NL-NAU88C22

User Manual

Evaluation Board for NAU88C22

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

www.nuvoton.com

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1 OVERVIEW

The NL-NAU88C22 is the evaluation board for NAU88C22. This board is developed for users to quickly understand the characteristics of NAU88C22. For development flexibility, this board has a built-in 3.5mm jacks and additional expansion connectors that provide the audio signal input, output, speaker output, headphone output and digital interface. For development convenience, NL-NAU88C22 can be connected with speakers or directly to customized system.

Nuvoton has also developed a USB control board, NU-NAUSB2I2C, which provides I^{2}C control interface and digital audio interface signals. Along with the software NuvotonAudioGUI, users can quickly set up and use NL-NAU88C22 on their PCs.

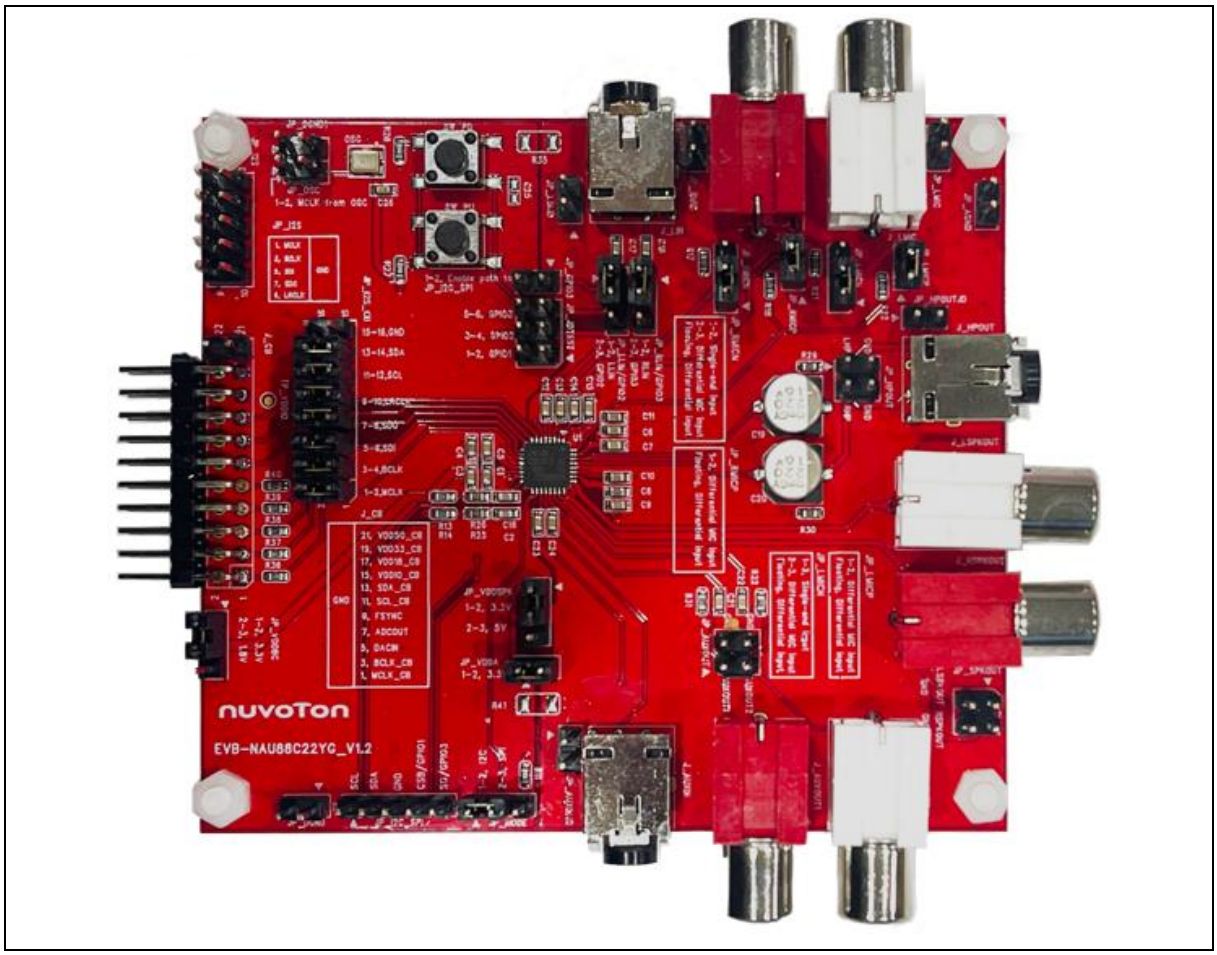

Figure 1-1 NL-NAU88C22 Evaluation Board

NL-NAU88C22 compatible ICs:

- NAU88C22YG
- NAU8822AYG
- NAU88U22AYG

2 HARDWARE CONFIGURATION

2.1 NL-NAU88C22 Front View

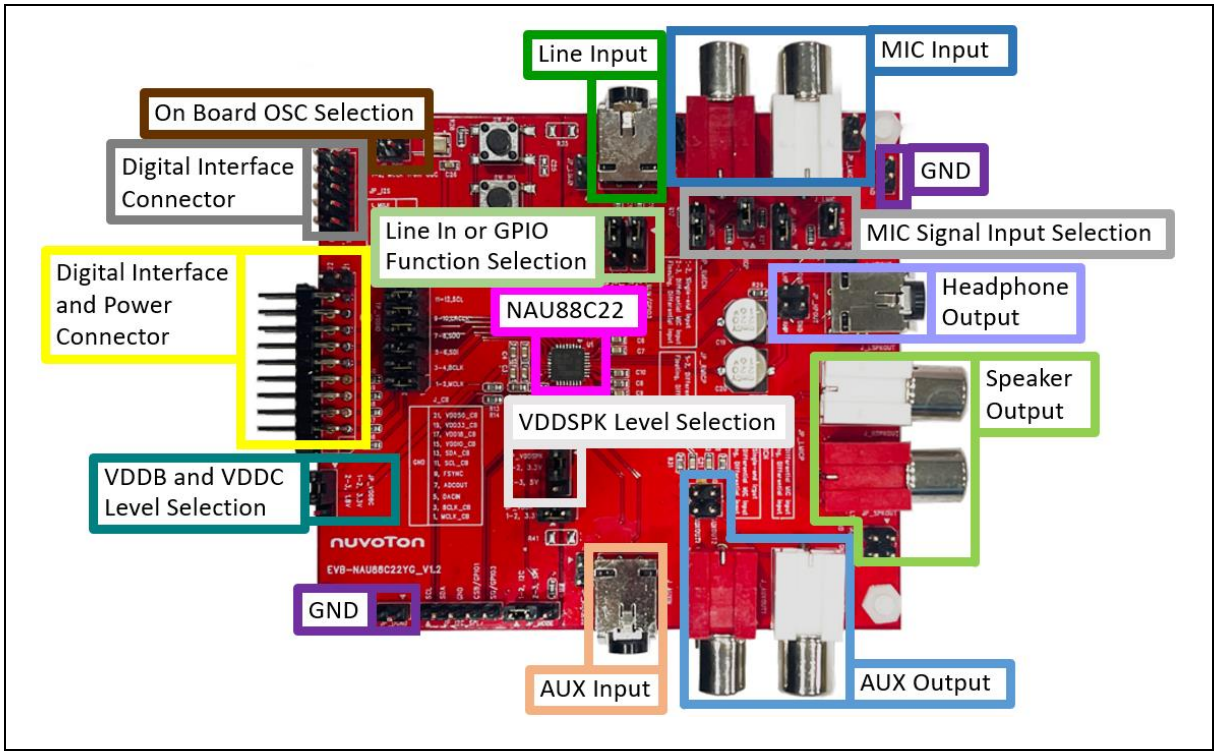

Figure 2-1 Front View of NL-NAU88C22

Figure 2-1 shows the main components and connectors from the front side of NL-NAU88C22 as the following list:

- Target Chip: NAU88C22 (U1)
- RCA Terminals and Additional Connectors for MIC Input
- 3.5mm Jack for Line In
- 3.5mm Jack and Additional Connectors for Headphone Output
- RCA Terminals and Additional Connectors for Speaker Output
- RCA Terminals and Additional Connectors for AUX Output
- 3.5mm Jack for AUXIN
- On Board 12.288M OSC (12.288M Hz) for MCLK Pin
- Major Digital Interface and Power Extension Connector
- Digital Interface Extension Connector
- Line In or GPIO Function Selection
- MIC Signal Input Type Selection
- VDDSPK Level Selection
- VDDB and VDDC Level Selection

2.2 NL-NAU88C22 Connectors

Table 2-1 describes the connectors on NL-NAU88C22. Users can also refer to Figure 2-1.

Header		NL-NAU88C22	
		Net Name in Schematic	Description
J_CB	J_CB.1	MCLK_CB	CODEC External Master Clock Source Input
	J_CB.2	DGND	GND
	J_CB.3	BCLK_CB	Serial Data Bit Clock Input / Output for I^{2}S / PCM Data
	J_CB.4	DGND	GND
	J_CB.5	DACIN	Serial Audio Data Input for I^{2}S / PCM Data
	J_CB.6	DGND	GND
	J_CB.7	ADCOUT	Serial Audio Data Output for I^{2}S / PCM Data
	J_CB.8	DGND	GND
	J_CB.9	FSYNC	Frame Sync Input / Output for I^{2}S / PCM Data
	J_CB.10	DGND	GND
	J_CB.11	SCL_CB	Serial Data Clock for I^{2}C
	J_CB.12	DGND	GND
	J_CB.13	SDA_CB	Serial Data for I^{2}C
	J_CB.14	DGND	GND
	J_CB.15	VDDIO_CB	VDDIO
	J_CB.16	DGND	GND
	J_CB.17	VDD18_CB	1.8V Power Supply
	J_CB.18	DGND	GND
	J_CB.19	VDD33_CB	3.3V Power Supply
	J_CB.20	DGND	GND
	J_CB.21	VDD50_CB	5V Power Supply
	J_CB.22	DGND	GND

Header		NL-NAU88C22	
		Net Name in Schematic	Description
JP_I2S	JP_I2S.1	MCLK	CODEC External Master Clock Source Input
	JP_I2S.2	DGND	GND
	JP_I2S.3	BCLK	Serial Data Bit Clock Input / Output for I^2S / PCM Data
	JP_I2S.4	DGND	GND
	JP_I2S.5	SDI	Serial Audio Data Input for I^2S / PCM Data
	JP_I2S.6	DGND	GND
	JP_I2S.7	SDO	Serial Audio Data Output for I^2S / PCM Data
	JP_I2S.8	DGND	GND
	JP_I2S.9	LRCLK	Frame Sync Input / Output for I^2S / PCM Data
	JP_I2S.10	DGND	GND
JP_LMIC	JP_LMIC.1	LMICP_CON	Left Channel MIC Positive Input
	JP_LMIC.2	LMICN_CON	Left Channel MIC Negative Input
J_LMIC			Left Channel MIC Input (RCA connector)
JP_RMIC	JP_RMIC.1	RMICP_CON	Right Channel MIC Positive Input
	JP_RMIC.2	RMICN_CON	Right Channel MIC Negative Input
J_RMIC			Right Channel MIC Input (RCA connector)
J_LIN			LLIN and RLIN input (3.5mm Jack)
JP_HPOUT	JP_HPOUT.1	LHP_CON	Headphone Left Channel Output
	JP_HPOUT.2	AGND	GND
	JP_HPOUT.3	RHP_CON	Headphone Right Channel Output
	JP_HPOUT.4	AGND	GND
J_HPOUT			LHP and RHP output (3.5mm Jack)
J_LSPKOUT			Speaker Left Channel Output (RCA connector)
J_RSPKOUT			Speaker Right Channel Output (RCA connector)

Header		NL-NAU88C22	
		Net Name in Schematic	Description
JP_SPKOUT	JP_SPKOUT.1	LSPKOUT	Speaker Left Channel Output
	JP_SPKOUT.2	AGND	GND
	JP_SPKOUT.3	RSPKOUT	Speaker Right Channel Output
	JP_SPKOUT.4	AGND	GND
J_AUXIN			LAUXIN and RAUXIN input (3.5mm Jack)
JP_AUXOUT	JP_AUXOUT.1	AUXOUT1_CON	AUXOUT1 Output
	JP_AUXOUT.2	AGND	GND
	JP_AUXOUT.3	AUXOUT2_CON	AUXOUT2 Output
	JP_AUXOUT.4	AGND	GND
J_AUXOUT1			AUXOUT1 Output (RCA connector)
J_AUXOUT2			AUXOUT2 Output (RCA connector)
JP_I2C_SPI	JP_I2C_SPI.1	SCL_CB1	Serial Data Clock for I^2C
	JP_I2C_SPI.2	SDA_CB1	Serial Data for I^2C
	JP_I2C_SPI.3	DGND	GND
	JP_I2C_SPI.4	CSB/GPIO1	3-Wire MPU Chip Select or GPIO1 Multifunction Input/Output
	JP_I2C_SPI.5	SO	When JP_GPIO3 is short, this pin connects to RLIN/GPIO3
JP_DGND	JP_DGND.1	DGND	GND
	JP_DGND.2		
JP_DGND1	JP_DGND1.1	DGND	GND
	JP_DGND1.2		
JP_AGND	JP_AGND.1	AGND	GND
	JP_AGND.2		

Table 2-1 NL-NAU88C22 Extension Connectors

2.3 NL-NAU88C22 Jumpers

Table 2-2 describes the connectors on NL-NAU88C22. Users can refer to Figure 2-1 at the same time.

Jumper	NL-NAU88C22		
	Function Description	Options	Jumper Option Description
JP_OSC	On Board OSC Selection	1 – 2	Onboard OSC to Provide MCLK (12.288 MHz) to NL-NAU88C22. (Need to Check JP_I2S_CB Jumper of Pin 1-2 is Floating)
		Floating	Using MCLK Clock from JP_I2S_CB
JP_VDDSPK	VDDSPK Selection	1 – 2	VDDSPK = 3.3V
		2 – 3	VDDSPK = 5V
JP_VDDBC	VDDBC Selection	1 – 2	VDDB and VDDC = 3.3V
		2 – 3	VDDB and VDDC = 1.8V
JP_LMICN	Signal Input Format Selection	1 – 2	For Mic In: Signal-End Input
		2 – 3	For Mic In: Differential Input
		Floating	Signal Differential Input. It needs to adjust with JP_LMICP
JP_LMICP	Signal Input Format Selection	1 – 2	For MIC input
		Floating	Signal Differential input. It needs to adjust with JP_LMICN.
JP_RMICN	Signal Input Format Selection	1 – 2	For Mic In: Signal-End Input
		2 – 3	For Mic In: Differential Input
		Floating	Signal Differential Input. It needs to adjust with JP_RMICP
JP_RMICN	Signal Input Format Selection	1 – 2	For MIC input
		Floating	Signal Differential input. It needs to adjust with JP_RMICN.
JP_LLIN/GPIO2	LIN/GPIO2 Function Selection	1 – 2	Left Channel Line Input
		2 – 3	GPIO2 Function
JP_RLIN/GPIO3	RLIN/GPIO3 Function Selection	1 – 2	Right Channel Line Input
		2 – 3	GPIO3 Function
JP_MODE	Control Interface Selection	1 – 2	The Control Interface is I^2C
		2 – 3	The Control Interface is SPI

Table 2-2 NL-NAU88C22 Jumpers

2.4 NU-NAUSB2I2C USB Control Board View

The NU-NAUSB2I2C provides I²C control signals and common audio digital formats. With this board, users can quickly evaluate the functions and features of the NL-NAU88C22 and perform basic operations on the NL-NAU88C22 in conjunction with the content of this document. For more details of NU-NAUSB2I2C, please refer to *NU-NAUSB2I2C User Manual*.

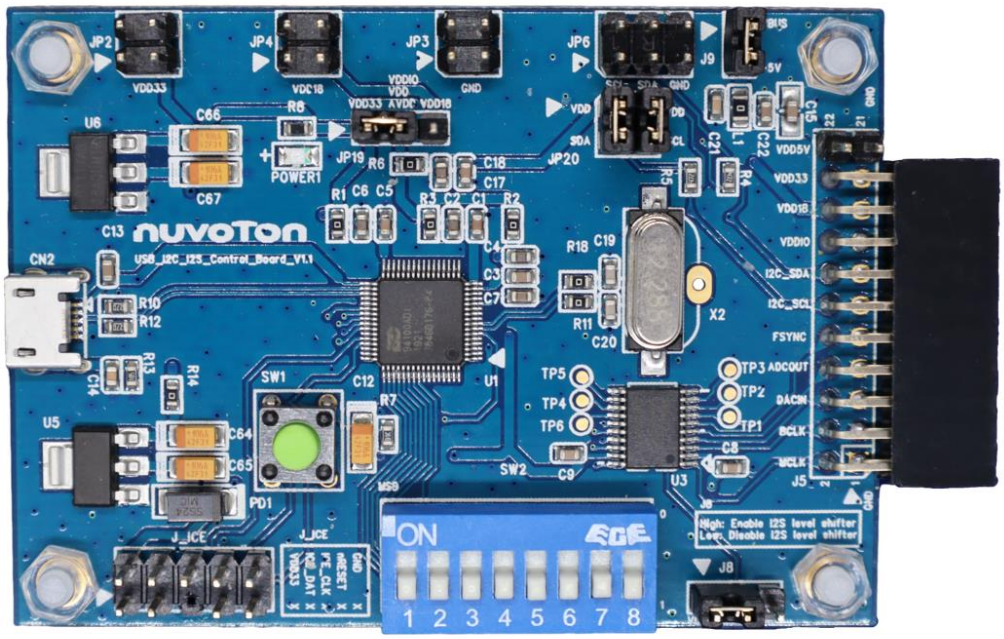

Figure 2-2 NU-NAUSB2I2C

2.5 Hardware Check and Connection

Before using NuvotonAudioGUI, please confirm the hardware configured as follows before connecting to a Windows based PC.

1. Confirm that pin 7 of SW2 of NU-NAUSB2I2C is high and the rest are low level, as shown in Figure 2-3.

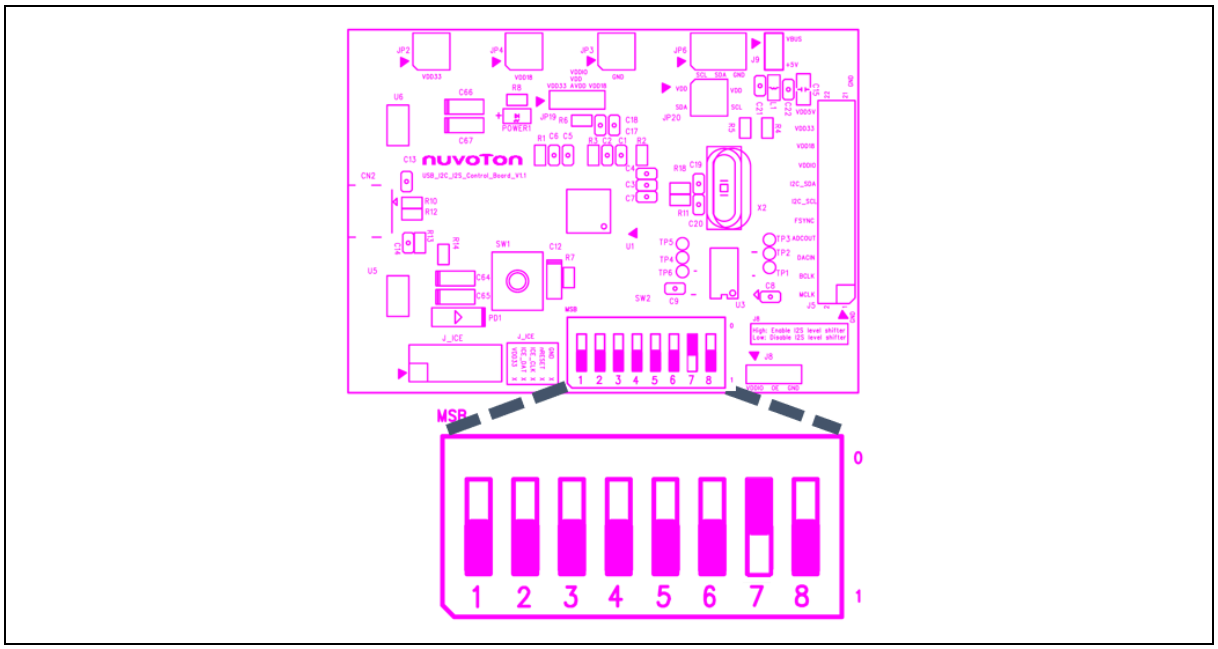

Figure 2-3 PIN Status of NU-NAUSB2I2C SW2

2. Connect J5 of NU-NAUSB2I2C to JP2 of NL-NAU88C22. Figure 2-4 is the diagram after two boards are connected to each other.

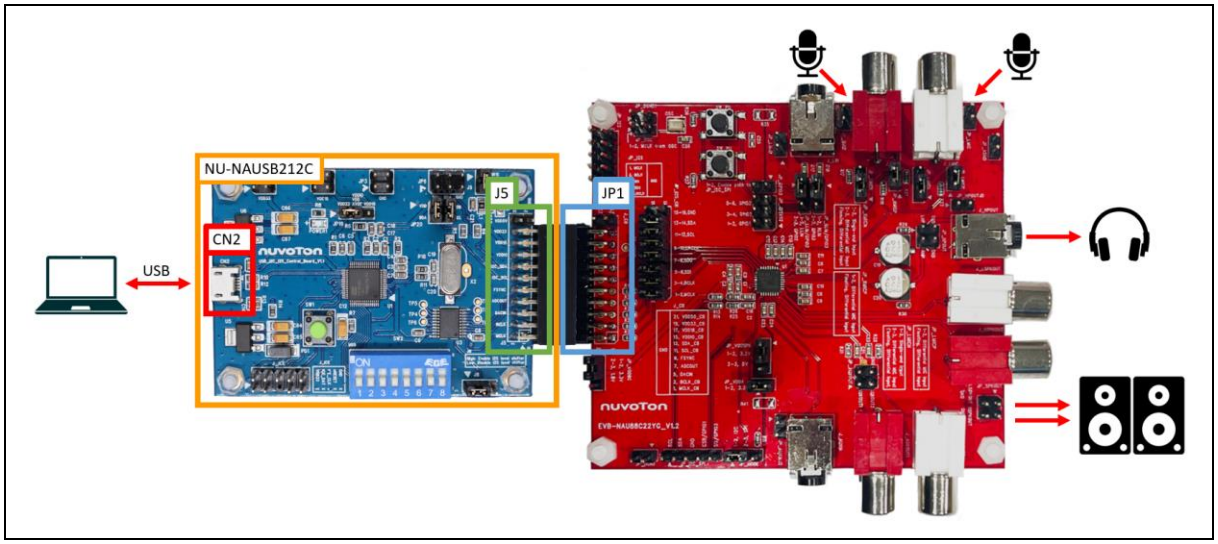

Figure 2-4 NU-NAUSB2I2C Connection

3. CN2 of NU-NAUSB2I2C uses USB Cable to connect to a PC under Windows system. (If possible, please do not connect to the PC through USB HUB). Figure 2-5 shows the audio signal path after the two boards are connected to each other.

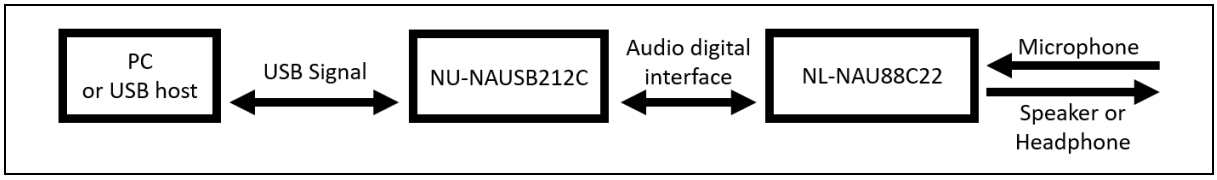

Figure 2-5 Signal Path of NU-NAUSB2I2C and NL-NAU88C22

4. Select the audio device on the PC as "Nuvoton UAC+HID Device". For example, under Win10 system, users can click the speaker icon on the bottom-right corner of the desktop and choose the device "Nuvoton UAC+HID Device," as shown in Figure 2-6. This will select "Nuvoton UAC+HID Device" as the current playback device.

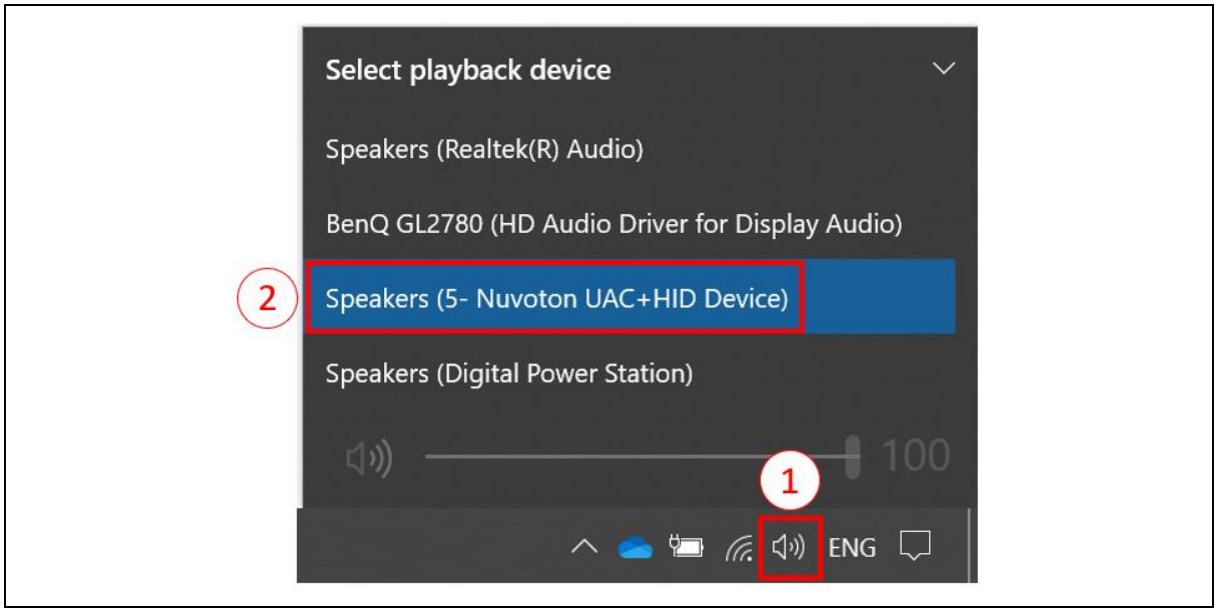

Figure 2-6 PC Audio Device Setting

3 SOFTWARE CONFIGURATION

This document is compatible with NuvotonAudioGUI V2.04 or later.

Evaluation of NL-NAU88C22 feature needs to install NuvotonAudioGUI.

3.1 NuvotonAudioGUI Installation

1. Visit Nuvoton Website.

   Download NuvotonAudioGUI software.

   https://www.nuvoton.com/tool-and-software/software-tool/programmer-tool/

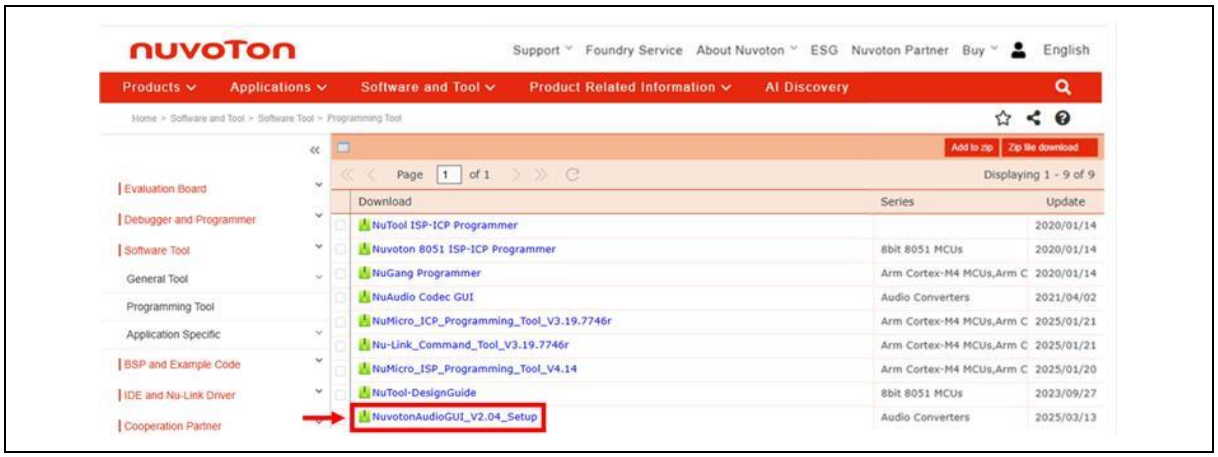

Figure 3-1 NuvotonAudioGUI Installation Step (1)

2. Install the NuvotonAudioGUI. The installation steps are shown in Figure 3-2 and Figure 3-3.

Figure 3-2 NuvotonAudioGUI Installation Step (2)

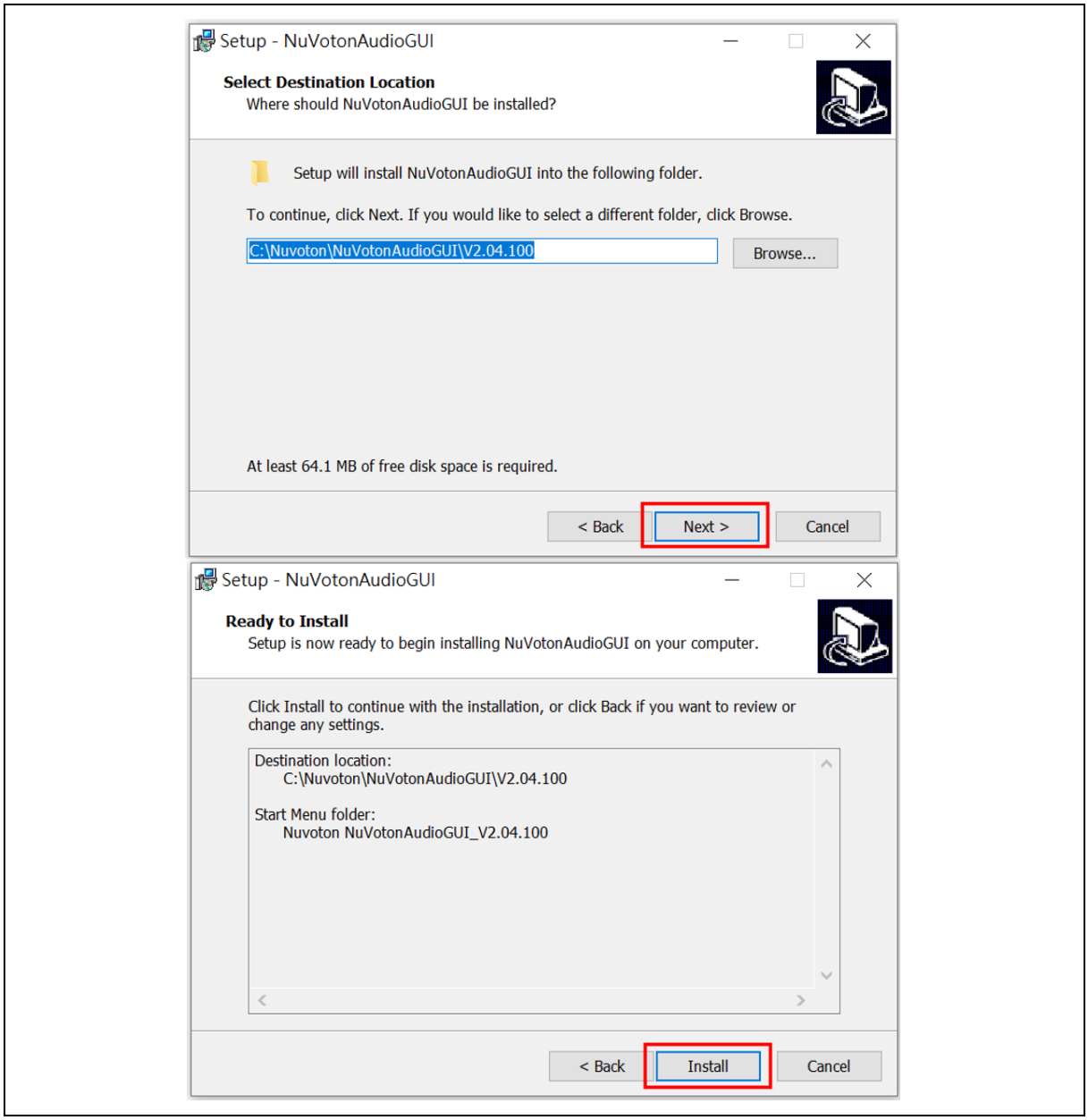

Figure 3-3 NuvotonAudioGUI Installation Step (3)

3.2 NuvotonAudioGUI Operating Instructions

1. Open NuvotonAudioGUI, choose the corresponding IC Part Number, and chick [OK], as shown in Figure 3-4.

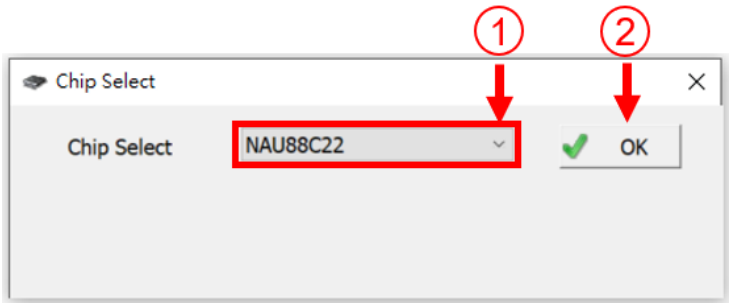

Figure 3-4 NuvotonAudioGUI Operating Step (1)

2. After clicking [OK], NuvotonAudioGUI will automatically read the connection status and verify the firmware version of the NU-NAUSB2I2C. If the firmware version is outdated, the version reminder window shown in Figure 3-5 will pop up. Users can ignore this message and continue operating NuvotonAudioGUI by clicking the [X] on the top-right corner.

   For more firmware update process information, please refer to *NU-NAUSB2I2C User Manual*.

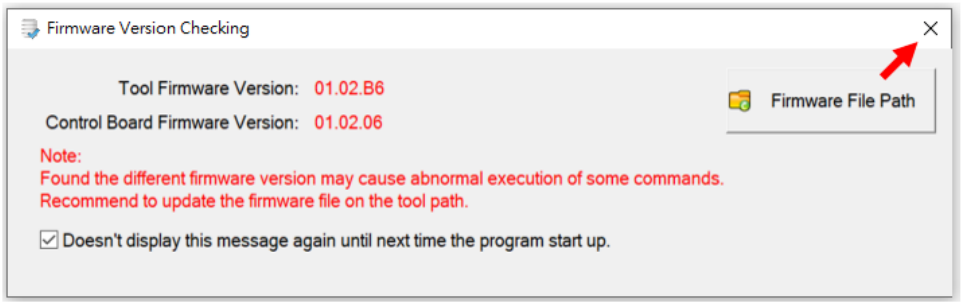

Figure 3-5 NuvotonAudioGUI Operating Step (2)

3. NuvotonAudioGUI will automatically read connection status. If the hardware and software are properly configured, a green [Connect] will appear on the upper left corner of the NuvotonAudioGUI window, as shown in Figure 3-6. Then users can issue I²C commands through NuvotonAudioGUI to control NL-NAU88C22.

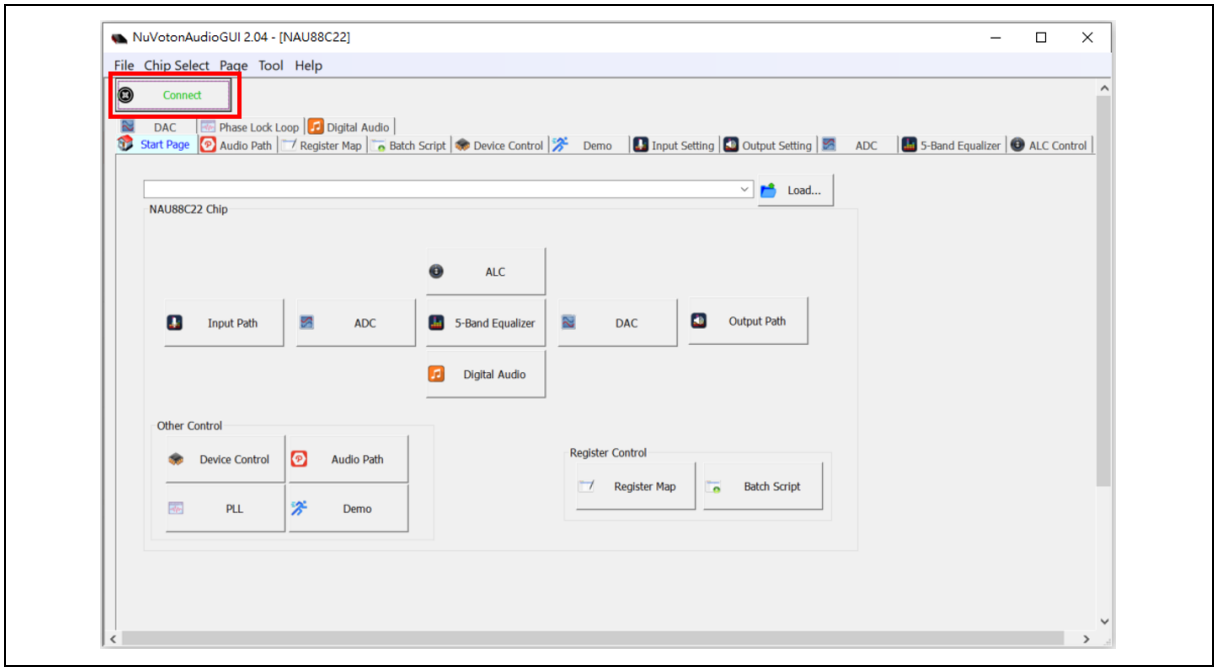

Figure 3-6 NuvotonAudioGUI Operating Step (3)

4. If the red [Disonnected] appears on the upper left corner of the NuvotonAudioGUI window, as shown in Figure 3-7, check if the hardware configuration is correct.

   For example: USB cable, whether your PC USB has read and write permissions, and whether Section 2.5 is executed correctly. If the problem still exists, please contact Nuvoton.

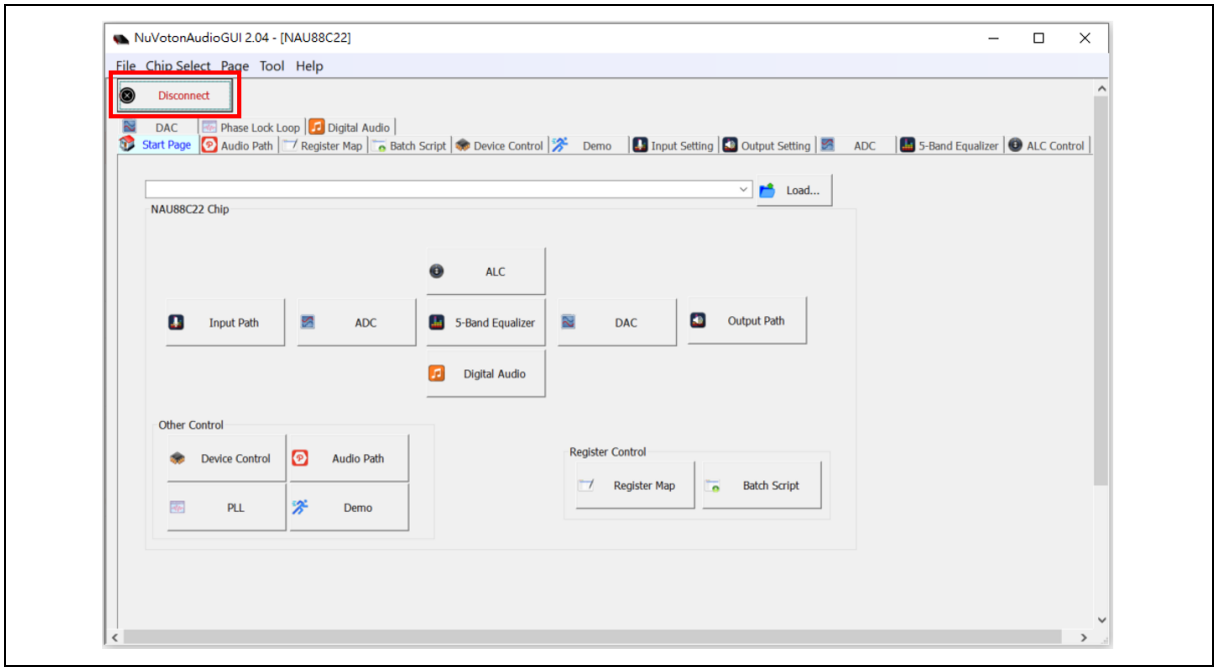

Figure 3-7 NuvotonAudioGUI Operating Step (4)

3.3 NuvotonAudioGUI Basic Page Introduction

NAU88C22 function settings are divided into multiple pages in NuvotonAudioGUI. This document will take a few frequently used pages as brief introduction.

3.3.1 Start Page and Demo Sequence

Start Page is the default view of NuvotonAudioGUI with links to all pages. Users can immediately enable the NL-NAU88C22 function by this page and the NuvotonAudioGUI built-in demo sequences. Refer to Figure 3-8 and the following description to operate.

1. Click the drop-down menu on the start page.
2. Select the option for the corresponding evaluation board.
3. Click the [Load] button.

NuvotonAudioGUI provides two sets of settings for users to choose from: DemoSequence_NAU88C22 and DemoSequence_NAU88C22+Sidetone.

- DemoSequence_NAU88C22:

  This setting enables the MIC IN (ADC function) and SPK OUT (DAC function) functions of the NAU88C22. Users can play their desired audio files using the playback device on the PC with the system playback device set to "Nuvoton UAC+HID Device". The audio will then be heard through the speakers or headphone installed on the NL-NAU88C22.

- DemoSequence_NAU88C22+Sidetone:

  This setting is almost identical to DemoSequence_NAU88C22, with the difference being that the speakers or headphone can directly play the sound received by the microphone.

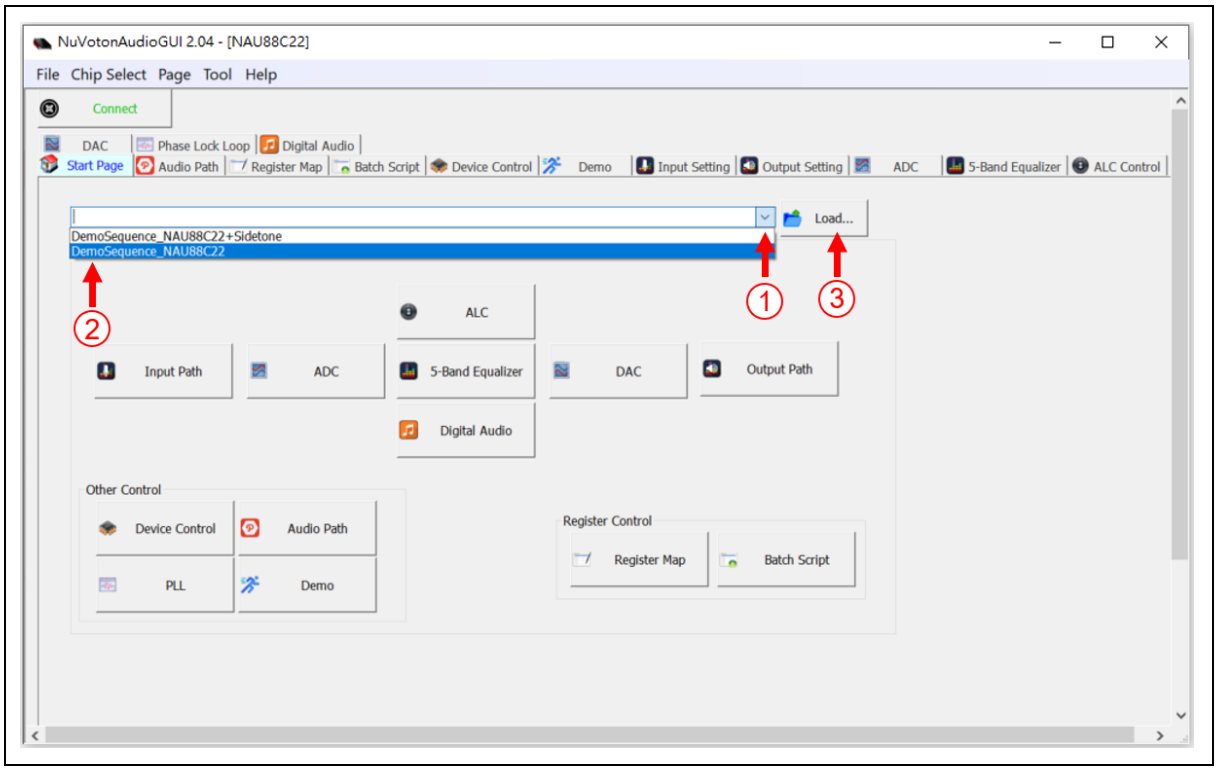

Figure 3-8 Start Page on NuvotonAudioGUI

3.3.2 Audio Path Page

The Audio Path page graphically presents path switches, power controls, and Gain adjustments, allowing users to configure NAU88C22 as easy as possible. It is high recommended to use the DemoSequence setting first, and then use the Audio Path page to do more customized control.

- Click on the red boxes in Figure 3-9 to adjust the power of this function. When power is on, the box will be green. When Power is off, the box will be gray.
- Click on the blue arrows in Figure 3-9 to adjust the enabling status of the path.
- Click on the pink arrows in Figure 3-9 and a drop-down menu will appear, where the user can adjust the Gain there.
- The blue box in Figure 3-9 lists the current graphical status here in text form. The user can also modify the status of the function from here.

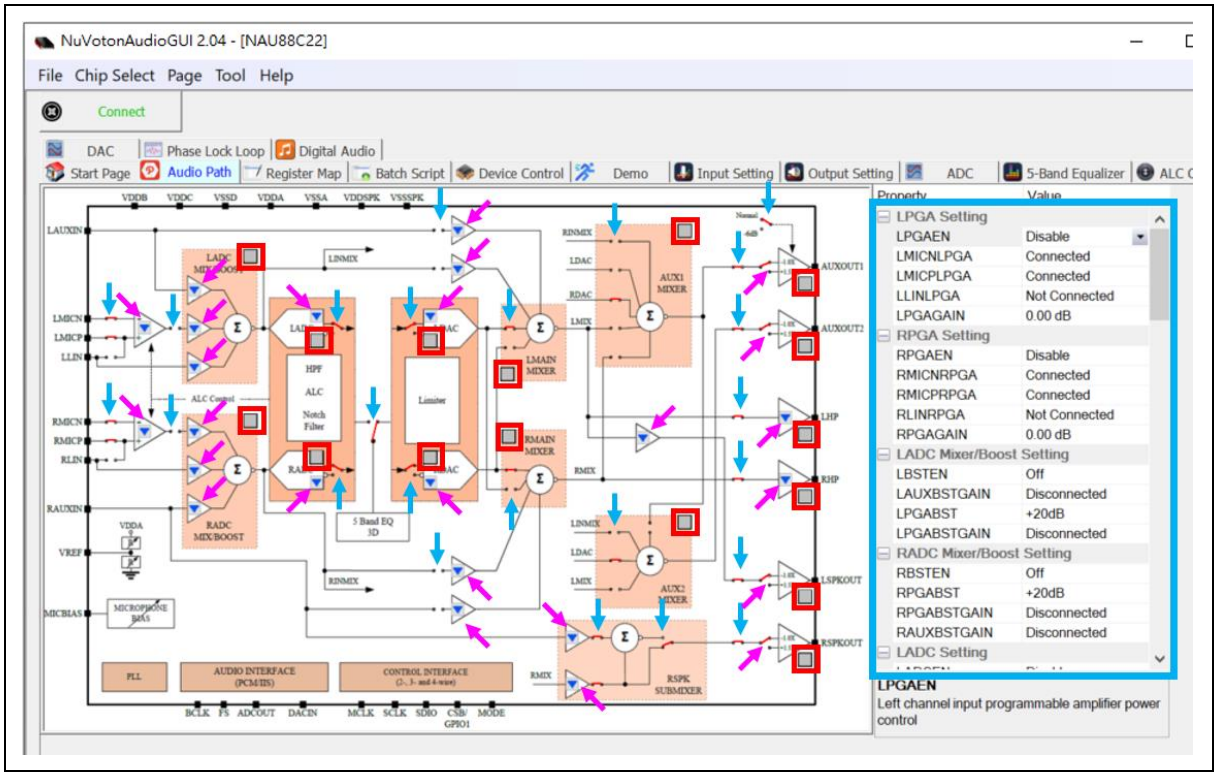

Figure 3-9 Audio Path Page on NuvotonAudioGUI

3.3.3 Register Map

The Register map page can modify the target register value through NuvotonAudioGUI. The following explains two main modification methods.

- Users can directly key in desired register values into the "Value" field next to the corresponding address, as shown in Figure 3-10. ("Value" has hexadecimal and binary column respectively, just select one to modify.)
- If users want to read the specified address value, enter the address value in the "Address" field, as shown in Figure 3-10. After clicking the [Read] button on the left, the address value will be displayed in the "Value" field. If users want to modify the specified address value, enter the desired address and corresponding value in the "Address" and "Value" fields respectively, and click the [Write] button on the left to complete the modification.

There are two functions [Import] and [Export] on the Register page:

- [Export]: Export the currently set values into a text file.
- [Import]: Import external text files and set them to the target evaluation board.

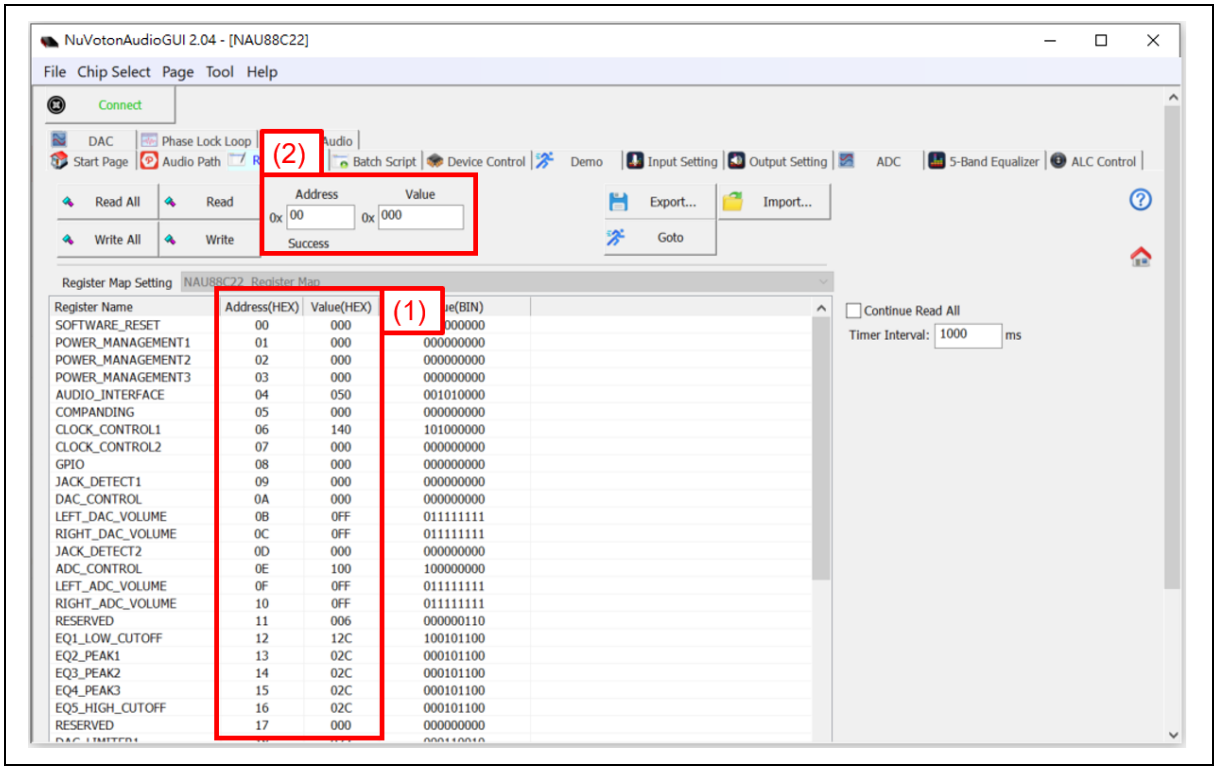

Figure 3-10 Register Map Page on NuvotonAudioGUI

3.4 Recording Software Verification

When user uses a microphone or other audio source devices to verify the ADC functionality of the NAU88C22, the digital signal from the converted ADC data is not easy to quickly verify or test using common instruments. However, when the NU-NAUSB2I2C is paired with the NL-NAU88C22, NU-NAUSB2I2C can convert the ADC data signal and deliver it to the PC, allowing the user to verify the ADC functionality of the NAU88C22 using Windows' built-in recording software or other recording applications.

Audacity is a free and user-friendly software that allows users to perform playback and recording tests. The following briefly introduces how to record with Audacity. After opening Audacity, confirm or set the recording device to "Nuvoton UAC+HID Device" by following the Step 1 to 3 in Figure 3-11. Click the icon shown in Step 4 of the figure to start recording and the icon in Step 5 of the figure to stop recording. The sound captured by the microphone or other audio source devices on the NL-NAU88C22 will be shown on the audio track.

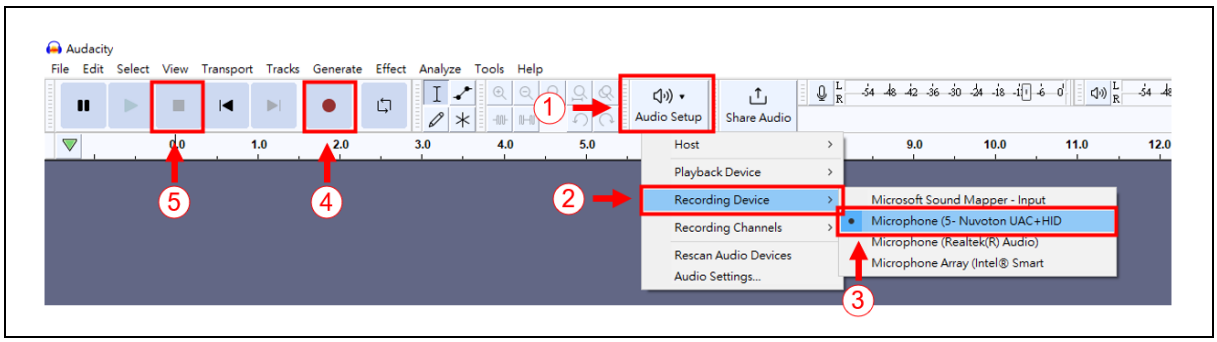

Figure 3-11 Audacity Recording Settings

4 SCHEMATICS

4.1 NL-NAU88C22 Schematic

Figure 4-1 and Figure 4-2 show the NL-NAU88C22 circuit.

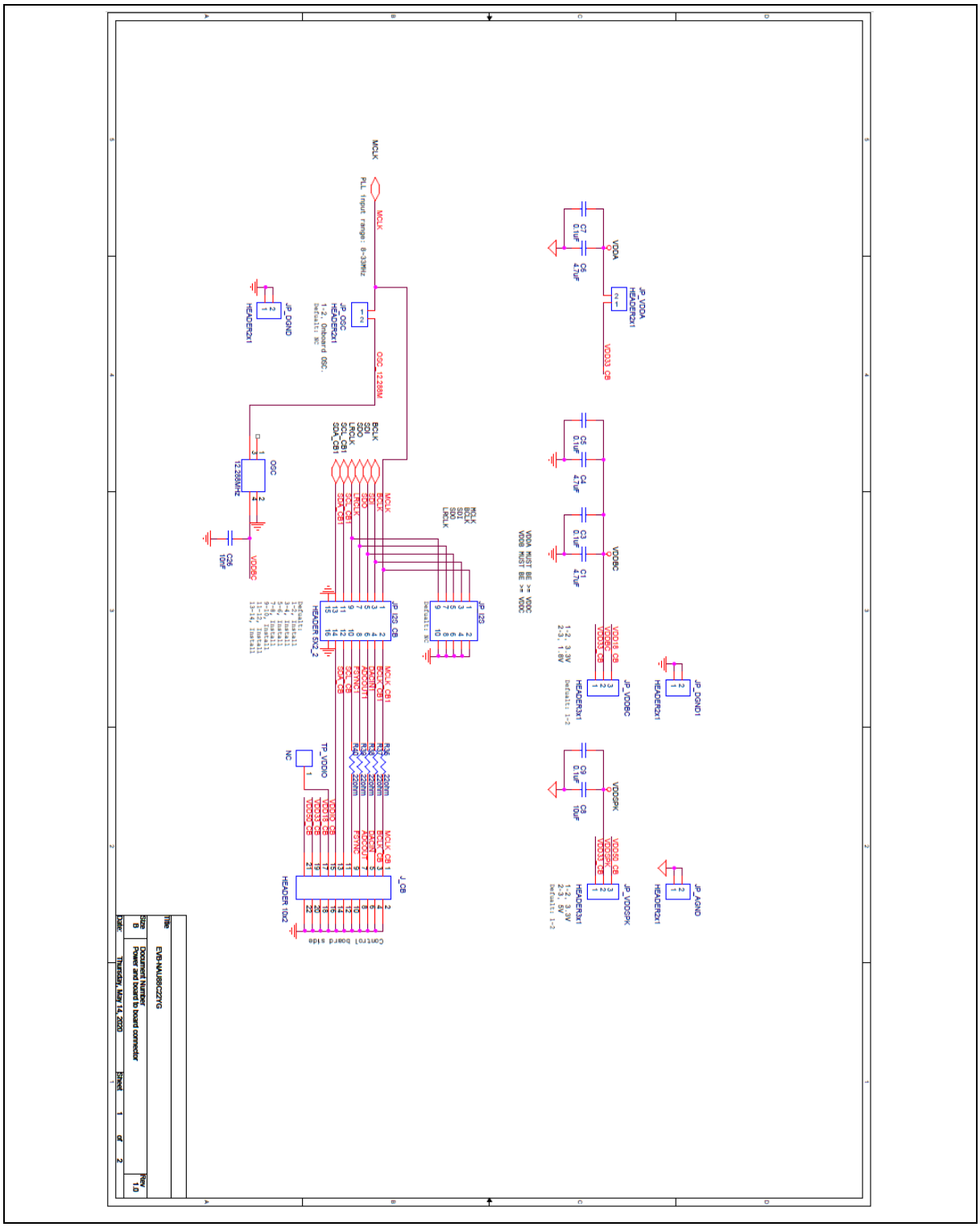

Figure 4-1 NL-NAU88C22 Circuit (1)

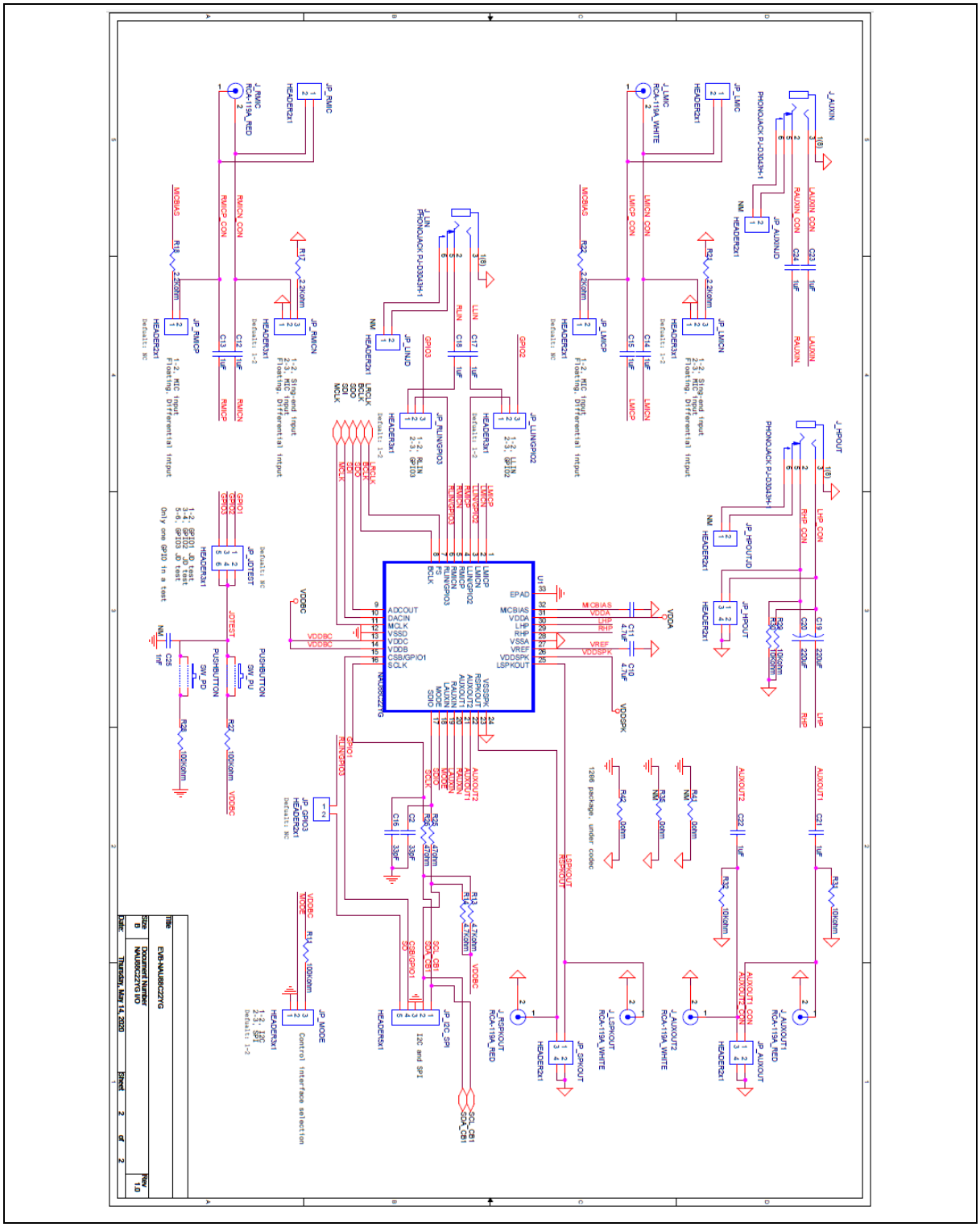

Figure 4-2 NL-NAU88C22 Circuit (2)

4.2 NL-NAU88C22 PCB Layout

Figure 4-3 shows the placement of NL-NAU88C22.

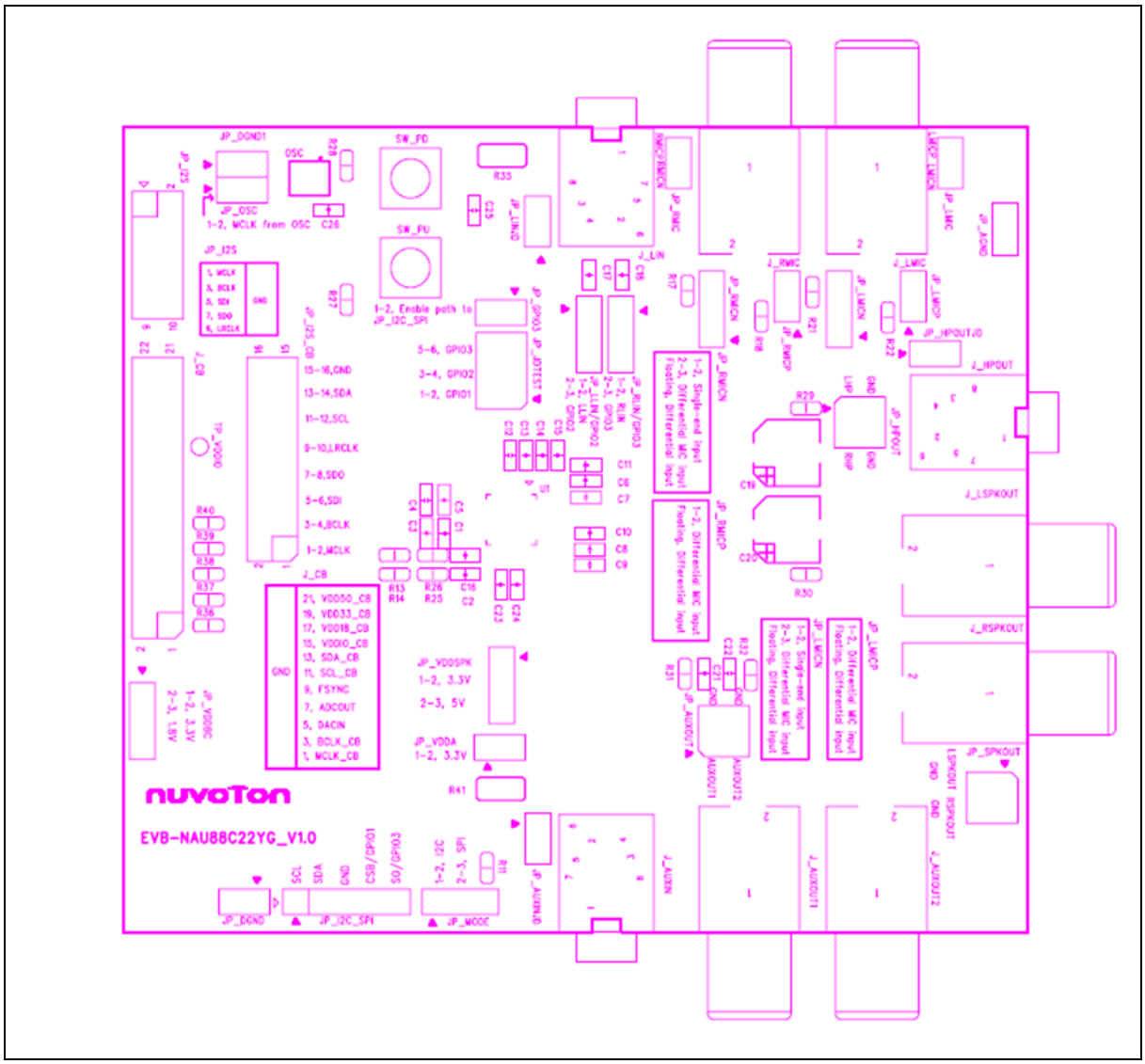

Figure 4-3 NL-NAU88C22 Layout

5 REVISION HISTORY

REVISION	DATE	DESCRIPTION
1.0	Feb 18, 2025	Initial Release
1.1	Mar 17, 2025	Update 3.1 NuvotonAudioGUI Installation

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.