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**O7A Core Plugins**  
**v2.4.0**

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# 1 Introduction

The O7A Core is a set of plugins designed for work with [seventh order ambisonic \(O7A\) audio streams](#). These streams can be used to create rich 3D mixes that can be played back in a wide variety of sound systems, including Virtual Reality systems with head tracking.

In general we recommend the use of O7A streams primary for research purposes, or in studios with high-end modern hardware. **The CPU load generated by the O7A plugins can be very high and may not be suitable for use on standard studio computer systems.** Third order (O3A) streams are an alternative. These carry enough spatial detail for most practical applications and present a much lighter processing load. Many O3A plugins run roughly four or sixteen times faster than their O7A equivalents.

## 1.1 Compatibility

O7A streams require audio busses with at least 64 channels, which (at the time of writing) most Digital Audio Workstations (DAWs) cannot handle. Some are limited at 2 channel stereo and many are limited at the 8 channels used for 7.1 surround mixes. **The O7A plugins will not work correctly with these DAWs**, which may even crash. In general, Reaper or Pro Tools Ultimate (version 2023.6 or later) are good options.

### 1.1.1 AAX

Most of the O7A plugins exist as AAX versions which are compatible with [Pro Tools Ultimate](#) version 2023.6 or later and plugin support (or not) is indicated in this text.

Pro Tools keeps careful track of exactly what stem formats are present on tracks and busses; this is a powerful feature which helps avoid mistakes and helps ensure plugins are used in the right places. However, where formats are not available in Pro Tools, corresponding plugins are generally not available. To avoid this in some cases, some plugins "misuse" stem formats with matching channel counts. Cases like this are described for individual plugins below in the text.

### 1.1.2 VST2

The plugin library works as a "shell" plugin. This means that a number of individual audio plugin effects are provided by a single library file. Some VST2 hosts may have a slightly different way of managing these plugins to ordinary ones. For instance, in [Max/MSP](#) the vst~ plugin uses "subname" messages to specify the individual plugin within the library. At the time of writing, VST2 shell plugins are not supported in Nuendo or Cubase.

Most VST2-compatible DAWs (such as [Reaper](#)) have a plugin "path", which is a list of directories which will be searched for VST2 plugins. You may need to change this path to point at the location of the plugins, or move the plugins there. By default, these plugins are installed into `/Library/Audio/Plug-Ins/VST` on macOS. Various directories may be used on Windows, but `C:\Program Files\Steinberg\VST2` is not uncommon.

### 1.1.3 Buffering

Some of the O7A plugins use internal buffering with a length of 128 samples. For smooth CPU load, you may wish to ensure your DAW buffer size is a multiple of this.

# 2 Getting Started

## 2.1 Working with O7A

When working with stereo, you normally "pan" a mono sound to stereo and "mix" it onto a stereo bus. With O7A, you can work in a similar way but there is an extra intermediate multichannel audio format, and a final "decoding" step. The simplest case is probably as follows:

1. Panning - mono sources are panned to 64 channel O7A. The [O7A Panner](#) plugin can be used for this.
2. Mixing - multiple streams of 64 channel O7A can be mixed together using your DAW's mixing engine. No special plugin is needed here, as long as the DAW can handle 64 channel busses. You end up with a final mix, as an O7A stream.
3. Decoding - during actual playback (and you probably want to listen while you work!) you "decode" the O7A stream for whatever speaker layout you are actually listening with. One of the huge advantages of ambisonic techniques is that the O7A mix is independent of its final playback environment, so you can switch between stereo speakers, headphones, 5.1, 22.2 or whatever. One of the simplest of these decoders is provided by the basic [O7A Decoder - Stereo](#) plugin.

These are just the basics. There are other ways to encode audio into O7A rather than panning, for instance by upmixing, or recording with ambisonic microphones.

You can also manipulate O7A streams. As a simple example, it is possible to [rotate](#) the soundfield almost perfectly, and much more complex transformations are possible, including spatial ones. Manipulator plugins typically have 64 channel O7A as both an input and output. There are some [technical notes on O7A streams](#) at the end of this document.

If you are also working with first order B-Format using the SN3D/ACN convention you can mix this in too, because the first four channels of O7A correspond to the four channels of first order. To reduce an O7A stream to first order, you can simply take these four channels and throw away the rest.

## 2.2 Getting Started with Reaper

This section gives an introduction to use of the VST2 version of the O7A plugins with [Reaper](#).

We are assuming that you know how to use Reaper already. A number of simple Reaper example projects are included in standard installations, along with simple explanatory text files.

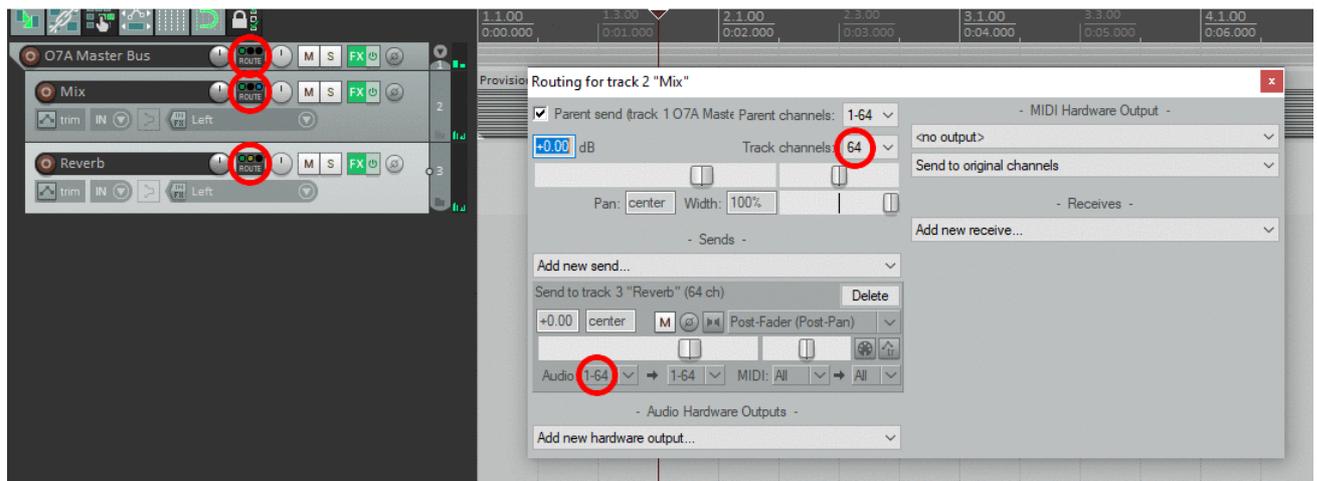
### 2.2.1 Shell Plugins

The O7A VST plugin libraries are VST2 "shell" plugins which each provide a number of plugin effects. If you find your list of O7A effects is short, with names like "O7ACore", this means that Reaper has not scanned the content of the libraries.

To fix this, go into the Reaper "Options" menu and select "Preferences..." to bring up the preferences screen. Then, under "Plug-ins", find "VST". On the VST tab, please ensure that "Get VST names/types when scanning" is checked and then click "Clear cache/re-scan".

### 2.2.2 Basics

In Reaper, whenever you create a track or send to be used with [O7A streams](#), make sure it has at least 64 channels.



### 2.2.3 Layout

On the folder track, add the following plugins *in this order* to the FX chain:

- [O7A Visualiser](#)
- [O7A Decoder - Stereo](#) (or whichever decoder best suits your speaker rig).

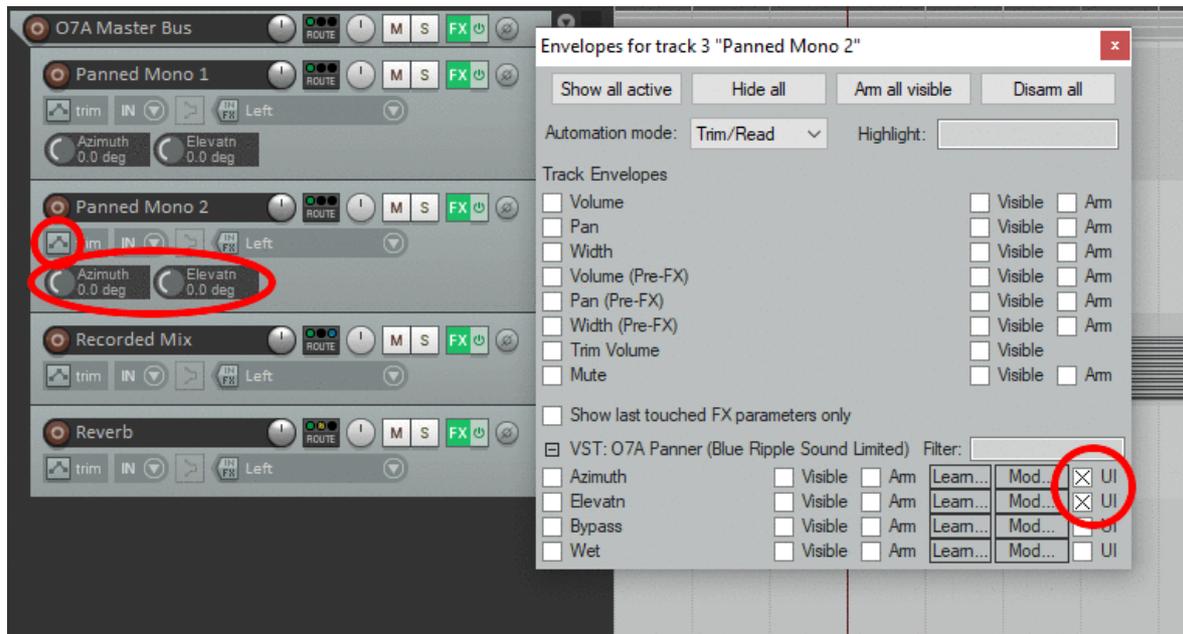
This means that after all the audio from the individual parts has been mixed together it will be visualised in 3D and then converted to stereo for monitoring.

On tracks for mono parts that are to be panned, add the following:

- An [O7A Panner](#) plugin.

Do *NOT* use the built-in Reaper stereo panner with O7A!

It is also possible to add azimuth and elevation controls to Reaper on these channels. To do this, add the panner as above and then use the "Trim" button and cross the "UI" boxes for the azimuth and elevation controls.



Parts that are already first order ambisonic B-Format can typically be injected directly without issue, although processing can help (e.g. the O7A First Order Injector plugin from the O7A Upmixers set, or the O7A Harpex Upsampler). Of course, other O7A material can be injected directly. FuMa material needs to be converted using the [O7A Injector - FuMa](#) plugin.

## 2.2.4 Processing O7A streams

Other plugins (for instance the [rotation](#) plugin) manipulate the O7A stream. The stream needs to be in O7A format (for instance by panning) before such processing can be used.

Applying processing to the O7A stream can be confusing at first. We suggest you spend a few minutes getting familiar with the [O7A Visualiser](#) plugin and put visualisers before and after your processing. You can then see what is going on, which can be really helpful!

Some plugins have O7A as an input but output something else. In these cases, make sure you only chain together processors in a combination that make sense. For instance, the [O7A Beamer](#) plugin produces mono which you might want to run through a mono distortion plugin before panning it back into O7A using the [O7A Panner](#).

## 2.2.5 Sends

Effect sends can be used in the normal way. Just be careful about which busses are expecting mono or O7A as input and output and be sure to check your channel counts.

Again, do not use the Reaper panner for the send (leave it set to the centre) or the spatial image will be damaged. For similar reasons, make sure the project's "Pan Law" (in Project Settings) is set to 0dB, or avoid use of Post-Fade sends.

## 2.2.6 Mastering

### 2.2.6.1 Keep Your O7A Master Mix

Keep your Reaper project files and inputs if you like, keep your favourite stereo and 5.1 downmixes etc. But whatever you do, *keep a copy of the 64 channel O7A mix*. This may not make a difference to you now, but when someone asks you for a 22.2 (or other) downmix in a few years time, you will not need to fake height information from the 5.1 mix, or go searching for a missing file needed by the original Reaper project. Instead, you will be able to produce the downmix from the ambisonic B-Format (i.e. O7A) master using whatever tools are in vogue then.

If you have taken the simple approach as described above, probably the easiest way to grab the O7A mix is simply to switch off the decoder on your Reaper master track, and then use the "Render..." menu item. You will probably need to set the Channels to "64" by typing the number in and use the "Stems (selected tracks)" option rather than what Reaper considers the master mix, in which case you will also need to have selected your folder track. If you want to check the output, you can always load it into a new Reaper session and run it through your favourite decoder.

### 2.2.6.2 Other Mixes

If you want to produce a number of different format outputs from your O7A master (stereo, headphones, 5.1 etc.) you could use a number of projects that use the O7A master file.

Another option is to place a number of decoders on your decoding/folder track and only switch on the one you want for the particular rendering.

However, our preferred option is to send from the O7A master bus to one of a number of separate decoding tracks which can be freely muted or unmuted. This is the approach taken in the example Reaper projects provided.

## 2.2.7 Troubleshooting

If you find plugin libraries are not picked up during Reaper plugin scanning, this can typically be fixed by backing up any relevant files and settings, removing the relevant libraries from the Reaper path (either by moving the files or changing the path), restarting Reaper, putting them back, and restarting Reaper again.

## 2.3 Getting Started with Pro Tools

This section gives an introduction to use of the AAX version of the O7A plugins with [Pro Tools Ultimate](#). Seventh order ambisonic support has been available in Pro Tools Ultimate since version 2023.6. It is *not* available in other editions of Pro Tools. In particular, Pro Tools Studio supports third order but not seventh order, so the O7A plugins will not work with it.

These notes assume you are familiar with Pro Tools already. A number of simple Pro Tools example projects are included in standard installations, along with simple explanatory text files.

### 2.3.1 Stem Formats

When effects are used on tracks, Pro Tools takes account of changes in the stem format in use, which is generally very convenient when working with ambisonics. In particular, effect lists shown will be appropriate to the current stem format you are using.

For instance, if you have a mono track that you wish to pan to O7A, you will find the insert effect list includes the [O7A Panner](#) (under "Sound Field"). Introducing this effect as an insert will change the track stem format from this point to seventh order ambisonics (O7A) automatically. Mono effects can still be used *before* the panner, but after panning the effect list will include a different set of plugins appropriate for a seventh order ambisonic stream, such as the [O7A Visualiser](#) and O7A decoders. If you decode to stereo, the stem will change to stereo and so on.

### 2.3.2 Stem Formats that Pro Tools does not support directly

However, Pro Tools does not have direct support for some of the more unusual stem formats used by some plugins in the Blue Ripple range. Consequently:

- Some of the plugins do *not support* AAX. For instance, plugins requiring the Hamasaki 22.2 stem format are not included in the AAX version of the plugin libraries.
- Some plugins "misuse" other stem formats with matching channel counts. For instance, the [O7A Decoder - FuMa](#) plugin outputs ambisonics using the FuMa convention, but labels its output stem format as ordinary ambisonics using the SN3D convention, which is not really correct. As a result, the Pro Tools effect lists shown will not be correct. Similarly, the [O7A Decoder - IMAX 6.0](#) plugin outputs audio targeting the IMAX 6.0 layout, but labels its output stem format as standard 6.0, which does *not* have exactly the same channel definitions.

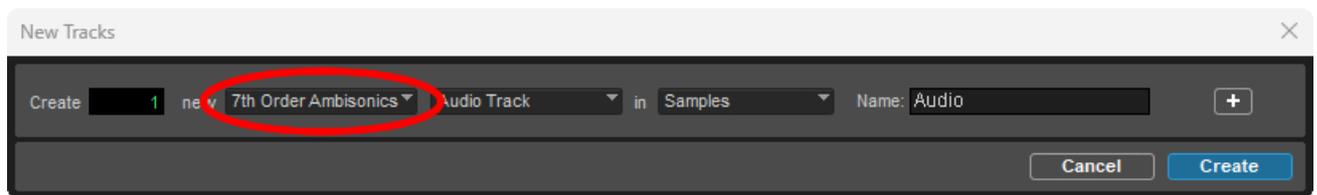
Where you are using standard Pro Tools stem formats only, these issues are not relevant. But, if you are using stem formats that Pro Tools does not support directly, care is needed.

Please see the documentation for each individual plugin for details.

### 2.3.3 Ambisonic Tracks

Pro Tools stem formats make it very straightforward to organise an ambisonic project. Often, tracks do not need to be created in special way as simply including an O7A panner or other ambisonic encoder will result in the track stem format changing automatically, e.g. from mono.

However, if you wish to create an ambisonic track directly, Pro Tools provides simple options on the track creation screen.



Like these plugins, Pro Tools normally uses the [SN3D/ACN](#) ambisonic format. You can convert from FuMa to SN3D using the [O7A Injector - FuMa](#) plugin.

## 2.3.4 Organising Projects

A recommended way to organise a project is to route all of your ambisonic material (panned or otherwise) to a single ambisonic "O7A Master" bus, set to seventh order ambisonics in much the same way as tracks (see above).



This gives a convenient place to bring the whole O7A mix together and send it to a number of tracks for visualisation (e.g. with [O7A Visualiser](#) or [O7A Flare](#)), metering and decoding for specific output formats.

For instance, you might create a "Stereo Decoding" track including the [O7A Decoder - Stereo](#) plugin, so the final stem format is stereo, ready for monitoring. You might also set up a "5.1

Decoding" track in parallel and mute the one you are not using - and so on for other final output formats.

Effect sends can be used in the normal way and Pro Tools will help you match up the stem formats in use.

## 2.4 Audio for Virtual Reality 360 Video

The [O7A streams](#) used by these plugins capture a spatial audio scene that can be used for Virtual Reality (VR) playback. Typically, the audio is delivered to the VR device in a raw ambisonic format and is rotated using head tracker data before live decoding. This has the effect of modifying the audio scene to take into account where the user is looking. Because raw ambisonic audio is delivered to the device, final mixes should not generally be decoded in the studio, except for monitoring.

O7A streams contain seventh order SN3D/ACN (AmbiX), which uses 64 channels. A subset of the channels is directly compatible with many VR systems.

### 2.4.1 YouTube 360-Degree Videos

YouTube 360-degree videos can use first order SN3D. To reduce your mix to first order, just take the first four channels of your 64 channel mix, or use [O7A Decoder - O1A](#).

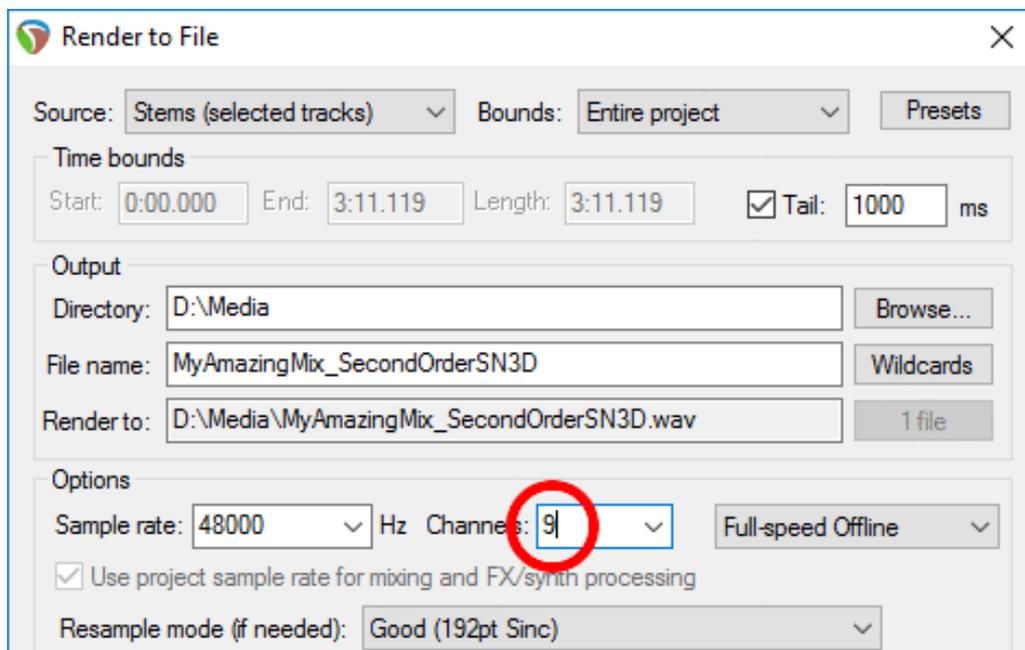
### 2.4.2 Google Jump Inspector

Google Jump Inspector can use third order SN3D audio. You can reduce your mix to third order by taking the first sixteen channels, or by using [O7A Decoder - O3A](#).

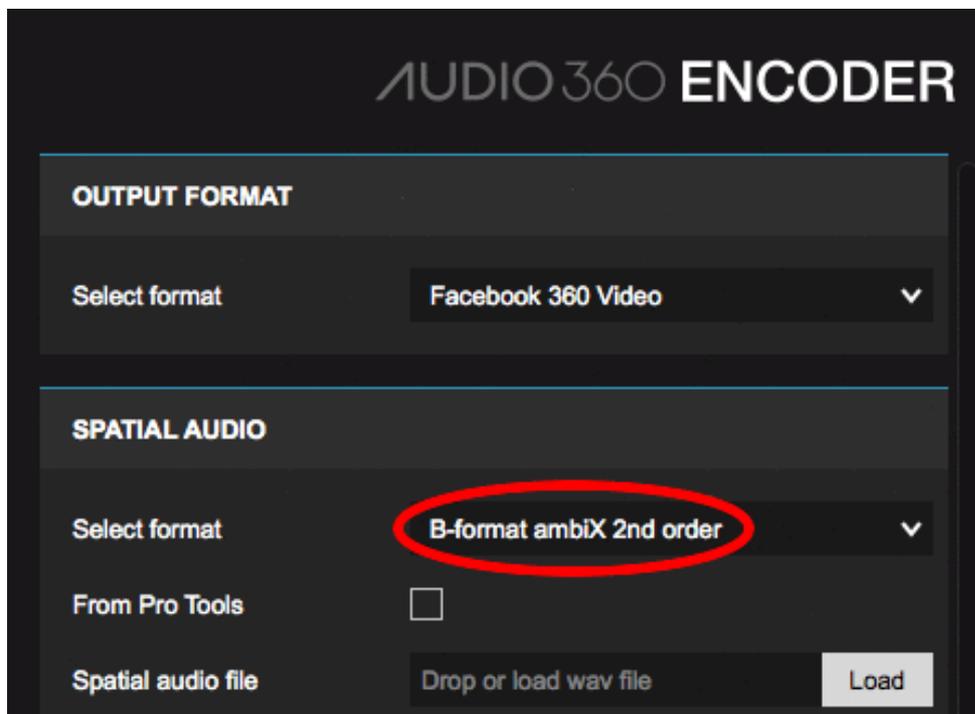
### 2.4.3 Facebook 360 Video

Facebook 360 videos can use second order SN3D audio, which uses nine channels.

The easiest way to reduce an O7A mix to just nine channels in Reaper is often to set the render channel count to nine by *typing* the number 9 into the Channels box.



Once you have a nine channel second order file, this can be encoded using the Facebook FB360 Encoder (v1.3.0 or later). Select format "B-format ambiX 2nd order".



#### 2.4.4 Rapture3D Universal

The Blue Ripple Sound Rapture3D Universal game/VR engine can render up to fifth order SN3D, so the channel count should be dropped at most to 36. In practice, third order gives excellent resolution and reduces processing load, so 16 channels may be better.

The easiest way to do this in Reaper is often to set the render channel count by *typing* the number into the Channels box (see above).

#### 2.4.5 Quad Binaural

Quad binaural is an alternative system that does *not* use raw ambisonic audio. Instead, four binaural stereo images are used, corresponding to different head orientations (front, left, back and right). These are mixed together live depending on where the user is looking. This system only supports one axis of rotation, unlike ambisonics which supports all three.

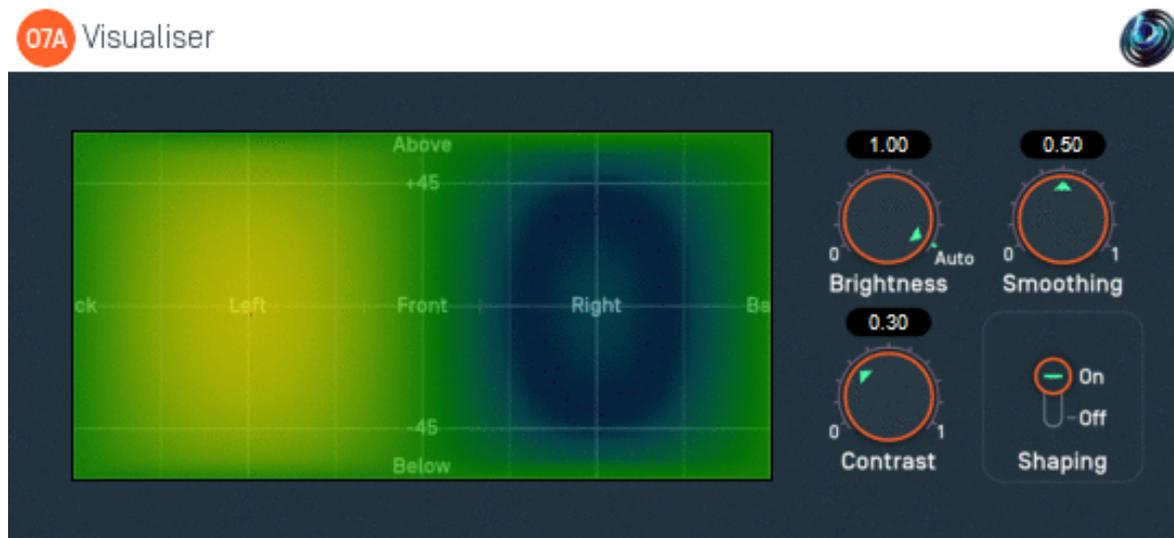
Quad binaural is generally delivered as four stereo files. To produce these, we recommend use of the the O7A Decoder - Quad Binaural plugin from the O7A Decoding pack. This will typically give better final results than rotating the O7A stream and using a more conventional binaural decoder to generate the Quad Binaural.

## 2.5 Spotting A Common Issue

In many DAWs it is easy to forget to set your track or send channel counts to 64 at some point and end up trying to handle O7A as stereo audio. We certainly do this regularly!

This is such a common problem that it is worth taking a moment to look at what then happens, so you can spot the issue more quickly:

- Sound positioning becomes vague.
- Sound movement is only to the left and right, with nothing definite in other directions.
- The O7A Visualiser typically shows a vague left or right image, or just one colour. The left-hand case typically looks something like this:

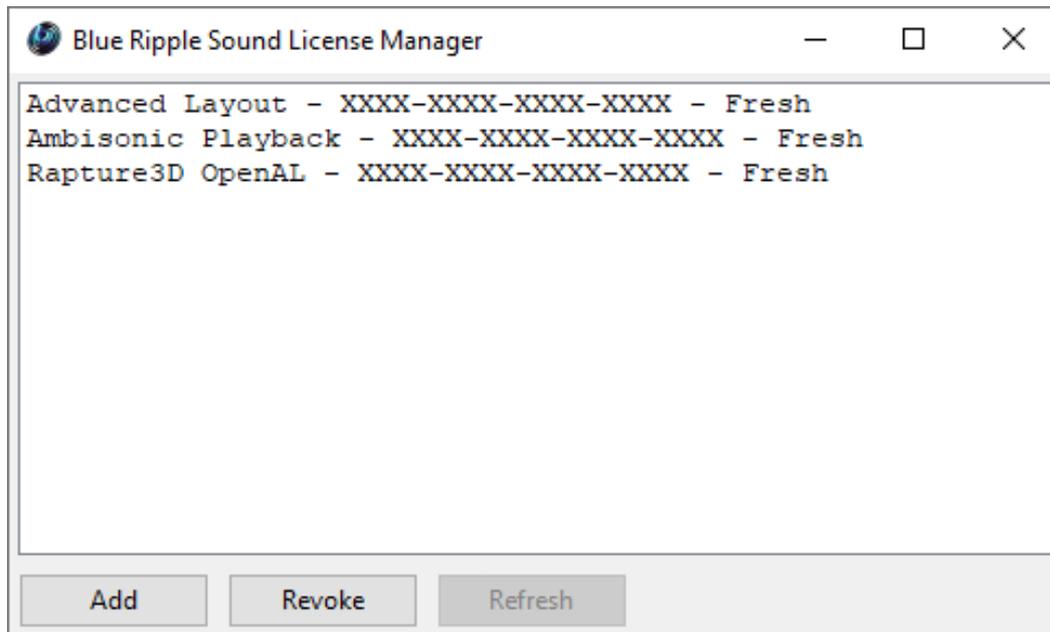


The reason this happens is that O7A needs 64 channels to work properly. If only the first two channels are present, these happen to be the omnidirectional and left-right ambisonic components, like in M/S stereo. These are enough to get an approximate sound level to transmit some basic left/right information, but definitely not the full detail of the soundfield!

So, keep your eyes and ears open and remember that O7A needs 64 channels.

## 2.6 The License Manager

The Blue Ripple Sound License Manager application can be used to move license keys around between computers.



The application is generally available in the Start Menu on Windows, and in your installation directory, which is typically:

- C:\Program Files\Blue Ripple Sound\ on Windows, and
- /Applications/Blue Ripple Sound/ on macOS.

License keys can be removed from a computer using the 'Revoke' button and added with 'Add'. If data is not 'Fresh' this probably indicates a network connectivity issue, in which case the 'Refresh' button may be used. Generally, licenses are refreshed automatically.

## 2.7 Technical Requirements

### 2.7.1 Operating System

Supported versions of Microsoft Windows are 10 or 11, 64bit Intel.

Supported versions of Apple macOS are 10.14 to 13.5, 64bit Intel or Apple Silicon.

### 2.7.2 VST Host

The VST plugins require a VST 2 host with shell plugin support.

**These plugins do not work with all VST 2 hosts.** One reason for this is that the O7A plugins need large numbers of channels on their input or output busses. Check the individual plugins for the channel counts they need, but all of the O7A plugins need at least 64 channels on each track. Also, at the time of writing VST 2 shell plugins are not supported in Nuendo or Cubase.

### 2.7.3 AAX Host

The AAX plugins require **Pro Tools Ultimate version 2023.6** or later.

### 2.7.4 PC Hardware

Please check your PC meets the following requirements:

- Intel Core i7 CPU or better, or Apple Silicon.
- 400MB of free disk space.

### 2.7.5 Permissions

You'll need administrator permissions while installing on Windows. The software probably won't install properly using a "restricted" account.

### 2.7.6 Internet Connection Required

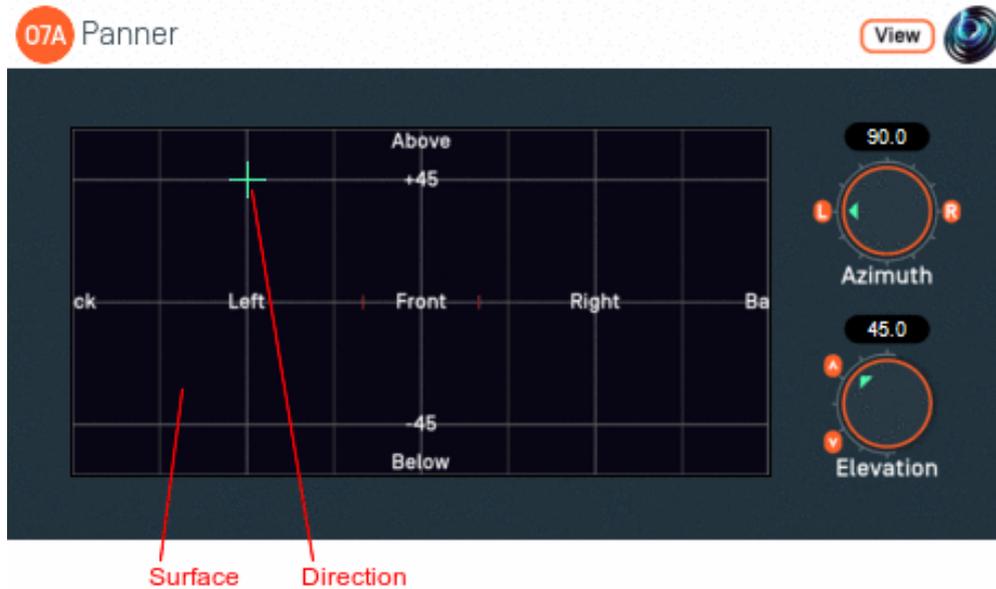
This software requires an Internet Connection for license activation and verification.

Successful license verification isn't required every time you use the software, but it is needed during installation and needs to succeed once every couple of weeks to keep the license fresh.

The license can be "revoked" to remove it from one machine so it can be moved on to another. You should also do this if you're updating your system in case the machine appears to have changed identity.

# 3 Panners

## 3.1 O7A Panner



### 3.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 3.1.2 Audio

	Channels	Content
Input	1	Mono
Output	64	O7A

### 3.1.3 Controls

- Azimuth
- Elevation

### 3.1.4 Description

This O7A panner takes a mono sound and places it in a particular direction in a 3D O7A mix.

There are various versions of this panner plugin, but this is our favourite. This version uses more screen real estate than the "classic" version but is typically easier to use, particularly if you are just starting out with this way of doing things.

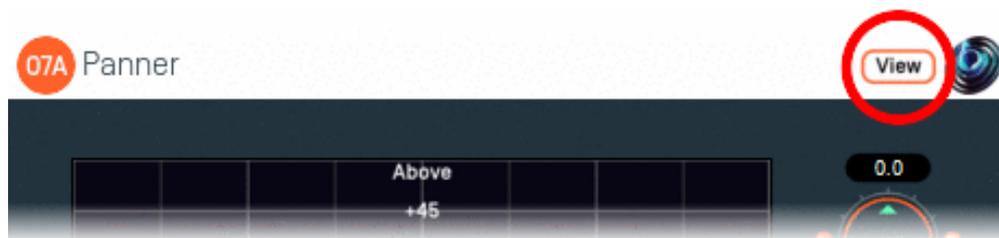
As well as azimuth and elevation dials, there is a control surface which can be used to visualise the current direction (indicated by the crosshairs). This direction can also be changed by clicking with the mouse.

There are labels on the control surface to help you find left, right, above etc. However, if this still does not make any sense, you might want to see our page on the [O7A Visualiser](#) which lays out its viewing region in the same way.

### 3.1.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross.	The current direction is shown using a beam and cross.
Hold the left mouse button to set the azimuth and elevation.	Hold a VR controller trigger to set the azimuth and elevation.

### 3.1.6 Controls

#### 3.1.6.1 Controls: Azimuth and Elevation

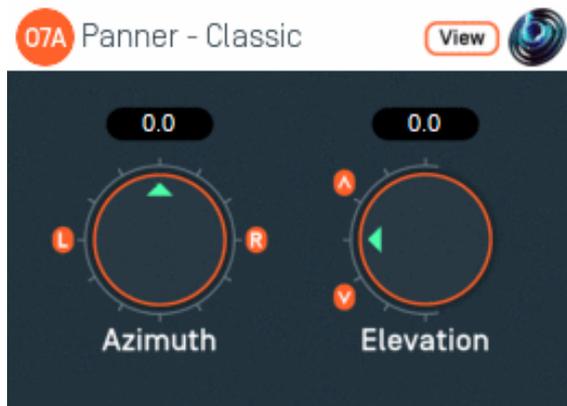
Azimuth and Elevation control the direction in which the input is placed in the 3D audio scene.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

It may help to experiment with the control surface to get used to this way of doing things.

## 3.2 O7A Panner - Classic



### 3.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 3.2.2 Audio

	Channels	Content
Input	1	Mono
Output	64	O7A

### 3.2.3 Controls

- Azimuth
- Elevation

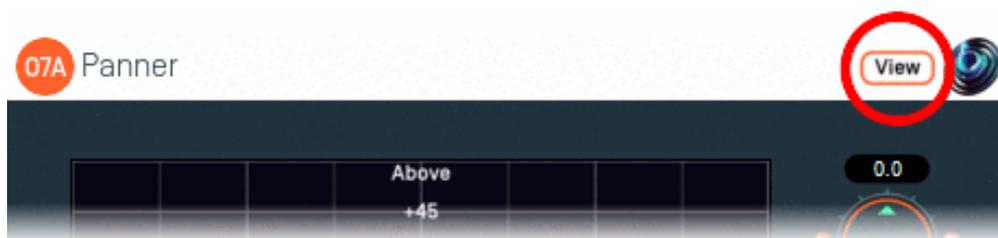
### 3.2.4 Description

There are various versions of this panner plugin and this is the most "raw" version. Only the "classic" azimuth/elevation controls are provided, largely to save screen real estate. These are great if you are used to them; if you are not, you might want to try the [standard version](#).

### 3.2.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

<b>View Support</b>	<b>ViewVR Support</b>
The current direction is shown using a cross.  Hold the left mouse button to set the azimuth and elevation.	The current direction is shown using a beam and cross.  Hold a VR controller trigger to set the azimuth and elevation.

## 3.2.6 Controls

### 3.2.6.1 Controls: Azimuth and Elevation

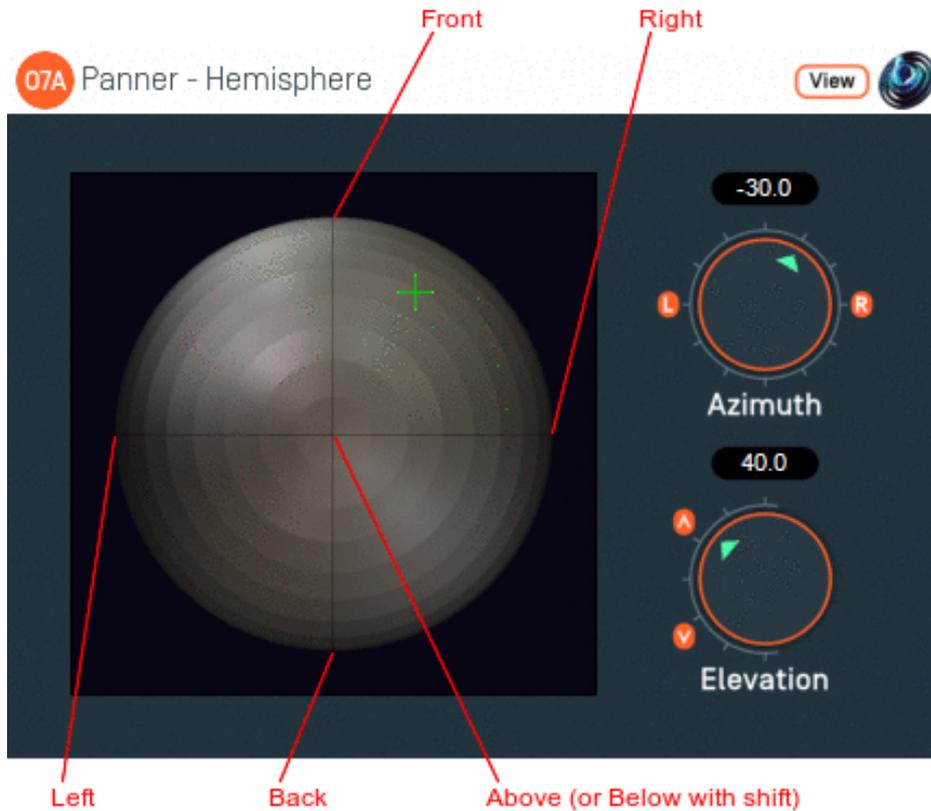
Azimuth and Elevation control the direction in which the input is placed in the 3D audio scene.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

It may help to experiment with the [standard version](#) to get used to this way of doing things.

### 3.3 O7A Panner - Hemisphere



#### 3.3.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

#### 3.3.2 Audio

	Channels	Content
Input	1	Mono
Output	64	O7A

#### 3.3.3 Controls

- Azimuth
- Elevation

#### 3.3.4 Description

There are various versions of this panner plugin. This version provides a control surface that maps directly onto the upper hemisphere of possible sound directions. You can click on the control surface to move the sound and holding some keys down changes how the sound is moved:

- Use the "shift" key to select the lower hemisphere (so sounds are below rather than above).
- Use the "alt" key to lock the elevation (so sounds move in a horizontal circle).

A [hemisphere visualiser](#) is available for use with this plugin. However, we generally recommend the [standard panner](#), which has a control surface using the same rectangular layout as the standard

### 3.3.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross. Hold the left mouse button to set the azimuth and elevation.	The current direction is shown using a beam and cross. Hold a VR controller trigger to set the azimuth and elevation.

### 3.3.6 Controls

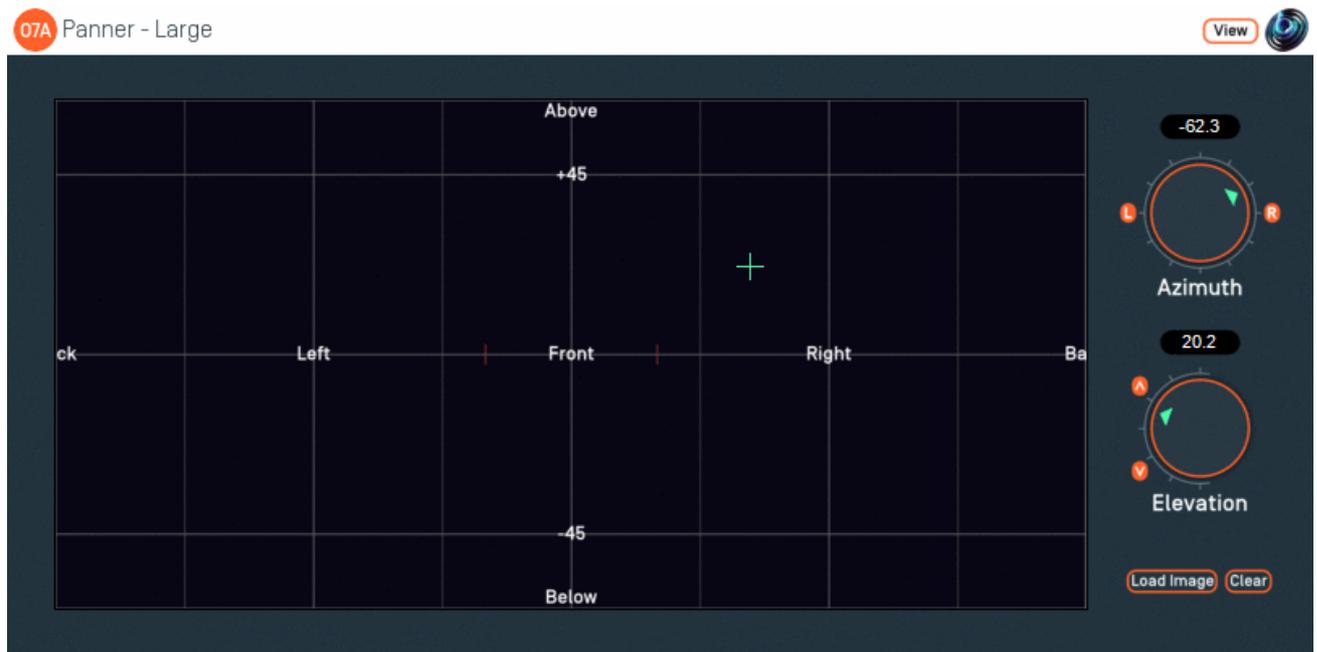
#### 3.3.6.1 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction in which the input is placed in the 3D audio scene.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

## 3.4 O7A Panner - Large



### 3.4.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 3.4.2 Audio

	Channels	Content
Input	1	Mono
Output	64	O7A

### 3.4.3 Controls

- Azimuth
- Elevation

### 3.4.4 Description

This O7A panner takes a mono sound and places it in a particular direction in a 3D O7A mix.

This plugin is an extra large version of our [standard panner plugin](#). It can be useful on high resolution screens. It also supports background images.

#### 3.4.4.1 Background Images

Press the "Load Image" button to load an image to replace the default grid background. JPG and PNG images are supported. Because of the way the plugin works, we recommend use of dark backgrounds.

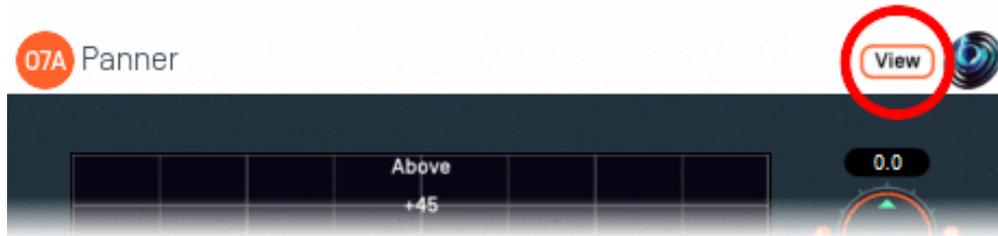
The target image size is 636x316. Other sizes are resized to fit.

The "Clear" button can be used to clear the image so the default grid background is shown again.

### 3.4.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross. Hold the left mouse button to set the azimuth and elevation.	The current direction is shown using a beam and cross. Hold a VR controller trigger to set the azimuth and elevation.

### 3.4.6 Controls

#### 3.4.6.1 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction in which the input is placed in the 3D audio scene.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

It may help to experiment with the control surface to get used to this way of doing things.

## 3.5 O7A Panner - Two Channel



### 3.5.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 3.5.2 Audio

	Channels	Content
Input	2	Stereo
Output	64	O7A

### 3.5.3 Controls

- Azimuth 1
- Elevation 1
- Azimuth 2
- Elevation 2
- Mouse Mode

### 3.5.4 Description

This O7A panner takes two mono sound sources and places them in particular directions in a 3D O7A mix.

It can also be used as a simple way to upmix stereo to O7A. However, we do not particularly

recommend you do this except for fairly narrow angles because a large "hole" can appear between the two sources. For a more thorough handling of material that was originally panned to stereo you wish to look at the O7A Upmixer - Stereo plugin.

There are azimuth and elevation dials for each of the two sources. Each works the same way as the controls in the [mono version](#). There is a control surface which can be used to visualise the current directions for the two sources, indicated by the green/blue and red crosshairs. These can be changed by clicking with the mouse, using the left mouse button for the first source and the right mouse button for the second. If you do not have a right mouse button, or are using a touch screen, you can hold down the 'Alt' key and press the main button instead. You can also move both sources around together using the 'Shift' key.

If pressing keys on the keyboard is inconvenient, there is a mouse mode slider on screen which can be used instead.

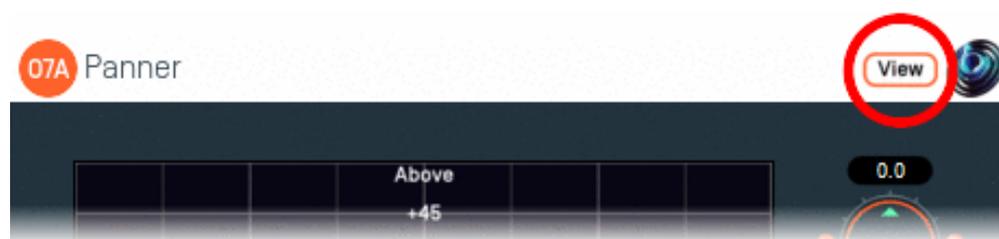
Mouse Mode	Key(s) Held	Function
Norm		Normal operation. Left click to move the first source, right click to move the second source.
Alt	Alt	Flips the source moved when the control surface is clicked, so a left click moves the second source rather than the first (and vice versa). Typically used to select the second source on a mouse with only one button.
Both	Shift	Changes the control surface so that movements of the mouse shift both sources.
Opp	Alt & Shift	Changes the control surface so that movements of the mouse shift both sources, but the sources move in opposite directions.

There are labels on the control surface to help you find left, right, above etc. However, if this still does not make any sense, you might want to see our page on the [O7A Visualiser](#) which lays out its viewing region in the same way.

### 3.5.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
<p>The current panner directions are shown using green/blue and red crosses, similarly to the plugin display.</p> <p>Point at one and hold the left mouse button to select it. Then, drag to set its azimuth and elevation.</p>	<p>The current panner directions are shown using green/blue and red beams and crosses, similarly to the plugin display.</p> <p>Each VR controller moves one panner direction and the controllers show short green/blue and red beams to indicate which is which. Hold a VR controller trigger to set an azimuth and elevation.</p>

## 3.5.6 Controls

### 3.5.6.1 Controls: Azimuth 1 and 2 and Elevation 1 and 2

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

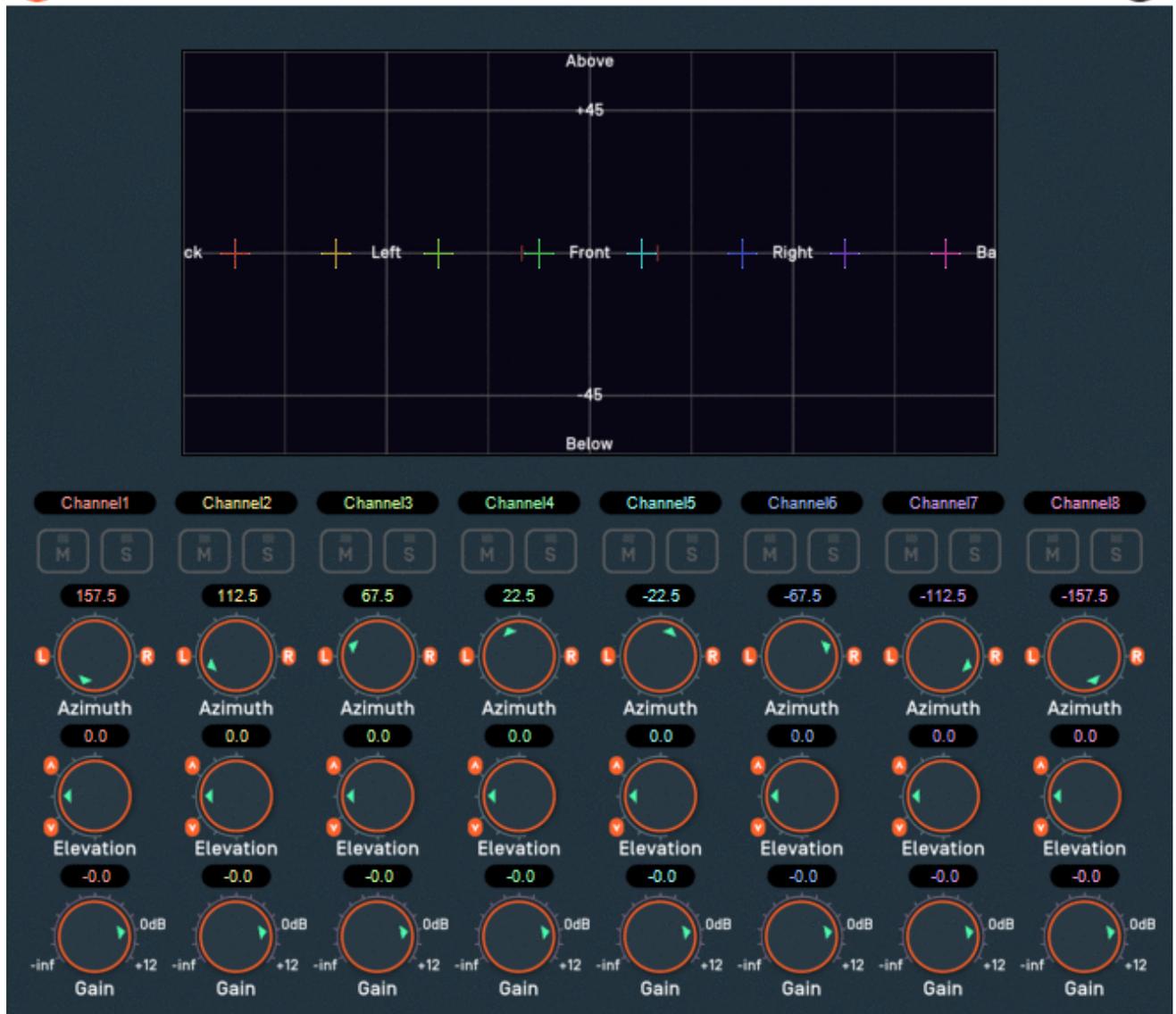
Azimuth 1 and Elevation 1 control the location used to pan the first source (which is shown in green/blue on the control surface). Azimuth 2 and Elevation 2 control the location used to pan the first source (which is shown in red).

### 3.5.6.2 Control: Mouse Mode

The mouse mode slider in the middle at the bottom of the screen determines the mouse mode used when the control surface is clicked. They are an alternative to use of the Alt and Shift keys. See the [table above](#) for details on how these options affect operation.

## 3.6 O7A Panner - Eight Channel

O7A Panner - Eight Channel



### 3.6.1 Host Support

Host Type	Support
AAX	Yes, input mapped to 7.1
VST2	Yes

### 3.6.2 Audio

	Channels	Content
Input	8	Eight channels of mono (mapped to 7.1 for AAX)
Output	64	O7A

### 3.6.3 Controls

- Azimuth 1 - 8
- Elevation 1 - 8
- Gain 1 - 8

- Mute 1 - 8
- Solo 1 - 8

### 3.6.4 Description

This O7A panner takes eight mono sound sources and places them in particular directions in a 3D O7A mix.

There are azimuth and elevation dials for each of the sources. These work the same way as the controls in the standard [single channel panner](#). Each source also has mute and solo buttons and a gain control.

There is a control surface which can be used to visualise the current directions for the sources, indicated by coloured crosshairs. These can be changed by dragging with the mouse.

There are labels on the control surface to help you find left, right, above etc. However, if this still does not make any sense, you might want to see our page on the [O7A Visualiser](#) which lays out its viewing region in the same way.

Text can be entered into channel labels above the mute/solo buttons to help you keep track of which channel is which. these labels are shown when used with this plugin's [View support](#).

#### 3.6.4.1 Reaper Note

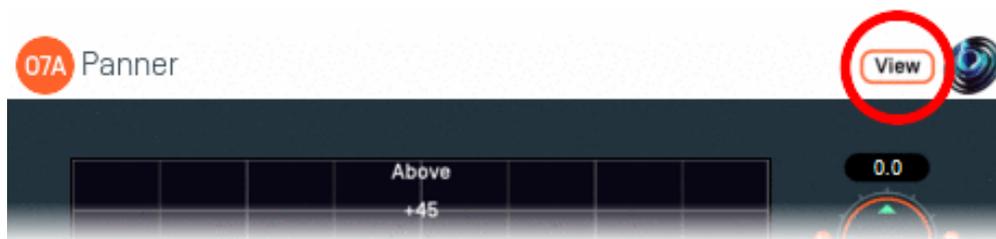
If you are using this panner with Reaper, it is fairly easy to set up the individual mono source inputs as subtracks of the track on which the panner is set.

On the routing panel for each subtrack, set the "Parent Channels" to send to the relevant pair of inputs in this plugin and then pan hard left or right depending on whether this should be an odd or even input. Set this panner plugin as the first effect on the parent track and check the routing using the solo button for each source.

### 3.6.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current panner directions are shown using colour-coded crosses and labels, similarly to the plugin display.	The current panner directions are shown using colour-coded beams, crosses and labels, similarly to the plugin display.  Point at one with a VR controller and the controller will indicate the label of the source pointed at. Then, hold the VR

View Support	ViewVR Support
Point at one and hold the left mouse button to select it. Then, drag to set its azimuth and elevation.	controller trigger to select it and move the controller to set its azimuth and elevation.

## 3.6.6 Controls

### 3.6.6.1 Controls: Azimuth 1 - 8 and Elevation 1 - 8

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

It may help to experiment with the control surface to get used to this way of doing things.

Azimuth and Elevation can also be changed by dragging the relevant source on the control surface.

### 3.6.6.2 Controls: Gain 1 - 8

Each panned source has its own gain control, with a range from -60dB to +12dB.

### 3.6.6.3 Controls: Mute 1 - 8 and Solo 1 - 8

Each panned source has its own mute and solo switch. These have the usual meanings and solo overrides mute.

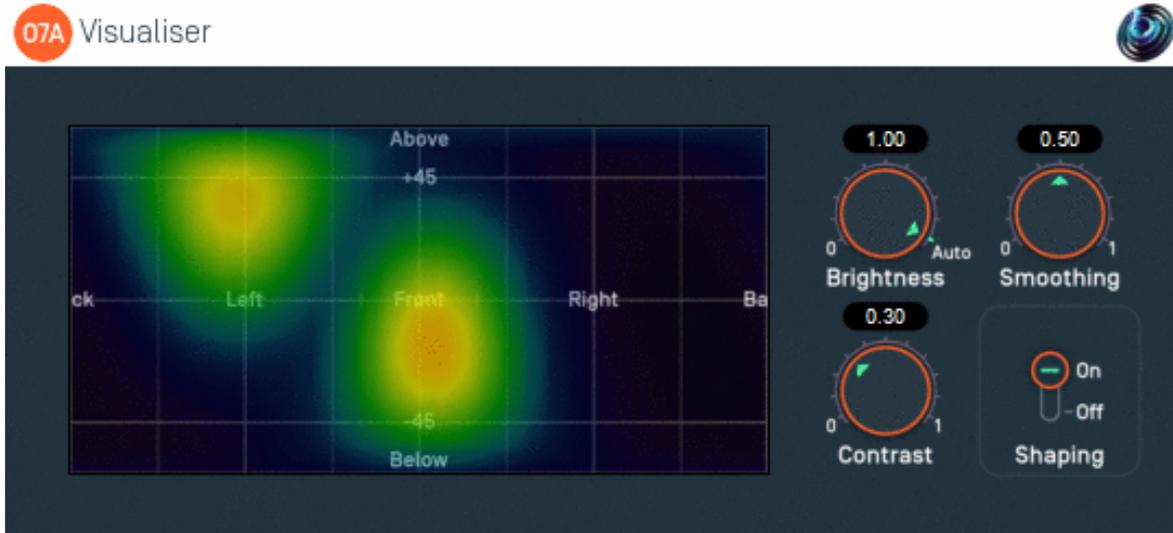
## 3.6.7 Presets

Presets are available for this plugin:

- 5.0
- 7.0
- Triangle
- Square
- Pentagon
- Hexagon
- Octagon
- Front Stage
- Bi-Triangle
- Octahedon
- Cube

# 4 Visualisers

## 4.1 O7A Visualiser



### 4.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 4.1.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

### 4.1.3 Controls

- Brightness
- Contrast
- Smoothing
- Shaping

### 4.1.4 Description

This plugin produces a view of an O7A stream which can help make sense of what is happening in it. Audio is passed through unmodified, so the plugin can be inserted in the middle of an O7A effects chain.

The stream is shown using a rectangular screen region. This rectangular region shows an equal-area cylindrical projection of the directional components of the O7A soundfield interpreted over a sphere.

Or, to put it another way, it lights up in different places depending on where a sound comes from. Some of those places are labelled in the image. The view is like a map of the world, where sounds above are at the "north pole" and are shown across the top of the view and sounds below are at the

"south pole" at the bottom. Sounds rotating around at head height move around the equator, so they move along the view halfway down, wrapping around between the left and right edges as they pass behind.

A good way to try this out is to chain the [O7A Panner](#) immediately before this plugin as this uses the same directional approach. Then set up a decoder after this suitable for use with your speakers or headphones. Then you can play around with different sound directions and hear *and see* the results.

To reduce CPU load, this visualiser stops most processing when it is not on screen.

This plugin does not have O7A View support. You might wish to consider [O7A Flare](#).

## 4.1.5 Controls

### 4.1.5.1 Control: Brightness

This controls the brightness of the image. If the screen is black when sounds are playing, you may wish to turn this up. If it is all red, turn it down.

Alternatively, you can set the dial to "Auto", in which case the plugin will try to ride the brightness control to keep the visualisation useful.

### 4.1.5.2 Control: Contrast

This controls the contrast of the image. Higher values produce a sharper image but map a smaller dynamic range onto the screen.

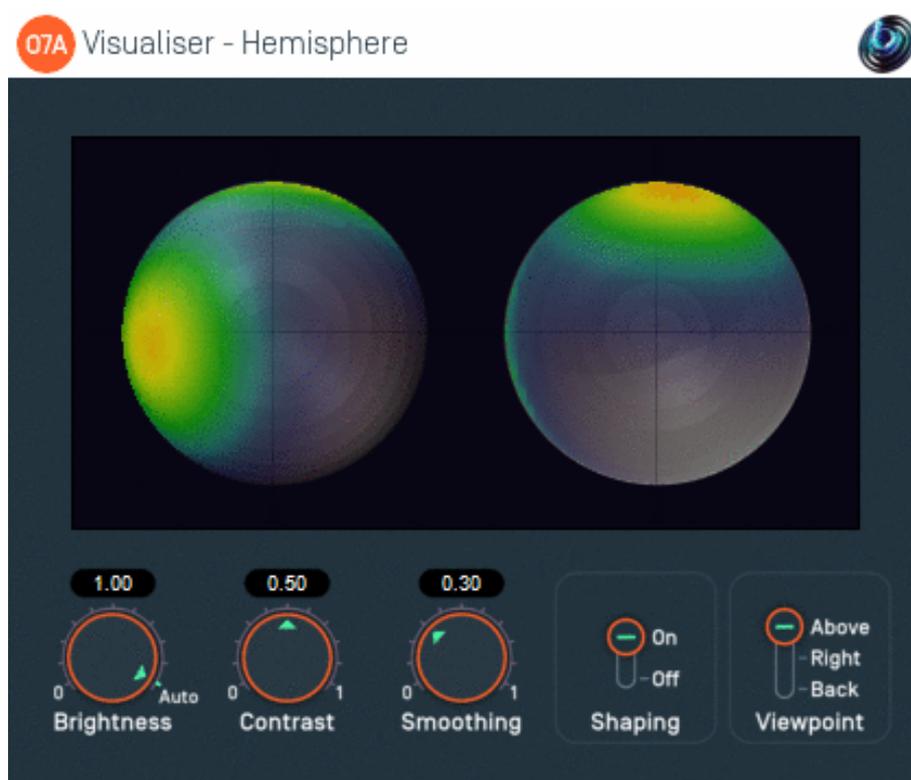
### 4.1.5.3 Control: Smoothing

The image generated is smoothed over time. Use more smoothing for a more stable, slower moving image. Use less for a more responsive one.

### 4.1.5.4 Control: Shaping

Shaping should normally be left on as it produces a more straightforward view. If this is turned off, the image will typically be sharper, but ripples will be visible in directions away from original sound directions.

## 4.2 O7A Visualiser - Hemisphere



### 4.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 4.2.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

### 4.2.3 Controls

- Brightness
- Contrast
- Smoothing
- Shaping
- Viewpoint

### 4.2.4 Description

This plugin produces a view of an O7A stream which can help make sense of what is happening in it. Audio is passed through unmodified, so the plugin can be inserted in the middle of an O7A effects chain.

The stream is shown using a two circular regions each showing a projection of a half of the directional components of the O7A soundfield interpreted over a sphere.

By default, the left sphere shows the upper hemisphere of the soundfield and the right sphere shows the lower hemisphere, as if both were viewed from above. The image is orientated so that sounds at the front appear at the top of both images. However, the [viewpoint](#) can be changed.

A good way to try this out is to chain the [O7A Panner - Hemisphere](#) plugin immediately before this one as that panner uses the same directional approach (as long as the [viewpoint](#) is set to "Above"). Then set up a decoder after this suitable for use with your speakers or headphones. Then you can play around with different sound directions and hear and see the results.

We do not particularly recommend this visualisation. Generally, we suggest you use the standard [O7A Visualiser](#) instead.

This plugin does not have O7A View support. You might wish to consider [O7A Flare](#).

## 4.2.5 Controls

### 4.2.5.1 Control: Brightness

This controls the brightness of the image. If the screen shows nothing when sounds are playing, you may wish to turn this up. If it is all red, turn it down.

Alternatively, you can set the dial to "Auto", in which case the plugin will try to ride the brightness control to keep the visualisation useful.

### 4.2.5.2 Control: Contrast

This controls the contrast of the image. Higher values produce a sharper image but map a smaller dynamic range onto the screen.

### 4.2.5.3 Control: Smoothing

The image generated is smoothed over time. Use more smoothing for a more stable, slower moving image. Use less for a more responsive one.

### 4.2.5.4 Control: Shaping

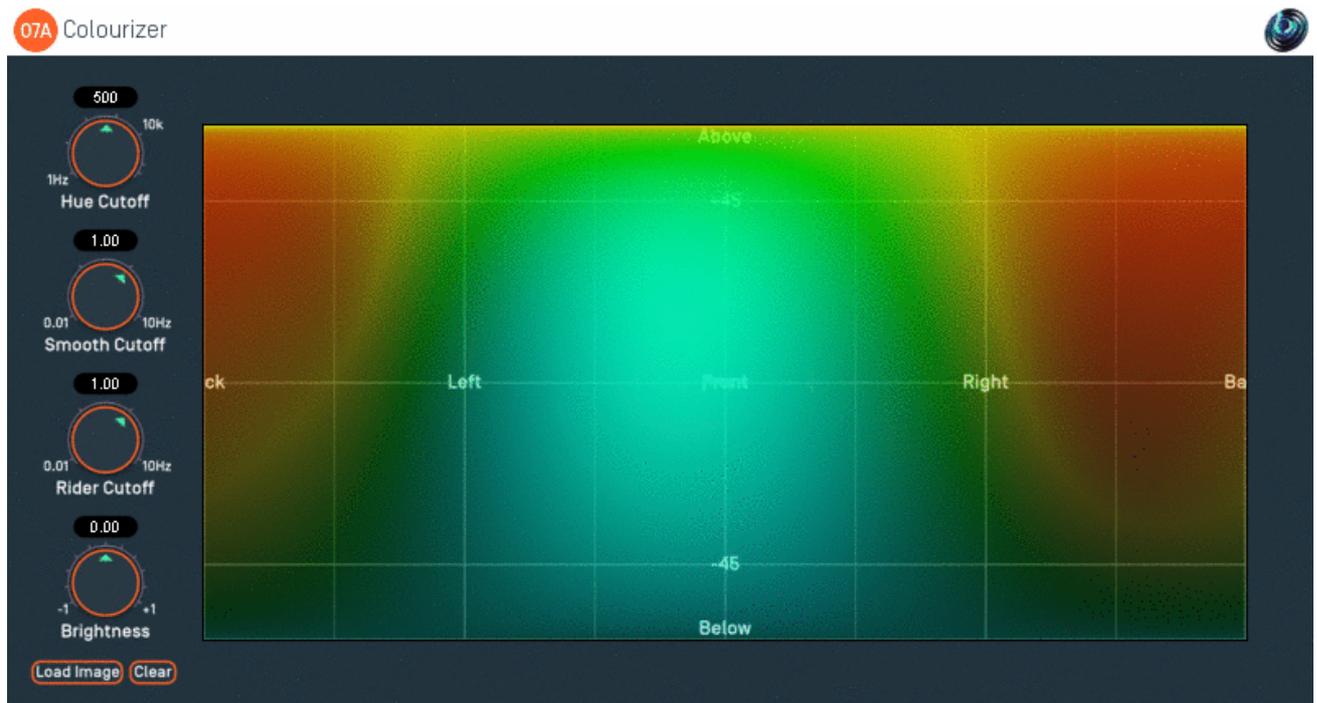
Shaping should normally be left on as it produces a more straightforward view. If this is turned off, the image will typically be sharper, but ripples will be visible in directions away from original sound directions.

### 4.2.5.5 Control: Viewpoint

By default, the visualisation shows the upper hemisphere on the left and the lower hemisphere on the right, both viewed as the viewpoint was from **above**.

Alternatively, the viewpoint can be changed to view from the **right** or from **behind**. In both cases sounds above appear at the top of the image.

## 4.3 O7A Colourizer



### 4.3.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 4.3.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

### 4.3.3 Controls

- Hue Cutoff
- Smooth Cutoff
- Rider Cutoff
- Brightness

### 4.3.4 Description

This plugin is a variant of the [O7A Visualiser](#) plugin. Like that plugin, it produces a view of an O7A stream which can help understand what is happening in it. Audio is passed through unmodified, so the plugin can be inserted in the middle of an O7A effects chain.

Two significant differences between this and the [O7A Visualiser](#) are the size of the plugin and how colours are mapped. With this plugin, colours are chosen using a hue that depends on the frequency content of the sound. Sounds that are predominantly low-frequency are coloured red and sounds that are predominantly high-frequency are coloured magenta. Sounds between are coloured with other hues accordingly.

To conserve CPU resources, the O7A version of this plugin ignores components above fourth order.

#### **4.3.4.1 Background Images**

Press the "Load Image" button to load an image to replace the default grid background. JPG and PNG images are supported. Because of the way the plugin works, we recommend use of dark backgrounds.

The target image size is 636x316. Other sizes are resized to fit.

The "Clear" button can be used to clear the image so the default grid background is shown again.

### **4.3.5 Controls**

#### **4.3.5.1 Control: Hue Cutoff**

The plugin selects hues by splitting the sound into low and high frequencies. To do this, it uses a low-pass filter with a cutoff frequency given by this control. Generally, it is best to set this where you want the greatest sensitivity to frequency content.

#### **4.3.5.2 Control: Smooth Cutoff**

The local image level is smoothed over time using a low-pass filter with a cutoff frequency given by this control. Lower values will give a more stable, slower moving image. Higher values will give a more responsive one.

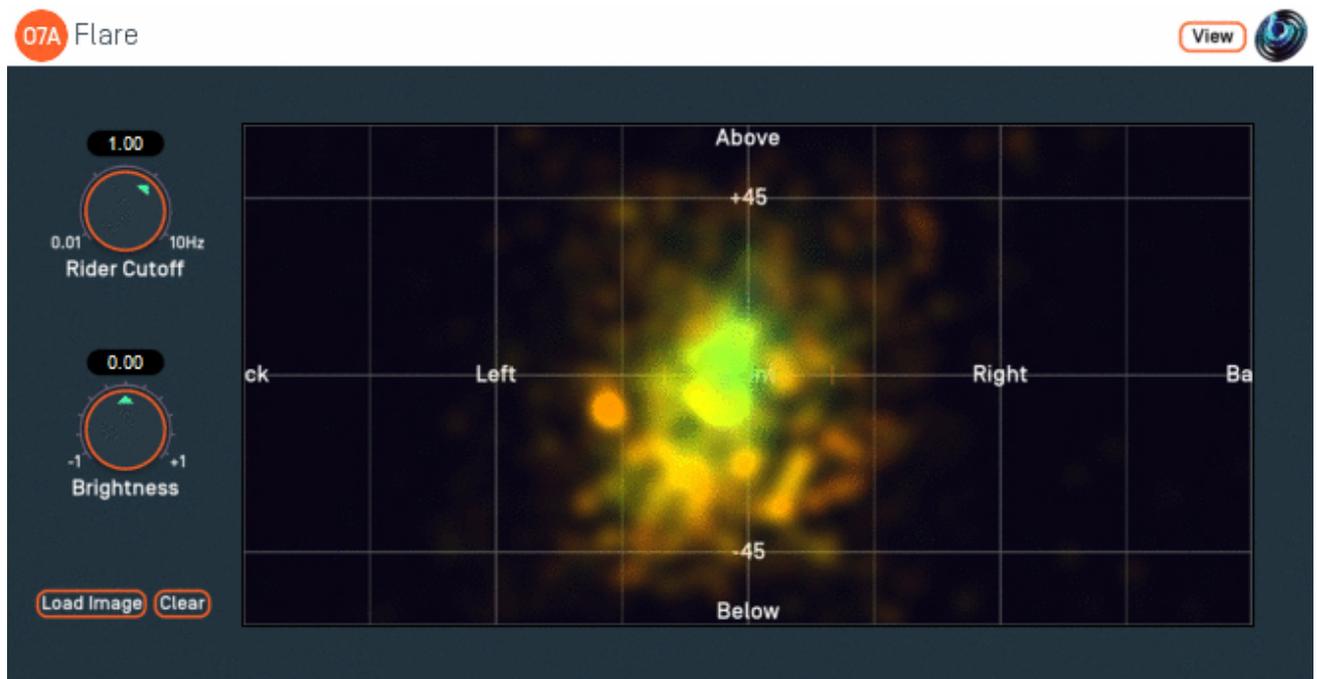
#### **4.3.5.3 Control: Rider Cutoff**

A "gain rider" tracks the overall signal level using another low-pass filter. Lower values respond more slowly to changes in the overall level of the signal. Higher values respond more quickly.

#### **4.3.5.4 Control: Brightness**

This modifies the overall brightness of the image.

## 4.4 O7A Flare



### 4.4.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 4.4.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

### 4.4.3 Controls

- Rider Cutoff
- Brightness

### 4.4.4 Description

This plugin is a variant of the [O7A Visualiser](#) plugin. Like that plugin, it produces a view of an O7A stream which can help understand what is happening in it. Audio is passed through unmodified, so the plugin can be inserted in the middle of an O7A effects chain.

Although this plugin uses the same layout, it uses substantially different processing to the [O7A Visualiser](#) and [O7A Colourizer](#) plugins. This plugin uses simple first order estimates of the predominant sound direction in a range of frequency bands. These directions are painted using colour coding, ranging from red for low frequencies up to magenta for high frequencies (up to about 20kHz). Plot accuracy is better for simpler scenes; multiple sources with similar frequency content will often result in smudged or misaligned images.

To reduce CPU load, this visualiser stops most processing when it is not on screen.

#### 4.4.4.1 Background Images

Press the "Load Image" button to load an image to replace the default grid background. JPG and PNG images are supported. Because of the way the plugin works, we recommend use of dark backgrounds.

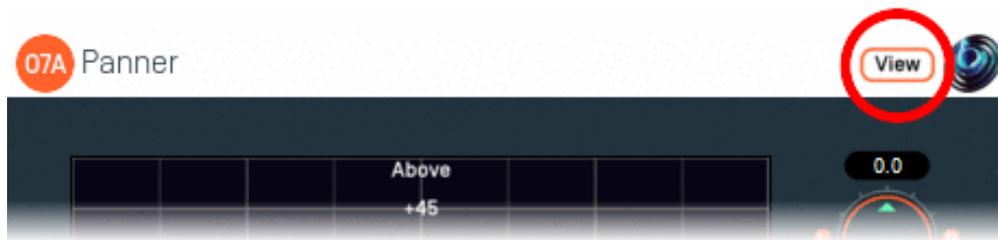
The target image size is 636x316. Other sizes are resized to fit.

The "Clear" button can be used to clear the image so the default grid background is shown again.

#### 4.4.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The flare visualisation is supported by View.	The flare visualisation is supported by ViewVR.

Warning: requires a fast network connection and powerful CPU.

#### 4.4.6 Controls

##### 4.4.6.1 Control: Rider Cutoff

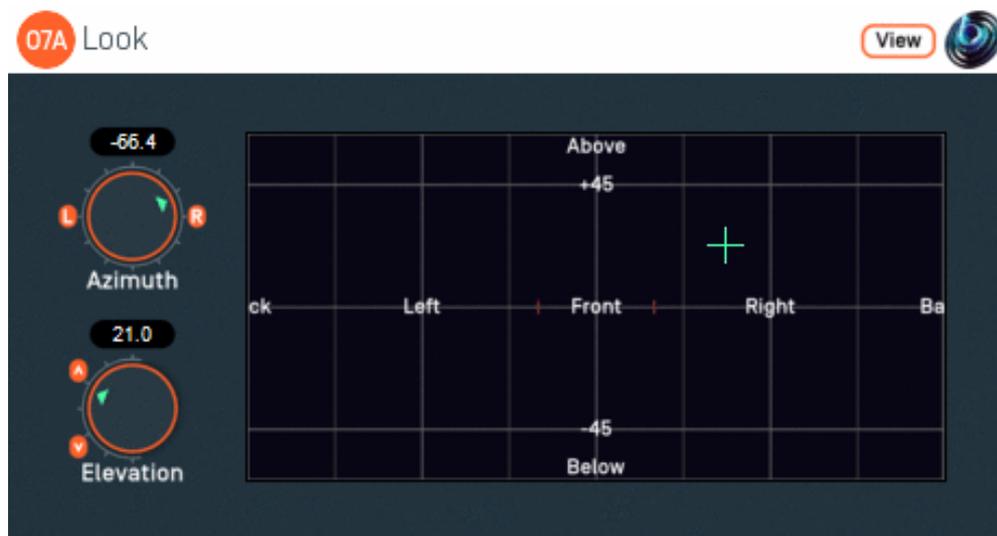
A "gain rider" tracks the overall level using another low-pass filter. Lower values respond more slowly to changes in the overall level of the signal. Higher values respond more quickly.

##### 4.4.6.2 Control: Brightness

This modifies the overall brightness of the image.

# 5 Rotation

## 5.1 O7A Look



### 5.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 5.1.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

### 5.1.3 Controls

- Azimuth
- Elevation

### 5.1.4 Description

This plugin changes where "front" is in the 3D audio scene, as if the listener had turned their head to look (and listen) in another direction.

The "look" direction is chosen using the dials or control surface, in the normal way (for instance, see the [O7A Panner](#)). Sounds that were in this direction will be to the front after processing.

This is essentially an simplified (and inverted) version of the [O7A Rotation](#) plugin. The "roll" and "ordering" controls are not provided. Instead, we just assume that the listener turns their head and pitches it backwards or forwards. Rolling to the sides is not supported (use the rotation plugin if you need this).

## 5.1.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross. Hold the left mouse button to set the azimuth and elevation.	The current direction is shown using a beam and cross. Hold a VR controller trigger to set the azimuth and elevation.

## 5.1.6 Controls

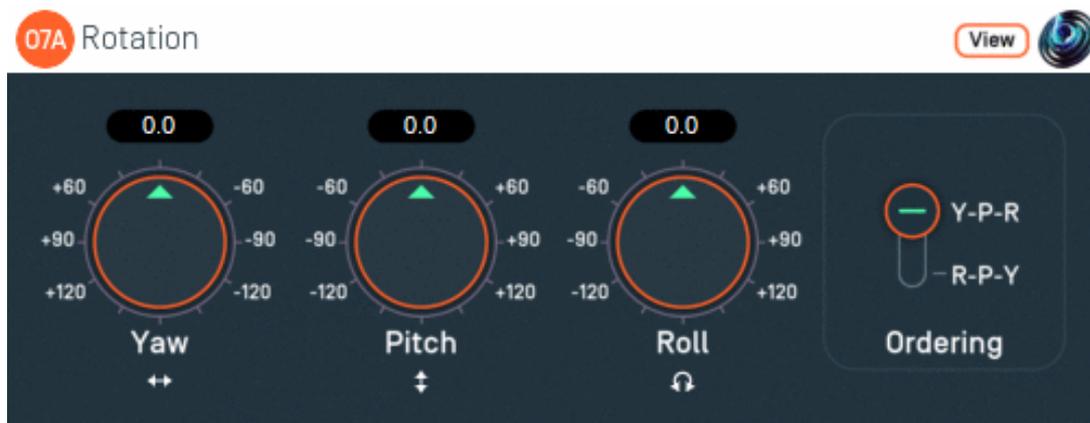
### 5.1.6.1 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction that is brought to the front by this plugin.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

## 5.2 O7A Rotation



### 5.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 5.2.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

### 5.2.3 Controls

- Yaw
- Pitch
- Roll
- Ordering

### 5.2.4 Description

This plugin rotates the entire O7A soundfield around the centre of the room.

Any rotation around the centre is possible and is built up using yaw, pitch and roll rotations. You can think of the rotations as being applied in order.

We *strongly recommend* that you use the [O7A Visualiser](#) when working with this plugin, particularly if you are going to use more than one of the dials at once. Otherwise, this plugin can be very confusing! It is easy to control in Virtual Reality using the ViewVR application however.

If you are using this plugin to simulate changes to the listener's orientation, you might also want to consider the [O7A Look](#) plugin, which is simpler to use but does not include a Roll control.

### 5.2.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
<p>The current post-rotation 'front' of the scene is shown using a cross.</p> <p>Hold the left mouse button to set all four rotation controls, moving the 'front' of the scene to the indicated direction. Only 2DOF is supported and the rotation will be set so 'up' is upwards.</p>	<p>The scene orientation is shown using a floating cube with matching marker beams on the cube and VR controllers.</p> <p>Rotate a VR controller into the chosen orientation and hold the trigger to set the four rotation controls. Full 3DOF is supported.</p>

## 5.2.6 Controls

### 5.2.6.1 Controls: Pitch, Roll and Yaw

These controls use angles between -180 and +180 degrees which can each be thought of as controlling individual rotations around three fixed axes. The overall rotation is a combination of the three.

Rotation	Axis	Description of Positive Movement
Yaw	Z	The soundfield is "rotated" left around the middle of the room. For instance, a sound that starts at the front moves left, a sound that starts at the left moves backwards and a sound directly above does not move.
Pitch	Y	The soundfield is "tumbled" backwards. For instance, a sound that starts at the front moves upwards, a sound that starts at the left does not move and a sound directly above moves backwards.
Roll	X	The soundfield is "tilted" clockwise. For instance, a sound that starts at the front does not move, a sound that starts at the left moves upwards and a sound directly above moves right.

This plugin can be used to simulate changes in the listener's orientation. If you are doing this, you will probably want to change the sign of the angles involved. For instance, turning the listener's head to the right means that the listener hears sound move to the left.

### 5.2.6.2 Control: Ordering

The ordering control determines the order in which the yaw, pitch and roll rotations are applied to make up a single rotation. The default is Y-P-R (i.e. yaw, pitch and then roll) but this can be switched to R-P-Y (i.e. roll, pitch and then yaw).

When simulating changes in the listener's orientation, we generally recommend the Y-P-R ordering. Then, the three dials can be thought of as turning the listener's head horizontally, then pitching it

forwards or backwards and finally rolling it from side to side.

# 6 Decoders and Converters

## 6.1 O7A Decoder - Stereo



### 6.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 6.1.2 Audio

	Channels	Content
Input	64	O7A
Output	2	Stereo

### 6.1.3 Controls

- [Method](#)

### 6.1.4 Description

This plugin takes a seventh order ambisonics (O7A) mix and decodes (renders) it as a simple, robust stereo mix.

Please note that **this is not a binaural decoder**. You may wish to consider [O7A Decoder - Headphones](#).

As another alternative to this plugin, you can use the [O7A Virtual Microphone](#) plugin to produce a stereo mix using a simple virtual stereo microphone.

### 6.1.5 Controls

### 6.1.5.1 Control: Method

Two decoder methods are supported, "Panner" and "Basic Head".

Method	Description
<b>Panner</b>	<p>This method produces a simple stereo mix, largely as if the sounds within the mix had been panned conventionally. This can work well on speakers or headphones.</p> <p>Sounds from the front and back are folded down on the stereo image using different angle conventions. Specifically, sounds panned from -30 to +30 degrees at the front will pass across the stereo image, as will sounds panned from -110 to +110 degrees at the back. Sounds above or below are fed to both speakers.</p>
<b>Basic Head</b>	<p>This method produces a stereo mix using a very crude model of a human head. When listened to on headphones, this imitates typical left and right ear levels that would occur naturally, albeit not in a frequency-dependent way. This can work well on speakers or headphones.</p> <p><b>This is not a binaural decoder.</b> Although the data for this method is based on the Amber HRTF, it has been simplified so that the output is not frequency-dependent, for better results on loudspeakers. This reduces the strength of 3D cues on headphones.</p> <p>For full binaural decoding, we recommend O7A Decoder - Headphones from the O7A Decoding library, O7A Decoder - VR Monitoring from the O7A View plugin library, or Rapture3D Advanced.</p> <p>Unlike most other O7A decoders, this decoder presents sounds from different directions at different levels. For instance, sounds to the front are louder than those behind.</p>

### 6.1.5.2 Technical Notes

The Blue Ripple Sound Amber HRTF uses data from the IRCAM LISTEN HRTF data set, available at <http://recherche.ircam.fr/equipes/salles/listen/index.html>. It has been processed and simplified heavily.

## 6.2 O7A Decoder - Mono

 O7A Decoder - Mono



### 6.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 6.2.2 Audio

	Channels	Content
Input	64	O7A
Output	1	Mono

### 6.2.3 Description

This plugin takes a seventh order ambisonics (O7A) mix and reduces it to mono by discarding everything but its omnidirectional component.

This type of mix is particularly suitable for level analysis, including loudness monitoring.

If you wish to extract a mono response from the soundfield in a particular direction, you might also want to try the [O7A Virtual Microphone](#) or [O7A Beamer](#) plugins.

## 6.3 O7A Decoder - FuMa

 O7A Decoder - FuMa



O7A (SN3D, AmbiX) -> FuMa 3

### 6.3.1 Host Support

Host Type	Support
AAX	Yes, output mapped to standard SN3D ambisonics
VST2	Yes

### 6.3.2 Audio

	Channels	Content
Input	64	O7A
Output	16	FuMa Ambisonic Audio (mapped to standard SN3D ambisonics for AAX)

### 6.3.3 Description

This plugin takes a seventh order ambisonic mix prepared with these plugins (O7A) and converts it to a third order mix using the FuMa ambisonic convention. The FuMa convention was used in early versions of these plugins (prior to version 2.0) and is an extension of classic First Order Ambisonics.

We have labelled this plugin as a decoder hopefully to make it clear that its output is an external format and no longer compatible with the [convention](#) that the rest of these plugins use.

You can convert back using the [O7A Injector - FuMa](#) plugin, although the drop from seventh to third order will typically result in significant loss of spatial detail.

#### 6.3.3.1 Orders

This plugin produces third order FuMa output. If you only want first or second order output, just take the first four or nine output channels and ignore the rest.

Alternatively, the [O7A Decoder - O1A, O2A or O3A plugins](#) can be "misused" to reduce the order of the FuMa material as this is a rare case where a plugin will work correctly for both SN3D and FuMa.

## 6.4 O7A Decoder - 5.1 Basic

 O7A Decoder - 5.1 Basic



### 6.4.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 6.4.2 Audio

	Channels	Content
Input	64	O7A
Output	6	5.1 Surround

### 6.4.3 Description

This plugin takes a seventh order ambisonics (O7A) mix and decodes it as a 5.1 surround mix.

A resilient decoding is used, suitable for small or large venues. ITU speaker angles are assumed.

A version of this plugin with more controls is available in the O7A Decoding plugin library.

#### 6.4.3.1 Channels

The channel ordering used is:

Channel	AAX	VST
1	Front Left	Front Left
2	Front Centre	Front Right
3	Front Right	Front Centre
4	Left Surround	LFE
5	Right Surround	Side Left
6	LFE	Side Right

The low frequency effect channel is *not* used.

## 6.5 O7A Injector - FuMa

 O7A Injector - FuMa



FuMa 3 -> O7A (SN3D, AmbiX)  
Warning: output has limited spatial detail.

### 6.5.1 Host Support

Host Type	Support
AAX	Yes, input mapped to standard SN3D ambisonics
VST2	Yes

### 6.5.2 Audio

	Channels	Content
Input	16	FuMa Ambisonic Audio (mapped to standard SN3D ambisonics for AAX)
Output	64	O7A

### 6.5.3 Description

This plugin takes a mix in the FuMa ambisonic convention and converts it to [seventh order ambisonics](#) (O7A) as used by the current version of these plugins. FuMa was used by old versions of these plugins (prior to version 2.0) and is an extension of classic First Order Ambisonics.

Note that this conversion does not sharpen the spatial image in any way, so the signal is still essentially third order and does not carry the detail you might normally expect in a seventh order stream.

You can convert back with the [O7A Decoder - FuMa](#) plugin.

#### 6.5.3.1 Orders

This plugin expects seventh order FuMa input. If you only have first or second order, feed this to the first four or nine input channels and feed silence to the rest.

Alternatively, the [O7A Injector - O1A, O2A or O3A plugins](#) can be "misused" to increase the order of the FuMa material as this is a rare case where a plugin will work correctly for both SN3D and FuMa.

## 6.6 O7A Decoder - O1A - O3A

 O7A Decoder - O1A



O7A [SN3D, AmbiX] -> O1A [SN3D, AmbiX]

### 6.6.1 Host Support

#### 6.6.1.1 O7A Decoder - O1A

Host Type	Support
AAX	Yes
VST2	Yes

#### 6.6.1.2 O7A Decoder - O2A

Host Type	Support
AAX	Yes
VST2	Yes

#### 6.6.1.3 O7A Decoder - O3A

Host Type	Support
AAX	Yes
VST2	Yes

### 6.6.2 Audio

#### 6.6.2.1 O7A Decoder - O1A

	Channels	Content
Input	64	O7A
Output	4	O1A

#### 6.6.2.2 O7A Decoder - O2A

	Channels	Content
Input	64	O7A
Output	9	O2A

#### 6.6.2.3 O7A Decoder - O3A

	Channels	Content
Input	64	O7A
Output	16	O3A

### 6.6.3 Description

These simple plugins take a seventh order (O7A) ambisonic mix and convert it to a lower resolution first, second or third order mix (O1A, O2A or O3A). In all cases, the SN3D convention is used.

These plugins are extremely simple and just reduce the channel count in use by discarding the later channels, which has the effect of reducing the spatial detail of the mix.

Note that some DAWs (such as Reaper) pass through channels that are not written to. These plugins will appear to have no effect in these DAWs!

These plugins can also be "misused" to reduce the order of N3D/ACN or FuMa material. This is a rare case where the same plugin will work correctly for all three ambisonic formats.

## 6.7 O7A Injector - O1A - O3A

 O7A Injector - O1A



O1A [SN3D, AmbiX] -> O7A [SN3D, AmbiX]  
Warning: output has limited spatial detail.

### 6.7.1 Host Support

#### 6.7.1.1 O7A Injector - O1A

Host Type	Support
AAX	Yes
VST2	Yes

#### 6.7.1.2 O7A Injector - O2A

Host Type	Support
AAX	Yes
VST2	Yes

#### 6.7.1.3 O7A Injector - O3A

Host Type	Support
AAX	Yes
VST2	Yes

### 6.7.2 Audio

#### 6.7.2.1 O7A Injector - O1A

	Channels	Content
Input	4	O1A
Output	64	O7A

#### 6.7.2.2 O7A Injector - O2A

	Channels	Content
Input	9	O2A
Output	64	O7A

#### 6.7.2.3 O7A Injector - O3A

	Channels	Content
Input	16	O3A
Output	64	O7A

### 6.7.3 Description

These simple plugins take a lower resolution first, second or third order mix (O1A, O2A or O3A) and convert it to a seventh order (O7A) ambisonic mix. In all cases, the SN3D convention is used.

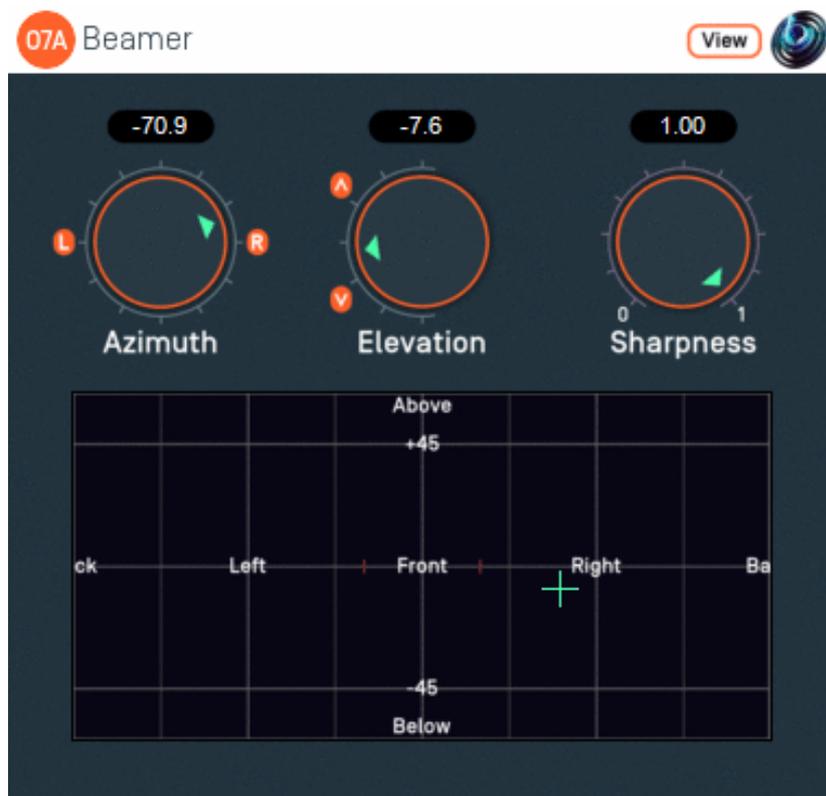
These plugins are extremely simple and just increase the channel count in use, filling new channels with silence. Although this increases the order of the mix, it does not increase its spatial detail. Further, the resulting mix may have unnatural features acoustically.

More sophisticated means to convert first order (O1A) to seventh order include the O7A Injector - First Order plugin from the O7A Upmixers pack and the O7A Harpex Upsampler.

These plugins can also be "misused" to increase the order of N3D/ACN or FuMa material. This is a rare case where the same plugin will work correctly for all three ambisonic formats.

# 7 Virtual Microphones

## 7.1 O7A Beamer



### 7.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 7.1.2 Audio

	Channels	Content
Input	64	O7A
Output	1	Mono

### 7.1.3 Controls

- Azimuth
- Elevation
- Sharpness

### 7.1.4 Description

The O7A Beamer extracts sound in a particular "beam" direction from a 3D O7A mix. You can think of this as a narrow directional microphone response, pointed in a particular direction in the soundfield.

The beam direction can be set using the azimuth and elevation controls, or the control surface, where the direction is indicated by the crosshairs.

There are labels on the control surface to help you find left, right, above etc. However, if this still does not make any sense, you might want to see our page on the [O7A Visualiser](#) which lays out its viewing region in the same way.

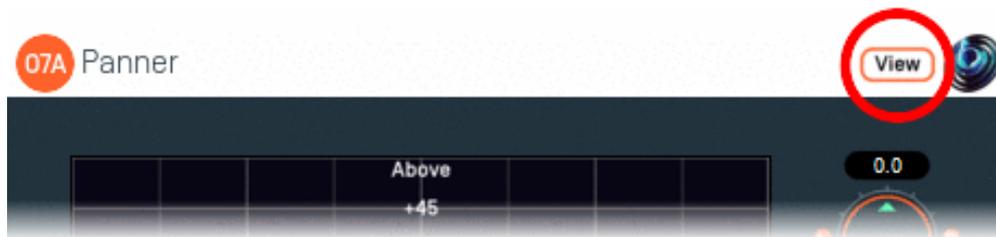
The algorithm used is a "passive" one and should not colour frequency content significantly.

If you are interested in producing simple virtual microphone responses from an O7A mix, you may also wish to read about the [O7A Virtual Microphone](#).

## 7.1.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross.	The current direction is shown using a beam and cross.
Hold the left mouse button to set the azimuth and elevation.	Hold a VR controller trigger to set the azimuth and elevation.

## 7.1.6 Controls

### 7.1.6.1 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction to extracted.

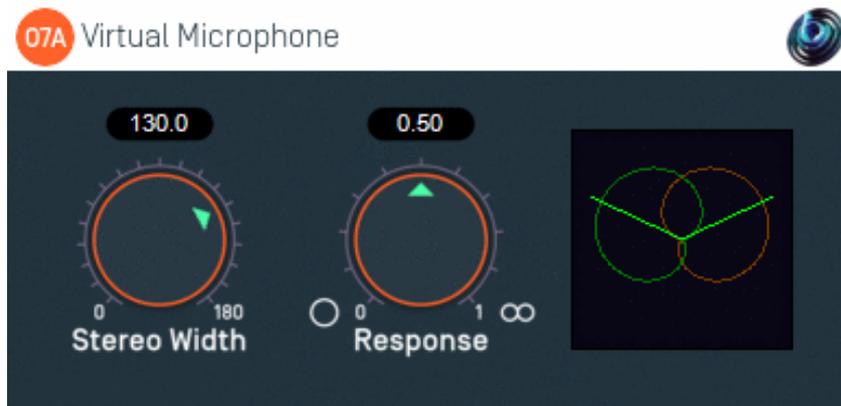
Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

### 7.1.6.2 Control: Sharpness

The sharpness control determines how directional the beam response is. A value of zero reduces the response to an omnidirectional one like that of the [mono decoder](#). A value of one is the usual case and gives the sharpest response.

## 7.2 O7A Virtual Microphone



### 7.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 7.2.2 Audio

	Channels	Content
Input	64	O7A
Output	2	Stereo

### 7.2.3 Controls

- [Stereo Width](#)
- [Response](#)

### 7.2.4 Description

The O7A Virtual Microphone extracts a stereo image from a 3D O7A mix using a front-facing "virtual" stereo microphone placed at the centre of the soundfield. The angle between the two capsules of this virtual microphone can be varied, along with their directional response. Available directional responses include omni, cardioid and figure-of-eight. This makes it possible to synthesise the results of various conventional coincident stereo recording techniques such as Blumlein X-Y and M/S.

This plugin does not allow you to point the front of the virtual microphone in other directions. If the front is not where you want, remember that you can rotate the soundfield using [O7A Rotation](#) or [O7A Look](#).

This plugin actually only needs first order ambisonic information (and even then, the height channel is not used).

Be careful using this as a stereo decoder, because the overall output level can be highly dependent on source locations, as with the "real" recording techniques. You might wish to consider [O7A Decoder - Stereo](#).

If you are interested in extracting sounds in particular directions from an O7A mix, you may also be interested in the sharper response of the [O7A Beamer](#) plugin.

## 7.2.5 Controls

### 7.2.5.1 Control: Stereo Width

This is the angle between the two virtual microphones, between 0 and 180 degrees. For instance, 90 degrees should be used for Blumlein X-Y.

### 7.2.5.2 Control: Response

The response control determines the directional response of the two microphone capsules. Some useful values are:

Response Value	Name
0.00	Omnidirectional
0.25	Subcardioid
0.50	Cardioid
0.75	Hypercardioid
1.00	Figure-of-Eight

For instance, 1.00 (figure-of-eight) should be used for Blumlein X-Y.

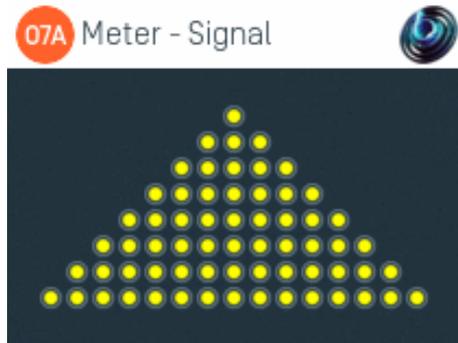
## 7.2.6 Presets

Presets are available for this plugin:

- Cardioids 130
- Cardioids 90
- Blumlein X/Y

# 8 Metering

## 8.1 O7A Meter - Signal



### 8.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 8.1.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

### 8.1.3 Description

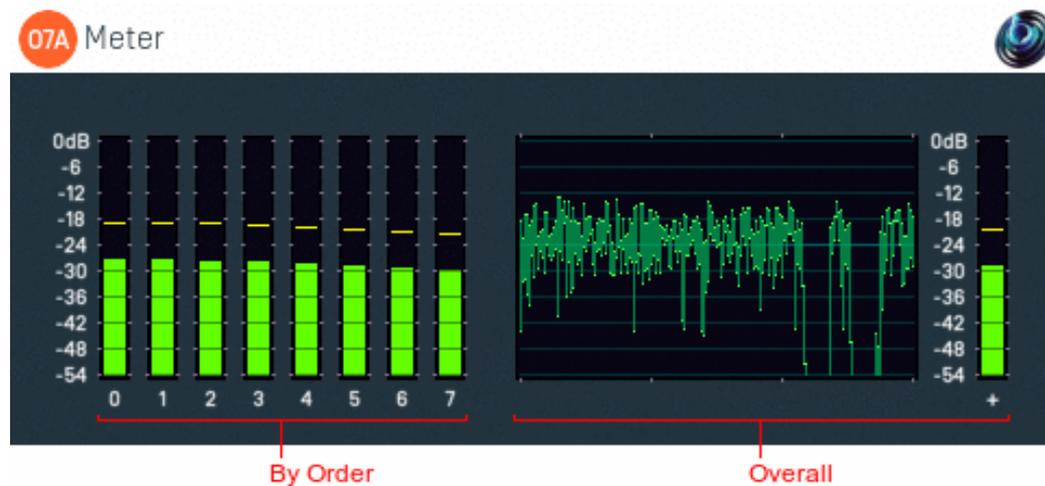
This extremely simple plugin measures the signal peak in each of the 64 channels of an [O7A stream](#) to indicate if a signal is present. It is intended for basic diagnostics (e.g. "are all my channels getting through?") and not for serious signal analysis. Audio is passed through unchanged.

#### 8.1.3.1 Meters

Lights are shown for each of the 64 channels in O7A. They are shown in rows corresponding to the ambisonic orders. Lights switch on with a yellow colour in the presence of very low signal levels (-100dB and above) and switch to red at high levels (0dB and above). These signal levels are simple peak levels, *not* "True Peak".

Note that first order ambisonic B-Format only uses the first four channels of O7A, in which case only the first four lights (top two rows) will be on. Sounds exactly on the horizontal plane switch on alternating lights on each row and a few special directions do other strange things. However, normal 3D streams should switch on all 64 lights; if they do not there is probably something wrong! A common error is to forget to set a track's channel count or send to at least 64, and this plugin will usually make that obvious.

## 8.2 O7A Meter



### 8.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 8.2.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

### 8.2.3 Description

This plugin measures the sound level in an O7A stream. A breakdown by ambisonic order is provided, along with a history graph and the current overall level. Audio is passed through unchanged.

#### 8.2.3.1 Meters

From left to right, the following displays are shown:

1. Bar meter showing the current and recent peak level in order 0 (ACN channel 0 only).
2. Bar meter showing the current and recent peak level in order 1 (ACN channels 1 to 3).
3. Bar meter showing the current and recent peak level in order 2 (ACN channels 4 to 8).
4. Bar meter showing the current and recent peak level in order 3 (ACN channels 9 to 15).
5. Bar meter showing the current and recent peak level in order 4 (ACN channels 16 to 24).
6. Bar meter showing the current and recent peak level in order 5 (ACN channels 25 to 35).
7. Bar meter showing the current and recent peak level in order 6 (ACN channels 36 to 48).
8. Bar meter showing the current and recent peak level in order 7 (ACN channels 49 to 63).
9. History min/max graph of overall level (all 64 channels).
10. Bar meter showing the overall current and peak level (all 64 channels).

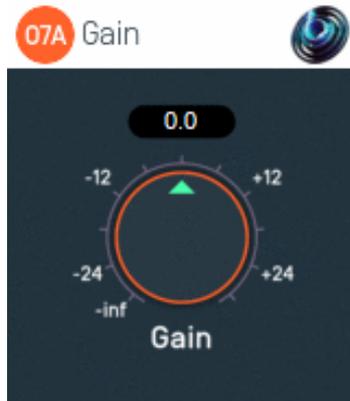
Each bar meter shows the current RMS level in green, averaged using a 400ms rectangular window and translated to a decibel scale, along with a recent peak calculation using a 2s memory. The history graph shows the last three minutes of the overall level, displaying the range from minimum to maximum for each second.

The meters are all normalised so that a 0dBFS peak sine wave panned in any direction will produce a -3.01dB output. There is no sensitivity to frequency or direction. If you are interested in measuring loudness, you may wish to consider the O7A Meter - Karma plugin from the O7A Decoding Decoding library, which will produce comparable numbers when set to use LUFS units, subject to directional and loudness weighting.

For material that has been assembled by simple panning, the bar meters should be roughly in line with each other.

# 9 Soundfield Modification

## 9.1 O7A Gain



### 9.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 9.1.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

### 9.1.3 Controls

- Gain

### 9.1.4 Description

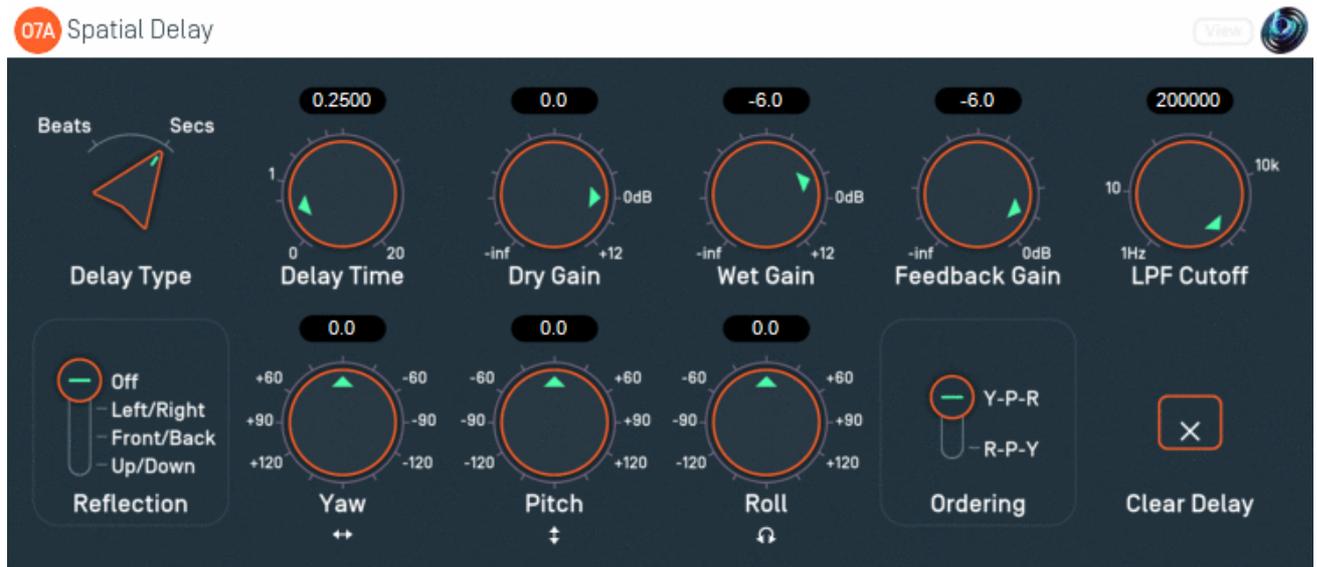
This trivial plugin applies a gain to the O7A stream. All channels of the stream are affected equally.

### 9.1.5 Controls

#### 9.1.5.1 Control: Gain

The gain to apply, in decibels, between -30dB and +30dB.

## 9.2 O7A Spatial Delay



### 9.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

### 9.2.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

### 9.2.3 Controls

- Delay Type
- Delay Time
- Dry Gain
- Wet Gain
- Feedback Gain
- LPF Cutoff
- Reflection
- Yaw
- Pitch
- Roll
- Ordering
- Clear Delay

### 9.2.4 Description

This plugin delays a seventh order ambisonic (O7A) stream, applying a scene reflection, rotation and low pass filter to the delayed sound. It also supports feedback, so the output of the plugin can be fed back to its input to create repeating sound effects.

The rotation module of this plugin operates in the same way as the [O7A Rotation](#) plugin and can be controlled by an external View application. The reflection, rotation and low pass filter appear *within*

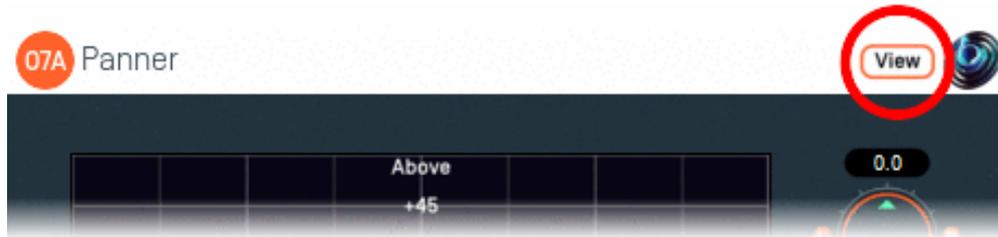
the feedback loop. The wet gain does not, applying only to the final output.

The "Clear Delay" button on the bottom right can be used to clear the audio in the delay line.

## 9.2.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.



When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current post-rotation 'front' of the scene is shown using a cross.  Hold the left mouse button to set all four rotation controls, moving the 'front' of the scene to the indicated direction. Only 2DOF is supported and the rotation will be set so 'up' is upwards.	The scene orientation is shown using a floating cube with matching marker beams on the cube and VR controllers.  Rotate a VR controller into the chosen orientation and hold the trigger to set the four rotation controls. Full 3DOF is supported.

## 9.2.6 Controls

### 9.2.6.1 Controls: Delay Time and Delay Type

The delay type determines whether the delay time is specified in beats or in seconds. When beats are used, the delay length is a multiple of the beat length in your DAW's current tempo, so if your tempo is in crotchets, then setting the delay to 2.0 results in a delay time equivalent to a minim.

Delay times are rounded to the nearest sample and the minimum delay is one sample. The maximum setting is 20 seconds or 20 beats.

Changes to the delay time are implemented using fades between different delay settings. This means that the delay cannot be used to simulate Doppler shift, but that changes are less likely to be disruptive to musical material. Continuous changes to the delay time may result in artefacts.

Please note that high delay time settings use a significant amount of memory (RAM). This memory is not released until the plugin instance is unloaded.

### 9.2.6.2 Controls: Dry Gain and Wet Gain

These control how much unmodified "dry" input and delayed "wet" material is included in the output.

### 9.2.6.3 Control: Feedback Gain

The feedback gain determines how much of the delayed output is sent back into the delay line. The wet gain is not applied here, but rotation and the low pass filter are.

When the feedback gain is set at or close to 0dB, the delay output level is liable to increase over time. Please be careful not to damage anything because of this. The delay line can be cleared using the [Clear Delay](#) button, but being conservative with the feedback gain setting is normally recommended.

### 9.2.6.4 Control: LPF Cutoff

This controls the cutoff frequency of a simple -6dB/octave low-pass filter applied to the delay output. This can be used to make the sound more distant as echoes repeat. Feedback can result in the filter being applied more than once to the same material.

### 9.2.6.5 Control: Reflection

This can be used to apply a fixed spatial reflection to the O7A material before a spatial rotation is applied. The spatial reflections available are:

- None
- Left/Right
- Front/Back
- Up/Down

Note that, by combination with the rotation, it is possible to construct any other angle of reflection.

### 9.2.6.6 Controls: Pitch, Roll and Yaw

A scene rotation is applied to the delayed O7A scene, in a similar way to the rotation used by the [O7A Rotation](#) plugin. Feedback can result in the rotation being applied more than once to the same material.

These controls use angles between -180 and +180 degrees which can each be thought of as controlling individual rotations around three fixed axes. The overall rotation is a combination of the three.

Rotation	Axis	Description of Positive Movement
Yaw	Z	The soundfield is "rotated" left around the middle of the room. For instance, a sound that starts at the front moves left, a sound that starts at the left moves backwards and a sound directly above does not move.
Pitch	Y	The soundfield is "tumbled" backwards. For instance, a sound that starts at the front moves upwards, a sound that starts at the left does not move and a sound directly above moves backwards.
Roll	X	The soundfield is "tilted" clockwise. For instance, a sound that starts at the front does not move, a sound that starts at the left moves upwards and a sound directly above moves right.

### 9.2.6.7 Control: Ordering

The ordering control determines the order in which the yaw, pitch and roll rotations are applied to make up a single rotation. The default is Y-P-R (i.e. yaw, pitch and then roll) but this can be switched to R-P-Y (i.e. roll, pitch and then yaw).

### **9.2.6.8 Control: Clear Delay**

The "Clear Delay" button can be found at the bottom right of the plugin. While pressed, this button clears the delay line and silences everything but the dry signal.

# 10 Appendix: O7A Streams

## 10.1 What is an O7A Stream?

A seventh order ambisonic (O7A) stream is made up of 64 individual channels of audio which together represent a 3D soundfield. Into this "audio scene" can be placed individual sound sources, reverberation and complex spatial textures.

These 64 channels can be quite confusing to understand conceptually. For instance, they do not relate to particular speaker directions, or to individual sound sources in the soundfield. You do *not* need to understand them to use them! But, it doesn't hurt to know the basics.

Each channel adds spatial detail to a sound scene. With just the first channel, you have a basically omnidirectional (mono) sound image. The second channel adds some basic detail left/right, the third up/down and the fourth front/back; these four channels make up first order ambisonics. The first and second channels together provide essentially the spatial detail available with the Mid/Side (M/S) stereo recording technique, which captures a sound image with left/right width. But with the further two channels the detail is available in all directions, not just left/right.

That covers the first 4 channels. The other 60 add further detail to make the image sharper. If you are interested in what exactly is in these channels (which is not so easy to describe) you may want to read up on Higher Order Ambisonics (HOA) and the mathematics of the Spherical Wave Equation and Spherical Harmonics. But you should *not* need to read up to *use* the techniques described here. If you want to make sense of what is going on spatially in an O7A stream, we find that it is normally best to use an [O7A Visualiser](#) or [O7A Flare](#) plugin.

## 10.2 What processing can I apply to an O7A stream?

As well as processing designed specifically for O7A streams, it is possible to mix streams together in the expected way. It is also possible to run conventional mono DSP algorithms on them directly by applying the algorithm to all 64 channels individually, subject to some rules. Failing to follow these rules is likely to shred the spatial imaging, so be careful! Specifically:

- If you process an O7A stream with a conventional mono DSP algorithm you *must apply the same processing to all 64 channels identically*.
- Only *linear* processing can be used (e.g. not distortion or compression). Also, be aware that time-variant processing can cause issues.

If you are working in Reaper, current versions do not make it particularly easy to set up this sort of processing, but it is possible if you are prepared to use some advanced features and do some rather tedious set-up. For instance, you can save an "FX Chain" in which a number of equalization plugins are "routed" correctly and in which controls are linked by "parameter modulation" so that one set of controls operates the others. Once the FX Chain is saved, you can load it into other projects.

## 10.3 Encoding

There are a number of ways in which the channels can be defined in HOA. To a large extent it does not matter which is chosen, as long as *everything uses the same convention*. This is critical and horrible things will happen to the spatial image if this is not the case. However, if you follow the convention, or convert explicitly where you need to, you will be able to pass audio around between different software packages.

These plugins use the "SN3D" ambisonic convention. As is usually the case, we order the channels using "ACN" ordering.

This encoding is used in the "AmbiX" file format and YouTube. It is supported directly by Rapture3D Universal.

## **10.4 How does O7A SN3D relate to FuMa and Classic Ambisonics?**

The ambisonic format used (SN3D) is not directly compatible with classic 1970s four channel "WXYZ" B-Format, or the extension (FuMa) which was used by versions of these plugins prior to version 2.0.

However, conversion is straightforward. The O7A Core pack includes plugins to do this: [O7A Decoder - FuMa](#) and [O7A Injector - FuMa](#).