marantz ®

THE NEW LEVEL OF DIGITAL AUDIO

THE USB DAC GUIDE TO COMPUTER-AUDIO

Contents:

- Introduction

- Digital Connections

- Audio Formats and TAGs

- System requirements

- System Setup for PC and Mac

- Tips and Tricks

- High Resolution audio download

- Audio transmission modes

Introduction

As you know, in recent years the way to listen to music has changed. There has been a progression from the use of physical media to a more digital approach, allowing access to unlimited digital entertainment content via the internet or from the library stored on a computer. It can be iTunes, Windows Media Player, streaming music or watching YouTube and many more. The computer is a center piece to all this entertainment.

The computer is just a simple player and in a standard setup the performance is just average or even less.

But there is also a way to lift the experience to a complete new level of enjoyment, making the computer a good player, by giving the responsibility for the audio to an external component, for example a "USB-DAC". A DAC is a Digital to Analogue Converter and the USB terminal is connected to the USB output of the computer.

Doing so we won't be only able to enjoy the above mentioned standard audio, but gain access to high resolution audio too, exceeding the CD quality of 16-bit / 44.1kHz. It is possible to enjoy studio master quality as 24-bit/192kHz recordings or even the SACD format DSD with a bitstream at 2.8MHz, 5.6MHz and even 11.2MHz.

However to reach the above, some equipment is needed which needs to be set up and adjusted. This document will guide you through this journey to Computer-Audio. It will provide you with the information you need to get a good understanding for the topic.

because music matters

An USB DAC is designed to give you access to a wide range of music stored on a PC / Mac or NAS (network attached storage) drive through your home computer network.

The computer will get connected to the rear USB-B connection for a direct transmission of the digital audio.

The USB-B connection is the recommended way for music lovers to enjoy their digital music in the best quality possible.
The USB-DAC – "Digital to Analogue Converter" in fact replaces the soundcard of your PC / Mac and directly converts the digital music signal to analogue domain to hand it over to the amplifier.
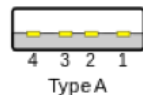
The USB-B connection can be found on a wide variety of our products, as dedicated USB-DACs, Network Audio Players, CD-Players or even integrated Amplifiers.

But first let's dig a bit more into the different ways of accessing music to get a better understanding and clarify some terminology. When you finish the document you will have all the information you need to get the best audio performance from your music stored on a computer via a USB DAC.

This is a USB-A port.

The Second USB-B port on the rear panels is for connecting a PC or Mac directly, and supports not only PCM signals up to 384 kHz/32bits, but also DSD2.8MHz, 5.6MHz and 11.2MHz for maximised versatility.

This is a USB-B port.
This is the connection we will explain in this document in more details.

Using the USB-B connection will bypass your Computer audio board (soundcard) to directly access the high quality audio processing on the external USB-DAC.
There are other technologies to it, such as "asynchronous mode" and "bit-transparent mode", but this will be explained at a later stage when we are going to explain how to use this connection and how to get the best audio quality. Another big benefit of this computer to DAC connection is that there is no file format limitation, as everything playing on your PC / Mac media player will be reproduced by the USB DAC, as long as it is a stereo signal in PCM or DSD.

DIGITAL CONNECTIONS

You might discover two different USB ports depending on the feature set of your USB DAC.

The first of these (USB-A) is conveniently placed on the front so you can plug in a USB key, a Smartphone or a portable HDD. This is a synchronous connection and is the simplest method of implementing USB audio from portable devices. Attention this one is not supported by all USB-DACs.

Just to complete the list of digital inputs we need to mention here the optical and the coaxial digital connection. By these an USB DAC can be used as high end DAC as well for other devices with this type of digital output, for example an Apple TV / set top boxes or other device, to dramatically increase their audio performance. On the image below you can see these inputs together with the USB-B input on the right.

CD-Player with USB-A connection on the front pannel.

marantz ®

AUDIO FORMATS AND TAGS

Let's first make a quick review of the most used audio format.

For this we need just to step back to the original digital audio source on the market, the CD. To get the analogue audio signal stored on a CD it needs to be digitized and this is done with a technology called Pulse Code Modulation (PCM). For the CD the PCM signal is fixed to a 44.1 kHz sample frequency and 16bit resolution, so it is often referred to 44.1 kHz/16bit. Packed with a special algorithm this information is stored on a CD. If you store it on a computer the format will change to be compatible with the computer operation system.

On a PC, the equivalent of PCM from a CD gets the file extension. WAV (Waveform Audio File Format WAVE/WAV). On a Mac this will be .AiFF (Audio Interchange File Format).
However the files require a big memory space. Therefore formats have been introduced to the markets which compress audio to reduce the memory space required. Some are lossy (data reduced - lost) others just compress the file, but keep the original quality – lossless formats.

Metadata - TAGs

Beside the need for large-size memory, there is another disadvantage of WAV files. WAV can only carry very limited metadata's (tags). However, tags are very useful as these contain information about the artist, title, album, cover art, etc., in other words, everything that is needed to build up and maintain a music library easily. The WAV format isn't the best choice to do so. That's why it isn't so often used even though the quality is like the original CD.
Other formats that do support tags are listed below and are preferred over WAV, but we have to be careful because of the quality. Let's start from the Lossy audio compression formats that are used most, due to their small size and ease-to-exchange on the web. However as "lossy" already tells you, they don't offer same quality as WAV.

MP3 is a data reduced (lossy) audio compression format that saves a lot of space but also decreases the audio quality. It's available in different compressions like 96kbs (kilobits per second), 128, 192 and 320 kbs. The higher the number, the better the quality.

AAC the most used for iPod's, iPhone's and iTunes is also a compression format, and also lossy format.

WMA is the Microsoft Windows Media Audio Format and it's also a compressed and lossy format. All are used because of lower data, less memory required and faster transmission when downloading from the internet.

However, as memory size is no big issue anymore and internet speed is high, there is no good argument left today to go for data reduced formats as shown above. So let's have a look at the below no-data- reduced formats and you will recognize a trend to even exceed the quality level which a standard CD can deliver, by new audio formats downloadable from the internet.

Here are the most common Lossless compression formats:

ALAC (Apple Lossless Audio Codec) 24bit/96kHz max (most used is 16 bit/44.1 kHz)

WMA Lossless (Windows Media Audio Lossless) 24bit/96kHz (most used is 16 bit/44.1kHz)

FLAC (Free Lossless Audio Codec), it's an open source codec GNU GPL; often used is **16 bit/ 44.1kHz**, but 24bit/88,2kHz and 24bit/96kHz gained a lot of popularity lately. And for high definition audio there is **FLAC HD** with **192kHz/24bit.**

These 3 are lossless compression formats and also include the useful tag functionalities.

All above are PCM – Pulse Code Modulation – Signals; however there is another very interesting audiophile format called DSD.

DSD or Direct Stream Digital is a one bit recording format and is used on SACD – the Super Audio CD offering much higher resolution than standard audio CD. By that, it gained a reputation as an audiophile medium.

If you store the information of an SACD on you PC or download a file from the Internet, you will find two file extensions: DSF and DFF. DSF has the ability to hold metadata (TAG) and DFF doesn't. Both can be played back on your computer running a supporting media player. To transfer the digital audio signal via USB, a technology will be used known as DoP – DSD over PCM. DoP is an open Standard Method for transferring DSD Audio over PCM Frames. On the DAC side the signal will then be converted back from PCM to the original DSD stream without any loss. It's just a way of sending data in an already known standard. There are different types of resolution available. These are 2.8MHz as used on SACD, but as well 5.6MHz and 11.2MHz, so double and four times the resolution. Files will be marked as DSD2.8 / DSD64, DSD5.6 / DSD128 or DSD11.2 / DSD256. The 64, 128 and 256 just mark the multiple of the standard CD sample frequency.

You remember? Correct 44,1kHz. 64 x 44,1khz = 2.8MHz and 128 x 44,1kHz = 5.6MHz.

USB-B CONNECTION IN DETAIL

High End audio DAC mode through USB-B port.

First of all this port is using the most advanced technologies to get the best sound from your audio files. There is no limitation by the audio DAC, as it handles 2ch PCM and DSD provided by the PC / Mac. You can enjoy any file stored on your computer and which can be played back by the media player on the computer. The signal will be outputted via the USB-A connection on the computer and send to the USB-B port of the DAC.

The USB cable needs to be a USB-A to USB-B type one.

A quick overview of the USB-B possibilities:

1st It will bypass the audio board of your PC / Mac in order to avoid all digital noise from your PC / Mac

2nd It will also be able to bypass the audio mixer in your computer which is a source for distortion.
The mixer is the DSP of the PC where all sound from any software will be mixed together and sent to the speakers, but in order to achieve this mixing the DSP has to convert all different formats coming from different software. This this will heavily modify the audio file and lower the sound quality. When we bypass the audio mixer, the original audio file will be outputted bit-perfect – no modification to original signal happens.

3rd The asynchronous mode will give control over the timing of audio data transmission to the receiver side (USB-DAC), thereby minimizing jitter for best audio performance.

4th It's compatible with all file formats including DSD via DoP (All the formats that your computer software player can read). This differs by USB-DAC specification.

SYSTEM REQUIREMENTS

In order to enjoy the best sound we will now explain how to make it happen.

List of equipment

Audio Files, Computer, Media Player on PC, USB-DAC cable, Driver for USB-B DAC, USB-B DAC

PC / Mac   *A Player JRiver or Audirvana*   *A good USB-A to USB-B Cable*

USB / DAC Driver For PC   *USB / DAC*

The music files

First we need high end audio files like Flac HD and DSF (DSD). In case you don't have any yet you can work with standard files too. It is not just limited to FLAC HD or DSF as we explained before. All formats can be played. However for the best quality you can get high definition files downloaded from the internet. At the end of the document we will list some web sites offering such high end audio tracks.

Then we need a so called bit-perfect player

A common thinking is that digital is equal to digital, however this is only the case if the data in the received file is "bit-perfect" to the playback file. However, this often isn't the case if you are using a computer as a source. In a computer the data signal has to pass many stages of input and output before the signal will be outputted via the USB connection to the USB-DAC.

First, the computer will use the on board DAC (Digital Audio Converter). All computers have an internal DAC, generally of poor quality, simply because the primary purpose of such a machine does not offer any guarantee in terms of quality sound reproduction. This is why music lovers often use an external DAC. However it is not all about an external DAC.

The OS "operating system" running on the computer itself contains a set of functions responsible for processing audio streams more or less "neutral", ideally without altering them. This software layer should not interfere with the characteristics of the signal, but in practice this is not the case, so one source of distortion.

And ultimately, the incoming signal to the DA converter may be very different than it was initially. In addition, there are various interference phenomena due to the mixer that allows different programs to play sound at the same time (mail coming in when you listen to music for example) and it's also related to the environment and highly disturbed electrical computer.

Let's have a look to the complete chain.
A lot of devices which can have an influence.

Of course: not to forget about the cable between PC and external DAC. The first 5 boxes represent the PC while the last box is the USB-DAC.
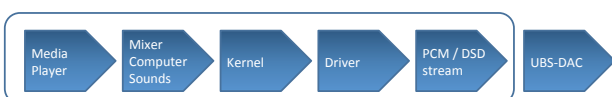
1. **Media player** – software running on your computer to play back the audio files
2. **Mixer** – this one will add the Windows Sounds to the original signal (if not by-passed)
3. **Kernel** – handling all the process to transfer the digital audio signal
4. **Driver** – ensures the audio signal will be properly transferred to the USB output in asynchronous mode (USB-DAC defines the clock and timing of the audio package sent)

1st we will need a bit-perfect is a player that will allow sending the complete data bit-to-bit without skipping or modifying any of the original data. So we will get the integer signal from the original file. Standard media players such as iTunes and Windows Media Player do not support bit-perfect transmission. Furthermore, they have limitations on the playable file formats.

That's why we recommend players like jRiver Media Center for PC and Mac and Audirvana (time being Mac only). Other software media players are available on the market, but we like to focus on these two for now as they support not only PCM- Signals but DSD streaming as well.

For the **Bit-Perfect** transmission we need to make some setting on the computer and the Software Player to get everything working together smoothly. These settings will allow us to bypass the Windows Sound Mixer (see below graphic) and on Mac we will give the priority to the audio sent to the player over any other sound.

These settings will affect the Audio Output Mode and key technologies here are **Kernel Streaming, WASAPI** and **ASIO**, beside others.

The goal is to use the Bit-Perfect mode also known as **"Bit-transparent"** mode. This means that all the data of the audio file is exactly the same as received in the USB DAC. Note this is not possible with any USB-DAC. The DAC, needs to support this too.

**2nd We also need a driver for the USB DAC (only for PC)**
For a PC, the driver is very important and you need to install it before connecting your USB DAC to your computer. For Mac operation there is no dedicated driver installation required for most of the DAC's. However this might be different for other USB-DAC devices.

The Driver will allow the USB DAC to control the clock, so the rhythm in which it receives the audio information. This is called **Asynchronous mode** and is needed to avoid Jitter, which deteriorates the signal quality. It will also give important information to the PC about the specification of the connected USB-DAC. Once the driver is installed on the PC the USB-DAC can be directly selected in the software media player as the output device (soundcard).

3rd There is a need for a good USB cable to connect the player to your Computer. It is not recommended to use a cable longer than 5m. And the quality of shielding will also have some influence on the sound quality. It is recommended to test several cables to optimize performance.

Audio handling inside a PC

To better understand this, take a look at the audio-handling diagram below – From the Media Player the audio will be send by Direct Sound, the default setting, through the Mixer, while Kernel Streaming, Asio and Wasapi bypasses it. The dedicate driver installed will allow the USB DAC to take the lead for the data re-quest – this is called Asynchronous Mode.
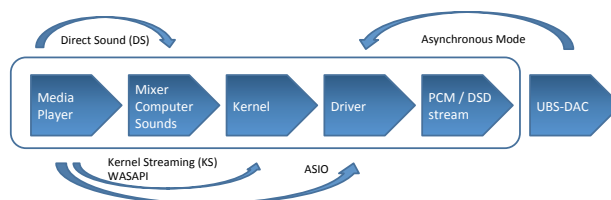
Just for the PC environment the Media player, for example JRiver, default setting is Direct Sound and uses the Mixer. So it is necessary to change the setting to **Kernel Streaming, WASAPI** or **ASIO** streaming.

NOTE: Any mode, WASAPI, ASIO or Kernel streaming, does have some influence to the sound characteristic. Please listen carefully to find the appropriated mode for your system.

Attention WASAPI is designed to work with Windows Vista and higher, but doesn't work on Windows XP. It is recommended to use an operation system like Windows Vista or higher, like Windows 7. Windows XP does work, however it has some limitations.

ASIO stands for Audio Stream Input / Output and is another method to bypass the Audio Mixer <u>and</u> in addition the Kernel but we won't go into details here.

This mainly covers the PC. On a **Mac** the Mixer is called Audio Core and to bypass it there is a so-called **"hog mode"** available which needs to be activated in the Media Player, like with WASAPI or Kernel Streaming. It's called here; **"exclusive mode"** and **"integer mode"**.

More information on these modes will be given at the end of the Document.

SETUP FOR PC AND MAC

With above you have got the information to understand PC-Audio well and we can start to show you by the example of jRiver Media Center for PC and Audirvana for Mac how to reach the best audio performance.

SETUP FOR HIGH END AUDIO WITH JRIVER MEDIA CENTER ON PC

The single steps to follow;

1. Install the USB DAC USB driver on the PC
2. Recommended operation system is Windows 7 or higher
3. Connect USB DAC by USB cable to the PC
4. Install jRiver Media Center
5. Setup jRiver Media Center
6. Enjoy

NOTE: Screen shots on your PC might look different depending on software version. However setup will be similar as described here. On the following pages screen shots of jRiver 20 are shown.
NOTE II: jRiver is available for Mac too.

Install the USB DAC driver on the PC

Download the driver from the www.marantz.com website, visiting the USB DAC product page. Installation guidelines are attached to it. Please follow accordingly.

NOTE: Never connect the USB-DAC before having installed the driver. Operation will not occur correctly if connected to the computer before the dedicated driver has been installed.

2. Connect USB DAC by USB cable to the PC

Connect the PC to the USB DAC by a USB-A to USB-B cable and select the PC or USB-B input on the USB DAC.

The PC will automatically detect the new USB device and will show a graphic similar to below. Then you can proceed with step 3.
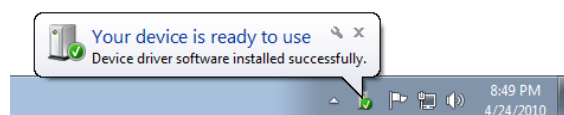
NOTE: In case you experience any problem during the installation please check our support area and FAQ section on our website.

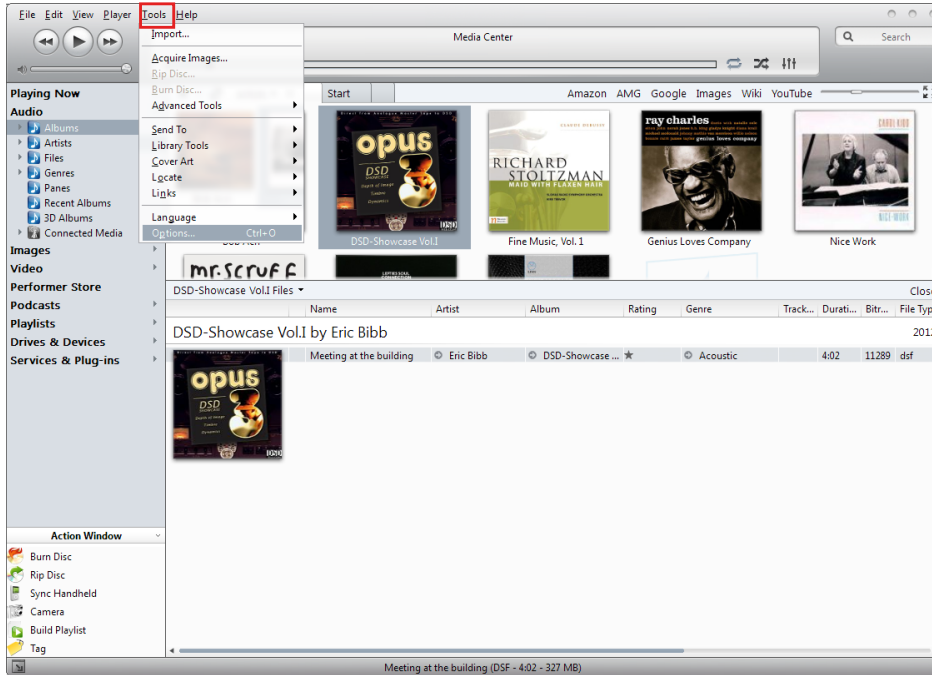**3. Install jRiver Media Center**

The software can be downloaded as a trial version at the www.jRiver.com site. After download just execute the installation. Restart your computer and open the jRiver Media Center software.

4. Setup jRiver Media Center

Open your jRiver Media Player and select **tools** → and **option**

Select **Audio** in the left column and then on the right **Audio Device**. Here you see the audio modes available and you can choose between ASIO, Wasapi and Kernel streaming, depending on modes supported by your DAC. Check "more" for other alternatives like Kernel streaming. All of the above mentioned will bypass the Windows Audio Mixer. Evaluate the different mode by personal listening session to define the best fitting mode for your system. Our priority is Wasapi, followed by Kernel streaming and ASIO.

This will open below setup window.

marantz ®
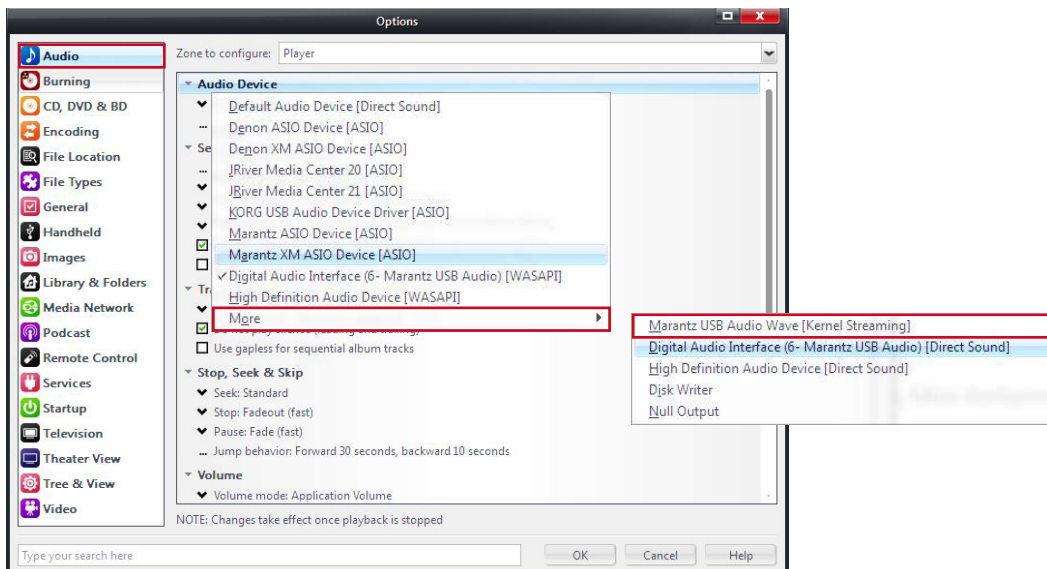
Now click on the line just under: **Device settings.** Just double check that. Open device for exclusive access is selected.
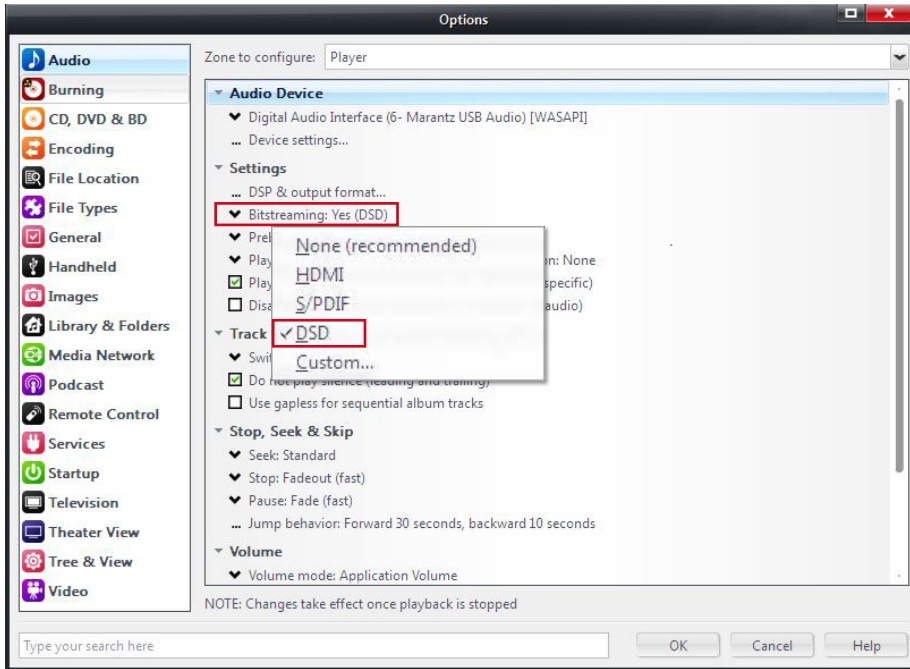
This will open a new window
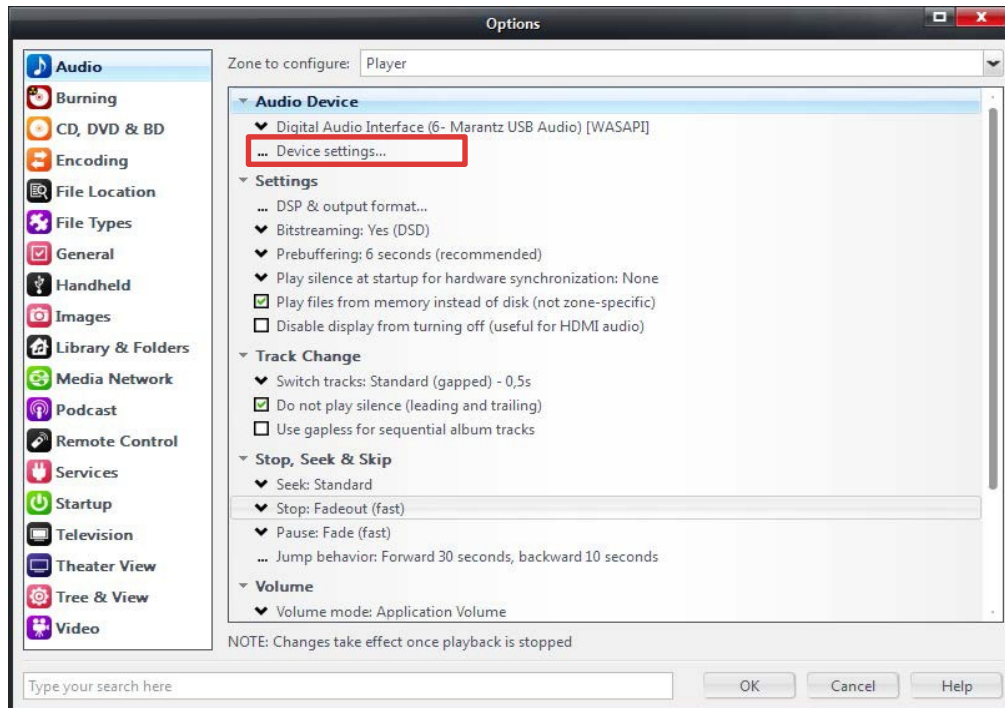
Buffering: This doesn't need to be changed, however if you experience drop outs while playing back your music you can try to improve by adjusting the buffer size.
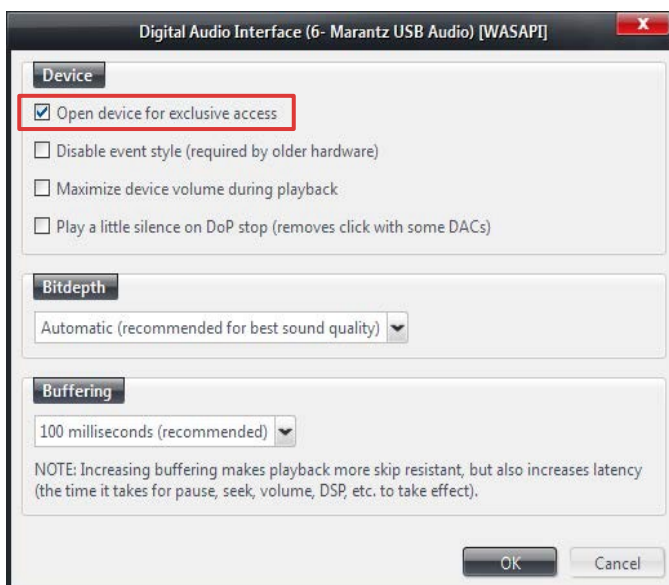
For DSD streaming (DoP Mode) one more setting is required. Please note this is only possible for Windows Vista and newer operation systems. Windows XP doesn't support this.

In the DSP output settings the best is to deselect the Output Format box. Only in the case your DAC doesn't support DSD or 352,800 Hz and up you might select a down conversion as shown below. Set the max sample rate your USB DAC can handle. Most of the time it's 192.000Hz. The following popup will appear to apply the right settings.
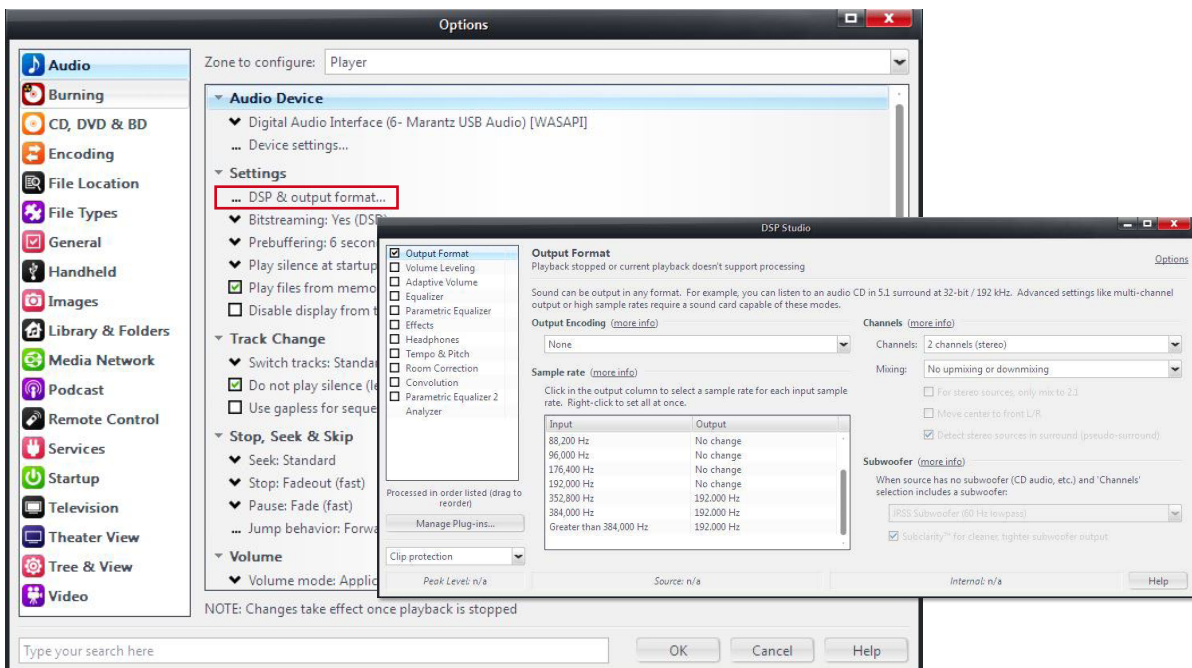
Enjoy
Select the right input on your USB DAC and start the music track on
the Media Player.

Now all settings are done and you can start to enjoy your music.
Congratulations!

SETUP FOR HIGH END AUDIO WITH AUDIRVANA ON MAC

1. USB driver installation
2. Connect USB DAC by USB cable to the Mac
3. Install Audirvana
4. Setup Audirvana
5. Enjoy

Attention it is Mac iso PC this time.

NOTE: Screen shots on your Mac might look different depending on software version. However setup will be similar as described here.

1. USB-Driver installation
For Mac operation there is no dedicated driver installation required. However this might be different for other USB-DAC devices.

2. Connect USB-DAC by USB cable to the Mac
Connect the Mac to USB DAC by a USB-A to USB-B cable and select the corresponding input on the USB DAC.

The Mac will automatically detect the new USB device.

3. Change Midi output rate

First of all we need to prepare the Mac.
Your Mac's Sound Preference Pane is the go-to place for choosing audio inputs and outputs.

You can find the Audio MIDI Setup app in Applications → Utilities.

Here we can set the sample rate for audio output devices by first selecting the device from the left-side column, and then clicking the Output tab. In our example the one to select is the USB High Speed Audio. Alternatively you will select your USB DAC mentioned here.
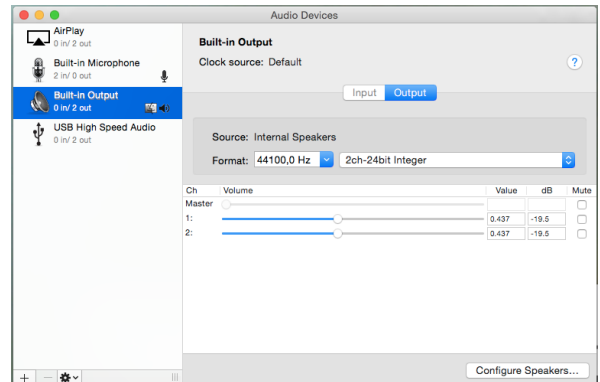
Now use the Format pop-up menu to choose the sample rate you want. Higher is generally better, but don't work with all generation of DACs. So try the max output level (352) but if the display on your DAC shows unsupported format please set it to 192 that work with most DACs.
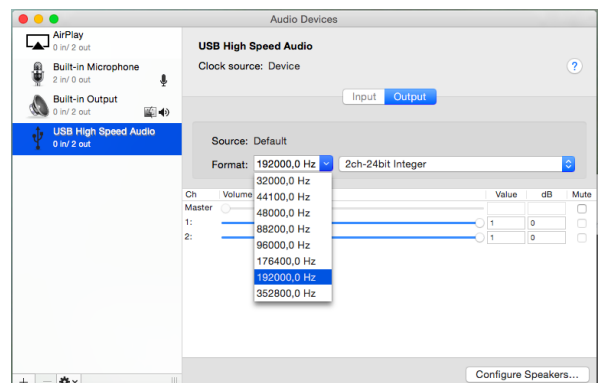
4. Install Audirvana

The software can be downloaded as a trial version at the www.audirvana.com site. After download just execute the installation. Restart your computer and open the Audirvana software.

The first time you launch Audirvana Plus, you get a wizard dialog asking you two questions to get started:

a. Select the Audio Device you want to use for playback. Note that it needs to be connected for being in the list. If it is not at the time you have launched Audirvana Plus, you can connect it now and it'll appear in this list.

b. Select the playback management: Audirvana Plus Library mode. Setup box with general setting will be opened.

The last step of the initial setup is to add your audio tracks to Audirvana Plus library.
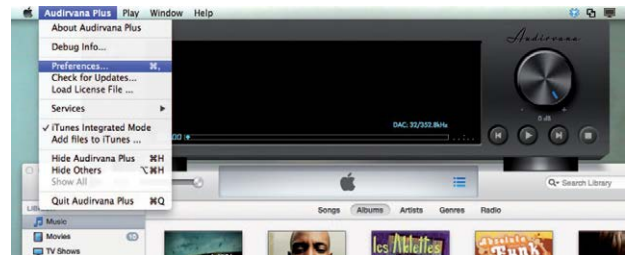
Two option to do this:

1) By adding the folders to sync with Audirvana Plus.

2) Synchronize with iTunes by importing iTunes library.
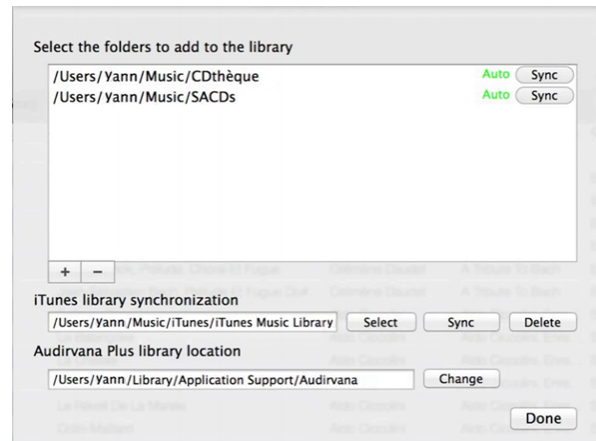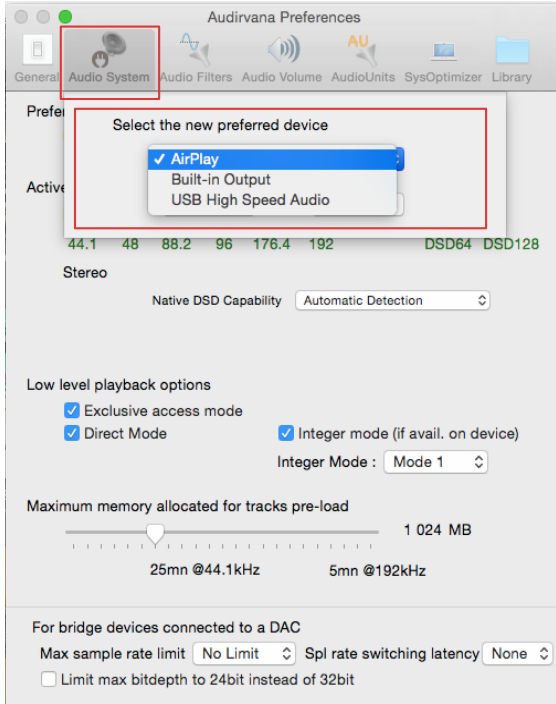

5. Setup Audirvana player

Open your Audirvana Music Player and select Audirvana Plus → and Preferences.

Select the **Audio system** then select Preferred Audio Device click on Change

Select USB High Speed Audio, this is the USB DAC or the name of your DAC. This will only appear if the USB DAC is connected and the input is set to USB-B input.

On the Native DSD Selection select Automatique detection
This will authorise DoP functionality if the DAC is compatible
In case this doesn't work select DSD Over PCM Standard 1.0
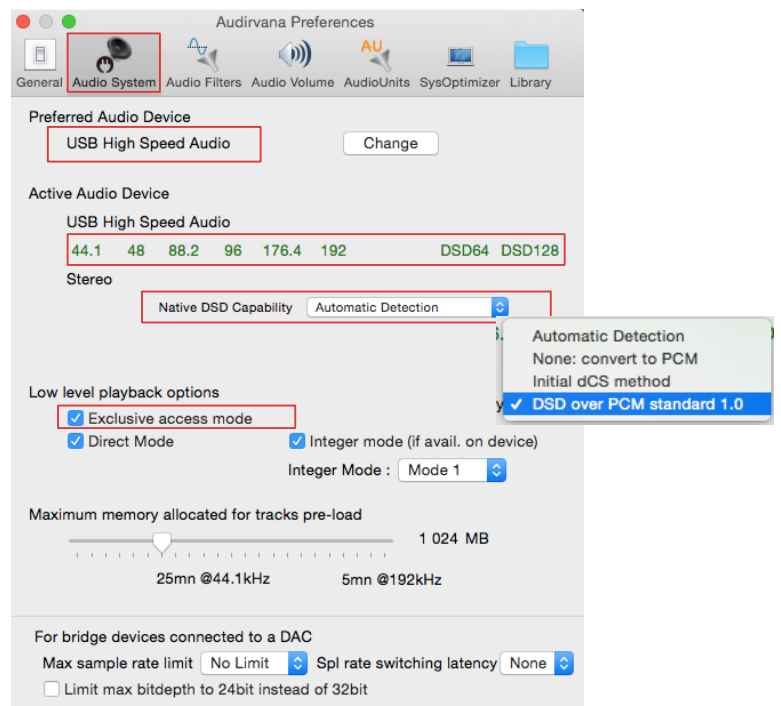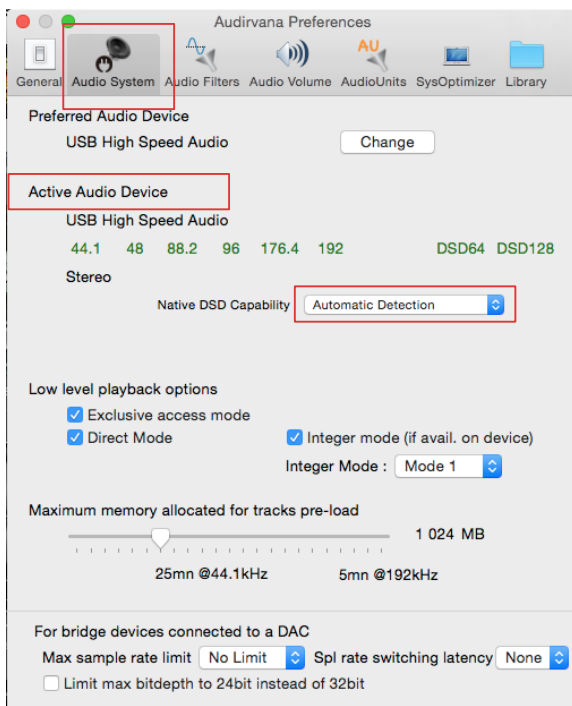
marantz®

Now please check that the Exclusive access mode is selected, this is the hog mode that gives priority to the player and avoids mixed sounds. Here in the red part select Exclusive access mode; Direct Mode and Integer mode. Also check for the integer mode, this is one step higher to by-pass the UNIX mixer from the OSX.

So now let's have a look on this screenshot for a final check: At the top, USB High Speed Audio is selected.

Active audio Device is on the USB High Speed Audio plus Native DSD over PCM (DoP) is activated in automatic detection (but if this not working like mentioned before select DSD over PCM standard 1.0) and, as you can see, all the formats that can be streamed are now shown in green.

And we also have the Exclusive Access mode (hog mode) and the Integer mode activated.
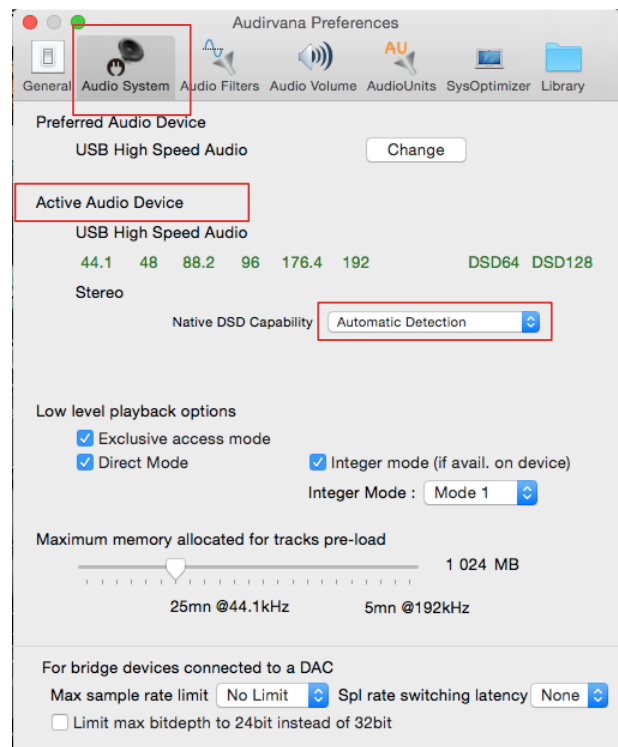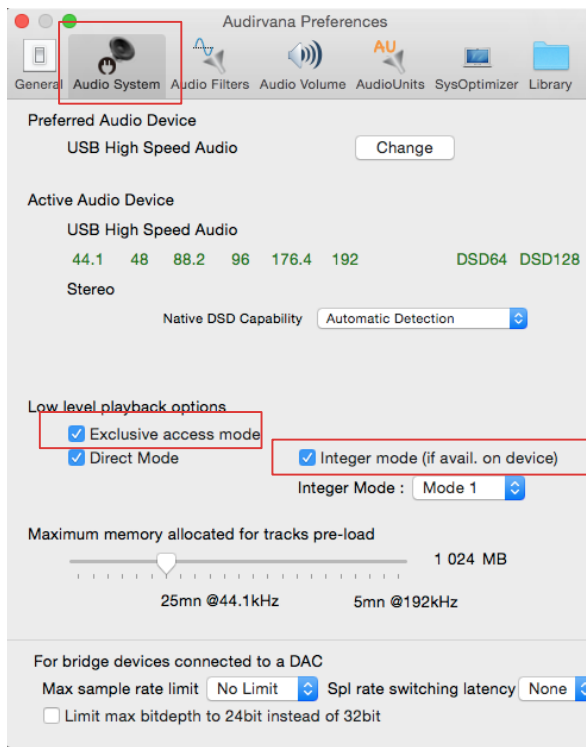
FOR ITUNES USERS

Audirvana may be integrated within iTunes to allow bitperfect playback - to enable this, with the Audirvana application active, select the "Preferences" entry from the "Audirvana Plus" tab and activate the "iTunes Integrated Mode" option.

Now you are ready to enjoy your high end audio files.
Enjoy

TIP AND TRICKS TO GET THE BEST FROM YOUR USB-DAC

1. Select a good USB cable (sound will be strongly influenced by the USB cable; interference & noise)

2. USB-Cable: Not longer than 5m, and the quality of shielding will also have some influence on the sound quality. Test several cables to optimise performance. Try adding a Ferrite Core as used on some network cables.

3. In case your USB DAC has a network connection integrated too, we strongly recommend you to add a **Ferrite Core** on your network cable to minimize noise interferences. Ferrite Core is shown below.

4. For the PC / Mac an SSD hard disc is preferable – SSD stands for Solid State Disk and has, in comparison to standard hard disc, no rotating elements inside. Another step to reduced interference. Sound will be even smoother and more detailed.

5. Use your PC or Mac only for Music listening. Kill all unnecessary running apps. There is no need for a high performance super-fast PC. Standard processor is just fine.

6. If you use Spotify streaming service, make sure you set the data rate to 320kps – highest resolution.

ONLINE PORTALS FOR MUSIC DOWNLOADS

Here just a list of some interesting portals for high resolution audio. More are out there and number is growing.

FindHDmusic	www.findhdmusic.com
Blue Coast Records	http://bluecoastrecords.com/
Downloads NOW!	http://downloadsnow.net
MA Recordings:	http://marecordings.com
Cybele Records:	www.cybele.de
David Elias:	www.davidelias.com
HD Tracks:	www.hdtracks.com
Highres Audio:	www.highresaudio.com
Naim Music:	www.naimlabel.com
Linn Records:	www.linnrecords.com
Qobuz:	www.qobuz.com
HDmusicstore:	www.hdmusicstore.it
Bleep:	www.bleep.com
Gimell:	www.gimell.com
hd-klassik:	www.hd-klassik.com
2L:	www.2l.no
iTrax:	www.itrax.com

Blue Coast Records:
http://bluecoastrecords.com/

Acousticsounds:
http://store.acousticsounds.com/superhirez

Berliner Philharmoniker:
www.berliner-philharmoniker-recordings.com

Free test file Downloads

2L: www.2l.no/hires/index.html

Blue Coast Records and AudioGate
http://audiogate.bluecoastrecords.com/

More can be found on
http://www.audiostream.com/content/hd-music-download-sites
http://dsd-guide.com/where-can-you-find-dsd-music-downloads

AUDIO TRANSMISSION MODES

Looking for bit perfect sound! – Audio transmission modes explain in details

Windows: direct sound

It's the standard playback mode on a Windows PC.

It goes thru the kernel mixer, that acts as an interface of the OS kernel between the various sound sources in a PC (PC sound, MIDI, players, etc…) and the sound card's driver. All the various sources can produce sounds with different sampling frequencies; the kernel mixer will resample all the various audio streams to a unique sampling frequency and allows them to be mixed before sending them to the audio card. But this mix will be at a low frequency (standard 44.1 kHz). On top of this the mixer will add some treatment (dynamic compression, tone control, loudness control, etc…) so this will generate a low sound quality.

For this reason, we should avoid direct sound mode for the best sound quality.

This is not bit perfect

Windows: kernel streaming
Kernel streaming is the "audiophile" playback mode for Windows. Standard players such as WMP or iTunes do not support this mode at the moment, so a dedicated media player is required. The audio data will be sent from the media player directly to the USB-DAC, by-passing the audio mixer. This will also need less CPU power. So your PC will be more stable and generate less Jitter (less errors). Now we have a so-called bit perfect sound. Kernel Streaming is often used on PCs running Windows XP.

Windows: WASAPI
WASAPI (Windows Audio Standard API) was developed for Windows Vista, Windows 7 and up to replace Direct Sound. WASAPI isn't intended to work on Windows XP. Standard WASAPI will make use of the Windows Sound Mixer and is not bit-perfect.

Windows: WASAPI Event Style
WASAPI Event Style is the bit-perfect version of WASAPI and will by-passed the audio mixer. The sound quality obtained using WASAPI Event Style is comparable to Kernel Streaming mode. WASAPI needs a bit more CPU power than plain kernel streaming. But, WASAPI gives access to a bigger choice of players. WASAPI Event Style is bit-perfect.

Windows: ASIO and ASIO4ALL
ASIO means Audio Stream Input / Output and is another method to bypass the Audio Mixer and in addition the Kernel, to let the media player directly talk to the USB-DAC. ASIO was built for XP but it works on all OS. ASIO was created to overcome the USB Audio 1.1 limitations. On USB 1.1 only 48 kHz/16bit in direct sound mode was possible, but with ASIO 96 kHz/24bit.

ASIO is bit-perfect.

Mac OS: Core Audio
Core Audio is the Mac equivalent for the Windows Audio Mixer and handles any kind of audio information – input and output.

Core Audio is not bit-perfect

Mac OS: "hog mode"
The difference between Core audio and hog mode operation is that Core audio allows more than one client to access the driver at the same time. The Core more mode will have the same issue that we already see on the Direct Sound streaming in windows so we will lose sound quality. To avoid this, on Mac we will use the "hog mode". The "hog mode" needs to be activated in the Media Player. The mode will allow the player to get first priority when started and block all other audio devices, so in this case we will get the best sound without any mixing processing.

Mac Integer/mode
Addressing directly the HAL [AppleHAL_2] gives the possibility to bypass the two main overhead

Processes of the above standard mode:
• Mixing buffer
• Float to DAC native format conversion

In Integer Mode the player software supplies a stream already formatted in the native DAC format.