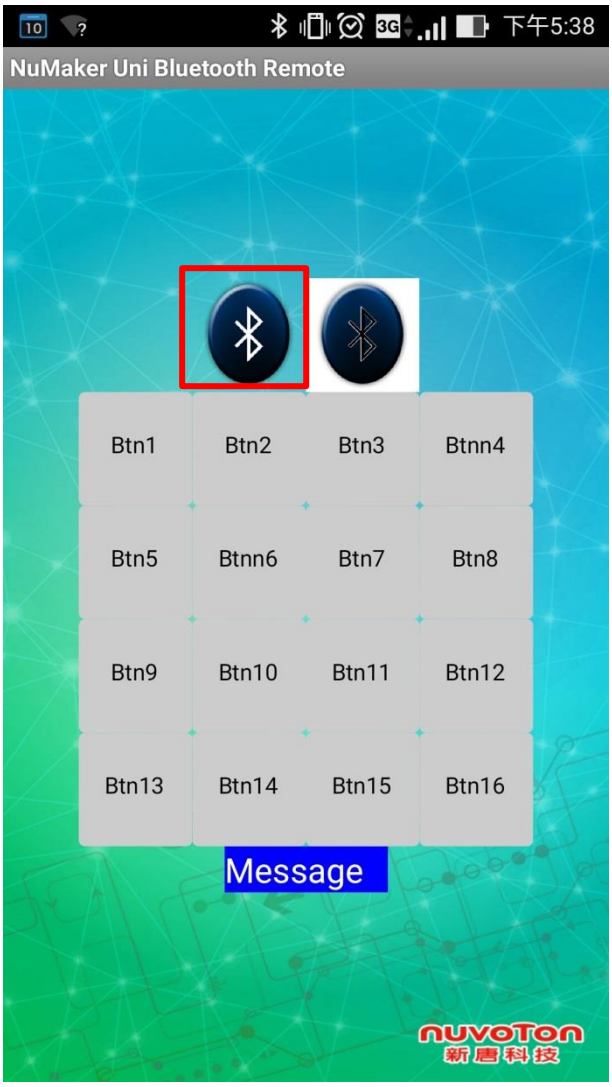


4. Install NuMaker_Uni_BT_Remote.apk on an android phone or tablet.

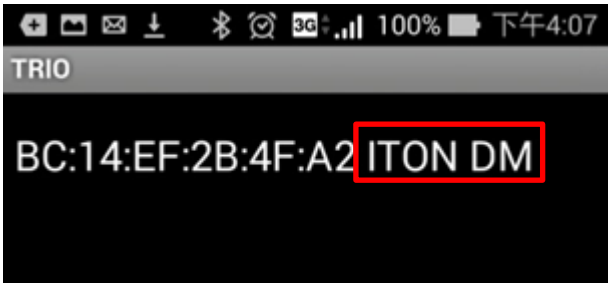
5. Set up your phone with Bluetooth on. Search for Bluetooth device “ITON DM” and pair with your phone.



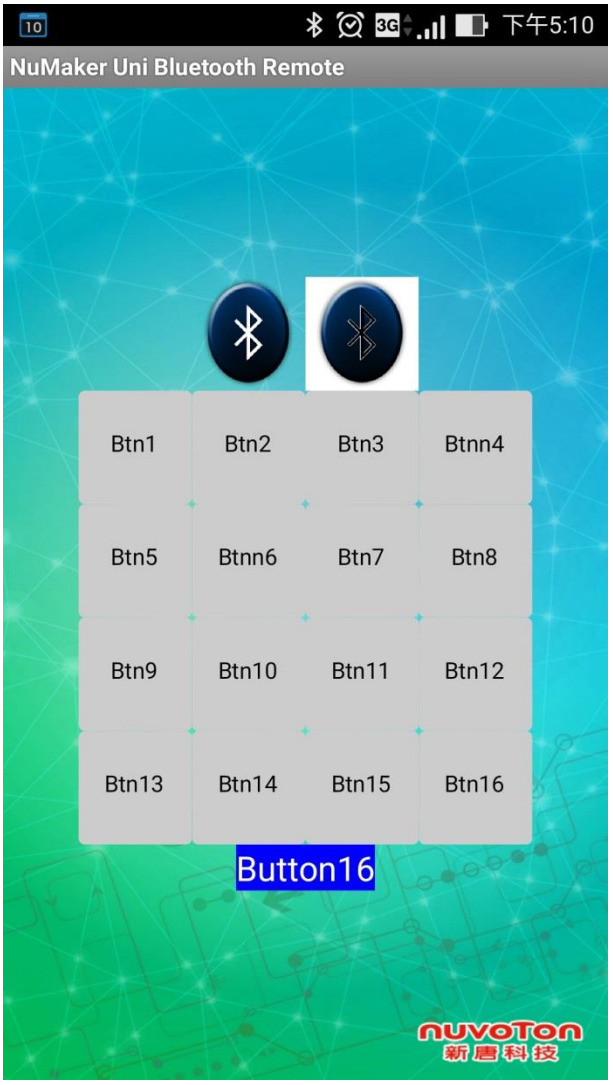
6. Open NuMaker Uni BT Remote APP and tap the left Bluetooth icon.



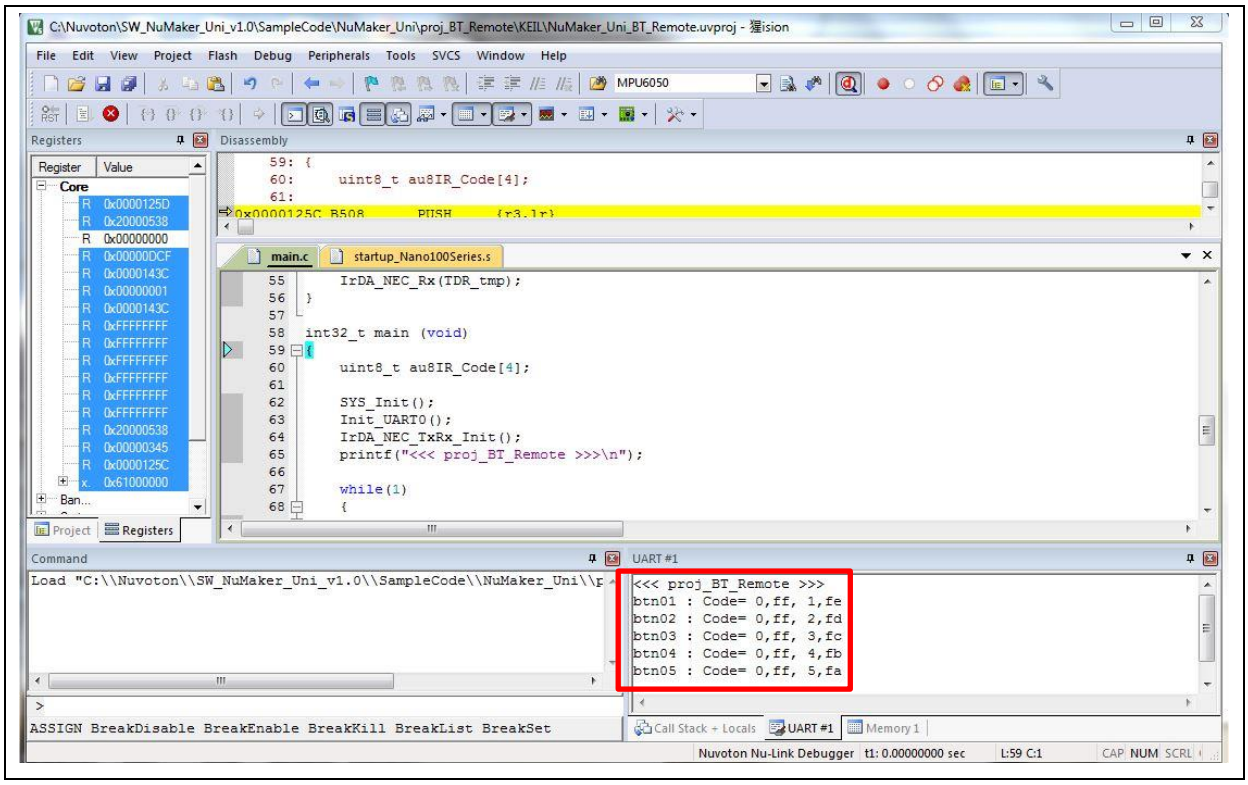
7. Select the Bluetooth device “ITOM DM”.



8. After connected, buttons Btn1 ~ Btn16 will be shown on NuMaker Uni BT Remote APP.



9. Randonly click the button. The result will be sent to the NuMaker Uni through Bluetooth, and shown immediately in the UART #1 windows.



7 REVISION HISTORY

Date	Revision	Description
2016.05.08	1.00	1. Initially issued.
2016.11.16	1.01	1. Updated the folder path of sample code in section 5.6 and section 6.1.

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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.