Nu-Bridge User Manual

Nov. 22, 2013 Rev. 0.02

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1 Overview

The Nu-Bridge dongle, a portable handy debugging tool, is developed based on the NuMicro™ NUC123 microcontroller (MCU) with Windows application for developers to control or monitor the SPI and I^2C interface of target chip. The Nu-Bridge provides an easy and convenient firmware update mechanism for users to change its function.

The Nu-Bridge application and firmware source code are open sourced, and thus users can add new features or develop new user interfaces.

1.1 Applications

The Nu-Bridge dongle is designed to support multiple uses. Some of possible applications are listed below.

- USB to UART
- USB to SPI
- USB to I^2C
- USB to PWM
- USB to I^2S
- ADC to USB
- UART/SPI/I^2C interface monitor

Note: The I^2S, PWM and ADC related functions are not implemented yet.

1.2 Features

- Supports USB 2.0 Full speed
- Supports firmware update with Windows File Explorer
- Supports Serial Interfaces, up to two SPI/ two I^2C / two UART interfaces
- Supports one I^2S interface with one I^2C interface
- Supports four PWM output channels
- Supports four ADC input channels
- Provides ten possible interface combinations and applications
- Windows application for controlling Nu-Bridge is included
- Both firmware and Windows application are open sourced

2 Environment Setup

2.1 System Requirements

The following table lists the system requirements to execute Nu-Bridge application. It is highly recommended to use Windows 7 or above instead of Windows XP system.

Suggested System Requirements	Minimum System Requirements
Windows® 7 (Updated with the latest Service Pack)	Windows® XP (Service Pack 3)
2 GB RAM or above	1 GB RAM
Supports USB2.0	Supports USB1.1
1280 x 800 screen resolution or above	1024 x 768 screen resolution

Table 2-1 System Requirements

2.2 Firmware Update

The Nu-Bridge dongle is shipped with Dual Virtual Com Port firmware inside. To use SPI master, SPI monitor, I^2C master or I^2C monitor function and connect with Nu-Bridge windows application, the dongle firmware needs to be updated. New firmware can be downloaded from Nu-Bridge official web page and updated via mass storage ISP function.

Official Nu-Bridge English web page: http://www.nuvoton.com/Nu-Bridge-EN

2.2.1 Mass Storage ISP

To start mass storage ISP, please short pin 2 and pin 7 of the Nu-Bridge dongle and then plug the dongle to an USB port on a computer. The Nu-Bridge dongle will be identified as a removable storage device with 64 KB capacity, as shown in Figure 2-1 Mass Storage ISP). Please select and copy firmware to the device for firmware update.

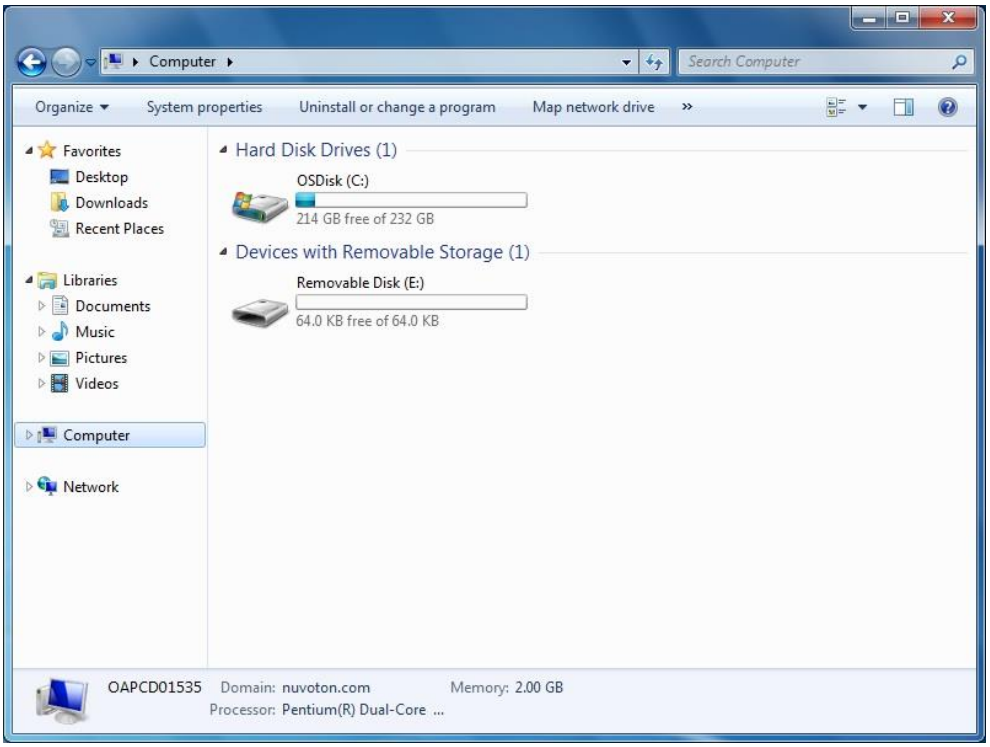


Figure 2-1 Mass Storage ISP

2.3 Dual Virtual Com Port Driver Installation

It is required to install a device driver when using the Nu-Bridge dongle as a Dual Virtual Com Port device. The installation steps on Windows 7 are listed below:

- Step 1: Plug Nu-Bridge dongle to an USB port on a computer.
- Step 2: Stop Windows from getting the driver automatically.

- Step 3: Open “Control Panel->Devices and Printers”, and there will be exclamation marks shown on two USB Virtual COM devices.

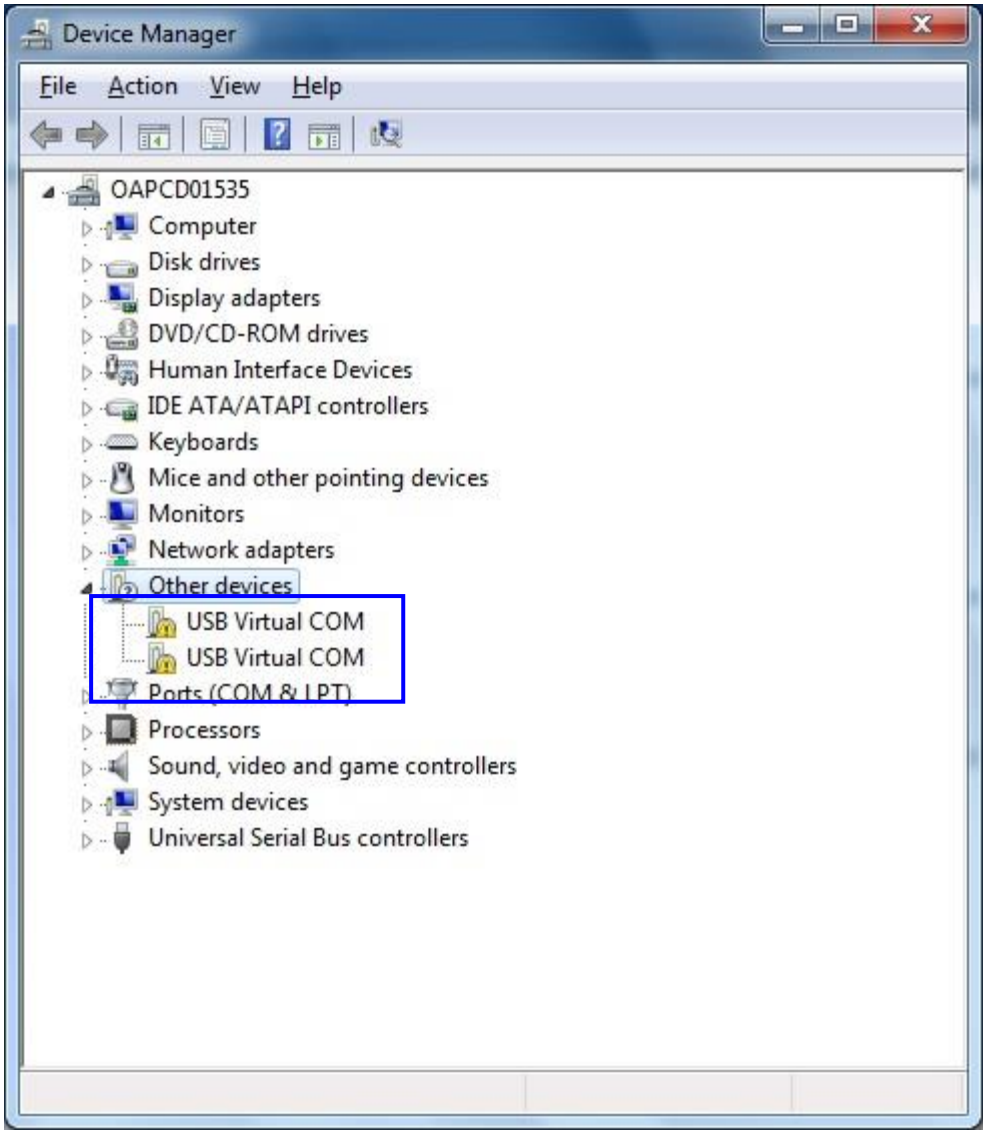


Figure 2-2 Device Manager Shows Dual Virtual Com

- Step 4: Update the drivers manually for the two Virtual COM Port devices.

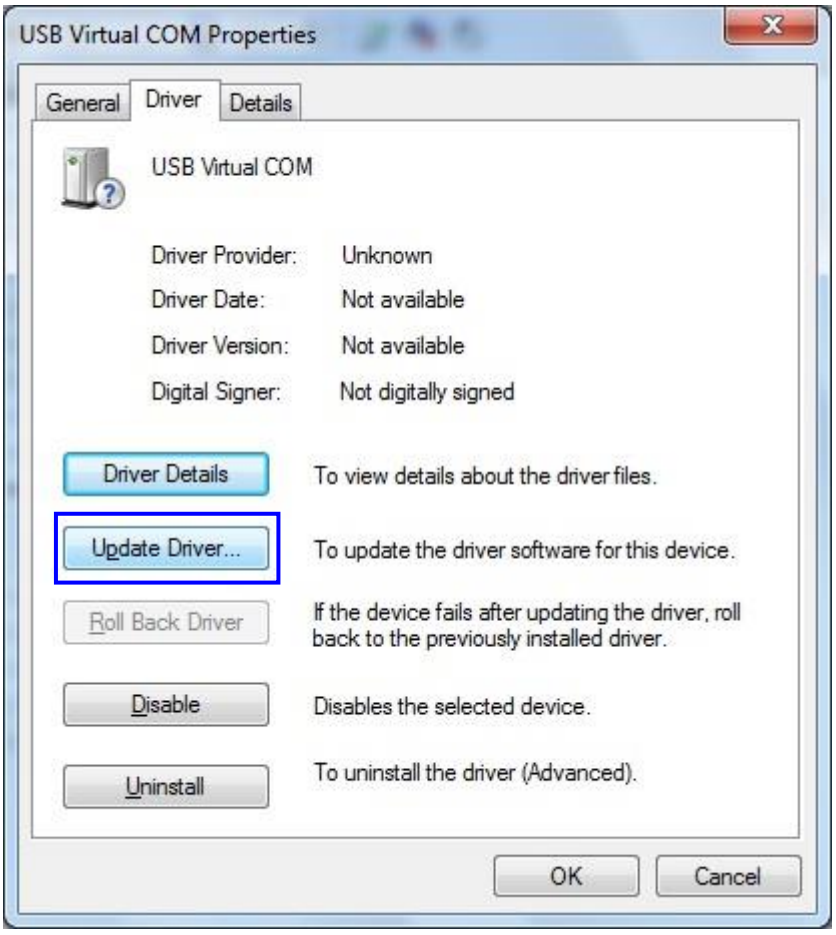


Figure 2-3 Update Driver Manually

- Step 5: Select the directory where the driver file is stored.

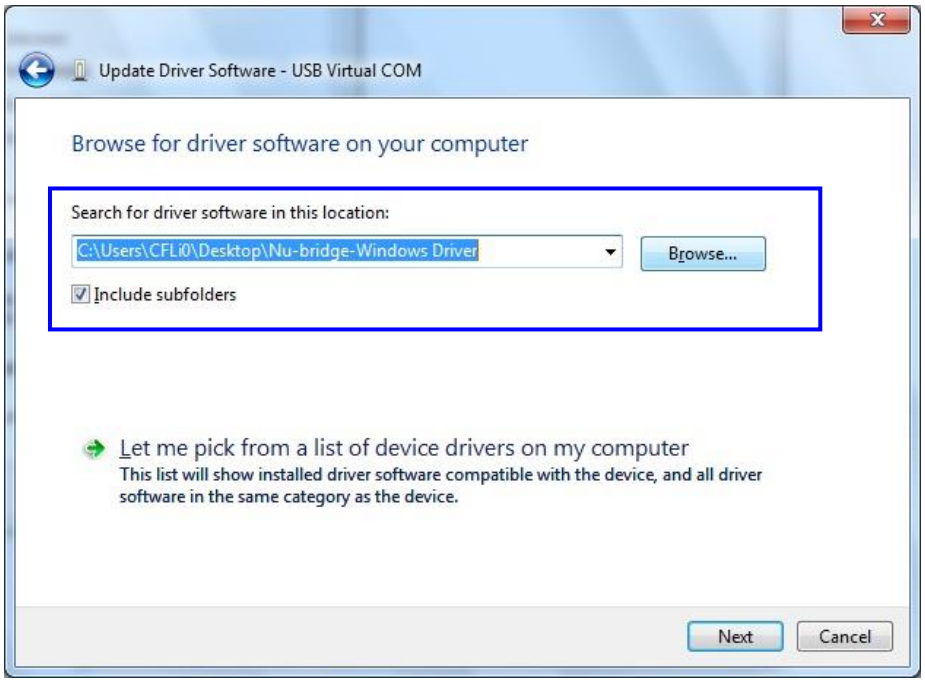


Figure 2-4 Select Device Driver

- Step 6: A Windows security warning message will appear after you select the driver file. Please select “Install this driver software anyway” to proceed with installation.

Figure 2-5 Driver Installation Warning Message

- Step 7: Virtual COM Port installation is complete.

Figure 2-6 Driver Installation Complete

- Step 8: Please follow Step 4 ~ 7 to install the driver for another Virtual Com Port.

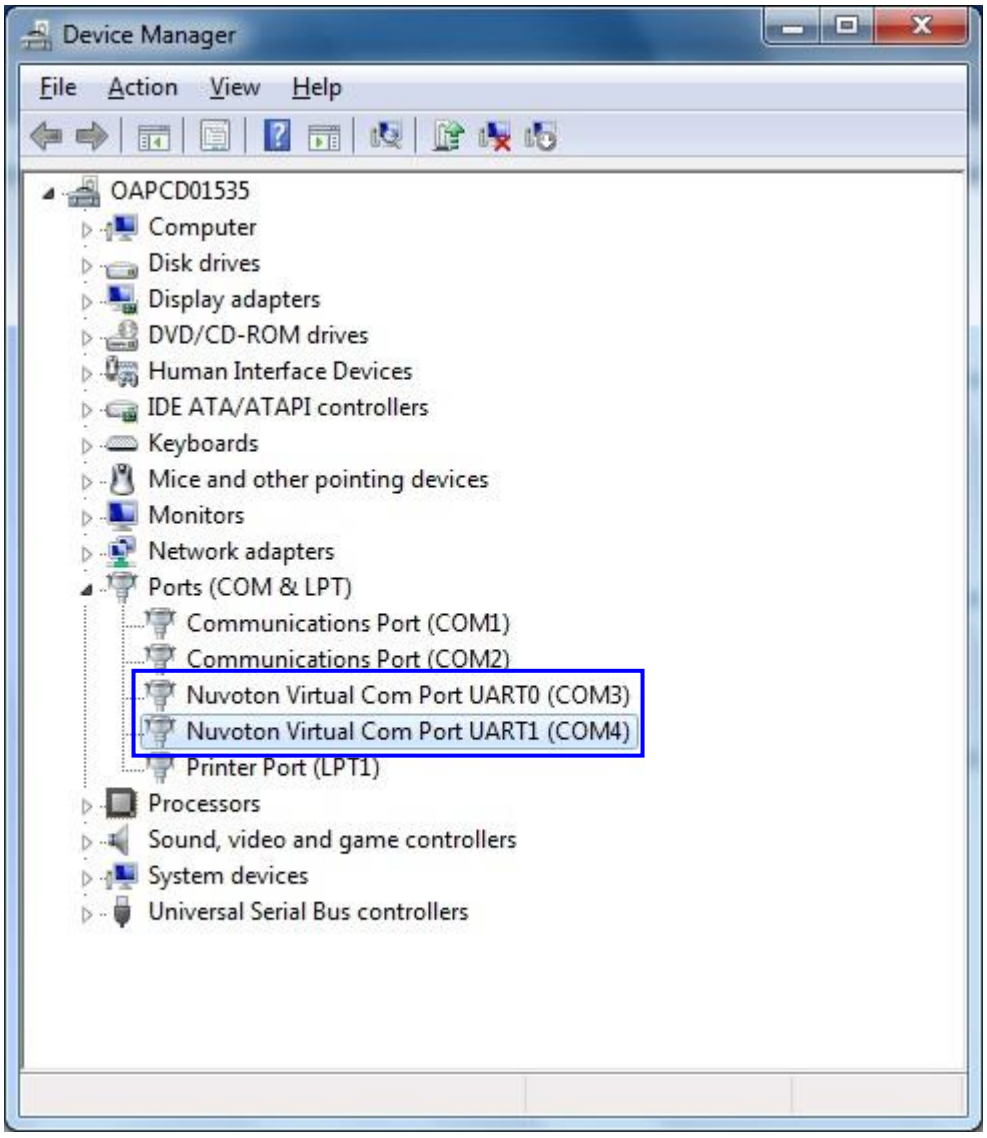


Figure 2-7 Dual Virtual COM Port Driver Installation Complete

2.4 USB Device Driver Installation

This section introduces the steps to install the Nu-Bridge device driver on Windows XP and Windows 7.

2.4.1 Microsoft Windows 7

Please follow the steps below to install USB device driver:

- Step 1: Double click the WinUSB4NuVCOM.exe to install the driver.
- Step 2: Click the “Next” button shown on the Setup Wizard window.

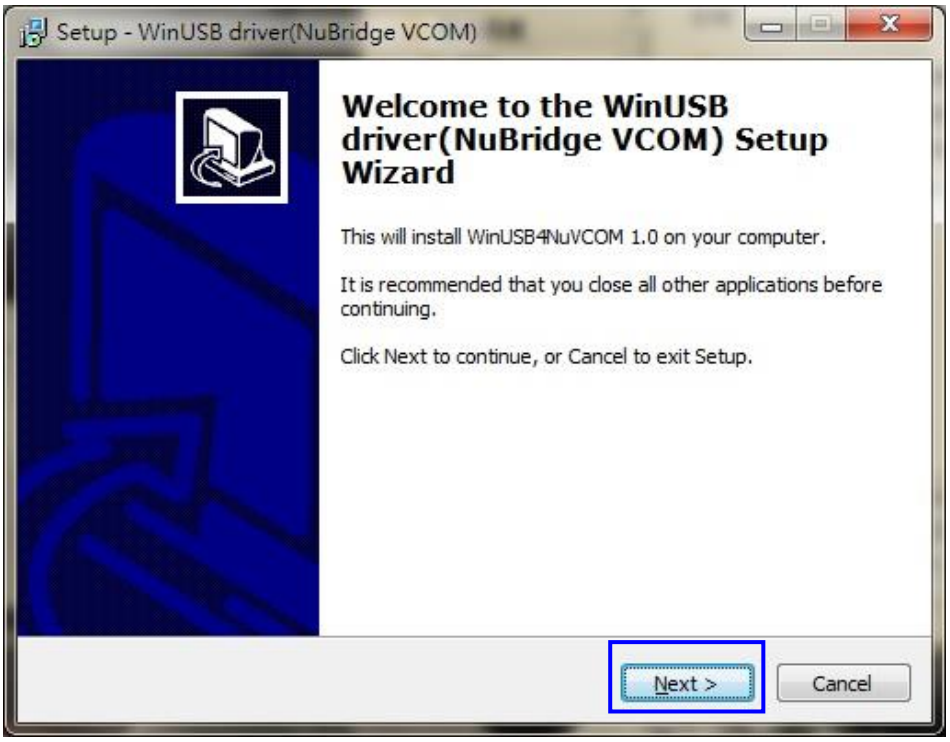


Figure 2-8 USB Device Driver Installation

- Step 3: Two warnings will be shown during installation. Please select “Install this driver software anyway” to install the driver.

Figure 2-9 USB Driver Installation Warning Message

- Step 4: After driver installation is complete, Windows operating system should be able to detect the Nu-Bridge dongle, and load the corresponding USB configuration automatically. Users can confirm if the driver is installed correctly by checking USB Tool through “Control Panel->Devices and Printers”. If the Nu-Bridge Virtual Com Port and WinUSB Driver (Nu-Bridge BULK) are shown, the driver is installed successfully.

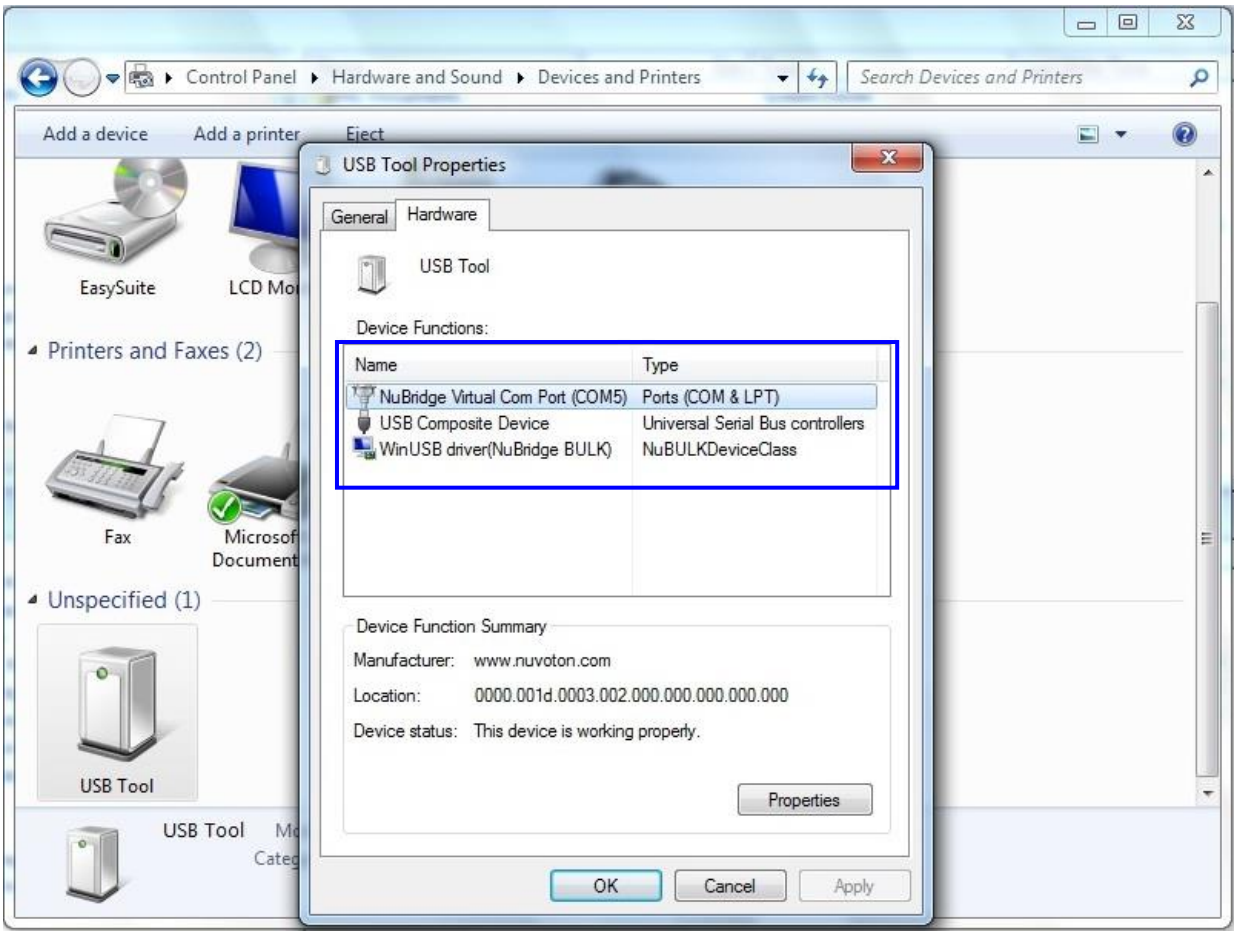


Figure 2-10 Nu-Bridge USB/Virtual Com Port Device

2.4.2 Microsoft Windows XP SP3

This section introduces driver installation on the Microsoft Windows XP SP3. The installation steps are listed below:

- Step 1: Select and execute the *WinUSB4NuVCOM.exe*, and click the “Next” button to install the driver.

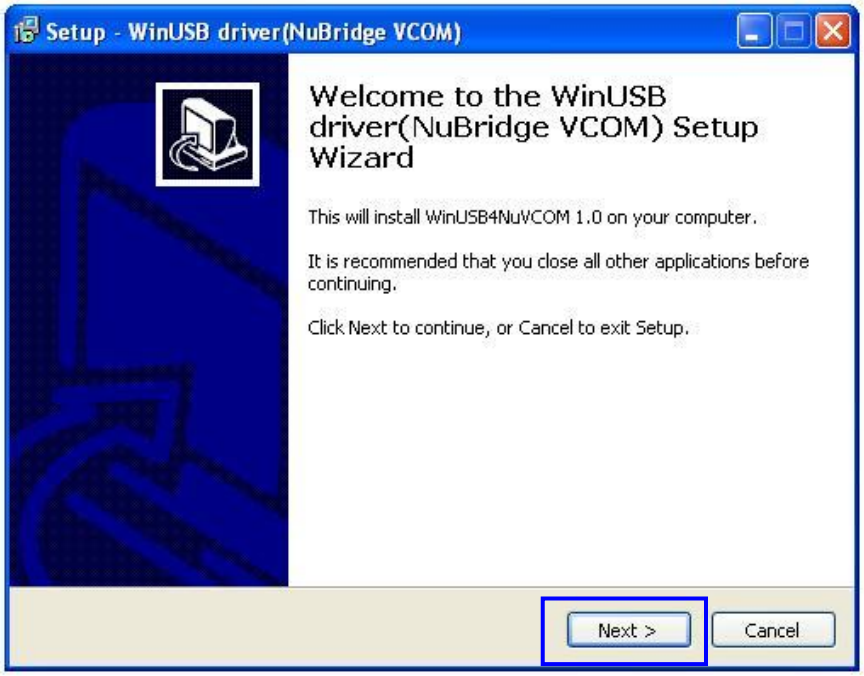


Figure 2-11 Windows XP USB Driver Installation - Step 1

- Step 2: Select a folder to install the driver, and then click the “next” button.

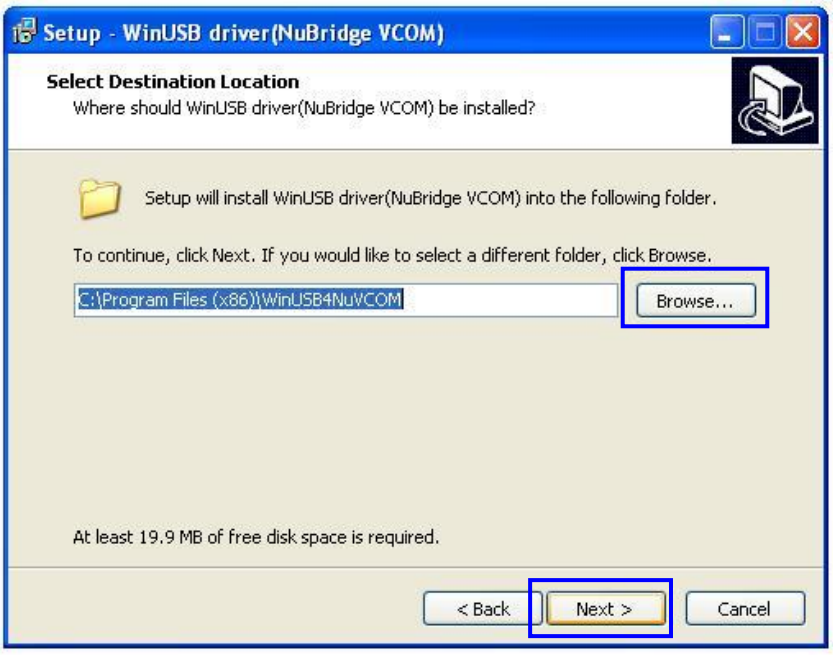


Figure 2-12 Windows XP USB Driver Installation - Step 2

- Step 3: Specify the folder name in Start Menu, and then click the “Next” button.

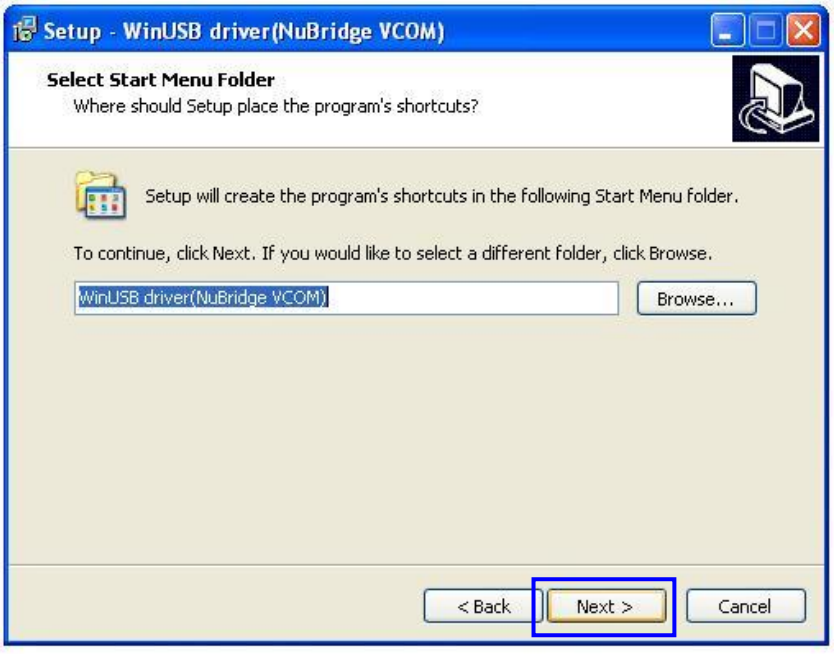


Figure 2-13 Windows XP USB Driver Installation - Step 3

- Step 4: Click the “Install” button to install driver.

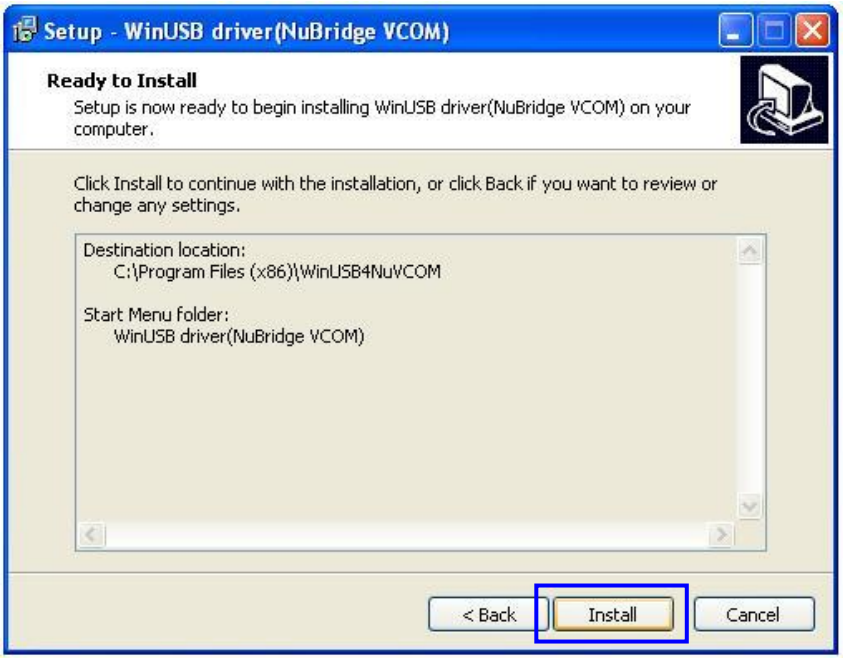


Figure 2-14 Windows XP USB Driver Installation - Step 4

- Step 5: Wait for the files to copy to their destination folder.

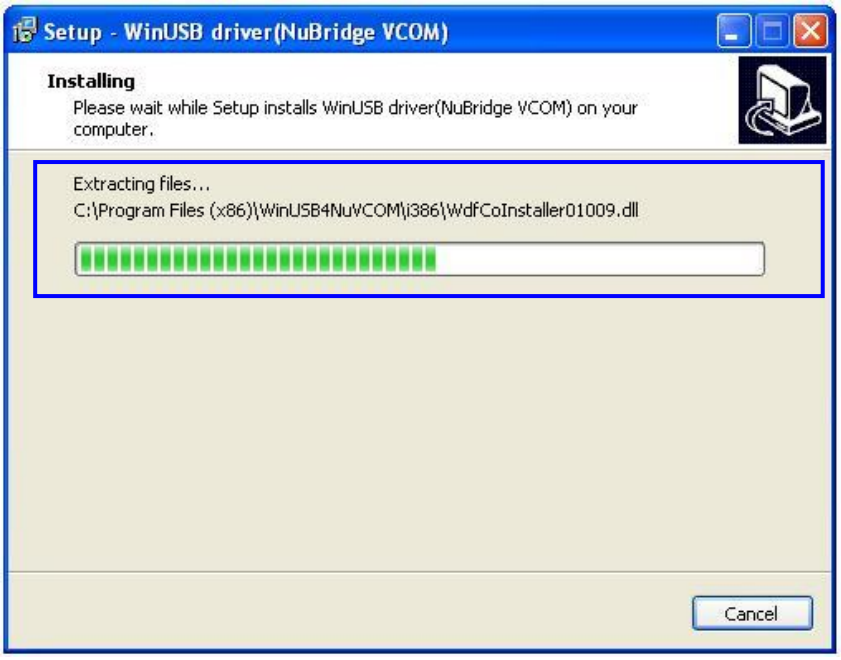


Figure 2-15 Windows XP USB Driver Installation - Step 5

- Step 6: Click “Next” to copy the driver files to the destination folder and the Device Driver Installation Wizard will be executed.

Figure 2-16 Windows XP USB Driver Installation - Step 6

- Step 7: Wait for the files to be copied to the system folder.

Figure 2-17 Windows XP USB Driver Installation - Step 7

- Step 8: If a warning message appears, click the “Continue Anyway” button.

Figure 2-18 Windows XP USB Driver Installation - Step 8

- Step 9: After driver installation is compete, Device Driver Installation Wizard shows that the two devices are ready to use. Click the “Finish” button.

Figure 2-19 Windows XP USB Driver Installation - Step 9

- Step 10: Click the “Finish” button in the WinUSB driver setup form.

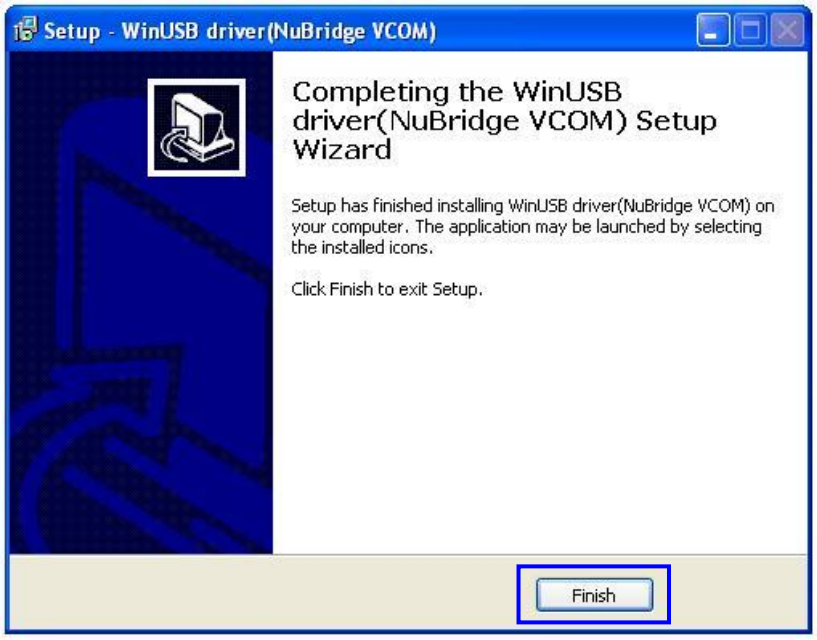


Figure 2-20 Windows XP USB Driver Installation - Step 10

- Step11: Plug the Nu-Bridge dongle to an USB port, and a dialog box will appear showing that a new hardware is found and ask to search for the driver software. Select “Yes, now and every time I will connect a device”.

Figure 2-21 Windows XP USB Driver Installation - Step 11

- Step 12: Found device Nu-Bridge Virtual Com Port, please select “Install the software automatically (Recommended)” and then click the “Next” button.

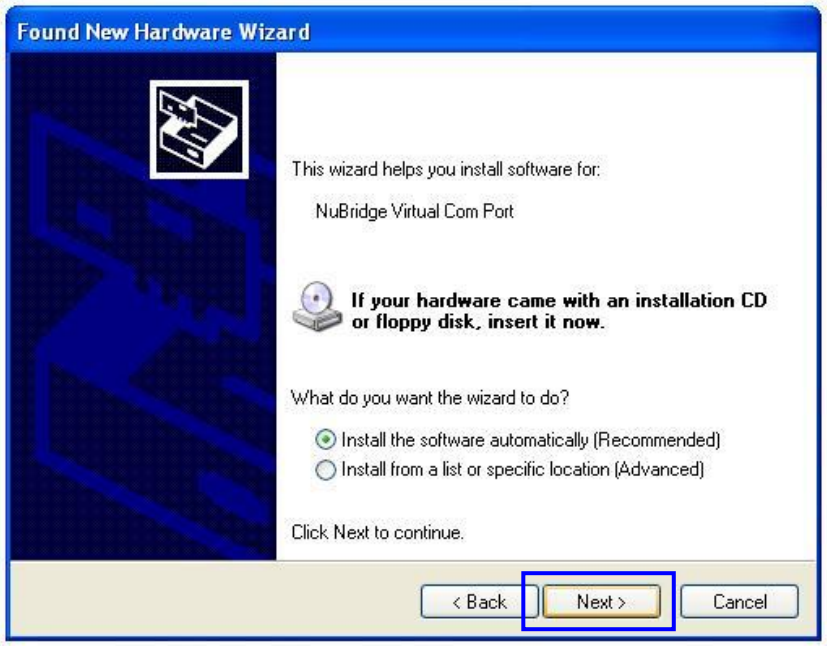


Figure 2-22 Windows XP USB Driver Installation - Step 12

- Step 13: Wait for the Found New Hardware Wizard to install the Nu-Bridge Virtual Com Port driver.

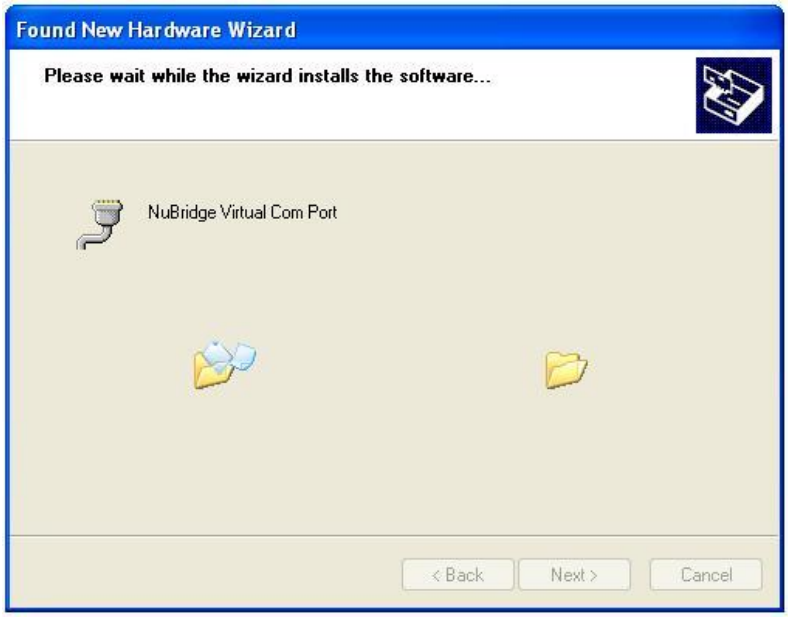


Figure 2-23 Windows XP USB Driver Installation - Step 13

- Step 14: A hardware installation form will pop up. Please click “Continue Anyway”.

Figure 2-24 Windows XP USB Driver Installation - Step 14

- Step 15: The Nu-Bridge Virtual Com Port driver installation is complete. Click the “Finish” button.

Figure 2-25 Windows XP USB Driver Installation - Step 15

- Step 16: Windows prompts a new device was found again.

Figure 2-26 Windows XP USB Driver Installation - Step 16

- Step 17: Repeat Step12 ~15 until the WinUSB (Nu-Bridge BULK) device driver installation is complete.

Figure 2-27 Windows XP USB Driver Installation - Step 17

- Step 18: After driver installation is complete. Users can find the WinUSB Driver (Nu-Bridge BULK) and Nu-Bridge Virtual Com Port through “Control Panel->Device Manager”.

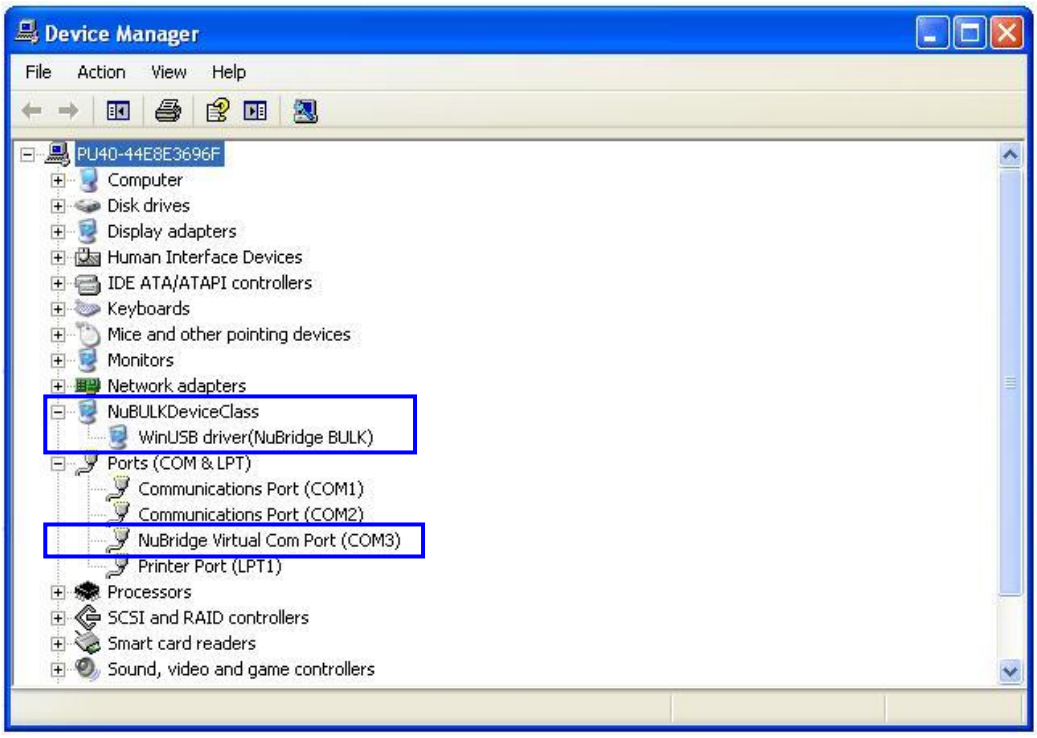


Figure 2-28 Windows XP Nu-Bridge Driver Installed Successfully

2.5 Windows Application Installation

Users can download the latest Nu-Bridge application from the official Nu-Bridge web page. It is a single executable file and ready for execution without installation.

Official Nu-Bridge English web page: http://www.nuvoton.com/Nu-Bridge-EN

3 Nu-Bridge User Interface and Function Introduction

3.1 User Interface

The Nu-Bridge supports English, Traditional Chinese and Simplified Chinese user interfaces. Users can set the UI language by using the “Language” pull-down menu on the upper left corner of the main window.

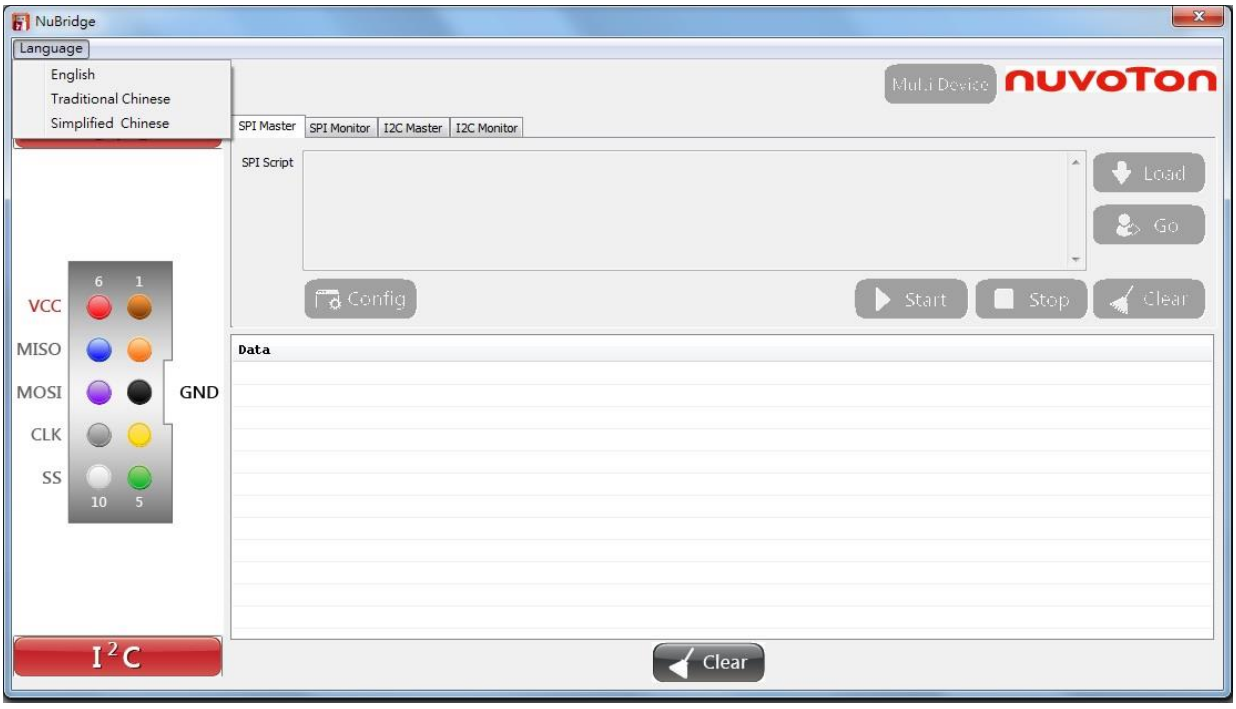


Figure 3-1 Application UI Language Selection

As shown in Figure 3-2 Operating Window, the user interface consists of the Control pane, Connector pane, Data pane and Connect and Clear buttons. The Connect button is used to detect the Nu-Bridge dongle and check if USB driver is installed successfully. The Clear button is used to clear the Data pane.

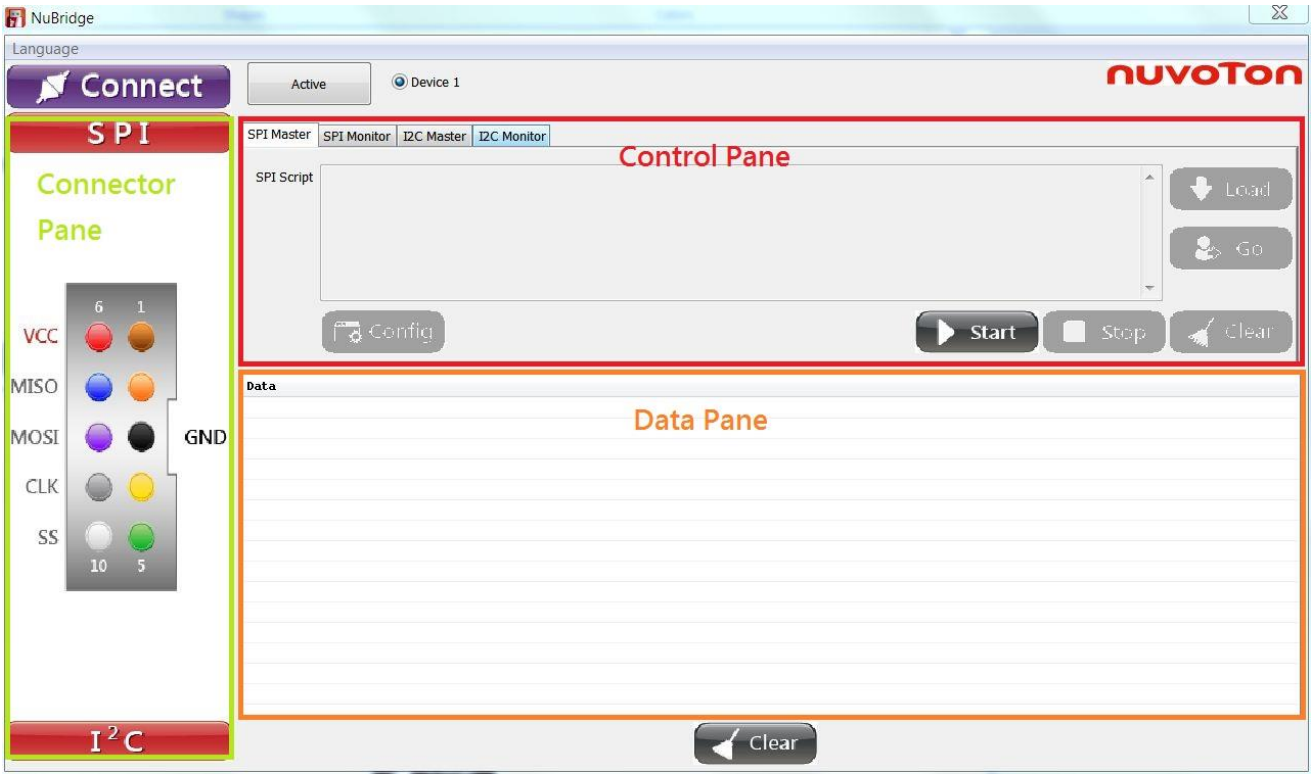


Figure 3-2 Operating Window

3.1.1 Control Pane

This pane provides SPI and I^2C master and monitor function, enables users select Nu-Bridge dongle to switch between different functions.

3.1.2 Connector Pane

When using different features of the Nu-Bridge dongle, this pane shows the correct connection on the dongle connector. So user can use this information to verify the connection between dongle and device under testing.

3.1.3 Data Pane

This pane shows the captured data in hexadecimal format.

3.2 Nu-Bridge Dongle Detection

When using the Nu-Bridge, firstly, click the “Connect” button to detect the connected dongle device. The detailed procedure is listed below:

- Step 1: Click the “Connect” button to detect the connected Nu-Bridge dongle.
- Step 2: Wait for an information window to show the number of Nu-Bridge detected.

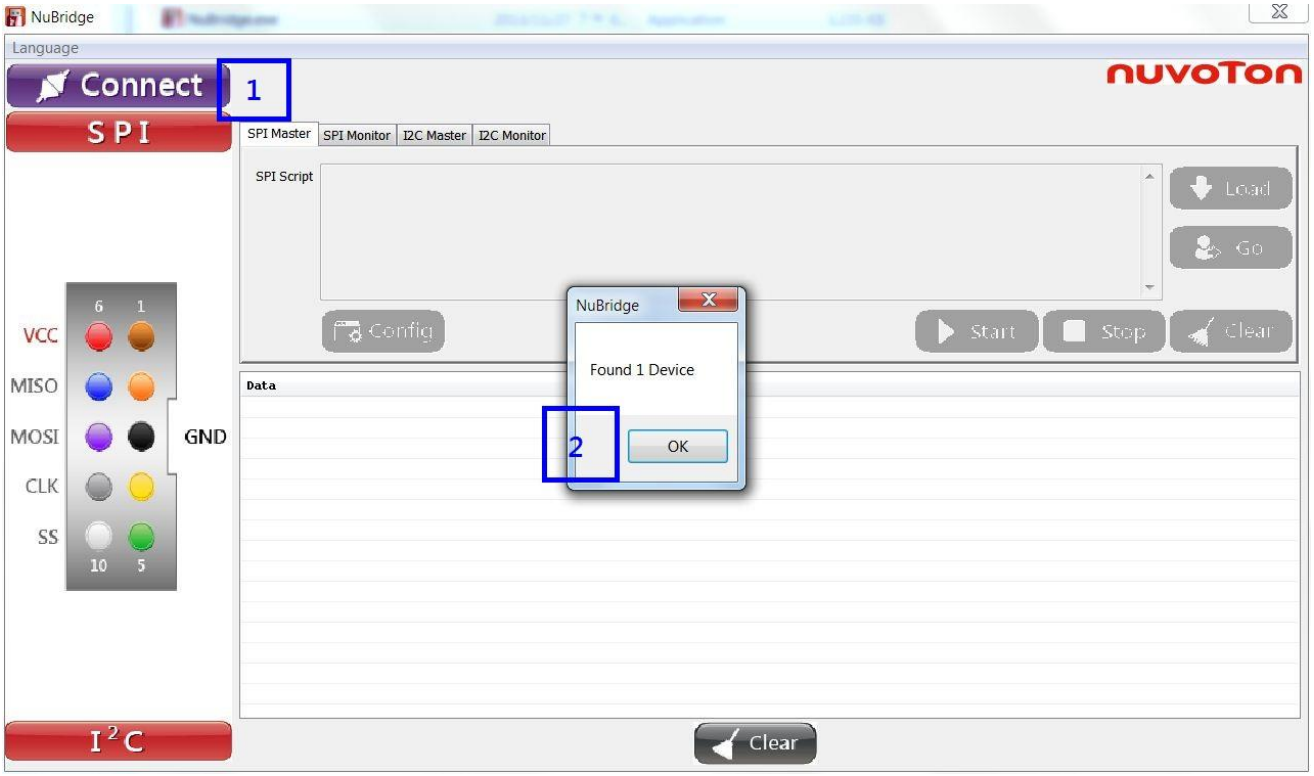


Figure 3-3 Detect Nu-Bridge Dongle

- Step 3: If more than one Nu-Bridge dongle is detected, select the active device by clicking the radio button. The LED on the selected dongle will flash to indicate it is currently active.

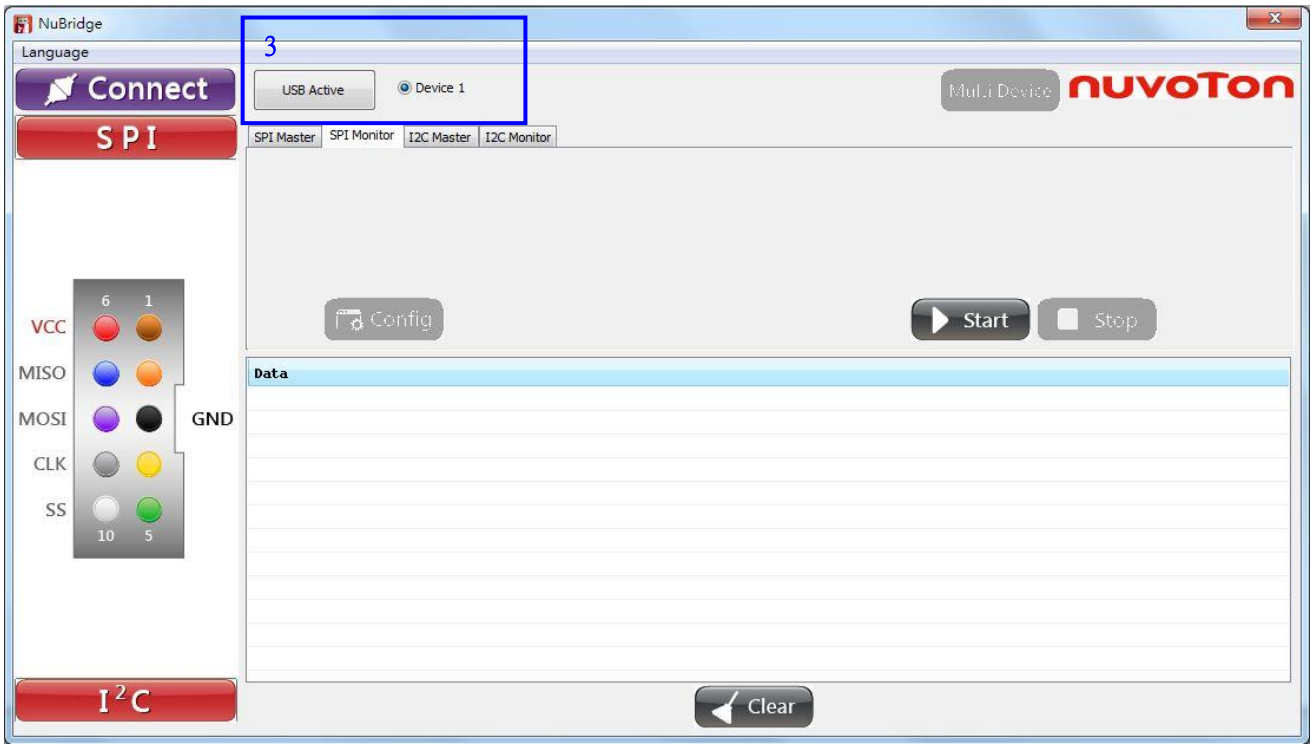


Figure 3-4 Active Nu-Bridge Dongle Selection

If application fails to detect any Nu-Bridge device after the “Connect” button is clicked, the Control pane will keep as inactive state and cannot take user command. Please refer to section 2.4 to confirm the dongle is setup properly.

3.3 SPI Master Mode

In SPI master mode, Nu-Bridge can read and write the connected SPI slave device. Here we connect Nu-Bridge SPI MOSI (pin 7) and MISO (pin 8) together to demonstrate the usage of SPI master mode.

- Step 1: Click the “Start” button to activate SPI master mode. (Once the button is clicked, all UI components will be disabled except SPI master mode tab until the “Stop” button clicked.)
- Step 2: Input raw data in the SPI Script field. (To clear the data in SPI Script field, click “Clear” button.). Refer to section 3.3.1 for the SPI master script format.
- Step 3: After the script input is complete, click the “Go” button to start the transmission.
- Step 4: The received data will be shown in Data pane.

- Step 5: Click the “Stop” button to deactivate SPI master mode.

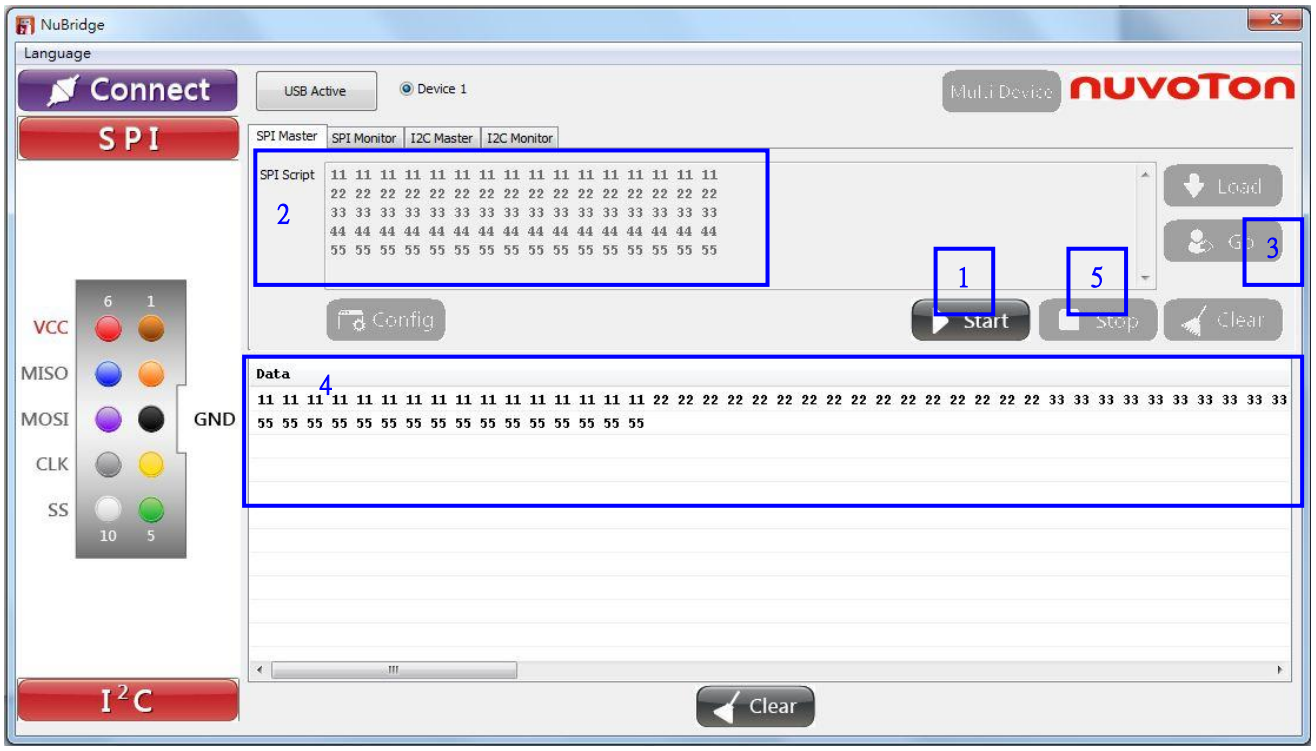


Figure 3-5 SPI Master Mode Operation

3.3.1 SPI Master Script Format

SPI master script is parsed in hexadecimal format, and each byte must be delimited by a space character. Transmission is using one row as a unit. User can press Enter key to step to next row.

The SPI master sets SS pin to active state and sends the data of one row to SPI slave, then sets SS pin back to idle state for 1ms before sending the data in next row. The operation repeats until all data are sent out.

3.3.2 SPI Master Related Parameter

Before accessing SPI slave device, SPI master’s attribute must be configured according to slave device attribute. Otherwise the transmission is likely to fail. To configure SPI master, click “Config” button to bring up SPI master setting window. SPI master attributes are shown in Figure 3-6 SPI Master Related Parameter Setting” and described below:

- **Clock:** Set the SPI master clock rate, ranging from 1 MHz to 12 MHz.
- **Type:** Select SPI types: Rising edge trigger (Type 0, Type 2) and falling edge

trigger (Type 1, Type 3), as shown in Figure 3-7 SPI Master Type Waveform.

- **Order:** Select sending/receiving from least significant byte (LSB) or most significant byte (MSB).
- **SS Active:** Set slave select (SS) active status, ether high active or low active.

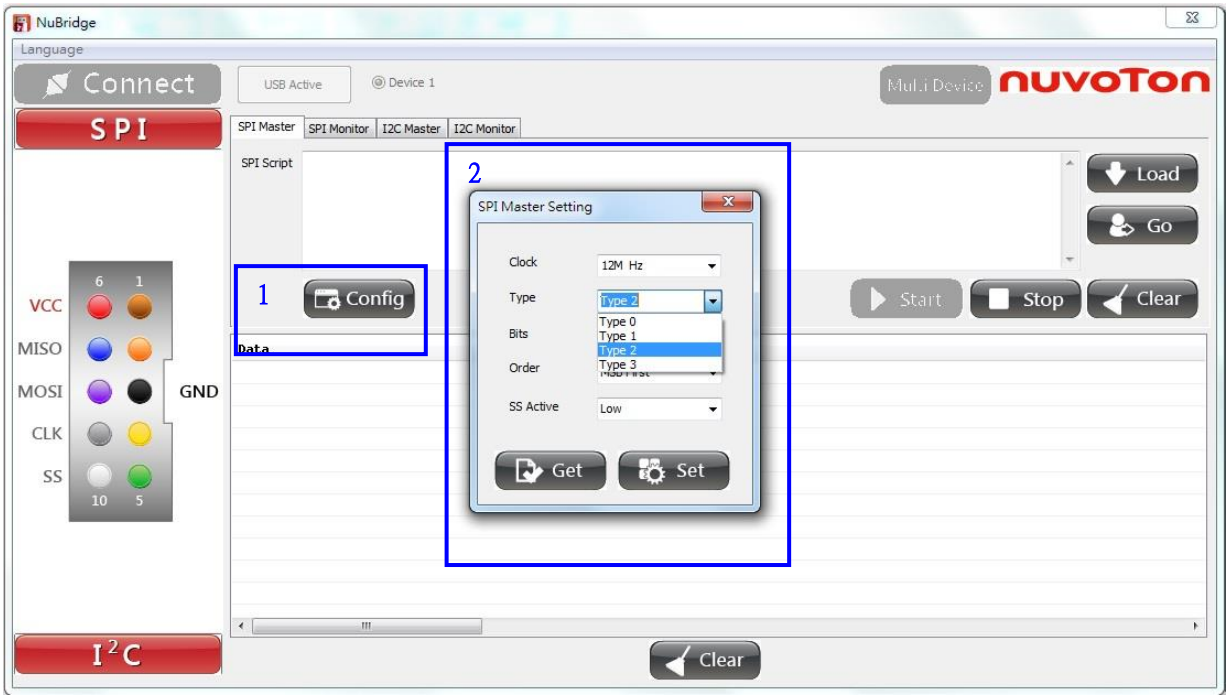


Figure 3-6 SPI Master Related Parameter Settings

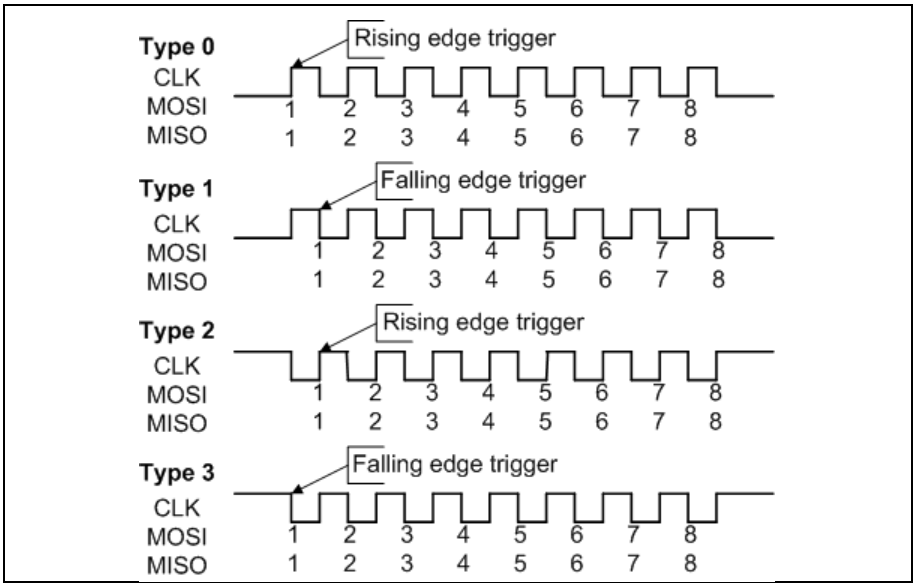


Figure 3-7 SPI Master Type Waveform

3.3.3 SPI Load Script File

Users can prepare a script file which complies SPI master script format in advance, and click the “Load” button to load the script file, to save the time to input raw data in the Control pane.

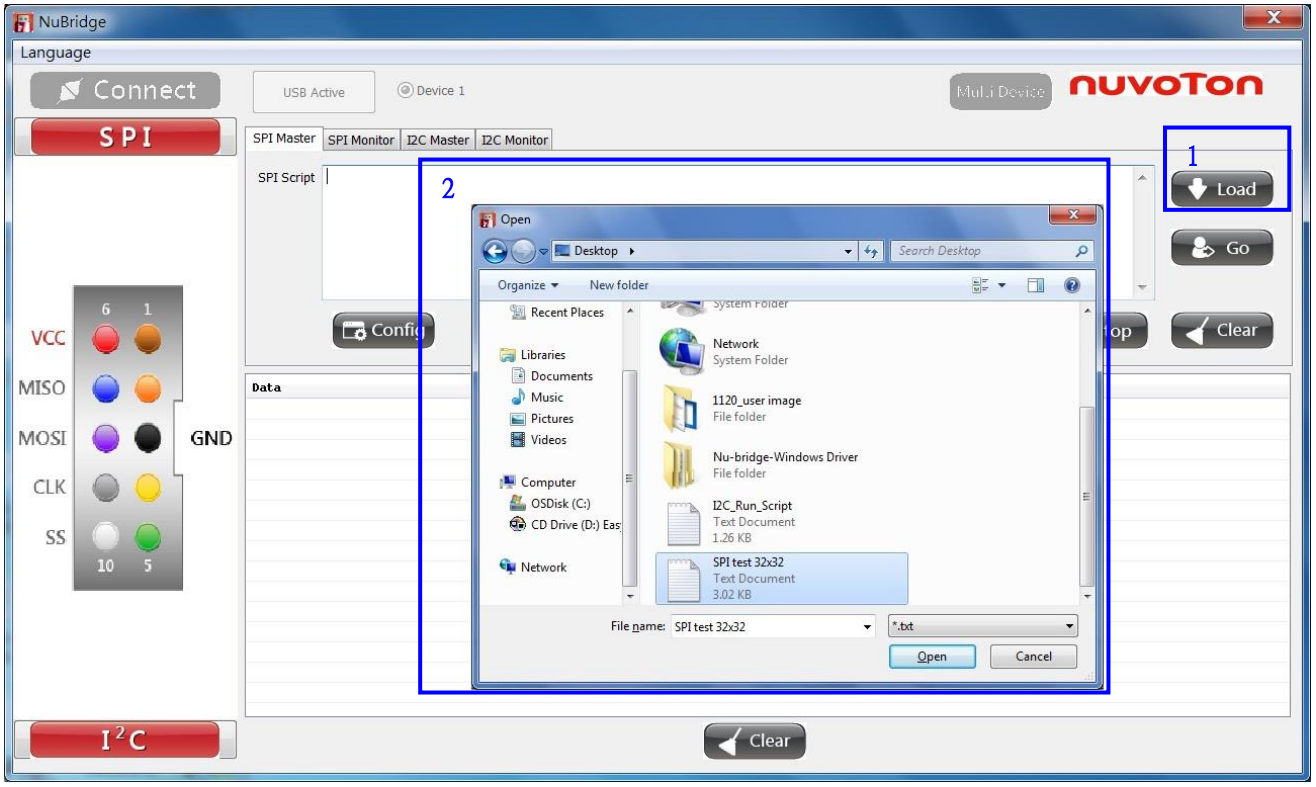


Figure 3-8 SPI Load Script File

3.4 SPI Monitor

SPI monitor mode is used to monitor the SPI interface activity, and sends the captured data to application via USB interface. The captured data will be displayed in the Data pane. Below are the steps to use SPI monitor function.

- Step 1: Click the “Start” button to activate SPI monitor mode. (Once the button clicked, all UI components will be disabled except SPI master mode tab until the “Stop” button clicked.)
- Step 2: Click the “Go” button, and captured data will be displayed on the Data Pane. Figure 3-10 SPI Monitor Wiring shows the wiring of SPI monitor mode. Data on both MOSI and MISO pins are captured and displayed interleaved while SS pin is in active state.

- Step 3: Click the “Stop” button to deactivate SPI monitor mode.

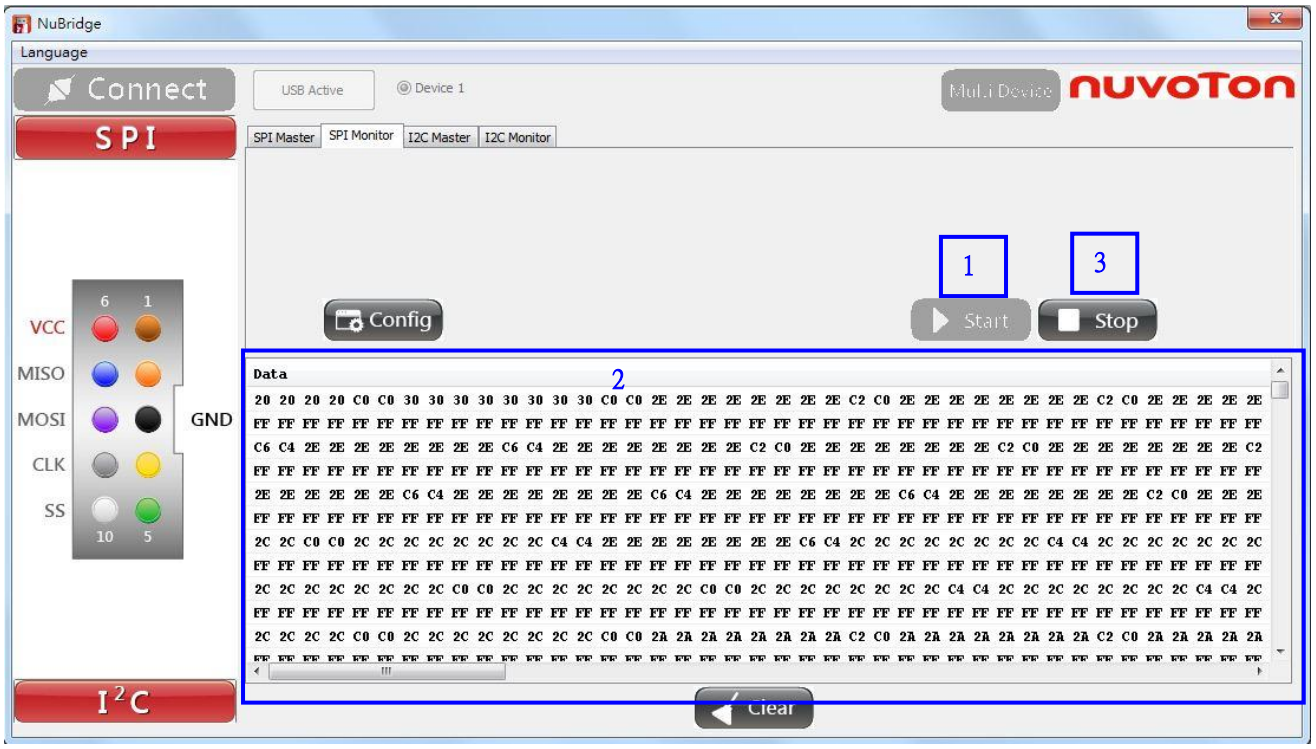


Figure 3-9 SPI Monitor Mode Operation

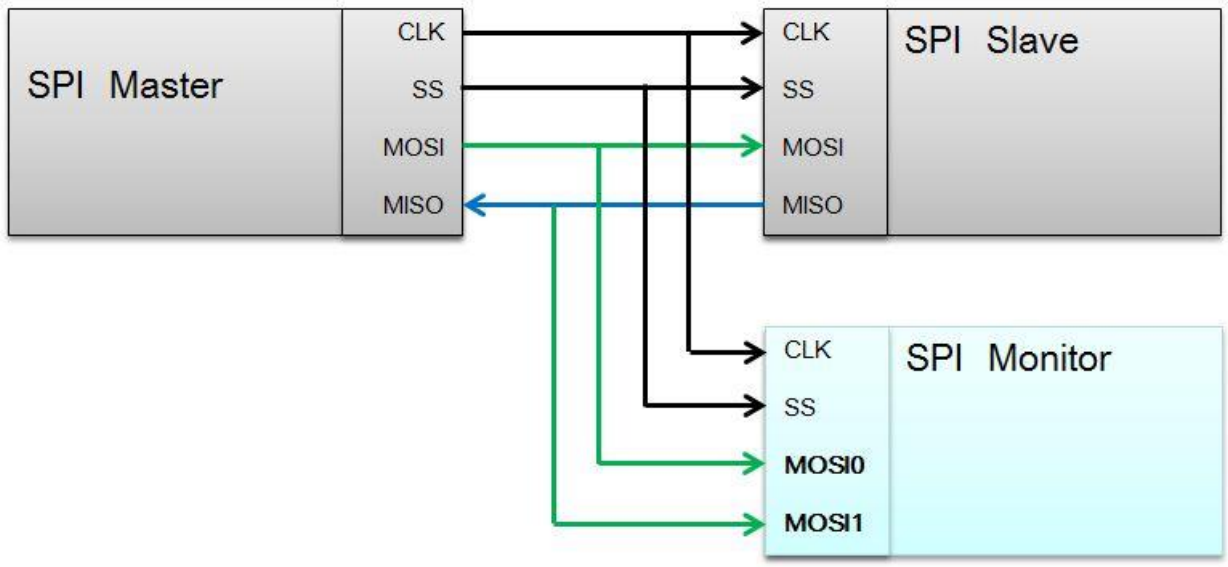


Figure 3-10 SPI Monitor Wiring

3.4.1 SPI Monitor Related Parameter Setting

Except the SPI clock rate which cannot be configured, other SPI monitor parameters are the same as SPI master mode. Click the “Config” button to open the parameter setting form.

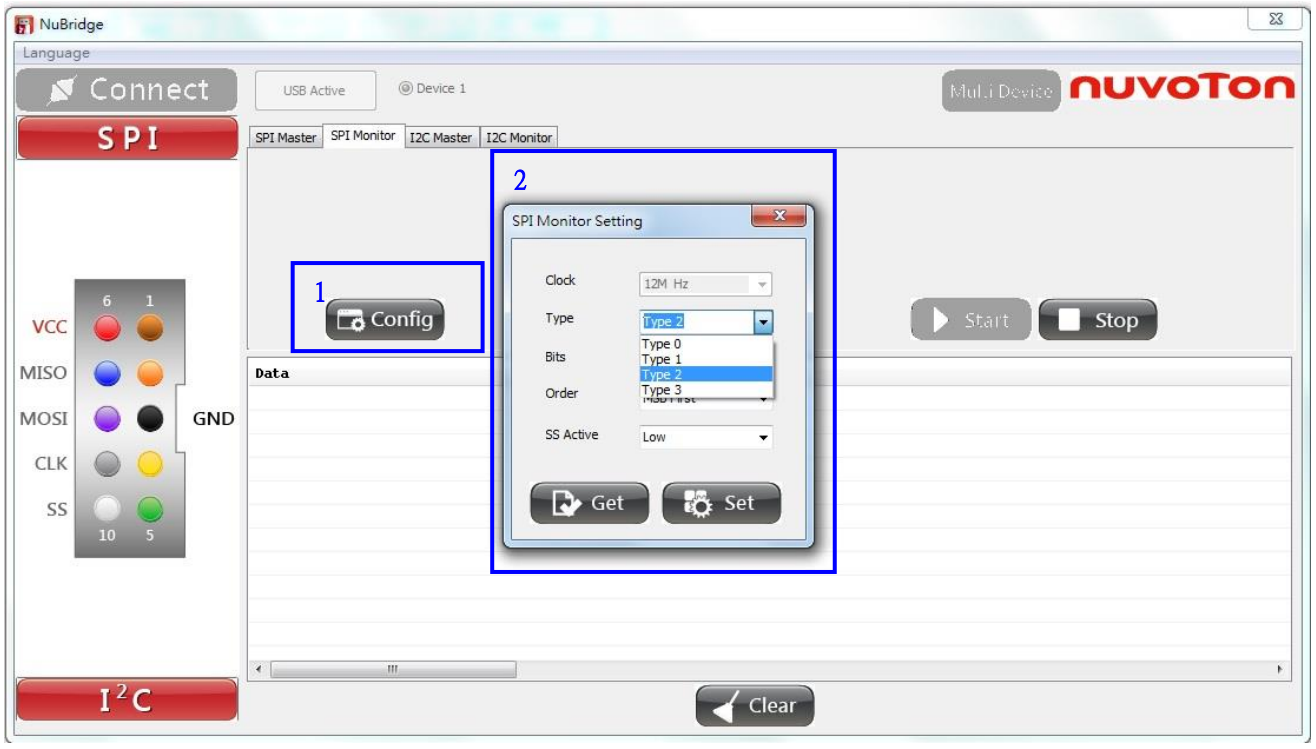


Figure 3-11 SPI Monitor Parameter Settings

3.5 I²C Master

The I²C master function is demonstrated by reading a 24C04 EEPROM on the M051 Learning Board. The control steps are listed below (assuming the EEPROM slave address is 0x51):

- Step 1: Click the “Start” button to activate I²C master mode. (Once the button is clicked, all UI components will be disabled except the I²C master mode tab until the “Stop” button is clicked.)
- Step 2: Input I²C command in I²C script field. (To clear the data in the I²C script field, click “Clear” button.). Refer to section 3.5.1 for the I²C master script format.
- Step 3: Click the “Go” button to send command to I²C Slave.
- Step 4: The read back data will be displayed on Data pane.

- Step 5: Click the “Stop” button to deactivate I²C Master mode

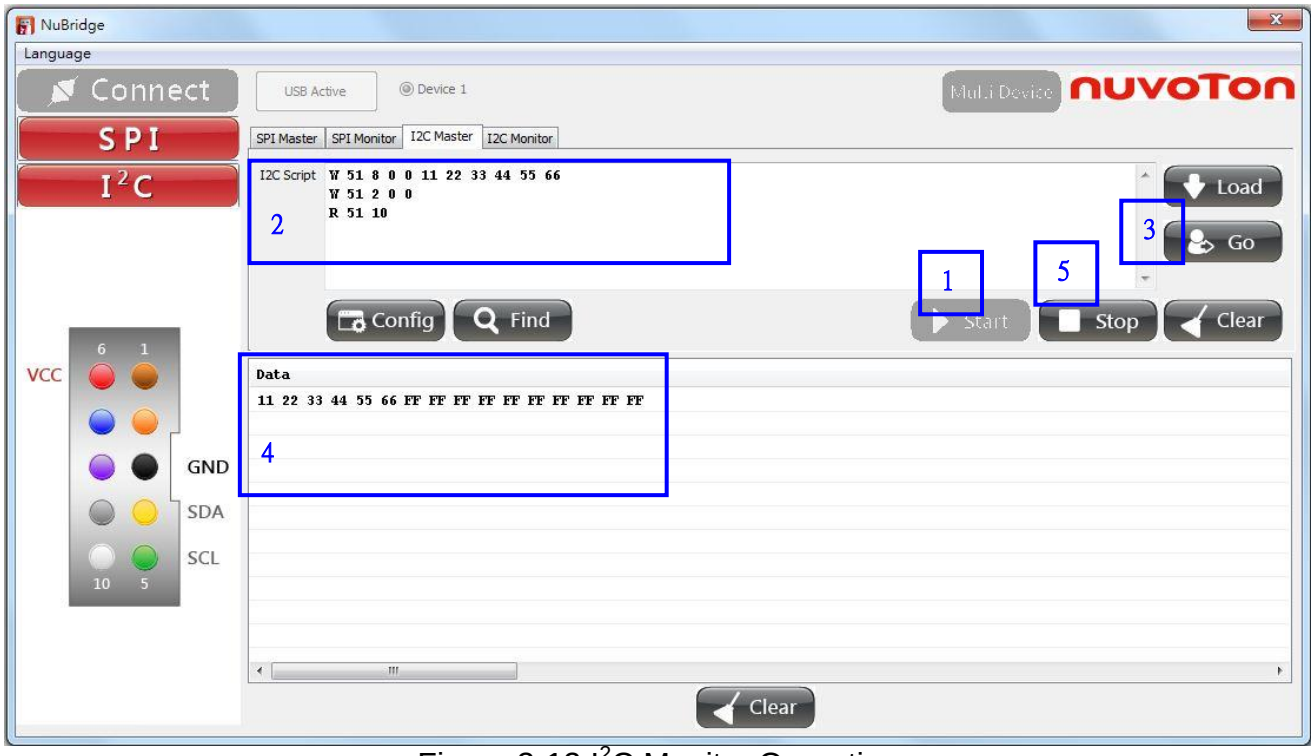


Figure 3-12 I²C Monitor Operation

3.5.1 I²C Master Script Format

Table 3-1 I2C Master Script Format lists the I²C master script format. The Nu-Bridge can automatically detect input syntax error and display error messages on a warning window (Table 3-2 I2C Master Script Syntax Error Messages).

Example 1~3 demonstrate how to use script file to write and read EEPROM on the M051 Learning Board. Figure 3-13 I2C Master Mode Demonstration displays the content of EEPROM **o**n Learning Board LCD panel after the demonstration.

- **Example 1, Write Command**

  Sequentially write 0x11, 0x22, 0x33, 0x44, 0x55, and 0x66 starting from address 0x0000 in EEPROM with slave address 0x51, the script looks like below:

  W 51 8 0 0 11 22 33 44 55 66

  (Every command must be delimited by a space character. Except W/w, data are input in hexadecimal format).

- **Example 2, Write Command**

  Below is a script set EEPROM (slave address 0x51) address to 0x0000:

  W 51 2 0 0

- **Example 3, Read Command**

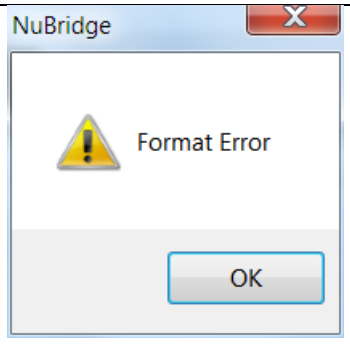
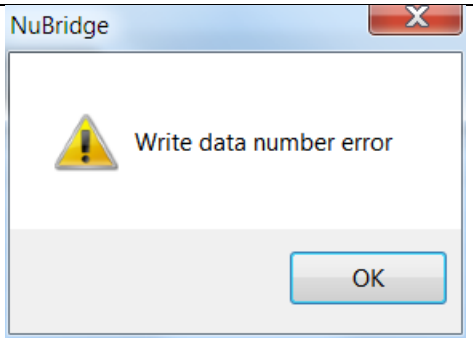
  This example script sequentially reads 16 bytes from EEPROM's (slave address 0x51) current address.

  R 51 10

  (Every command must be delimited by a space character, except R/r, data are input in hexadecimal format).

Write Command Format	Read Command Format
Byte0: 'W' or 'w'(Command) **Byte1**: 7Bits I^{2}C Slave Address **Byte2**: N : Data Length(01 ~ FF) **Byte3**: Data byte 0 … **Byte(3** + N-1): Data byte N-1 (Every command must be delimited by a space, except W/w, data are input in hexadecimal format)	**Byte0**: 'R' or 'r' (Command) **Byte1**: 7Bits I^{2}C Slave Address **Byte2**: N : Data Length(01 ~ FF) (Every command must be delimited by a space, except R/r, data are input in hexadecimal format)

Table 3-1 I^{2}C Master Script Format

	
Script format error	Data length inconsistent with data number in write command

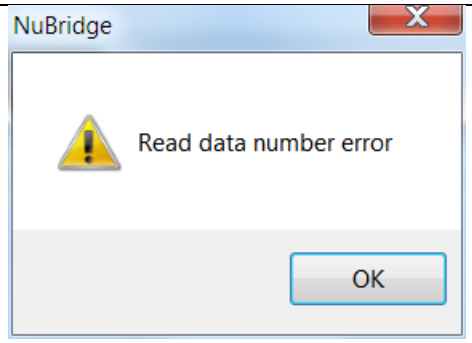
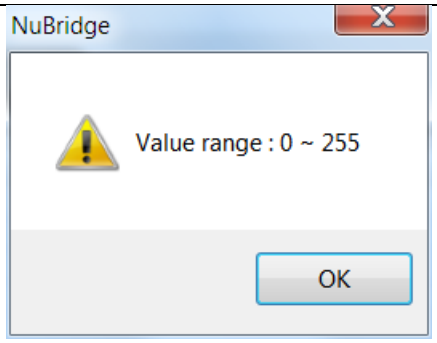
	
Data length inconsistent with data number in read command	Invalid data length

Table 3-2 I²C Master Script Syntax Error Messages

Figure 3-13 I²C Master Mode Demonstration

3.5.2 I²C Master Related Parameter Settings

User can configure the I²C master clock rate by clicking the “Config” button under the I²C master tab to open the parameter setting form. The available options include 1 MHz, 2 MHz and 4 MHz.

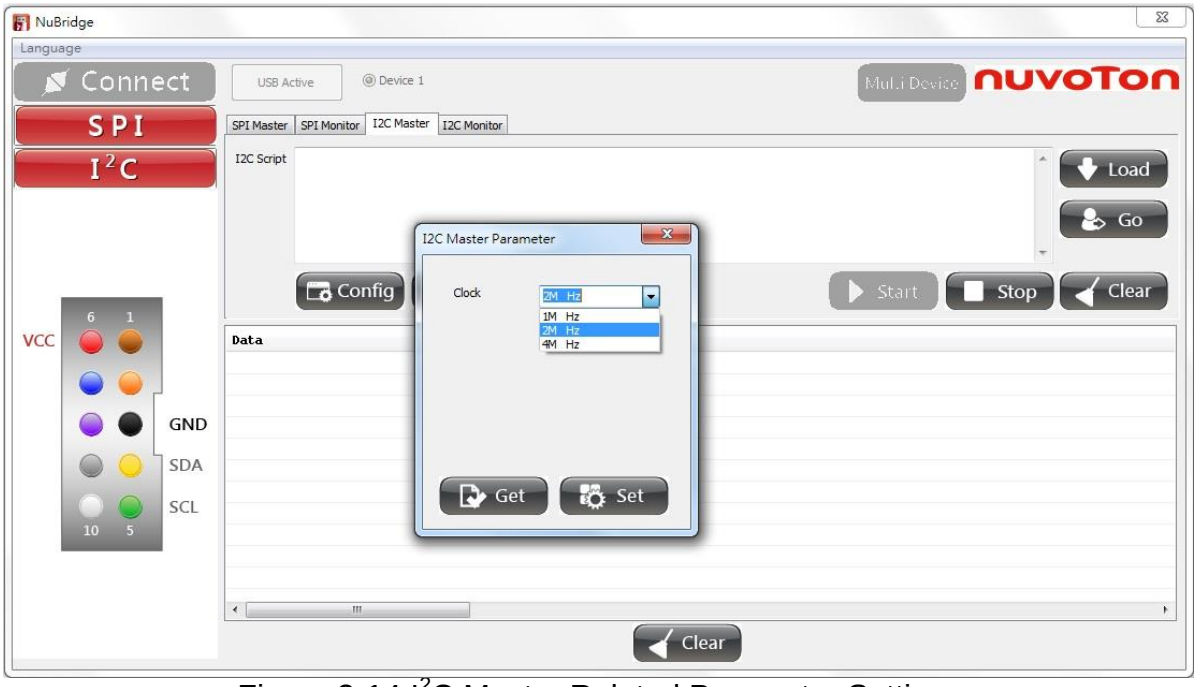


Figure 3-14 I²C Master Related Parameter Settings

3.5.3 I²C Load Script File

User can click the “Load” button to load a script file prepared in advance complied with I²C Master Script Format. This saves the time to input the script.

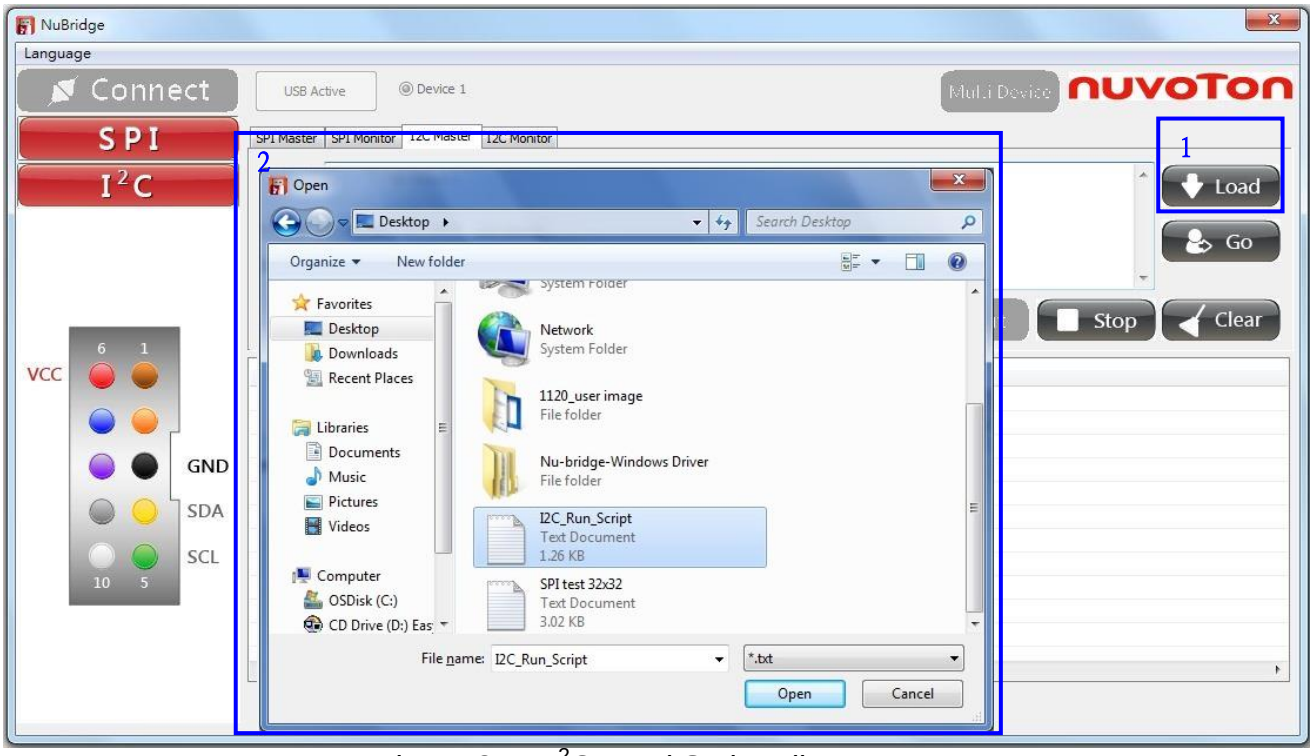


Figure 3-15 I²C Load Script File

3.6 I²C Monitor

This mode is used to monitor the traffic on I²C bus, and send the captured data from the Nu-Bridge dongle to PC via USB interface to display on the Data pane. This section uses EEPROM (I²C slave address 0x51) in M051 Learning Board as an example.

- Step 1: Click the “Start” button to activate I²C monitor mode and capture the I²C bus traffic. (Once the button clicked, all UI components will be disabled except I²C master mode tab until the “Stop” button clicked.)
- Step 2: The data sent by I²C master will be displayed in the Data pane.
- Step 3: Click the “Stop” button to deactivate I²C monitor mode.

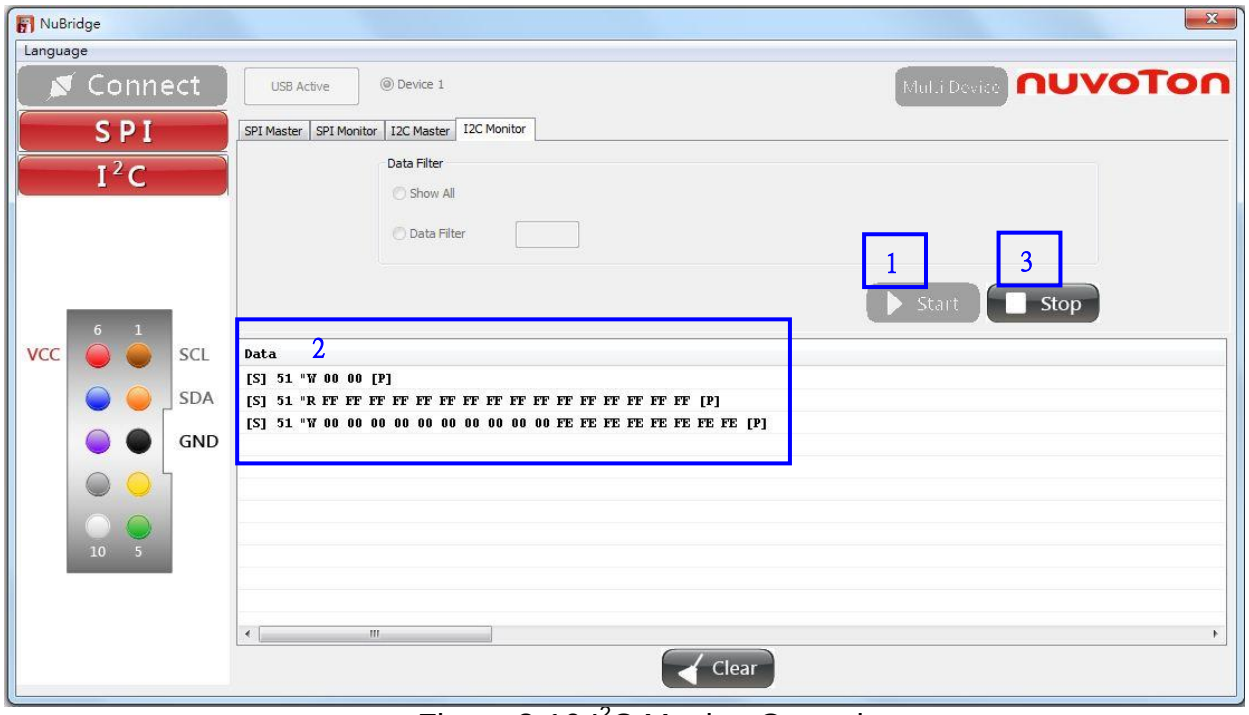


Figure 3-16 I²C Monitor Operation

The application executing on M051 Learning Board also shows the execution results on LCD panel.

Figure 3-17 I²C Monitor Demonstration

3.6.1 I²C Monitor Data Display Format

Nu-Bridge application shows captured data in the Data pane. Below describes the I²C Monitor display data format:

[S]	51	"W	00	00	[P]
Start	7-bit I²C slave device address in hexadecimal format	Write	8-bit response data in hexadecimal format		Stop

Table 3-3 I²C Monitor Data Display Format 1

[S]	51	"R	FF	…	FF	[P]
Start	7-bit I²C slave device address in hexadecimal format	Read	8-bit response data in hexadecimal format			Stop

Table 3-4 I²C Monitor Data Display Format 2

4 Limitations and Known Issues

4.1 SPI Monitor Memory Limitation

Because the maximum SPI bus clock supports in SPI Monitor mode is 12 MHz, data comes in SRAM is faster than USB bandwidth. Also, the firmware code handling USB communication may be interrupted by SPI interrupt. Although Nu-Bridge firmware reserved 16 KB as SPI monitor buffer, buffer over run still may occur while receiving large amount of SPI data in higher clock rate.

4.2 I^2C Monitor Clock Rate Limitation

The Nu-Bridge I^2C monitor function is using GPIO pin to monitor I2C bus traffic. It does not send ANK or NACK signal to interfere the bus. And no slave address setting is required.

Monitoring both I^2C Clock and I^2C Data pins consumes huge amount of MCU computing power. Nu-Bridge cannot correctly capture the bus data while the clock is too fast. Currently, the highest I^2C clock supported in I^2C monitor mode is 200 kHz.

4.3 Nu-Bridge Dongle Firmware Update Limitation

Mass Storage ISP used for firmware update does not support Windows 8.1. Please connect to Windows XP, Windows 7, or Windows 8 to update firmware.

5 Revision History

Revision	Date	Description
0.01	Nov. 19, 2013	Preliminary Release.
0.02	Nov. 22, 2013	● Modified SPI Master Script Format ● Added Windows XP driver installation description. ● Added Nu-Bridge limitation and known issues