ARM® Cortex®-M

32-bit Microcontroller

NuMicro®Family
NK-LVMDM V2.8
User Manual

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

www.nuvoton.com

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1 OVERVIEW

The Nu-LVMDM V2.8 Learning board is composed of Nu-LVMDM-MOS V2.8 and Nu-MDA-Contral Board. Users can develop/simulate their projects on them.

The Nuvoton Low Voltage Motor Development Module using MOSFET power stage (Nu-LVMDM-MOS-V2.8)(Nu-DB-Gate Driver)and Nuvoton Motor Development Adapter (Nu-MDA-NM1120/NM1200/NM1230/NM1530) 。 Allows users to quickly develop motor-related applications。

Nuvoton Motor Development Adapter Nu-MDA-(NM1120/NM1200/NM1230/NM1530) is NuMicro® Motor-specific series of control chips， Users can use these motor-specific series of chips to develop and verify system programs.

Low Voltage Motor Development Module (Nu-LVMDM-MOS-V2.8) provide LDO conversion 15V、LDO conversion 5V、OPA、Gate Driver、NMOS、QEI、DAC、LCD、UART and speed control component, convenient for users to develop motor application products.

The components on the board that receive power are described as follows

- IR2101S Gate drivers: from LDO15V provide +15V power
- NCT3612 Gate drivers: from VIN provide power
- OP Amplifiers: from LDO5V provide +5Vpower
- USB to UART Bridge: from LDO5V provide +5V power
- LCD Display: from LDO3.3V provide +3.3V power
- Nu-MDA-NMxxxx: from “Nu-LVMDM-MOS-V2.8 LDO5V“or “NCT3612 Gate drivers LDO5V out”

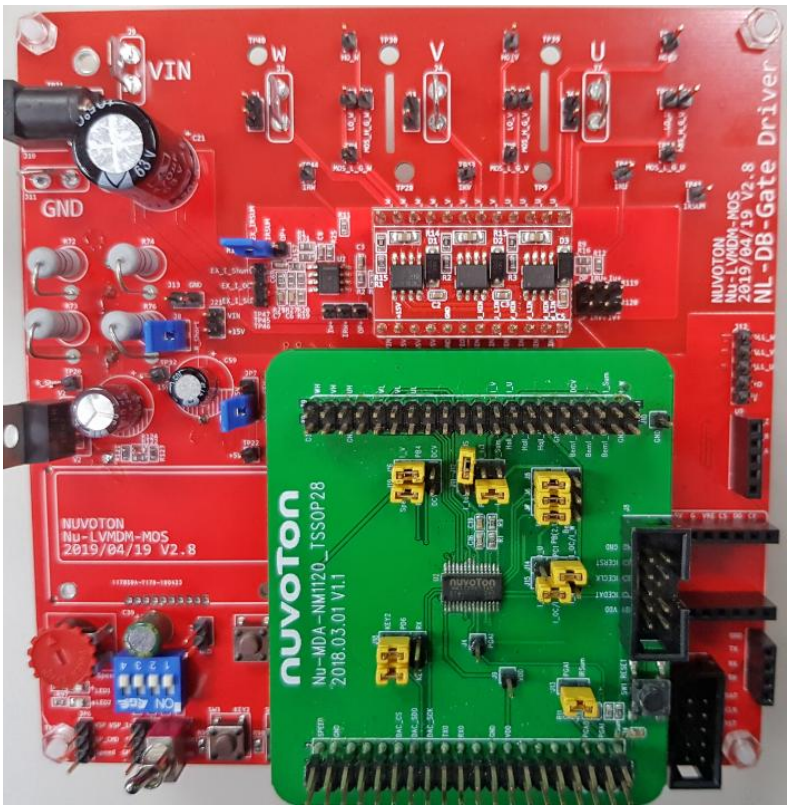


Figure 1-1 Nu-LVMDM-MOS-V2.8+ Nu-MDA-NM1120

2 FEATURES

The key features of this board include the following:

- Motor Control Module
  - Vin input DC18V~48V can use LDO conversion to 15V、5V、3V to provide peripheral circuit power.
  - The preset maximum current is 5A，If you need more than 5A, please replace F1 (FUSE), install heat sink, and C21 need to connect one more.
  - The MOS is use 40V/50A。
  - Support switching sine wave / square wave control
  - Support switching single phase / two phase / three phase current detection
  - Support for the Hall sensors interface (J12)
  - Support phase voltage signal feedback
  - Support DC Bus voltage detection
  - Support overcurrent protection
  - Support VSP input signal control speed
  - Support speed control component
  - Support QEI interface for sensing motor use
  - Support DAC interface to convert digital signals into waveform output
  - Support Nuvoton motor special chip: NM1120、NM1200、NM1230、NM1530
- IO input/output control switching
  - Support two push buttons for trigger control (SW2、SW3)
  - Support two LEDs for debug warning lights (LED1、LED2)
  - Support a 50K Ω VR as a speed control command (JP4)
  - Support LCD display debugging information (not available)
  - Support toggle switch for motor start
  - Support DIP4 switch for IOs High and Low control
- Communication interface
  - UART Communication interface (J11)
- Burning/decoding interface
  - Use Nu-Link-Me V3.0 to connect Nu-MDA-XXXXXX (J8) or Nu-LVMDM-MOS-V2.8 (JP3)

3 NU-LVMDM-MOS-V2.8 INTRODUCTION

(Nu-LVMDM-MOS V2.8) provide for users to develop motor application products, targeted to control a brushless DC (BLDC) motor or permanent magnet synchronous motor (PMSM) in sensor or sensorless operation. This flexible and cost-effective module can be configured in different ways for use with Nuvoton's specialized motor control Microcontrollers (MCUs).

Nu-LVMDM-MOS V2.8 （NL-DB-Gate Driver） support NM1120、NM1200、NM1230、NM1530。It different（Nu-LVMDM-MOS V2.4）is addition "IRSUM" signal for MUC internal OPA. Addition Nuvoton three in one Gate Driver for couster choose Gate Driver source. It offers a mounting option to connect a generic 80-pin Plug-In Module (PIM). The Nu-LVMDM-MOS also has a three-phase inverter bridge circuit. The circuit drives a BLDC or PMSM motor using different control techniques without requiring any additional hardware.

It is recommended to use DC18V~DC48V for input power. When using different input voltages, please pay attention to the voltage divider resistance of VDC detection and the voltage divider resistance value of anti-electric detection. Please configure it below 5V after partial pressure.

This module includes DC18V~DC48V conversion LDO15V, LDO5V, LDO3.3V circuit, current detection supports single resistance sampling (NM1120 can be switched to use internal PGA sampling), Two-phase/three-phase current sampling uses an external OP amplification signal (NM1230 can be switched to use internal OP sampling), Phase voltage sampling supports sine wave, square wave and Hall sensor detection. The external control commands are available with VR variable resistors or VSP external PWM input signals. The communication interface provides a UART interface.

Note: If the output power is too large, you need to install the heat sink yourself (Q1~Q6), and there are 5 screw holes on the side to lock.

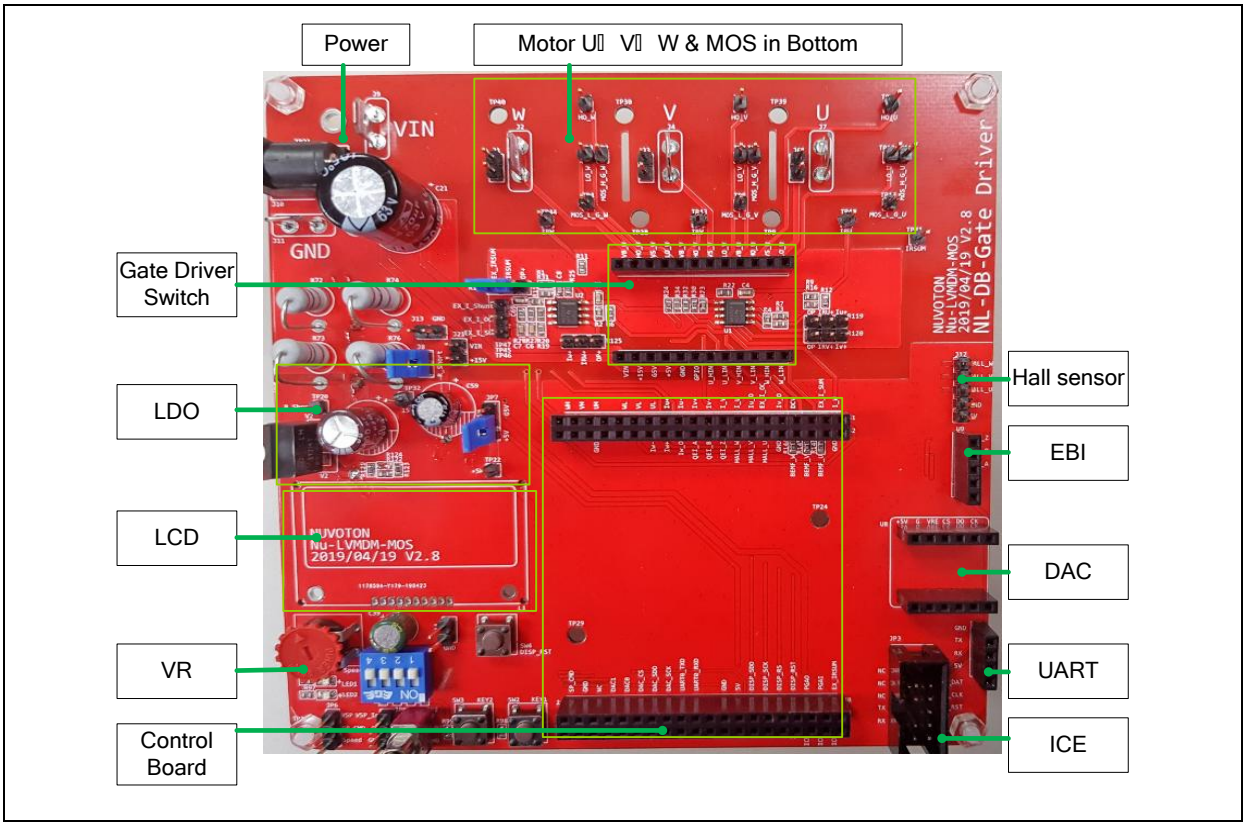


Figure 3-1 Nu-LVMDM-MOV2.8 (PCB Board)

3.1 Nu-LVMDM-MOS V2.8 IO Pin-out Functionality

3.1.1 Plug-In Module (PIM) Configuration

The following Table 3-1 summarizes the PIM (Nu-MDA-xxx) pin-out for the Nu-LVMDM-MOS Development Board Table 3-1 (**C28A 及 C35B**) 。

Pin No	Port	Pin Function (J23)	Pin No	Port	Pin Function (J24)
01	GND	GND	41	I_W	Amplified W phase current
02	Speed	Speed signal	42	GND	GND
03	N/A	N/A	43	EX_I_Sum	Amplified sum current
04	GND	GND	44	Bemf_U	Voltage feedback signal for U phase
05	N/A	N/A	45	N/A	N/A
06	N/A	N/A	46	Bemf_V	Voltage feedback signal for V phase
07	N/A	N/A	47	DCV	DC bus voltage (downscaled)
08	N/A	N/A	48	Bemf_W	Voltage feedback signal for W phase
09	N/A	N/A	49	N/A	N/A
10	N/A	N/A	50	GND	GND
11	N/A	N/A	51	EX_I_OC	Over Current signal (Second-order RC filter)
12	DAC_CS	DAC Chip Select	52	Hall_U	Hall sensor signal for U phase
13	N/A	N/A	53	N/A	N/A
14	DAC_SDO	DAC Serial Data	54	Hall_V	Hall sensor signal for V phase
15	GND	GND	55	I_U	Amplified U phase current
16	DAC_SCK	DAC Serial Clock	56	Hall_W	Hall sensor signal for W phase
17	KEY2	KEY2	57	I_V	Amplified V phase current
18	TXD	UART Transmit	58	QEI-Z	QEI input
19	KEY1	KEY1	59	N/A	N/A
20	RXD	UART Receive	60	QEI-B	QEI input
21	RUN	Motor start or stop	61	Iv+	V phase current feedback into MCU internal OP1+
22	N/A	N/A	62	QEI-A	QEI input

23	GND	GND	63	N/A	N/A
24	GND	GND	64	N/A	N/A
25	5V	5V input for MCU	65	Iu+	U phase current feedback into MCU internal OP0+
26	5V	5V input for MCU	66	Iw+	W phase current feedback into MCU internal OP2+
27	N/A	N/A	67	UL	PWM Output UL
28	DISP_SDO	LCD Display Serial Data Out	68	N/A	N/A
29	LED1	LED1	69	VL	PWM Output VL
30	DISP_SCK	LCD Display Serial Clock	70	Bemf_O	Voltage feedback signal for (U+V+W) phase
31	LED2	LED2	71	WL	PWM Output WL
32	DISP_RS	LCD Display Select Register	72	N/A	N/A
33	N/A	N/A	73	N/A	N/A
34	DISP_RST	LCD Display Display Reset	74	N/A	N/A
35	ICE_DAT	ICE_DAT	75	UH	PWM Output UH
36	N/A	N/A	76	GND	GND
37	ICE_CLK	ICE_CLK	77	VH	PWM Output VH
38	N/A	N/A	78	N/A	N/A
39	ICE_RST	ICE_RST	79	WH	PWM Output WH
40	EX_IRSUM	Sum (U+V+W) current feedback	80	N/A	N/A

Table 3-1Nu-LVMDM-MOS V2.8 IO Pin-out Functionality

3.2 Nu-LVMDM-MOS V2.8 connect description

3.2.1 Power connect

- J9: DC power connect (DC18V~48V)
- Power supply connection Vin(J9,TP21) and GND(J11,TP23)
- Vin DC 18V~48V，LDO15V conversion DC15V for Gate Driver,LDO5V conversion DC5V for Hall sensor and OP, LDO3.3 conversion DC3.3V for LCD(LCD default not available)

3.2.2 IO connect

- **C28A and C35B**: Nu-LVMDM-MOS V2.8 all IO define function

3.2.3 USRT connect

- U10: UART connect

Pin #	Terminal Name	Function
1	+5V	5V power
2	UART_RXD	UART Transmit
3	UART_TXD	UART Receive
4	GND	GND

Table 3-2 UART connect description

3.2.4 Hall connect

- J12:, can transmitting signals to the MCU from Motor Hall sensor line singnal

Pin #	Terminal Name	Function
1	+5V	Hall sensor power
2	GND	Hall sensor GND
3	H_U	U phase Hall sensor feeback
4	H_V	V phase Hall sensor feeback
5	H_W	W phase Hall sensor feeback

Table 3-3 Hall sensor connect description

3.2.5 Nu-Link connect

- JP3: MCU connect Nu-Link or Nu-Link-Me can sue can be debugged and program。

	
Nu-Link-Me V3.0	Nu-Link

Pin #	Terminal Name	Function
1	N/A	N/A
2	+5V	5V power
3	N/A	N/A
4	ICE_DAT	Tandem adjuster data pin
5	N/A	N/A
6	ICE_CLK	Tandem adjuster clock pin
7	N/A	N/A
8	ICE_RST	External reset input: Active low. Set this pin to low to reset to the initial state.
9	N/A	N/A
10	GND	GND

Table 3-4 ICE connect description

3.2.6 DAC connect (U8)

This external DAC uses the SPI interface. For each pin function, please refer to Table 3-5

Pin #	Terminal Name	Function
1	5V	5V power
2	GND	GND
3	VRE	External reference analog input
4	CS	Falling edge of the pulse indicating the start of the serial data.
5	DO	Serial data input
6	CK	Serial clock input
7	O4	DAC D Analog voltage output
8	O3	DAC C Analog voltage output
9	GND	GND
10	GND	GND
11	O2	DAC B Analog voltage output
12	O1	DAC A Analog voltage output

Table 3-5DAC connect description

3.2.7 QEI connect(U9)

QEI(Quadrature encoder interface connector) Please refer to Table 3-6 for description of each pin.

For more detailed QEI information, please refer to the NM1530 technical manual.

Pin #	Terminal Name	Function
1	+5V	5V power
2	GND	GND
3	QEI_A	Quadrature coded A phase input
4	QEI_B	Quadrature coded B phase input
5	QEI_C	Quadrature coded index phase input

Table 3-6 QEI connect description

3.2.8 Input command switching

- JP6: Use Jumper to switch input control commands from the VR variable resistor or VSP external input PWM signal.

3.2.9 Button, LEDs, IO switch connect and VR(speed command)

(Nu-LVMDM-MOS V2.8) learning board contains the following features:

- VR50K (JP4) variable resistor as speed control command (JP6 requires SP_CMD to connect with Speed)
- Support two push button as IO trigger (SW2,SW3)
- Support two LEDs as debug or warning lights (LED1,LED2)
- Support a rocker switch (JP2)
- Support push button for LCD Reset (SW4)

3.2.10 LCD Inferface use “NHD-C0216CZ”(default not available)

3.2.11 Gate Driver choose

The Nu-LVMDM-MOS V2.8(NL-DB Gate Driver) Development Board has two gate drivers that configure the functionality of the board. Please refer to the Figure 3-2 for pin description .

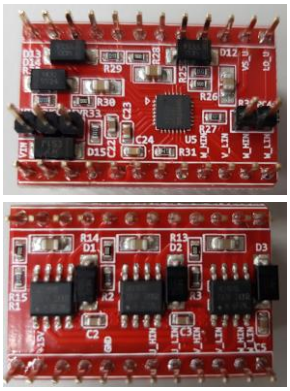


Figure 3-2 Gate Driver choose Demo Board

J19	1	LO_U	J20	1	W_LIN
	2	VS_U		2	W_HIN
	3	HO_U		3	V_LIN
	4	VB_U		4	V_HIN
	5	LO_V		5	U_LIN
	6	VS_V		6	U_HIN
	7	HO_V		7	RUM-GPIO (IR2101 NC)
	8	VB_V		8	GND
	9	LO_W		9	5V (IR2101 NC)
	10	VS_W		10	G5V(IR2101 NC)
	11	HO_W		11	15V
	12	VB_W		12	VIN (IR2101 NC)

Table 3-7 Gate Driver pin description

4 NU-LVMDM-MOS V2.8 APPLICATION CIRCUIT

4.1 Hall Sensor

If want use “Hall sensor”, the function switching resistor R82, R83, R84 need use 100Ω connect to Hall sensor signal line “Hall_(U,V,W)” and R149,R148,R147 need remove. If want use Bemf detection, R82, R83, R84 need remove, and R149,R142,R148,R133,R147,R143 need use 0R, Follow the configuration to avoid conflicts.

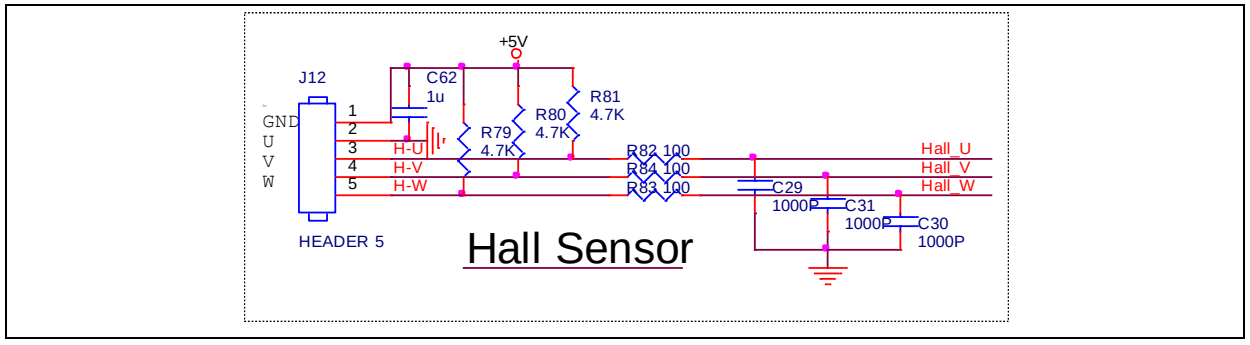


Figure 4-1 Hall sensor circuit

4.2 Input command switching from VR and PPM

JP6 can switch the speed command sourse, VR(JP4) use 50K variable resistor adjusts 0~5V as an input command or PPM (JP9) as an external command PWM signal as a speed command.

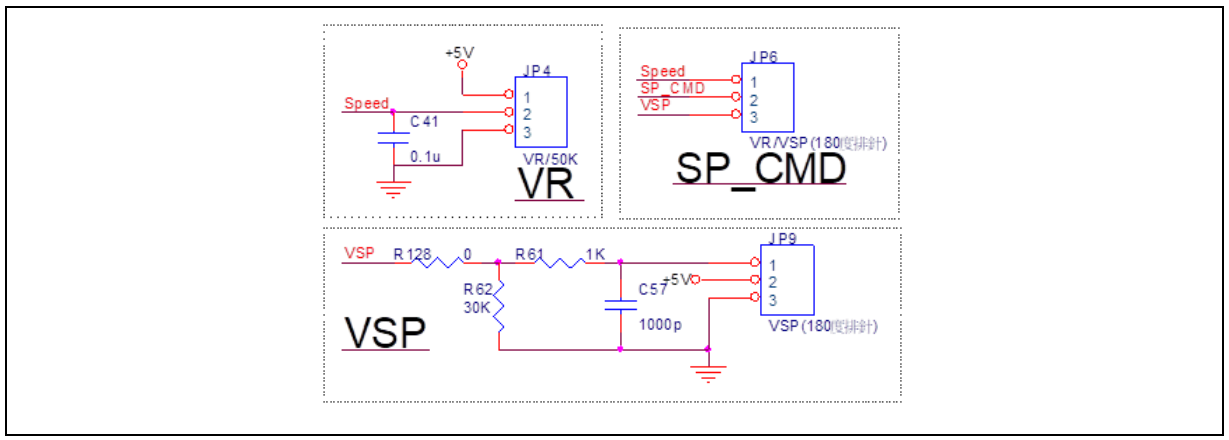


Figure 4-2 choose speed commeand

4.3 Choose DC bus detection voltage divider resistor

When changing the input voltage source, Please calculate that the divided DCV cannot exceed the limit of MUC IO. Example: VIN 24V divided voltage to 3.63V, if VIN up to 48V and not modify divider resistor, then the voltage is 7.27V and has exceeded the IO usage range of the MCU. Therefore, if you choose 48V input voltage "R77" need to use at least 91K ohms.

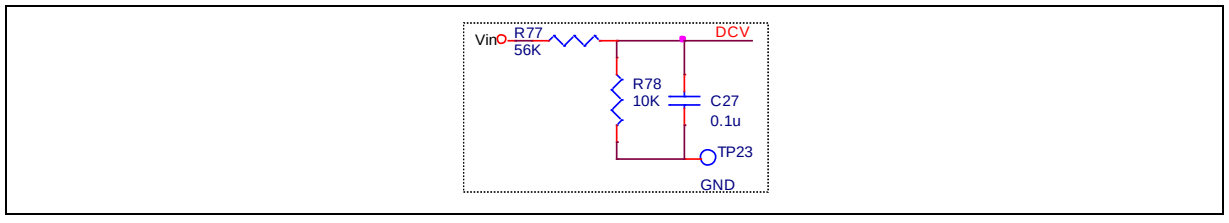


Figure 4-3 Choose DC bus detection voltage divider resistor

4.4 Internal and external OP selection

Nu-LVMDM-MOS V2.8 provide internal and external OP selection, it can amplify the current signal. The signal can be used to detect the direction of current or overcurrent detection.

Example: if you choose the external OP, you will connect OP & IRU+(pin1&pin2) with Jump, if you choose the internal OP, you will connect IRU+ & Iu+(pin2 & pin3) with Jump.

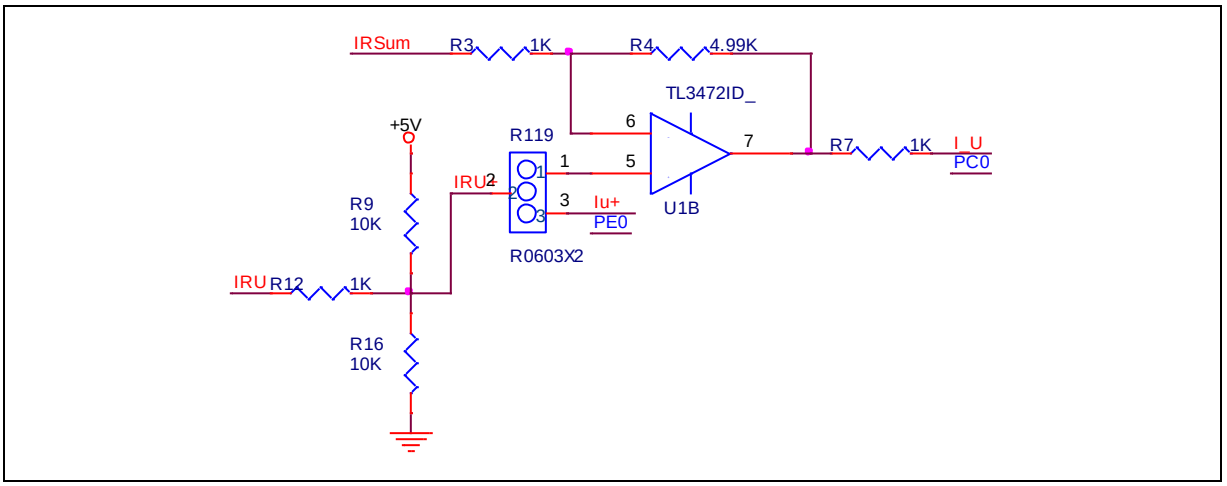


Figure 4-4 Internal and external OP selection (Phase current)

Example: NM1120 can use PGAI input signal, then the PGAO outputs to the ADC or ACMP for detection. Therefore, if you choose the internal OP, you will connect IRSum & EX_IRSum (pin2 & pin3) with Jump. If MUC not have internal OP, you will connect IRSum & OP+(pin2 & pin1) with Jump, The signal is amplified by the external OP and then transmitted back to the MCU for detection.

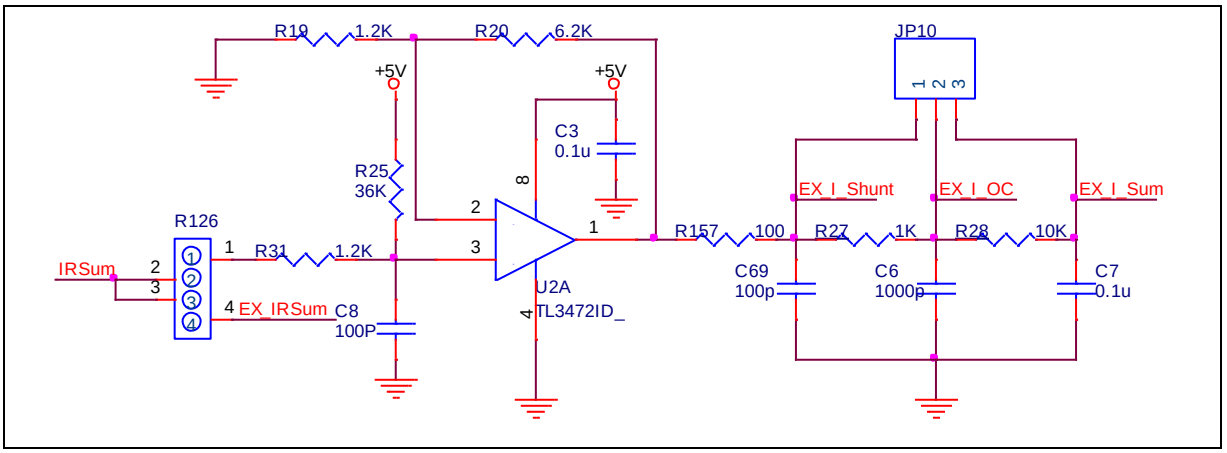


Figure 4-5 Internal and external OP selection (Total current)

4.5 Select phase voltage feedback mode

Nu-LVMDM-MOS V2.8 provide a variety of phase voltage detection methods, user can replace or remove resistors to change phase voltage feedback mode. please refer Table 4-1。

U Phase voltage detection mode selection					V Phase voltage detection mode selection					W Phase voltage detection mode selection				
Component	Bemf_U	Hall_U	Bemf_O	IPD_U	Component	Bemf_V	Hall_V	Bemf_O	IPD_V	Component	Bemf_W	Hall_W	Bemf_O	IPD_W
R149	V		V		R148	V		V		R147	V		V	
R142	V		V		R133	V		V		R143	V		V	
R82		V			R84		V			R83		V		
R139				V	R136				V	R132				V
R138				V	R137				V	R134				V
R146			V		R145			V		R144			V	

Table 4-1 Phase voltage detection mode selection

Example: If use Hall sensor R149,R142 resistor need remove to avoid circuit influence measurement (V&W the same position of the resistor also needs to be removed.

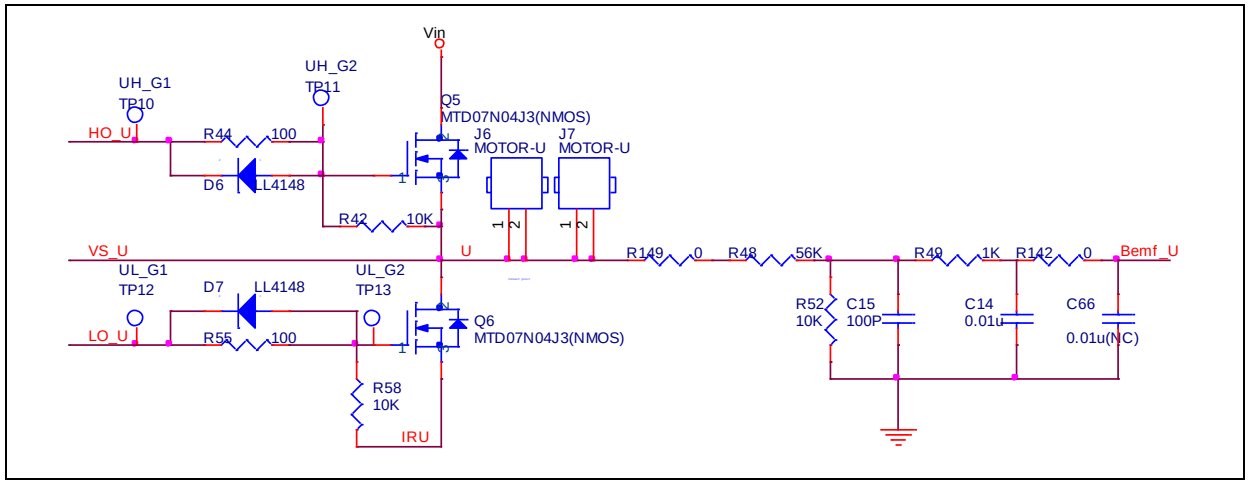


Figure 4-6 Phase voltage detection mode selection

4.5.1 Choose Bemf detection voltage divider resistor

When changing the input voltage source, Please calculate that the divided DCV cannot exceed the limit of MUC IO. Example: VIN 24V divided voltage to 3.63V, if VIN up to 48V and not modify divider resistor, then the voltage is 7.27V and has exceeded the IO usage range of the MCU. Therefore, if you choose 48V input voltage "R77" need to use at least 91K ohms.

	R13	R35	R48
48V VIN	91K	91K	91K
24V VIN	56K	56K	56K

5 NU-MDA-NM1120 INTRODUCTION

Nu-MDA-NM1120E(NK-NM1120E) is the specific development tool for NuMicro® NM1120 series. Users can use Nu-MDA-NM1120E to develop and verify the application program easily.

The ARM® Cortex®-M0 core within NuMicro® NM1120 series can run up to 48 MHz and offers 29.5K-bytes embedded program flash, size configurable Data Flash (shared with program flash), 2K-bytes Flash for the ISP, 1.5K-byte SPROM for security, and 4K-byte SRAM. Plentiful system level peripheral functions, such as I/O Port, Timer, UART, SPI, I2C, PWM, ADC, Watchdog Timer, Analog Comparator and Brown-out Detector, have been incorporated into the NM1120 series in order to reduce component count, board space and system cost. These useful functions make the NM1120 series powerful for a wide range of motor driver applications.

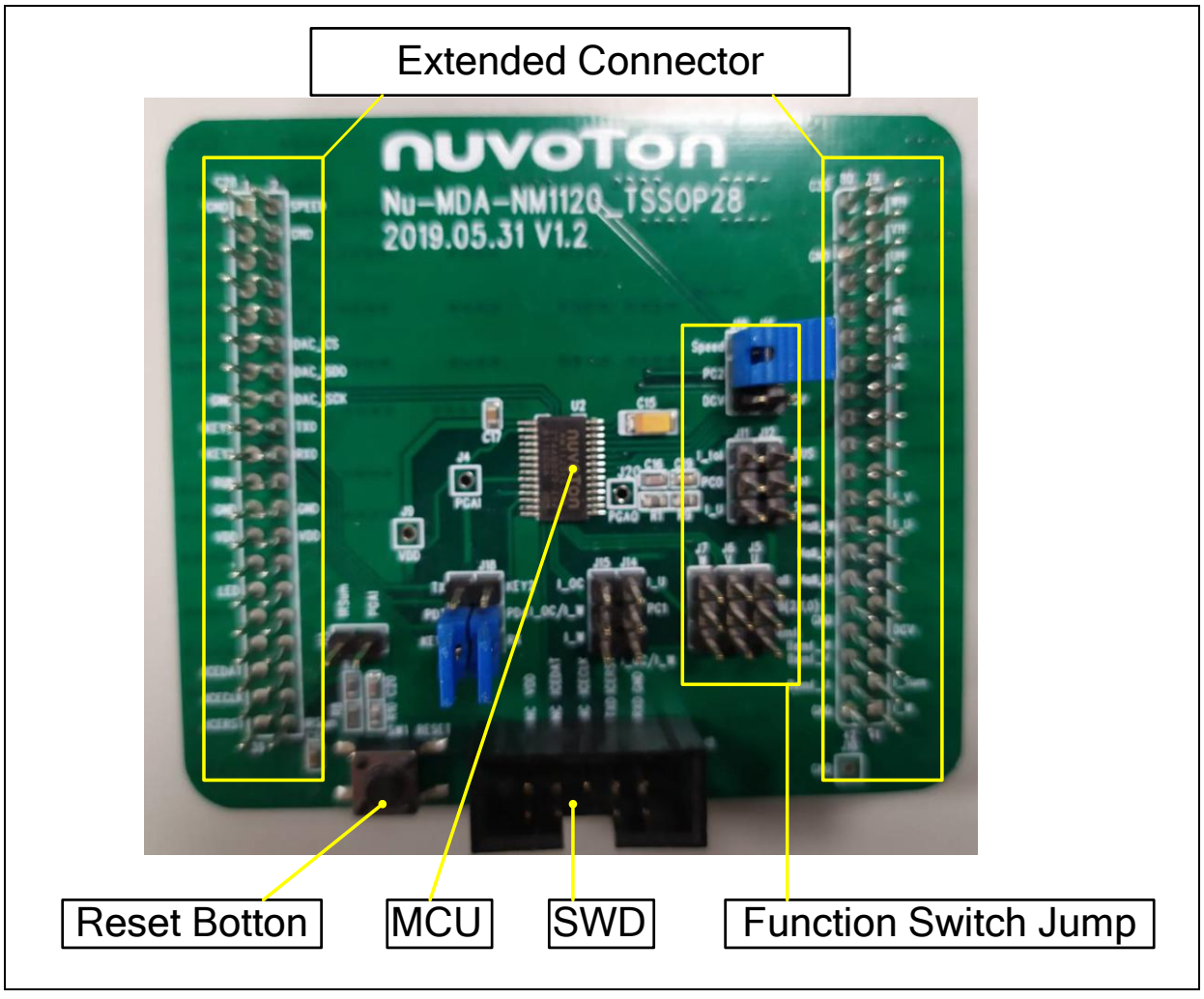


Figure 5-1 Nu-MDA-NM1120 INTRODUCTION

5.1 Nu-MDA-NM1120 IO INTRODUCTION

The following Table summarizes the PIM (Nu-MDA-xxx) pin-out for the Nu-LVMDM-MOS Development Board Table 5-1 (**C28A 及 C35B**) . The multiple functions jump please refer **13.6.**

Pin No	Port	Pin Function (J23)	Pin No	Port	Pin Function (J24)
01	GND	GND	41	PC1	I_W :Amplified W phase current
02	PC2	SP_CMD: Speed signal	42	GND	GND
03	N/A	N/A	43	PC0	EX_I_Sum : Amplified sum current
04	GND	GND	44	PB0	Bemf_U :Voltage feedback signal for U phase
05	N/A	N/A	45	N/A	N/A
06	N/A	N/A	46	PB1	Bemf_V : Voltage feedback signal for V phase
07	N/A	N/A	47	PC2	DCV :DC bus voltage (downscaled)
08	N/A	N/A	48	PB2	Bemf_W : Voltage feedback signal for W phase
09	N/A	N/A	49	N/A	N/A
10	N/A	N/A	50	GND	GND
11	N/A	N/A	51	N/A	N/A
12	PD5	DAC_CS :DAC Chip Select	52	PB0	Hall_U : Hall sensor signal for U phase
13	N/A	N/A	53	N/A	N/A
14	PD2	DAC_SDO :DAC Serial Data	54	PB1	Hall_V : Hall sensor signal for V phase
15	GND	GND	55	PC0/PC1	I_U : Amplified U phase current
16	PD1	DAC_SCK:DAC Serial Clock	56	PB2	Hall_W : Hall sensor signal for W phase
17	PD4	KEY2	57	PB4	I_V : Amplified V phase current
18	PD3	TXD :UART Transmit	58	N/A	N/A
19	PD3	KEY1	59	N/A	N/A
20	PD4	RXD :UART Receive	60	N/A	N/A
21	PC4	RUN :Motor start or stop	61	N/A	N/A

22	N/A	N/A	62	N/A	N/A
23	GND	GND	63	N/A	N/A
24	GND	GND	64	N/A	N/A
25	5V	5V input for MCU	65	N/A	N/A
26	5V	5V input for MCU	66	N/A	N/A
27	N/A	N/A	67	PA1	UL : PWM Output UL
28	N/A	N/A	68	N/A	N/A
29	PD6	LED1	69	PA3	VL : PWM Output VL
30	N/A	N/A	70	N/A	N/A
31	N/A	N/A	71	PA5	WL :PWM Output WL
32	N/A	N/A	72	N/A	N/A
33	N/A	N/A	73	N/A	N/A
34	N/A	N/A	74	N/A	N/A
35	PD2	ICE_DAT	75	PA0	UH : PWM Output UH
36	N/A	N/A	76	GND	GND
37	PD1	ICE_CLK	77	PA2	VH : PWM Output VH
38	N/A	N/A	78	N/A	N/A
39	ICE_RST	ICE_RST	79	PA4	WH :PWM Output WH
40	PB3	EX_IRSUM : Sum (U+V+W) current feedback	80	N/A	N/A

Table 5-1 Nu-MDA-NM1120 IO INTRODUCTION

5.2 Nu-MDA-NM1120 Jumper Description

5.2.1 Function Choose

The Development Board has meny jumpers that configure the functionality of the board, User and short PIN1 & PIN2 or short PIN2 & PON3 to choose function. The following shows the functionality of each terminal.

Connector	PIN1	PIN2	PIN3	Description
JP5	Bemf_U	PB0	Hall_U	Bemf_U and Hall_U function choose
JP6	Bemf_V	PB1	Hall_V	Bemf_V and Hall_V function choose
JP7	Bemf_W	PB2	Hall_W	Bemf_W and Hall_W function choose
JP11	I_tol	PC0	I_U	I_tol is total current. I_U is U phase current
JP12	I_Bus	I_tol	EX_I_Sum	I_Bus is use NM1120 internal OP output and connect to RC filtering signal. I_Sum is use external OP and connect to RC filtering signal.
JP13	IRSum	PGAI	-	IRSum is total current not connect to OP signal. This connect short can let IRSum signal connect to RC filtering and level shift 161 mV.
JP14	I_U	PC1	I_OC/I_W	I_U is U phase current. I_OC/I_W is over current detection and W phase current signal choose.
JP15	I_OC	I_OC/I_W	I_W	I_OC is over current detection. I_W is W phase current signal choose.
JP16	I_V	PB4	DCV	I_V is V phase current. DCV is over DC voltage detection.
JP17	TX	PD5	KEY1	TX is connect to MUC UART TX signal. KEY1 is connect to MCU GPIO pin.
JP18	RX	PD6	KEY2	RX is connect to MUC UART RX signal. KEY1 is connect to MCU GPIO pin.
JP19	Speed	PC2	DCV	Speed is connect to variable resistance circuit. DCV is over DC voltage detection.

Table 5-2 Nu-MDA-NM1120 Function Choose Details

6 NU-MDA-NM1200 INTRODUCTION

Nu-MDA-NM1200L(NK-NM1200L) is the specific development tool for NuMicro® NM1200 series. Users can use Nu-MDA-NM1200L to develop and verify the application program easily.

The ARM® Cortex®-M0 core within NuMicro® NM1200 series can run up to 48 MHz and operate at 2.1V ~ 5.5V, -40℃ ~ 105℃, and thus can afford to support a variety of industrial control and applications which need high CPU performance. The NM1200/NM1100 series 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, PWM, ADC, Watchdog Timer, Analog Comparator and Brown-out Detector, have been incorporated into the NM1200/NM1100 series in order to reduce component count, board space and system cost. These useful functions make the NM1200/NM1100 series powerful for a wide range of applications.

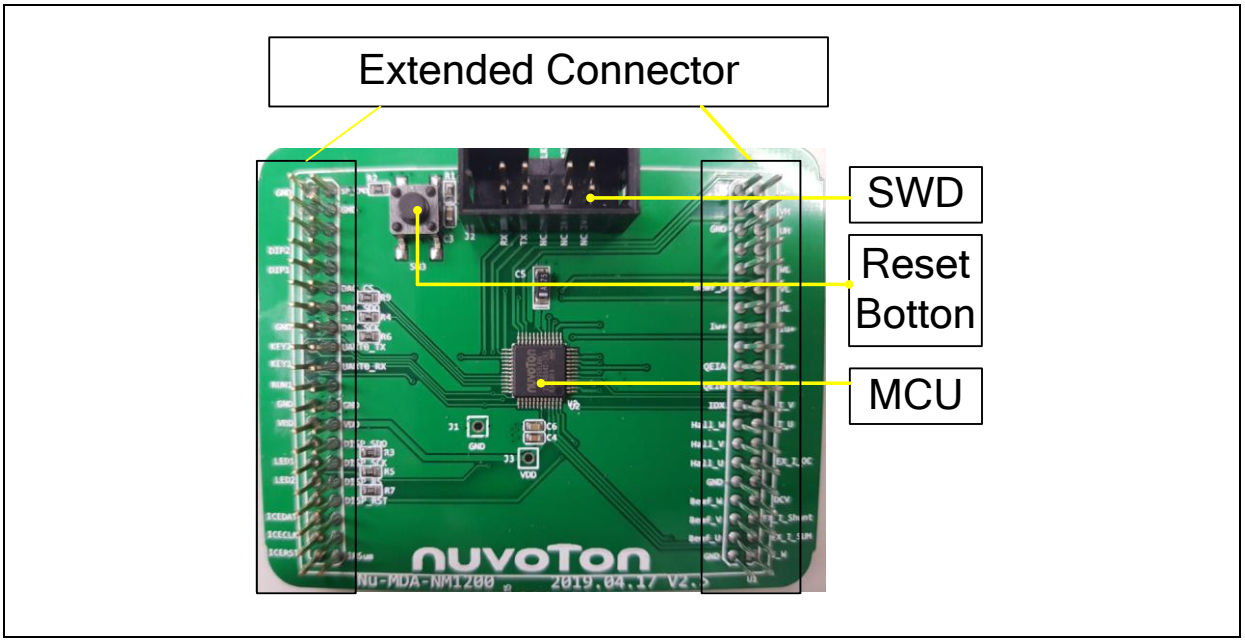


Figure 6-1 Nu-MDA-NM1200 INTRODUCTION

6.1 Nu-MDA-NM1200 IO INTRODUCTION

The following Table summarizes the PIM (Nu-MDA-xxx) pin-out for the Nu-LVMDM-MOS Development Board Table 6-1 (**U6A 及 U6B**) 。

Pin No	Port	Pin Function (J23)	Pin No	Port	Pin Function (J24)
01	GND	GND	41	P1.2	I_W :Amplified W phase current
02	P3.1	SP_CMD: Speed signal	42	GND	GND
03	N/A	N/A	43	N/A	N/A
04	GND	GND	44	P1.4	Bemf_U :Voltage feedback signal for U phase
05	N/A	N/A	45	P1.3	EX_I_Shunt : Amplified I_Shunt current
06	N/A	N/A	46	P1.5	Bemf_V : Voltage feedback signal for V phase
07	P5.2	DIP2	47	P3.0	DCV :DC bus voltage (downscaled)
08	N/A	N/A	48	P5.4	Bemf_W : Voltage feedback signal for W phase
09	P5.1	DIP1	49	N/A	N/A
10	N/A	N/A	50	GND	GND
11	N/A	N/A	51	P3.2	EX_I_OC : Over Current signal (Second-order RC filter)
12	P0.6	DAC_CS :DAC Chip Select	52	P3.4	Hall_U : Hall sensor signal for U phase
13	N/A	N/A	53	N/A	N/A
14	P0.5	DAC_SDO :DAC Serial Data	54	P3.5	Hall_V : Hall sensor signal for V phase
15	GND	GND	55	P5.3	I_U : Amplified U phase current
16	P0.7	DAC_SCK:DAC Serial Clock	56	P3.6	Hall_W : Hall sensor signal for W phase
17	P5.2	KEY2	57	P1.0	I_V : Amplified V phase current
18	P0.0	TXD :UART Transmit	58	N/A	N/A
19	P3.7	KEY1	59	N/A	N/A
20	P0.1	RXD :UART Receive	60	N/A	N/A

21	P2.7	RUN :Motor start or stop	61	N/A	N/A
22	N/A	N/A	62	N/A	N/A
23	GND	GND	63	N/A	N/A
24	GND	GND	64	N/A	N/A
25	5V	5V input for MCU	65	N/A	N/A
26	5V	5V input for MCU	66	N/A	N/A
27	N/A	N/A	67	P2.3	UL : PWM Output UL
28	P0.5	DISP_SDO : LCD Display Serial Data Out	68	N/A	N/A
29	P5.5	LED1	69	P2.5	VL : PWM Output VL
30	P0.7	DISP_SCK : LCD Display Serial Clock	70	N/A	N/A
31	N/A	N/A	71	P0.4	WL :PWM Output WL
32	P0.6	DISP_RS : LCD Display Select Register	72	N/A	N/A
33	N/A	N/A	73	N/A	N/A
34	P1.6	DISP_RST : LCD Display Display Reset	74	N/A	N/A
35	P4.7	ICE_DAT	75	P2.2	UH : PWM Output UH
36	N/A	N/A	76	GND	GND
37	P4.6	ICE_CLK	77	P2.4	VH : PWM Output VH
38	N/A	N/A	78	N/A	N/A
39	ICE_RST	ICE_RST	79	P2.6	WH :PWM Output WH
40	N/A	EX_IRSUM : Sum (U+V+W) current feedback	80	N/A	N/A

Table 6-1 Nu-MDA-NM1200 IO INTRODUCTION

7 NU-MDA-NM1230 INTRODUCTION

Nu-MDA-NM1230 (NA-NM1234) is the specific development tool for NuMicro® NM1230 series. Users can use Nu-MDA-NM1234 to develop and verify the application program easily.

The NuMicro® NM1230 series 32-bit microcontrollers are embedded with ARM® Cortex®-M0 core for industrial applications which need high performance, high integration, and low cost. The Cortex®-M0 is the newest ARM® embedded processor with 32-bit performance at a cost equivalent to the traditional 8-bit microcontroller.

The NM1230 series can run up to 48/72 MHz and operate at 2.2V ~ 5.5V, -40℃ ~ 105℃, and thus can support a variety of industrial control applications which need high CPU performance. The NM1230 offers 48/64 Kbytes embedded program Flash, size configurable Data Flash (shared with program flash), 7.5 Kbytes Flash for the ISP, 1.5 Kbytes SPROM for security, and 16Kbytes SRAM.

Many system level peripheral functions, such as I/O Port, Timer, UART, SPI, I^2C, PWM, ADC, Watchdog Timer, Analog Comparator and Brown-out Detector, have been incorporated into the NM1230 to reduce component count, board space and system cost. These useful functions make the NM1230 powerful for a wide range of applications.

Additionally, the NM1230 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.

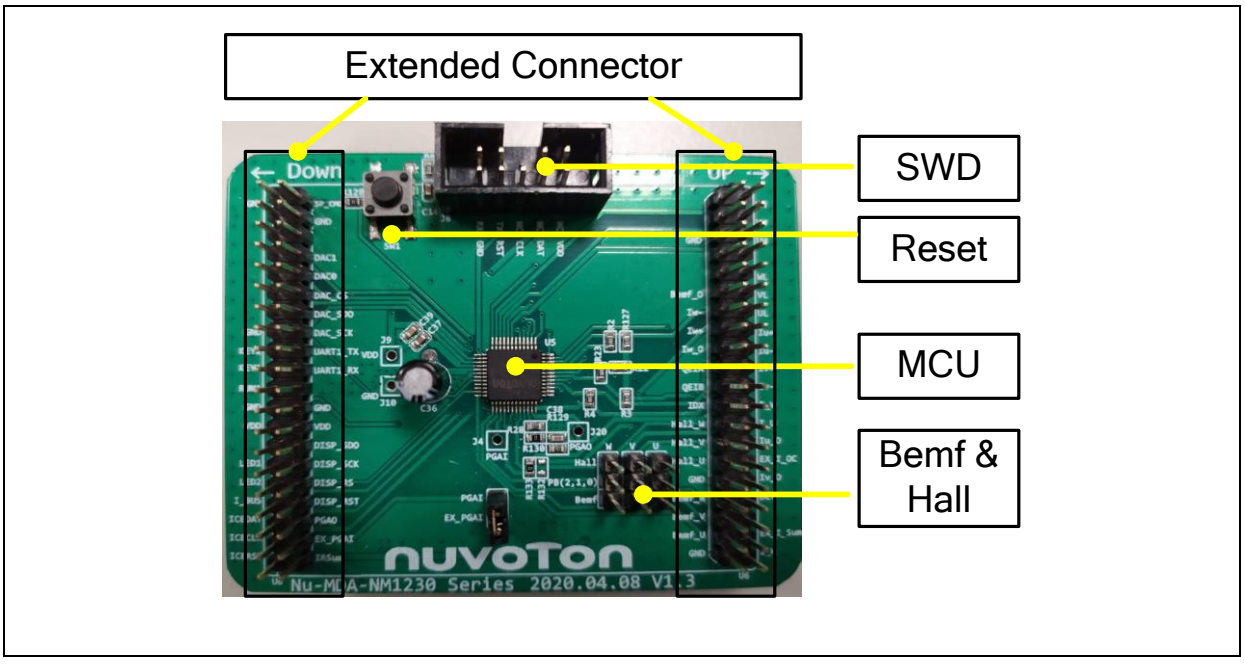


Figure 7-1 Nu-MDA-NM1234D INTRODUCTION

7.1 Nu-MDA-NM1230 IO INTRODUCTION

The following Table summarizes the PIM (Nu-MDA-xxx) pin-out for the Nu-LVMDM-MOS Development Board Table 7-1 (**U6A 及 U6B**) 。

Pin No	Port	Pin Function (J23)	Pin No	Port	Pin Function (J24)
01	GND	GND	41	PC1	I_W :Amplified W phase current
02	PC5	SP_CMD: Speed signal	42	GND	GND
03	N/A	N/A	43	N/A	EX_I_Sum : Amplified sum current
04	GND	GND	44	PB0	Bemf_U :Voltage feedback signal for U phase
05	N/A	N/A	45	N/A	EX_I_Shunt : Amplified I_Shunt current
06	N/A	N/A	46	PB1	Bemf_V : Voltage feedback signal for V phase
07	N/A	N/A	47	PF3	DCV :DC bus voltage (downscaled)
08	N/A	N/A	48	PB2	Bemf_W : Voltage feedback signal for W phase
09	N/A	N/A	49	N/A	N/A
10	N/A	N/A	50	GND	GND
11	N/A	N/A	51	N/A	EX_I_OC : Over Current signal (Second-order RC filter)
12	PA7	DAC_CS :DAC Chip Select	52	PB0	Hall_U : Hall sensor signal for U phase
13	N/A	N/A	53	PC4	Iu_O : U phase internal OP amplification output
14	PA6	DAC_SDO :DAC Serial Data	54	PB2	Hall_V : Hall sensor signal for V phase
15	GND	GND	55	PC0	I_U : Amplified U phase current
16	PF1	DAC_SCK:DAC Serial Clock	56	PB3	Hall_W : Hall sensor signal for W phase
17	PD6	KEY2	57	PB4	I_V : Amplified V phase current
18	PD3	TXD :UART Transmit	58	PF2	QEI-Z : QEI input
19	PD5	KEY1	59	PE3	Iv-: V phase OP negative OP1-

20	PD4	RXD :UART Receive	60	PC7	QEI-B : QEI input
21	PB6	RUN :Motor start or stop	61	PE4	Iv+: V phase current feedback into MCU internal OP1+
22	N/A	N/A	62	PF0	QEI-A : QEI input
23	GND	GND	63	PE0	Iu-: U phase OP negative OP0-
24	GND	GND	64	PE5	Iw_O : W phase internal OP amplification output
25	5V	5V input for MCU	65	PE1	Iu+: U phase current feedback into MCU internal OP0+
26	5V	5V input for MCU	66	PE7	Iw+: W phase current feedback into MCU internal OP2+
27	N/A	N/A	67	PA1	UL : PWM Output UL
28	N/A	DISP_SDO : LCD Display Serial Data Out	68	PE6	Iw-: W phase OP negative OP2-
29	PD7	LED1	69	PA3	VL : PWM Output VL
30	N/A	DISP_SCK : LCD Display Serial Clock	70	N/A	Bemf_O : Voltage feedback signal for (U+V+W) phase
31	N/A	N/A	71	PA5	WL :PWM Output WL
32	PF4	DISP_RS : LCD Display Select Register	72	N/A	N/A
33	PB7	LED2	73	N/A	N/A
34	N/A	DISP_RST : LCD Display Display Reset	74	N/A	N/A
35	PD2	ICE_DAT	75	PA0	UH : PWM Output UH
36	N/A	N/A	76	GND	GND
37	PD1	ICE_CLK	77	PA2	VH : PWM Output VH
38	N/A	N/A	78	N/A	N/A
39	ICE_RST	ICE_RST	79	PA4	WH :PWM Output WH
40	PB3	EX_IRSUM : Sum (U+V+W) current feedback	80	N/A	N/A

Table 7-1 Nu-MDA-NM1230 IO INTRODUCTION

8 NU-MDA-NM1240 INTRODUCTION

Nu-MDA-NM1244 (NK-NM1244) is the specific development tool for NuMicro® NM1240 series. Users can use Nu-MDA-NM1244 to develop and verify the application program easily.

The NuMicro® NM1240 series 32-bit microcontrollers are embedded with ARM® Cortex®-M0 core for industrial applications which need high performance, high integration, and low cost. The Cortex®-M0 is the newest ARM® embedded processor with 32-bit performance at a cost equivalent to the traditional 8-bit microcontroller.

The NM1240 series can run up to 48(60) MHz and operate at 2.2V(3.3V) ~ 5.5V, -40℃ ~ 105℃, and thus can support a variety of industrial control applications which need high CPU performance. The NM1240 offers 48/64 Kbytes embedded program Flash, size configurable Data Flash (shared with program flash), 7.5 Kbytes Flash for the ISP, 1.5 Kbytes SPROM for security, and 8Kbytes SRAM.

Many system level peripheral functions, such as I/O Port, Timer, UART, SPI, I2 C, PWM, ADC, OP, Watchdog Timer, Analog Comparator and Brown-out Detector, have been incorporated into the NM1240 to reduce component count, board space and system cost. These useful functions make the NM1240 powerful for a wide range of applications.

Additionally, the NM1240 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.

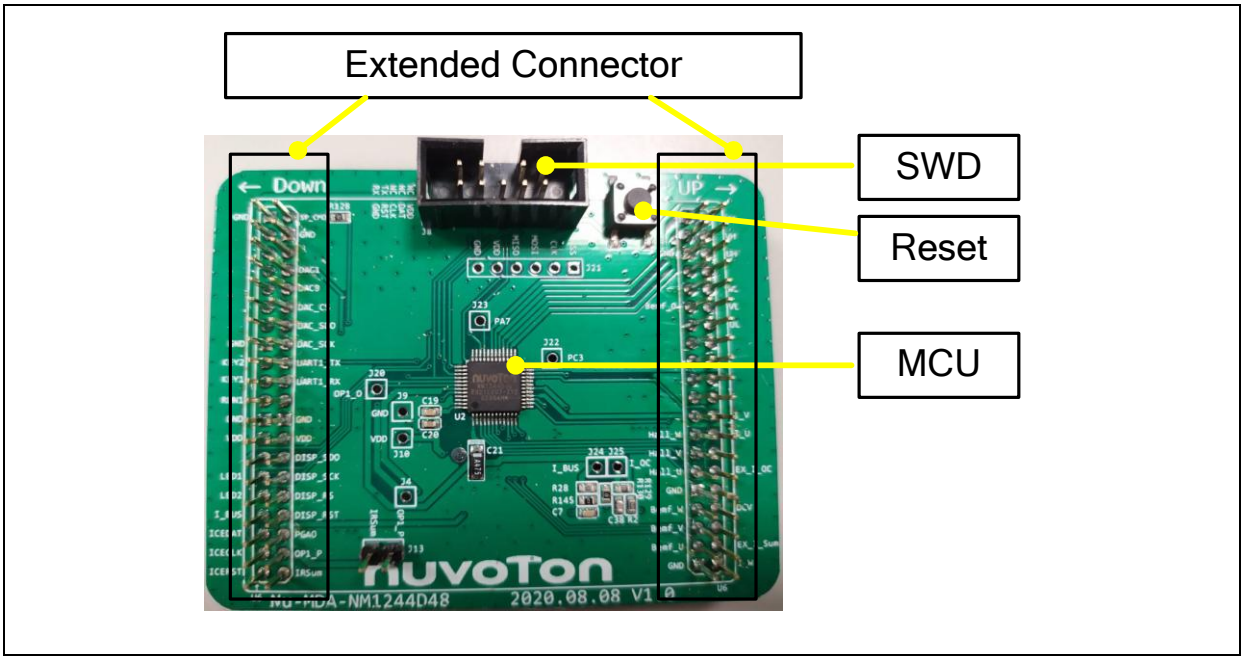


Figure 8-1 Nu-MDA-NM1244D INTRODUCTION

8.1 Nu-MDA-NM1240 IO INTRODUCTION

The following Table summarizes the PIM (Nu-MDA-xxx) pin-out for the Nu-LVMDM-MOS Development Board Table 7-1 (**U6A 及 U6B**) 。

Pin No	Port	Pin Function (J23)	Pin No	Port	Pin Function (J24)
01	GND	GND	41	PC2	I_W :Amplified W phase current
02	PC7	SP_CMD: Speed signal	42	GND	GND
03	N/A	N/A	43	N/A	EX_I_Sum : Amplified sum current
04	GND	GND	44	PB0	Bemf_U :Voltage feedback signal for U phase
05	N/A	N/A	45	N/A	EX_I_Shunt : Amplified I_Shunt current
06	N/A	N/A	46	PB1	Bemf_V : Voltage feedback signal for V phase
07	N/A	N/A	47	PB6	DCV :DC bus voltage (downscaled)
08	N/A	N/A	48	PB2	Bemf_W : Voltage feedback signal for W phase
09	N/A	N/A	49	N/A	N/A
10	N/A	N/A	50	GND	GND
11	N/A	N/A	51	N/A	EX_I_OC : Over Current signal (Second-order RC filter)
12	PD6	DAC_CS :DAC Chip Select	52	PF0	Hall_U : Hall sensor signal for U phase
13	N/A	N/A	53	N/A	N/A
14	PF7	DAC_SDO :DAC Serial Data	54	PF1	Hall_V : Hall sensor signal for V phase
15	GND	GND	55	PD2	I_U : Amplified U phase current
16	PE5	DAC_SCK:DAC Serial Clock	56	PF2	Hall_W : Hall sensor signal for W phase
17	PB3	KEY2	57	PC0	I_V : Amplified V phase current
18	PD7	TXD :UART Transmit	58	N/A	N/A
19	PF3	KEY1	59	N/A	N/A
20	PE0	RXD :UART Receive	60	N/A	N/A

21	PA6	RUN :Motor start or stop	61	N/A	N/A
22	N/A	N/A	62	N/A	N/A
23	GND	GND	63	N/A	N/A
24	GND	GND	64	N/A	N/A
25	5V	5V input for MCU	65	N/A	N/A
26	5V	5V input for MCU	66	N/A	N/A
27	N/A	N/A	67	PA1	UL : PWM Output UL
28	PC4	DISP_SDO : LCD Display Serial Data Out	68	N/A	N/A
29	PE1	LED1	69	PA3	VL : PWM Output VL
30	PB7	DISP_SCK : LCD Display Serial Clock	70	PB4	Bemf_O : Voltage feedback signal for (U+V+W) phase
31	PF4	LED2	71	PA5	WL :PWM Output WL
32	PD4	DISP_RS : LCD Display Select Register	72	N/A	N/A
33	PC1	I_Bus : Internal OP output to external RC	73	N/A	N/A
34	PD3	DISP_RST : LCD Display Display Reset	74	N/A	N/A
35	PD5	ICE_DAT	75	PA0	UH : PWM Output UH
36	N/A	N/A	76	GND	GND
37	PD1	ICE_CLK	77	PA2	VH : PWM Output VH
38	N/A	N/A	78	N/A	N/A
39	ICE_RST	ICE_RST	79	PA4	WH :PWM Output WH
40	PE4	EX_IRSUM : Sum (U+V+W) current feedback	80	N/A	N/A

Table 8-1 Nu-MDA-NM1240 IO INTRODUCTION

9 NU-MDA-NM1530 INTRODUCTION

Nu-MDA-NM1530L(NA-NM1530V) is the specific development tool for NuMicro® NM1530 series. Users can use Nu-MDA-NM1530V to develop and verify the application program easily.

The ARM® Cortex®-M0 core within NuMicro® NM1530 series can run up to 50 MHz and supports a variety of industrial control and applications which need high CPU performance. The NuMicro® NM1530 Series provides 128K/64K/32 bytes embedded flash, 4 Kbytes data flash, 8 Kbytes flash for the ISP, and 16K/8K/4K bytes embedded SRAM. This MCU includes advanced PWM function, MDU (Motor Drive Unit), QEI (Quadrature Encoder Interface) and ECAP (Enhance Input Capture Timer) which are specially designed for motor driving application. It is also equipped with plenty of peripheral devices, such as Timers, Watchdog Timer, UART, SPI, I2C, PWM Timer, GPIO, 12-bit ADC, Low Voltage Detector and Brown-out detector. These useful functions make the NuMicro® NM1530 Series powerful for a wide range of applications.

In addition, the NuMicro® NM1530 Series is equipped with ISP (In-System Programming), ICP (In-Circuit Programming) functions and IAP (In-Application Programming) which allow user to update the program memory without removing the chip from the actual end product.

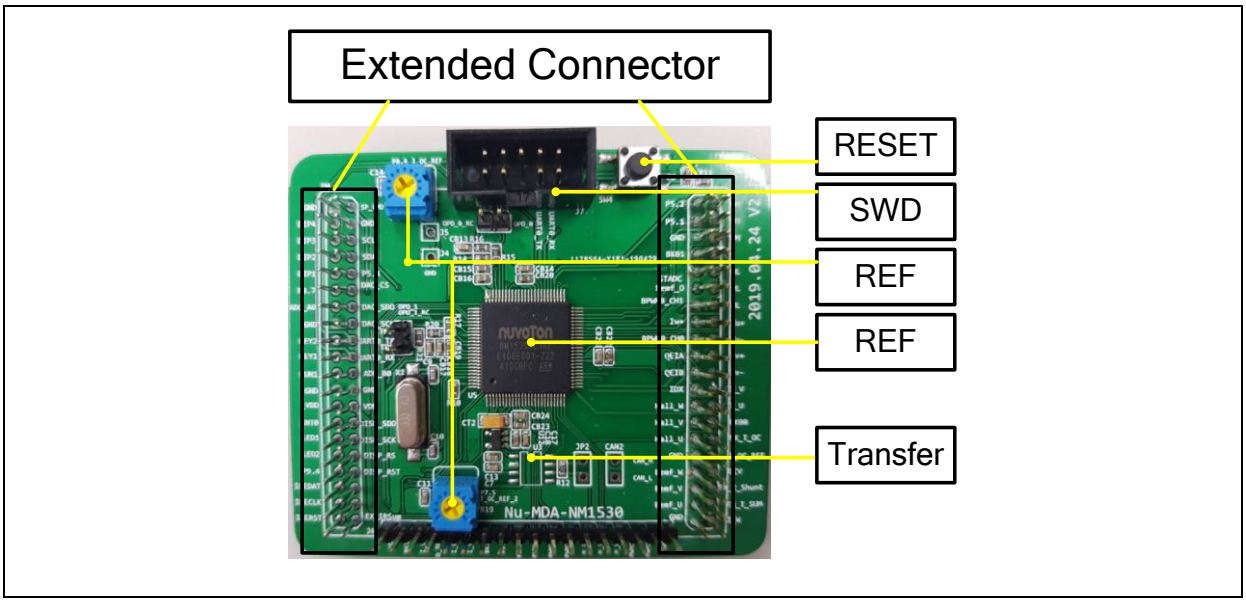


Figure 9-1 Nu-MDA-NM1530V INTRODUCTION

9.1 Nu-MDA-NM1530 IO INTRODUCTION

The following Table summarizes the PIM (Nu-MDA-xxx) pin-out for the Nu-LVMDM-MOS Development Board Table 9-1 (**U8A 及 U8B**) 。

Pin No	Port	Pin Function (J23)	Pin No	Port	Pin Function (J24)
01	GND	GND	41	P6.6	I_W :Amplified W phase current
02	P7.3	SP_CMD: Speed signal	42	GND	GND
03	P8.6	DIP4: DIP Switch	43	P6.5	EX_I_Sum : Amplified sum current
04	GND	GND	44	P6.3	Bemf_U :Voltage feedback signal for U phase
05	P4.6	DIP3: DIP Switch	45	P6.4	EX_I_Shunt : Amplified I_Shunt current
06	P3.5	SCL :I2C Clock	46	P7.7	Bemf_V : Voltage feedback signal for V phase
07	P5.5	DIP2: DIP Switch	47	P6.7	DCV :DC bus voltage (downscaled)
08	P3.4	SDA : I2C Data	48	P7.6	Bemf_W : Voltage feedback signal for W phase
09	P4.3	DIP1: DIP Switch	49	P8.4	I_OC_REF : Reference voltage
10	P5.4	GPIO	50	GND	GND
11	P8.7	GPIO	51	P8.3	EX_I_OC : Over Current signal (Second-order RC filter)
12	P4.7	DAC_CS :DAC Chip Select	52	P2.3	Hall_U : Hall sensor signal for U phase
13	P6.0	ADC_A0: Extra available ADC	53	P1.6	BK00: Extra available Brake
14	P5.0	DAC_SDO :DAC Serial Data	54	P2.2	Hall_V : Hall sensor signal for V phase
15	GND	GND	55	P6.1	I_U : Amplified U phase current
16	P2.7	DAC_SCK:DAC Serial Clock	56	P2.1	Hall_W : Hall sensor signal for W phase
17	P2.0	KEY2	57	P7.1	I_V : Amplified V phase current
18	P3.1	TXD :UART Transmit	58	P2.6	QEI-Z : QEI input
19	P5.3	KEY1	59	P9.1	Iv-: V phase OP negative

					OP1-
20	P3.0	RXD :UART Receive	60	P2.5	QEI-B : QEI input
21	P8.5	RUN :Motor start or stop	61	P9.2	Iv+: V phase current feedback into MCU internal OP1+
22	P7.0	ADC_B0: Extra available ADC	62	P2.4	QEI-A : QEI input
23	GND	GND	63	P8.1	Iu-: U phase OP negative OP0-
24	GND	GND	64	P5.6	BPWM0_CH0:Extra available BPWM
25	5V	5V input for MCU	65	P8.2	Iu+: U phase current feedback into MCU internal OP0+
26	5V	5V input for MCU	66	N/A	Iw+: W phase current feedback into MCU internal OP2+
27	P3.2	INT0: Extra available INT0	67	P0.1	UL : PWM Output UL
28	PA.0	DISP_SDO : LCD Display Serial Data Out	68	P5.7	BPWM0_CH1:Extra available BPWM
29	P3.3	LED1	69	P0.3	VL : PWM Output VL
30	P4.4	DISP_SCK : LCD Display Serial Clock	70	N/A	Bemf_O : Voltage feedback signal for (U+V+W) phase
31	P9.7	LED2	71	P0.5	WL :PWM Output WL
32	PA.1	DISP_RS : LCD Display Select Register	72	P0.7	STADC: Extra available STADC
33	P9.4	GPIO	73	N/A	N/A
34	P4.5	DISP_RST : LCD Display Display Reset	74	P1.7	BK01: Extra available Brake
35	ICE_DAT	ICE_DAT	75	P0.0	UH : PWM Output UH
36	N/A	N/A	76	GND	GND
37	ICE_CLK	ICE_CLK	77	P0.2	VH : PWM Output VH
38	N/A	N/A	78	P5.1	GPIO
39	ICE_RST	ICE_RST	79	P0.4	WH :PWM Output WH
40	EX_IRSUM	EX_IRSUM : Sum (U+V+W) current feedback	80	P5.2	GPIO

Table 9-1 Nu-MDA-NM1530 IO INTRODUCTION

10 HOW TO START NU-MDA-NM1120 ON THE KEIL MVISION® IDE

10.1 Keil uVision® IDE Software Download and Install

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

10.2 Nuvoton Nu-Link Driver Download and Install

Please visit the Nuvoton company NuMicro® website (http://www.nuvoton.com/NuMicro) to download "NuMicro® Keil µVision® 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.

10.3 Hardware Setup

The hardware setup is shown as Figure 10-1

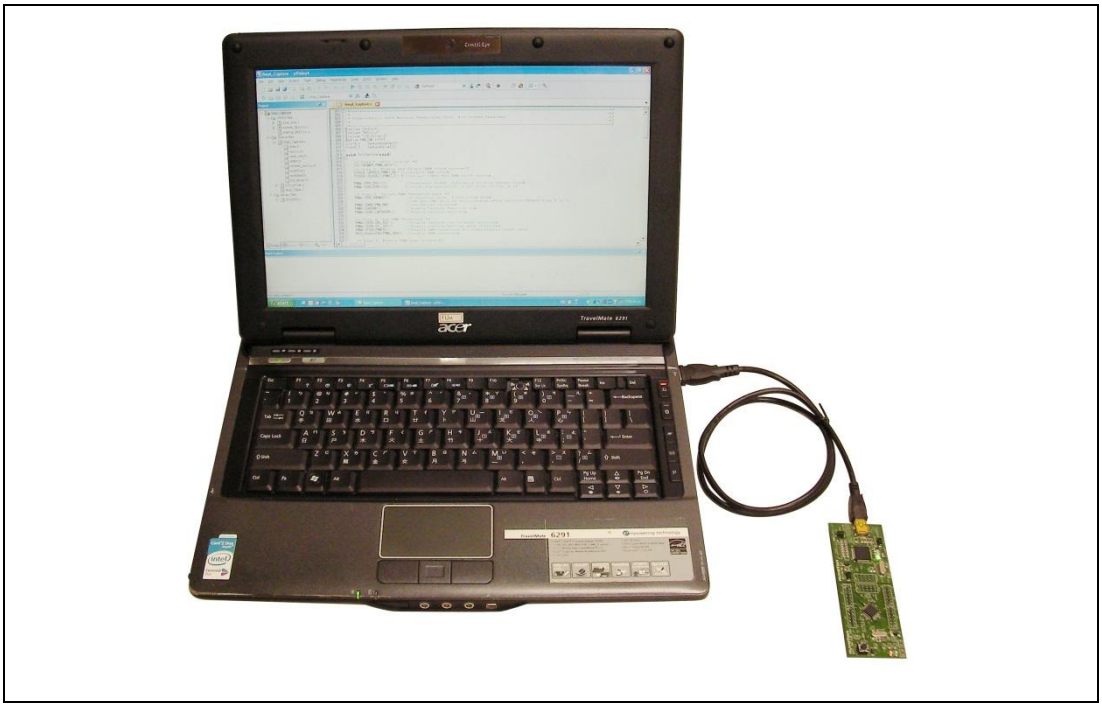


Figure 10-1 Nu-MDA-NM1120 Hardware Setup

10.4 Example Program

This example demonstrates the ease of downloading and debugging an application on a Nu-MDA-NM1120 board. It can be found on Figure 10-2 list directory and downloaded from Nuvoton NuMicro® website.

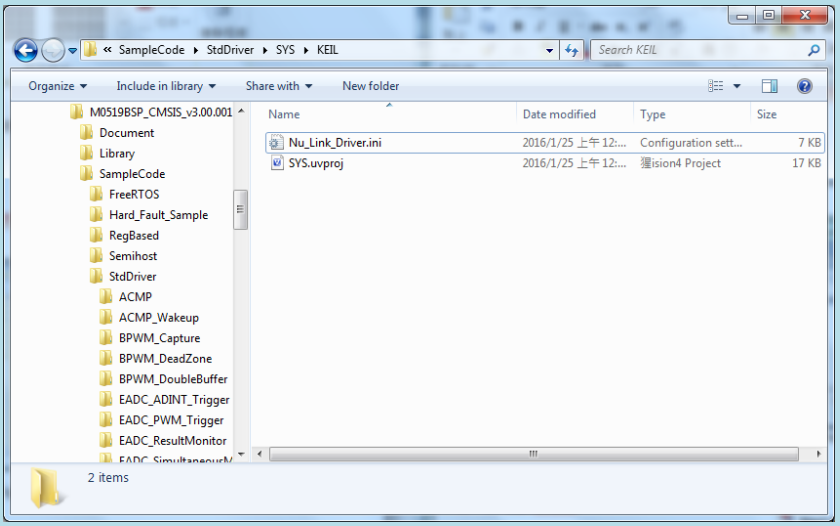
Directory	C:\ Nuvoton\BSP Library\NM1120BSP\SampleCode \StdDriver\SYS\KEIL
Project File	

Figure 10-2 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

11 HOW TO START NUTINY -SDK-NM1120 ON THE IAR EMBEDDED WORKBENCH

11.1 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.

11.2 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.

11.3 Hardware Setup

The hardware setup is shown as Figure 11-1

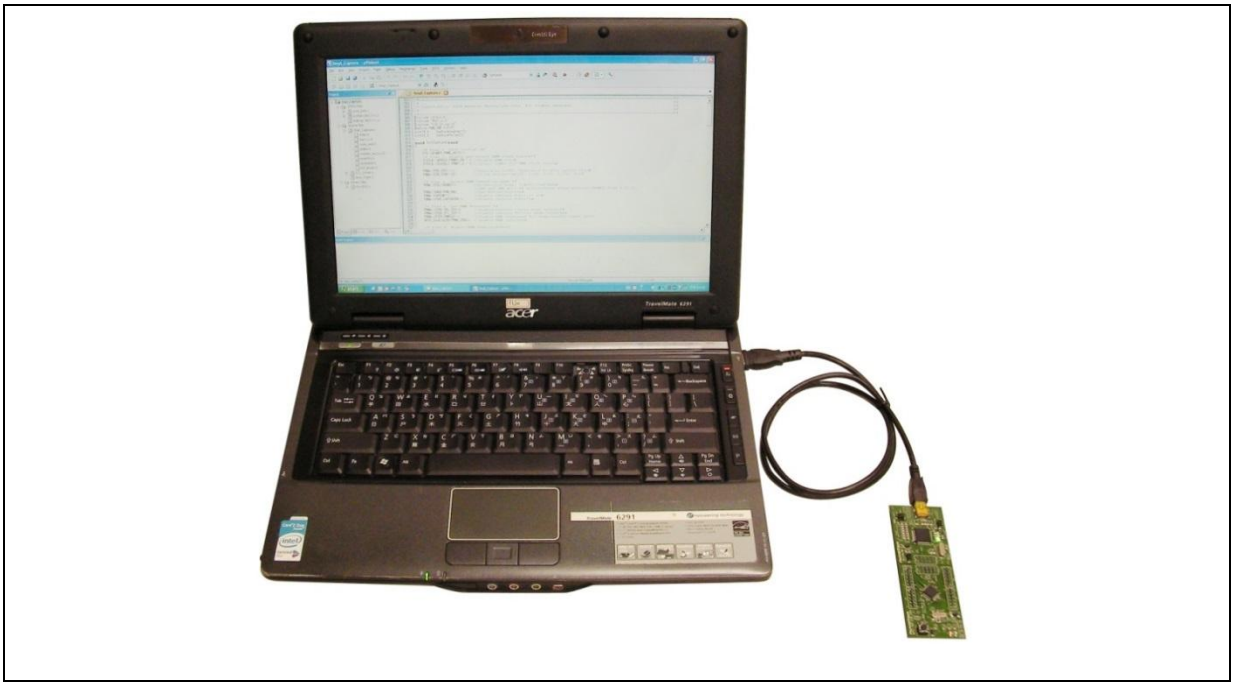


Figure 11-1 Nu-MDA-NM1120 Hardware Setup

11.4 Example Program

This example demonstrates the ease of downloading and debugging an application on a Nu-MDA-NM1120 board. It can be found on Figure 11-2 list directory and downloaded from Nuvoton NuMicro® website.

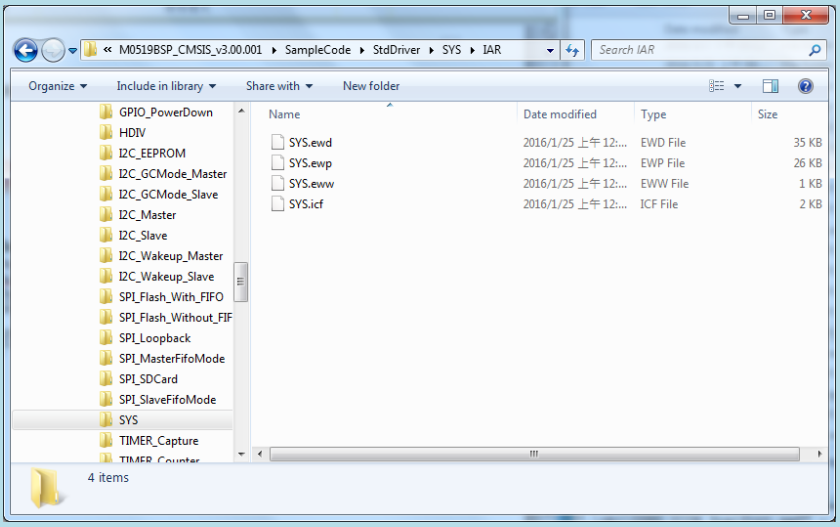
Directory	C:\ Nuvoton\BSP Library\NM1120BSP\SampleCode \StdDriver\SYS\IAR
Project File	

Figure 11-2 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

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

12.1 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.

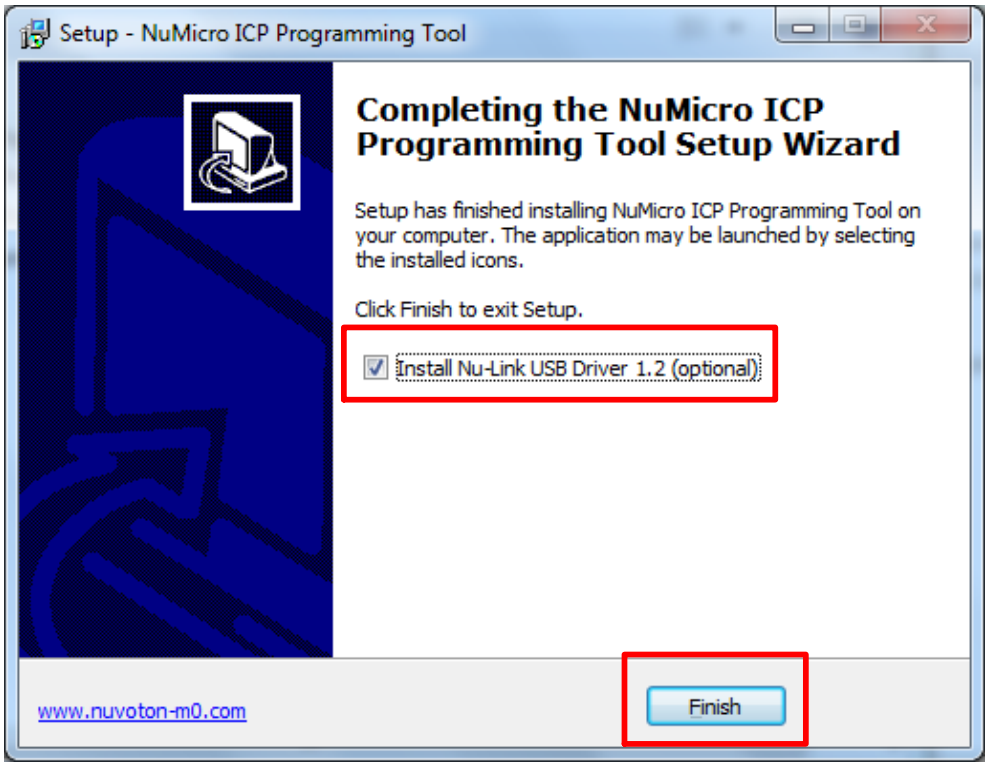


Figure 12-1 Optional Step after ICP Programming Tool Installation

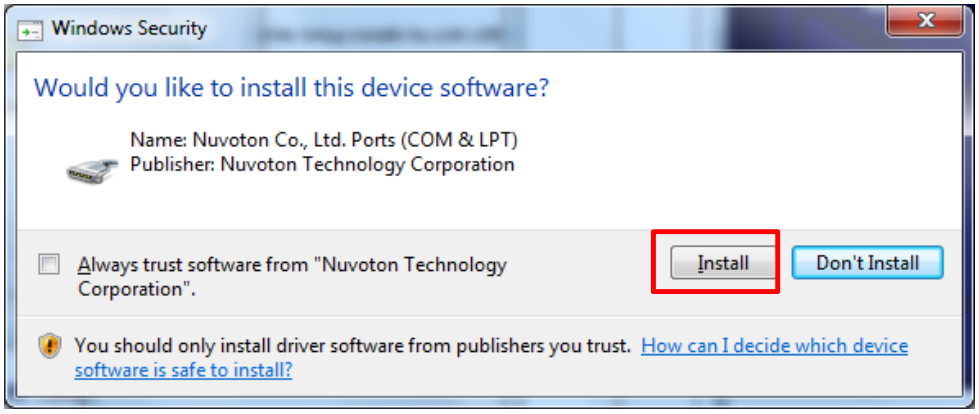


Figure 12-2 Install Nuvoton COM&LPT Driver

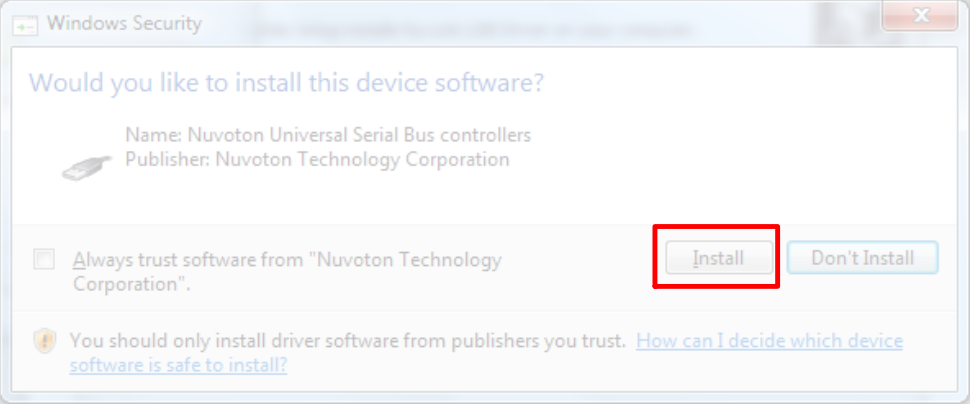


Figure 12-3 Install Nuvoton Universal Serial Bus Controllers

12.2 VCOM Mode Setting on Nu-MDA-NM1120

Before the Nu-MDA-NM1120 is connected to the PC, please enable SW3 VCOM function by switching on SW3. The Nu-MDA-NM1120 transmits through UART0 to VCOM to send out data. Switch SW3 off when using UART0 function without VCOM function.

12.3 Setup on the Development Tool

The example is demonstrated on the Keil µVision® IDE.

12.3.1 Check the Using UART on the Keil µVision® IDE

Please open the project and find system_NM1120.h to check the using UART in DEBUG_PORT, which has to be the same as the using UART in the Nu-MDA-NM1120.

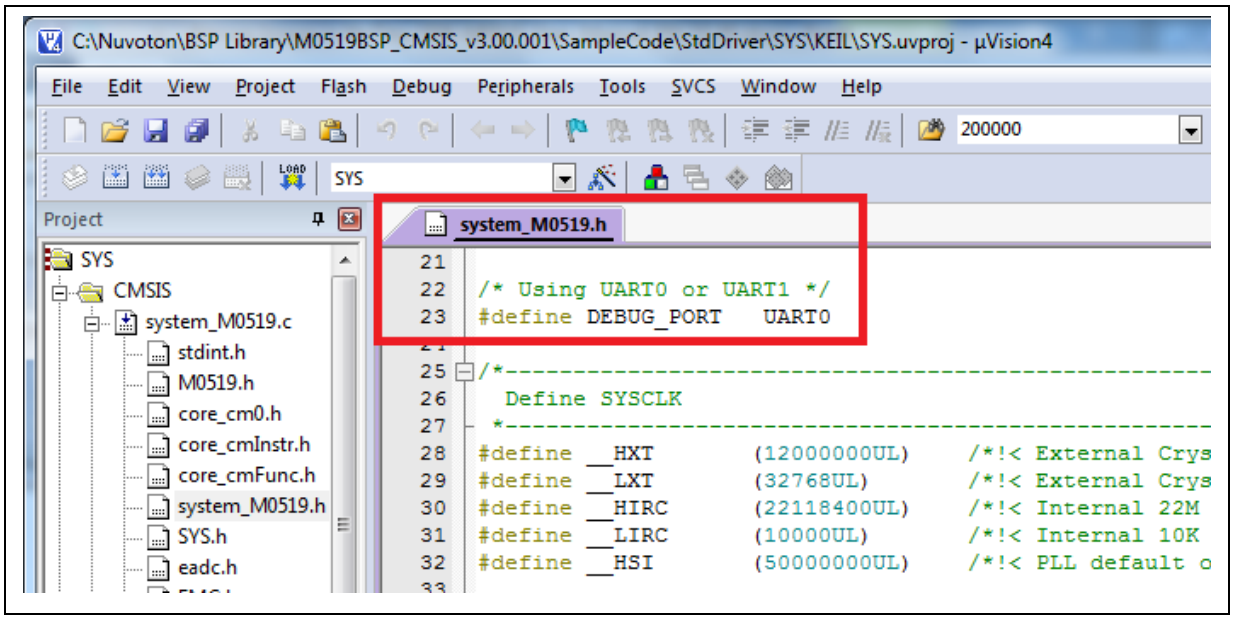
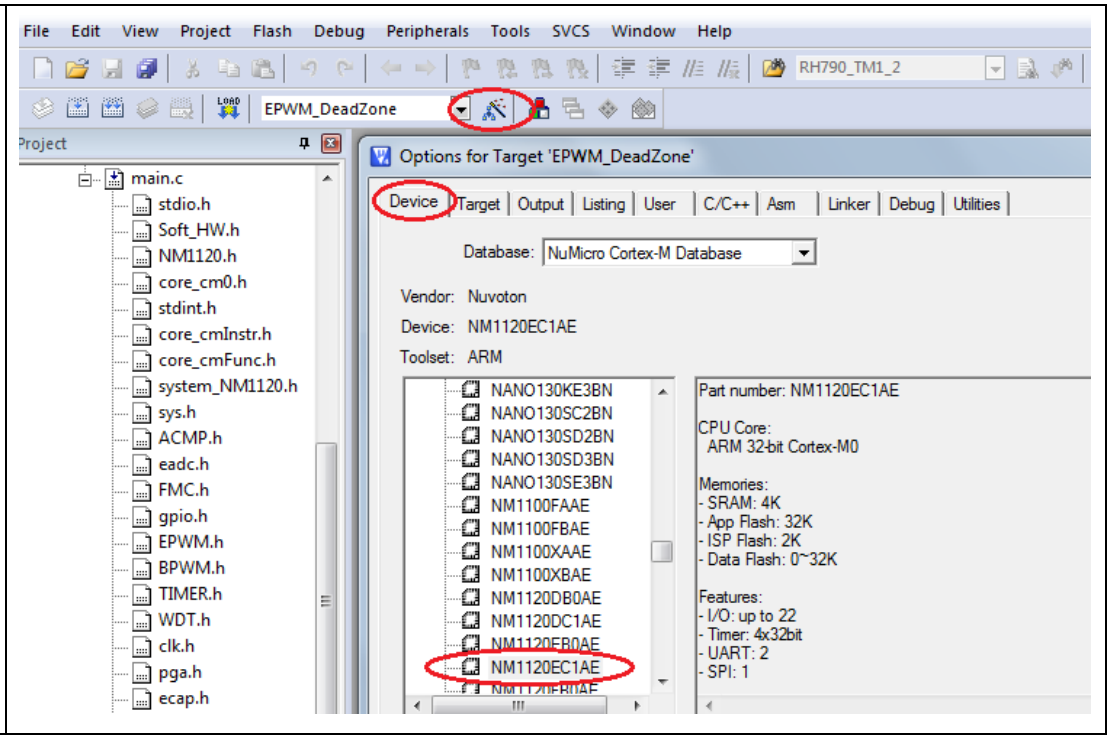
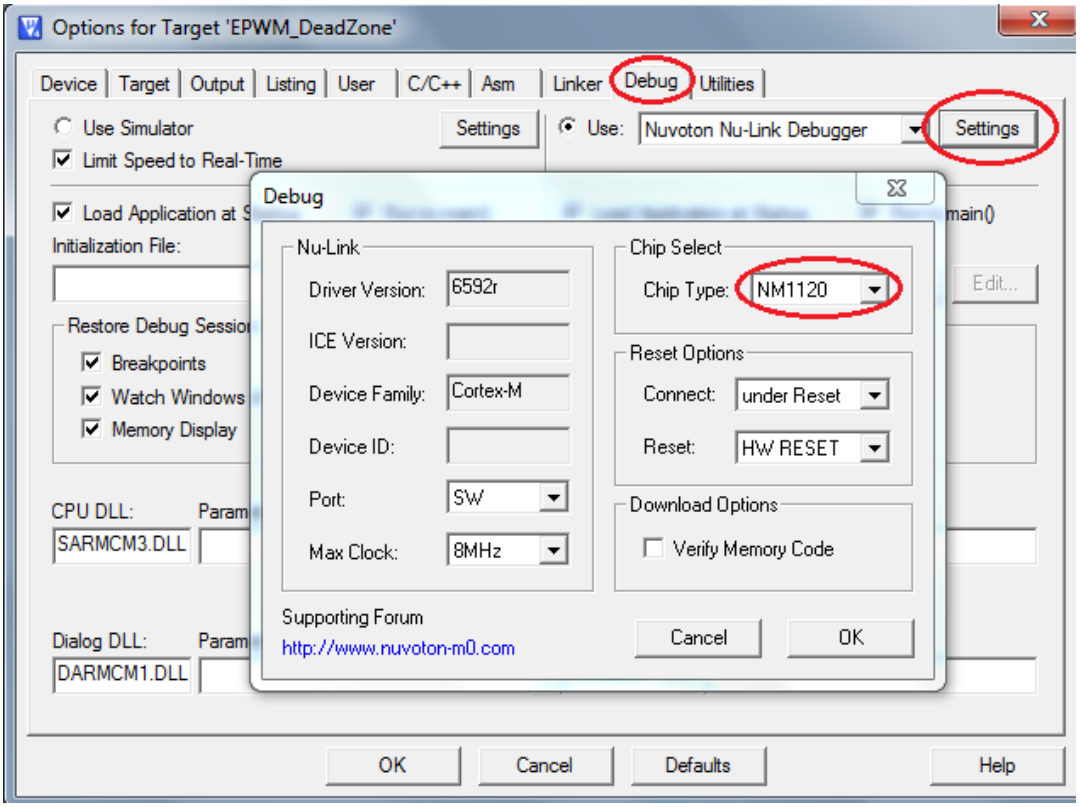
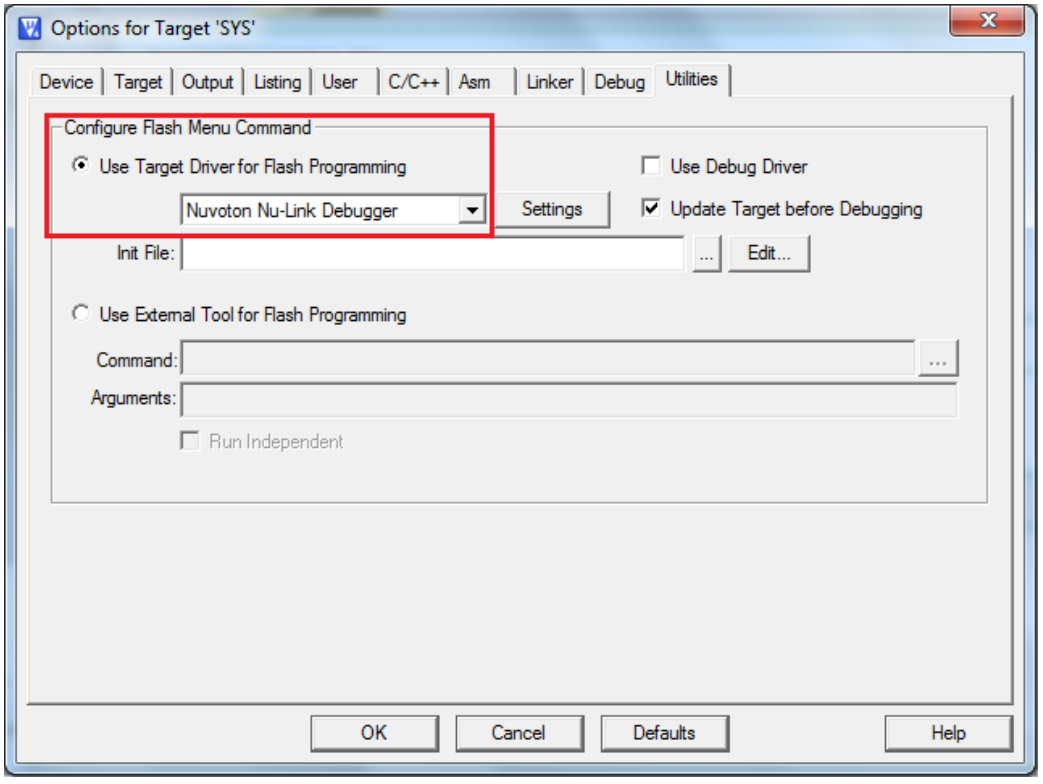


Figure 12-4 The Using UART on Keil µVision® IDE

12.3.2 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 1	

Step 2	 Options for Target 'EPWM_DeadZone' Device Target Output Listing User C/C++ Asm Linker Debug Utilities Use Simulator Settings Use: Nuvoton Nu-Link Debugger Settings Limit Speed to Real-Time Load Application at S Initialization File: Restore Debug Sessio Breakpoints Watch Windows Memory Display CPU DLL: Param SARMCM3.DLL Dialog DLL: Param DARMCM1.DLL Debug Nu-Link Driver Version: 6592r ICE Version: Device Family: Cortex-M Device ID: Port: SW Max Clock: 8MHz Chip Select Chip Type: NM1120 Reset Options Connect: under Reset Reset: HW RESET Download Options Verify Memory Code Supporting Forum http://www.nuvoton-m0.com Cancel OK OK Cancel Defaults Help
Step 3	 Options for Target 'SYS' Device Target Output Listing User C/C++ Asm Linker Debug Utilities Configure Flash Menu Command Use Target Driver for Flash Programming Nuvoton Nu-Link Debugger Settings Use Debug Driver Update Target before Debugging Init File: Edit... Use External Tool for Flash Programming Command: Arguments: Run Independent OK Cancel Defaults Help

12.3.3 Build and Download Code to Nu-MDA-NM1120

Please build the project and download code to Nu-MDA-NM1120.

12.3.4 Open the Serial Port Terminal

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

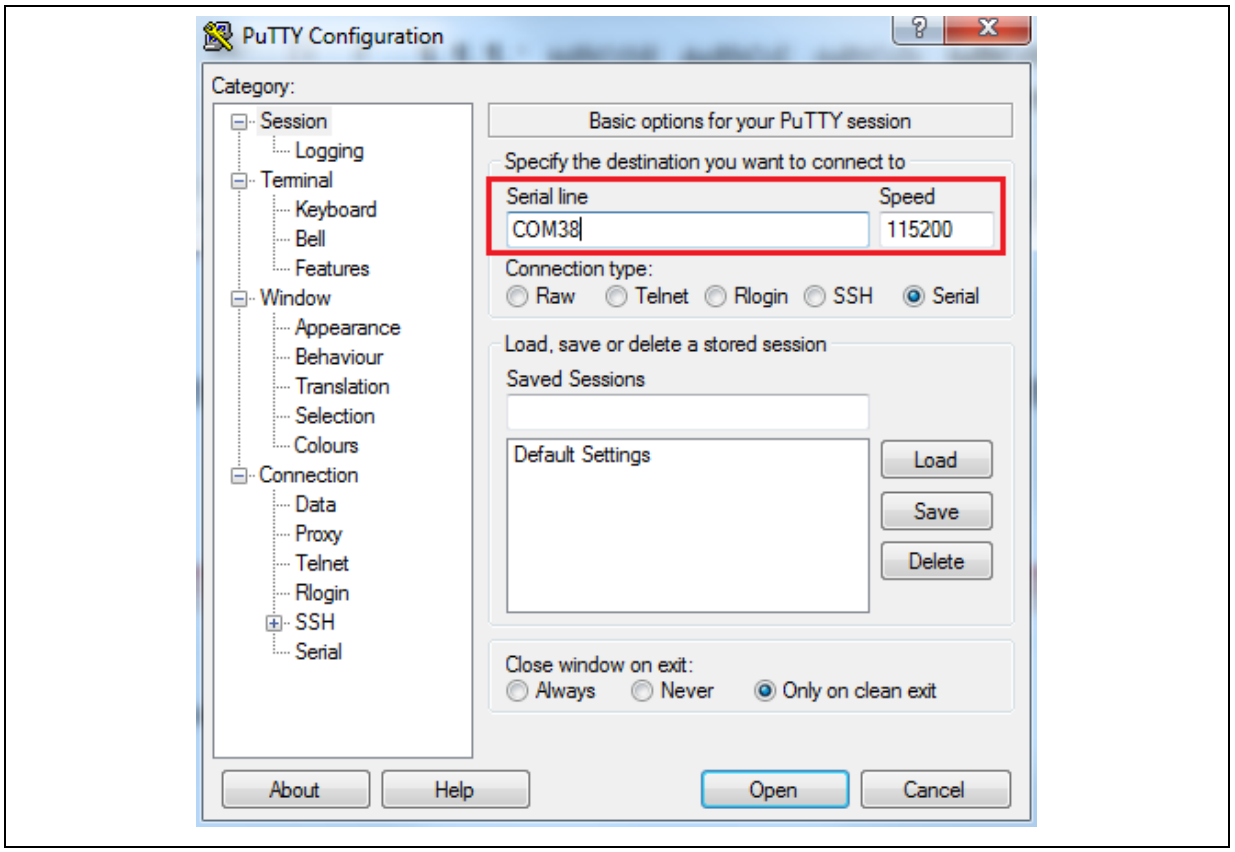


Figure 12-5 Set Baud Rate

12.3.5 Reset Chip

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

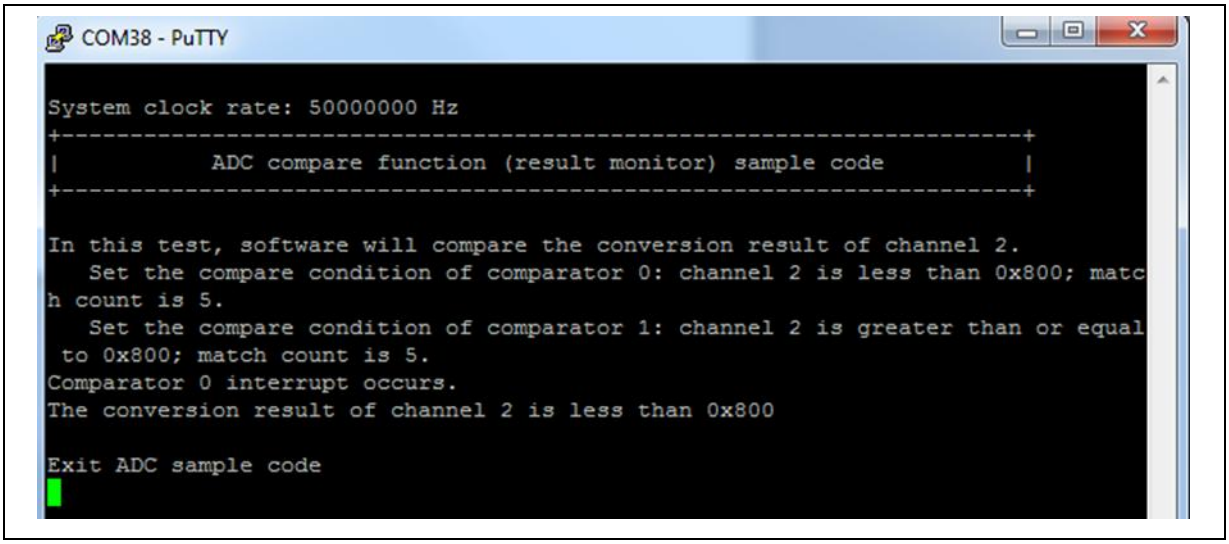


Figure 12-6 Serial Port Terminal Windows

Notice: Please switch SW3 on before the Nu-MDA-NM1120 connects to the PC. When the Nu-MDA-NM1120 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.

13 REFERENCE SCHEMATIC

13.1 Nu-LVMDM-MOS V2.8 Driver Board Schematic

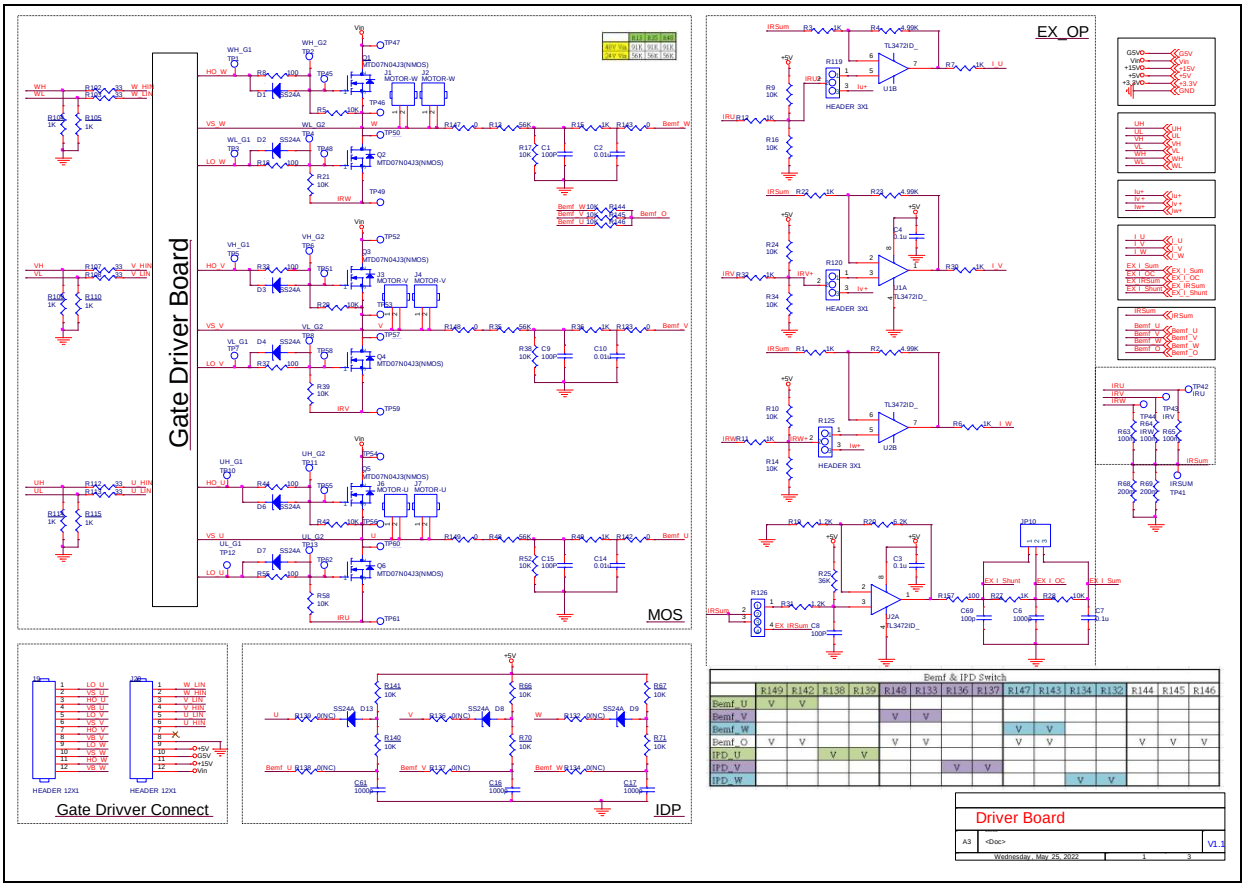


Figure 13-1 Nu-LVMDM-MOS V2.8 Driver Board Schematic

13.2 Nu-LVMDM-MOS V2.8 Connect Schematic

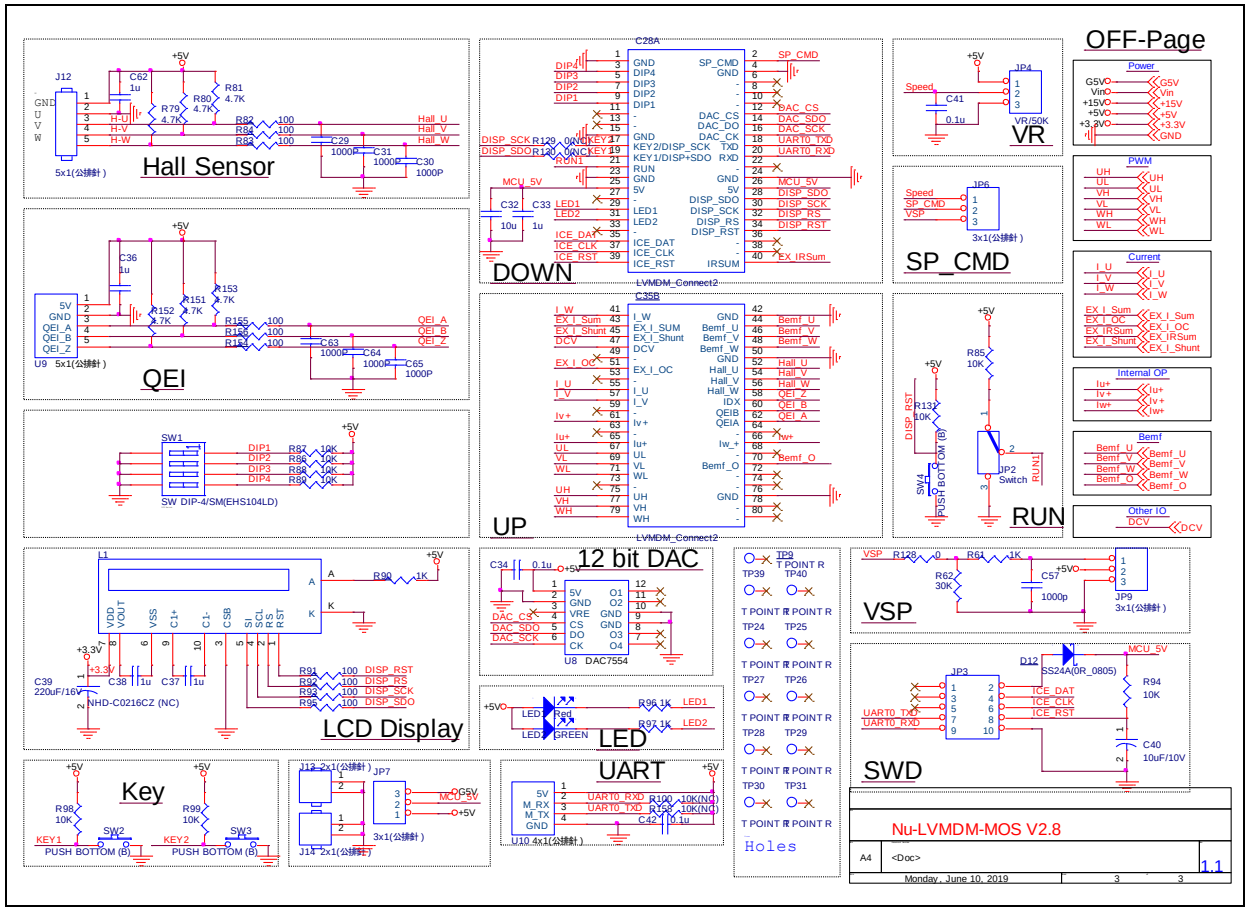


Figure 13-2 Nu-LVMDM-MOS V2.8 Connect Schematic

13.3 Nu-LVMDM-MOS V2.8 Power Schematic

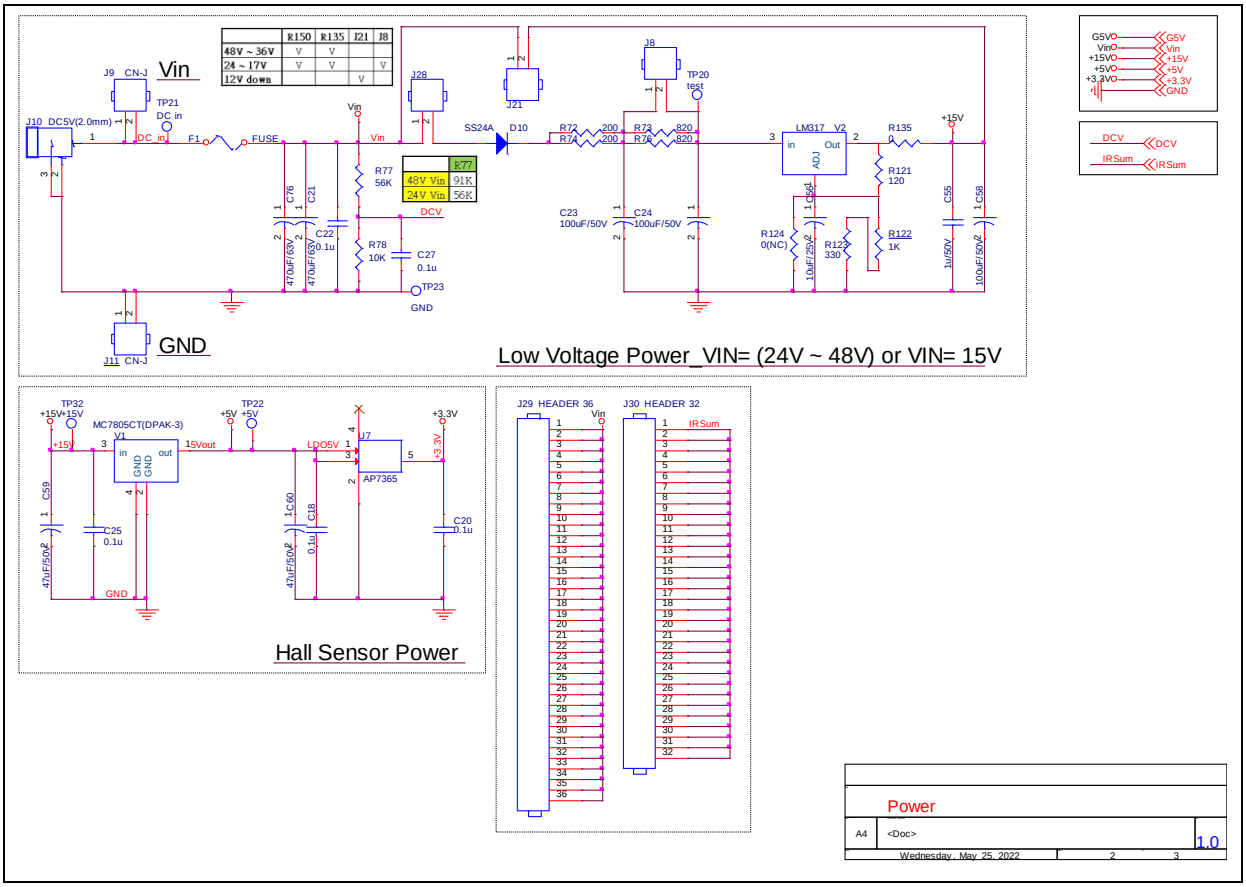


Figure 13-3 Nu-LVMDM-MOS V2.8 Power Schematic

13.4 Gate Driver NCT3612Y Schematic

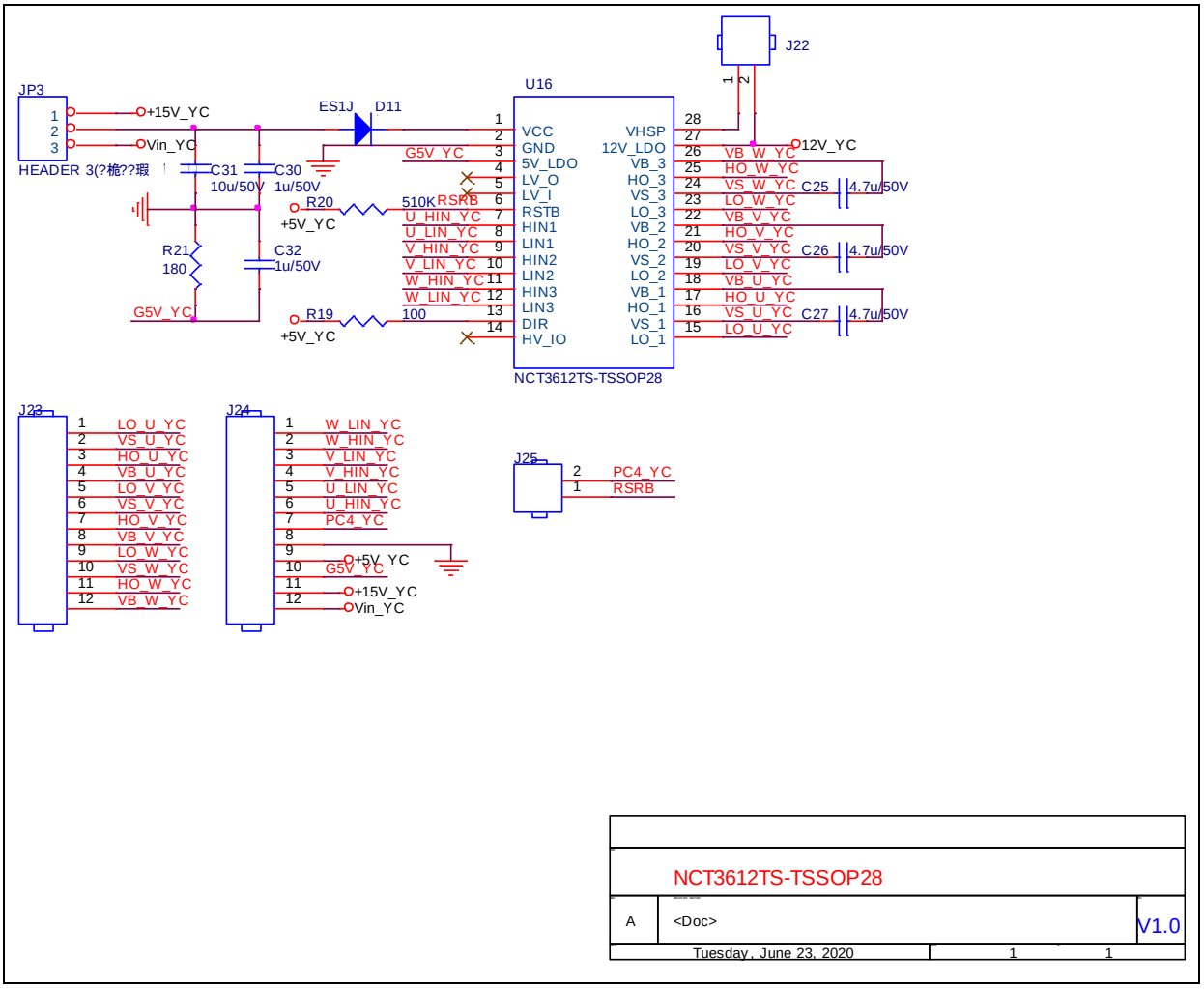


Figure 13-4 Gate Driver NCT3612Y Schematic

13.5 Gate Driver IR2101 Schematic

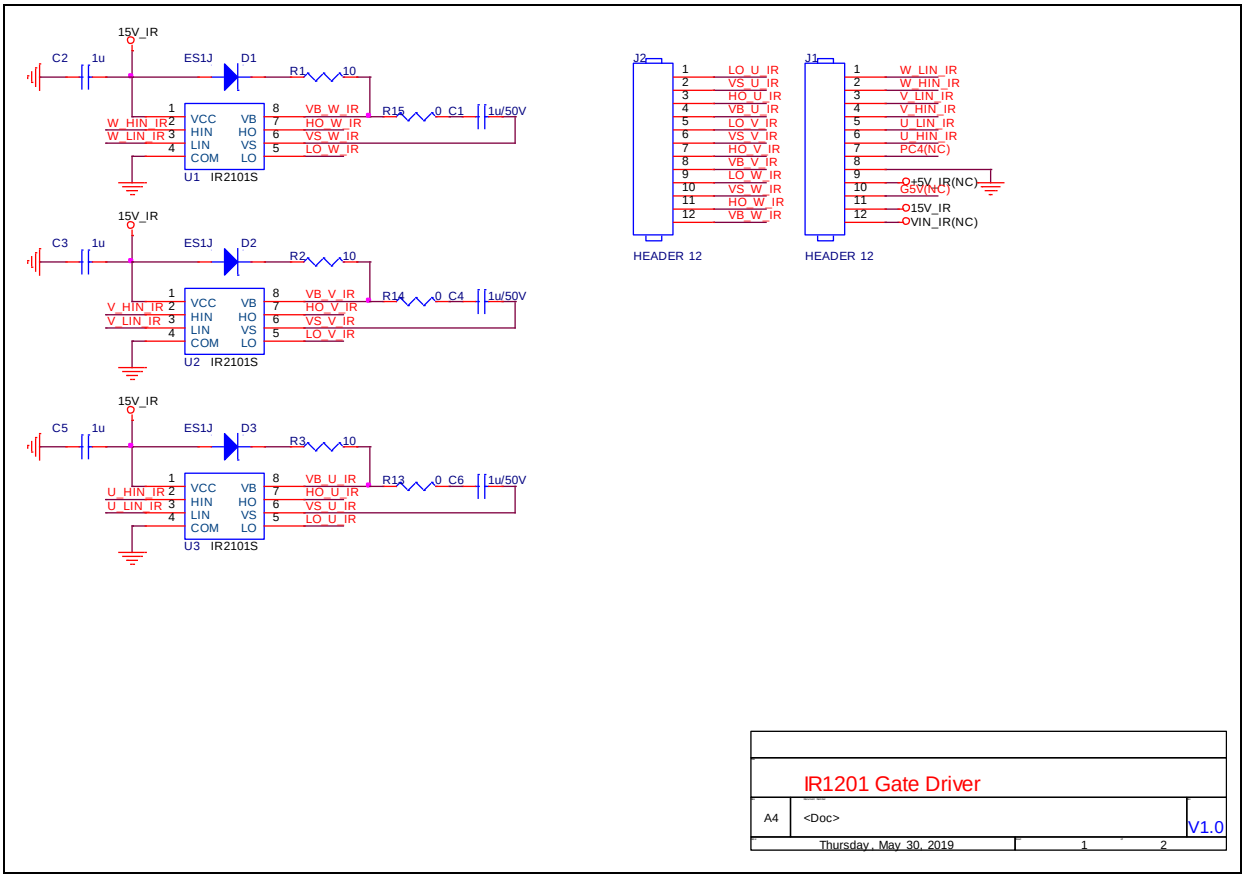


Figure 13-5 Gate Driver IR2101 Schematic

13.6 Nu-MDA-NM1120 Schematic

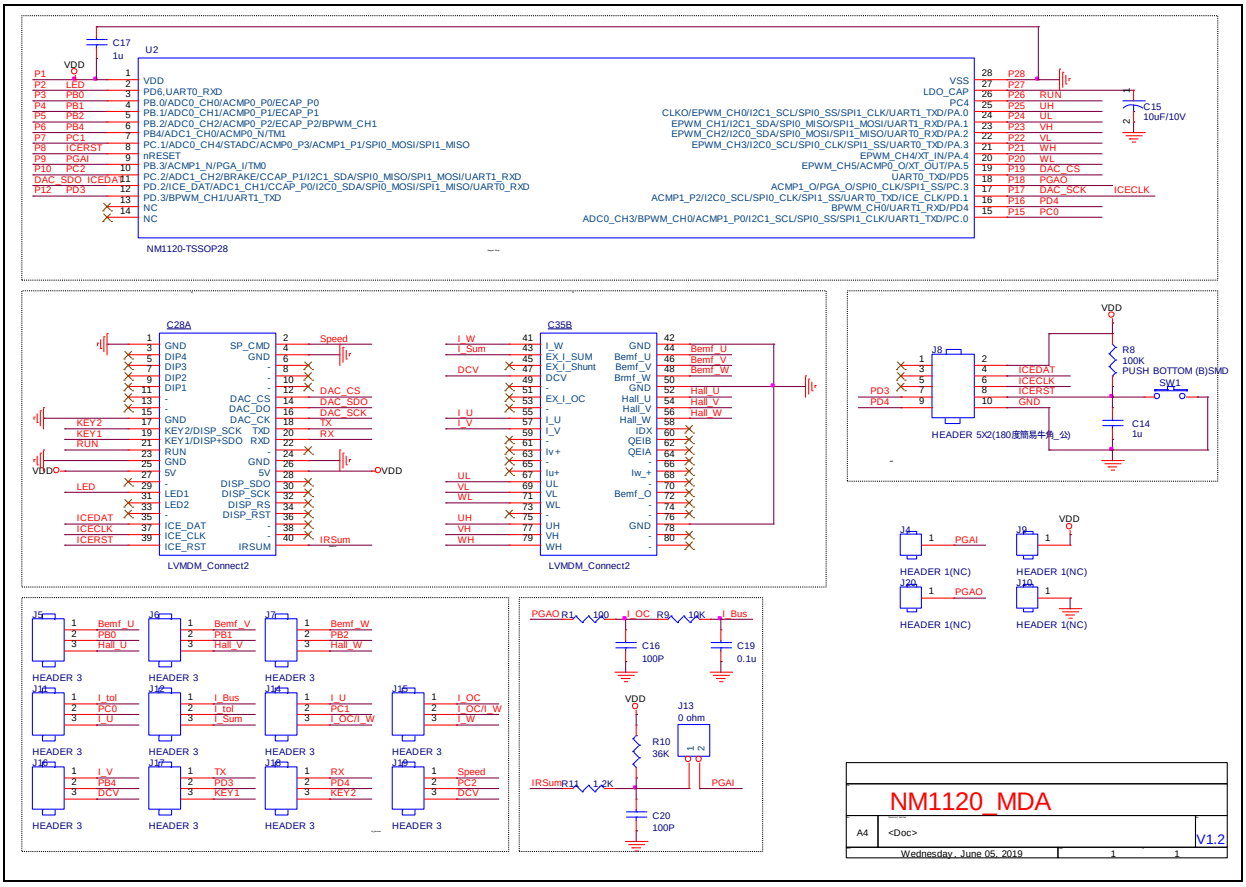


Figure 13-6 Nu-MDA-NM1120 Schematic

13.7 Nu-MDA-NM1200 Schematic

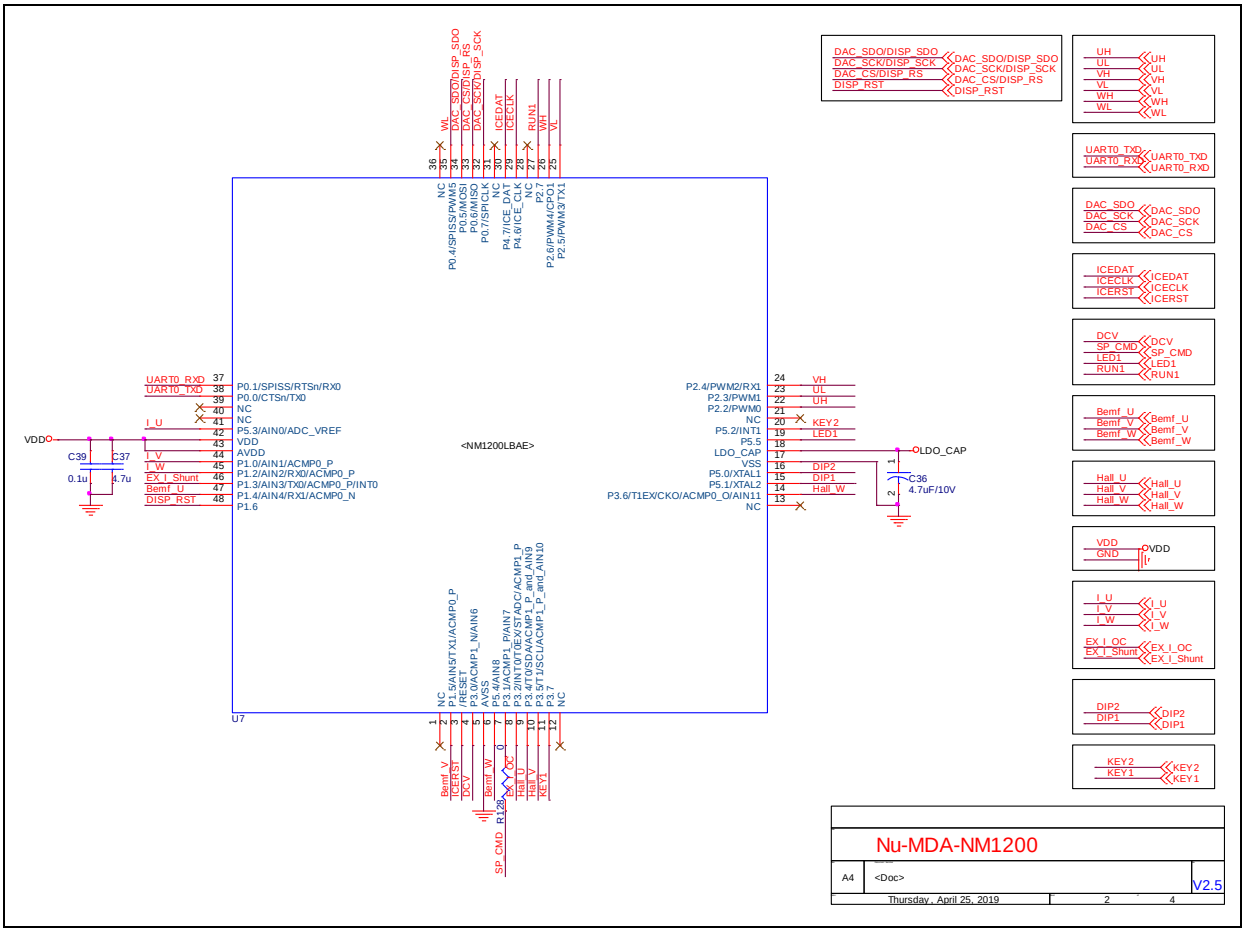


Figure 13-7 Nu-MDA-NM1200 Schematic

13.8 Nu-MDA-NM1200 Schematic

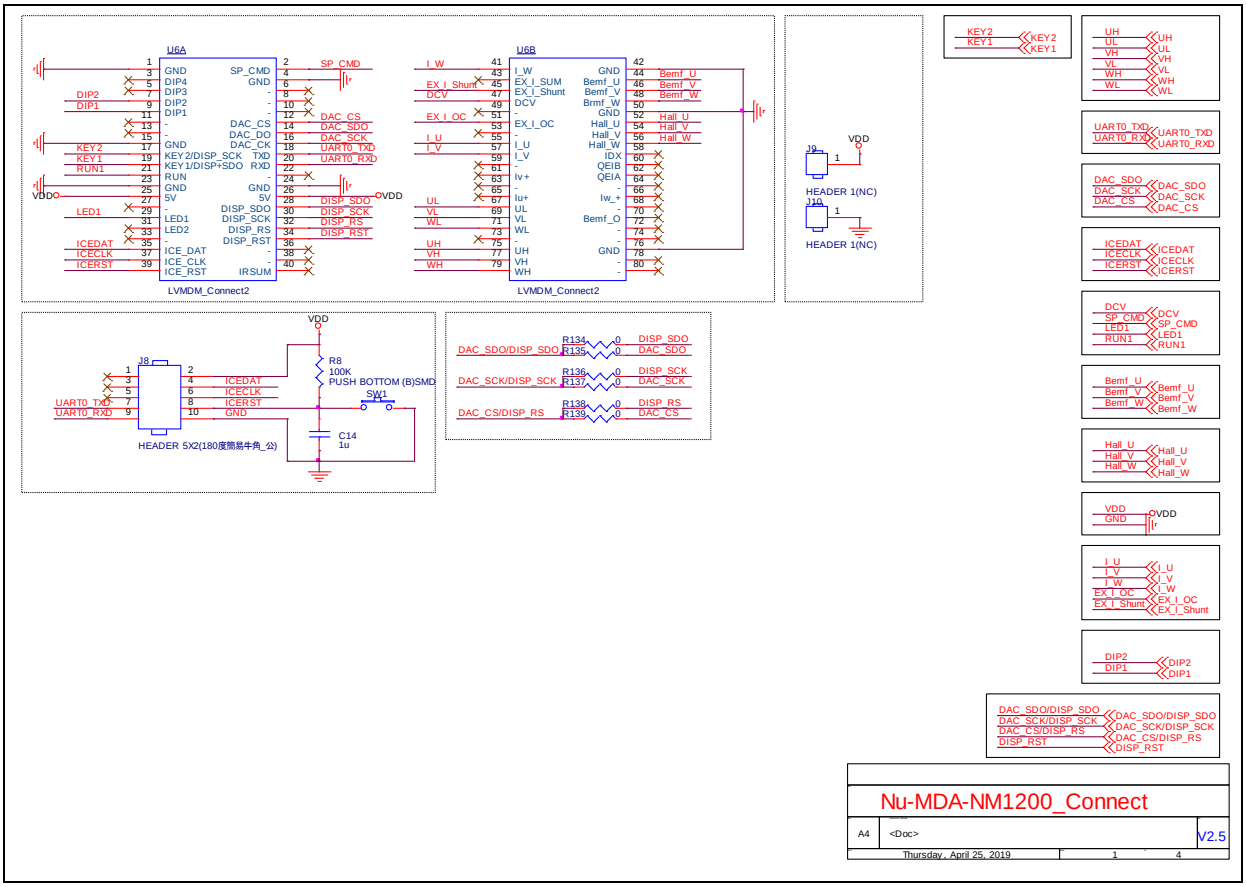


Figure 13-8 Nu-MDA-NM1200 Schematic

13.9 Nu-MDA-NM1230 Schematic

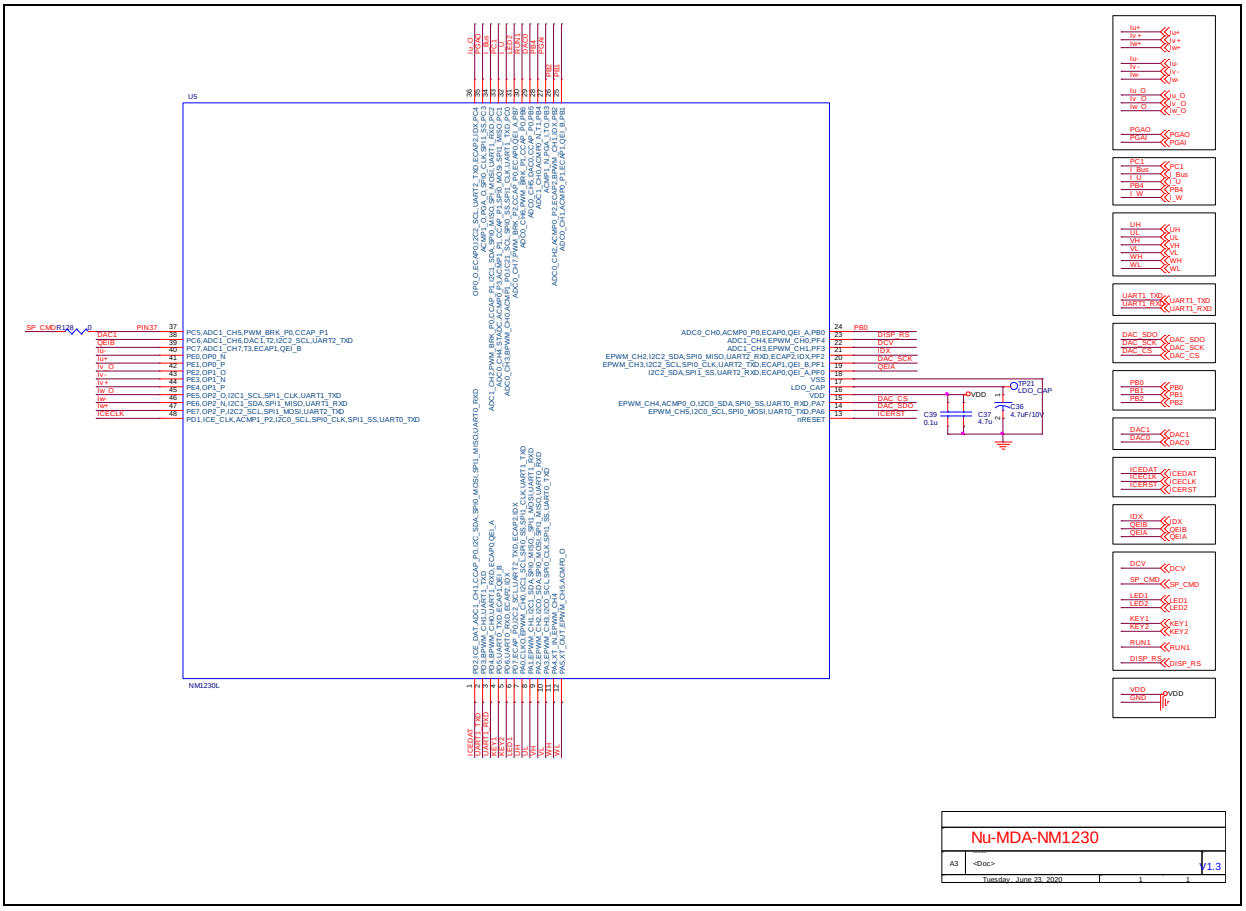


Figure 13-9 Nu-MDA-NM1230 Schematic

13.10Nu-MDA-NM1230 Schematic

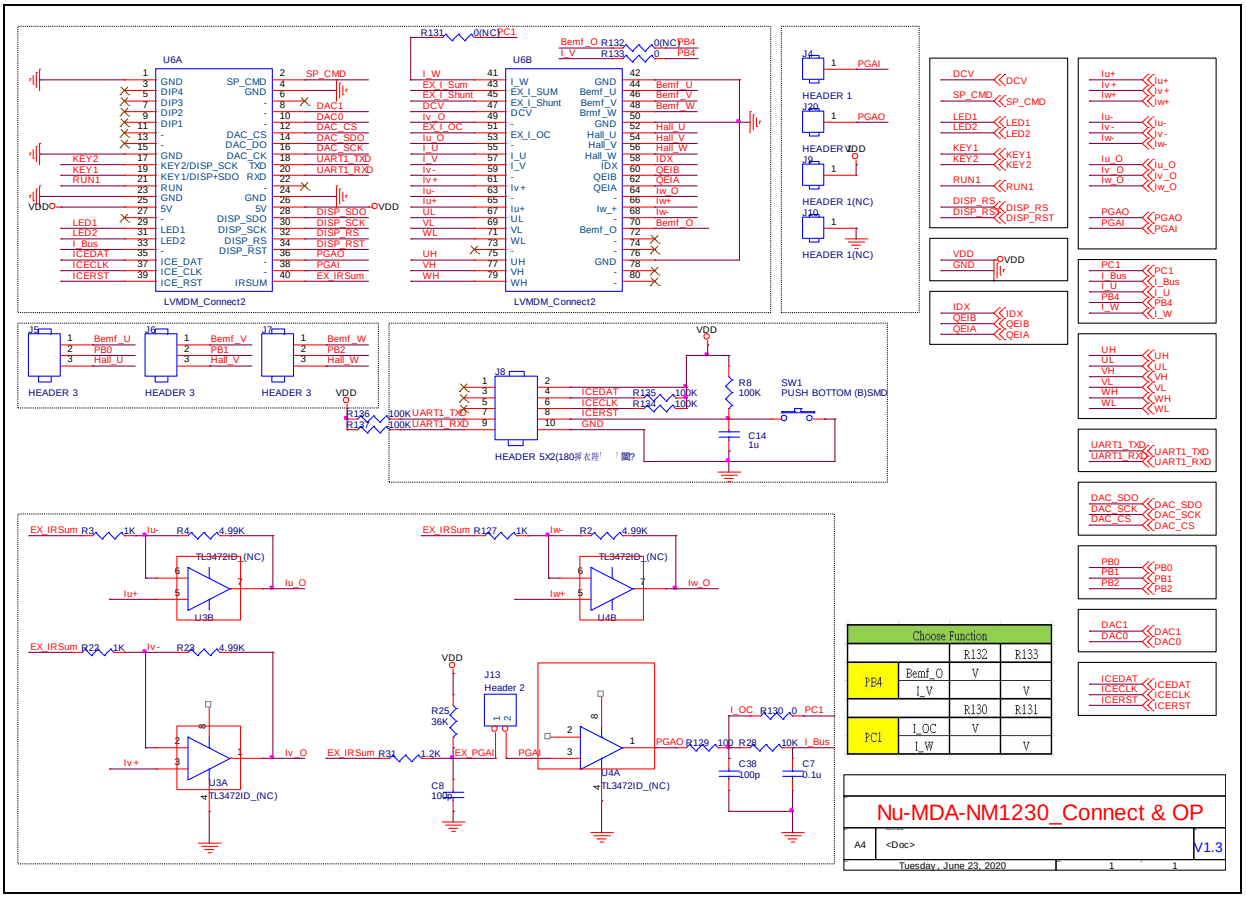


Figure 13-10 Nu-MDA-NM1230 Schematic

13.11Nu-MDA-NM1240 Schematic

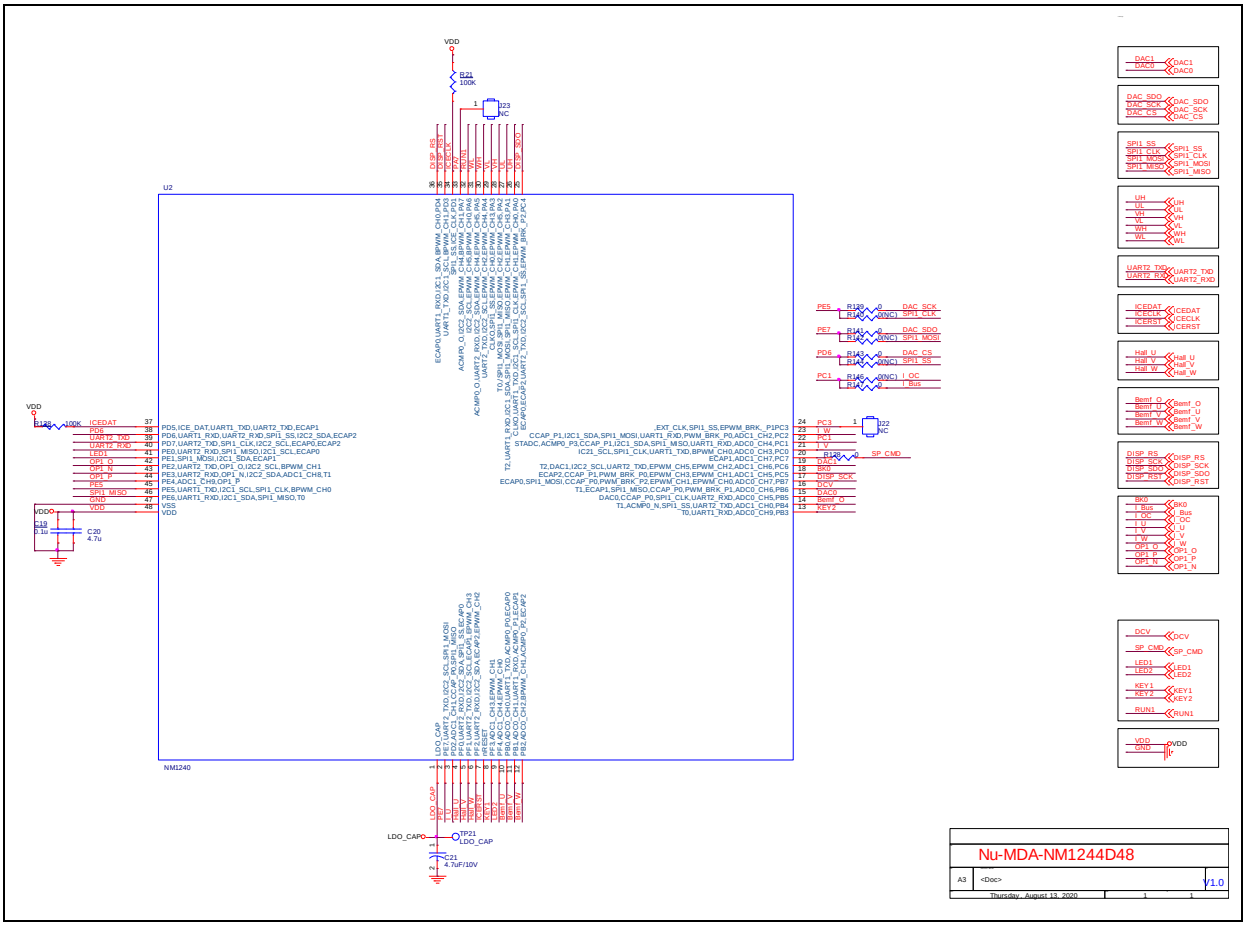


Figure 13-11 Nu-MDA-NM1240 Schematic

13.12Nu-MDA-NM1240 Schematic

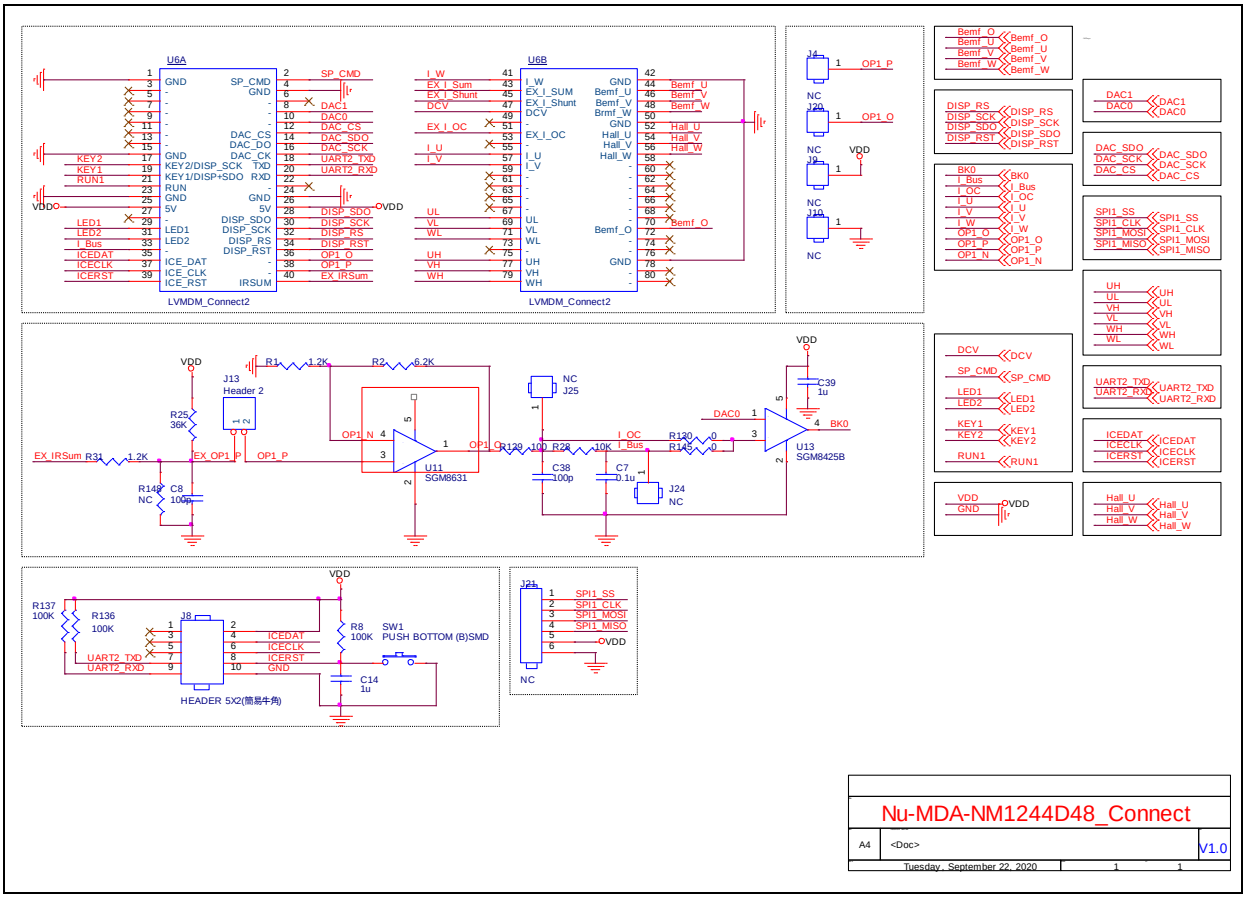


Figure 13-12 Nu-MDA-NM1240 Schematic

13.13Nu-MDA-NM1530 Schematic

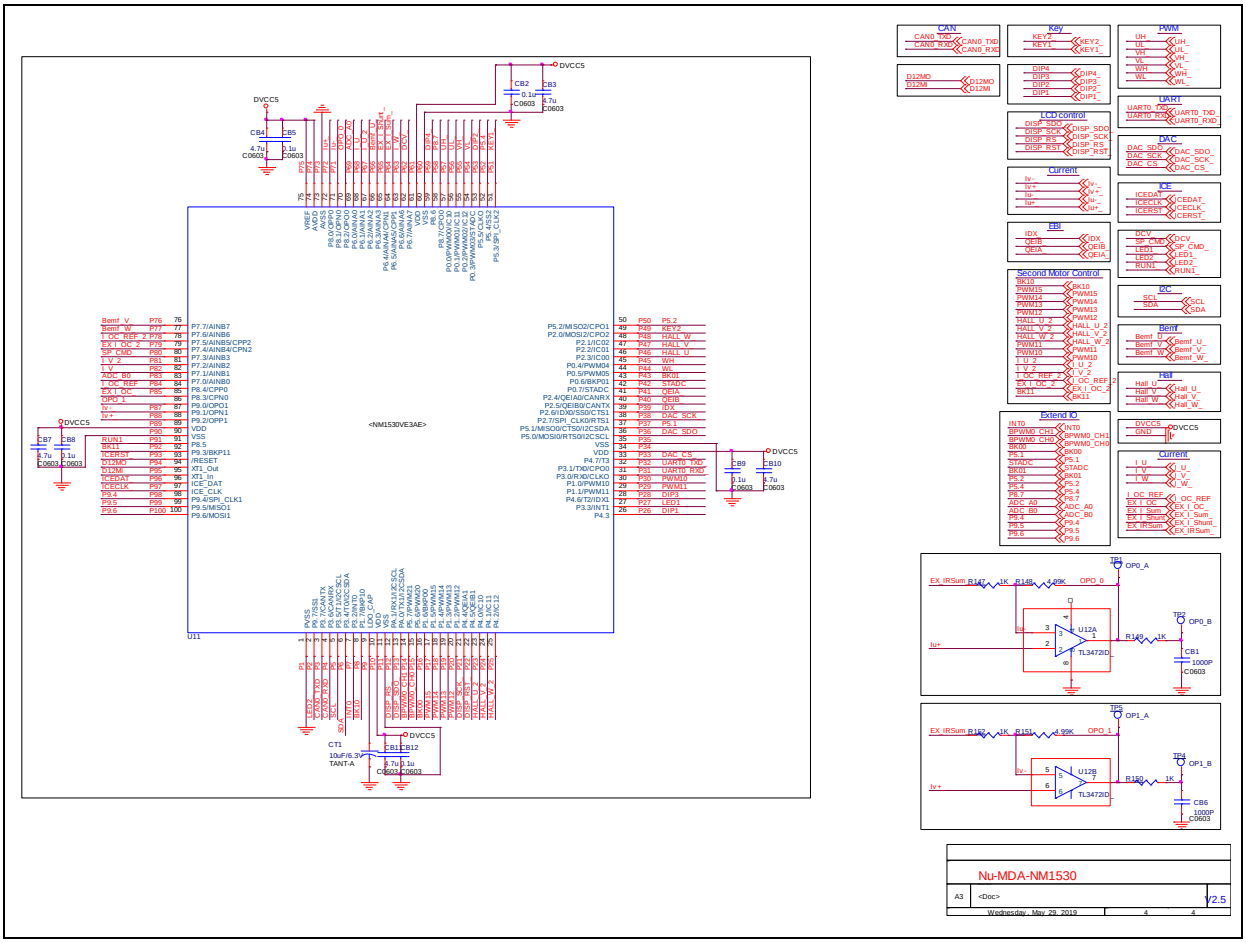


Figure 13-13 Nu-MDA-NM1530 Schematic

13.14Nu-MDA-NM1530 Schematic

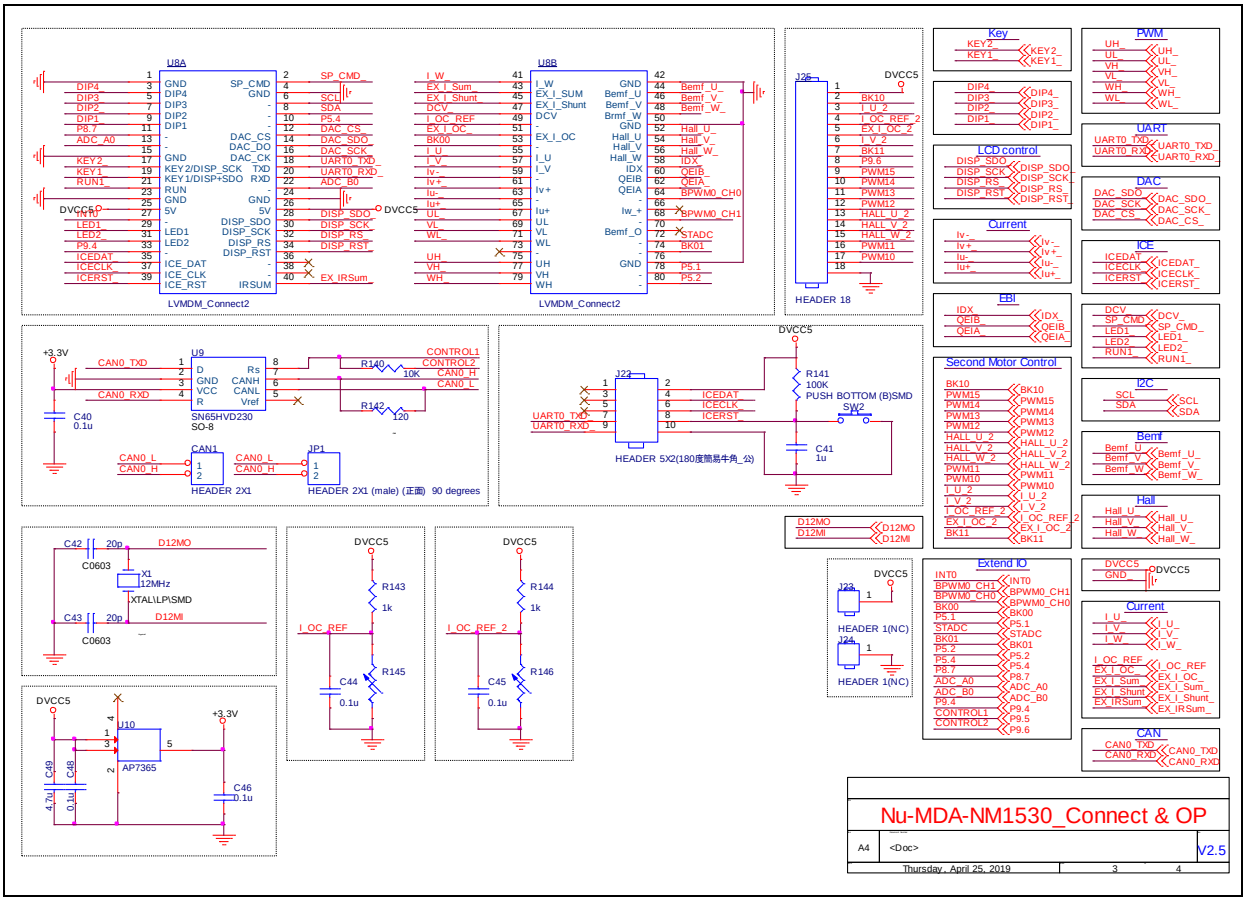


Figure 13-14 Nu-MDA-NM1530 Schematic

14 REFERENCE PCB PLACEMENT

14.1 Nu-LVMDM-MOS V2.8 PCB Placement

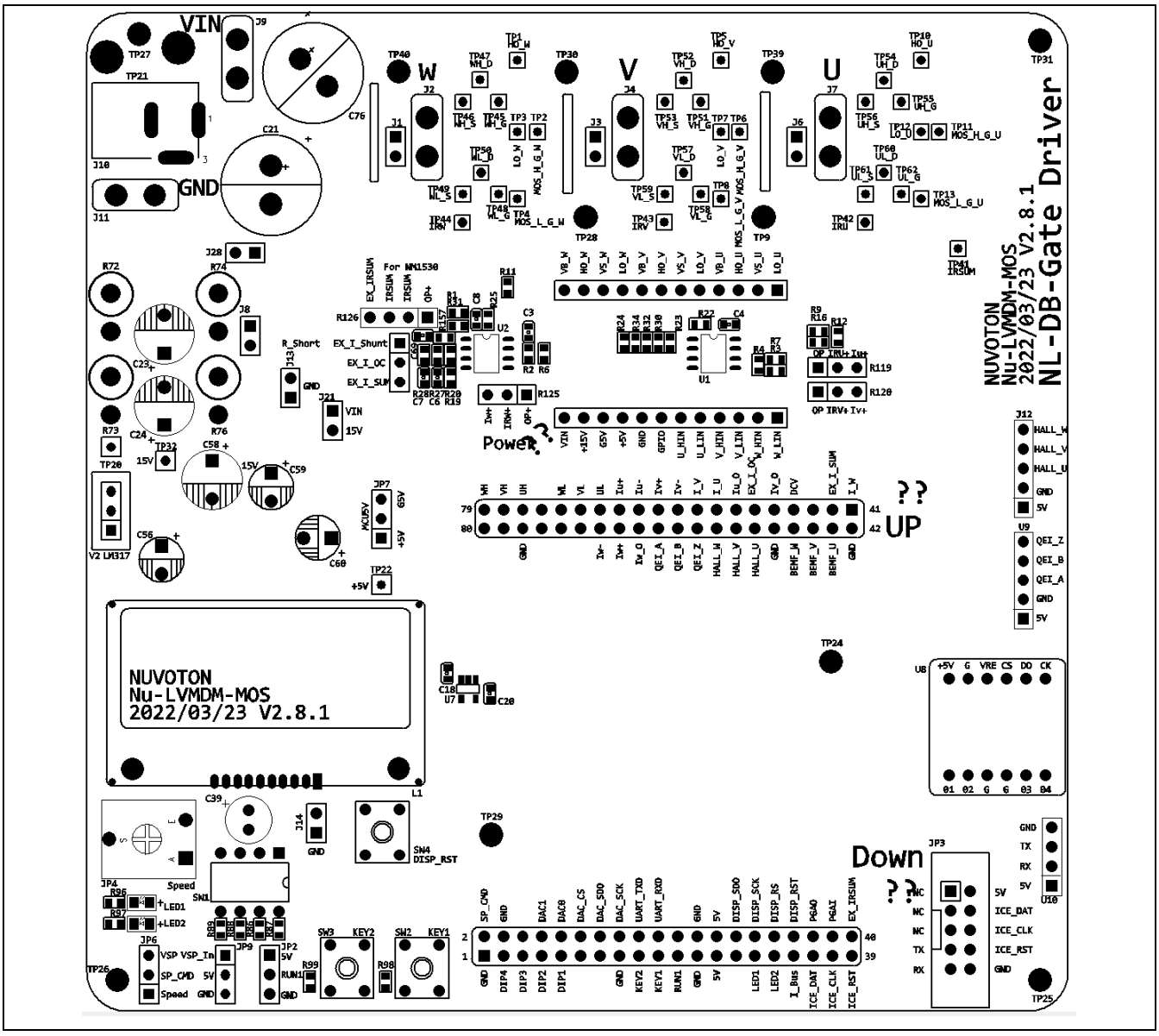


Figure 14-1 Nu-LVMDM-MOS 2.8 PCB Placement -TOP

14.2 Nu-LVMDM-MOS V2.8 PCB Placement

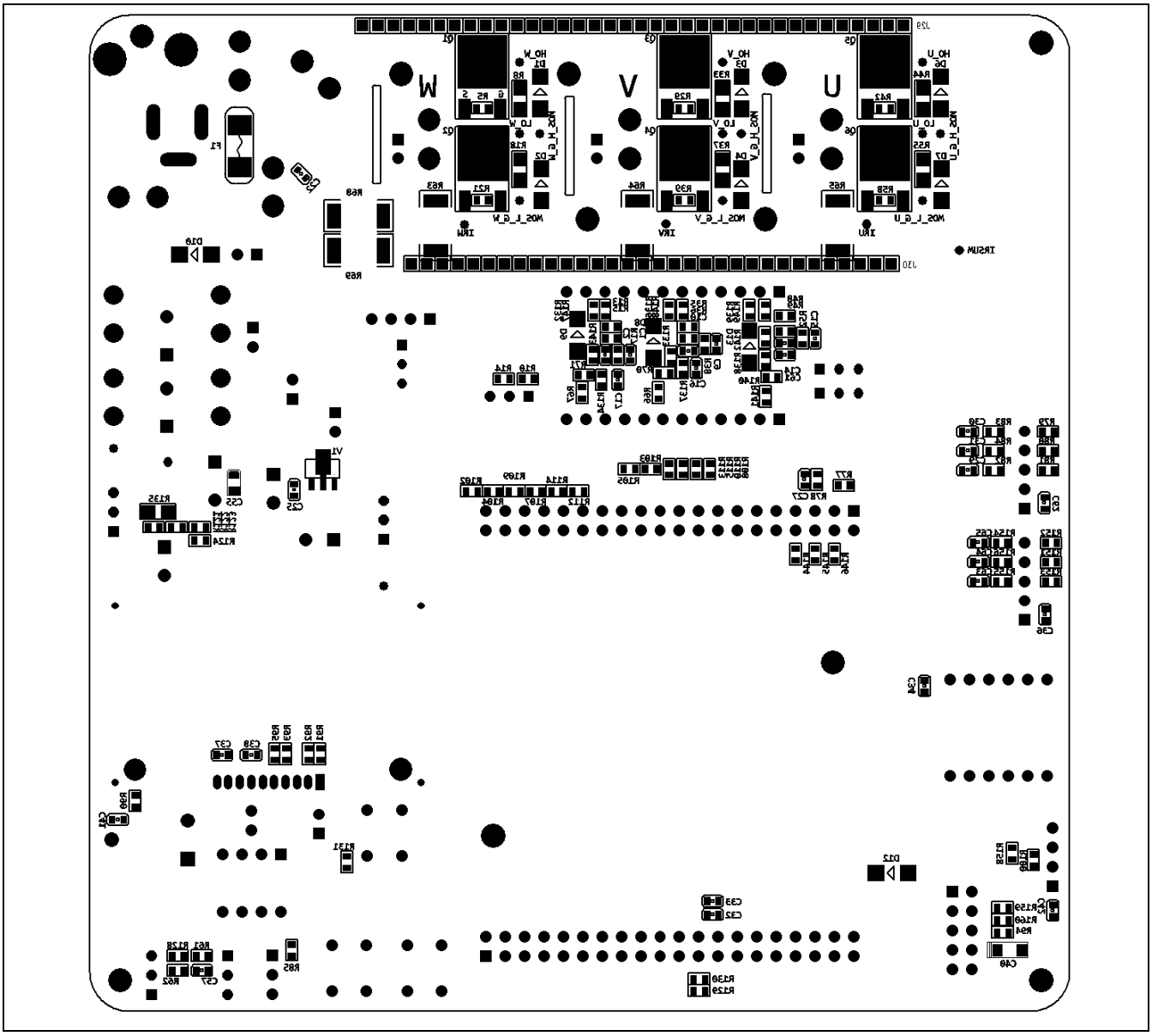


Figure 14-2 Nu-LVMDM-MOS 2.8 PCB Placement -Bottom

14.3 Gata Driver NCT3612 PCB Placement

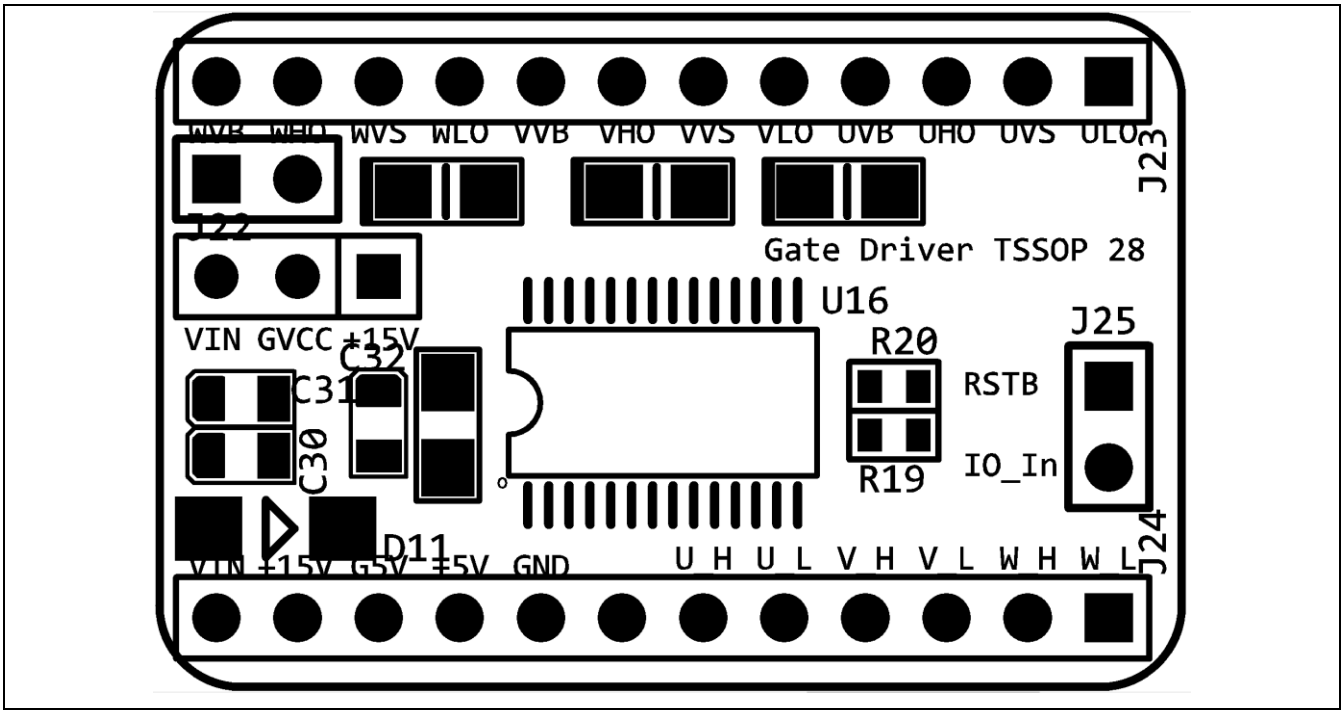


Figure 14-3 Gate Driver NCT3612Y PCB Placement -TOP

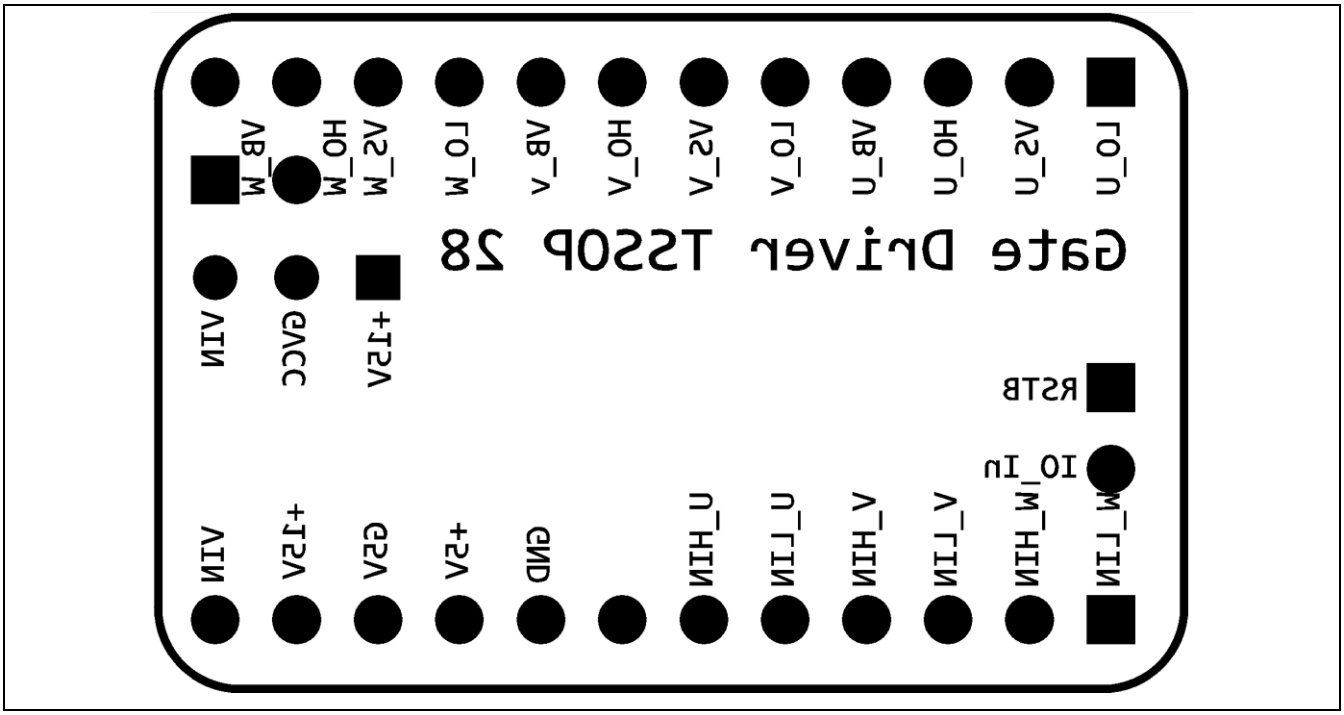


Figure 14-4 Gate Driver NCT3612Y PCB Placement -Bottom

14.4 Gate Driver IR2101 PCB Placement

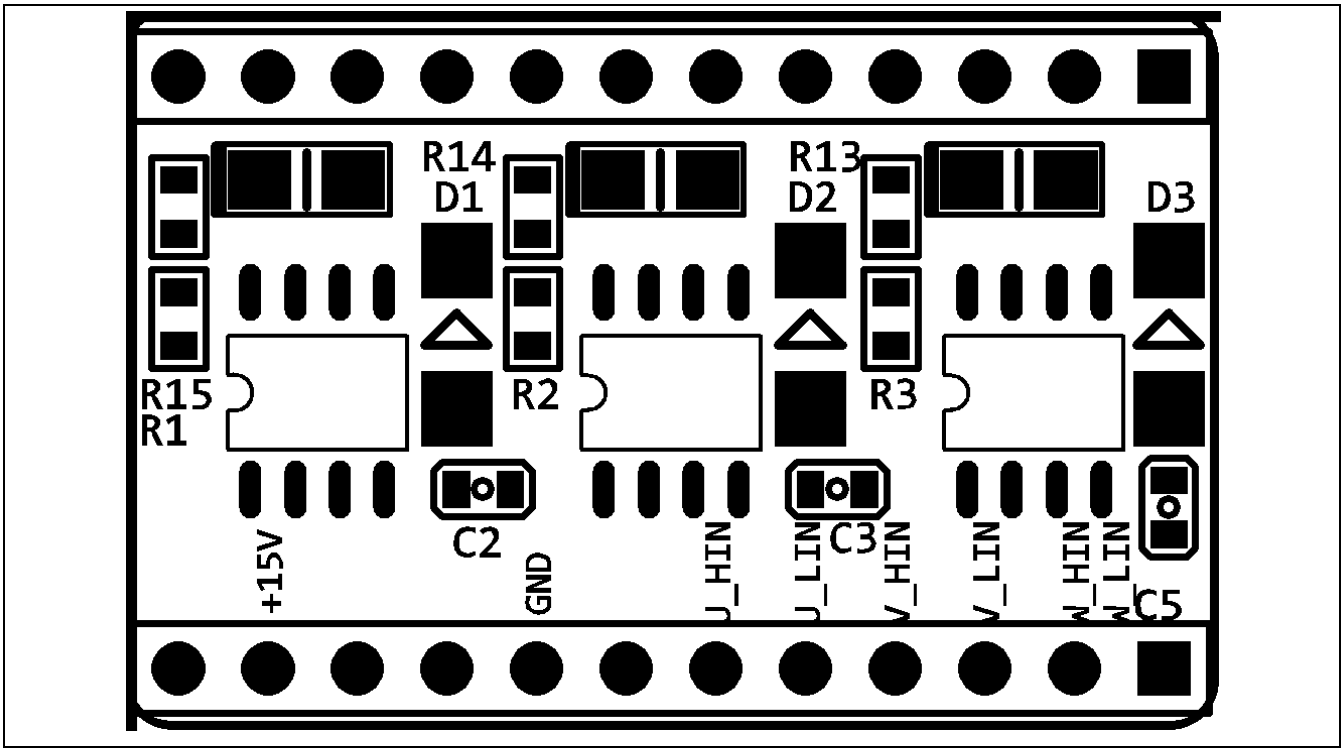


Figure 14-5 Gate Driver IR2101PCB Placement -TOP

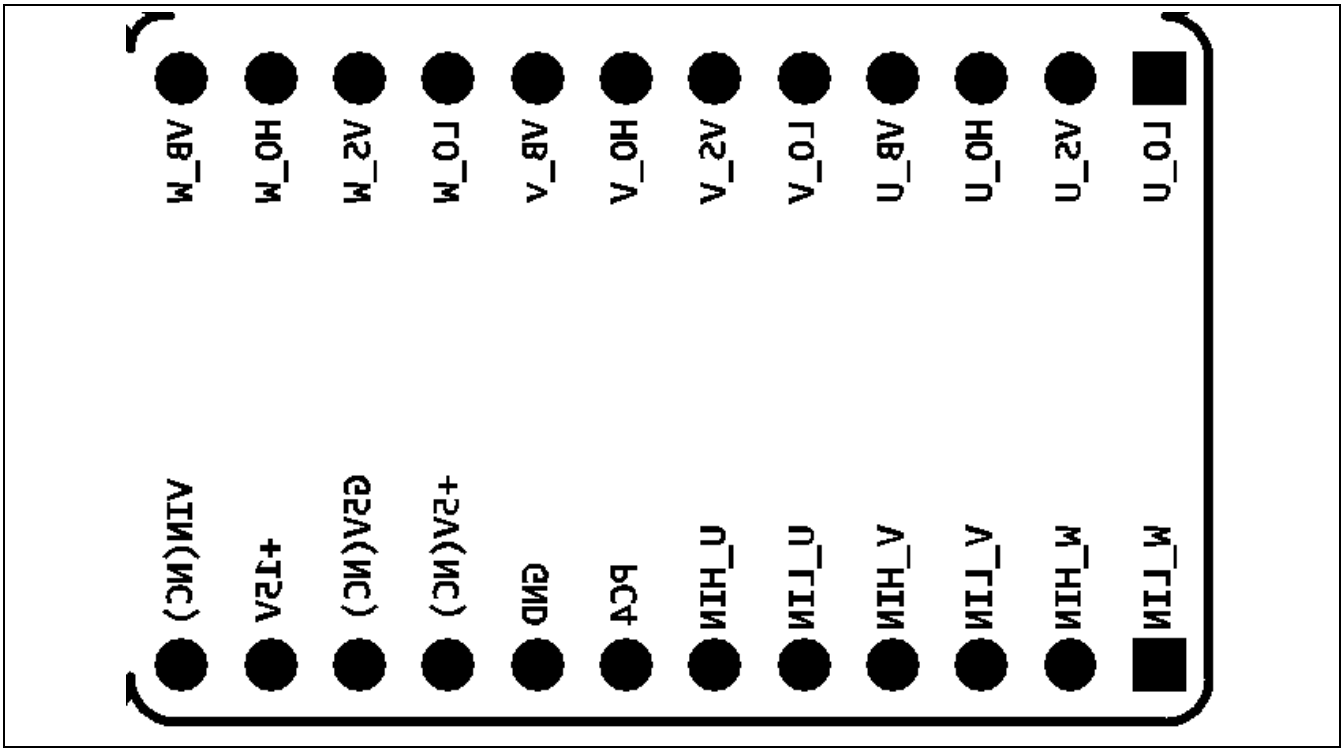


Figure 14-6 Gate Driver IR2101PCB Placement -Bottom

14.5 Nu-MDA-NM1120 PCB Placement

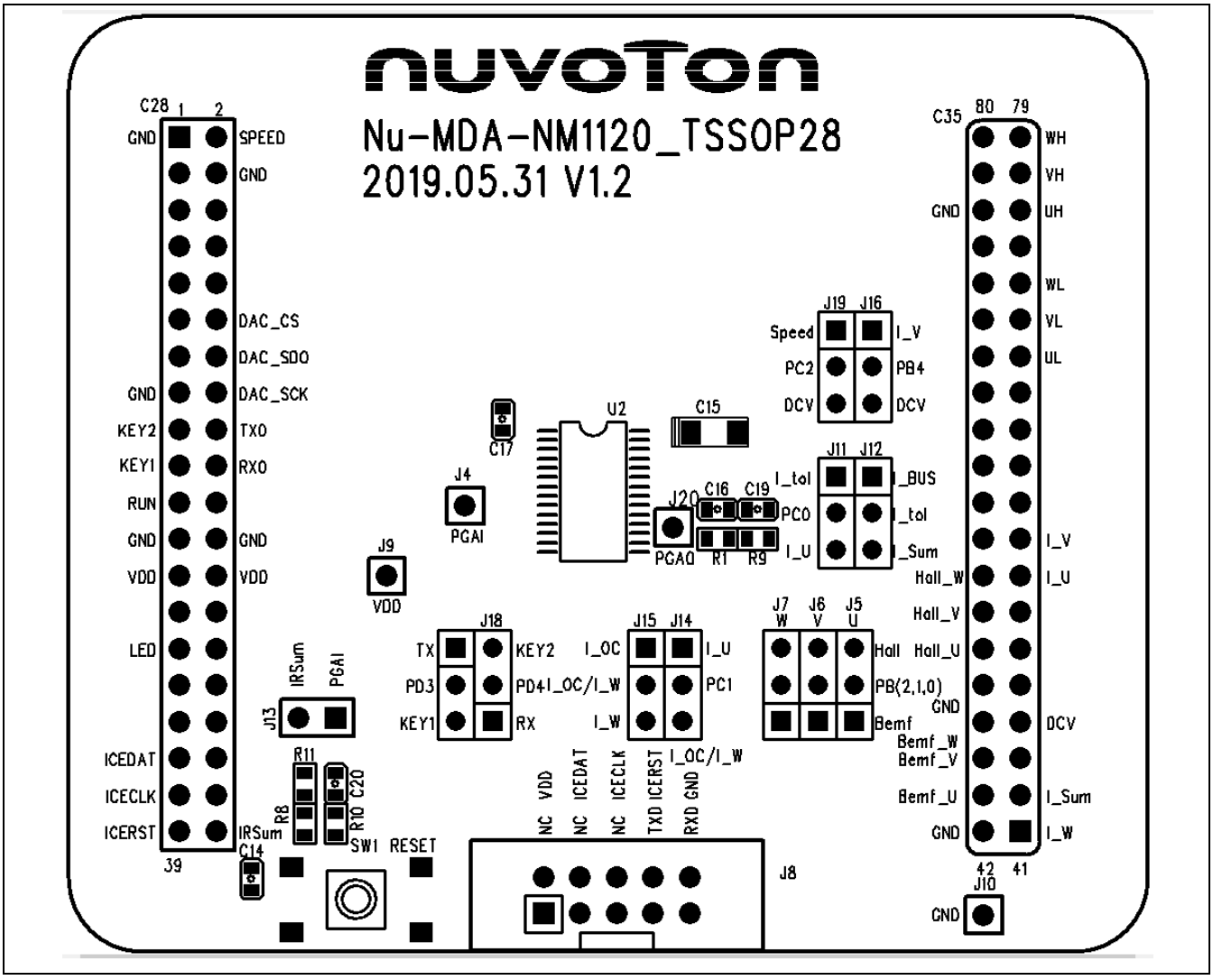


Figure 14-7 Nu-MDA-NM1120 PCB Placement

14.6 Nu-MDA-NM1200 PCB Placement

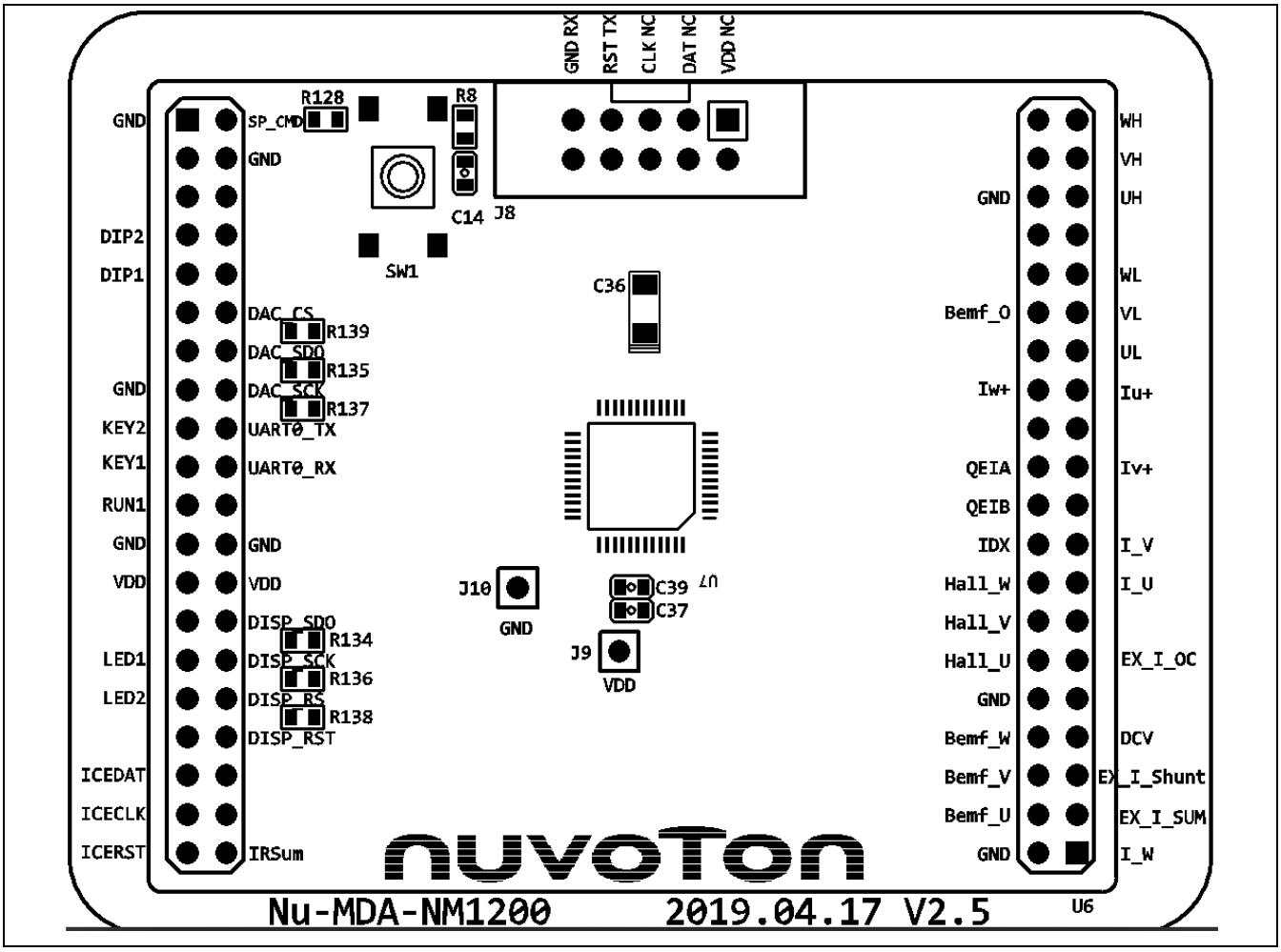


Figure 14-8 Nu-MDA-NM1200 PCB Placement

14.7 Nu-MDA-NM1230 PCB Placement

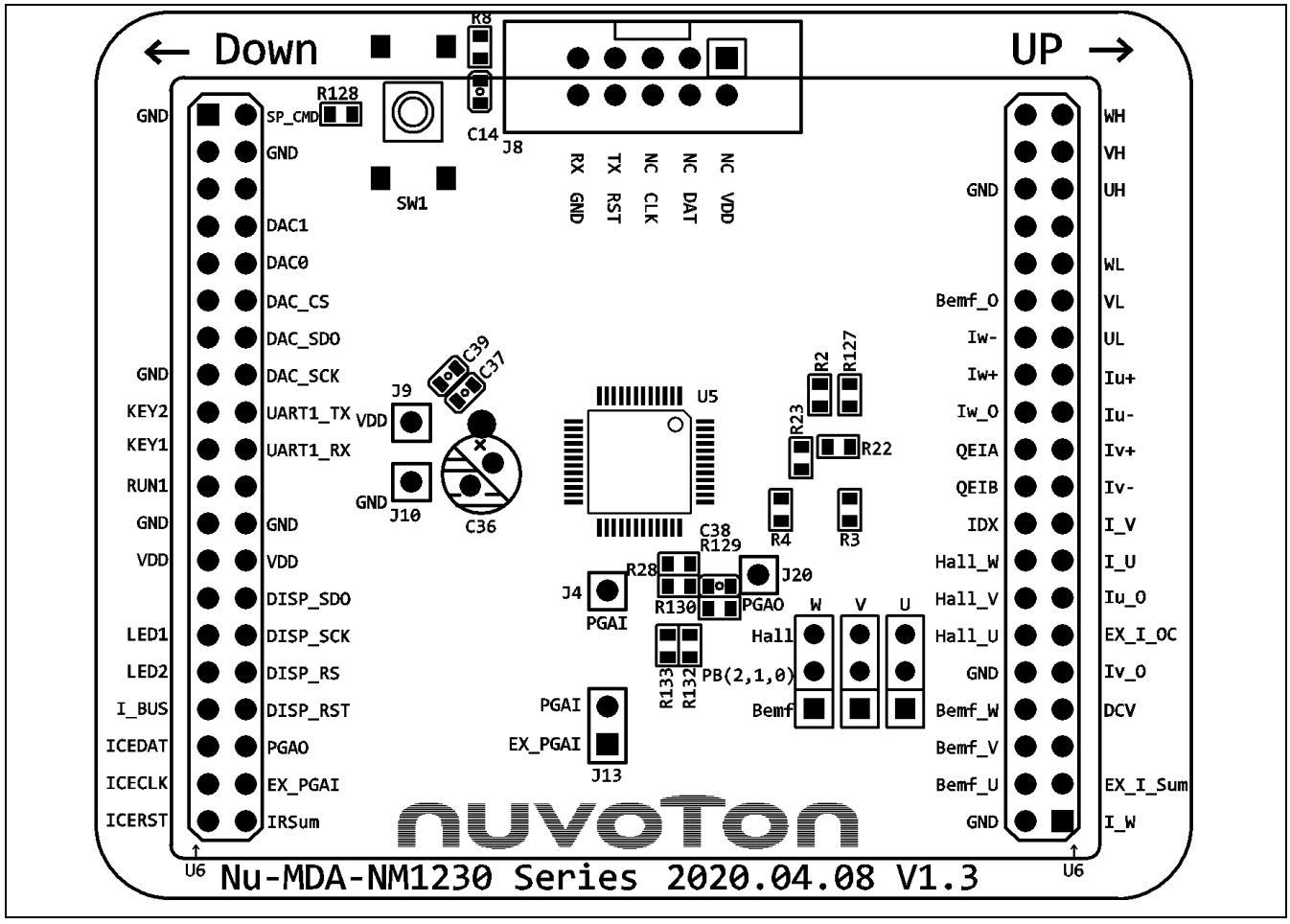


Figure 14-9 Nu-MDA-NM1230 PCB Placement

14.8 Nu-MDA-NM1240 PCB Placement

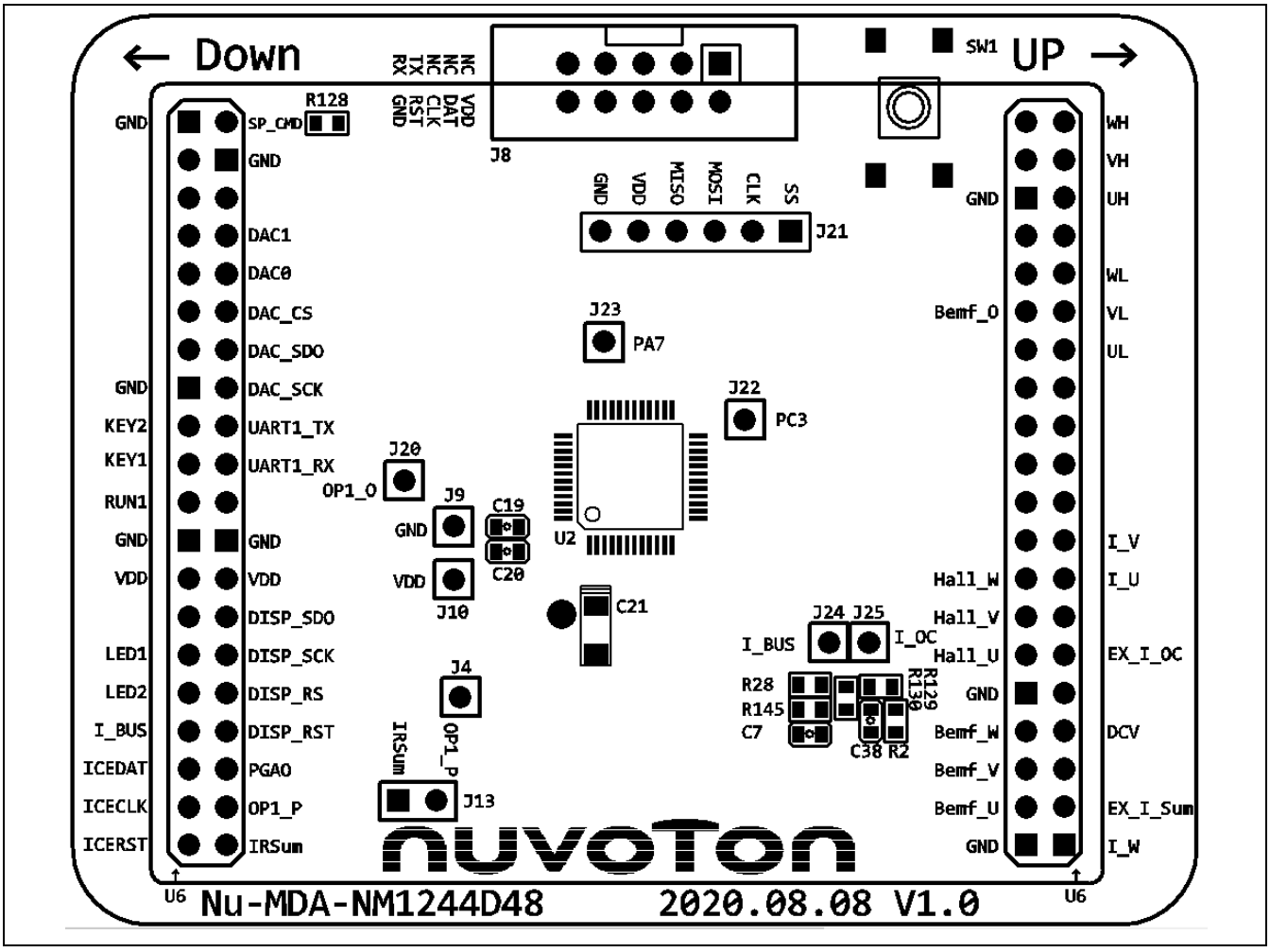


Figure 14-10 Nu-MDA-NM1240 PCB Placement

14.9 Nu-MDA-NM1530 PCB Placement

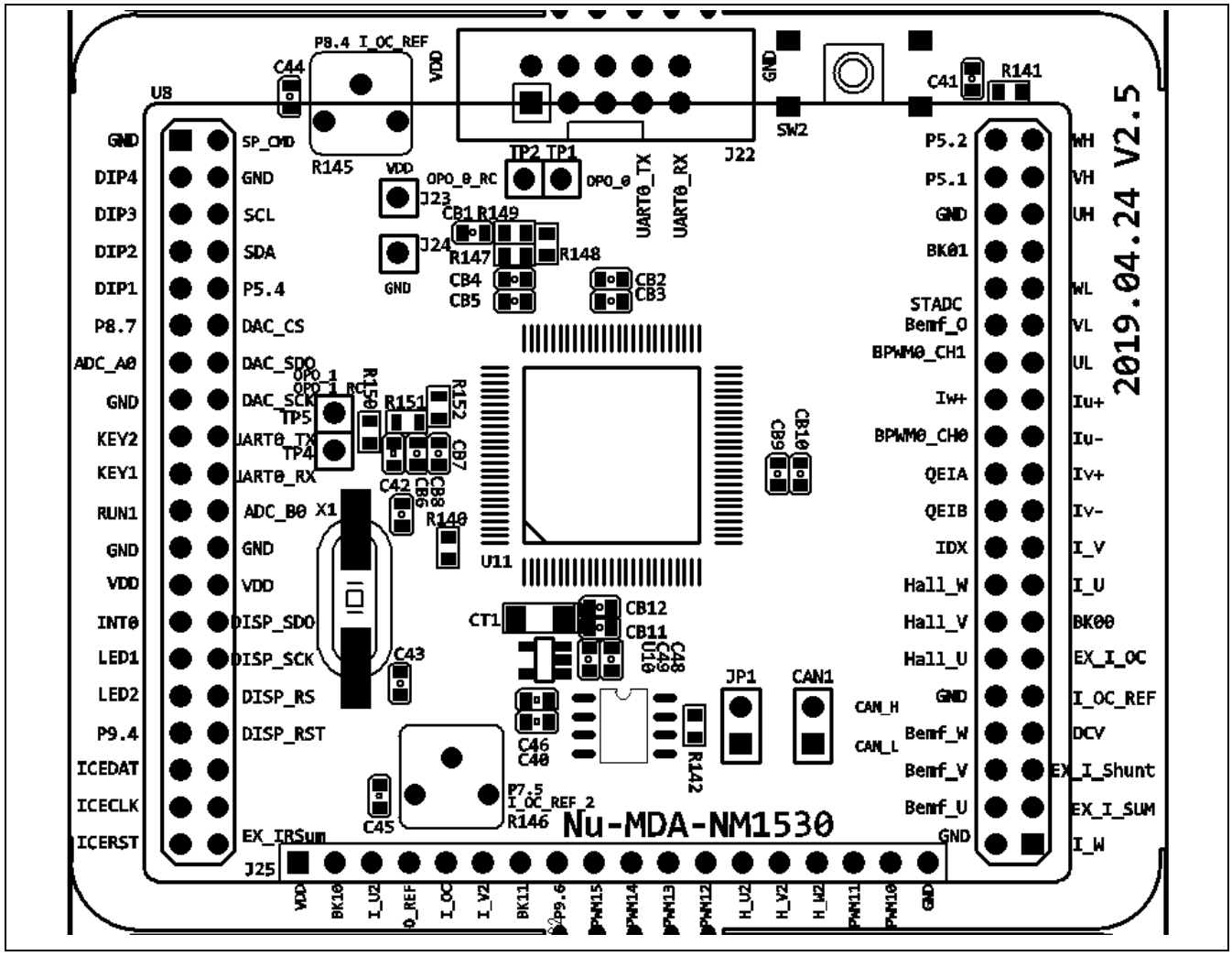


Figure 14-11 Nu-MDA-NM1530 PCB Placement

15 MOTOR LINE AND MOTOR HALL TEST

15.1 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.

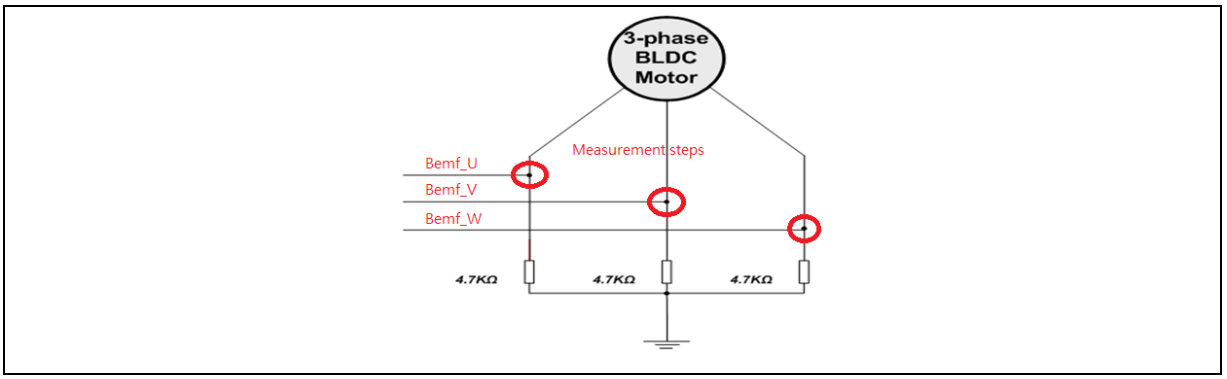


Figure 15-1 Motor connect to risister

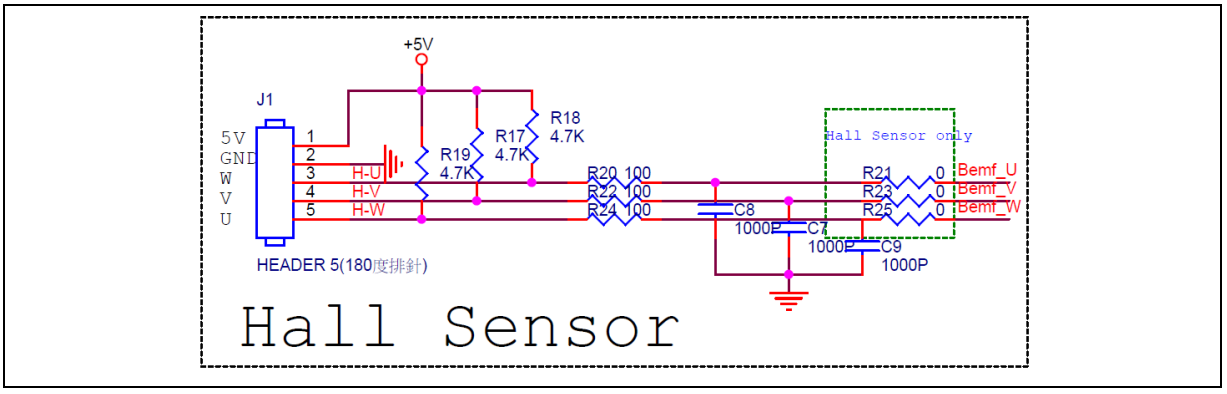
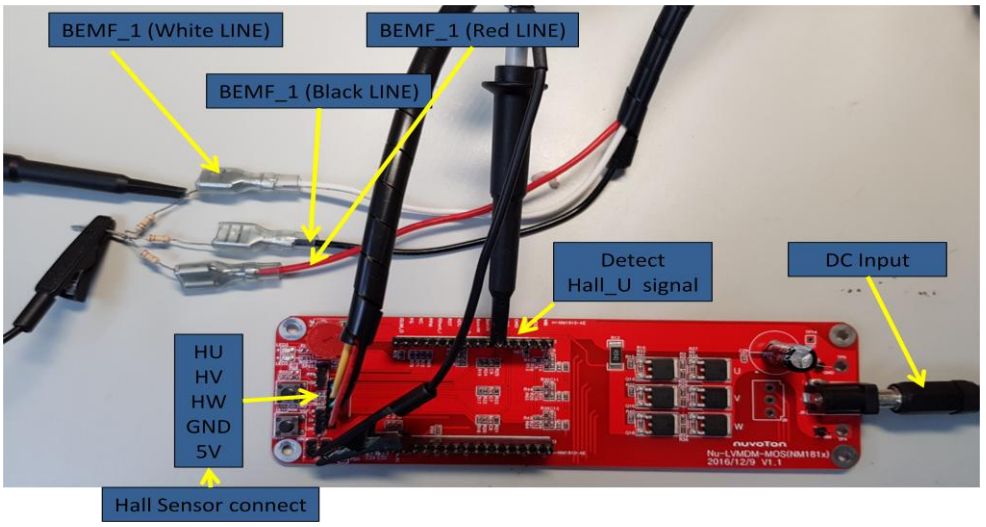
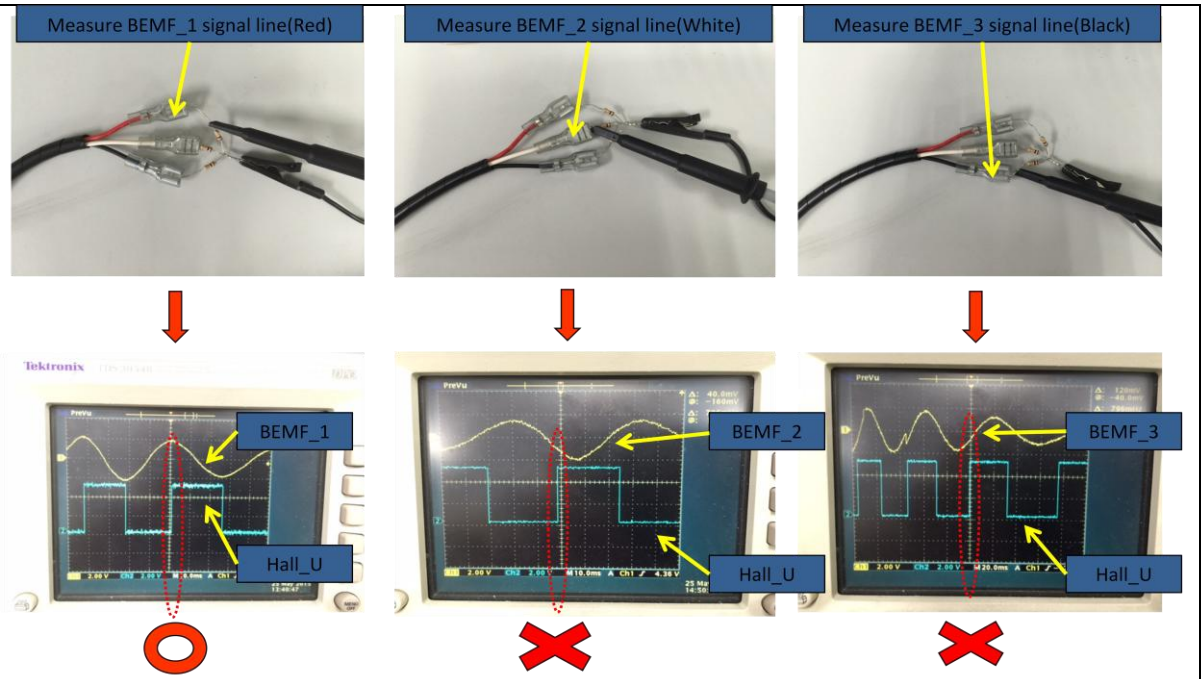


Figure 15-2 Hall sensor Circuit

15.2 Step2: Physical circuit connection

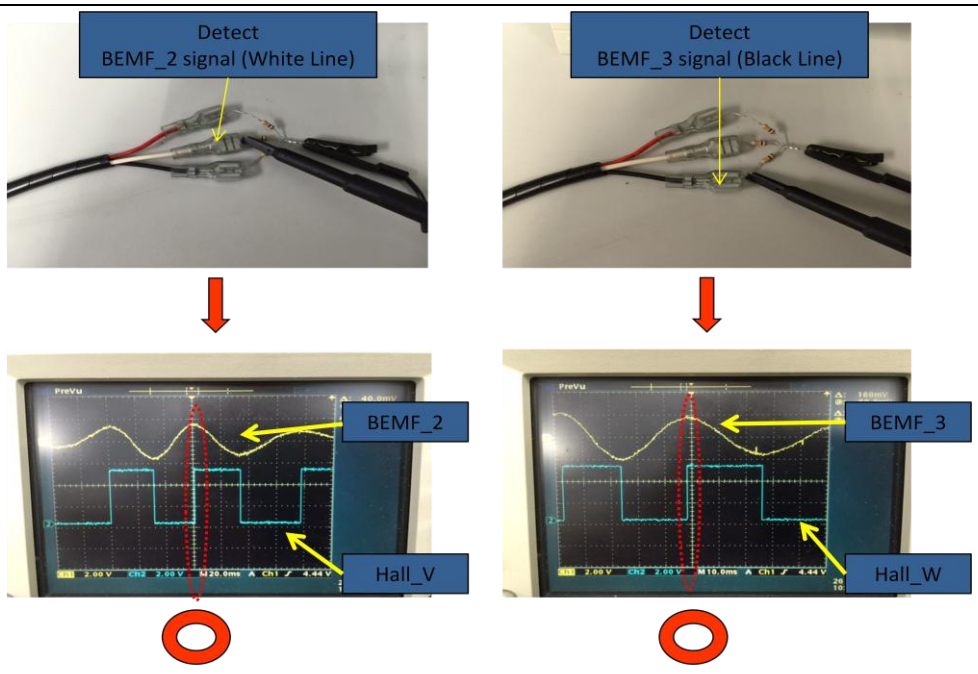


15.3 Step3: Find the signal of U phase



15.4 Step4: Find the signal of V & W phase

Find 1K ohm~10k ohm



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.

15.5 Step5: Check Hall Type

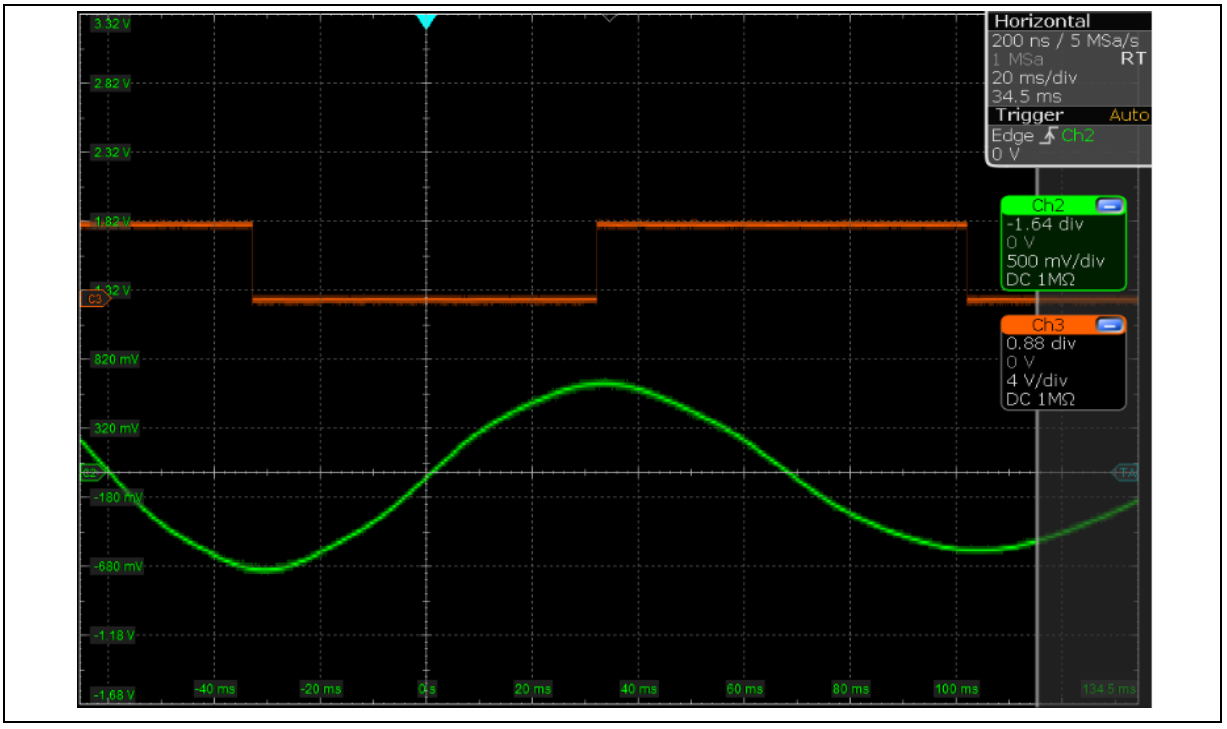


Figure 15-3 Type1 – Hall & BEMF

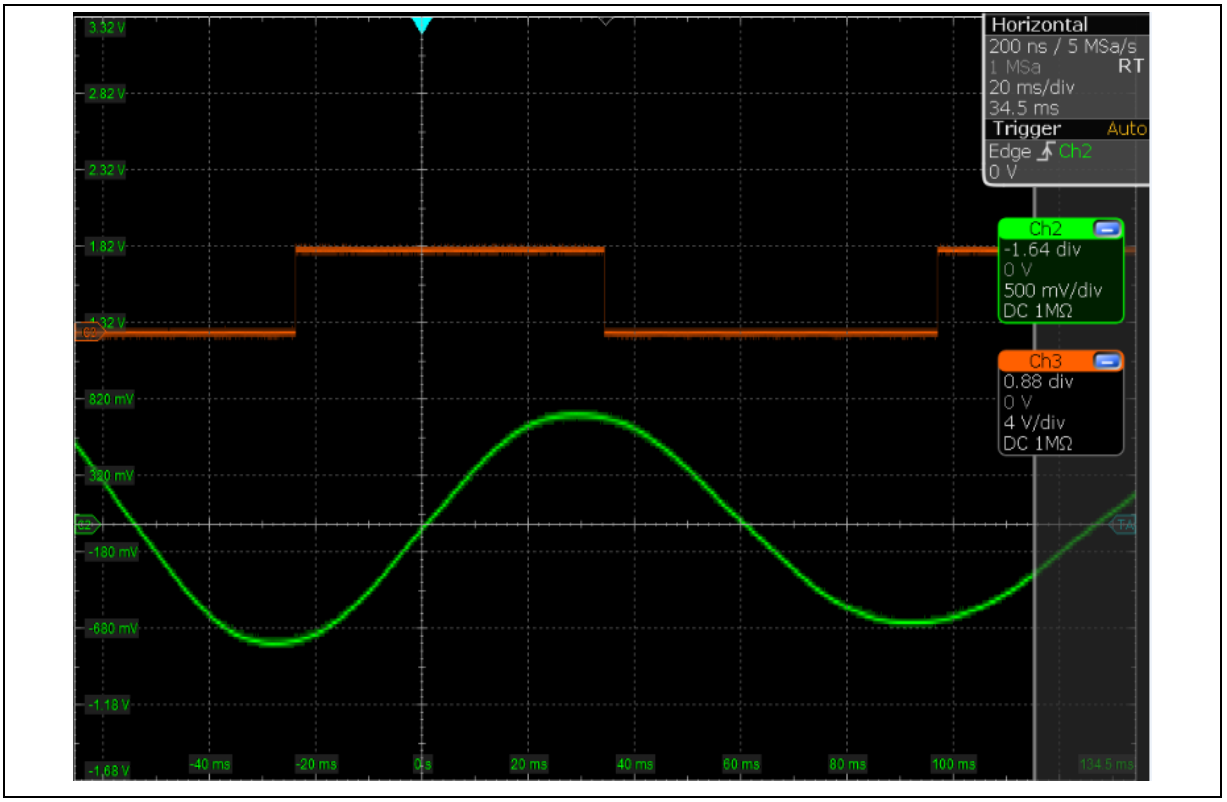


Figure 15-4 Type0 – Hall & BEMF

16 REVISION HISTORY

Date	Revision	Description
2019.04.02	1.00	1. Initially issued.
2019.06.13	1.01	2. Increase article content
2022.05.26	1.02	3. Add NM1240 series

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.