ARM® Cortex®-M0

32-bit Microcontroller

NuMicro® Family
Nu-Link-Gang
User Manual

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www.nuvoton.com

Supported devices of Nu-Link-Gang				
Cortex-M0 series				
M031	M051	M0518	M0519	M0564
M058S	Mini51	Mini51X	Mini57	Mini58
NM1120	NM1200	NM1230	NM1320	NM1330
NM1500	NM1810	NM1820	TF5100	Nano100
Nano103	NDA102	NUC029	NUC100	NUC121
NUC126	NUC131	NUC200	AU9110	I91000
N569	N570	N572	N575	N576
Cortex-M4 series				
M451	NUC400	NUC505	M480	I94000
Cortex-M23 series				
M251	M2351	M261		
8051 series				
N76E003	N76E616	N76E885	ML51	MS51

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1 GENERAL DESCRIPTION

The Nu-Link-Gang programmer is the new generation four-chip gang programmer, supports all Nuvoton NuMicro® Family and 8051 1T series and packages. The Nu-Link-Gang provides flexible programming setting, which is designed especially for mass-production. It supports four different chips with individual firmware image file programming functionality, 3 options of programming voltage, and off-line programming four chips simultaneously or individually. The Nu-Link-Gang can also be connected to a automatic IC programming system. Overall, the Nu-Link-Gang offers more flexibility and high efficiency than what usual programmers offer for mass-production.

The Nu-Link-Gang programmer is easy to use. User first loads the programming firmware image file through ICP programming tool on PC into the programmer, then use only one botton to start the off-line programming process. The LCD display on the Nu-Link-Gang shows the detail of IC's part number, programming times, programming voltage, error message, and etc. User can connect the Nu-Link-Gang programmer and target chips by using a automatic IC programming system, Nuvoton ICP Gang Adapters or customize adapter boards. Different ICs or different packages use different Nuvoton ICP Gang Adapters.

Figure 1-1 Nu-Link-Gang Programmer

2 HARDWARE INTRODUCTION

2.1 Nu-Link-Gang

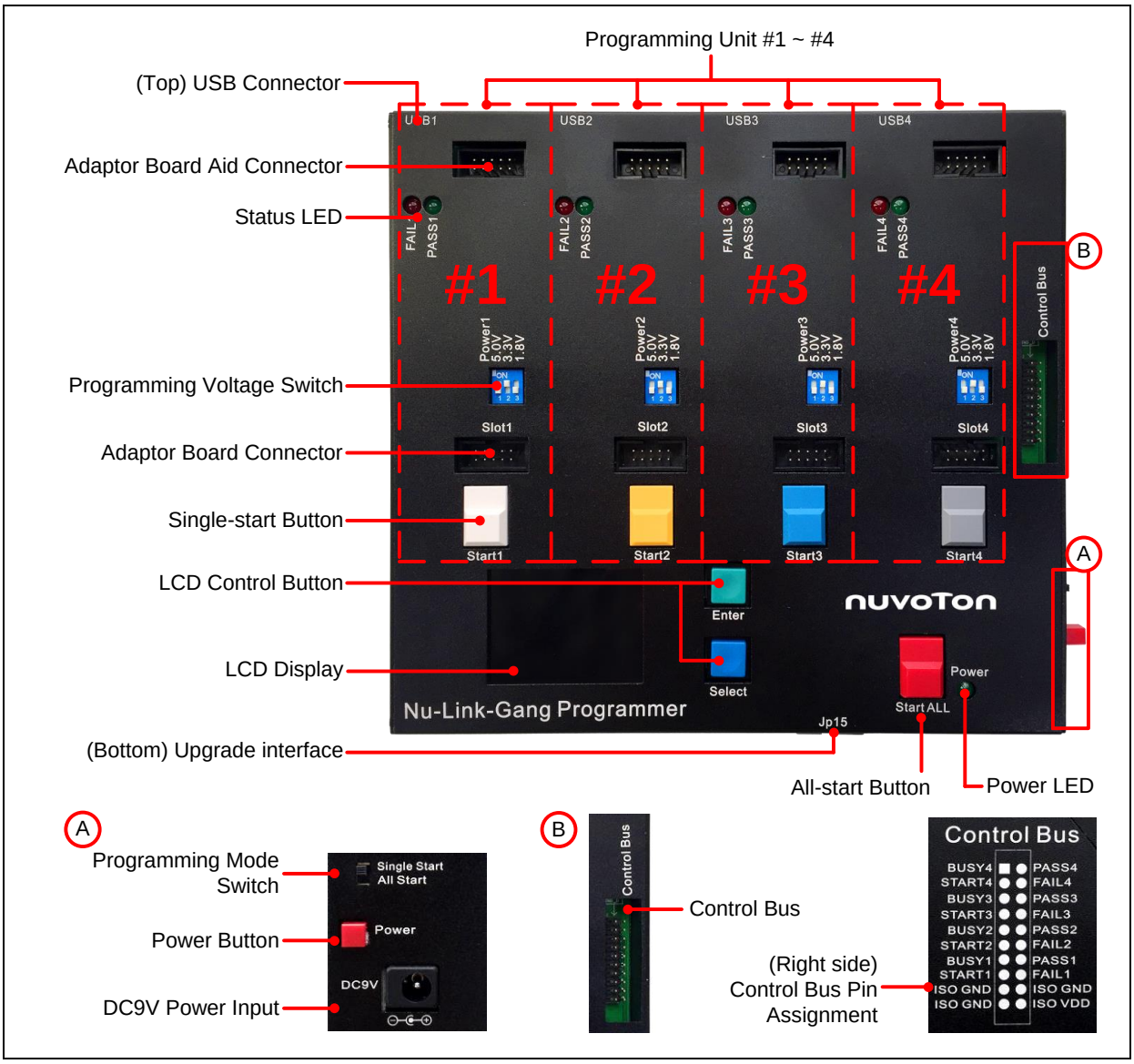


Figure 2-1 Nu-Link-Gang

2.1.1 Programming Unit

Programming unit #1, #2, #3, and #4, four independent units with identical functions.

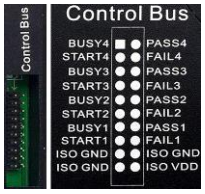
Programming unit		#1	#2	#3	#4
	USB Connector	USB1	USB2	USB3	USB4
	Status LED	FAIL1 PASS1	FAIL2 PASS2	FAIL3 PASS3	FAIL4 PASS4
	Programming Voltage Switch	Power1	Power2	Power3	Power4
	Adapter Board Connector	Slot1	Slot2	Slot3	Slot4
	Single-start Button	Start1	Start2	Start3	Start4
	Control Bus	PASS1 FAIL1 BUSY1 START1	PASS2 FAIL2 BUSY2 START2	PASS3 FAIL3 BUSY3 START3	PASS4 FAIL4 BUSY4 START4

Table 2-1 Programming Unit's Component List

2.1.2 Power Supply

Use DC 9V/1A power adapter with DC tip polarity: internal positive (+), external negative (-).

Power ON: Connects the Nu-Link-Gang and the power adapter, and press the Power Button once. The LCD display and the Power LED illuminates.

Power OFF: Press the Power Button once to release it. The Power LED does not illuminate, and the Nu-Link-Gang truns off. Remove the power adapter from the Nu-Link-Gang.

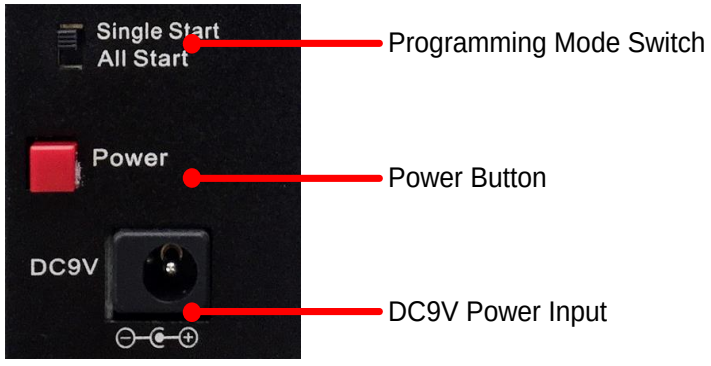


Figure 2-2 Power Supply and Programming Mode Switch

2.1.3 Programming Mode Switch

Switches the programming mode as shown as Figure 2-2 to control Single-start button or All-start button.

All-start button controls all four programming units. Each Single-start button controls corresponding unit.

Programming Mode Switch	StartALL	Start1	Start2	Start3	Start4
Single Start	X	V	V	V	V
All Start	V	X	X	X	X

X:Unused

Table 2-2 Programming Mode Switch

2.1.4 LCD Display and LCD Control Button

The LCD display shows each unit's detail such as IC's part number, programming times, programming voltage, error message, and etc. Uses LCD control buttons to switch pages.

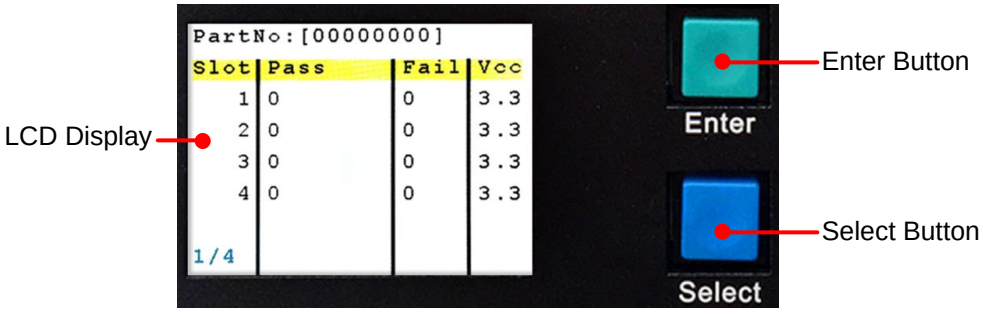


Figure 2-3 LCD Display and Control Buttons

2.1.5 Programming Voltage Switch

Turns off the Nu-Link-Gang, and switches the programming voltage to 1.8 V, 3.3 V, or 5.0 V.

Programming Voltage	1	2	3
5.0 V	ON	OFF	OFF
3.3 V	OFF	ON	OFF
1.8 V	OFF	OFF	ON

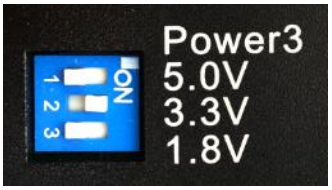


Figure 2-4 Programming Voltage Switch

Table 2-3 Programming Voltage Switch

2.1.6 Status LED

The status LEDs on the Nu-Link-Gang and the Nuvoton ICP Gang Adapter show the programming results of every unit.

Light	Status
Green	PASS
Red	FAIL

Figure 2-5 Status LED

Table 2-4 Status LED on Nu-Link-Gang

2.1.7 Control Bus

The Nu-Link-Gang can be connected to a automatic IC programming system through the control bus.

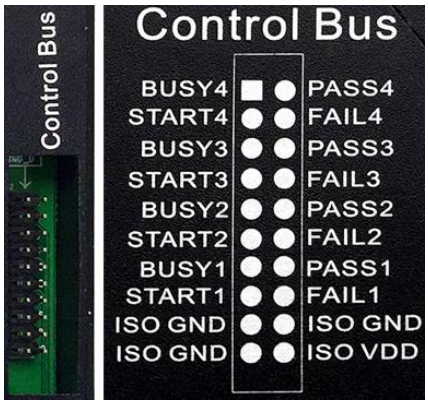


Figure 2-6 Control Bus

2.1.8 Upgrade Interface

JP15 is the SWD interface only for the Nu-Link-Gang firmware upgrade.

Figure 2-7 JP15

2.2 Nuvoton ICP Gang Adapter

The pin 1 of the socket is at the bottom left corner. Different chips or different packages use different Nuvoton ICP Gang Adapters. Please refer to section 3.4.1 for the usage.

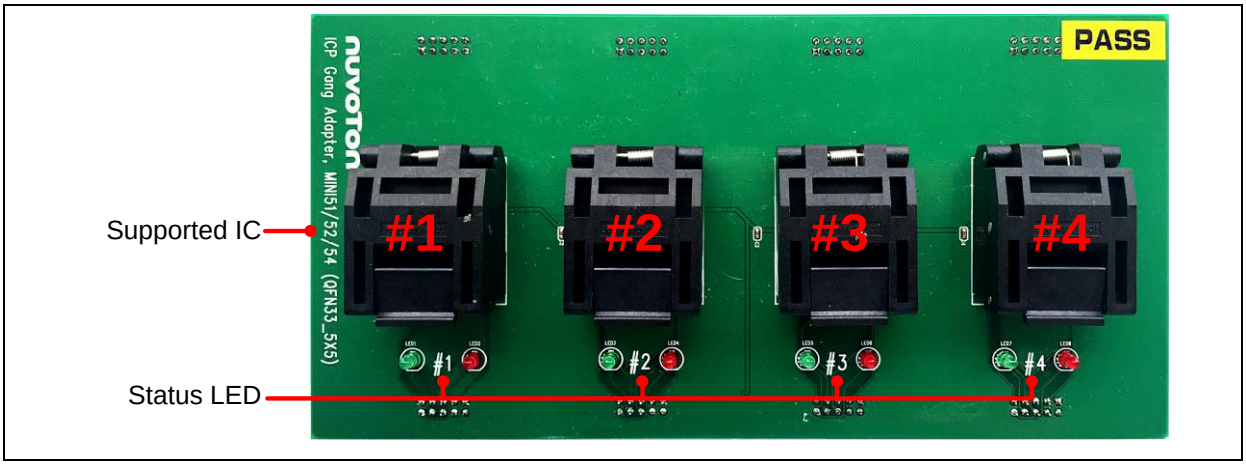


Figure 2-8 Nuvoton ICP Gang Adapter

Programming Unit	#1	#2	#3	#4
Nuvoton ICP Gang Adapter	#1	#2	#3	#4
Status LED on Nuvoton ICP Gang Adapter	LED1 LED2	LED3 LED4	LED5 LED6	LED7 LED8

Table 2-5 Nuvoton ICP Gang Adapter Component List

2.2.1 Status LED

The status LEDs on the Nu-Link-Gang and the Nuvoton ICP Gang Adapter show the programming results of every unit.

Light	Status
Green	PASS
Red	FAIL

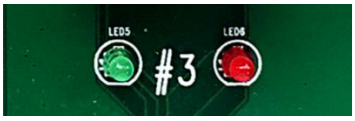


Figure 2-9 Status LED

Table 2-6 Status LED on Nuvoton ICP Gang Adapter

2.3 Nuvoton NUC505 ICP Gang Adapter

The pin 1 of the socket is at the bottom right corner, marked in white arrow. Different packages use different Nuvoton NUC505 ICP Gang Adapters.

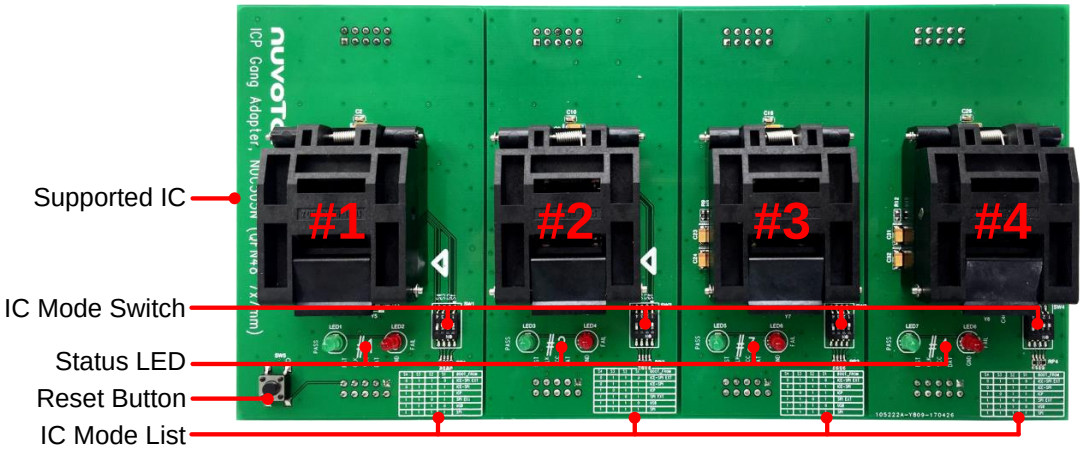


Figure 2-10 Nuvoton NUC505 ICP Gang Adapter

Programming Unit	#1	#2	#3	#4
Nuvoton ICP Gang Adapter	#1	#2	#3	#4
Status LED on Nuvoton ICP Gang Adapter	LED1 LED2	LED3 LED4	LED5 LED6	LED7 LED8
IC Mode Switch on Nuvoton NUC505 ICP Gang Adapter	SW1	SW2	SW3	SW4

Table 2-7 Nuvoton NUC505 ICP Gang Adapter Component List

2.3.1 IC Mode Switch

The IC mode switch on the NUC505 Nuvoton ICP Gang Adapter must be set before programming process. Please refer to chapter 4.

Mode	1	2	3	4
Mode 1	OFF	OFF	ON	OFF
Mode 2	OFF	OFF	OFF	ON

Figure 2-11 IC Mode Switch

Table 2-8 IC Mode Switch

2.3.2 Status LED

The status LEDs on the Nu-Link-Gang and the Nuvoton ICP Gang Adapter show the programming results of every unit.

Light	Status
Green	PASS
Red	FAIL

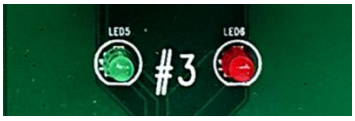


Figure 2-12 Status LED

Table 2-9 Status LED on Nuvoton NUC505 ICP Gang Adapter

3 NU-LINK-GANG PROGRAMMER SETUP

3.1 Choose the Programming Voltage

The Nu-Link-Gang supports three kinds of programming voltage, 1.8 V, 3.3 V, or 5.0 V. Users can choose different programming voltage for each programming unit by setting corresponding programming voltage switch. Please sets the programming voltage before the Nu-Link-Gang power on.

3.2 Set the Programming Mode

Switch the programming mode to single-start or all-start.

3.3 Load Firmware Image Files through NuMicro® ICP Programming Tool

Please access Nuvoton NuMicro® website (http://www.nuvoton.com/NuMicro) to download the NuMicro ICP tool - ICP Programming Tool. Unzip the file and execute “NuMicro ICP Programming Tool.exe”. Please refer to section 3.3.1 and 3.3.2 for the detailed flow. For more information, please refer to the “Nuvoton NuMicro ICP Programmer User Guide”.

3.3.1 Connect to ICP Programming Tool

Connects one programming unit’s to PC through USB connector as Figure 3-1, then open the ICP Programing Tool on the PC.

Figure 3-1 Nu-Link-Gang Connects to PC

3.3.2 ICP Programming Tool Setting

1. Choose “Connect”. The window will shows “NuLink connected” when the connection between programming unit and ICP Programming Tool is built.

2. Load the firmware image files to the corresponding flash region.
3. Set the Config Bits by the using IC series.
4. Select the programming area.
5. Set the program option. It is necessary to select the “Offline Programming Mode” option.
6. Click “Start”. The ICP Programming Tool will start loading the firmware image files to the Nu-Link-Gang.

User needs to repeat section 3.3.1 and 3.3.2 to load firmware image file to every programming unit.

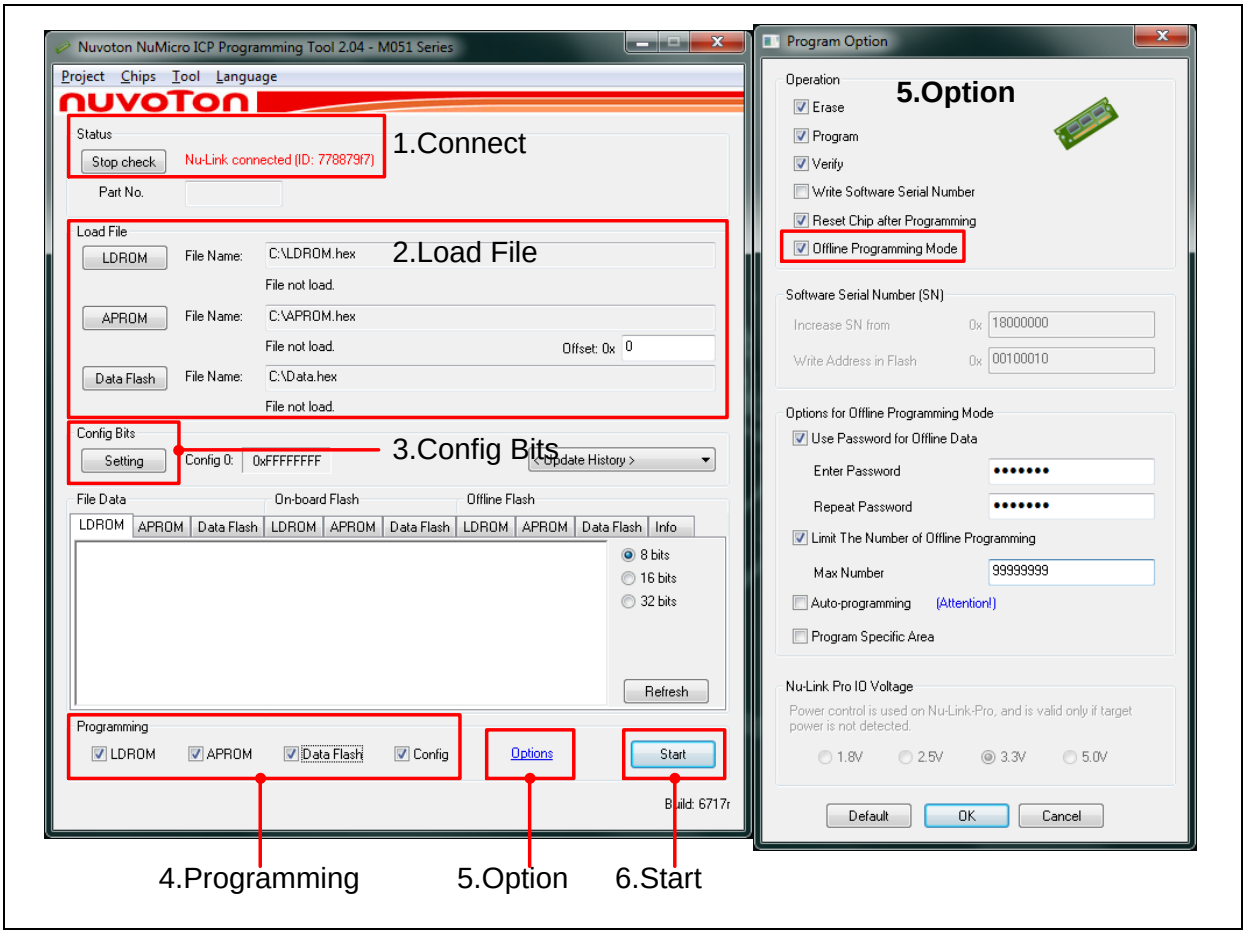


Figure 3-2 ICP Programming Tool Setting

3.3.3 Import/Export Project

The user settings of the ICP Programming Tool can be save and load by import or export the .icp project file. It can also do the binary code protection through exporting with a ceritificate.

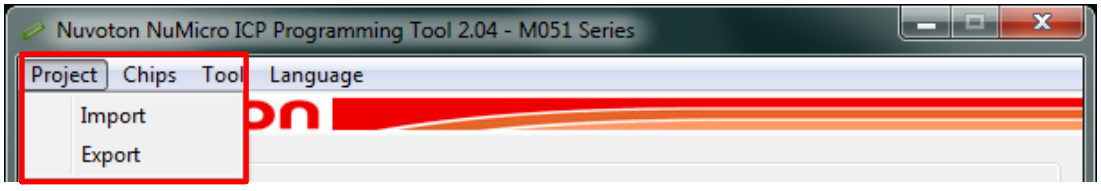


Figure 3-3 ICP Programming Tool Import/Export Project

3.4 Connect to the Target Chip

3.4.1 Nuvoton ICP Gang Adapter

Connect the Nuvoton ICP Gang Adapter to Nu-Link-Gang as Figure 3-4. Put the target chip into the socket. Pin 1 is on the bottom-left hand side.

Figure 3-4 Nuvoton ICP Gang Adapter with Nu-Link-Gang

3.4.2 Customized Adapter Board

Follow Figure 3-5 to connect the adapter board and the Nu-Link-Gang slot. The slot VCC pin voltage is set by the programming voltage switch.

The recommended wiring between adapter board and the Nu-Link-Gang is using stranded conductors with AWG size 24 and length 50 cm.

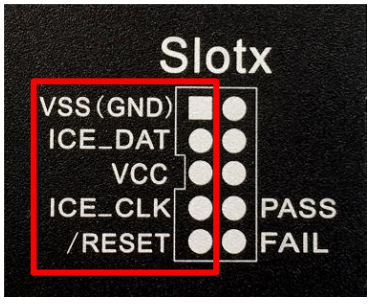


Figure 3-5 Slot Pin Description

3.5 Start Programming

3.5.1 Programming

Plug-in a 9V/1A power adapter to the Nu-Link-Gang and press the Power button once as Figure 3-6.

Figure 3-6 Nu-Link-Gang Power On

1. To start the programming process, press the Start ALL button or the individual Start button depends on the programming mode switch setting.
2. The status LEDs on the Nu-Link-Gang and the Nuvoton ICP Gang Adapter will show the programming results of every unit.
   - Green light: PASS.
   - Red light: FAIL.
3. Change the target chip in the adapter, and repeat section 3.5 process.

3.5.2 LCD Display

Users can switch pages by pressing buttons to show the individual programming unit's status and information. There are four pages:

- Page 1: Shows all four units programming status includes programming times and programming voltage as Figure 3-7. Press Enter button to go to the next page.
- Page 2: Programming unit selection page as Figure 3-8. Press Select button to choose the unit. The choosen unit is high-lighted in yellow. Press Enter button to go to the next page.

- Page 3: Shows programming unit Information as Figure 3-9. List the programming chip's part number, programming unit's version number, maximum programmable times, PASS/FAIL status records, and error code. Press Enter button to go to the next page.
- Page 4: Shows programming unit Information as Figure 3-10. List the checksum data of every programming area, and config bits. The checksum data and config bits are the same as the data in ICP Programming Tool. Press Enter button to go to page 1.

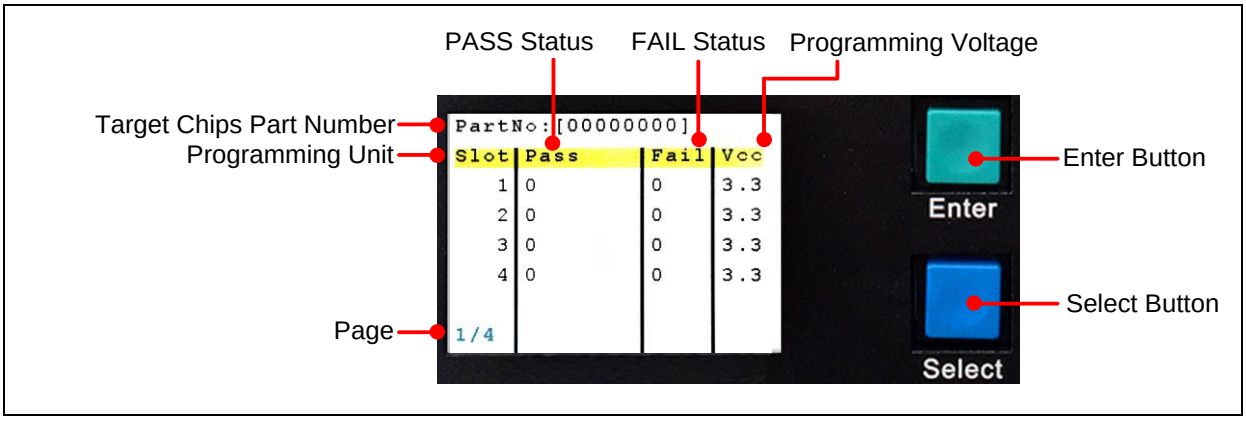


Figure 3-7 Page 1 – Programming Status

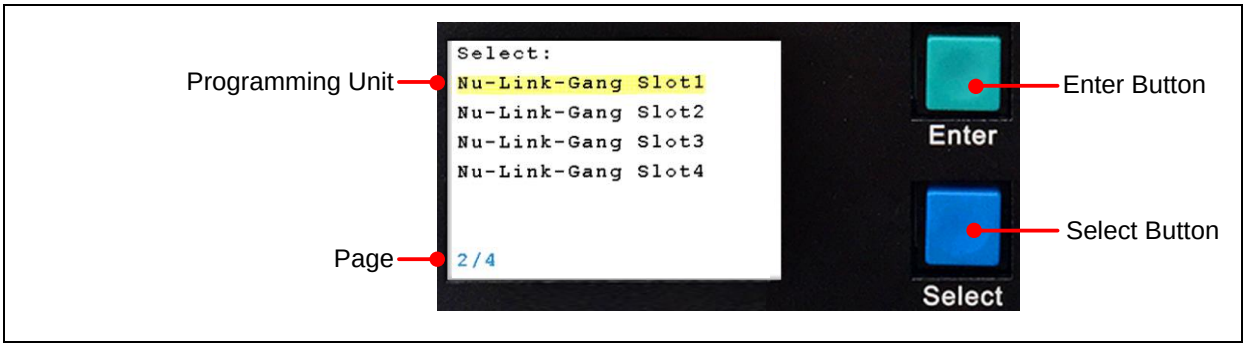


Figure 3-8 Page 2 - Programming Unit Selection Page

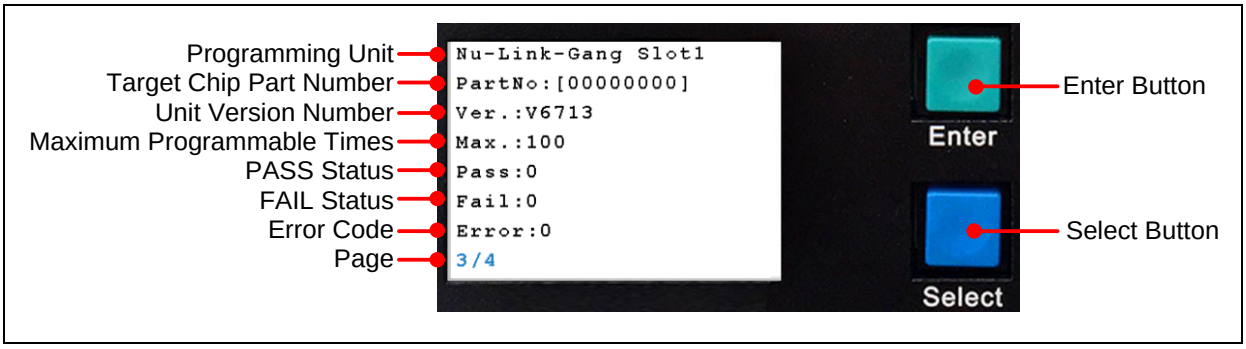


Figure 3-9 Page 3 - Programming Unit Information

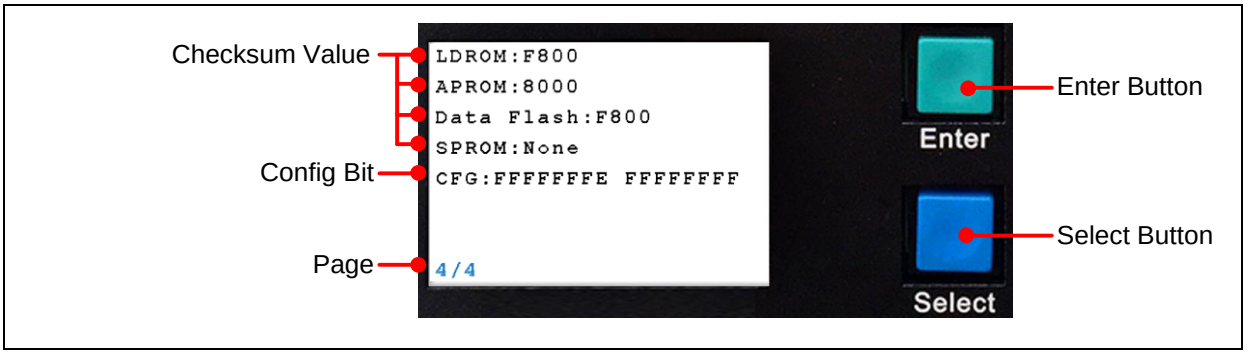


Figure 3-10 Page 4 - Programming Unit Information

Connects the Nu-Link-Gang to the target chip before to the computer, and then config the ICP Programming Tool as 3.3, the part number of the target chips will shows on the LCD display as Figure 3-11 and Figure 3-12.

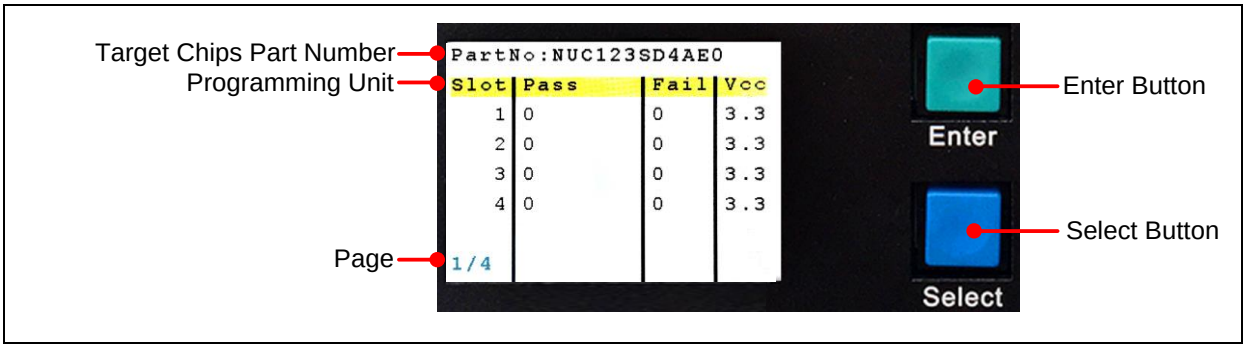


Figure 3-11 All Four Target Chips are the Same Part Number

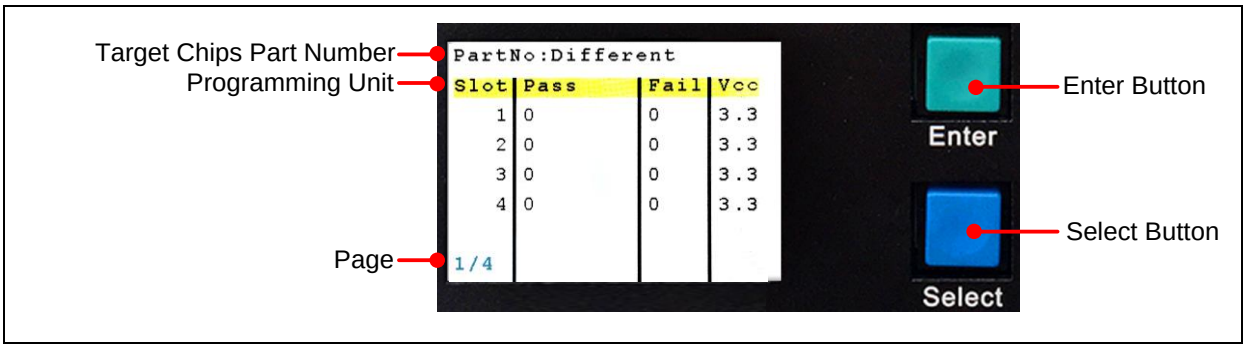


Figure 3-12 At Least One Different Part Number Target Chip

4 NU-LINK-GANG PROGRAMMER SETUP FOR NUC505 SERIES

4.1 Choose the Programming Voltage

The Nu-Link-Gang supports three kinds of programming voltage, 1.8 V, 3.3 V, or 5.0 V. Users can choose different programming voltage for each programming unit by setting corresponding programming voltage switch. Please sets the programming voltage before the Nu-Link-Gang power on.

4.2 Set the Programming Mode

Switch the programming mode to single-start or all-start.

4.3 Connect to the Target Chip

4.3.1 Nuvoton NUC505 ICP Gang Adapter

Connect the Nuvoton NUC505 ICP Gang Adapter to Nu-Link-Gang as Figure 4-1. Put the target chip into the socket. Pin 1 is on the bottom-right hand side, marked in white arrow.

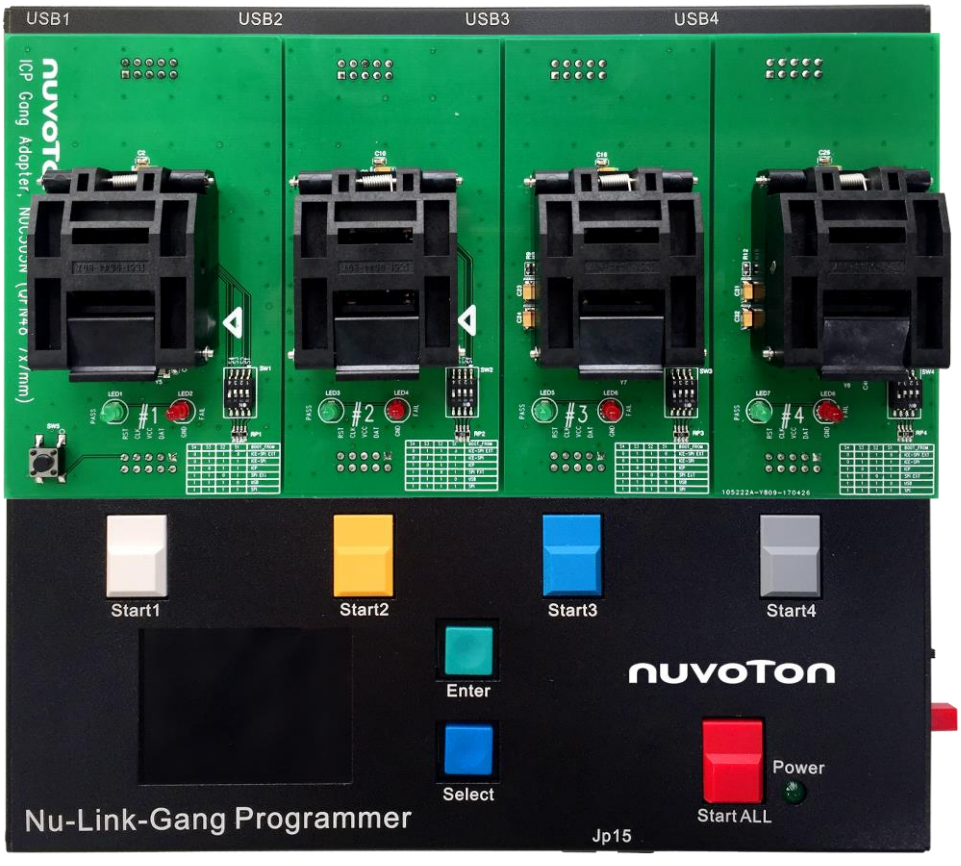


Figure 4-1 Nuvoton NUC505 ICP Gang Adapter with Nu-Link-Gang

4.3.2 Customized Adapter Board

Follow Figure 4-2 to connect the adapter board and the Nu-Link-Gang slot. The slot VCC pin voltage is set by the programming voltage switch.

The recommended wiring between adapter board and the Nu-Link-Gang is using stranded conductors with AWG size 24 and length 50 cm.

Customized adapter board for NUC505 must have IC mode switch and Reset button function. If users have customized adapter board demand, please contact Nuvoton Technology Corporation for adapter board specifications.

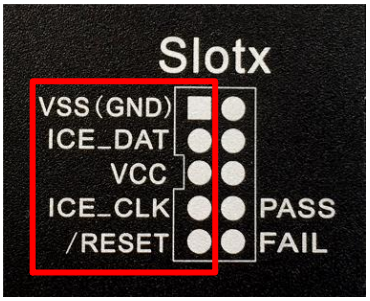


Figure 4-2 Slot Pin Description

4.4 IC Mode Switch

Switch four programming units' IC mode to Mode 1 on the Nuvoton NUC505 ICP Gang Adapter as Figure 4-3.

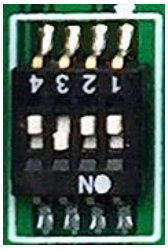


Figure 4-3 IC Mode in Mode 1

4.5 Load Firmware Image Files through NuMicro® ICP Programming Tool

Please access Nuvoton NuMicro® website (http://www.nuvoton.com/NuMicro) to download the NuMicro ICP tool - ICP Programming Tool. Unzip the file and execute "NuMicro ICP Programming Tool.exe". Please refer to section 4.5.1 and 4.5.2 for the detailed flow. For more information, please refer to the "Nuvoton NuMicro ICP Programmer User Guide".

4.5.1 Connect to ICP Programming Tool

Connects one programming unit's to PC through USB connector as Figure 4-4. Press the Reset button on the Nuvoton NUC505 ICP Gang Adapter, and then open the ICP Programing Tool on the PC.

Figure 4-4 Nu-Link-Gang Connects to PC

4.5.2 ICP Programming Tool Setting

1. Choose “Connect”. The window will shows “NuLink connected” when the connection between programming unit and ICP Programming Tool is built.
2. Load the firmware image files to the corresponding flash region.
3. Set the program option. It is necessary to select the “Offline Programming Mode” option.
4. Click “Start”. The ICP Programming Tool will start loading the firmware image files to the Nu-Link-Gang.

User needs to repeat section 4.5.1 and 4.5.2 to load firmware image file to every programming unit.

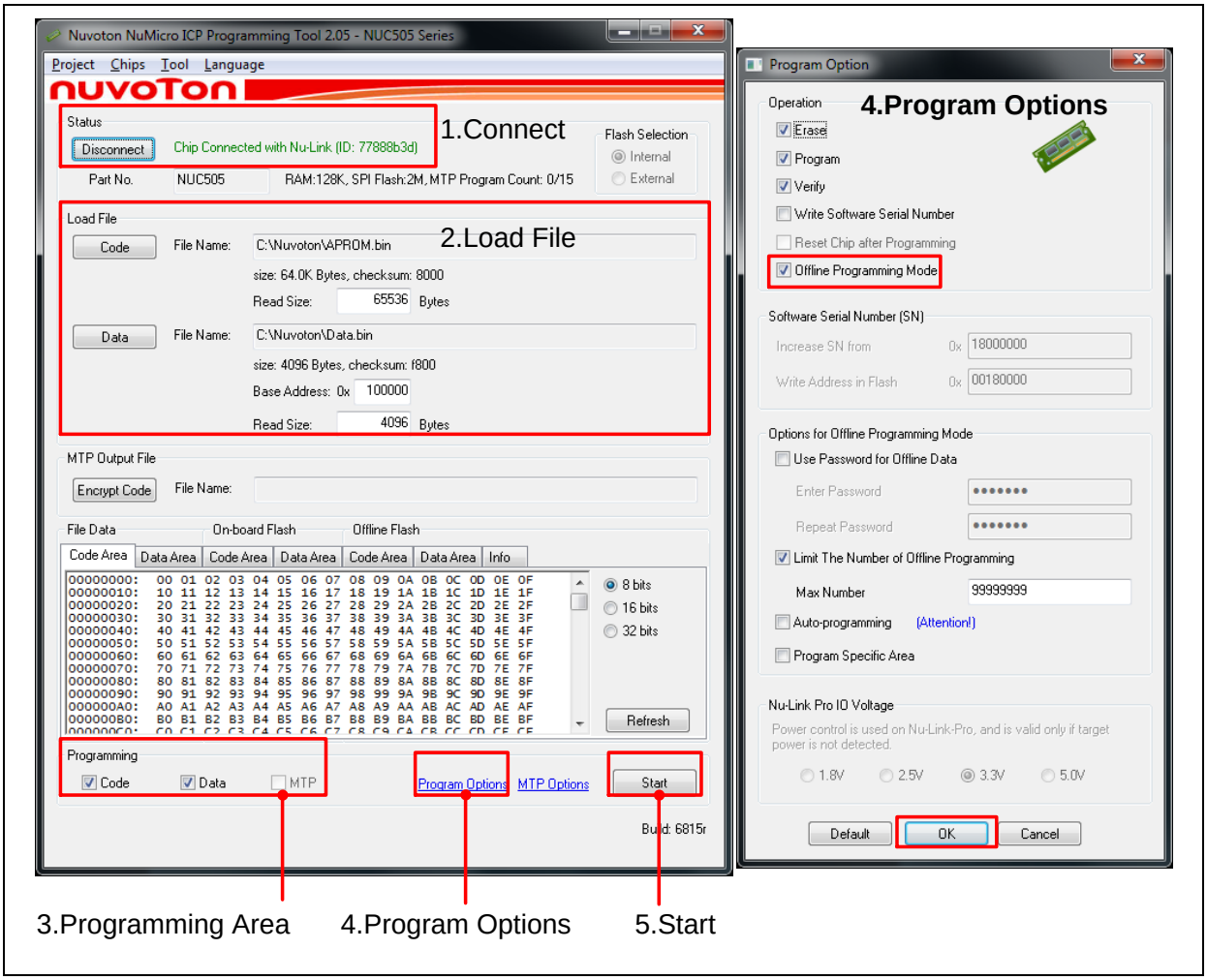


Figure 4-5 ICP Programming Tool Setting

4.5.3 Import/Export Project

The user settings of the ICP Programming Tool can be save and load by import or export the .icp project file. It can also do the binary code protection through exporting with a ceritificate.

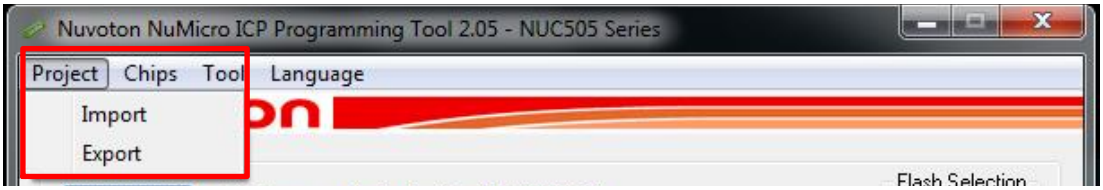


Figure 4-6 ICP Programming Tool Import/Export Project

4.6 IC Mode Switch

Switch four programming units' IC mode to Mode 2 on the Nuvoton NUC505 ICP Gang Adapter as Figure 4-7.

Figure 4-7 IC Mode in Mode 2

4.7 Start Programming

4.7.1 Programming

Plug-in a 9V/1A power adapter to the Nu-Link-Gang and press the Power button once as Figure 4-8, and press the Reset button on the Nuvoton NUC505 ICP Gang Adapter.

Press the Start ALL button or the individual Start button depends on the programming mode switch setting to start the programming process. The status LEDs on the Nu-Link-Gang and the Nuvoton NUC505 ICP Gang Adapter will show the programming results of every unit. Change the target chip in the adapter, and repeat section 4.6 process.

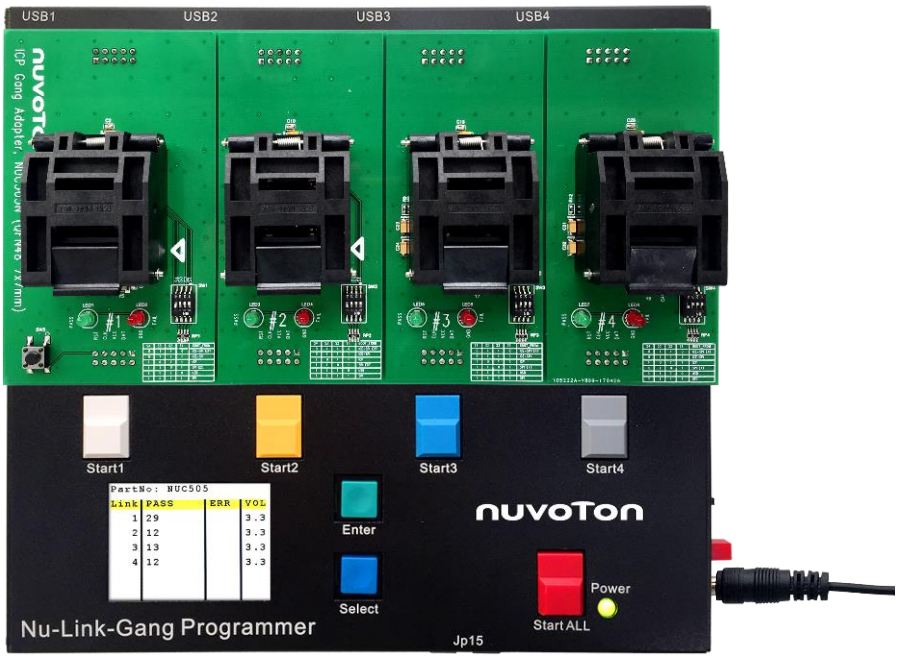


Figure 4-8 Nu-Link-Gang Power On

4.7.2 LCD Display

LCD display shows four units programming status includes programming times and programming voltage as Figure 4-9. The LCD control buttons function please refer to section 3.5.2.

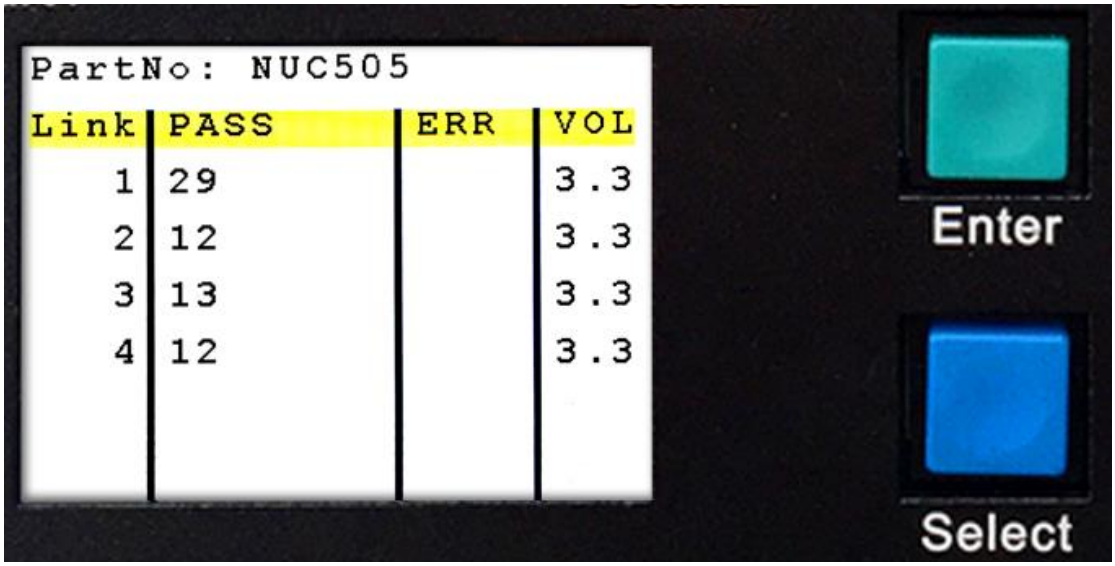


Figure 4-9 LCD Display

5 NU-LINK-GANG PROGRAMMER SETUP FOR AUTOMATIC IC PROGRAMMING SYSTEM

5.1 Software and Hardware Setup

Follow section 3.1 and 3.3 to setup the programming voltage and firmware image file for four programming units individually. Switch the programming mode to single-start.

5.1.1 Connection

Each programming units connects to the automatic IC programming system through individual slot and the control bus as Figure 5-1.

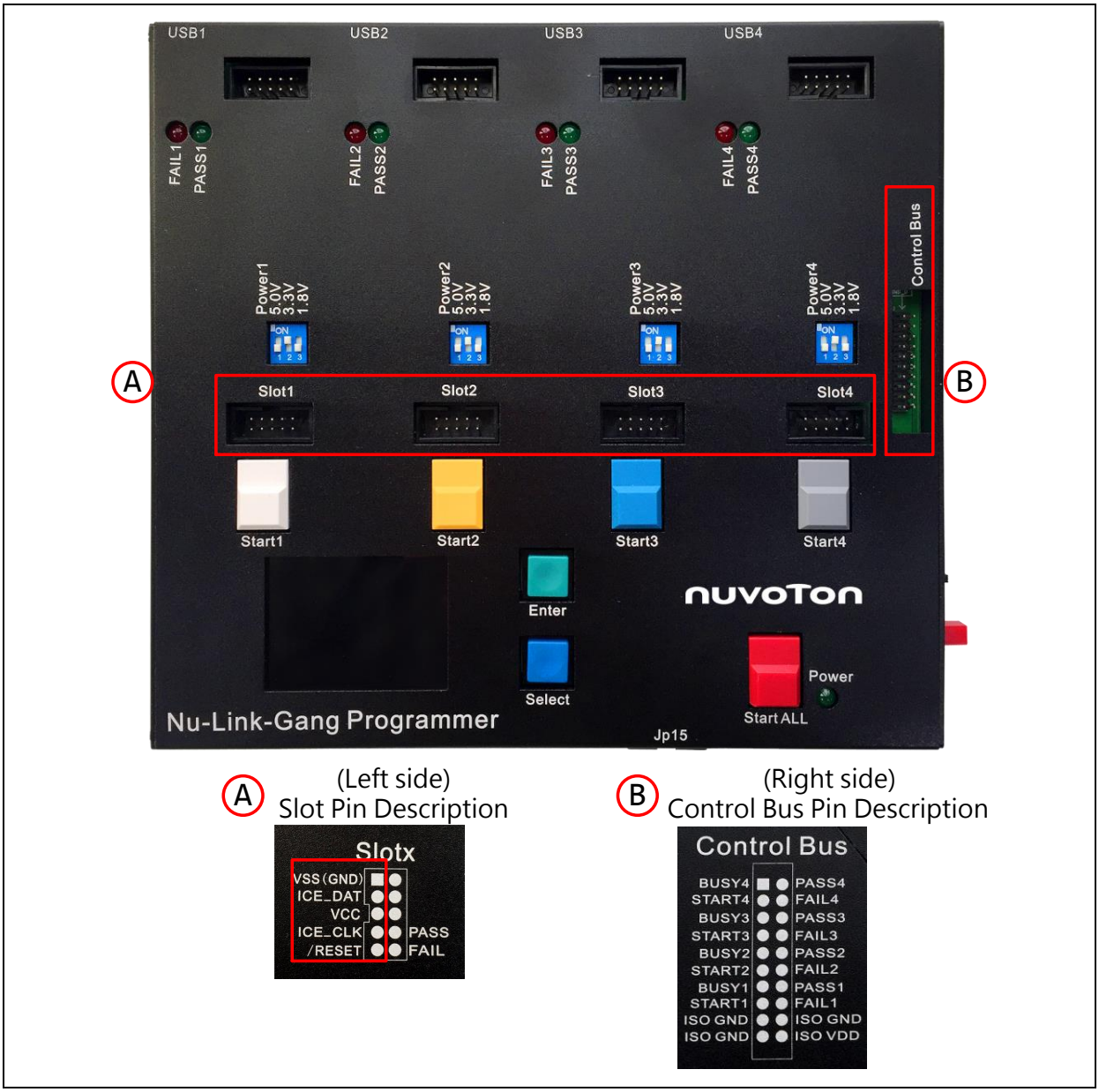


Figure 5-1 Automatic IC Programming System Connection

5.1.2 Waveform

1. The Nu-Link-Gang power on. STARTx, BUSYx, PASSx, and FAILx are set to logic 1.
2. To start programming, STARTx needs to be set to logic 0 for TSTART, $50\text{ms} \leq T_{START} \leq 80\text{ms}$.
3. Programming start-up. BUSYx is set to logic 0 , and might toggle during programming.
4. When finish programming, BUSYx is set to logic 1, and PASSx or FAILx is set to logic 0.
   - When BUSYx is set to logic 1, and PASSx is set to logic 0, means “PASS”.
   - When BUSYx is set to logic 1, and FAILx is set to logic 0, means “FAIL”.

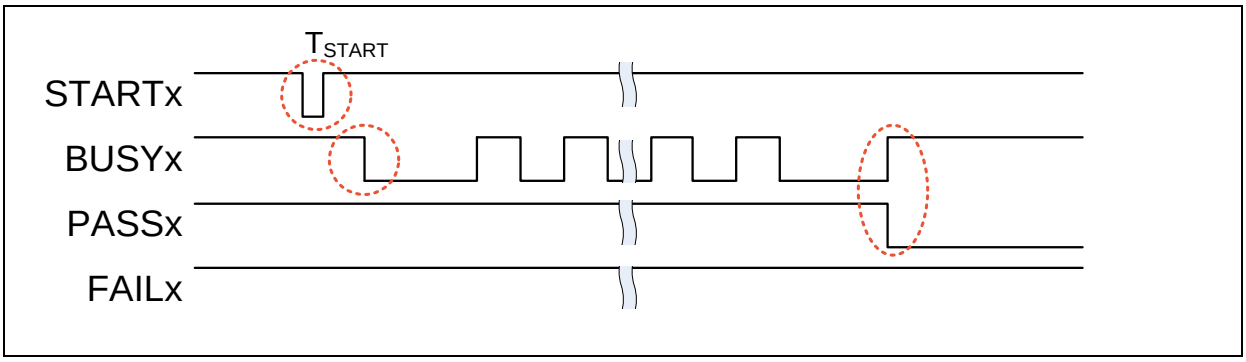


Figure 5-2 PASS Waveform

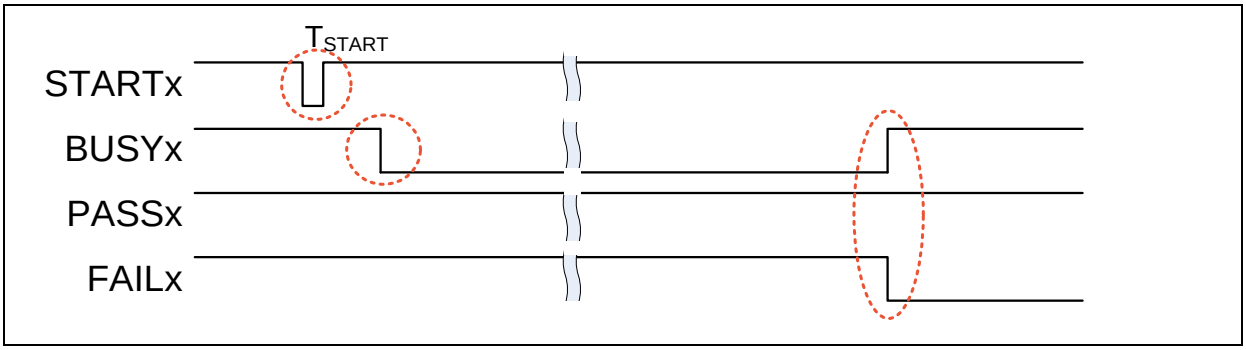
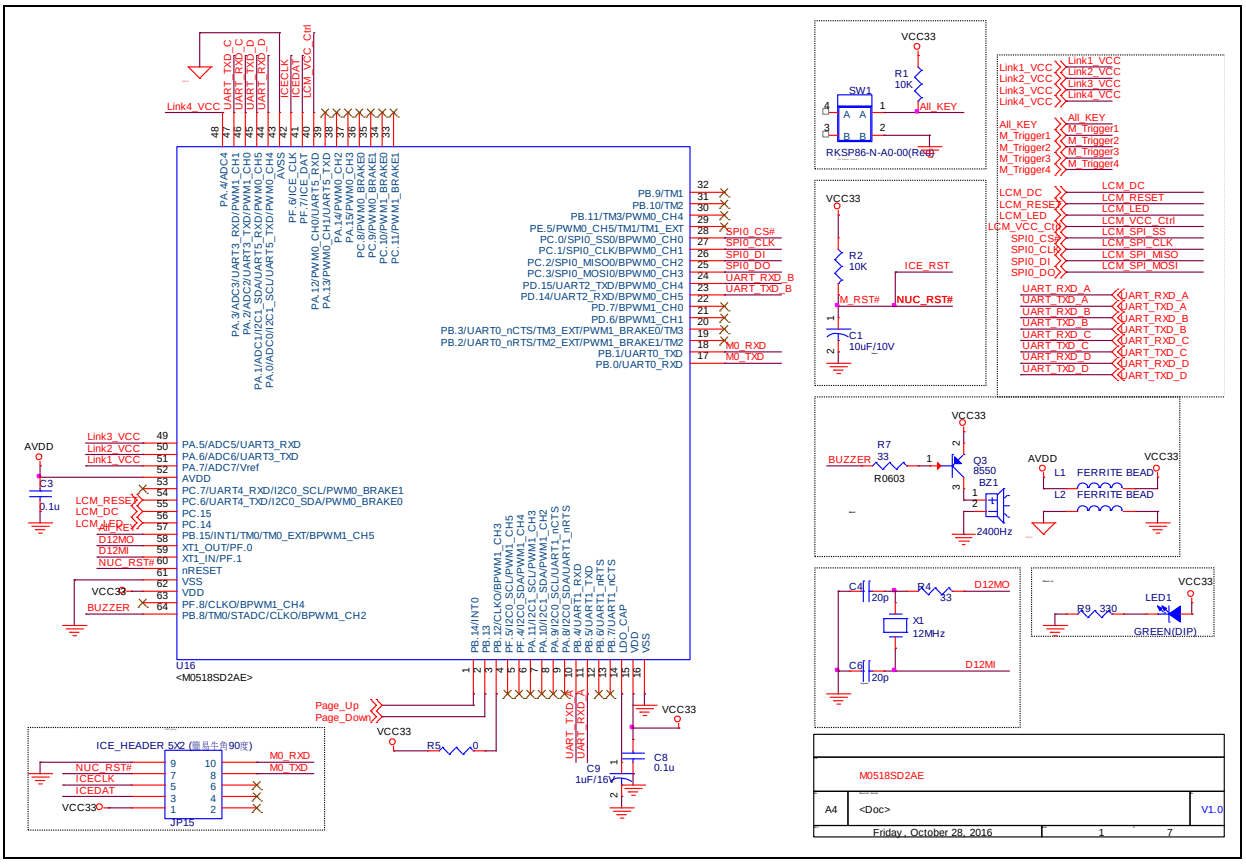


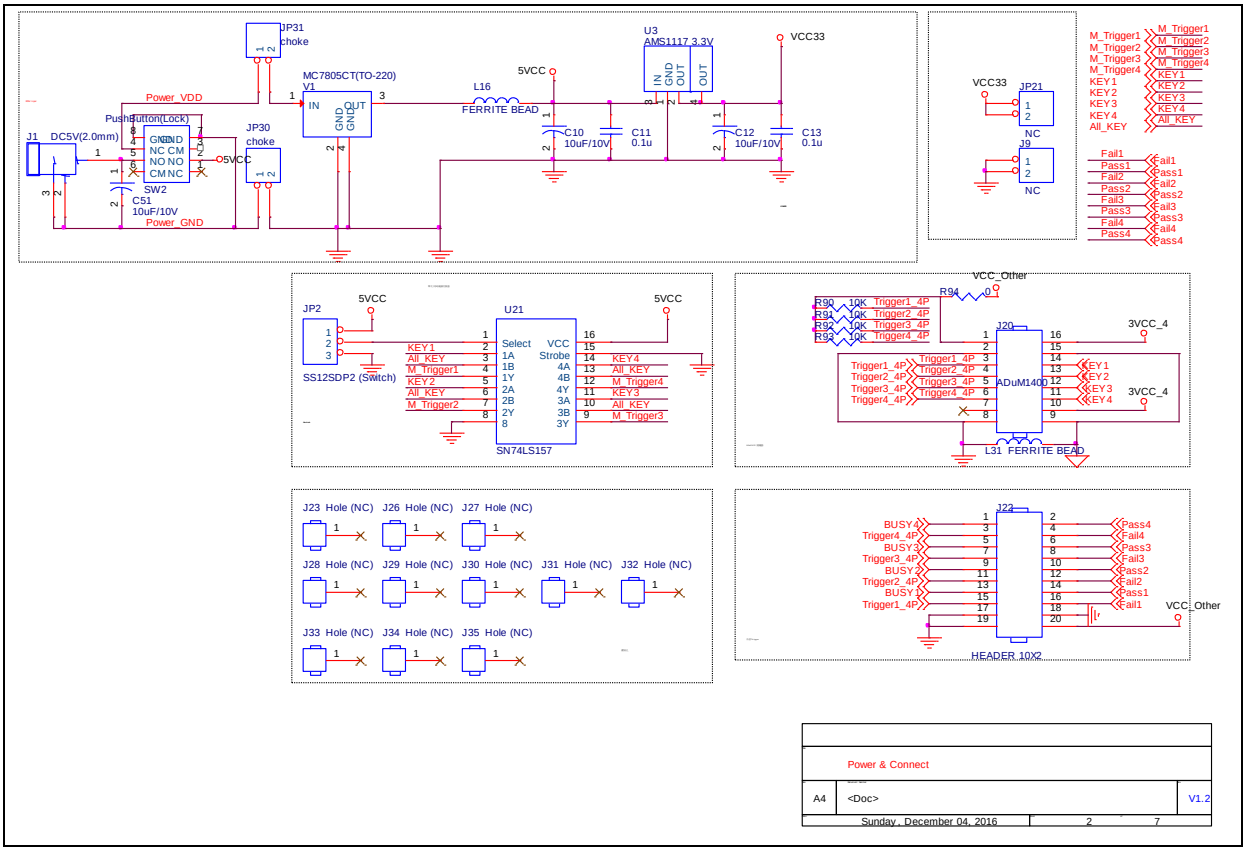
Figure 5-3 FAIL Waveform

6 NU-LINK-GANG PCB SCHEMATIC

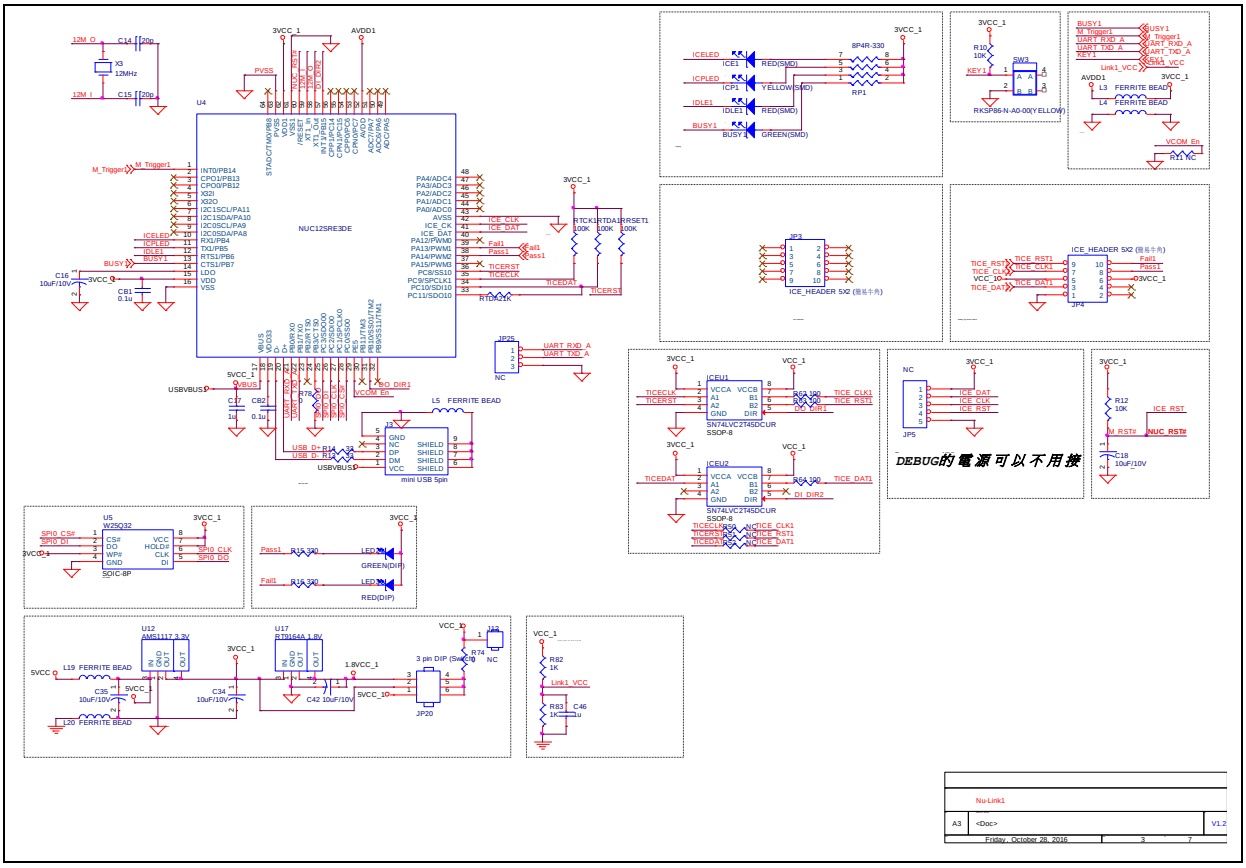
6.1 Control Unit Schematic



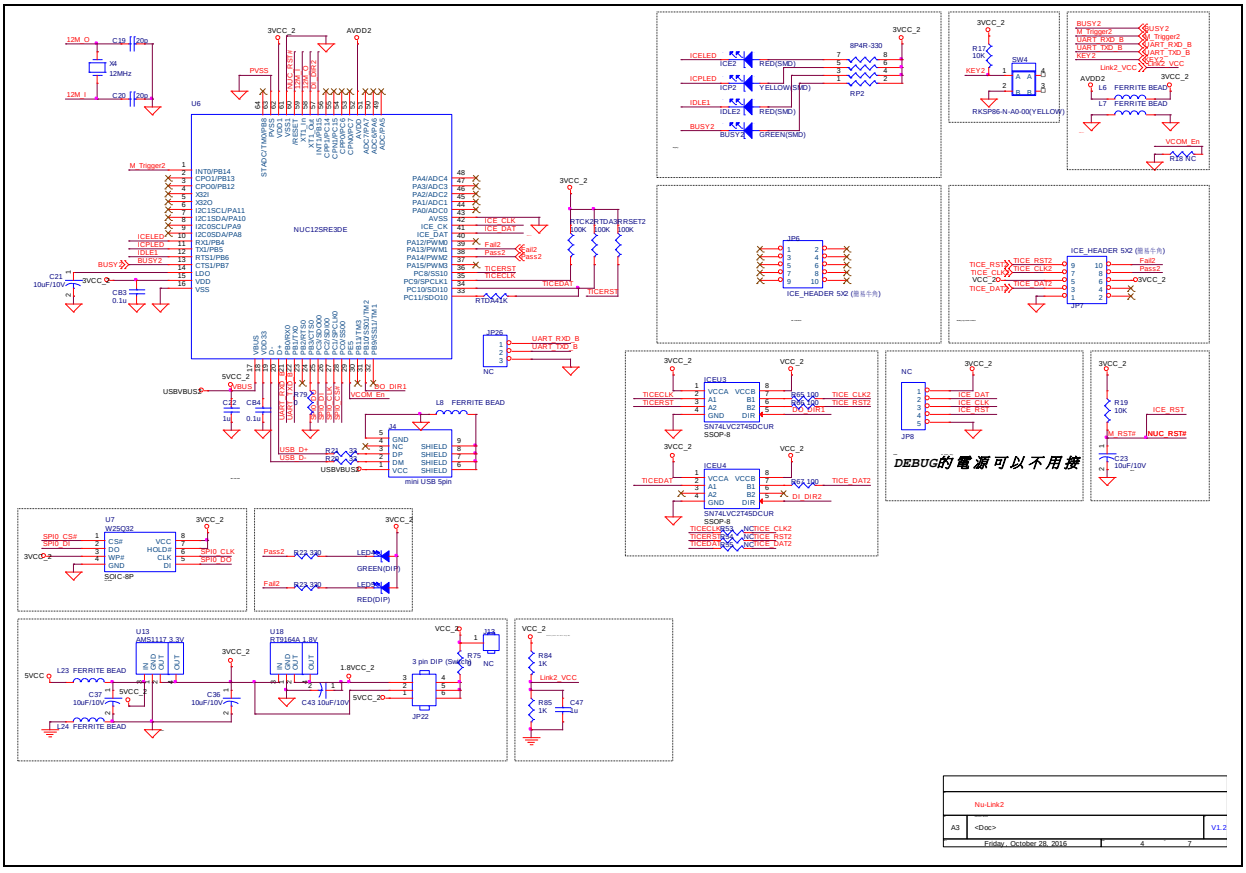
6.2 Power and Connection Schematic



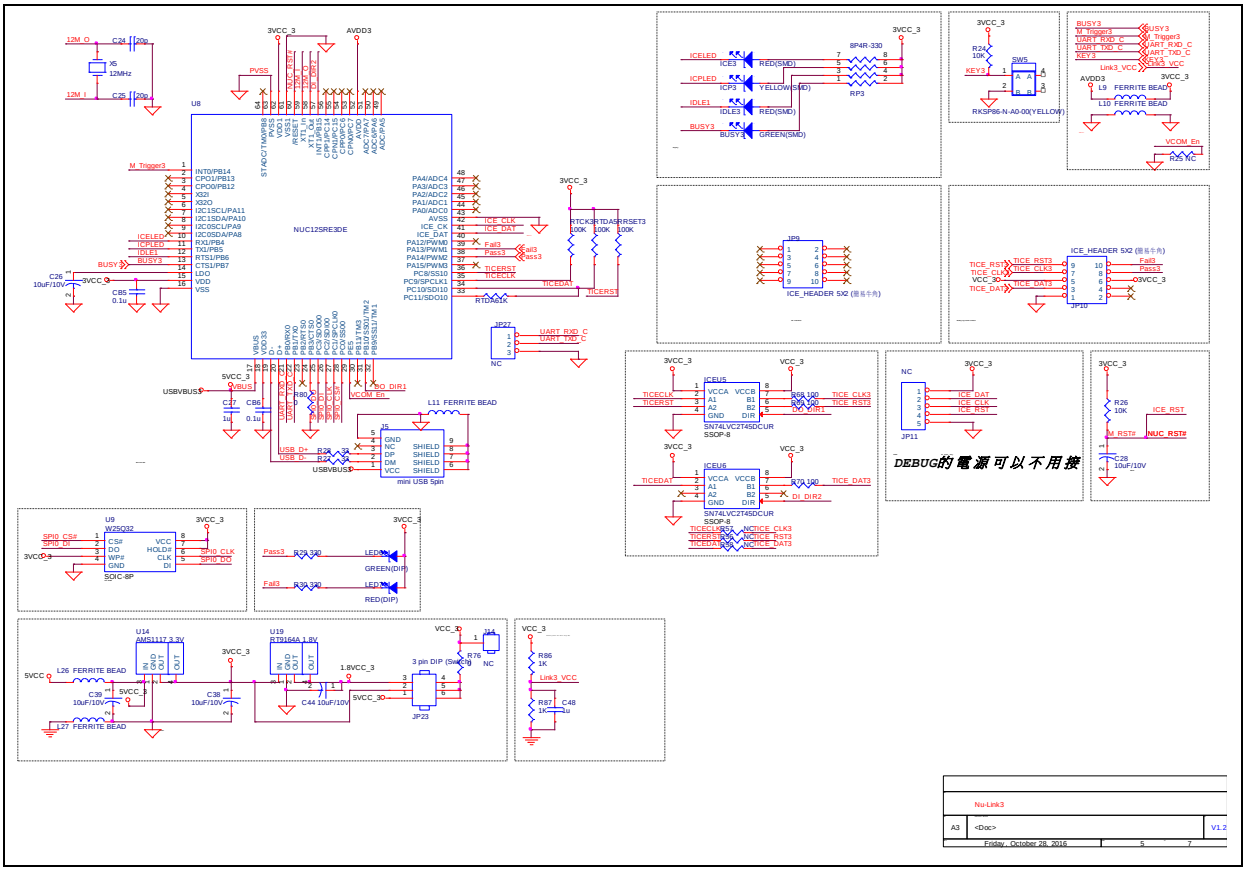
6.3 #1 NuLink Schematic



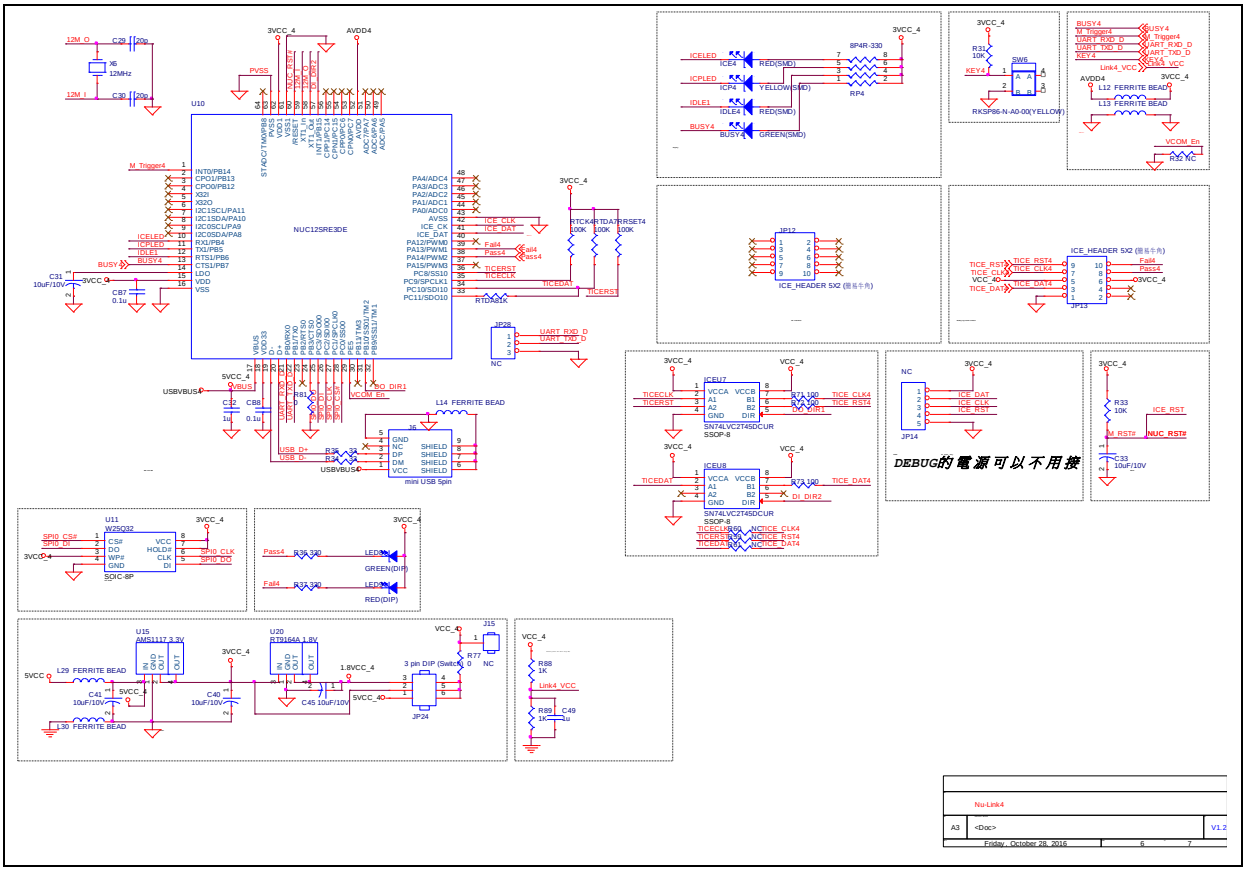
6.4 #2 NuLink Schematic



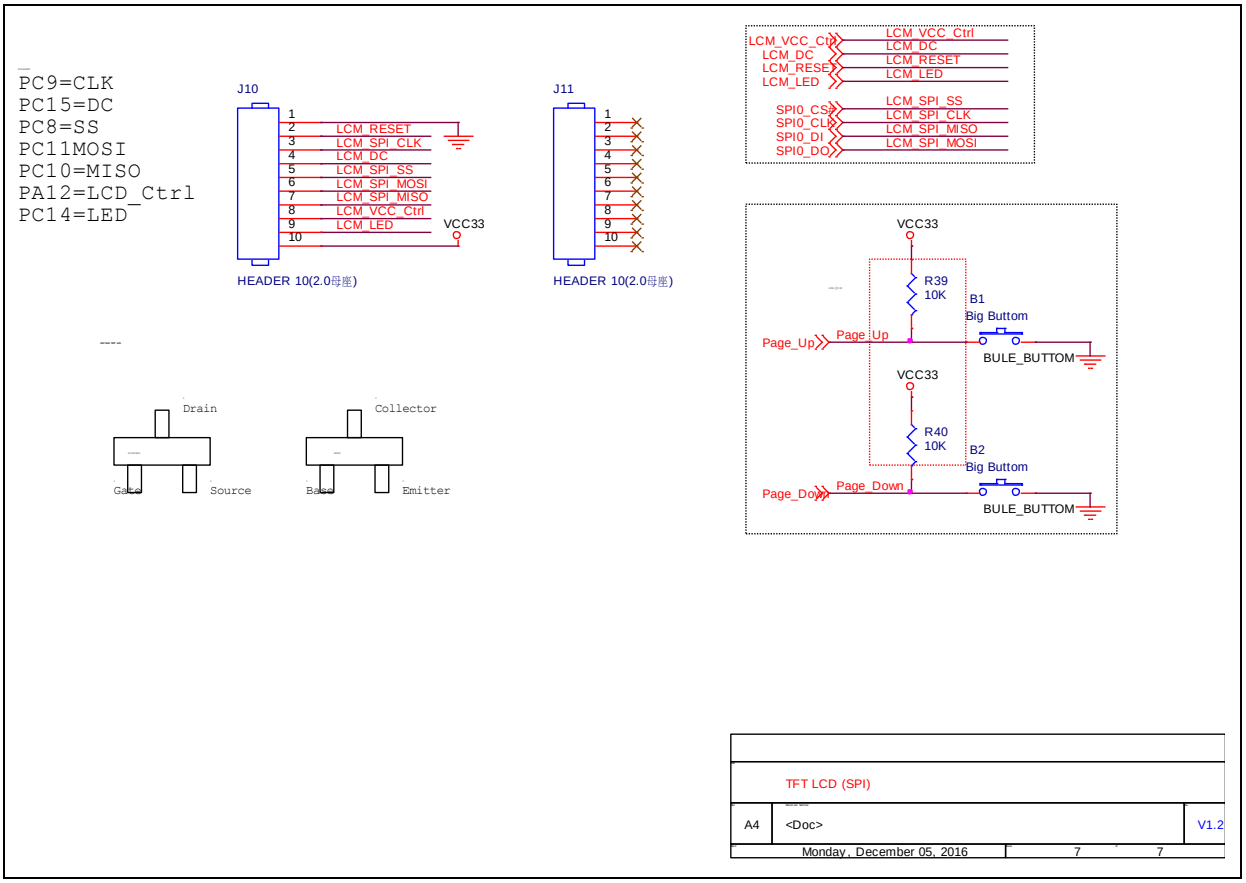
6.5 #3 NuLink Schematic



6.6 #4 NuLink Schematic



6.7 LCD Display Schematic



7 TROUBLESHOOTING

7.1 Pop-up Warning Message When Programming NUC505 Series

When pop-up warning message shows as Figure 7-1 while programming NUC505 series, please check all four programming units' IC mode is set to Mode 1 on the Nuvoton NUC505 ICP Gang Adapter and press Reset button. If the warning message still pop-up, please check the NUC505 chip is placed currectly.

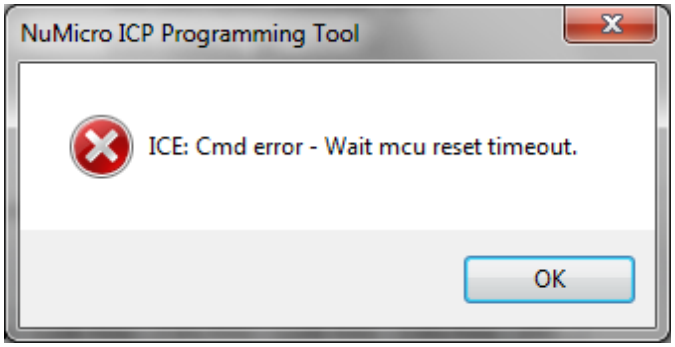


Figure 7-1 Pop-up Warning Message

7.2 Nu-Link-Gang Firmware Update

The Jp15 interface is to update the Nu-Link-Gang firmware provided by Nuvoton.

Note: When update the Nu-Link-Gang firmware, please update the programming units firmware to the lastest version as well.

7.3 Programming Unit Firmware Update

It is recommended to update the ICP Programming Tool to the lastest version. Connects the programming unit to ICP Programming Tool as section 3.3.1 and 3.3.2, the ICP Programming Tool will check the programming unit firmware version. The warning message as Figure 7-2 pops up when ICP Programming Tool starts updating programming unit. By following the tips shown by pop-up windows as Figure 7-2 and Figure 7-3, users can update the programming units' firmware.

Note 1: When update the programming units firmware, please update the Nu-Link-Gang firmware to the lastest version as well.

Note 2: Please update all four programming units firmware to the same version.

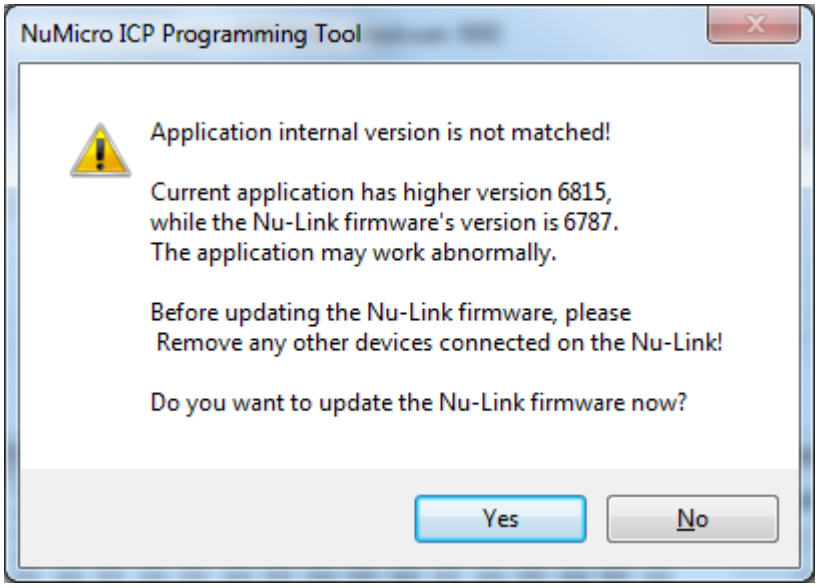


Figure 7-2 Pop-up Warning Message

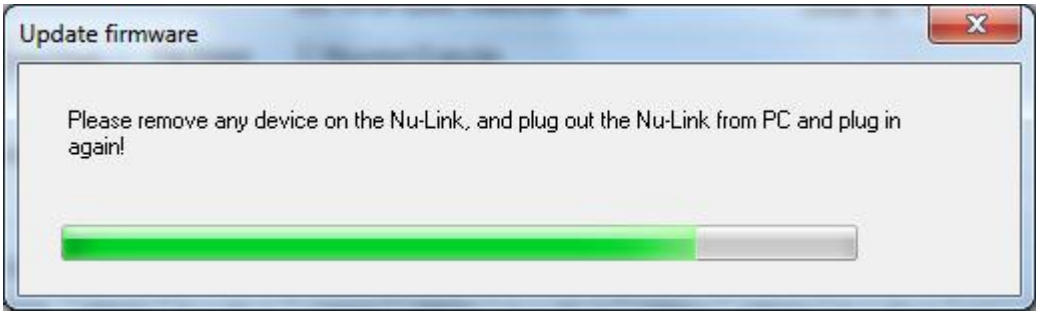


Figure 7-3 Programming Unit Firmware Update

8 REVISION HISTORY

Date	Revision	Description
2019.12.23	1.00	1. Preliminary version.

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