Overview

Provide Pico C demo.

Introduction

The Pico-Audio is an audio expansion module designed for Raspberry Pi Pico, which incorporates PCM5101A low power stereo decoder, and uses I2S bus for transmitting the audio signals. It supports a wide range of audio sampling rates, and allows headphone and speaker signal output at the same time.



Rev2.1 version: This product is an audio module designed based on Pico. It adopts a CS4344 low-power stereo decoder, an I2S interface to transmit audio, and supports a wide range of audio sampling frequencies. It also can be output by headphones and speakers at the same time.

Features

- Support audio sampling frequency of 8~384,000Hz.
- Using 3-wire I2S, effectively reducing EMI.
- With undervoltage protection and a double mute system, it can automatically mute (stop output) when there is a clock error or power failure.
- Provides 20dB of out-of-band noise.
- Onboard standard 3.5mm headphone and 4-wire speaker output interface, support audio output.
- Provides Pico sound card, driver-free driver, compatible with Windows, Linux and other systems.
- Pico audio player provided.

Rev2.1:

- Support audio sampling frequency of 2~200KHz.
- The chip has a built-in PLL, and the audio clock pin can obtain the main clock screen and automatically reduce the frequency.
- Onboard standard 3.5mm headphone and 4-wire speaker output interface,

support audio output.

- Provides Pico sound card driver-free program, compatible with Windows, Linux and other systems.
- Pico audio player provided.

Specification

- Operating voltage: 5V
- Logic voltage: 3.3V
- Audio Decoder: PCM5101A
- DAC SNR: 106 dB
- Logic level: 3.3V
- Audio bus: I2S
- Speaker driving: 2.6W/channel (4 Ω BTL)
- Earphone driving: 40W per channel ($16@\Omega 3.3V$)

Rec2.1

- Operating voltage: 5V
- Logic voltage: 3.3V
- Audio Decoder: CS4344
- DAC SNR: 105 dB
- Logic level: 3.3V
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- Speaker driving: 2.6W/channel (4 Ω BTL)
- Earphone driving: 40W per channel ($16@\Omega 3.3V$)

Hardware Resource

Initial Version

GP0	1	"usp"	40	VBUS	V	SYS	Power supply
GND	2		39	GND	3V3	(OUT)	Logic power
GP2	4		37	3V3_EN		ND	Conund
	5	11111111	36	3V3(OUT)		SND	Ground
	7		34	GP28	GP26	DIN	Audio data input
GND	8	TABAPA	33	GND	GP27	BCK	Audio data bit clock input
	9		32	GP27 GP26	6000	LDC1/	
	11		30	RUN	GP28	LRCK	Audio data word clock input
GP9	12	1 Hanniels	29	GP22			
GND GP10	13		28	GND			
GP11	15		26				
	16		25				



L+ and L- correspond to the positive and negative poles of the left speaker respectively; R+ and R- correspond to the positive and negative poles of the right speaker respectively.

Pin Function	Pico Pins (BCM)	Description				
VSYS	VSYS	Power supply (5V power input)				
3V3(OUT) 3V3(OUT)		Logic Power (3.3V Power Input)				
GND	GND	Power Ground				
DIN	GPIO26	Audio data input				
BCk	GPIO27	Audio data bit clock input				
LRCK GPIO28		Audio data word clock input				

Rev2.1 Version

	1	USB.	40	VBUS	V	'SYS	Power Supply (5V)
GND	3	Banan B	38	GND	(GND	Ground
	4		37	3V3_EN 3V3IOUTD	GP22	DIN	Audio data input
	6	-	35	ADC_VREF	GP26	MCLK	Chip master clock input
GND	8		33	GP28 GND	GP27	LRCK	Audio data word clock input
	9	erece Brimer	32	GP27 GP26	GP28	SCLK	Audio data bit clock input
	11		30	RUN GP22	0-20	JULK	Audio data bit clock input
GND	13		28	GND			
	14 15		27				
	16		25	GP19 GP18			
GND	18		23	GND			
	20		22				

L+ and L- correspond to the positive and negative poles of the left speaker respectively; R+ and R- correspond to the positive and negative poles of the right speaker respectively.

Function Pin	Pico Pin (BCM)	Description		
VSYS	VSYS	Power supply (5V)		
GND	GND	Ground		
DIN	GPIO22	Audio data input		
MCLK	GPIO26	Chip main clock input		
LRCK	GPIO27	Audio data word clock input		
SCLK GPIO28		Audio data bit clock input		

Dimension

•



12S

■I2S通信协议1.png

The most important thing to note about the I2S protocol is that it takes the second clock after the change of the sampling pulse as the first bit of data, and the first clock after the change of the following sampling pulse as the last bit of data. LRCK: Audio data word clock input, when it is low level for the left channel data acquisition when it is a high level for the right channel data acquisition. BCK: Audio data word clock input, when it produces a rising edge jump to collect data, the frequency must be 32 or 48 or 64 times the frequency of LRCK. DATA: Audio data input, note that the data is signed data, data transmission can choose 16-bit, 24-bit, 32-bit data, high in the front, low in the back.

Get Started with Pico

Hardware Connection

Please take care of the direction when connecting the board to Pico according to the USB port.

You can also wire it according to the table:

PCM5101A	Pico		Description				
VSYS	VSYS		Power input (5V)				
3V3(OUT)	3V3(OUT)		Logic level (3.3V)				
GND	GND		Ground				
DIN	DIN GPIO26		Audio data input				
BCk	GPIO27		Audio data bit clock input				
LRCK	GPIO28		Audio data word clock input				
Pico-Audio Rev2.1		Pico	Description				
VSYS		VSYS	Power supply (5V)				
GND		GND	GND Ground				

DIN	GPIO22	Audio data input
MCLK	GPIO26	Chip main clock input
LRCK	GPIO27	Audio data word input
SCLK	GPIO28	Audio data bit input



Download Examples

Open a terminal of Raspberry Pi and run the following commands:

```
sudo apt-get install p7zip-full
cd ~
sudo wget https://files.waveshare.com/upload/7/7c/Pico_Audio.7z
7z x Pico_Audio.7z -o./Pico-Audio
cd ~/Pico_Audio
```

Please use the following command for Rev2.1:

```
sudo apt-get install p7zip-full
cd ~
sudo wget https://files.waveshare.com/upload/9/92/Pico-Audio-V2.7z
7z x Pico-Audio-V2.7z -o./Pico-Audio-V2
cd ~/Pico-Audio-V2
```

There are two folders in the Pico_Audio file, the audio output program is stored in the Pico_Audio folder, and the uf2 file of the sound card is stored in the usb_sound_card folder, which can be copied directly into Pico.

Run Examples

C Codes

- The following tutorials are operated on the Raspberry Pi, but due to the multiplatform and portable characteristics of CMake, it can be compiled successfully on the PC, but the operation is slightly different, and you need to judge by yourself.
- Go into the Pico-Audio directory and build the codes.

cd ~/Pico_Audio/Pico-Audio/

Please use the following command for Rev2.1.

cd ~/Pico-Audio-V2/Pico-Audio/

Create a "build" folder and enter, add the path of SDK:

../../pico-sdk is the default path of SDK, you need to modify it if the actual path is different in your pi.

We have created the build folder in the example, you can just enter it.

```
cd build
export PICO_SDK_PATH=../../pico-sdk
```

Run cmake to generate Makefile file:

cmake ..

Run make command to build the codes:

make -j9

After building, the uf2 file is generated.

Press and hold the key on the Pico board to connect the Pico to the USB port of the computer through the Micro USB cable, then release the key. After plugging in, the computer will automatically recognize a removable disk (RPI-RP2). Copy the audio_firmware.uf2 file in the build folder to the removable disk (RPI-RP2) recognized.

Resource

Documents

- Schematic Diagram
- Schematic-Rec2.1
- PCM5101A Datasheet 🗗
- APA2068 Datasheet
- CS4344 🗗

Demo Codes

- Demo code 🗗
- Example-Rev2.1

Development Software

- Thonny Python IDE (Windows V3.3.3) &
- Zimo221.7z ₽
- Image2Lcd.7z ₽

Pico Quick Start

Download Firmware

MicroPython Firmware Download	
C_Blink Firmware Download	[Expand]
Video Tutorial	[Expand]
Pico Tutorial I - Basic Introduction	
Pico Tutorial II - GPIO	[Expand]
Pico Tutorial III - PWM	[Expand]
Pico Tutorial IV - ADC	[Expand]
Pico Tutorial V - UART	[Expand]
 Pico Tutorial VI - To be continued 	[Expand]

MicroPython Series

- [MicroPython] machine.Pin Function
- [MicroPython] machine.PWM Function
- [MicroPython] machine.ADC Function
- [MicroPython] machine.UART Function
- [MicroPython] machine.I2C Function
- [MicroPython] machine.SPI Function
- [MicroPython] rp2.StateMachine

C/C++ Series

- 【C/C++】 Windows Tutorial 1 Environment Setting
- 【C/C++】 Windows Tutorial 1 Create New Project ₽

Arduino IDE Series

Install Arduino IDE

1. Download the Arduino IDE installation package from Arduino website d.



Downloads



The new major release of the Arduino IDE is faster and even more powerful! In addition to a more modern editor and a more responsive interface it features autocompletion, code navigation, and even a live debugger.

For more details, please refer to the Arduino IDE 2.0 documentation.

Nightly builds with the latest bugfixes are available through the section below.

SOURCE CODE

The Arduino IDE 2.0 is open source and its source code is hosted on GitHub.

DOWNLOAD OPTIONS

Windows Win 10 and newer, 64 bits Windows MSI installer Windows ZIP file

Linux Appimage 64 bits (X86-64) Linux ZIP file 64 bits (X86-64)

macOS 10.14: "Mojave" or newer, 64 bits

2. Just click on "JUST DOWNLOAD".

Support the Arduino IDE

Since the release 1.x release in March 2015, the Arduino IDE has been downloaded **69,954,557** times — impressive! Help its development with a donation.



4. Note: You will be prompted to install the driver during the installation process, we can click Install.

Install Arduino-Pico Core on Arduino IDE

1. Open Arduino IDE, click the File on the left corner and choose "Preferences". File Edit Sketch Tools Help

File Edit Sketch 100is Help

Ope	en	Ctrl+O	
Sket	tchbook		×
Exa	mples		۲
Clos	se	Ctrl+W	
Save	e	Ctrl+S	
Save	e As	Ctrl+Shift+S	
Pref	erences	Ctrl+這号	
Adv	anced		۲
Qui	t	Ctrl+Q	

2. Add the following link in the additional development board manager URL, then click OK.

Preferences		>
	Settings Network	
Sketchbook location:		
c:\Users\xutong\Documents\A	rduino	BROWSE
Show files inside Sketches		
Editor font size:	14	
Interface scale:	Automatic 100 %	
Theme:	Light (Arduino) 👻	
Language:	English v (Reload required)	
Show verbose output during	🗌 compile 🗌 upload	
Compiler warnings	None 👻	
Verify code after upload		/
Auto save		
Editor Quick Suggestions		-

Note: If you already have the ESP8266 board URL, you can separate the URLs with commas like this:

https://dl.espressif.com/dl/package_esp32_index.json,https://github.co m/earlephilhower/arduino-pico/releases/download/global/package_rp2040_i ndex.json

3. Click on Tools -> Dev Board -> Dev Board Manager -> Search for pico, it shows installed since my computer has already installed it.

 neip.		
Auto Format	Ctrl+T	
Archive Sketch		
Manage Libraries	Ctrl+Shift+I	
Serial Monitor	Ctrl+Shift+M	
Carriel Diattan		

Board: "ESP32 Dev Module" Port Get Board Info Core Debug Level: "None" Flash Frequency: "240MHz (WIF/BT)" Core Debug Level: "None" Flash Frequency: "240MHz" Flash Mode: "QIO" Flash Size: "4MB (32Mb)" Partition Scheme: "Default 4MB with splifs (1.2MB APP/1.5MB SPIFFS)" PSRAM: "Disabled" Upload Speed: "321600" Bum Bootloader BUM Bootloader BOARDS MANAGER pico Type: All Arduino Mbed OS RP2040 Arduino Boards included in this package: Raspberry Pi Pico More info 4.0.4 INSTALL Raspberry Pi Pico/RP2040 by Earle F. Philhower, III Boards included in this package: Raspberry Pi Pico More info 4.0.4 INSTALL Raspberry Pi Pico/RP2040 by Earle F. Philhower, III Boards included in this package: Raspberry Pi Pico, Raspberry Pi Pico/N, 0xCB Helios, Adafruit Feather RP2040, Adafruit Feather Mere info	Board: "ESP32 Dev Module" Port Get Board Info CPU Frequency: "240MHz (WiFi/BT)" Core Debug Level: "None" Flash Frequency: "80MHz" Flash Mode: "QIO" Flash Size: "4MB (32Mb)" Partition Scheme: "Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS)" PSRAM: "Disabled"	Boards Manager Ctrl+Shift+B Arduino AVR Boards esp32
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More mo	Boards included in this package: Raspberry Pi Pico, Raspberry Pi Pico W, 0xCB Helios, Adafruit Feather RP2040, Adafruit Feather More info	

Upload Demo At the First Time

1. Press and hold the BOOTSET button on the Pico board, connect the Pico to the USB port of the computer via the Micro USB cable, and release the button when the computer recognizes a removable hard drive (RPI-RP2).





- 2. Download the demo, open arduino\PWM\D1-LED path under the D1-LED.ino.
- 3. Click Tools -> Port, remember the existing COM, do not need to click this COM (different computers show different COM, remember the existing COM on your computer).

໑ ເ	GV01	BASE Ar	duino	IDE 2.0.2					
File	Edit	Sketch	Tools	Help					
	1			Auto Format		Ctrl+T			
				Archive Sketch					
P	٦	UGV01_E		Manage Libraries		Ctrl+Shift+I		ServoCtrl.h	connect
		43		Serial Monitor		Ctrl+Shift+M		2047,"spd"	:500,"a
ę		44		Serial Plotter					
	2	45 46							
n-0		47		Board: "ESP32 Dev	Module"		•		
Ш	Ŋ	48		Port			N	Serial po	rts
1165		49		Get Board Info				COM1	
₩ 1	>	50		WIEI101 / WIEININA	Firmware Undater			:0}	
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C		52		Upload SSL Root Ce	ertificates				
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		55		Core Debug Level			۲		
		56		Flash Frequency			۲		
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		60		PSRAM			Þ		
		61		Partition Scheme			Ň		
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		63		upload Speed			P.		
		64		Burn Bootloader					
		65	// S	ET_SPD_RATE	: {"T":901,"	'L":1.0,"R"	:1.	.0}	

4. Connect the driver board to the computer with a USB cable, then click Tools > Ports, select uf2 Board for the first connection, and after the upload is complete, connecting again will result in an additional COM port.

໑ ເ	IGV01	BASE Ar	duino	IDE 2.0.2						
File	Edit	Sketch	Tools	Help						
	1			Auto Format		Ctrl+T				
				Archive Sketch						
P	7	JGV01_E		Manage Libraries		Ctrl+Shift+I		Serv	oCtrl.h	connectio
_		43		Serial Monitor		Ctrl+Shift+M		2047	7,"spd"	:500,"ac
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	2	45 46								
D-0		47		Board: "ESP32 Dev N	/lodule"		•			
Ш	0	48		Port: "COM10"			Þ.		Serial po	rts
		49		Get Board Info					COM1	
T ₽	>	50		MEETOT / MEETNINIA				~	COM10	
		51		WITTOT / WITHNINA	niniware opuater					
0		52		Upload SSL Root Cer	rtificates					
	< l	53 54		CPU Frequency			Þ			
		55		Core Debug Level			×			
		56		Flash Frequency			Þ			
		57 E0		Flash Mode			×			
		59		Flash Size			F			
		60		PSRAM			×			
		61		Dartition Scheme			S.			
		62					8			
		63		Upload Speed			•			
		64		Burn Bootloader						
		65	11 S	ET_SPD_RATE	: {"T":901,"	L":1.0,"R"	:1.	0}		

5. Click Tool -> Dev Board -> Raspberry Pi Pico/RP2040 -> Raspberry Pi Pico.

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10015	пеір

- · · - · P					
Auto Format	Ctrl+T				
Archive Sketch					
Manage Libraries	Ctrl+Shift+I				
Serial Monitor	Ctrl+Shift+M				
Serial Plotter					
WiFi101 / WiFiNINA Firmware Updater					
Upload SSL Root Certificates					
Board: "ESP32 Dev Module"	1	•	Boards Manager	Ctrl+Shift+B	3
Port)	•	Arduino AV/P Poprde		
Get Board Info			esp32		
CPU Frequency: "240MHz (WiFi/BT)"	,	•	Raspberry Pi Pico/RP2040		•
Core Debug Level: "None"	,				_
Flash Frequency: "80MHz"	,	· I ·			
Flash Mode: "QIO"	,	· -			
Flash Size: "4MB (32Mb)"	,				
Partition Scheme: "Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS)"	,	•			
PSRAM: "Disabled"	,	•			
Upload Speed: "921600"	,				
Burn Bootloader					
	Auto Format Auto Format Archive Sketch Manage Libraries Serial Monitor Serial Plotter WiFi101 / WiFiNINA Firmware Updater Upload SSL Root Certificates Board: "ESP32 Dev Module" Port Get Board Info CPU Frequency: "240MHz (WiFi/BT)" Core Debug Level: "None" Flash Frequency: "80MHz" Flash Frequency: "80MHz" Flash Mode: "QIO" Flash Size: "4MB (32Mb)" Partition Scheme: "Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS)" PSRAM: "Disabled" Upload Speed: "921600" Burn Bootloader	Auto Format Ctrl+T Archive Sketch Manage Libraries Ctrl+Shift+I Serial Monitor Ctrl+Shift+M Serial Plotter WiFi101 / WiFiNINA Firmware Updater Upload SSL Root Certificates Board: "ESP32 Dev Module" Port Port Port Port Port Port Port Port	Auto Format Ctrl+T Archive Sketch Manage Libraries Ctrl+Shift+I Serial Monitor Ctrl+Shift+M Serial Plotter WiFi101 / WiFiNINA Firmware Updater Upload SSL Root Certificates Board: "ESP32 Dev Module" Port Get Board Info CPU Frequency: "240MHz (WiFi/BT)" Core Debug Level: "None" Flash Frequency: "80MHz" Flash Mode: "QIO" Flash Size: "4MB (32Mb)" Partition Scheme: "Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS)" PSRAM: "Disabled" Upload Speed: "921600" Burn Bootloader	Auto Format Ctrl+T Archive Sketch Manage Libraries Ctrl+Shift+I Serial Monitor Ctrl+Shift+M Serial Plotter WiFi101 / WiFiNINA Firmware Updater Upload SSL Root Certificates Board: "ESP32 Dev Module" Port Get Board Info Core Debug Level: "None" Flash Frequency: "240MHz (WiFi/BT)" Core Debug Level: "None" Flash Frequency: "80MHz" Flash Mode: "QIO" Flash Size: "4MB (32Mb)" Partition Scheme: "Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS)" PSRAM: "Disabled" Upload Speed: "921600"	Auto Format Ctrl+T Archive Sketch Manage Libraries Ctrl+Shift+I Serial Monitor Ctrl+Shift+M Serial Plotter WiFi101 / WiFiNINA Firmware Updater Upload SSL Root Certificates Board: "ESP32 Dev Module" Port Port Get Board Info Get Board Info Core Debug Levei: "None" Flash Frequency: "80MHz" Flash Mode: "QIO" Flash Size: "4MB (32Mb)" Partition Scheme: "Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS)" PSRAM: "Disabled" Upload Speed: "921600" Burn Bootloader

6. After setting, click the right arrow to upload.



If you encounter problems during the period, you need to reinstall or replace the Arduino IDE version, uninstall the Arduino IDE needs to be uninstalled cleanly, after uninstalling the software you need to manually delete all the contents of the folder C:\Users\
 [name]\AppData\Local\Arduino15 (you need to show the hidden files in order to see it) and then reinstall.

Pico-W Series Tutorial (To be continued...)

Open Source Demo

- MicroPython Demo (GitHub) 🗗
- MicroPython Firmware/Blink Demo (C) ₽
- Official Raspberry Pi C/C++ Demo ₽
- Official Raspberry Pi MicroPython Demo
- Arduino Official C/C++ Demo ₽

Support

Technical Support

If you need technical support or have any feedback/review, please click the **Submit Now** button to submit a ticket, Our support team will check and reply to you within 1 to 2 working days. Please be patient as we make every effort to help you to resolve the issue.

Working Time: 9 AM - 6 AM GMT+8 (Monday to Friday)

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