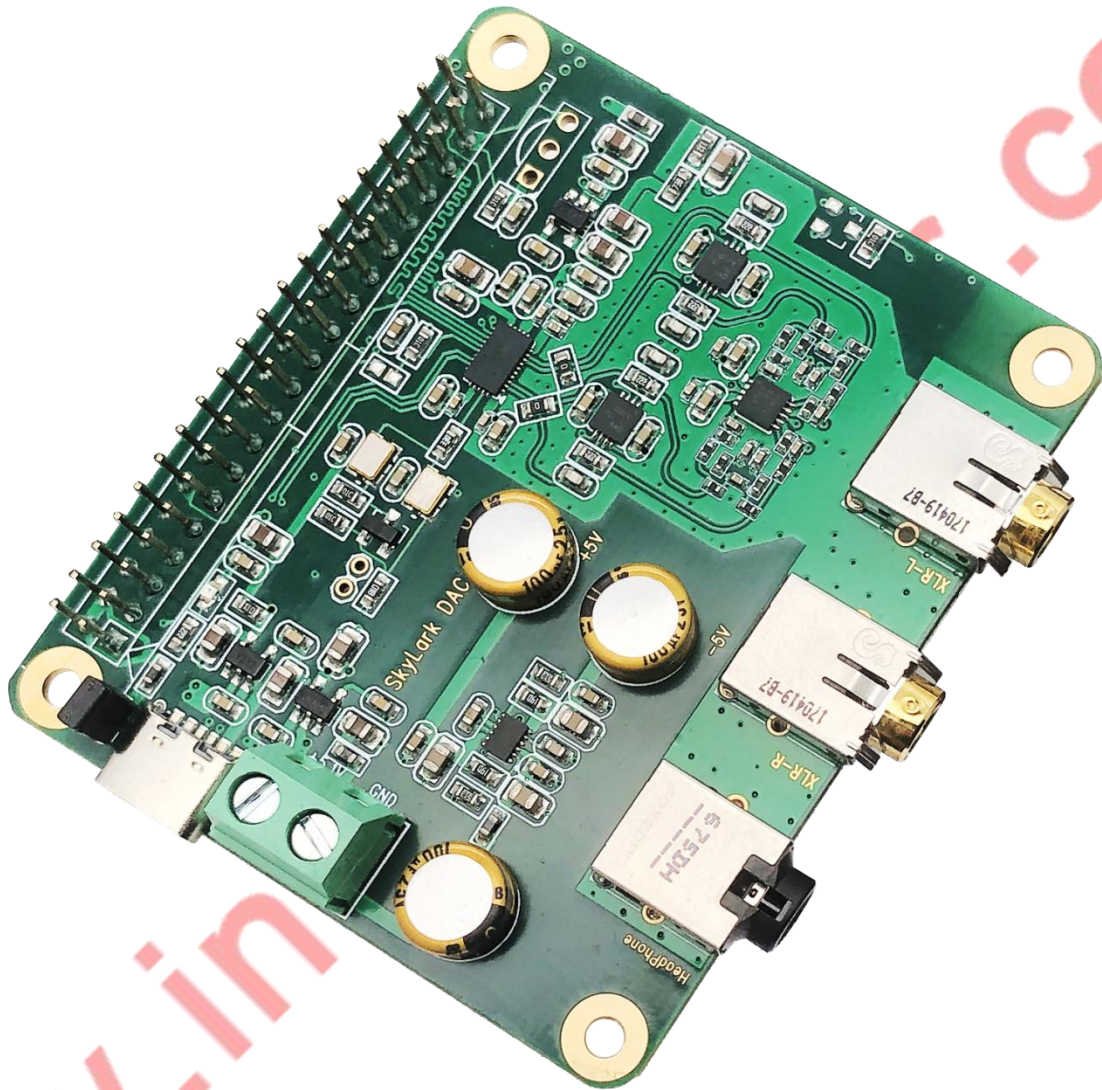


DAC PRO HAT UserManual



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1. General

The Innomaker DAC PRO HAT is based on the world's highest performance audio DAC chip ES9038Q2M. The ES9038Q2M handles up 32-bit/384kHz PCM, DSD256 and DSD512 data in master or slave timing modes. It use the critically acclaimed ESS patented 32-bit HyperStream II DAC architecture and Time Domain Jitter Eliminator and delivers a DNR of up to 129dB and THD+N of -120db, a performance level that will satisfy the most demanding audio enthusiasts.

On-board two low jitter oscillators(45.158M and 49.152M) to support ES9038Q2M master mode ,support more exact sample rate clocks of ES9038Q2M. Different from other DAC hat that forced user to use the IIS master clocks from Raspberry Pi which comes with a lot of jitter, just for save cost and design time.

On-board three Texas Instruments SoundPlus High-Fidelity Audio Operational Amplifier, afford 2.1vrms output. The best output level for most of device.

A lot of high-end music mobile phone, digital music players, digital music workstations were based on the ES9038Q2M chips and same designed. So we are very pleasure to take it to the Raspberry Pi player. No soldering, no additional cables. Just plug it in and do some simple configuration, You can get a same high-class music player, but only pay 1/100 to 1/1000 of the market price.

2. Features

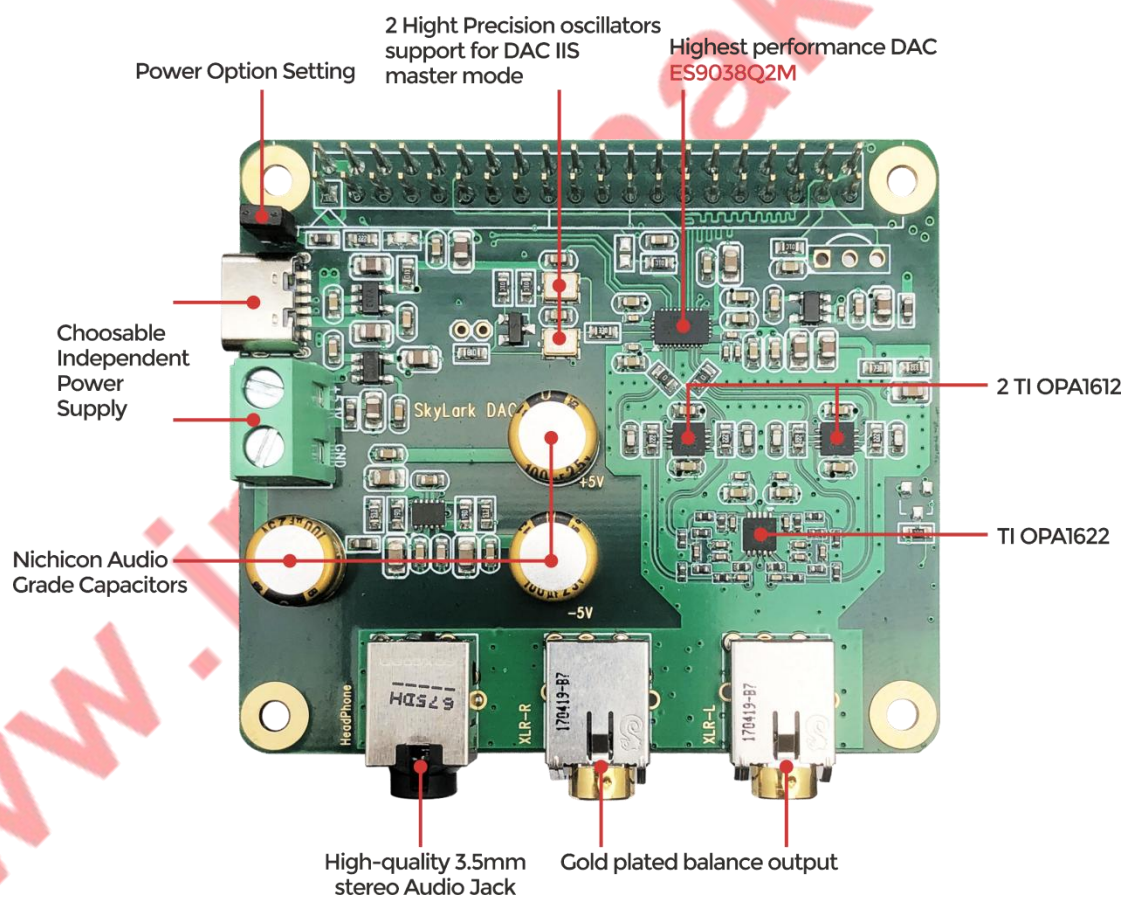
1. Compatible with all Raspberry Pi board via the 40-pin connector. Connects directly to the Raspberry Pi board, no additional cables required, no soldering. Easy to get more beautiful and fantastic sound.
2. Support all Raspberry Pi music playback system ,such as LibreELEC, RuneAudio, Volumio, Moode, PiCorePlayer, OpenELEC, Raspbian, Ubuntu etc. Support play music from a hard disk or over the network.
3. Very High-performance audio DAC ES9038Q2M, sample rates up to 384-KHz/32-Bit. Paired with three Texas Instruments SoundPlus High-Fidelity Audio Operational Amplifier, afford 2.1vrms output.
4. On-board a 3.5mm high-end headphone jack and two balanced out(X- ,X+) output, allow you free to play your music through Raspberry Pi to another terminals.

5. Comes with software, documents and friendly technology support. For more information please refer to our github (view the link on page comes with the goods).

3. Hardware Description

Connect the HIFI DAC HAT module and RPI with 40 pin connector .While installing the module attention to align the first leg of the raspberry pi and HIFI DAC HAT module.

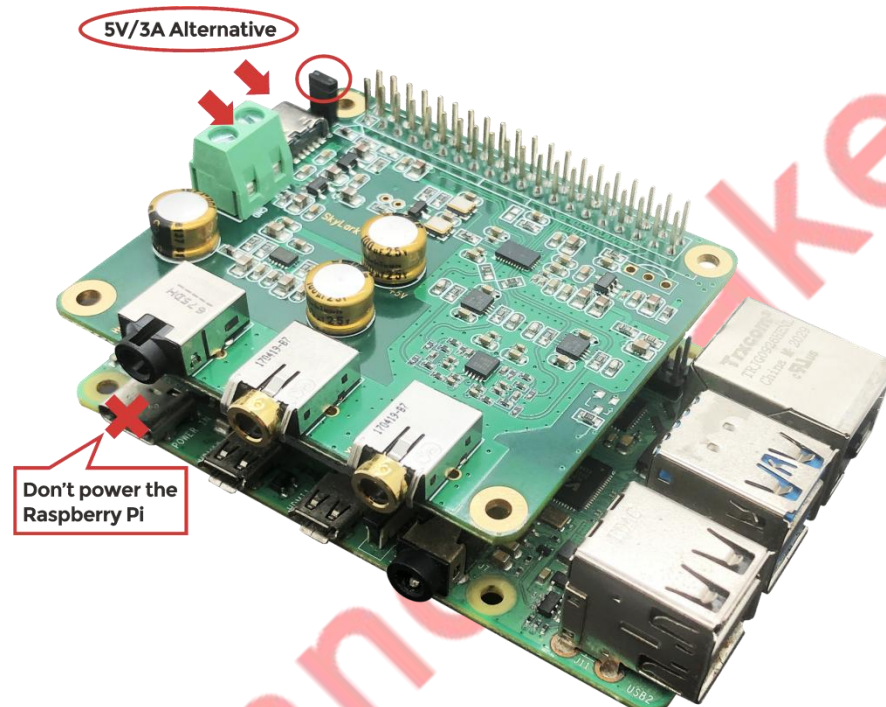
3.1 Overview



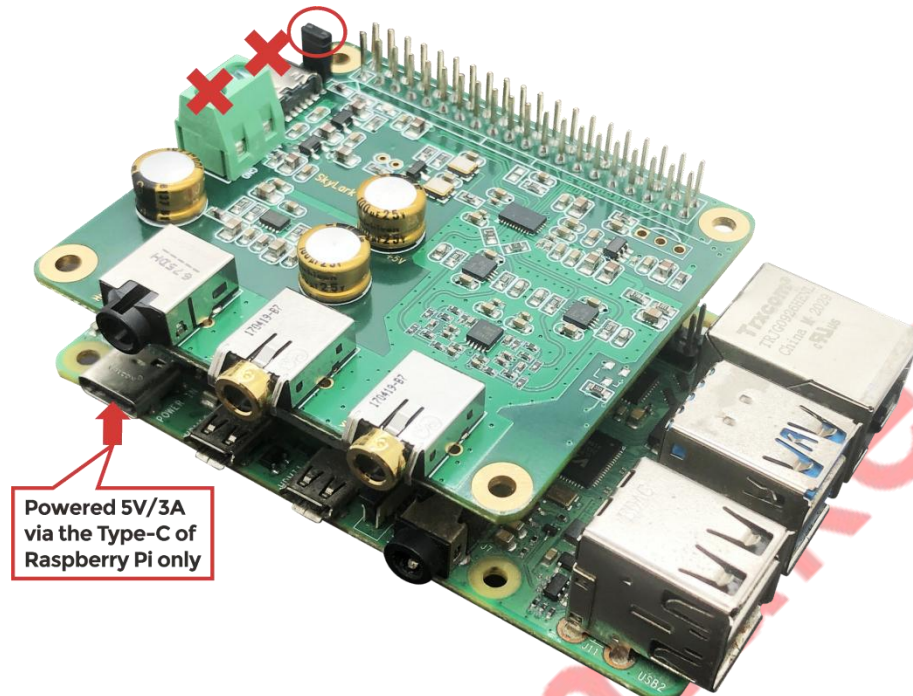
3.2 Power Supply

There are three ways for power supply. We suggest that using the Raspberry Pi 4 official power supply or other clean power source. Otherwise you may hearing a lot of EMI noise.

- 1) Fit the jumper, powered the DAC hat and Raspberry Pi only through the on-board Type-C connector or 2 pins terminal only. Do not use any additional method to power the Raspberry Pi.

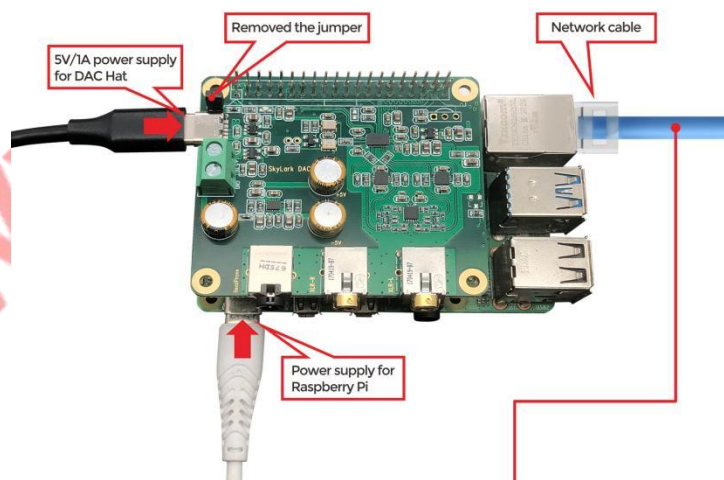


2) Fit the jumper, powered the DAC hat and Raspberry Pi only through the type C port of Raspberry Pi.



3) Remove the jumper, Power the Raspberry Pi and DAC hat separately. This way can be properly isolated the Raspberry Pi and DAC hat. The dac have only need 5V/1A independent power supply. This is the best power supply way for music quality.

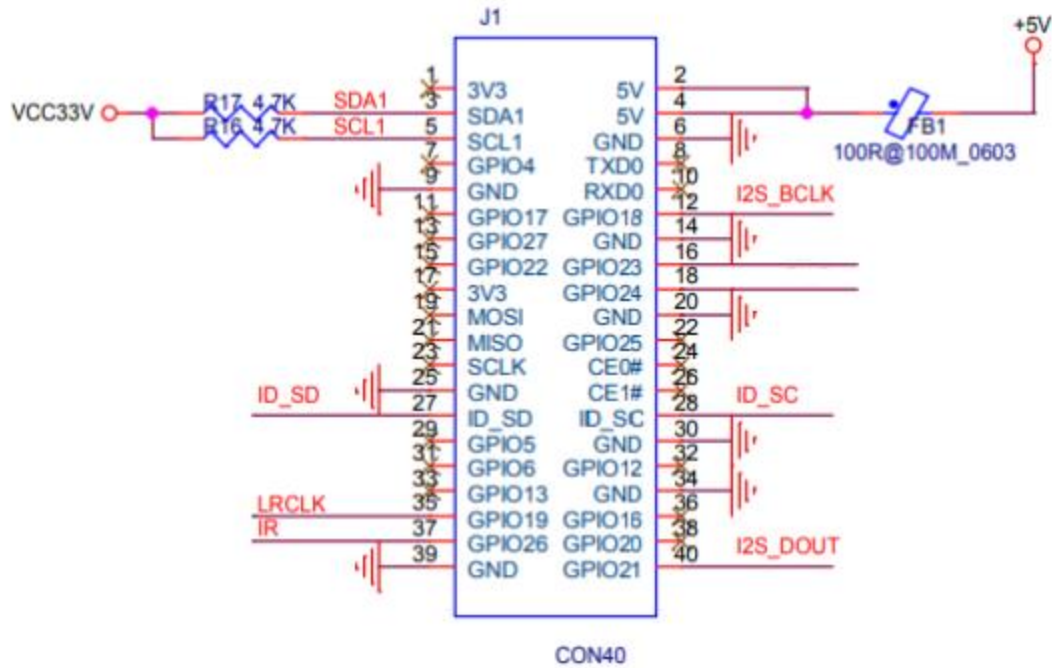
Remove the jumper, Power the Raspberry Pi and DAC Hat separately. This way can properly isolate the Raspberry Pi and DAC Hat. The DAC Hat need only 5V/1A independent power supply. **This is the best power supply way for music quality**



Use wired network instead of the Raspberry Pi build-in WIFI can help you cut noise pollution completely. Esp the build-in WIFI be used as wireless hotspot.

3.3 PINOUT USAGE- FEMALE CONNECTOR

1) 40 PIN Interface Schematic



2) 40 PIN Interface Description

PIN	Symbol	Description
2, 4	+5V	+5V Supply Pin, connected to the main 5V supply of the Raspberry Pi
3	SDA1	SDA Used for DAC and EEPROM
5	SCL1	SCL Used for DAC and EEPROM
12	GPIO_18	IIS_BCLK
35	GPIO_19	IIS_LRCLK
37	GPIO_26	Infrared receiver reserved port
40	GPIO_21	IIS_DOUT
27, 28	ID SC and ID SD	Reserved for an ID EEPROM on the Raspberry Pi. These pins are always reserved and should never be used to connect external components
6, 9, 14, 20, 25, 30, 34, 39	GND	Ground Pin, connected to the main system Ground of the Raspberry Pi

The remaining pins are unused, You can use them for your other hardware boards.

For more information about GPIO of Raspberry PI, please refer to below link:

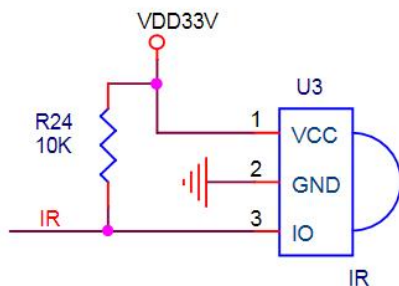
<https://www.raspberrypi-spy.co.uk/2012/06/simple-guide-to-the-rpi-gpio-header-and-pins/#prettyPhoto>

<https://docs.microsoft.com/en-us/windows/iot-core/learn-about-hardware/pinmappings/pinmappingsrpi>

3.4 Extended Function

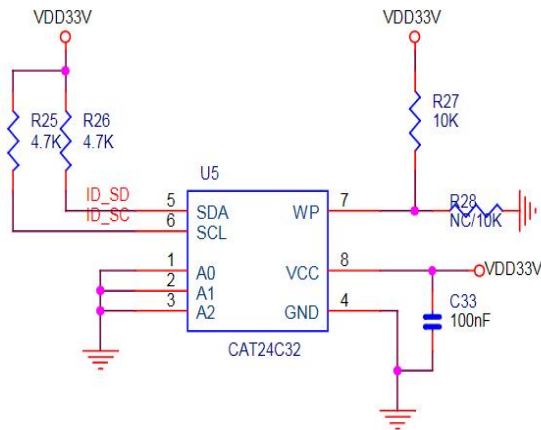
We reserved some function for customer DIY by themselves.

1) Infrared Receiver Function: (U3, No Soldering On-board)



IR is connected to PIN37(GPIO_26) , But we have no software for it right now. We will release new software version after finish it. If you have any advices please feel free to E-mail to us.

2) ID EEPROM: (U5, No soldering on-board)



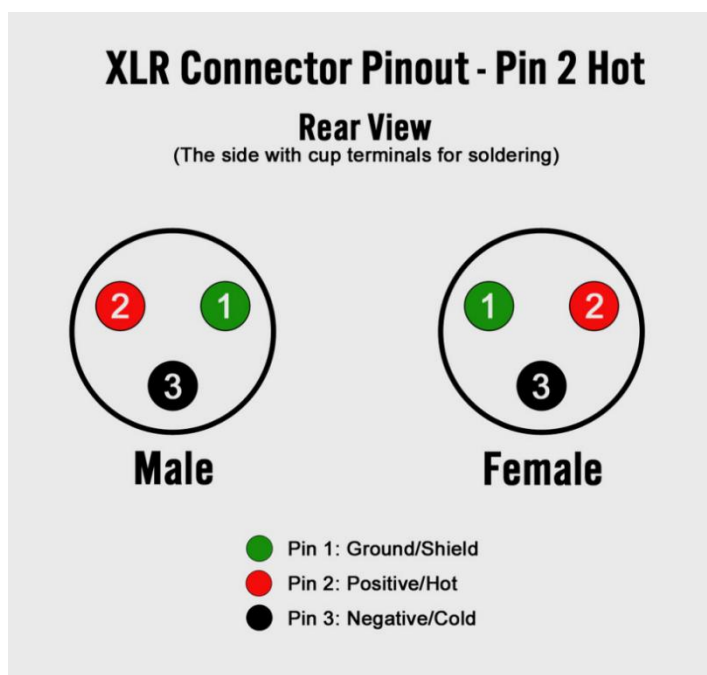
Pin 27 and 28 are always reserved for an ID EEPROM on the Raspberry Pi. Independently which card you use. It's useless for most application. If you want to use this function, you need to solder the IC, resistance and capacitance by yourself.

3.5 Balanced Analog Audio Output (XLR output)

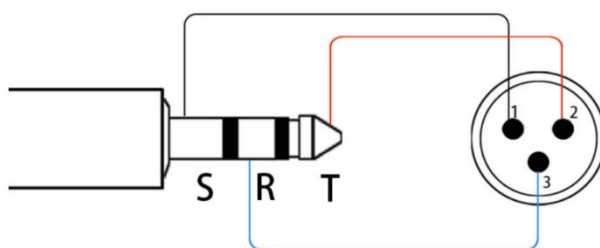
Due the size of the boards, we use two 3.5mm headphone jacks to support balanced analog audio output. So you need to use two 3.5mm to XLR cable for it. We provide this cable on our Amazon shop, and you also can buy from other supplier. Below are the detail features of this cable. Please double check them before you buy the cables.

1) XLR Connector Pinout

Below is the XLR connector we support.



3.5mm to XLR Male



3.5mm

XLR male

4. Software Description

4.1 Overview

HIFI DAC HAT module compatible with many Raspberry pi music playback system such as: OSMC / Max2Play / RuneAudio / Volumio / Moode / PiCorePlayer / PiMusicBox / OpenELEC etc. You can choose your favorite. We take **rAudio/Volumio/MoOde/LibreELEC/Max2play/Raspbian /OSMC** Preset System for Example.

May I draw your attention below:

- 1) Because the third party will update the version unscheduled, so the actual UI may different from below user guide. But the configurations will be the same. If you meet any problem, you can Check the user help on the website of the third party or feel free to e-mail to our support team (support@inno-maker.com).
- 2) The default sound is loud of most system, it may offensive your ears. So please turn down the volume before you enjoy it.

4.2 Download Image from website

Download the latest image for Raspberry PI:

rAudio:

<https://github.com/rern/rAudio/releases>

Volumio Image:

<http://volumio.org/get-started/>

MoOde Image:

<http://www.moodeaudio.org/>

LibreELEC:

<https://libreelec.tv/downloads/raspberry/>

Max2Play Image:

<https://www.max2play.com/en/max2play-image/>

Raspbian and Raspbian lite Image:

<https://www.raspberrypi.com/software/operating-systems/>

OSMC:

<https://osmc.tv/download/>

4.3 Load Image on to SD card.

Prepare a capacity of at least 16GB TF card and a card reader. Load the image file onto a SD card, using the instructions provided on the Raspberry Pi website for Linux, Mac or PC:

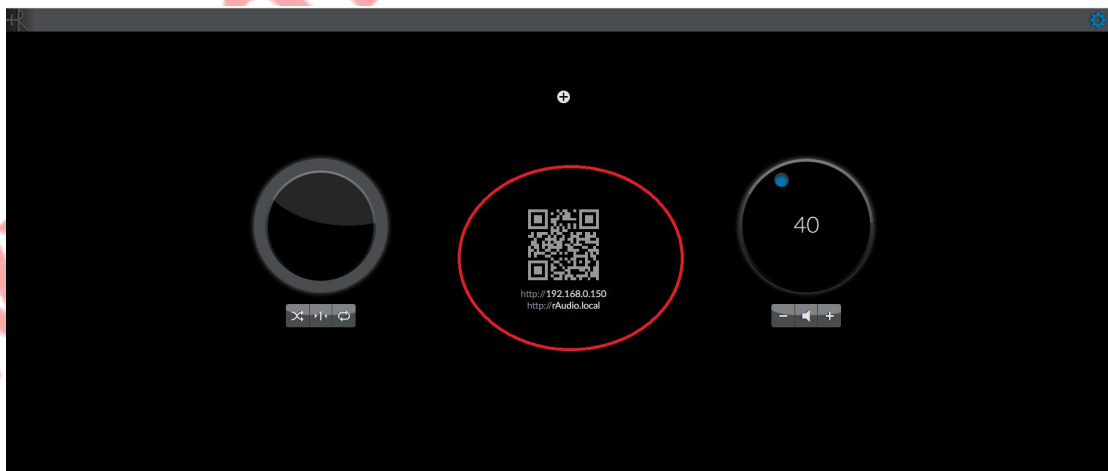
<https://www.raspberrypi.org/documentation/installation/installing-images/README.md>

4.4 rAudio Setup

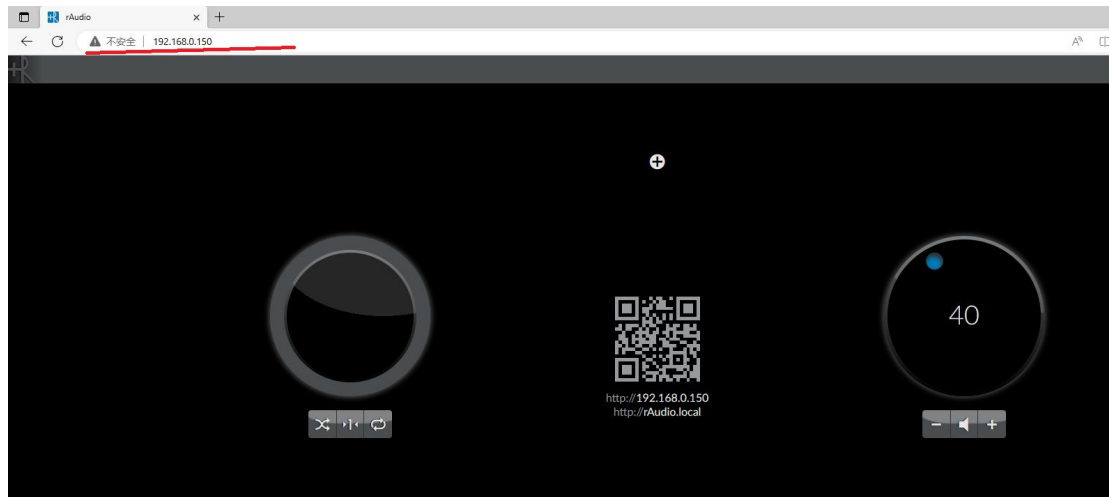
rAudio is an Arch Linux-based, active and constantly improved fork of an audio player project called Runeaudio. It is available for all Raspberry Pi

Step:

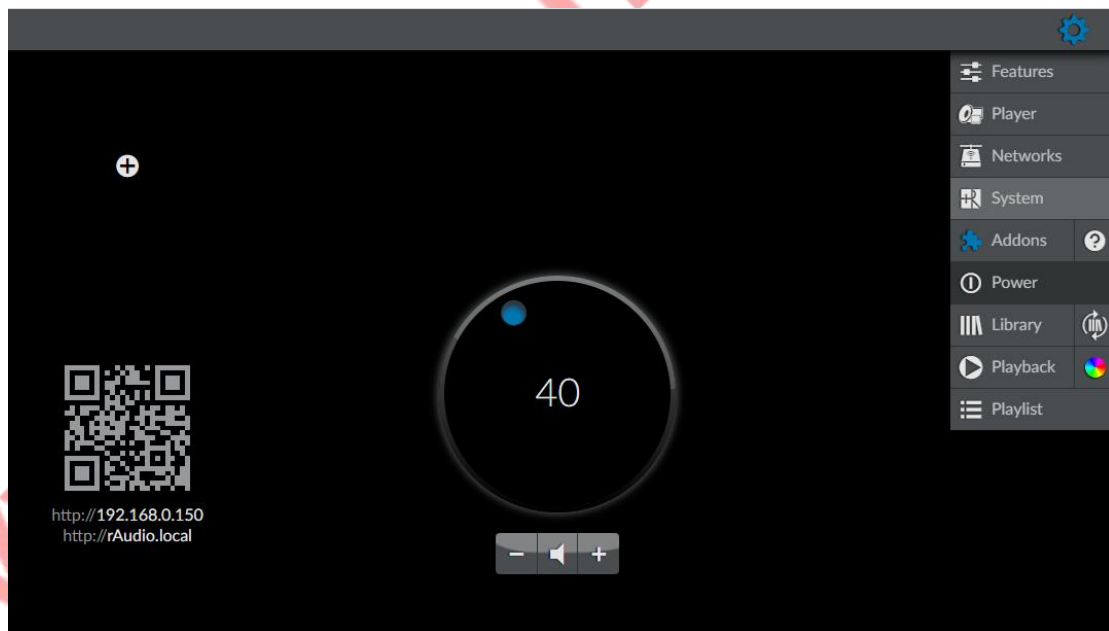
- 1) Insert the TF card with rAudio image into the Raspberry pi then power on.
- 2) Connect the Raspberry Pi to your local router by LAN cable. Check the IP address of Raspberry PI through check up the router or use some IP checker tools. If you have connect Raspberry Pi to HDMI Monitor, you could see the IP directly.



3) Use your device (mobile phones, laptop, pad and so on) which is on the same network. Open the browser, and then enter the IP. You could see the UI of rAudio.



4) Click the setting icon, select the "system"



5) Set the Audio-I2S as "Allo Katana DAC".



4.5 VOLUMIO Setup

Volumio is an entirely new music system. It is designed to play all your music, whether is an Hi-Res file or a Web Radio, with the highest quality. Control it with your favourite device, a smartphone, PC or tablet, and enjoy your music as you never did before.

Volumio is a Free and Open Source Linux Distribution, designed and fine-tuned exclusively for music playback. It supports all filetypes: FLAC, Alac, Aac, Vorbis, Mp3, DSD etc. and support

By flashing (installing) Volumio on any platforms, it will then become a headless Audiophile Music Player. Headless means that the only way to control it will be with another device, such as a Smartphone, Tablet, PC or anything that has a browser.

For more detail please refer to <https://volumio.org/discover/>.

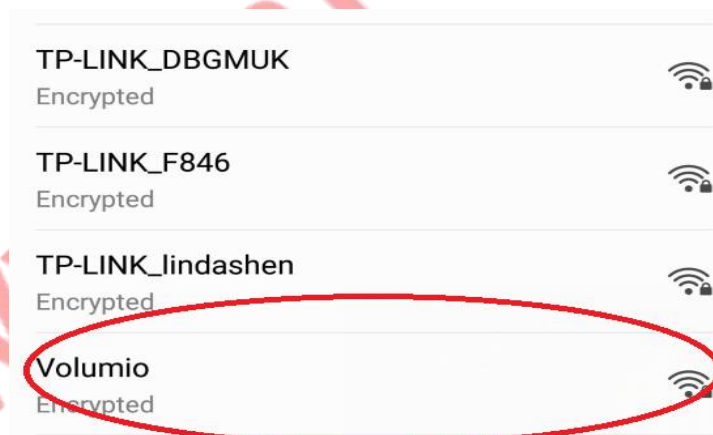
STEP:

1) Insert the TF card with volumio image into the Raspberry pi then power on.

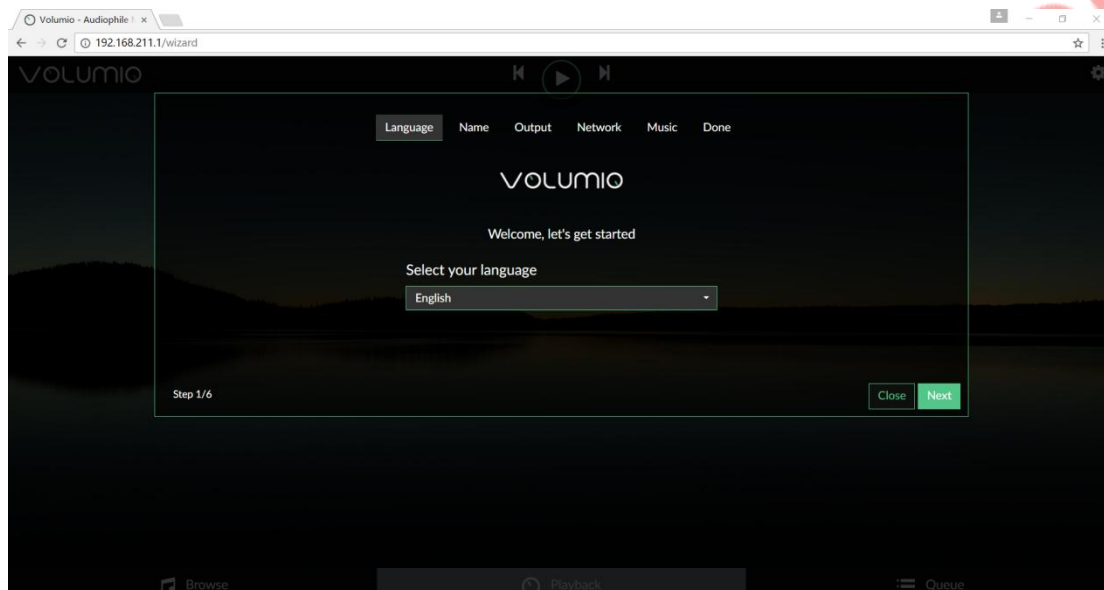
2) By using your smart phone, tablet or any device with WIFI and browser search for WIFI hotspots.

You can see a 'Volumio' name in the search list. Connect this hotspot with password 'volumio2'.

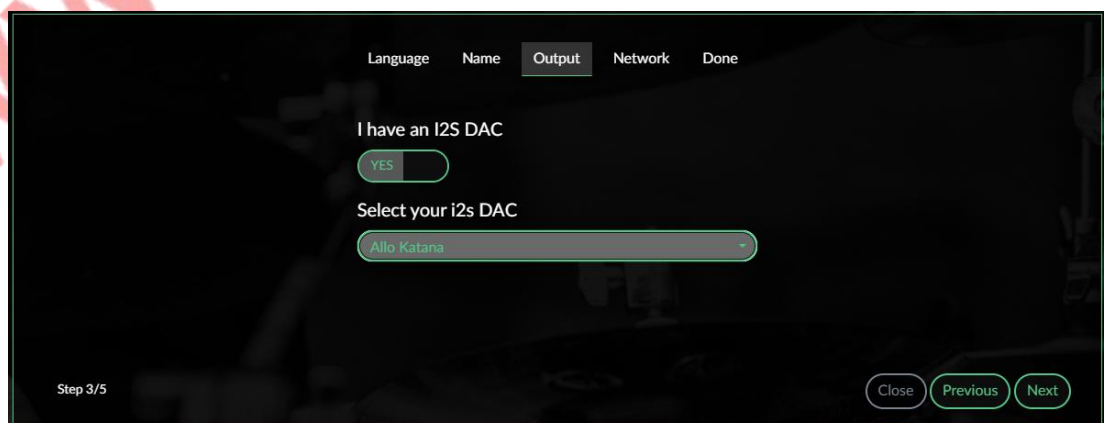
You can change your password after login.



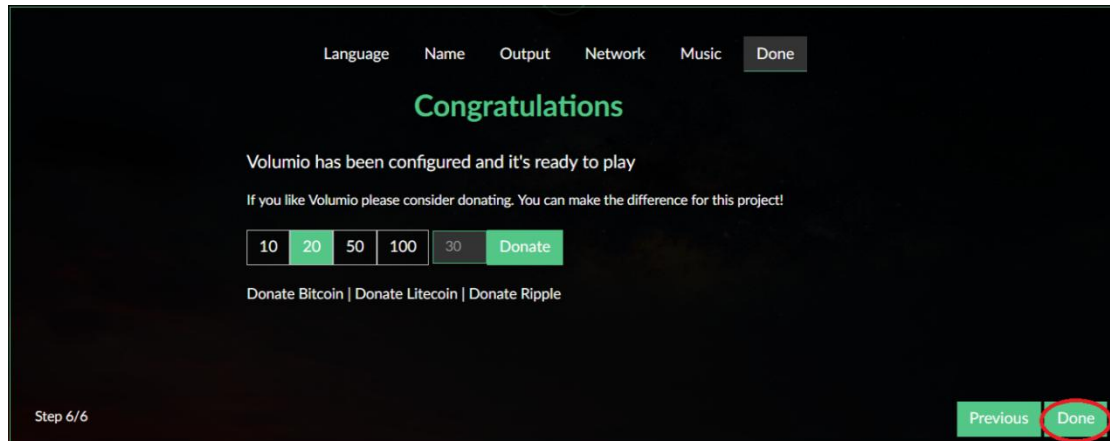
3) The browser will automatically eject playback software UI which is based on web interface (if you connect the hotspot successfully but for some reason browser can't pop up the playback page automatically, you can use <http://192.168.211.1> to login. You can see below wizard of Volumio. We only need to set "Language", "Name" "Output" and "Done" for simple application.



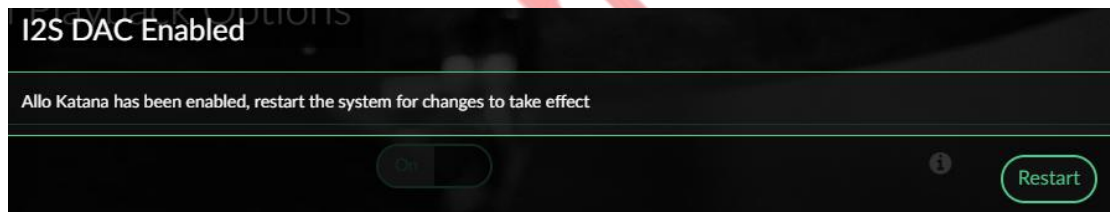
4) It should be noted that 'Output' page must be set as below. This is an essential step, otherwise you can't hear anything.



5) In 'Done' Page, you can see a request for donations from Volumio. It's depend on you. You can give them some help if you like this application. Gifts of roses, hand a fragrance.



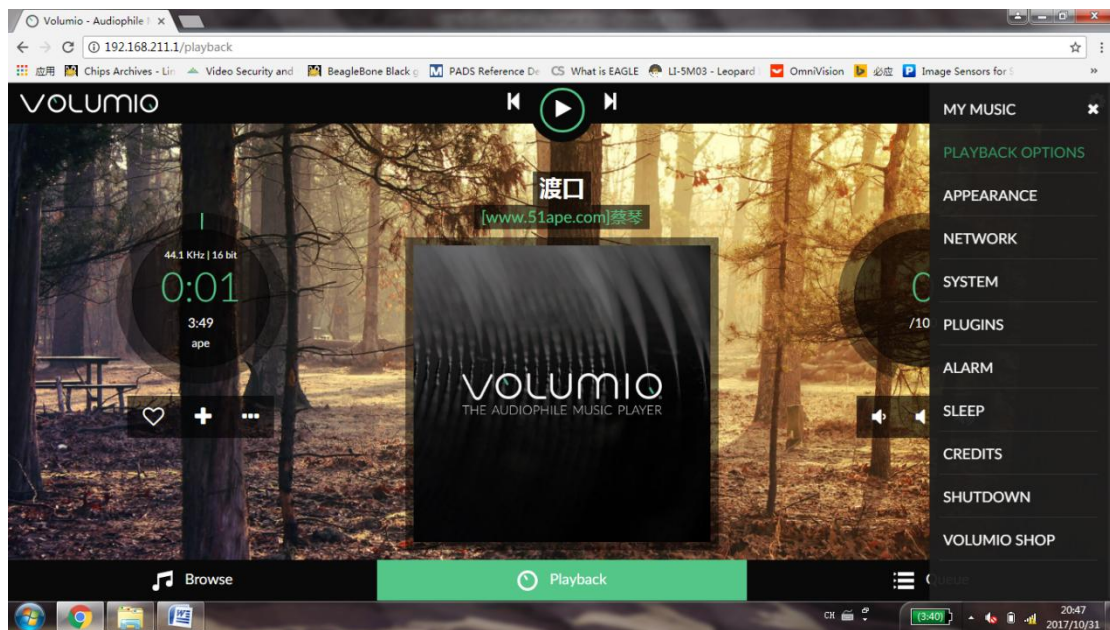
6) Click 'Done' to finish initialization of Volumio. And then restart Volumio.



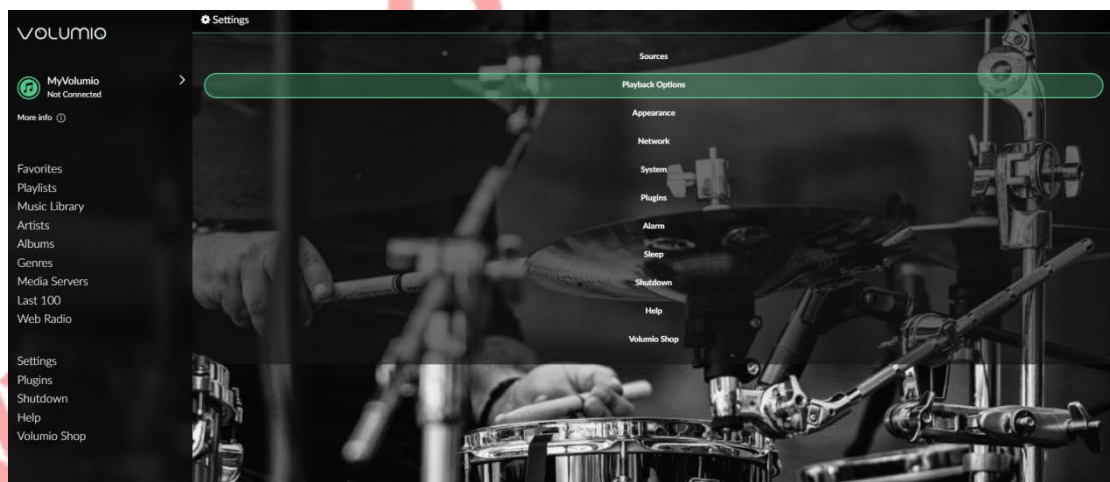
7) In this restart process, "Volumio" hotspot will turn off for a moment. Sometimes your mobile phone, Tablet or PC will automatic reconnect to your wifi nearly. You need to set back to 'Volumio' hotspot. If you have already configure the network of volumio, you need to type Volumios' IP address in your browser. You can look for the IP address with these apps:

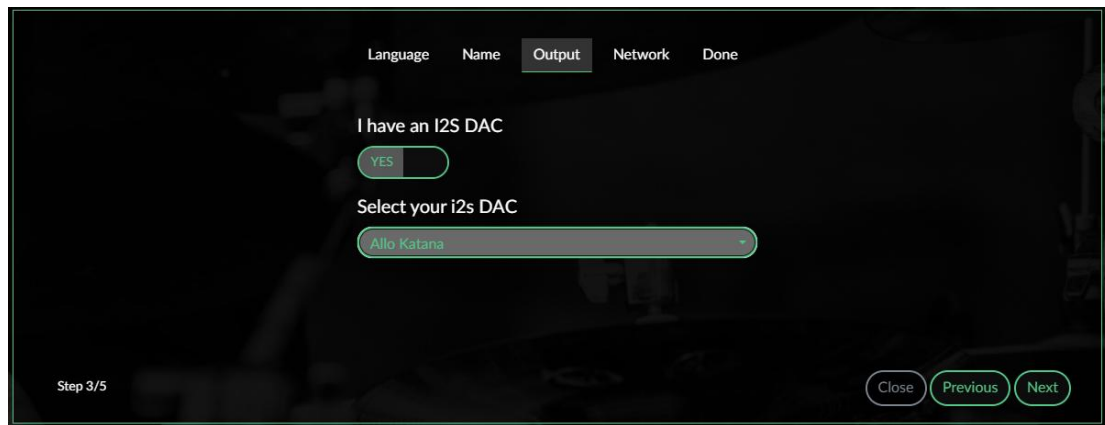
ANDROID & IOS: FING
Chrome: mDNS Browser

After restart you can see the main page of Volumio.

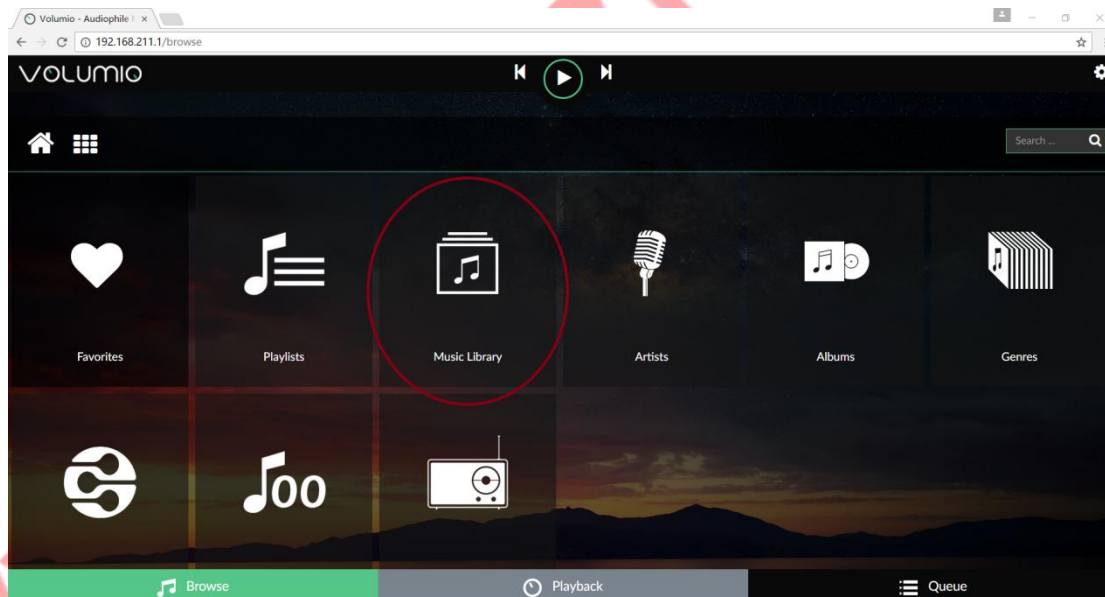


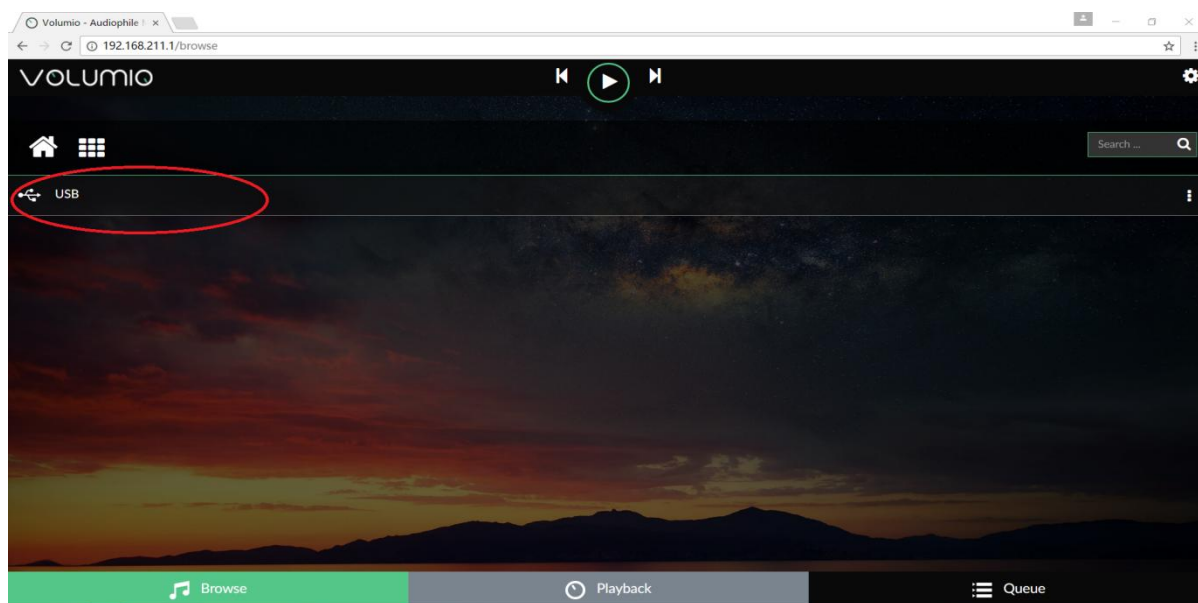
8) If you can't play music properly, please Click 'Setting' → 'PLAYBACK OPTION', check the output setting as below picture. This is an essential step, otherwise you can't hear anything.





9) You can insert the USB Disk or mobile hard disk with your own audio file into Raspberry Pi USB connector, and find the music list of your USD disk in “Music Library” .





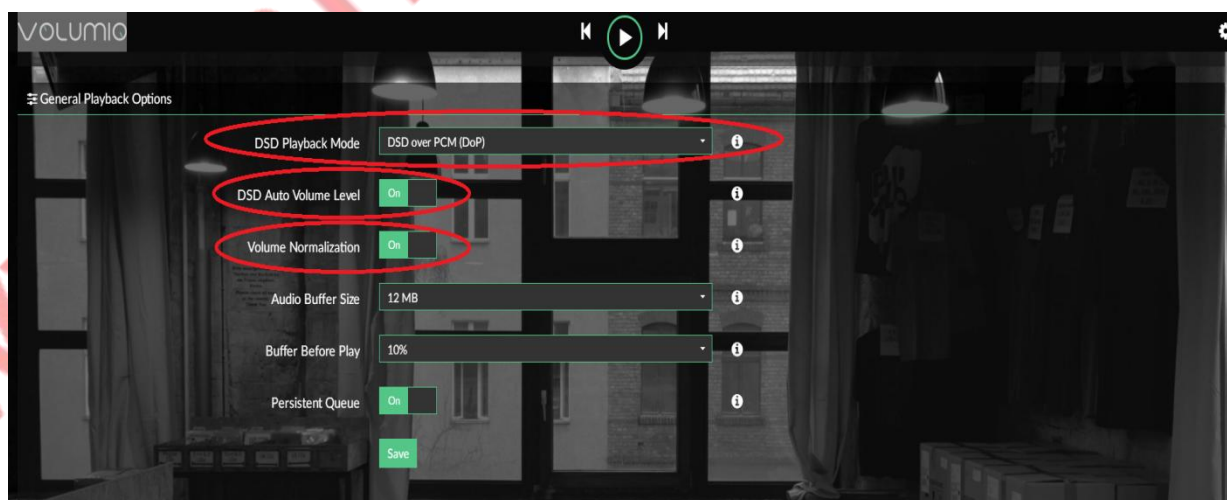
4.6 VOLUMIO Play DSD Music Files

DSD64, DSD128 AND DSD256 are now natively supported in direct DSD mode on Volumio.

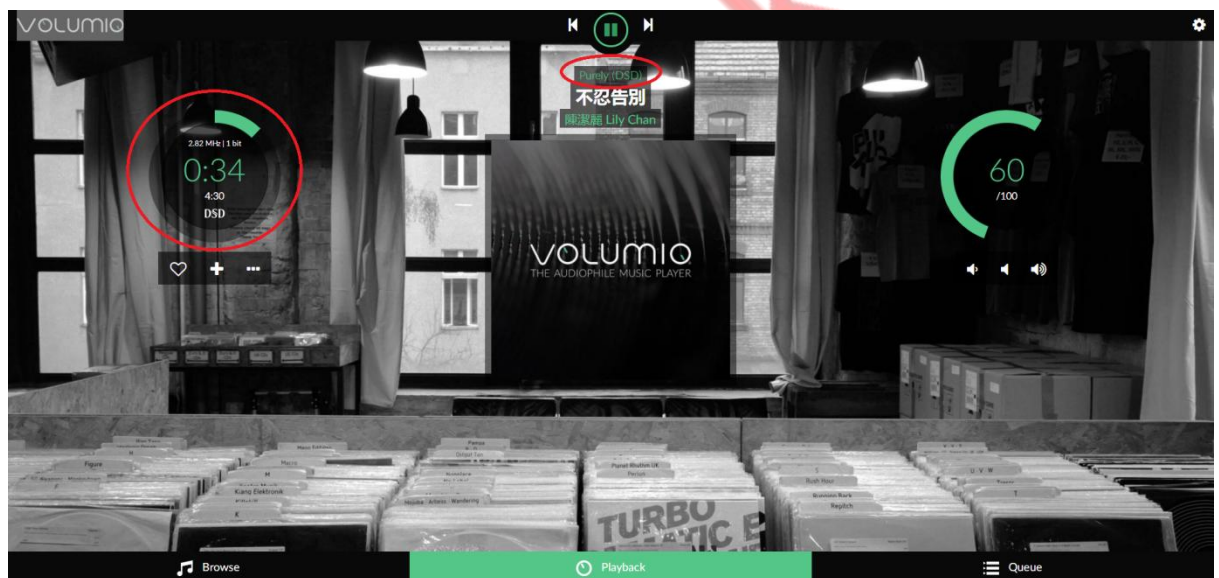
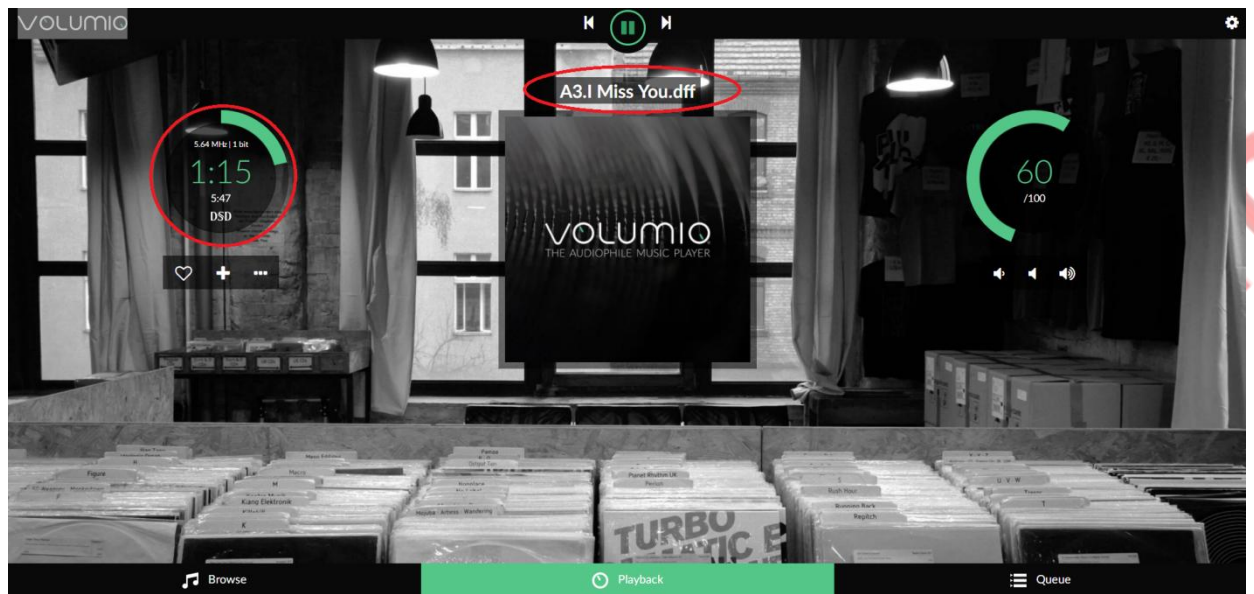
For more DSD information please refer to Volumio link:

<https://volumio.org/direct-dsd-support-volumio-dsd512/>

Please set 'General Playback Options' mode as below picture:



Restart and enjoy DSD music.



4.7 MoOde Setup

1) We just talk about the basics, for more Information please read the official user manual:

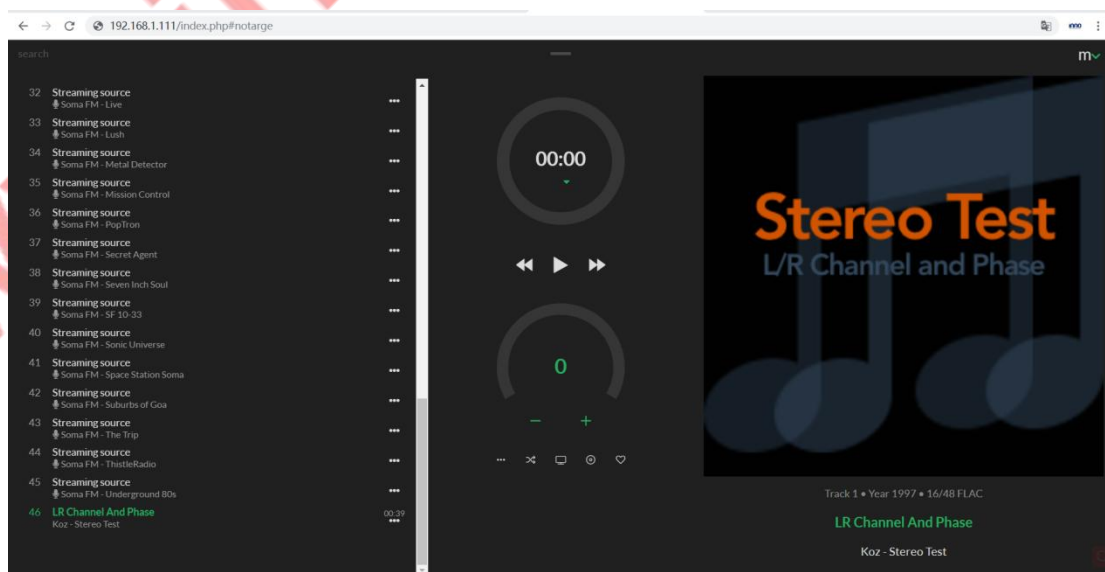
<https://github.com/moode-player/moode/blob/master/www/setup.txt>

2) Insert the TF card with MoOde image into the Raspberry pi, and then connect to your router by LAN cable, Finally power on. Make sure your Raspberry Pi , Desktop (mobile phones, laptop, pad and so on) in the same local area network(LAN). Get the IP address of Raspberry PI through check up the router or use some IP checker tools.

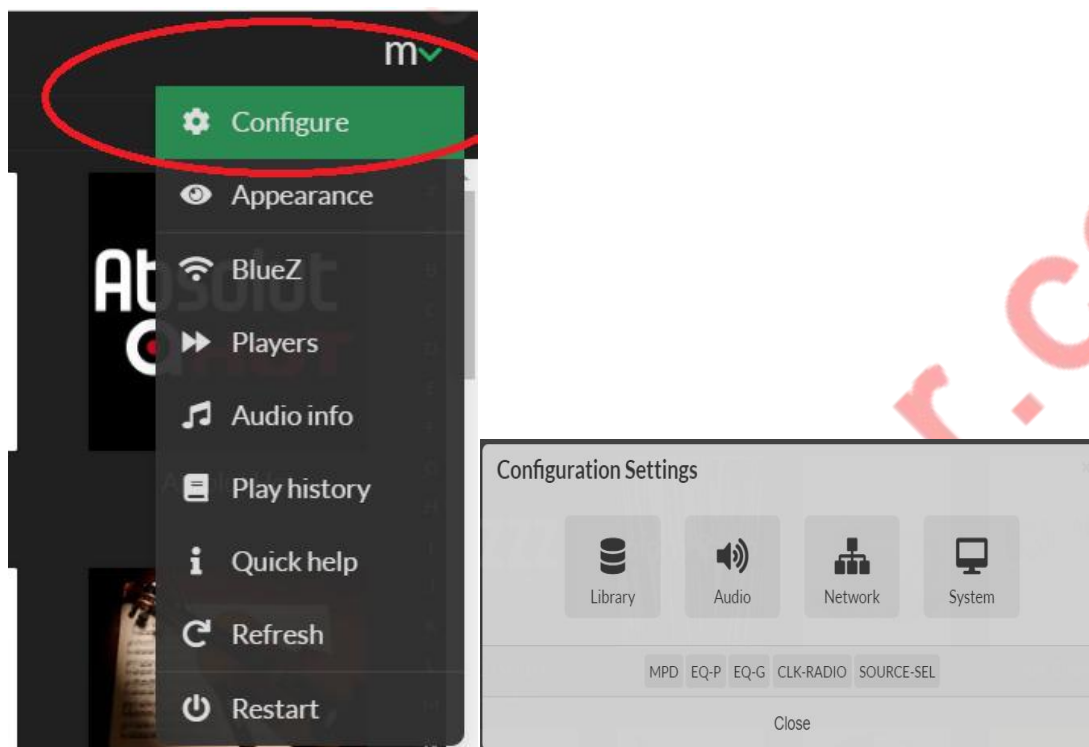


3) You also use your device(mobile phones, laptop, pad and so on) to connect the hotspot of moode. Named: 'Moode', and Password is 'moodeaudio'. Login page: <http://172.24.1.1/>

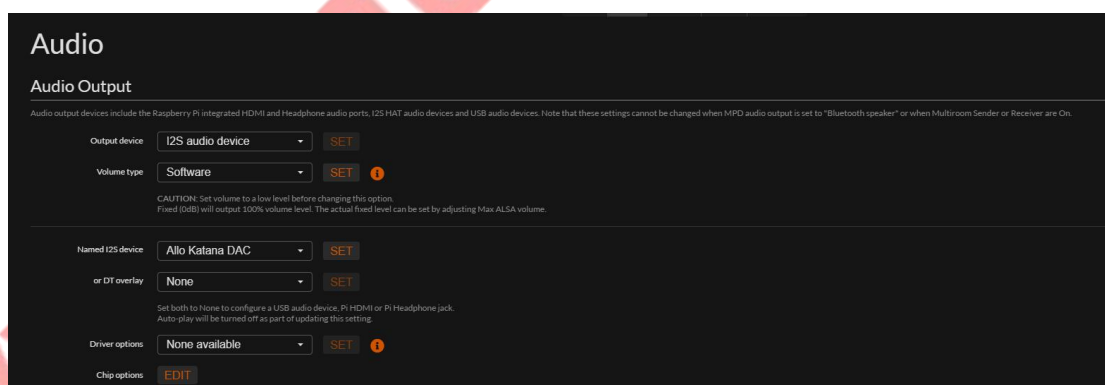
4) Connected the Raspberry Pi through browser. You get the display of Moode.



5) Click the icon in the upper right for setting the system.

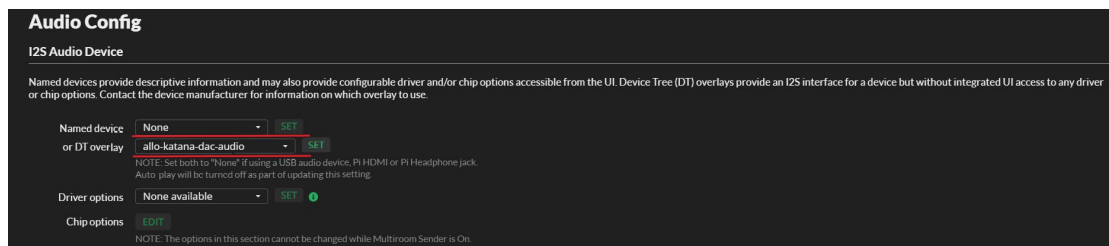


6) Click 'Audio', choose the Output device as **"I2S audio device"** and Named I2S device as **"Allo Katana DAC"**



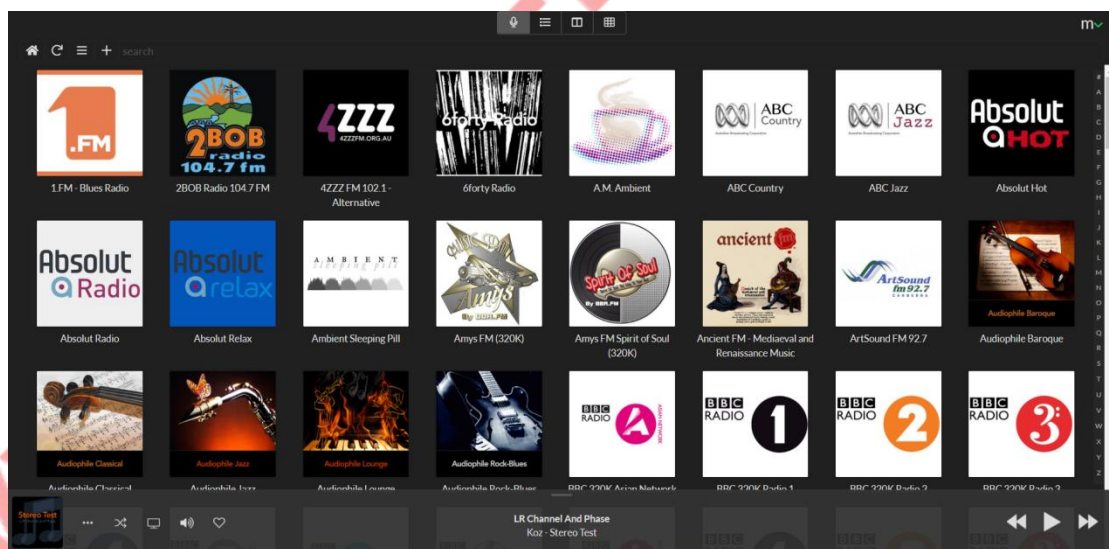
Note:

If you are using the moode earlier version (such as 7.6). Choose 'None' for Named device and select 'allo-katana-dac-audio' for DT overlay. Do not select 'All Katana DAC' for Named device, keep "None". Otherwise the Moode system will be breakdown and only re-image. There may be a BUG for earlier moode.



7) Now you can enjoy your music. For more setting, pls refer to below link

<https://github.com/moode-player/moode/blob/master/www/setup.txt>



4.8 Raspbian System Setup

1) Modify the config.txt

Open the config.txt in system.

```
sudo nano /boot/config.txt
```

```
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Nov 12 10:15:35 2021 from 192.168.0.124

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set
a new password.

pi@raspberrypi:~$ sudo nano /boot/config.txt
```

2) Append the following lines to the end of the file, enable the audio module. Notice the format

Otherwise it doesn't work.

```
dtoverlay=allo-katana-dac-audio
```

```
[cm4]
# Enable host mode on the 2711 built-in XHCI USB controller.
# This line should be removed if the legacy DWC2 controller is required
# (e.g. for USB device mode) or if USB support is not required.
otg_mode=1

[all]

[pi4]
# Run as fast as firmware / board allows
arm_boost=1

[all]
dtoverlay=allo-katana-dac-audio
```

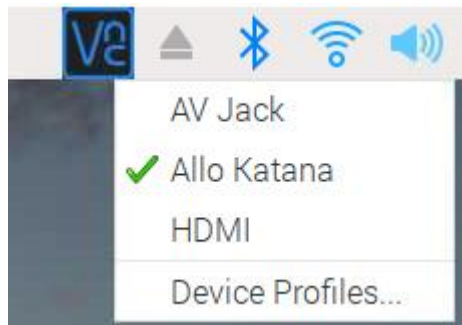
1) And then press ctrl+ x to exit and press 'y' to save.

```
Save modified buffer? [Y] Yes
N No      AC Cancel
```

2) Rebooted your Pi

```
sudo reboot
```

3) Right click the sound icon on the top right corner, set the raspberry pi audio output as 'Allo Katana'. This is an essential step, otherwise you can't hear anything.



4.9 Raspbian Lite SetUp

1) Modify the config.txt

Open the config.txt in system.

```
sudo nano /boot/config.txt
```

```
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Nov 12 10:15:35 2021 from 192.168.0.124

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set
a new password.

pi@raspberrypi:~ $ sudo nano /boot/config.txt
```

Append the following lines to the end of the file, enable the audio module. Draw your attention to the format, Otherwise it doesn't work. press "ctrl+o" and press "Enter" to save the file. Finally, Reboot the system.

```
dtoverlay=allo-katana-dac-audio
```

```
# Uncomment this to enable infrared communication.
#dtoverlay=gpio-ir,gpio_pin=17
#dtoverlay=gpio-ir-tx,gpio_pin=18

# Additional overlays and parameters are documented /boot/overlays/README

# Enable audio (loads snd_bcm2835)
dtparam=audio=on

# Automatically load overlays for detected cameras
camera_auto_detect=1

# Automatically load overlays for detected DSI displays
display_auto_detect=1

# Enable DRM VC4 V3D driver
dtoverlay=vc4-kms-v3d
max_framebuffers=2

# Disable compensation for displays with overscan
disable_overscan=1

[cm4]
# Enable host mode on the 2711 built-in XHCI USB controller.
# This line should be removed if the legacy DWC2 controller is required
# (e.g. for USB device mode) or if USB support is not required.
otg_mode=1

[all]

[pi4]
# Run as fast as firmware / board allows
arm_boost=1

[all]
dtoverlay=allo-katana-dac-audio
```

```
[all]
dtoverlay=allo-katana-dac-audio

Save modified buffer?
Y Yes
N No      ^C Cancel
```

2) Check the DAC module

Type in the commands that are shown below. You can see the DAC device, the **3** is the dac device number.

`aplay -l`

`cat /proc/asound/cards`

```
pi@raspberrypi:~$ aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: Headphones [bcm2835 Headphones], device 0: bcm2835 Headphones [bcm2835 Headphones]
  Subdevices: 8/8
    Subdevice #0: subdevice #0
    Subdevice #1: subdevice #1
    Subdevice #2: subdevice #2
    Subdevice #3: subdevice #3
    Subdevice #4: subdevice #4
    Subdevice #5: subdevice #5
    Subdevice #6: subdevice #6
    Subdevice #7: subdevice #7
card 1: vc4hdmi0 [vc4-hdmi-0], device 0: MAI PCM i2s-hifi-0 [MAI PCM i2s-hifi-0]
  Subdevices: 1/1
    Subdevice #0: subdevice #0
card 2: vc4hdmi1 [vc4-hdmi-1], device 0: MAI PCM i2s-hifi-0 [MAI PCM i2s-hifi-0]
  Subdevices: 1/1
    Subdevice #0: subdevice #0
card 3: Katana [Allo Katana], device 0: bcm2835-i2s-allo-katana-codec allo-katana-codec.1-0030-0 [bcm2835-i2s-allo-katana-codec allo-katana-codec.1-0030-0]
  Subdevices: 1/1
    Subdevice #0: subdevice #0
```

```
pi@raspberrypi:~$ cat /proc/asound/cards
0 [Headphones      ]: bcm2835_headpho - bcm2835 Headphones
bcm2835 Headphones
1 [vc4hdmi0        ]: vc4-hdmi - vc4-hdmi-0
vc4-hdmi-0
2 [vc4hdmi1        ]: vc4-hdmi - vc4-hdmi-1
vc4-hdmi-1
3 [Katana           ]: Allo_Katana - Allo Katana
Allo Katana
```

3) Set as default sound card.

Create `/etc/asound.conf`

`sudo nano /etc/asound.conf`

```
pi@raspberrypi:~$ sudo nano /etc/asound.conf
```

Type in the following content and then press "ctrl+x" and press "Enter" to save the file. Reboot again. 3 is the DAC module device number.

4) Alsamixer

Type in the commands that are shown below, you can see the alsamixer tool.

```

AlsaMixer v1.2.4
Cards: Allo Katana
Chip:
View: F3:[Playback] F4: Capture F5: All
Item: Master [dB gain: -20.00, -20.00]
F1: Help
F2: System information
F6: Select sound card
Esc: Exit

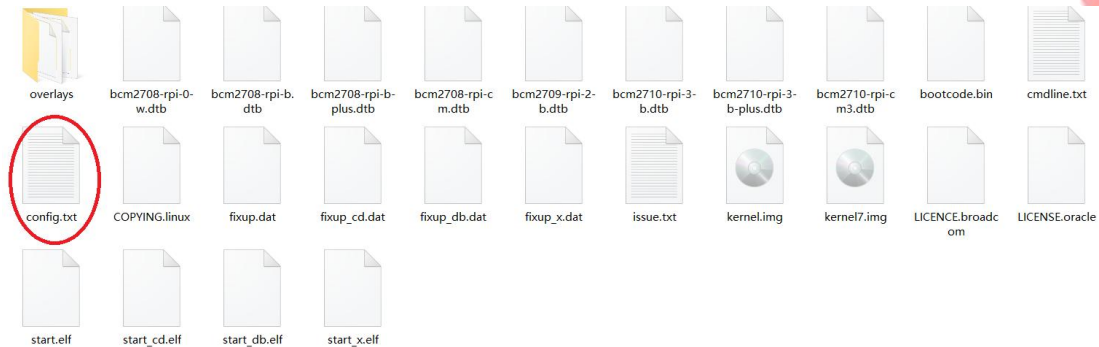
lqqk
x x
x x
x x
x x
x x
x x
x x
x x
x x
x x
x x
xxxx
xxxx
xxxx
xxxx
xxxx
xxxx
xxxx
xxxx
xxxx
xxxx
vqqu Apodizing Fa Bypass lqqk
x00x x00x
mqqd mqqd
46<>46
< Master > DSP Program Deemphasis DoP

```


4.10 LibreELEC Setup

1) Modify the config.txt

After load the LibreELEC image into the TF card, Open TF disk directory on your computer and check the file named config.txt. For more information about this file please refer to :
<https://www.raspberrypi.org/documentation/configuration/config-txt/>



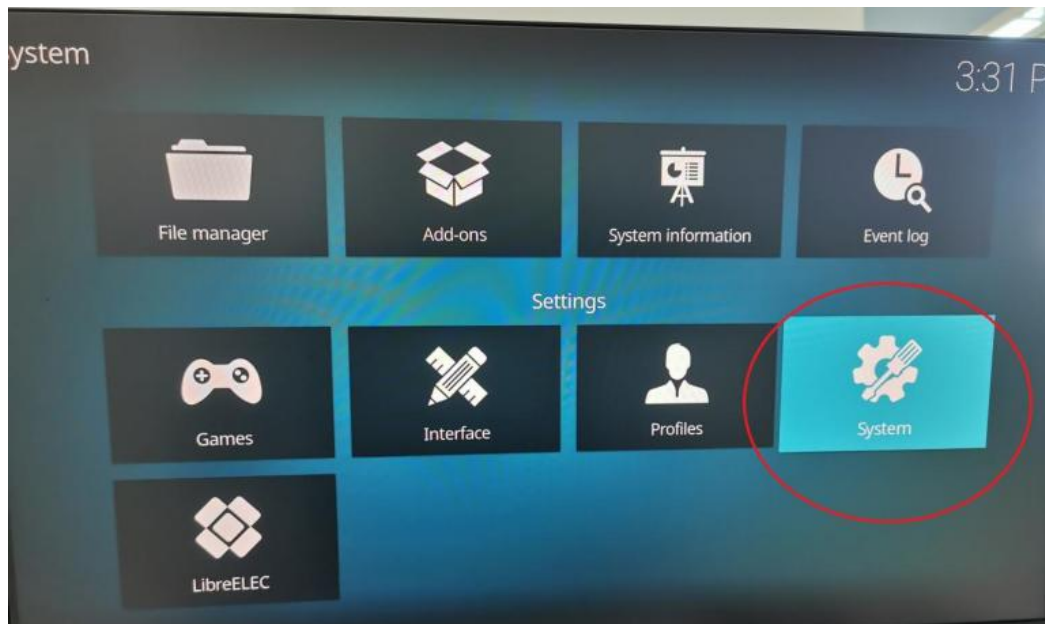
Append the following lines to the end of the file, enable the audio module. Draw attention to the format, Otherwise it doesn't work.

`dtoverlay=allo-katana-dac-audio`

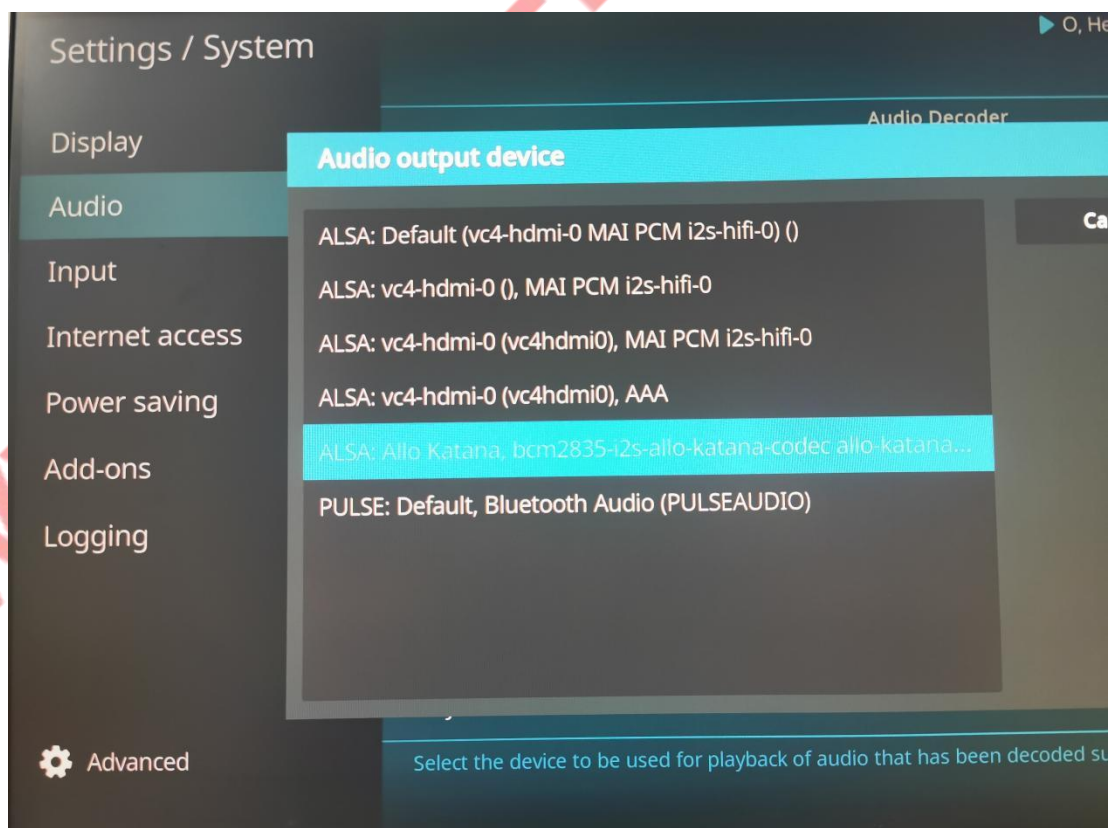
```
#####
# Include distribution specific config file if it exists.
#####
[all]
include distroconfig.txt

# uncomment to enable infrared remote receiver connected to GPIO 18
#dtoverlay=gpio-ir,gpio_pin=18
dtoverlay=allo-boss-dac-pcm512x-audio
```

2) Open the system page on LibreELEC



3) Set the Audio output device as Allo Katana.



5. Pops and Crackles Solutions

Some customers said that there are some pops and crackles when play music over our dac module, but no problem over with HDMI of Raspberry Pi. Please try below solutions.

5.1 Power Supply

Change a better 5V power supply. The inferior power supply will limits you to pursue the better audio quality. The battery pack linear power supply is a better choice.

5.2 Hotspot

Some music system open the Raspberry Pi build-in hotspot default. But the 3.5 mm jacks will be an antenna and received the interference signal from the WIFI module. So use wired network instead of the Raspberry Pi build-in WIFI can help you cut noise pollution completely. Esp the build-in WIFI be used as wireless hotspot.

6. User Manual Version Descriptions

Version	Description	Date	E-mail
V1.0		2022.03.02	support@inno-maker.com sales@inno-maker.com calvin@inno-maker.com
V1.1	Added Rune description	2022.06.15	support@inno-maker.com sales@inno-maker.com calvin@inno-maker.com