

ARM[®] Cortex[®]-M 32-bit Microcontroller

NuMicro[®] Family NuTiny-SDK-NM1820xS and Driver control board User Manual

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www.nuvoton.com

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1 OVERVIEW

NuTiny-EVB-NM1820xS(NT-NM18200S) is the specific development tool for NuMicro® NM1820xS series. Users can use NuTiny-SDK-NM1820xS to develop and verify the application program easily.

NuTiny-EVB-NM1820xS includes two portions. One is NuTiny-EVB-NM1820xS and the other is Nu-Link-Me. NuTiny-EVB-NM1820xS is the evaluation board and Nu-Link-Me is its Debug Adaptor. Thus, users do not need other additional ICE or debug equipment.

The ARM® Cortex®-M0 core within NuMicro® NM1820xS series can run up to 48 MHz and offers 17.5K-bytes embedded program flash, size configurable data flash (shared with program flash), 2K-byte flash for the ISP, and 2K-byte SRAM. Many system level peripheral functions, such as I/O Port, Timer, UART, SPI, I2C, ADC, Watchdog Timer, Analog Comparator and Brown-out Detector, have been incorporated into the NM1820 series in order to reduce component count, board space and system cost. These useful functions make the NM1820 series powerful for a wide range of motor driver applications.

The power supply input of NM1820 is up to 40V. The UVLO circuits prevent malfunction when VCC is lower than the specified threshold voltage. It also build-in bootstrap diodes that can reduce output component.

Additionally, the NM1820 series is equipped with ISP (In-System Programming) and ICP (In-Circuit Programming) functions, which allow the user to update the program memory without removing the chip from the actual end product.

2 NUTINY-SDK-NM1820XS INTRODUCTION

NuTiny-SDK-NM1820xS uses the NM1820xSEB0AE as the target microcontroller. Figure 2-1 is NuTiny-SDK-NM1820xS for NM1820xS series, the left portion is called NuTiny-EVB-NM1820xS and the right portion is Debug Adaptor called Nu-Link-Me.

NuTiny-EVB-NM1820xS is similar to other development boards. Users can use it to develop and verify applications to emulate the real behavior. The on board chip covers NM1820xS series features. The NuTiny-EVB-NM1820xS can be a real system controller to design users' target systems, supports usb high speed interface, audio headphone out, audio line in and sdcard slot.

Nu-Link-Me is a Debug Adaptor. The Nu-Link-Me Debug Adaptor connects your PC's USB port to your target system (via Serial Wired Debug Port) and allows you to program and debug embedded programs on the target hardware. The Nu-Link-Me V3.0 also supports VCOM function, which gives users more flexibility when debug. To use Nu-Link-Me Debug adaptor with IAR or Keil, please refer to "Nuvoton NuMicro® IAR ICE driver user manual" or "Nuvoton NuMicro® Keil ICE driver user manual" in detail. These two documents will be stored in the local hard disk when the user installs each driver. To use Nu-Link-Me 3.0 VCOM function, please refer to Chapter 5.

Nu-LVDMD-NM1820xS(NL-NM1820xS) Figure 2-2 is Motor driver board. Users can use it to develop Motor control function.

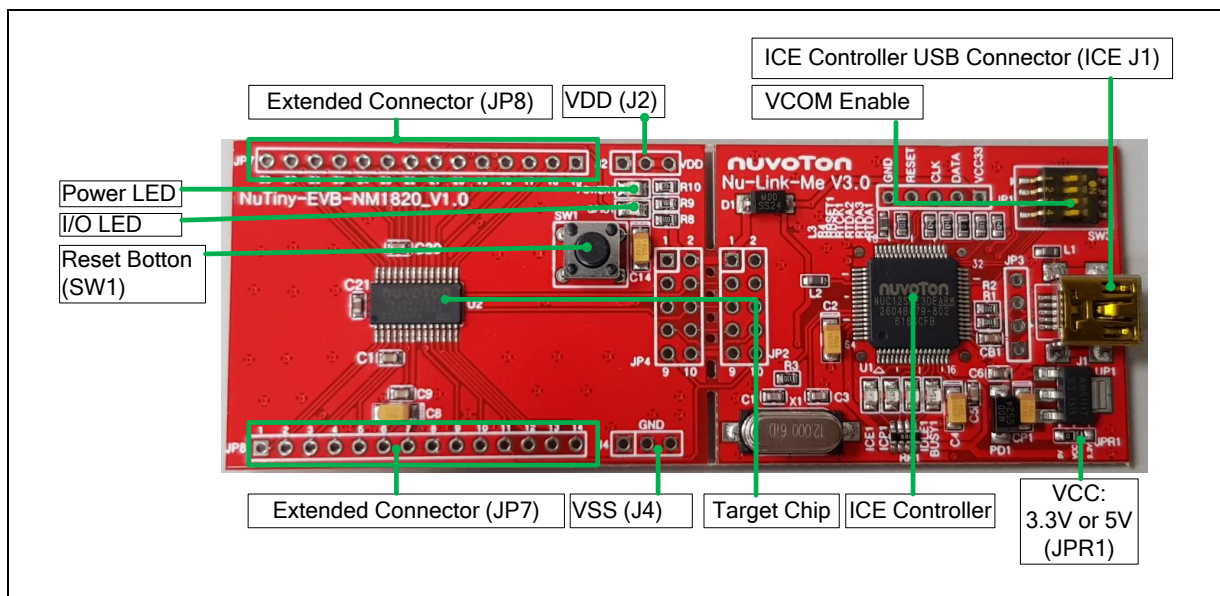


Figure 2-1 NuTiny-SDK-NM1820xS (PCB Board)

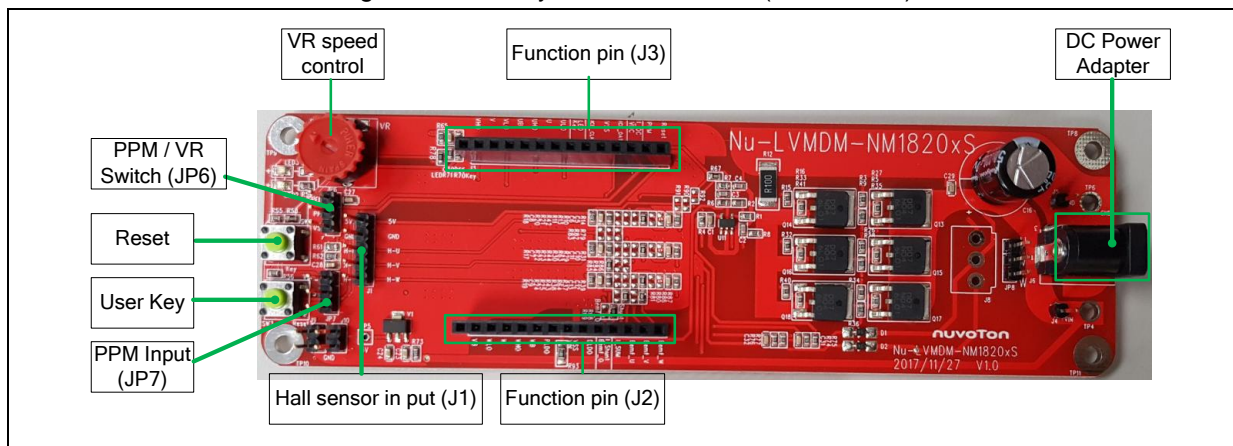


Figure 2-2 Nu-LVMDM-MOS(NM1820xS) (PCB Board)

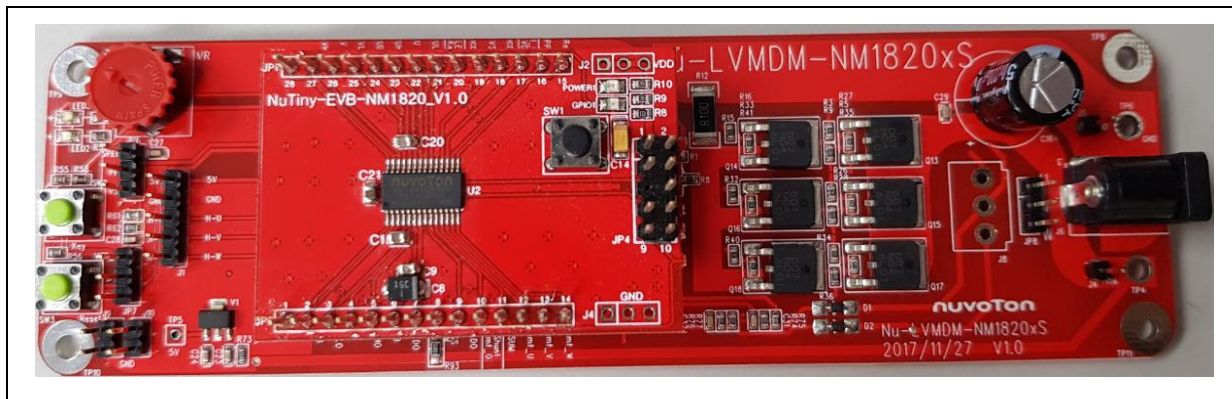


Figure 2-3 NuTiny-SDK-NM1820xS + Nu-LVMDM-NM1820xS (PCB Board)

2.1 NuTiny -SDK-NM1820xS Jumper Description

2.1.1 Power Setting

- J1: USB port in Nu-Link-Me
- JP4: VCC Voltage connector in NuTiny-EVB-NM1820xS

Model	JPR1	J1 USB port	JP4 VCC	J2 VDD	MCU Voltage
Model 1	Select VCC5 (default)	Connect to PC	X	DC 5 output	DC 5V
Model 2	X	X	DC 4.5 V ~ 30 V Input	DC 5 output	Voltage by JP4 input

X: Unused.

2.1.2 Debug Connector

- JP4: Connector in target board (NuTiny-EVB-NM1820xS) for connecting with Nuvoton ICE adaptor (Nu-Link-Me V3.0)
- JP2: Connector in ICE adaptor (Nu-Link-Me V3.0) for connecting with a target board (for example NuTiny-EVB-NM1820xS)

2.1.3 USB Connector

- J1: Mini USB Connector in Nu-Link-Me V3.0 connected to a PC USB port

2.1.4 Extended Connector

- JP7, JP8: Show all chip pins in NuTiny-EVB-NM1820xS

2.1.5 Reset Button

- SW1: Reset button in NuTiny-EVB-NM1820xS

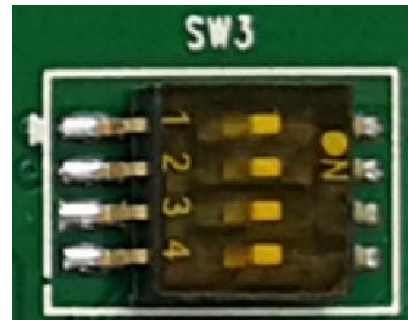
2.1.6 Power Connector

- J2: VCC connector in NuTiny-EVB-NM1820xS
- J4: VSS connector in NuTiny-EVB-NM1820xS

2.1.7 VCOM Enable

- **SW3**: VCOM function enable for NuTiny-SDK-NM1820xS. Switch SW3 on before power on to enable VCOM function. SW3 connects pin 11(P1.2/RXD) and pin 12(P1.3/TXD) in NuTiny-EVB-NM1820xS with pin 22(PB.1/TXD) and pin 21(PB.0/RXD) in Nuvoton ICE adaptor (Nu-Link-Me V3.0). SW3 connects pin 29(VCOM) in Nuvoton ICE adaptor (Nu-Link-Me V3.0) to GND to enable VCOM function.

Switch Pin Number	Function Name	UART0 Mode	VCOM Mode
1	ICE_TX	Off	On
2	ICE_RX	Off	On
3	VCOM_EN	Off	On
4	X	X	X



X: Unused.

2.2 Nu-LVMDM-MOS(NM1820xS) Jumper Description

2.2.1 Power Setting

Model	J6 DC power adapter	Vin connect power
Model 1	DC 7 V ~ 30 V Input	x
Model 2	x	J4, TP4

X: Unused.

2.2.2 Extended Connector

- J2 and J3: Show all function pins in Nu-LVMDM-MOS(NM1820xS)

2.2.3 Reset Button

- SW3: Reset button in Nu-LVMDM-MOS(NM1820xS)

2.2.4 User Key

- SW2: User button in Nu-LVMDM-MOS(NM1820xS)

2.2.5 Hall Connector

- J1: Hall connect in Nu-LVMDM-MOS(NM1820xS)

2.2.6 VR and PPM swith Connector

- JP6: VR and PPM Connect to input Command to MCU in Nu-LVMDM-MOS(NM1820xS)

2.3 NuTiny -SDK-NM1820xS Pin Assignment for Extended Connector

NuTiny-EVB-NM1820xS provides NM1820xSEB0AE on board and the extended connector for (JP7 and JP8) for TSSOP 28-pin. Table 2-1 is the pin assignment for NM1820Xs.

Pin No	Pin Name	Pin No	Pin Name
01	VB	15	/RESET
02	WLO	16	P3.0,ADC_CH6,ACMP1_N, CCAP
03	W	17	P3.5,TM1,I2C_SCL, ACMP1_P3, ADC_CH10
04	WHO	18	P4.7, ICE_DAT
05	WB	19	VSS
06	PLDO5V	20	P4.6, ICE_CLK
07	VIN	21	P5.2, INT1, CCAP
08	VSS	22	ULO
09	DLDO5V	23	U
10	P1.0, ADC_CH1, ACMP0_P1	24	UHO
11	P1.2, ADC_CH2, UART0_RX1, ACMP0_P2	25	UB
12	P1.3, ADC_CH3, UART0_TX1, UART0_TX1, ACMP0_P3, INT0	26	VLO
13	P1.4, ADC_CH4, ACMP0_N, UART1_RX0	27	V
14	P1.5, ADC_CH5, ACMP0_P0, UART1_TX0	28	VHO

Table 2-1 Pin Assignment for NM1820xS MCU

2.4 Nu-LVMDM-MOS(NM1820xS) Pin Assignment for Extended Connector

Nu-LVMDM-(NM1820xS) provides the extended connector for (J2 and J3) for function-pin. Table 2-2 is the pin assignment for NM1820xS driver board.

Pin No	Pin Name	Pin No	Pin Name
J2 connect		J3 connect	
01	VB	15	nRESET
02	WLO	16	PPM
03	W	17	I_OC / VDC
04	WHO	18	ICEDAT
05	WB	19	VSS
06	PLDO	20	ICECLK
07	VIN	21	LED / Key
08	VSS	22	ULO
09	DLOD	23	U
10	Bemf_O / I_Shunt	24	UHO
11	I_SUM	25	UB
12	Bemf_U	26	VLO
13	Bemf_V	27	V
14	Bemf_W	28	VHO

Table 2-2 Pin Assignment for NM1820xS Driver Board

2.5 NuTiny-SDK-NM1820xS PCB Placemen

Users can refer to Figure 2-4 for the NuTiny-SDK-NM1820xS PCB placements.

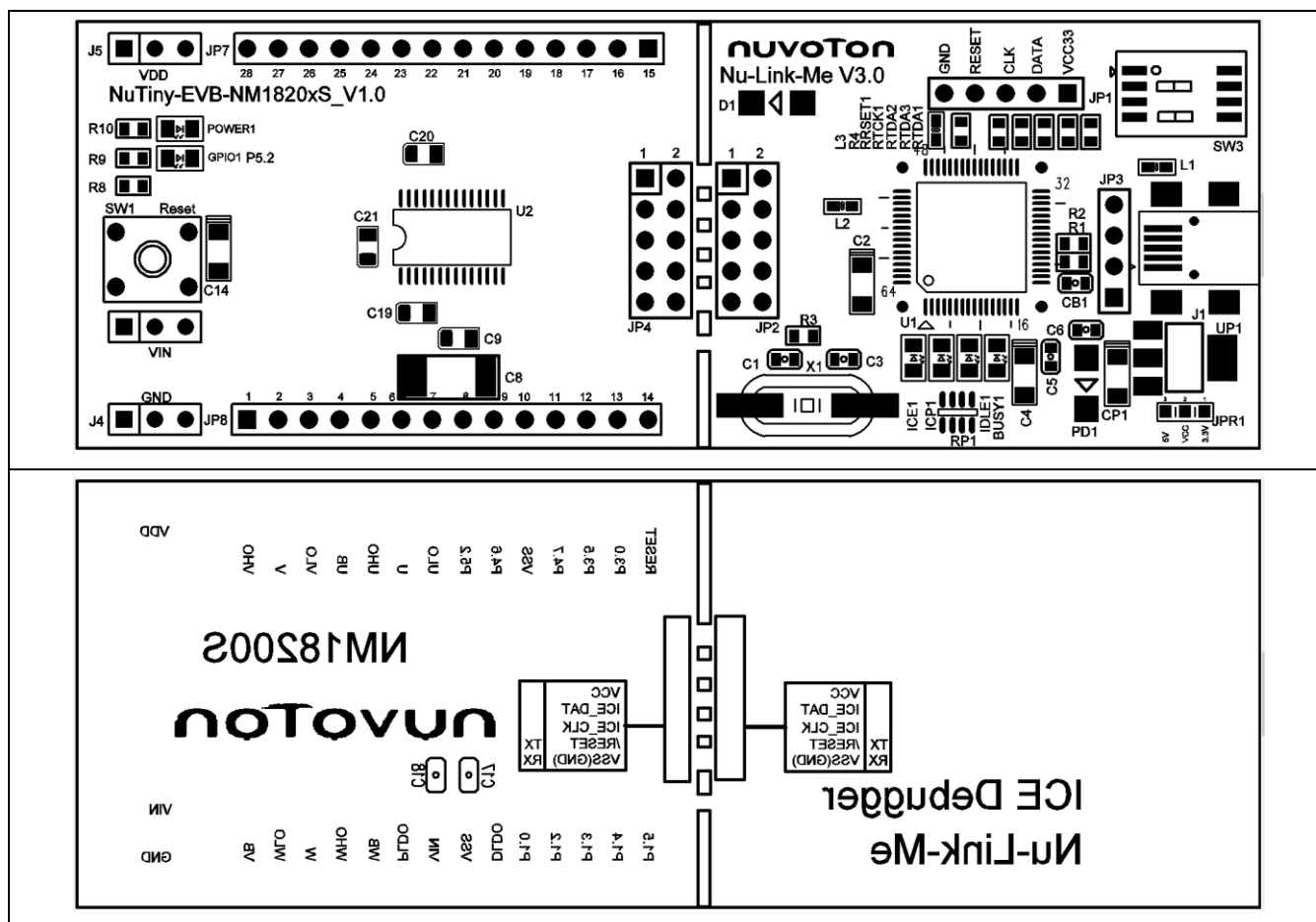


Figure 2-4 NuTiny-SDK-NM1820xS PCB Placement

2.6 Nu-LVMDM-MOS(NM1820xS) PCB Placemen

Users can refer to Figure 2-5 for the Nu-LVMDM-MOS(NM1820xS) PCB placements.

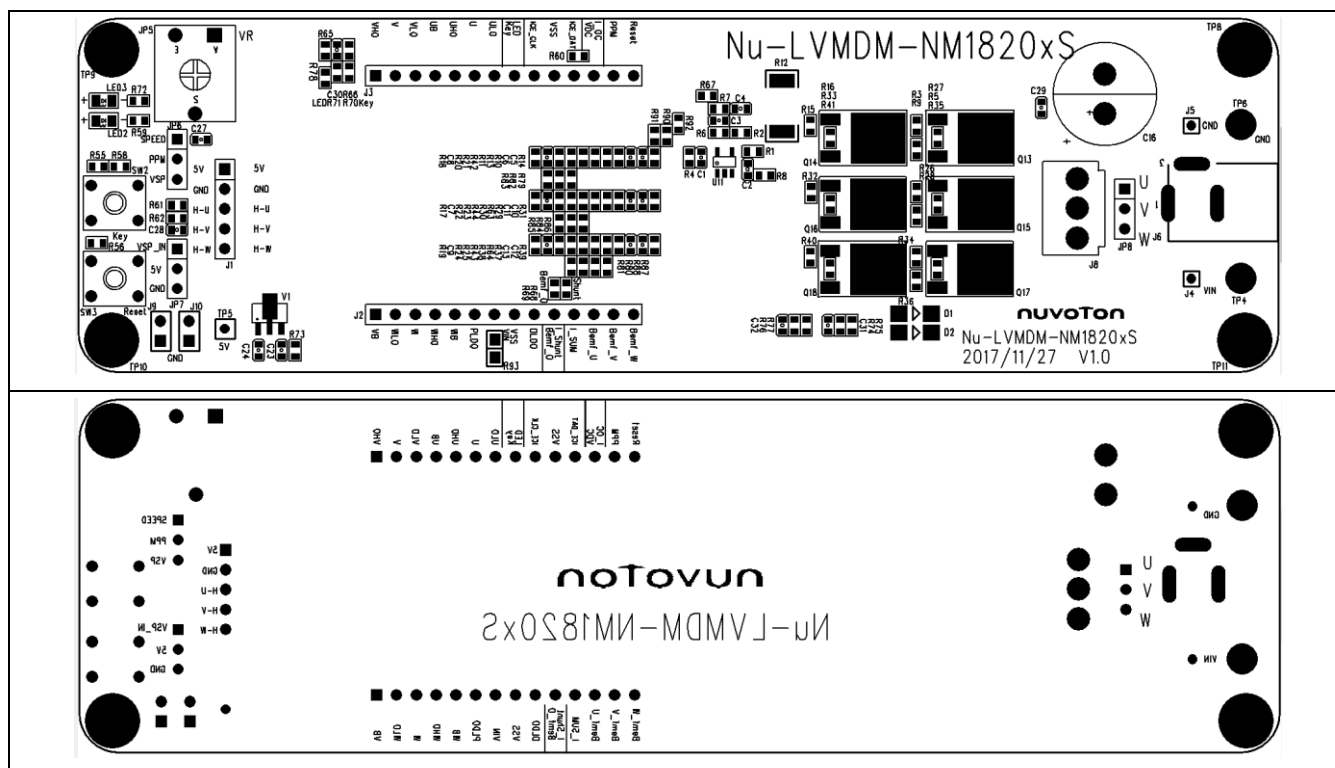


Figure 2-5 NuTiny-SDK-NM1820xS PCB Placement

3 HOW TO START NUTINY-SDK-NM1820XS ON THE KEIL MVISION® IDE

3.1 Keil uVision® IDE Software Download and Install

Please visit the Keil company website (<http://www.keil.com>) to download the Keil μ Vision® IDE and install the RVMDK

3.2 Nuvoton Nu-Link Driver Download and Install

Please visit the Nuvoton company NuMicro® website (<http://www.nuvoton.com/NuMicro>) to download “NuMicro® Keil μ Vision® IDE driver” file. When the Nu-Link driver has been well downloaded, please unzip the file and execute the “Nu-Link_Keil_Driver.exe” to install the driver.

3.3 Hardware Setup

The hardware setup is shown as Figure 3-1.

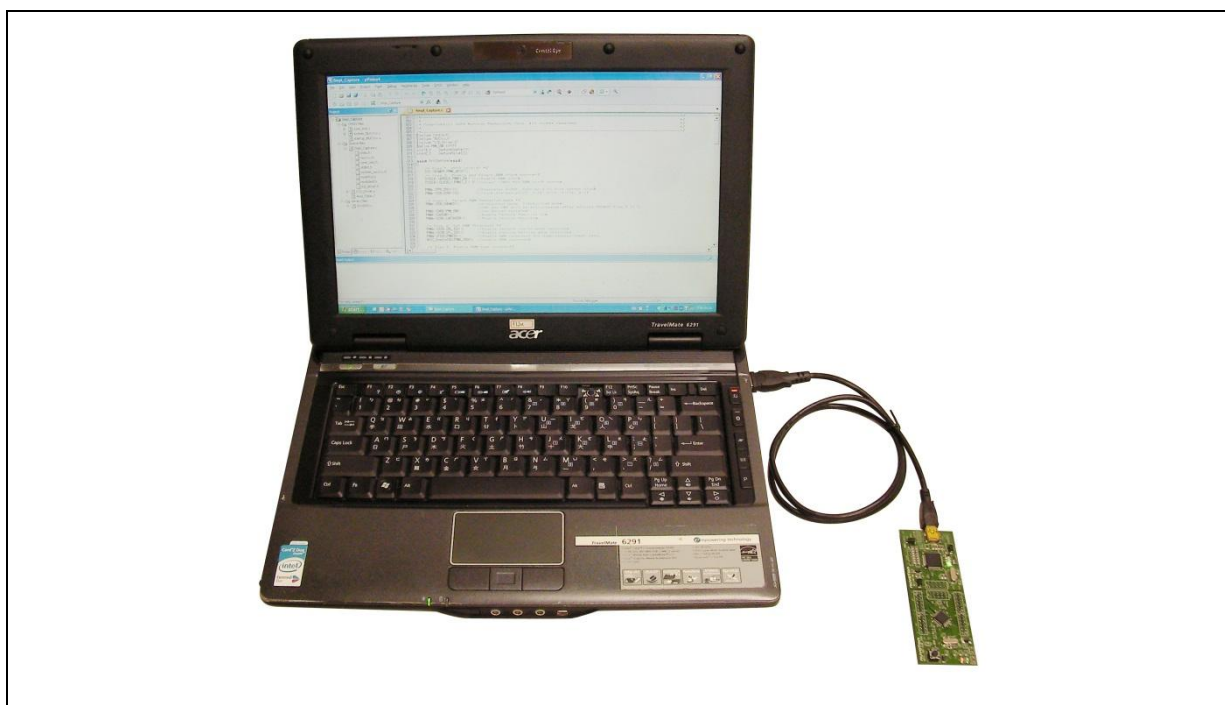


Figure 3-1 NuTiny-SDK-NM1820xS Hardware Setup









3.4 Example Program

This example demonstrates the ease of downloading and debugging an application on a NuTiny-SDK-NM1820xS board. It can be found on Figure 3-2 list directory and downloaded from Nuvoton NuMicro® website.

Directory	C:\Nuvoton\BSP Library\NM1820xSBSP\SampleCode \StdDriver\SYS\KEIL			
Project File	<div> <div> <div>NM1200_NM1100BSP_CMSIS_v3.00.000</div> <div>Document</div> <div>Library</div> <div>SampleCode</div> <div>Hard_Fault_Sample</div> <div>RegBased</div> <div>Semihost</div> <div>StdDriver</div> <div>ACMP</div> </div> <div> <div>Name</div> <div>Nu_Link_Driver.ini</div> <div>SYS.uvproj</div> </div> <div> <div>Date modified</div> <div>2015/4/20 上午 09...</div> <div>2018/6/11 下午 03...</div> </div> <div> <div>Type</div> <div>Configuration sett...</div> <div>uVision4 Project</div> </div> <div> <div>Size</div> <div>7 KB</div> <div>17 KB</div> </div> </div>			

Figure 3-2 Example Directory

This sample code will show some functions about system manager controller and clock controller.

-  Start uVision®
- Project – Open
Open the SYS.uvproj project file
-  Project – Build
Compile and link the SYS application
-  Flash – Download
Program the application code into on-chip Flash ROM
-  Start debug mode
When using the debugger commands, you may:
 - ◆  Review variables in the watch window
 - ◆  Single step through code
 - ◆  Reset the device
 - ◆  Run the application

4 HOW TO START NUTINY -SDK-NM1820XS ON THE IAR EMBEDDED WORKBENCH

4.1 IAR Embedded Workbench Software Download and Install

Please connect to IAR company website (<http://www.iar.com>) to download the IAR Embedded Workbench and install the EWARM.

4.2 Nuvoton Nu-Link Driver Download and Install

Please visit the Nuvoton company NuMicro® website (<http://www.nuvoton.com/NuMicro>) to download the “NuMicro® IAR EWARM Driver” file. When the Nu-Link driver has been well downloaded, please unzip the file and execute the “Nu-Link_Keil_Driver.exe” to install the driver.

4.3 Hardware Setup

The hardware setup is shown as Figure 4-1.

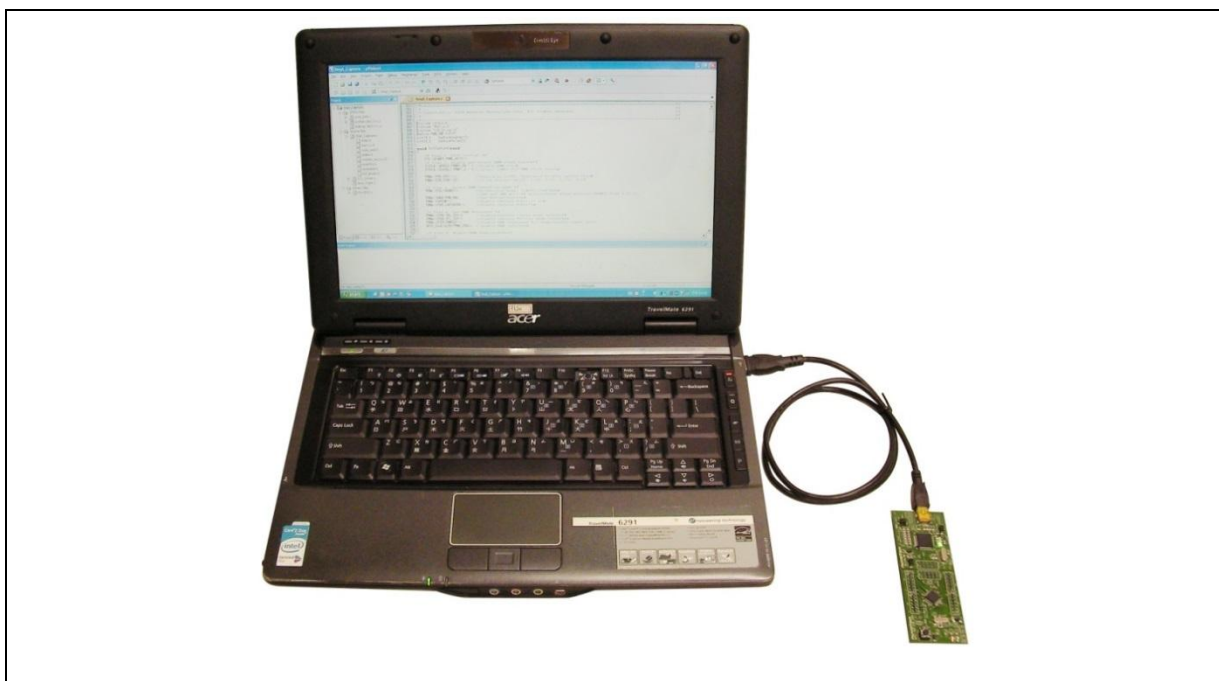


Figure 4-1 NuTiny-SDK-NM1820xS Hardware Setup

4.4 Example Program

This example demonstrates the ease of downloading and debugging an application on a NuTiny-SDK-NM1820xS board. It can be found on Figure 4-2 list directory and downloaded from Nuvoton NuMicro® website.

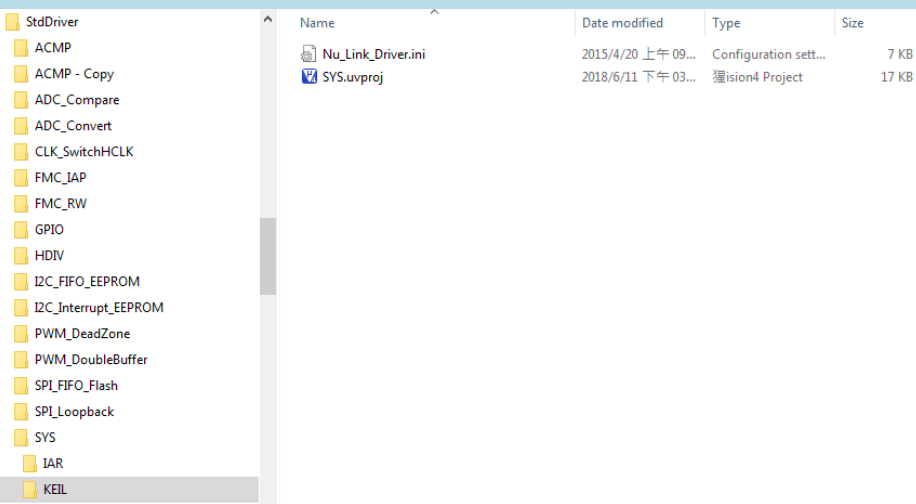




Directory	C:\ Nuvoton\BSP Library\NM1820xSBSP\SampleCode \StdDriver\SYS\IAR			
Project File				


Figure 4-2 Example Directory


This sample code will show some functions about system manager controller and clock controller.


-  Start IAR Embedded Workbench

■  File-Open-Workspace
Open the SYS.eww workspace file

■  Project - Make
Compile and link the SYS application
-  Project – Download and Debug
Program the application code into on-chip Flash ROM

■  Single step through code

■  Reset the device

■  Run the application

5 STARTING TO USE NU-LINK-ME 3.0 VCOM FUNCTION

5.1 Downloading and Installing VCOM Driver

Please connect to Nuvoton NuMicro® website (<http://www.nuvoton.com/NuMicro>) to download the “NuMicro® ICP Programming Tool” file. After the ICP Programming Tool driver is downloaded, please unzip the file and execute the “ICP Programming Tool.exe”. Simply follow the installation and optional steps to install ICP Programming Tool and Nu-Link USB Driver, which included VCOM driver.

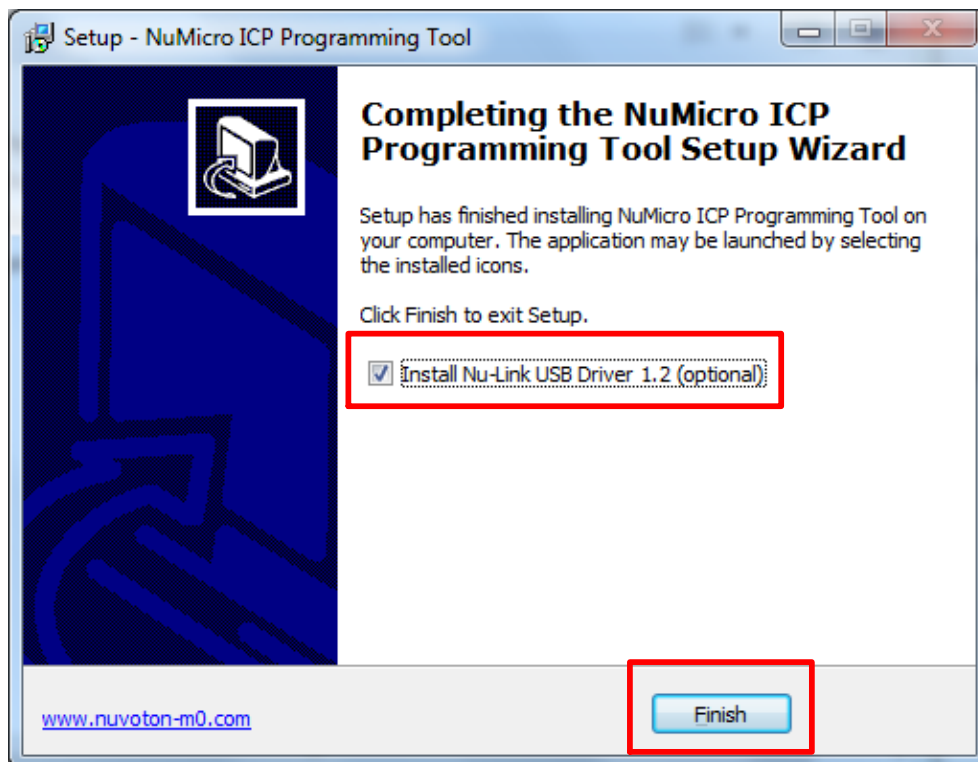


Figure 5-1 Optional Step after ICP Programming Tool Installation

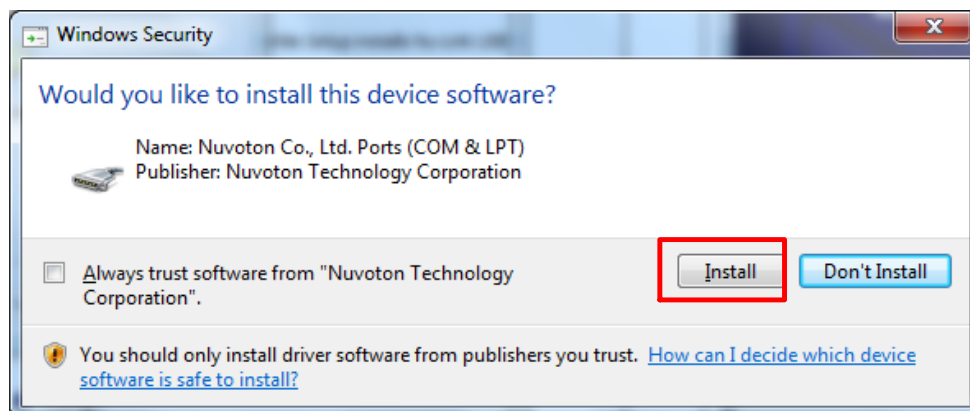


Figure 5-2 Install Nuvoton COM&LPT Driver

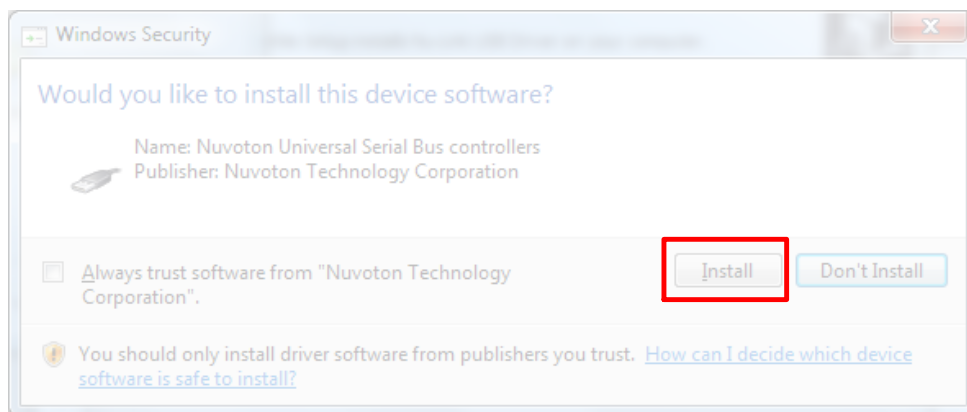


Figure 5-3 Install Nuvoton Universal Serial Bus Controllers

5.2 VCOM Mode Setting on NuTiny-SDK-NM1820xS

Before the NuTiny-SDK-NM1820xS is connected to the PC, please enable SW3 VCOM function by switching on SW3. The NuTiny-EVB-NM1820xS transmits through UART0 to VCOM to send out data. Switch SW3 off when using UART0 function without VCOM function.

5.3 Setup on the Development Tool

The example is demonstrated on the Keil μ Vision[®] IDE.

5.3.1 Check the Using UART on the Keil μ Vision[®] IDE

Please open the project and find system_NM1820xS.h to check the using UART in DEBUG_PORT, which has to be the same as the using UART in the NuTiny-EVB-NM1820xS.

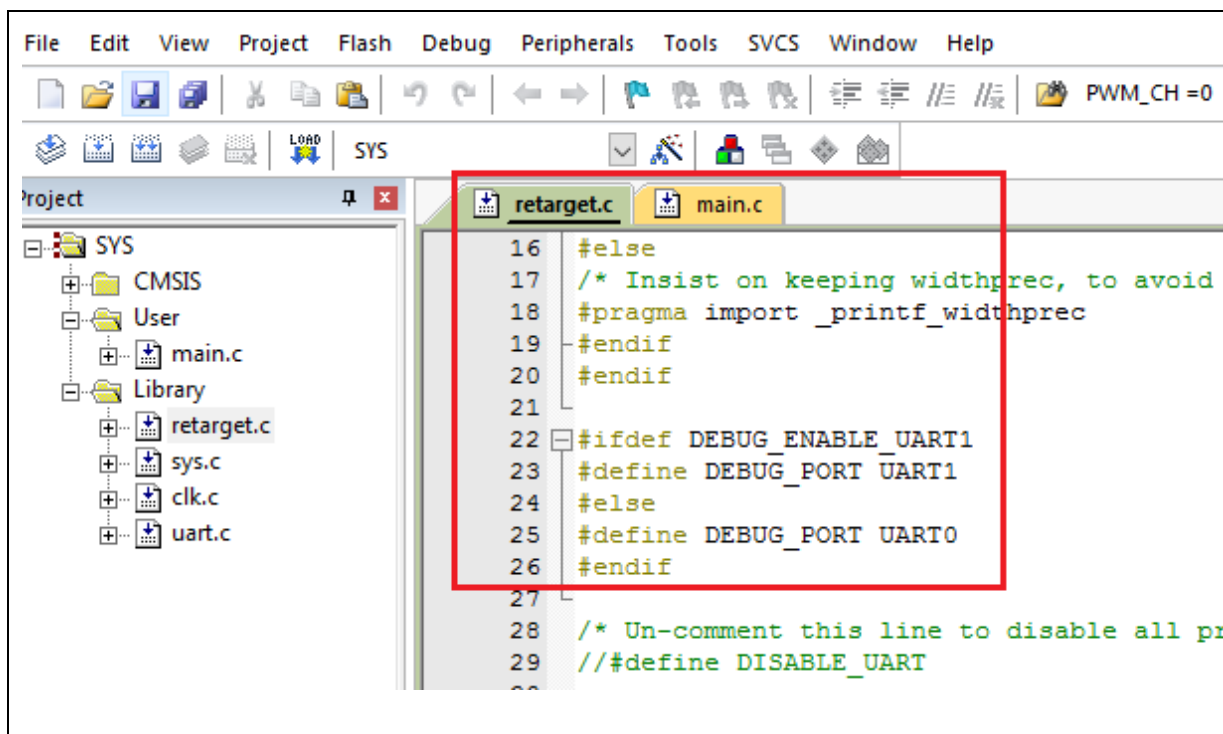
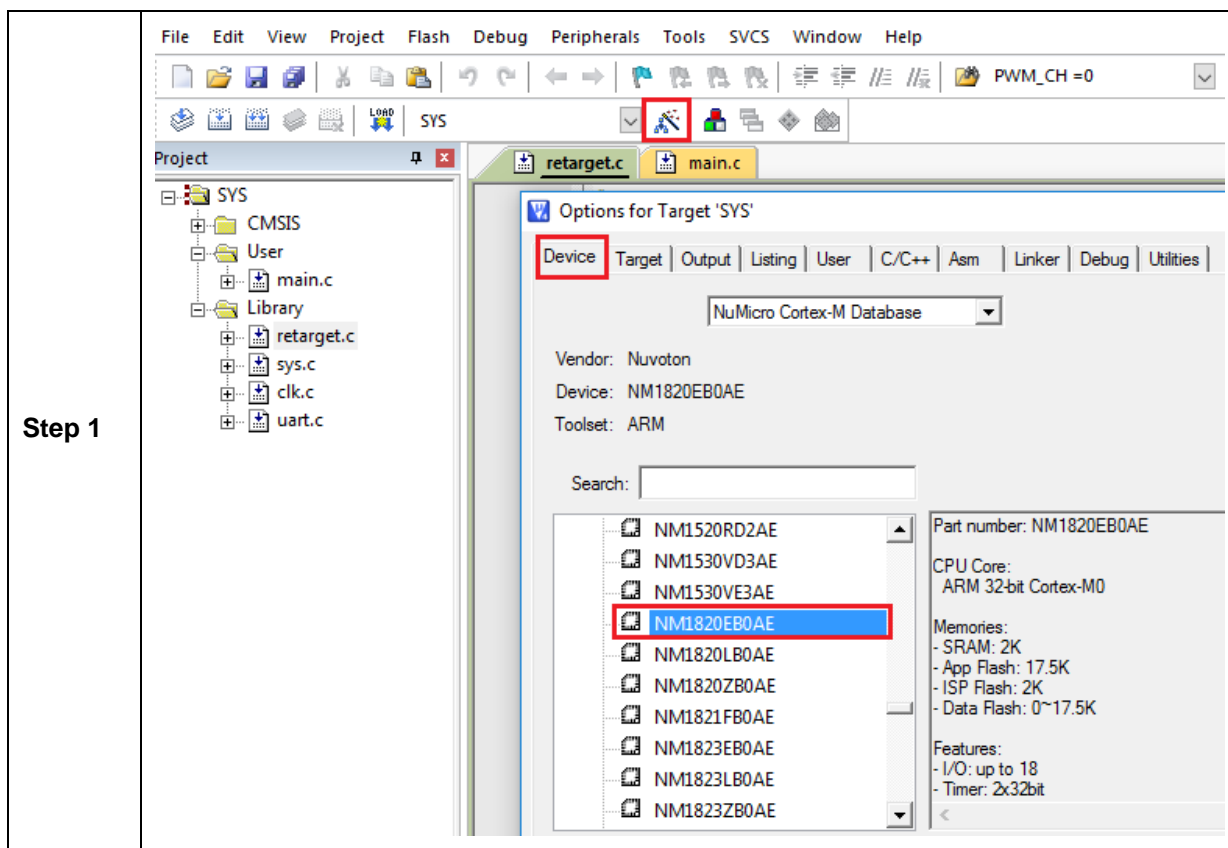


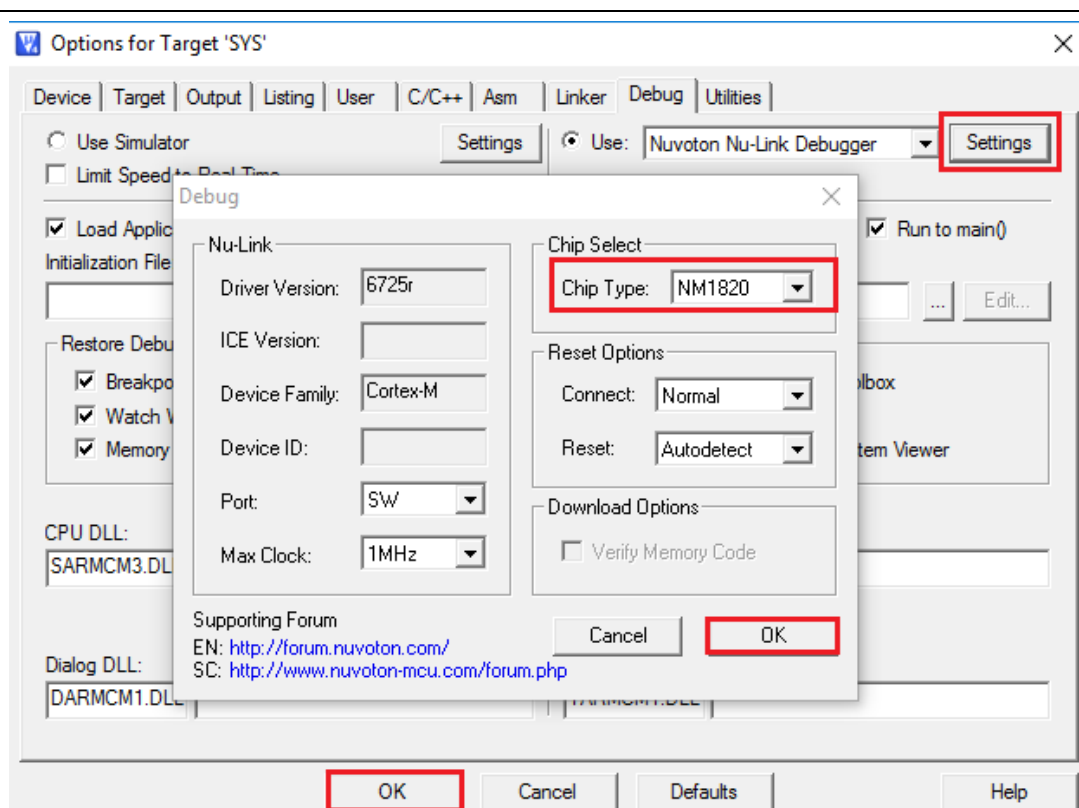
Figure 5-4 The Using UART on Keil μ Vision[®] IDE

5.3.2 Check the Target Device and Debug Setting

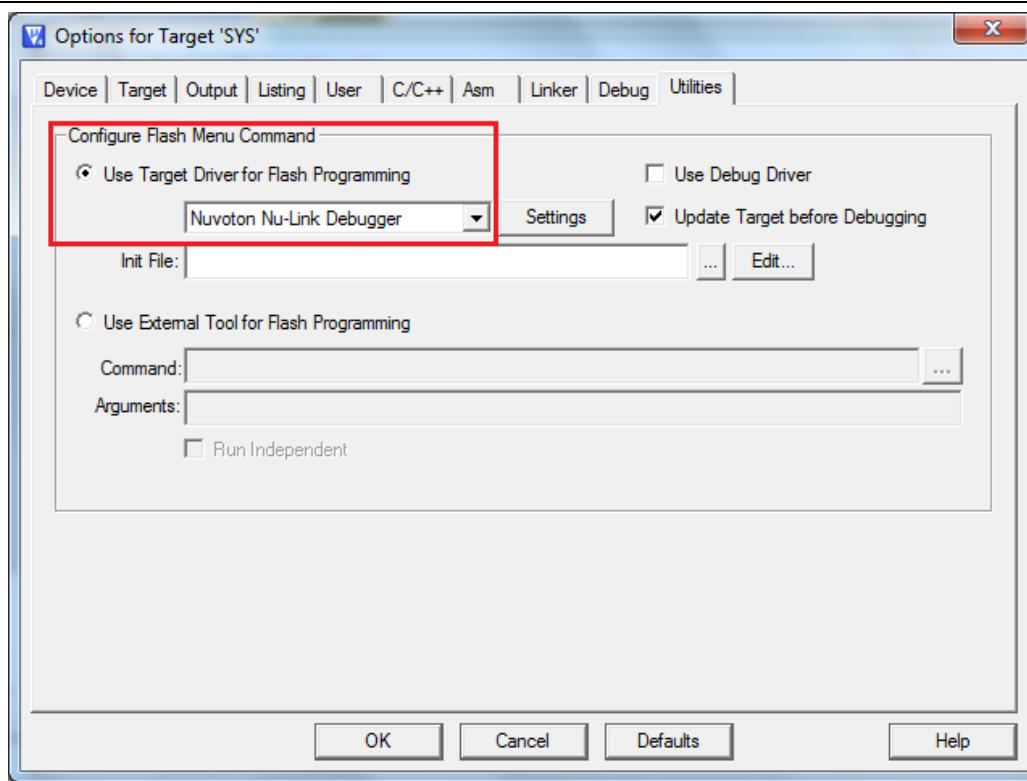
The target device has to be the same as the setting in Debug. Please click “Target Option” to open the Option windows, and find the setting in “Device”, “Debug”, and “Utilities” page. Please follow the steps below to check the setting.



Step 2



Step 3



5.3.3 Build and Download Code to NuTiny-SDK-NM1820xS

Please build the project and download code to NuTiny-SDK-NM1820xS.

5.3.4 Open the Serial Port Terminal

User can use serial port terminal, PuTTY for example, to print out debug message.

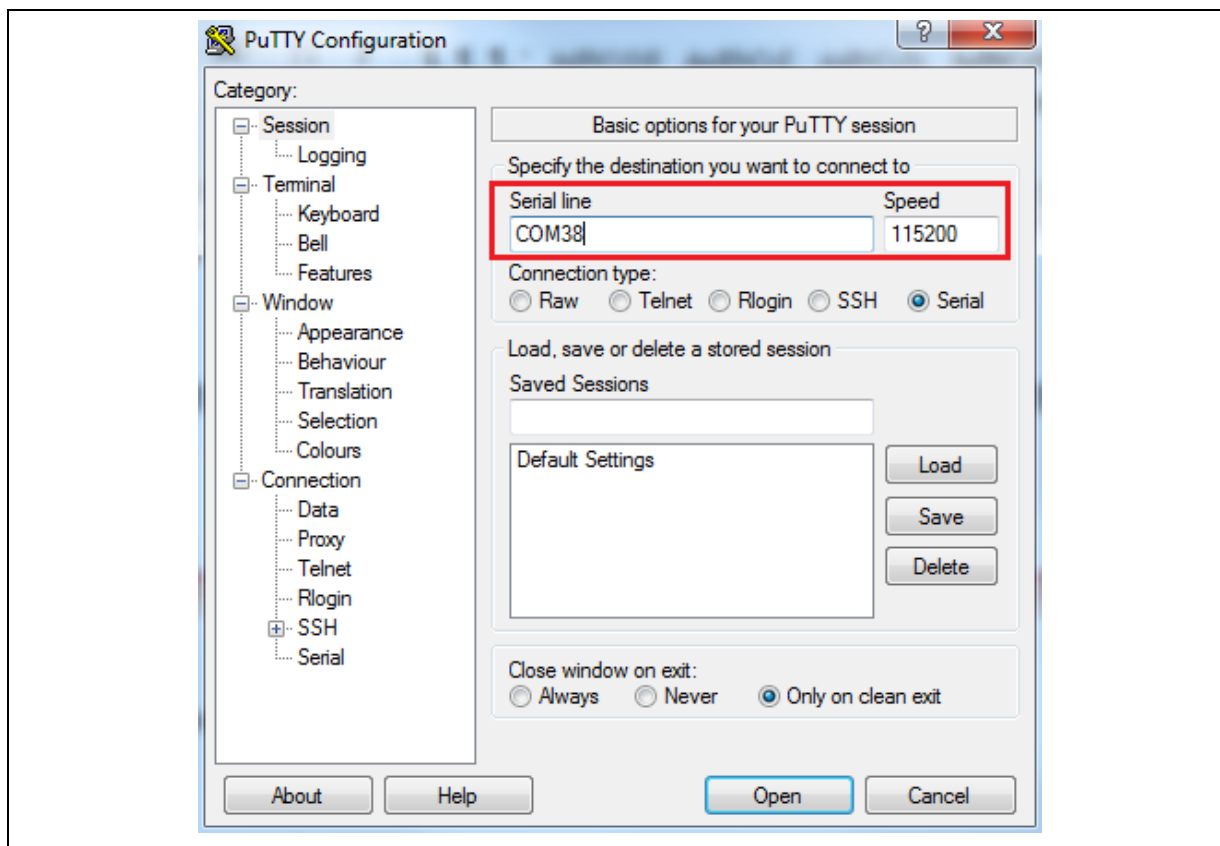
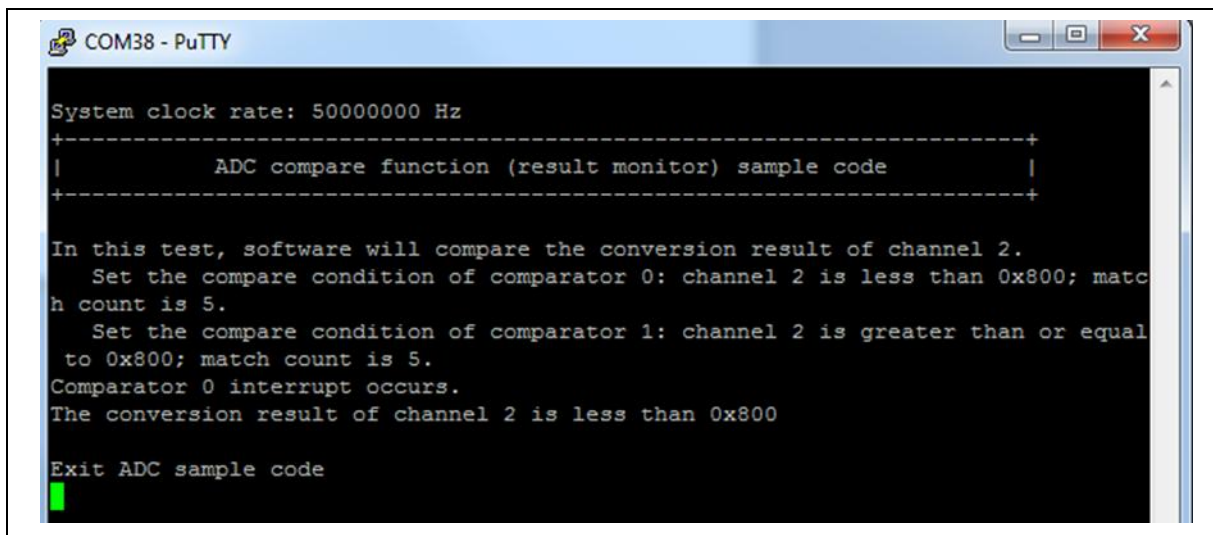


Figure 5-5 Set Baud Rate

5.3.5 Reset Chip

After pushing the reset button, the chip will reprogram application and print out debug message.



```

COM38 - PuTTY

System clock rate: 50000000 Hz
+-----+
|          ADC compare function (result monitor) sample code          |
+-----+

In this test, software will compare the conversion result of channel 2.
  Set the compare condition of comparator 0: channel 2 is less than 0x800; match count is 5.
  Set the compare condition of comparator 1: channel 2 is greater than or equal to 0x800; match count is 5.
Comparator 0 interrupt occurs.
The conversion result of channel 2 is less than 0x800

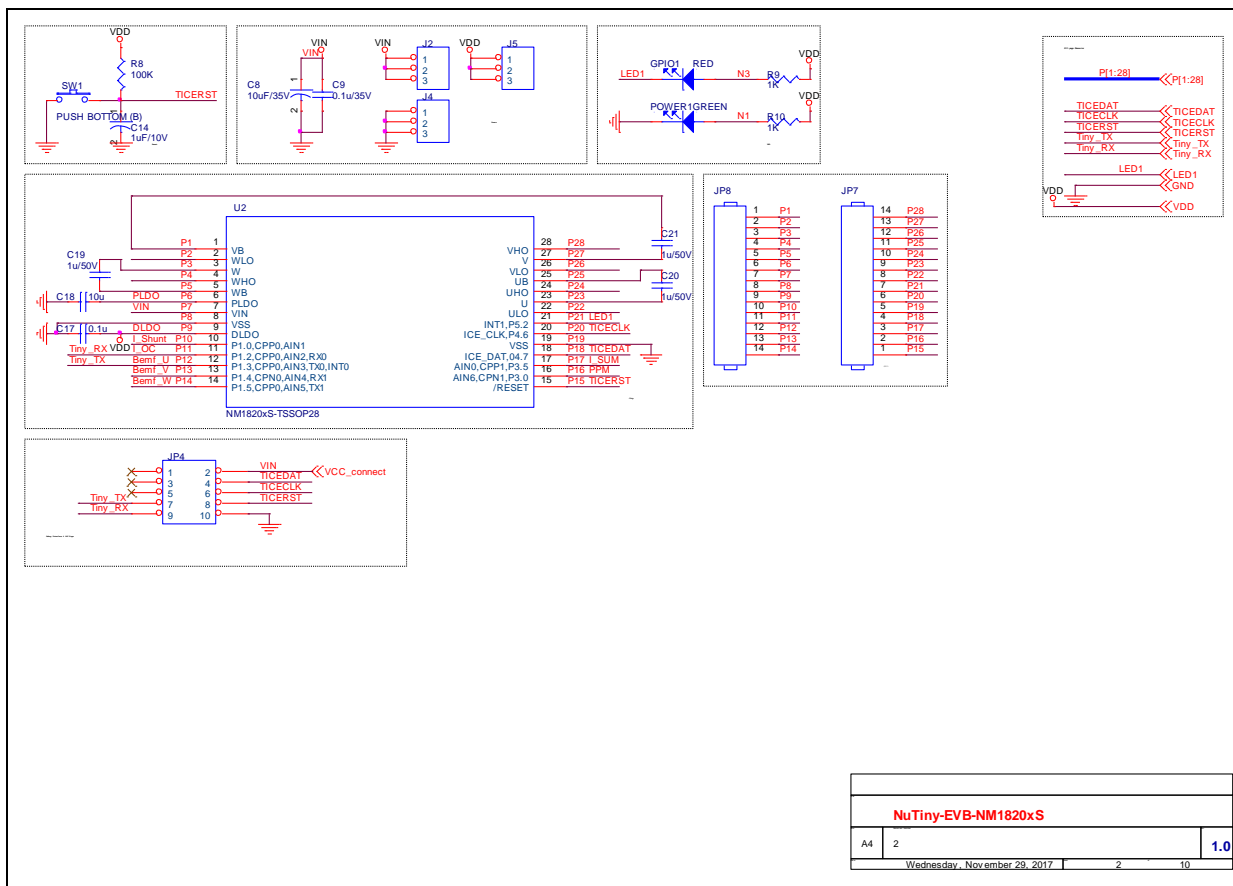
Exit ADC sample code
  
```

Figure 5-6 Serial Port Terminal Windows

Notice: Please switch SW3 on before the NuTiny-SDK-NM1820xS connects to the PC. When the NuTiny-SDK-NM1820xS connects to the PC with SW3 switch on, PC will detect VCOM as a USB device and the detection will only be processed once. VCOM will not function if switch on SW3 after the connection.

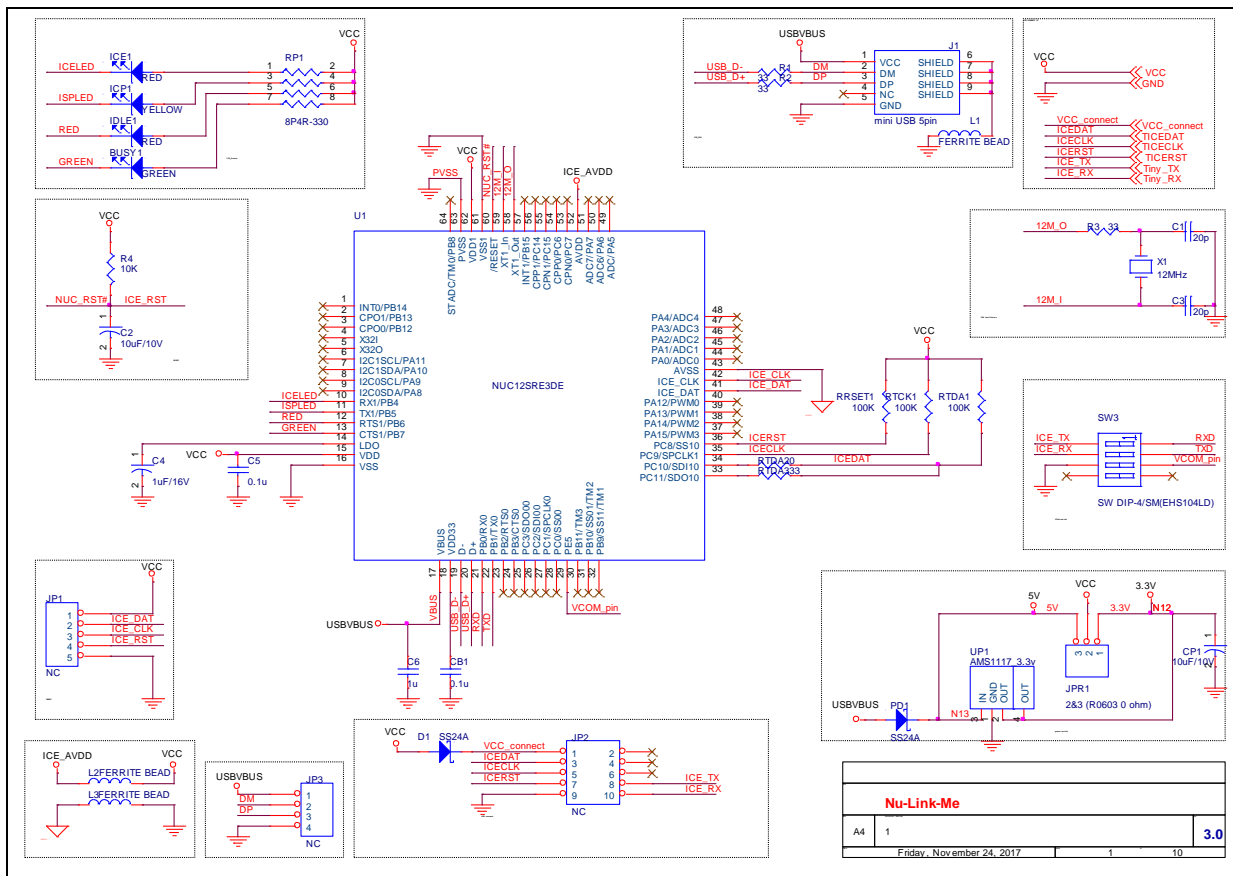
6 NUTINY-SDK-NM1820XS SCHEMATIC

6.1 SDK Circuit Schematic



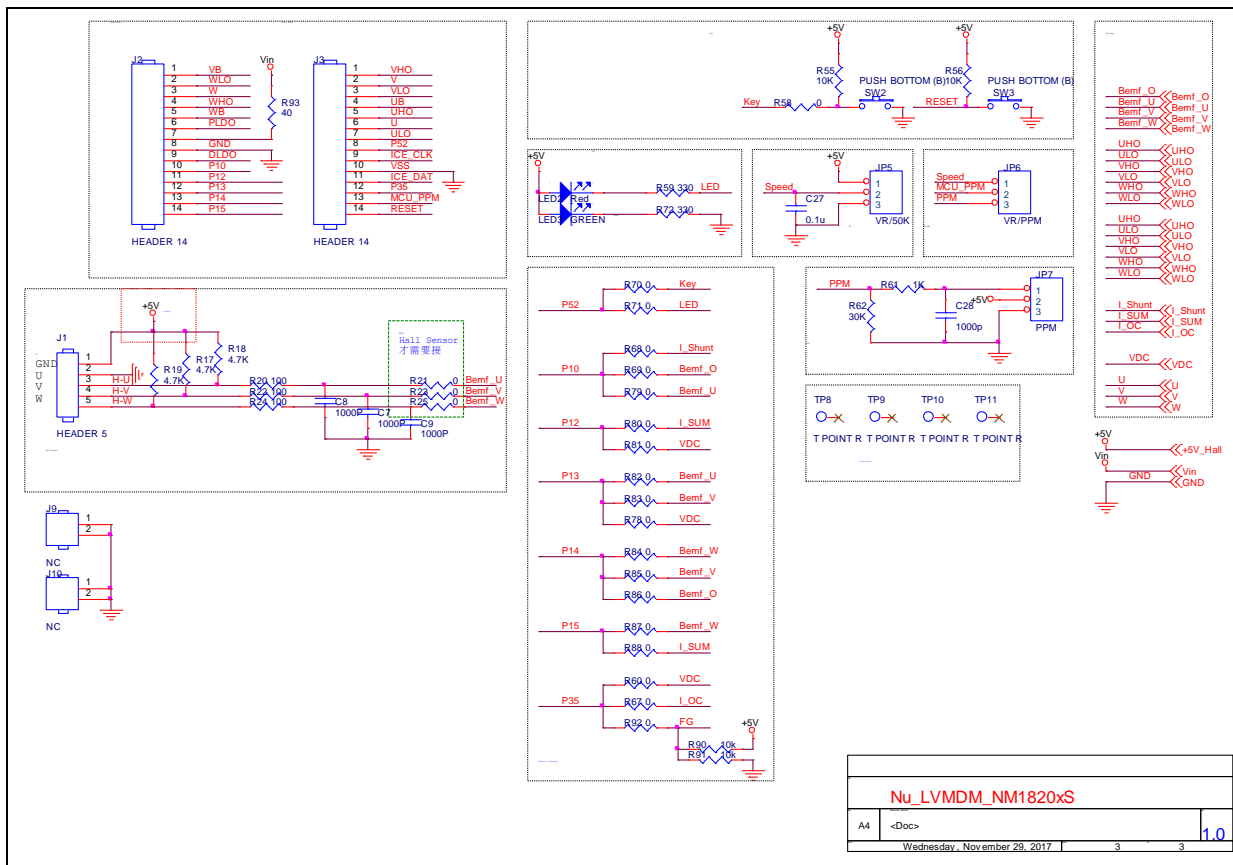
NuTiny-EVB-NM1820xS			
A4	2	Wednesday, November 29, 2017	1.0

6.2 Nu-Link-Me V3.0 Schematic

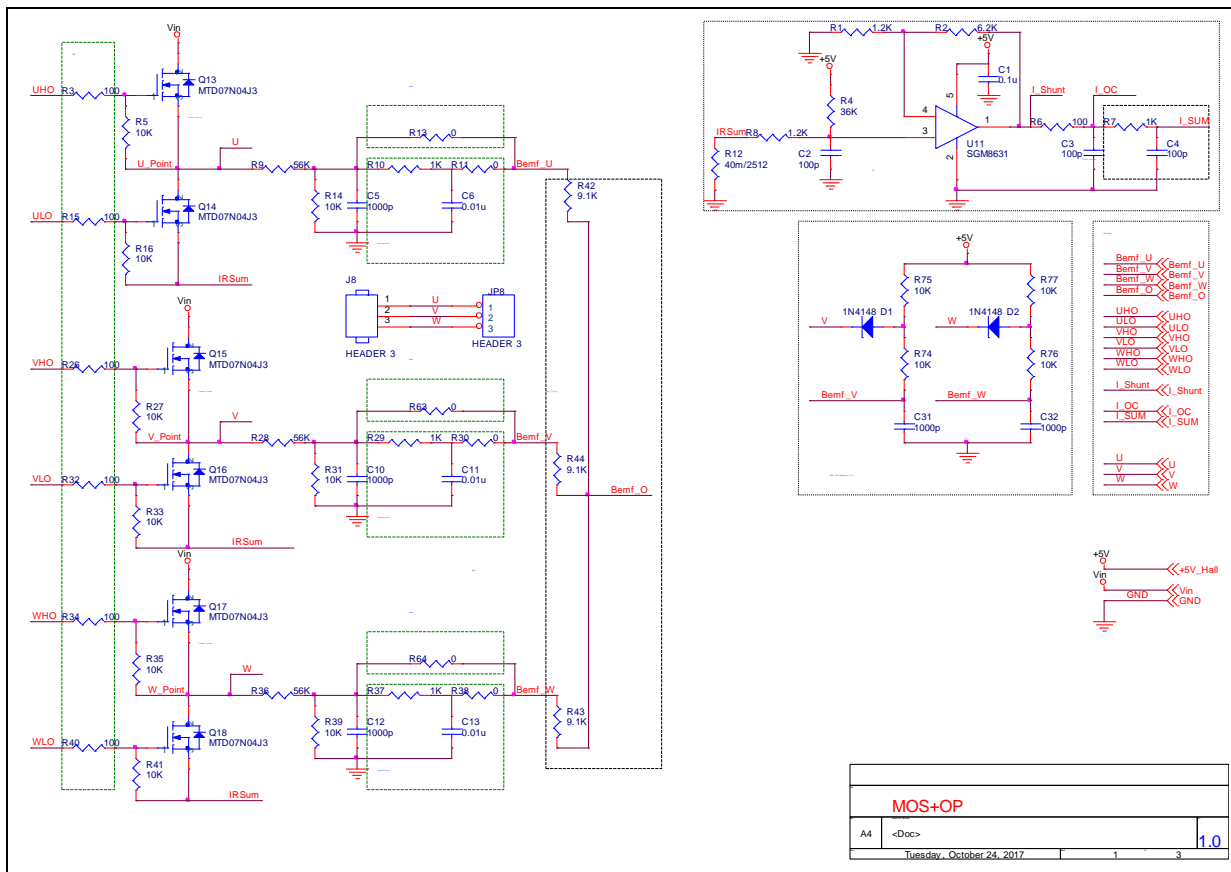


7 NU-LVMDM-MOS(NM1820XS) SCHEMATIC

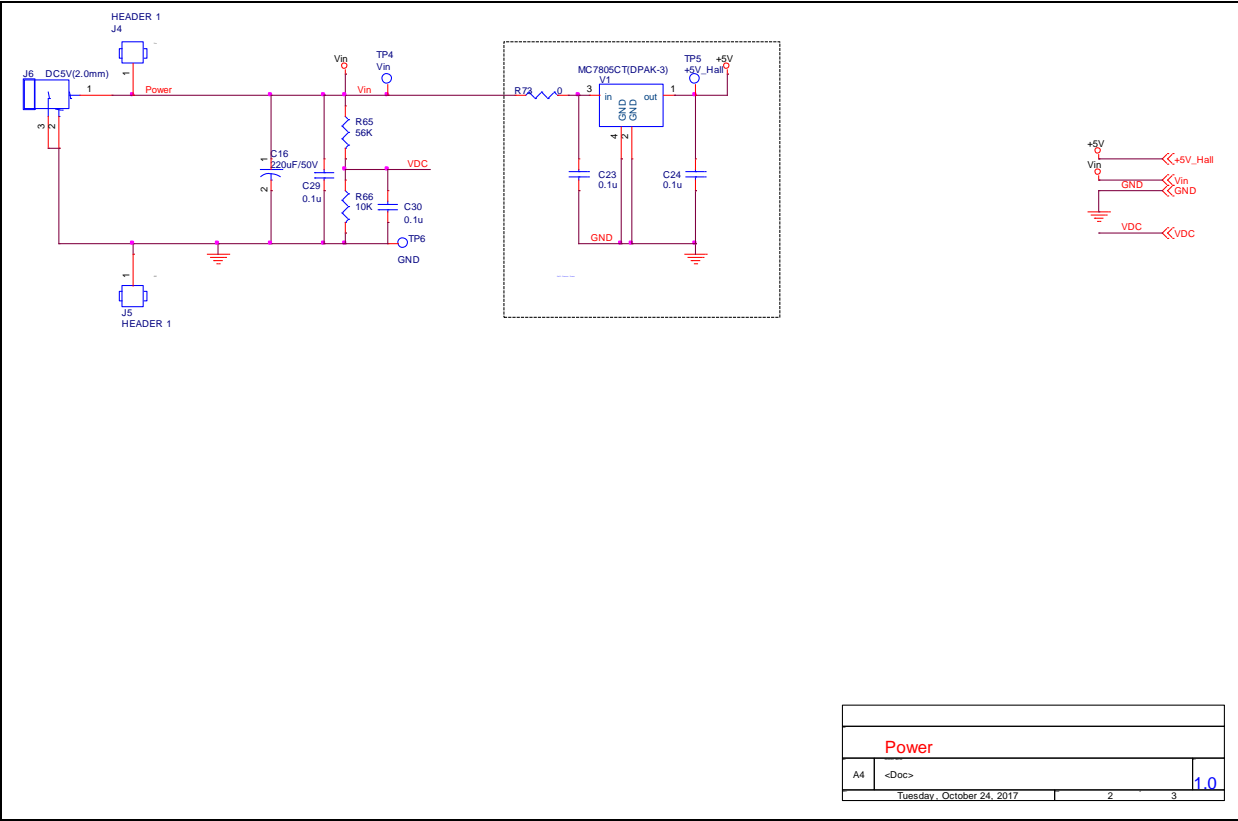
7.1 Connect Schematic



7.2 MOS and Driver Schematic



7.3 Power Schematic



8 NU-LVMDM-MOS(NM1820XS) APPLICATION CIRCUIT DESCRIPTION

8.1 Hall Sensor Description

If want use "Hall sensor", the R21, R23, R25 need use 0Ω connect to Bemf_(U,V,W). But want use back electromotive force, the R21, R23, R25 need remove it.

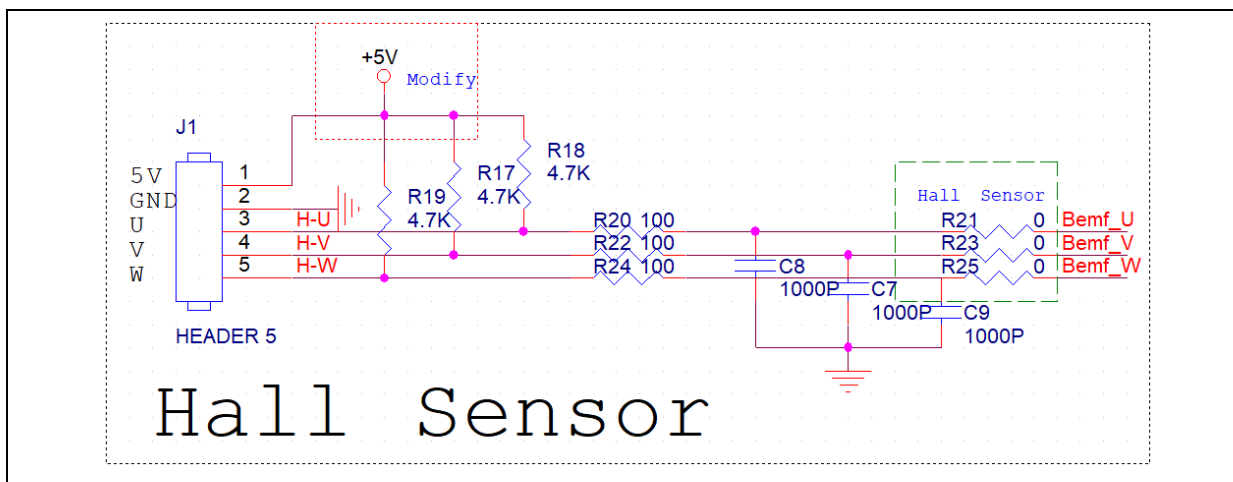


Figure 8-1 NuTiny-SDK-NM1820xS PCB Placement

8.2 VR and PPM Command Function Description

The "speed" signal is use variable resistance(JP5) to provide voltage changes. The VSP is PWM filter signal to MCU(JP7), user can detect voltage to changes motor rotating speed. The JP6 is choose "speed" or "VSP" input to MCU.

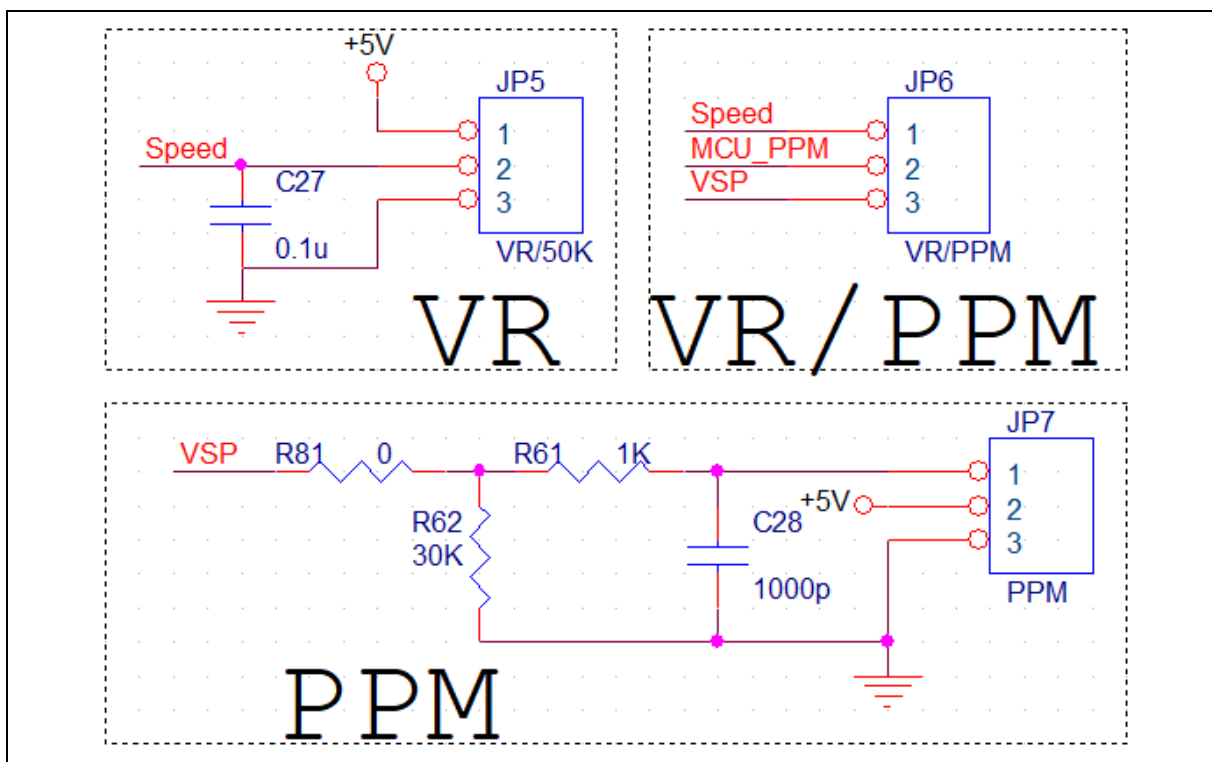


Figure 8-2 NuTiny-SDK-NM1820xS PCB Placement

8.3 Nu-LVMDM-MOS(NM1820xS) Function Mode Switch Description

The Nu-LVMDM-MOS(NM1820xS) can switch to “Sine wave Back electromotive force”, “Square wave Back electromotive force” and “Hall sensor” mode. Please follow the table to choose.

	R9	R10	R11	R13	R14	C5	C6
Mode1: Sine wave Back electromotive force	V	X	X	V	V	V	X
Mode2: Square wave Back electromotive force	V	V	V	X	V	V	V
Mode3: Hall sensor	X	X	X	X	X	X	X

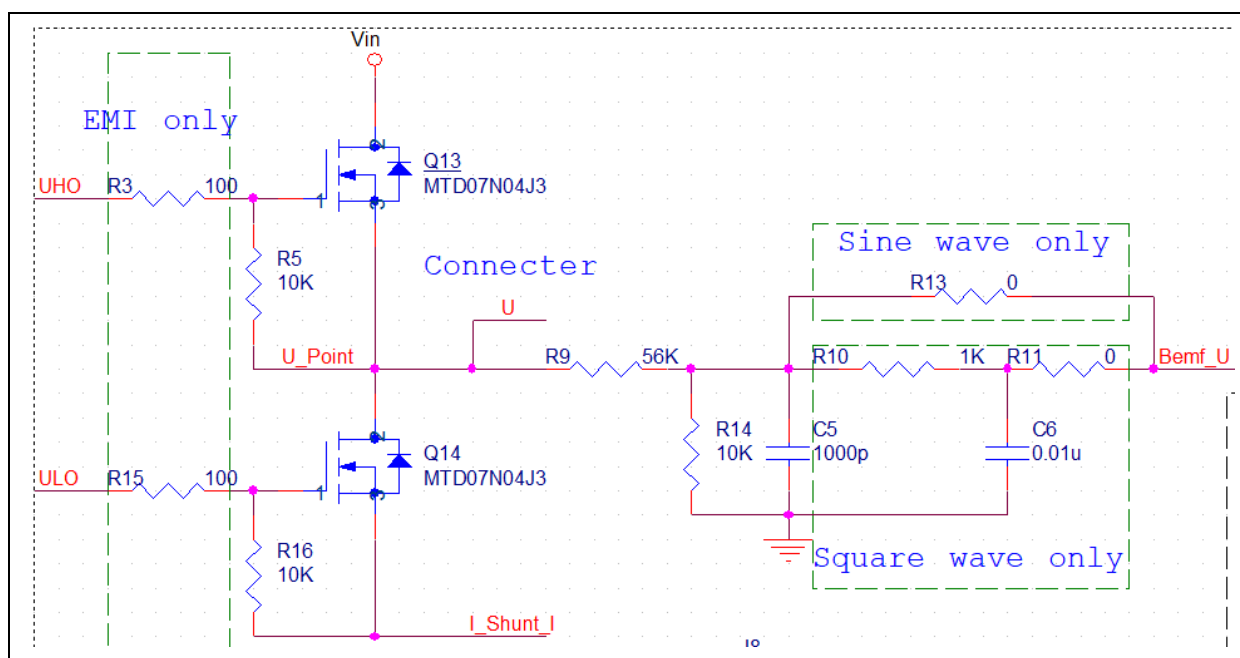


Figure 8-3 NuTiny-SDK-NM1820xS PCB Placement

9 MOTOR HALL AND MOTOR LINE MEASUREMENT STEPS

9.1 Step1: Application Circuit Measurement Points

Find 1K ohm~10k ohm resistor and connect to 3 phases of motor as right picture.

Use Nu-link to connect with demo board and USB to supply 5V for Hall.

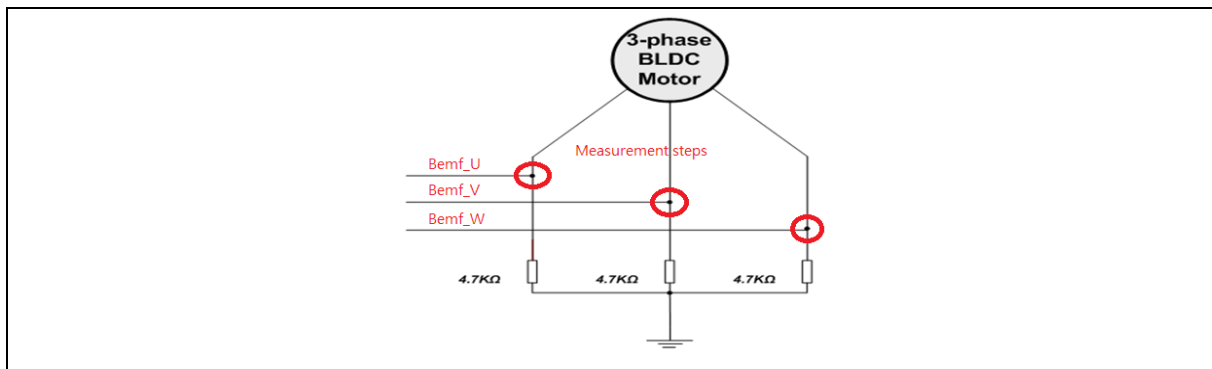


Figure 9-1 NuTiny-SDK-NM1820xS PCB Placement

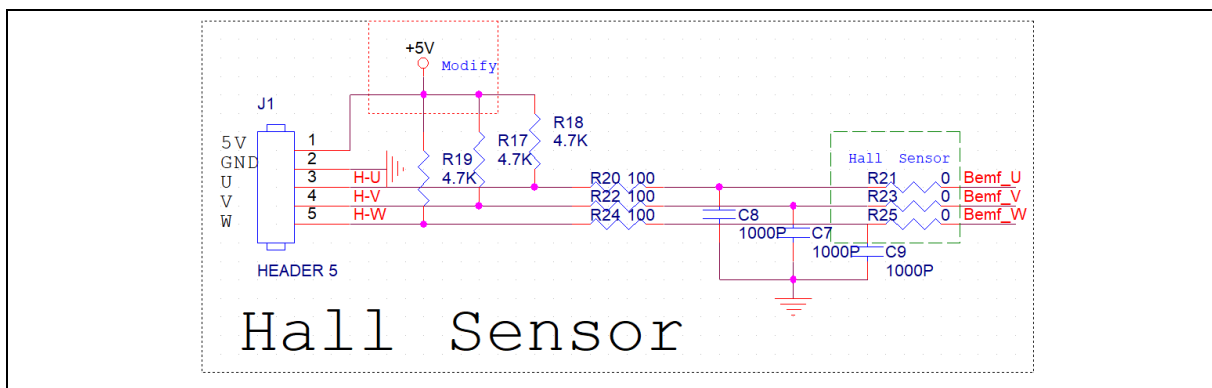
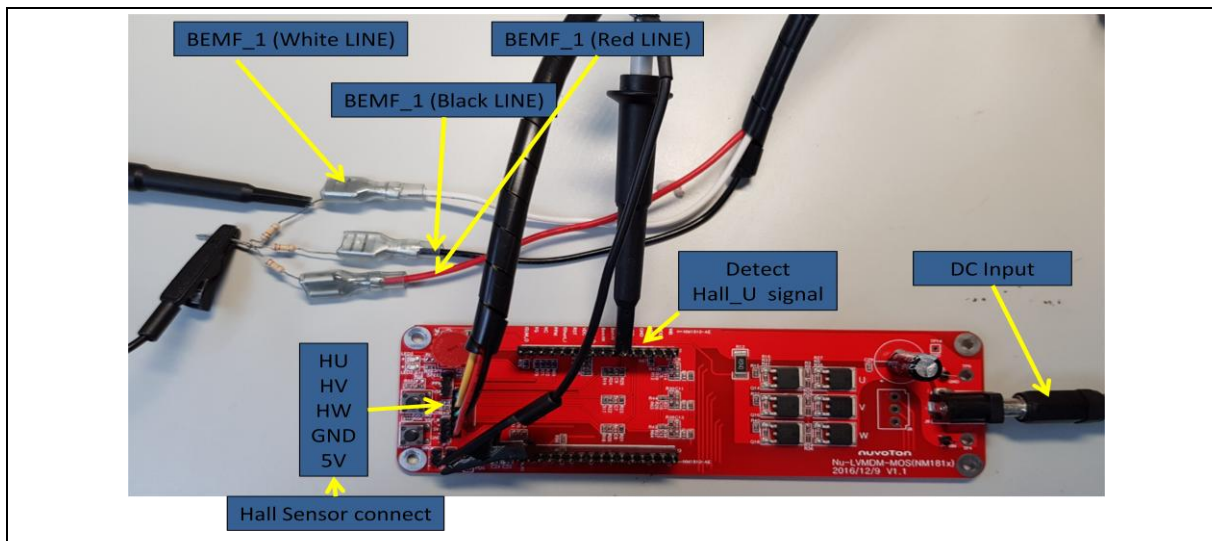
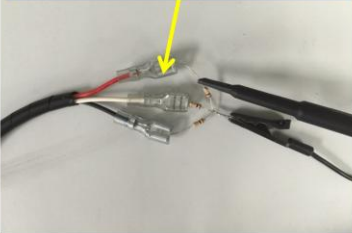
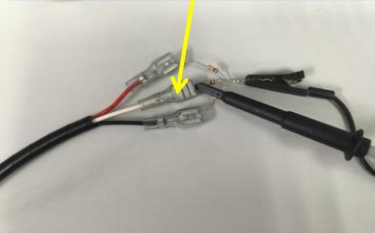
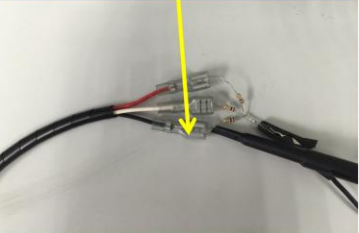
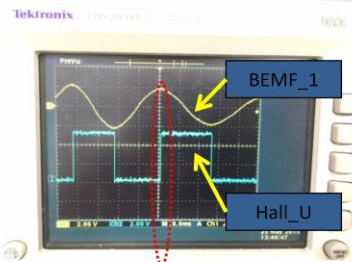




Figure 9-2 NuTiny-SDK-NM1820xS PCB Placement

9.2 Step2: Physical circuit connection

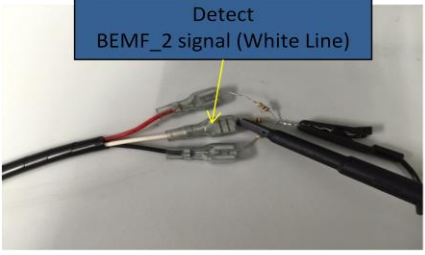
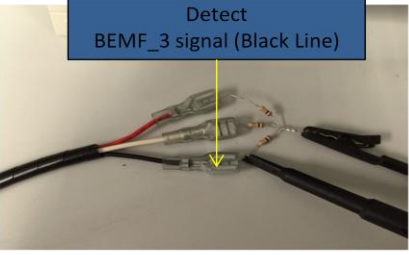
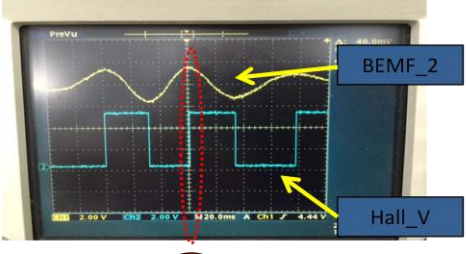
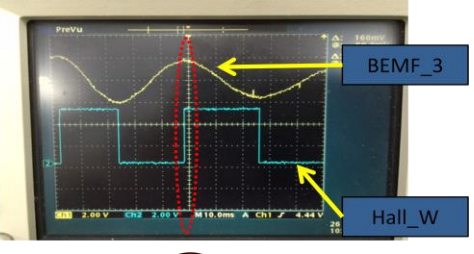


9.3 Step3: Find the signal of U phase

Measure BEMF_1 signal line(Red)	Measure BEMF_2 signal line(White)	Measure BEMF_3 signal line(Black)
		
		
Hall_U Rising edge is aligned to BEMF_1 at 90°(Type1), so we can define BEMF_1 as U phase line	Hall_U Rising edge is not aligned to BEMF_2 (90° or 270°)	Hall_U Rising edge is not aligned to BEMF_3 (90° or 270°)

9.4 Step4: Find the signal of V & W phase

Find 1K ohm~10k ohm

Detect BEMF_2 signal (White Line)	Detect BEMF_3 signal (Black Line)
	
	
Hall_V Rising edge is aligned to BEMF_2 90°(Type1), so we can define BEMF_2 as V phase line.	Hall_W Rising edge is aligned to BEMF_3 90°(Type1), so we can define BEMF_3 as W phase line.

9.5 Step5: Check Hall Type

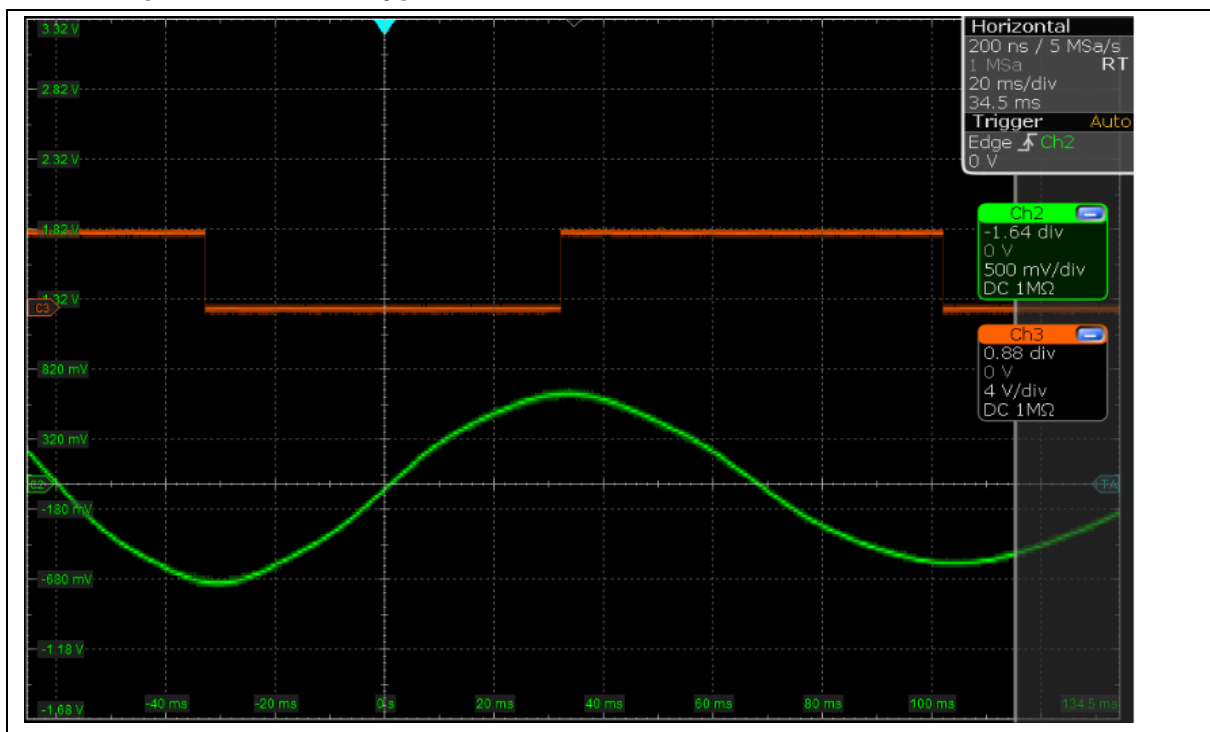


Figure 9-3 Type0 – Hall & BEMF

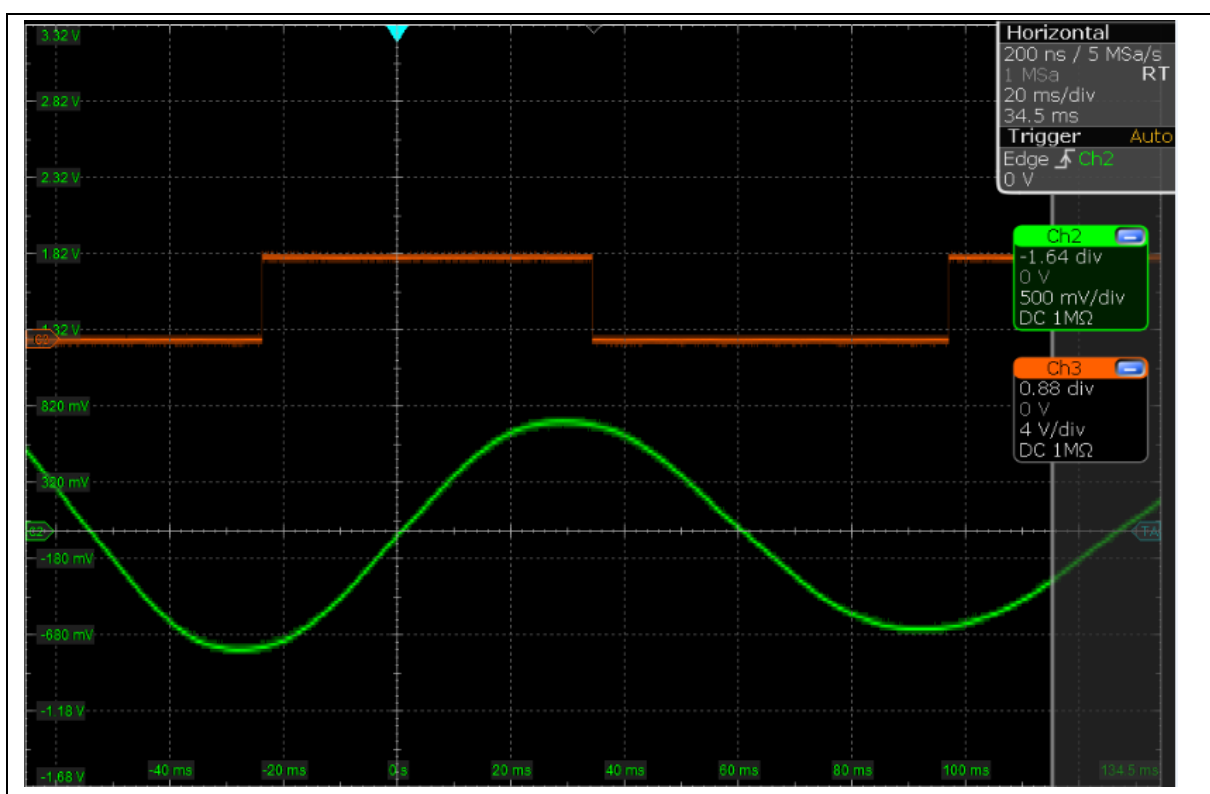


Figure 9-4 Type1 – Hall & BEMF

10 REVISION HISTORY

Date	Revision	Description
2017.11.21	1.00	1. Initially issued.

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