NL-NAU88C14 User Manual

Evaluation Board for NAU88C14

The information described in this document is the exclusive intellectual property of Nuvoton Technology Corporation and shall not be reproduced without permission from Nuvoton.

Nuvoton is providing this document only for reference purposes of NuMicro microcontroller and microprocessor based system design. Nuvoton assumes no responsibility for errors or omissions.

All data and specifications are subject to change without notice.

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

www.nuvoton.com

Tabl	e of Contents
1	OVERVIEW5
2	HARDWARE CONFIGURATION
	2.1 NL-NAU88C14 Front View
	2.2 NL-NAU88C14 Connectors7
	2.3 NL-NAU88C14 Jumpers
	2.4 NU-NAUSB2I2C USB Control Board View10
	2.5 Hardware Check and Connection11
3	SOFTWARE CONFIGURATION13
	3.1 NuvotonAudioGUI Installation13
	3.2 NuvotonAudioGUI Operating Instructions16
	3.3 NuvotonAudioGUI Basic Page Introduction19
	3.3.1 Start Page and Demo Sequence
	3.3.2 Audio Path Page
	3.3.3 Register Map
	3.4 Recording Software Verification22
4	SCHEMATICS23
	4.1 NL-NAU88C14 Schematic23
	4.2 NL-NAU88C14 PCB Layout24
5	REVISION HISTORY25

List of Figures

Figure 1-1 NL-NAU88C14 Evaluation Board5
Figure 2-1 Front View of NL-NAU88C14
Figure 2-2 NU-NAUSB2I2C10
Figure 2-3 PIN Status of NU-NAUSB2I2C SW211
Figure 2-4 NU-NAUSB2I2C Connection11
Figure 2-5 Signal Path of NU-NAUSB2I2C and NL-NAU88C1412
Figure 2-6 PC Audio Device Setting12
Figure 3-1 NuvotonAudioGUI Installation Step (1)13
Figure 3-2 NuvotonAudioGUI Installation Step (2)14
Figure 3-3 NuvotonAudioGUI Installation Step (3)15
Figure 3-4 NuvotonAudioGUI Operating Step (1)16
Figure 3-5 NuvotonAudioGUI Operating Step (2)16
Figure 3-6 NuvotonAudioGUI Operating Step (3)17
Figure 3-7 NuvotonAudioGUI Operating Step (4)18
Figure 3-8 Start Page on NuvotonAudioGUI19
Figure 3-9 Audio Path Page on NuvotonAudioGUI20
Figure 3-10 Register Map Page on NuvotonAudioGUI21
Figure 3-11 Audacity Recording Settings
Figure 4-1 NL-NAU88C14 Circuit23
Figure 4-2 NL-NAU88C14 Layout24

List of Tables

Table 2-1 NL-NAU88C14 Extension Connectors	. 8
Table 2-2 NL-NAU88C14 Jumpers	. 9

1 OVERVIEW

The NL-NAU88C14 is the evaluation board for NAU88C14. This board is developed for users to quickly understand the characteristics of NAU88C14. For development flexibility, this board has built-in additional expansion connectors that provide the audio signal input, output, speaker output, headphone output and digital interface. For development convenience, NL-NAU88C14 can be connected with speakers or directly to customized system.

Nuvoton has also developed a USB control board, NU-NAUSB2I2C, which provides I²C control interface and digital audio interface signals. Along with the software NuvotonAudioGUI, users can quickly set up and use NL-NAU88C14 on their PCs.



Figure 1-1 NL-NAU88C14 Evaluation Board

NL-NAU88C14 compatible ICs:

- NAU88C14YG
- NAU8814YG
- NAU88U14YG

2 HARDWARE CONFIGURATION

2.1 NL-NAU88C14 Front View



Figure 2-1 Front View of NL-NAU88C14

Figure 2-1 shows the main components and connectors from the front side of NL-NAU88C14 as the following list:

- Target Chip: NAU88C14 (U1)
- Additional Connectors for MIC Input
- Additional Connectors for AUX Inpu
- Additional Connectors for Mono Output
- Additional Connectors for Speaker Output
- On Board 12.288M OSC (12.288M Hz) for MCLK Pin
- Major Digital Interface and Power Extension Connector
- VDDSPK Level Selection
- MIC Signal Input Selection
- Control Interface Selection

2.2 NL-NAU88C14 Connectors

Table 2-1 describes the connectors on NL-NAU88C14. Users can also refer to Figure 2-1.

			NL-NAU88C14						
неа	ider	Net Name in Schematic	Description						
	CON1.1	MCLK_CB	CODEC External Master Clock Source Input						
	CON1.2	DGND	GND						
	CON1.3	BCLK_CB	Serial Data Bit Clock Input / Output for I ² S / PCM Data						
	CON1.4	DGND	GND						
	CON1.5	DACIN	Serial Audio Data Input for I ² S / PCM Data						
	CON1.6	DGND	GND						
	CON1.7	ADCOUT	Serial Audio Data Output for I ² S / PCM Data						
	CON1.8	DGND	GND						
	CON1.9	FSYNC	Frame Sync Input / Output for I ² S / PCM Data						
	CON1.10	DGND	GND						
CON1	CON1.11	SCL_CB	Serial Data Clock for I ² C						
CONT	CON1.12	DGND	GND						
	CON1.13	SDA_CB	Serial Data for I ² C						
	CON1.14	DGND	GND						
	CON1.15	VDDIO_CB	VDDIO						
	CON1.16	DGND	GND						
	CON1.17	VDD18_CB	1.8V Power Supply						
	CON1.18	DGND	GND						
	CON1.19	VDD33_CB	3.3V Power Supply						
	CON1.20	DGND	GND						
	CON1.21	VDD50_CB	5V Power Supply						
	CON1.22	DGND	GND						

			NL-NAU88C14				
неа	ider	Net Name in Schematic	Description				
11.4	J14.1	MIC+_CON2	Microphone Positive Input				
514	J14.2	MICCON2	Microphone Negative Input				
115	J15.1	AUX	Aux Input				
515	J15.1	AGND	GND				
17	J7.1		MONO Output				
57	J7.2	AGND	GND				
	J3.1	SDKOLIT	Speaker Positive Output				
13	J3.2	SPROUT-					
55	J3.3	SDKOLT.	Speaker Positive Output				
	J3.4	SPK001+					
	J17.1	SDA_J5	Serial Data for I ² C				
117	J17.2	SDL_J5	Serial Data Clock for I ² C				
517	J17.3	AGND	GND				
	J17.4	CSB/GPIO	SPI Chip Select or General Purposes I/O				
110	J10.1		CND				
510	J10.2	AGND					
144	J11.1						
JII	J11.2	DGND	GND				

Table 2-1 NL-NAU88C14 Extension Connectors

2.3 NL-NAU88C14 Jumpers

Table 2-2 describes the connectors on NL-NAU88C14. Users can refer to Figure 2-1 at the same time.

	NL-NAU88C14							
Jumper	Function Description	Options	Jumper Option Description					
	On Board OSC	J4.1 – J4.2	Onboard OSC to Provide MCLK (12.288 MHz) to NL-NAU88C14					
J4	Selection	J4.2 – J4.3	Using MCLK Clock from JP_I2S_CB					
		J6.1 – J6.2	VDDSPK = 3.3V					
J 6	VDDSPK Selection	J6.2 – J6.3	VDDSPK = 5V					
		J9.1 – J9.2	For Mic In: Differential Input					
J9	Signal Input Format Selection	J9.2 – J9.3	For Mic In: Signal-End Input					
		Floating	Signal Differential Input. It needs to adjust with J8					
19	Signal Input Format	J8.1 – J8.2	For MIC input					
JO	Selection	Floating	Signal Differential input. It needs to adjust with J9					
14.6	Control Interface	J16.1 – J16.2	I ² C Mode					
J16	Selection	J16.2 – J16.3	SPI Mode					

Table 2-2 NL-NAU88C14 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-NAU88C14 and perform basic operations on the NL-NAU88C14 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-NAU88C14. 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-NAU88C14

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-NAU88C14 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/

Products 🗸 🛛 🗚	Applications \sim	Software and Tool V Product Related Information V Al Discovery		Q
Home > Software and To	iol > Software Tool > P	rogramming Tool	公	< 0
	~		Add to top Zip 1	ie download
1 martine Proved		<pre><< Page 1 of 1 >>>> C</pre>	Displayi	ng 1 - 9 of
Evaluation Board		Download	Series	Update
Debugger and Program	imer 💙	NuTool ISP-ICP Programmer		2020/01/1
Software Tool	~	Nuvoton 8051 ISP-ICP Programmer	8bit 8051 MCUs	2020/01/1
General Tool		U UGang Programmer	Arm Cortex-M4 MCUs,Arm C	2020/01/1
Programming Tool		U NUAudio Codec GUI	Audio Converters	2021/04/0
r rogramming roor		NuMicro_ICP_Programming_Tool_V3.19.7746r	Arm Cortex-M4 MCUs,Arm C	2025/01/2
Application Specific	*	Nu-Link_Command_Tool_V3.19.7746r	Arm Cortex-M4 MCUs,Arm C	2025/01/2
BSP and Example Code	è č	NuMicro_ISP_Programming_Tool_V4.14	Arm Cortex-M4 MCUs,Arm C	2025/01/2
IDE and Nu-Link Driver	×	A NuTool-DesignGuide	8bit 8051 MCUs	2023/09/2
Cooperation Partner		NuvotonAudioGUI_V2.04_Setup	Audio Converters	2025/03/1

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)

NL-NAU88C14



🕵 Setup - NuVotonAudioGUI		_		<
Select Destination Location Where should NuVotonAudioGUI be instal	led?		<u> 1</u>	3
Setup will install NuVotonAudioGUI	into the followin	g folder.		
To continue, click Next. If you would like t	o select a differen	t folder, click Br	owse.	
C:\Nuvoton\NuVotonAudioGUI\V2.04.100)		Browse	
At least 64.1 MB of free disk space is requi	red.			
	< Back	Next >	Cancel	
🕵 Setup - NuVotonAudioGUI		_		<
Ready to Install Setup is now ready to begin installing NuV	otonAudioGUI or	n your computer		3
Click Install to continue with the installatio change any settings.	n, or click Back if	you want to rev	iew or	
Destination location: C:\Nuvoton\NuVotonAudioGUI\V2.04	4.100		^	
Start Menu folder: Nuvoton NuVotonAudioGUI_V2.04.1	00			
			~	
<			>	
	< Back	Install	Cancel	
L				

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.

		1	2	
Chip Select		•	×	
Chip Select	NAU88C14	~	🗸 ок	

Figure 3-4 NuvotonAudioGUI Operating Step (1)

 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-NAUSB2/2C User Manual.

Tool Firmware Version: 01.02.B6	_	Eirmurara Eila Bath
Control Board Firmware Version: 01.02.06		Filmwale File Faul
Note: Found the different firmware version may cause abnormal execution of some comman Recommend to update the firmware file on the tool path.	ds.	
✓ Doesn't display this message again until next time the program start up.		

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-NAU88C14.

Conne	đ														
Phase Lock	Loop 2 Digital	Audio	5-Band Equaliz	er									1891	1	
Start Page	Audio Path	/ Regist	ter Map 👩 Bate	ch Script 1	W Device Contro	De De	emo 👪 Inpu	it Setting	Uutput Sett	ng 🔮 AL	C Control 🖺	a ADC	🔤 Di	AC	
									- 📩 La	ad					
NAU88C	14 Chip														
						1									
				Θ	ALC										
										1					
	Input Path	2	ADC	🛄 :	5-Band Equalizer		DAC		Output Path						
					Distal Audia	1									
					Digital Audio										
Other C	Control	1													
۲	Device Control	1965	PLL			Regis	ter Control								
-	Duma	-				-	Degister Mar	_	Patch Corin	.					
5	Demo	2	Audio Path				Register Ma	° '	 Batch Scrip 	·					

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.

NuvotonAudioGUI 2	.04 - [NAU88C1	[4]		– L ,
e Chip Select Pag	e Tool Help			
Disconnect				
🛛 Phase Lock Loop 🛛 🛃	Digital Audio	5-Band Equ	alizer	
🕽 Start Page [🙆 Aud	io Path 🗾 Regis	ster Map 🐻	Batch Script 🏟 Device	e Control 🚀 Demo 🛛 🔛 Input Setting 🖾 Output Setting 🔞 ALC Control 💆 ADC 🛛 📓 DAC
		Address	Value	
🔦 Read All 🔦	Read	v 00	ox 000	Export
	Maile	^	04	Seto Coto
write All	write	Success		<u>~ 3010</u>
				18
Register Map Setting	NAU88C14 Regis	ster Map		×
legister Name	Address(HEX)	Value(HEX)	Value(BIN)	Continue Read All
SOFTWARE_RESET	00	000	000000000	Timer Interval: 1000 ms
POWER_MANAGEMENT	1 01	000	000000000	
POWER_MANAGEMENT	2 02	000	000000000	
POWER_MANAGEMENT	3 03	000	000000000	
AUDIO_INTERFACE	04	000	000000000	
COMPANDING	05	000	000000000	
CLOCK_CONTROL1	06	000	000000000	
CLOCK_CONTROL2	07	000	000000000	
SPIO_CTRL	08	000	000000000	
DAC_CTRL	OA	000	000000000	
DAC_VOLUME	OB	000	000000000	
ADC_CTRL	OE	000	000000000	
ADC_VOLUME	OF	000	000000000	
EQ1_LOW_CUTOFF	12	000	00000000	
EQ2_PEAK1	13	000	00000000	
Q3_PEAK2	14	000	000000000	
EO4 PEAK3	15	000	000000000	
O5 HIGH CUTOFF	16	000	00000000	
DAC LIMITER1	18	000	00000000	
and the second sec	10	000	00000000	
DAC LIMITER2	19	000		

Figure 3-7 NuvotonAudioGUI Operating Step (4)

3.3 NuvotonAudioGUI Basic Page Introduction

NAU88C14 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-NAU88C14 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_NAU88C14 and DemoSequence_NAU88C14+Sidetone.

• DemoSequence_NAU88C14:

This setting enables the MIC IN (ADC function) and SPK OUT (DAC function) functions of the NAU88C14. 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-NAU88C14.

• DemoSequence_NAU88C14+Sidetone:

This setting is almost identical to DemoSequence_NAU88C14, with the difference being that the speakers or headphone can directly play the sound received by the microphone.

Connect					
Phase Lock Loop	Audio	Cariat Davies Cantral	🐼 Dama 🕅 Janu	h Setting I 🗖 Output Setting I 🗛 ALC Control I	
Start Page Mudio Path	📝 Register Map 👩 Batch	Script 🗰 Device Control	🎢 Demo 🛃 Inpu	t setting Utput setting W ALC Control	ADC I DAC I
				Load	
DemoSequence_NAU8	3C14 3C14+Sidetone			1 1	
1				1 3	
$\overline{2}$		ALC			
Input Path	MDC ADC	5-Band Equalizer	DAC	Output Path	
		Digital Audio			
Other Control	1				
Device Control	PLL PLL		Register Control		
🛠 Demo	Audio Dath		Register Mag	Batch Script	
	Audio Paul				

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 NAU88C14 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.

le Chip Select Page	Tool Help										
Connect Connect Phase Lock Loop C Con Start Page C Audio Read All Write All	Digital Audio Path 2 Rev Read Write	(2) Equali Balance Address Control Control	zer tch Script 🏶 Device Value _{IX} 000	Control 🎊 D	lemo 🛛 🚺	Input Settin Export Goto	g 🔹 O	utput Setting Import) 🕢 ALC Control 💆 ADC 📓	DAC	?☆
Register Map Setting N/	AU88C14 Regis	ter Map	Velue (DTN)	_							
Register Name	Address(HEX)	Value(HEX)	Value(BIN)	(1)					Continue Read All		
SOFTWARE_RESET	00	000	00000000						Timer Interval: 1000 ms		
POWER_MANAGEMENT1	01	15D	101011101								
POWER_MANAGEMENT2	02	015	000010101								
POWER_MANAGEMENT3	03	OED	011101101								
AUDIO_INTERFACE	04	050	001010000								
COMPANDING	05	000	00000000								
CLOCK_CONTROL1	06	008	000001000								
CDUCK_CONTROL2	0/	000	00000000								
	08	000	00000000								
DAC_UCIKE	0A 0P	008	000001000								
AC_VOLUME	OB	108	100001000	-							
ADC_CIKL	OE	106	011111111								
EO1 LOW CUTOEE	12	120	100101100								
	12	020	000101100								
EQ2_PEAK2	14	020	000101100								
EQUILINA PEAKS	15	020	000101100								
EOS HIGH CUTOFF	16	020	000101100								
DAC LIMITER1	18	032	000110010					_			
DAC LIMITER2	19	000	00000000								
AND A REAL PROPERTY AND A			000000000000000000000000000000000000000								

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 NAU88C14, 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-NAU88C14, NU-NAUSB2I2C can convert the ADC data signal and deliver it to the PC, allowing the user to verify the ADC functionality of the NAU88C14 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-NAU88C14 will be shown on the audio track.



Figure 3-11 Audacity Recording Settings

4 SCHEMATICS

4.1 NL-NAU88C14 Schematic

Figure 4-1 shows the NL-NAU88C14 circuit.



4.2 NL-NAU88C14 PCB Layout

Figure 4-2 shows the placement of NL-NAU88C14.



Figure 4-2 NL-NAU88C14 Layout

5 REVISION HISTORY

REVISION	DATE	DESCRIPTION
1.0	Feb 18, 2025	Initial Release
1.1	Apr 24, 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.

Please note that all data and specifications are subject to change without notice. All the trademarks of products and companies mentioned in this datasheet belong to their respective owners.