O3A Upmixer Plugins

v2.4.0

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1 Introduction

The O3A Upmixer plugins take existing multichannel mixes and convert them into third order ambisonic (O3A) streams.

Speaker layout upmixers are available for various standard speaker layouts (5.1, 7.1, 7.1.2, Auro-3D, IMAX and so on). Other plugins handle stereo upmixing, ambience generation, and injection or upmixing of some other formats.

This documentation also covers the O3A Core.

1.1 Compatibility

O3A streams require audio busses with at least 16 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 O3A plugins *will not work correctly* with these DAWs**, which may even crash.

1.1.1 AAX

Most of the O3A plugins exist as AAX versions which are compatible with Pro Tools Ultimate or Studio 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 O3A 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 O3A

When working with stereo, you normally "pan" a mono sound to stereo and "mix" it onto a stereo bus. With O3A, 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 16 channel O3A. The O3A Panner plugin can be used for this.
2. Mixing - multiple streams of 16 channel O3A can be mixed together using your DAW's mixing engine. No special plugin is needed here, as long as the DAW can handle 16 channel busses. You end up with a final mix, as an O3A stream.
3. Decoding - during actual playback (and you probably want to listen while you work!) you "decode" the O3A stream for whatever speaker layout you are actually listening with. One of the huge advantages of ambisonic techniques is that the O3A 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 O3A Decoder - Stereo plugin.

These are just the basics. There are other ways to encode audio into O3A rather than panning, for instance by upmixing, or recording with ambisonic microphones.

You can also manipulate O3A 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 16 channel O3A as both an input and output. There are some technical notes on O3A 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 O3A correspond to the four channels of first order. To reduce an O3A 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 O3A 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 O3A VST plugin libraries are VST2 "shell" plugins which each provide a number of plugin effects. If you find your list of O3A effects is short, with names like "O3ACore", 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 O3A streams, make sure it has at least 16 channels. A few plugins need even more (e.g. a decoder for Hamasaki 22.2).
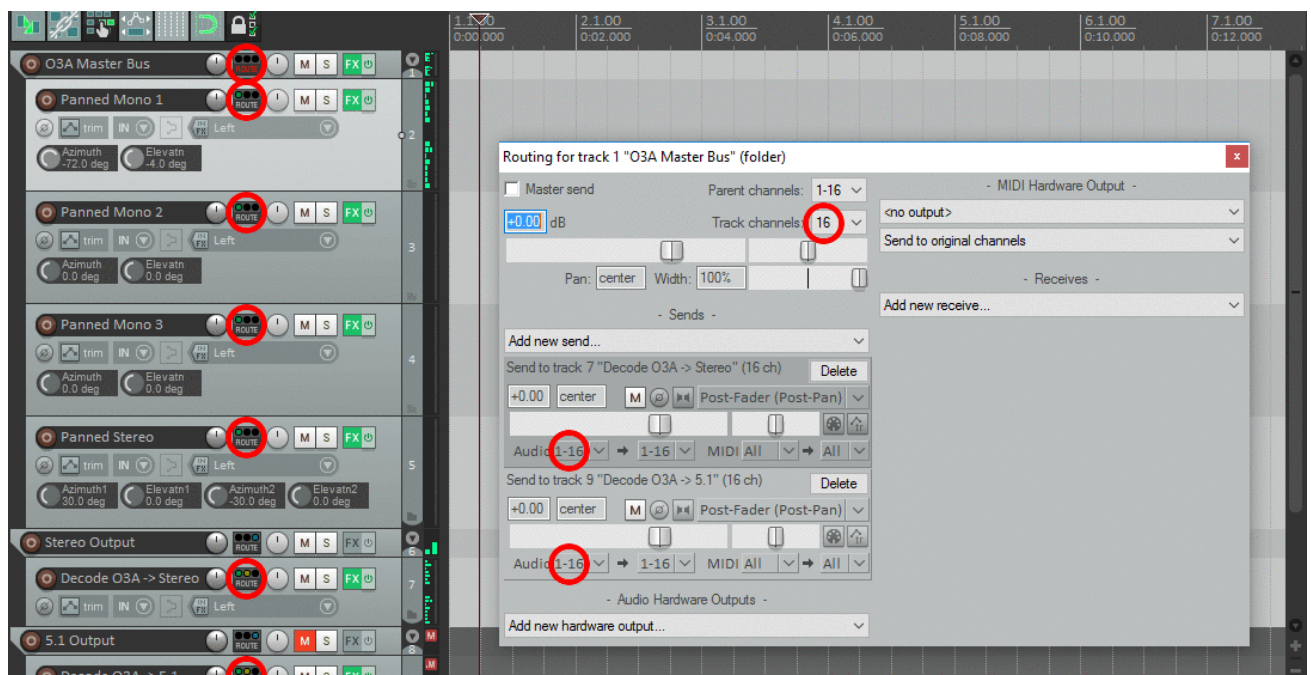
2.2.3 Layout
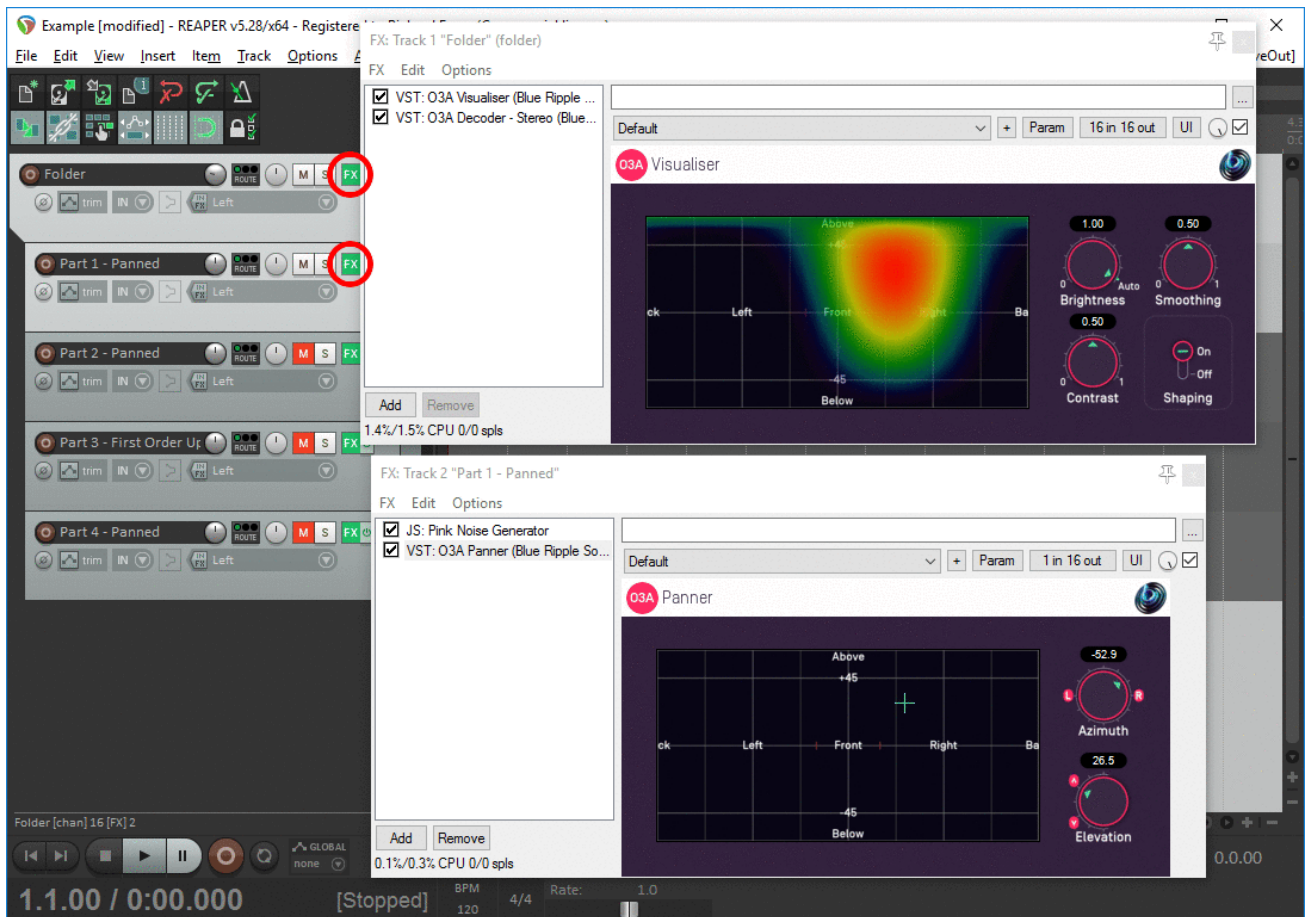
On the folder track, add the following plugins *in this order* to the FX chain:

- O3A Visualiser
- O3A 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 O3A Panner plugin.

Do *NOT* use the built-in Reaper stereo panner with O3A!

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.
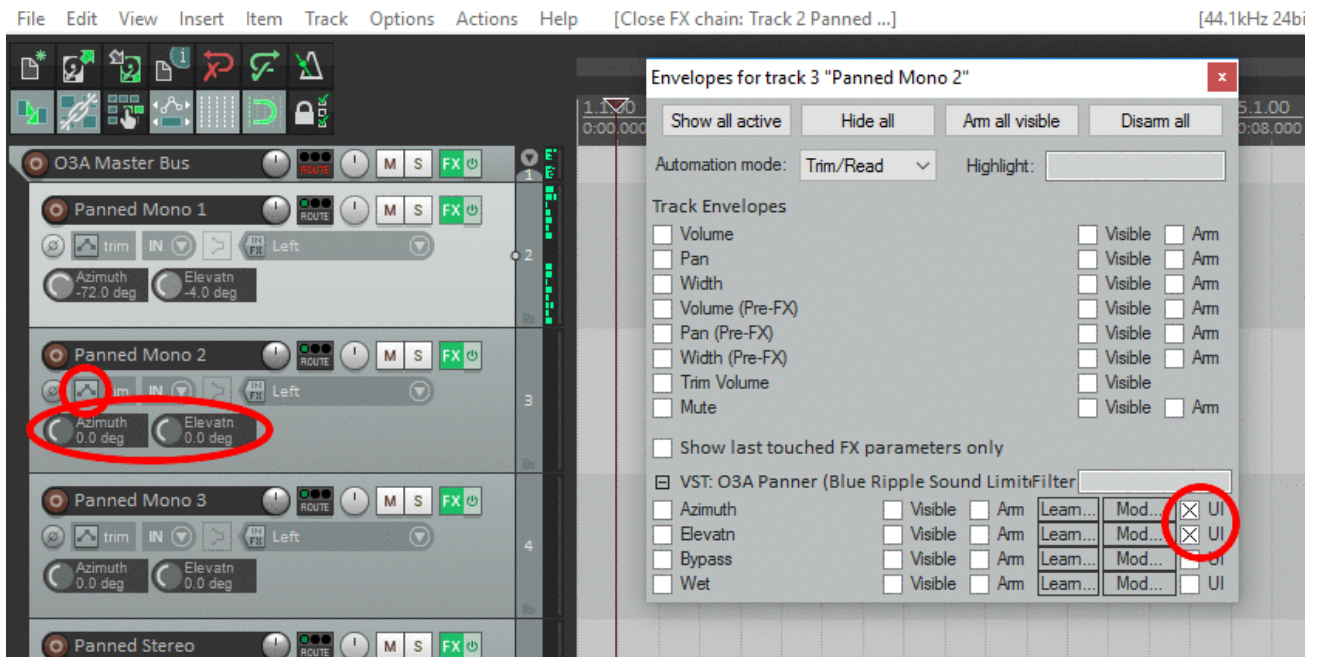
Parts that are already first order ambisonic B-Format can typically be injected directly without issue, although processing can help (e.g. the O3A First Order Injector plugin from the O3A Upmixers set, or the O3A Harpex Upsampler). Of course, other O3A material can be injected directly. FuMa material needs to be converted using the O3A Injector - FuMa plugin.

2.2.4 Processing O3A streams

Other plugins (for instance the rotation plugin) manipulate the O3A stream. The stream needs to be in O3A format (for instance by panning) before such processing can be used.

Applying processing to the O3A stream can be confusing at first. We suggest you spend a few minutes getting familiar with the O3A 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 O3A 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 O3A Beamer plugin produces mono which you might want to run through a mono distortion plugin before panning it back into O3A using the O3A Panner.

2.2.5 Sends

Effect sends can be used in the normal way. Just be careful about which busses are expecting mono or O3A 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 O3A 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 16 channel O3A 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. O3A) 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 O3A 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 "16" 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 O3A master (stereo, headphones, 5.1 etc.) you could use a number of projects that use the O3A 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 particularly rendering.

However, our preferred option is to send from the O3A 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 Premiere Pro

In Adobe Premiere Pro, as with Reaper, it is essential to make sure that your audio tracks have 16 channels (or more if you are using plugins that need them).

2.3.1 Sequence Settings

In particular, when creating a New Sequence, go to the "Tracks" tab and make the following changes:

1. The "Master" Track should be set to "Multichannel".
2. The "Number of Channels" should be set to "16", or as many as you need.
3. Each audio "Track Type" that is going to carry O3A audio (or suchlike) should be set to "Adaptive" or "Adaptive Submix".
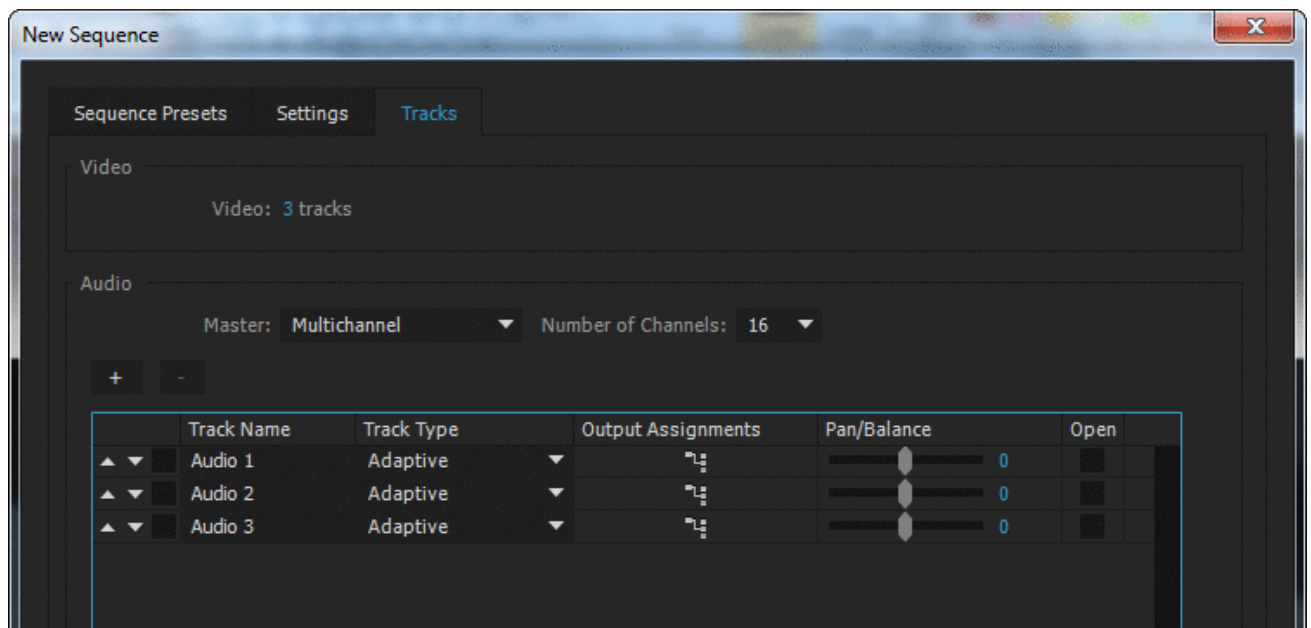
Premiere Pro includes some VR Sequence Presets that support ambisonics. However, these only set the number of channels to 4 by default, which is correct for first order ambisonics, but not for third order. 16 channels are needed by these plugins, so please check the "Number of Channels" as above, or plugins may not work and spatialisation quality may be seriously compromised.

2.3.2 Importing Audio

When importing audio with many channels, Premiere Pro may place each channel of the audio onto a different track rather than keeping the spatial mix together. If this happens, find the clip, right click and select "Modify" and then "Audio Channels..." and do the following before trying again:

1. Set the "Clip Channel Format" to "Adaptive".
2. Check the "Active Channels Per Clip" matches the audio (for instance, 4 for first order ambisonics or 16 for third order ambisonics).
3. Set the "Number of Audio Clips" to 1.

You can also make this the default behaviour by going into Premiere Pro's "Preferences...", finding the "Audio" section and setting the "Multichannel Mono Mode" item to "Adaptive".

2.3.3 Compatibility

Our plugins do not work with all versions of Premiere. They do not work with versions prior to v12.1, or versions from v14.4 to the current version.

The "O3A View Sync" plugin from the O3A View library is not fully compatible with the current version of Premiere Pro. Necessary VST2 timing information is currently not available in Premiere, which means that video playback cannot synchronize correctly.

The Premiere list of "Available Plug-Ins" only shows one plugin from each of the plugin libraries, but they all should be available for use.

Plugin presets are not available in Premiere Pro.

2.4 Getting Started with Pro Tools

This section gives an introduction to use of the AAX version of the O3A plugins with Pro Tools Ultimate, which was previously known as Pro Tools HD. Ambisonic support has been available in Pro Tools HD since version 12.8.2. It is also available in Pro Tools Studio, but not Pro Tools Intro or Artist.

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.

2.4.1 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 O3A, you will find the insert effect list includes the O3A Panner (under "Sound Field"). Introducing this effect as an insert will change the track stem format from this point to third order ambisonics (O3A) 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 third order ambisonic stream, such as the O3A Visualiser and O3A decoders. If you decode to stereo, the stem will change to stereo and so on.

2.4.2 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 O3A 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 O3A 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.

2.4.3 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 O3A 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.
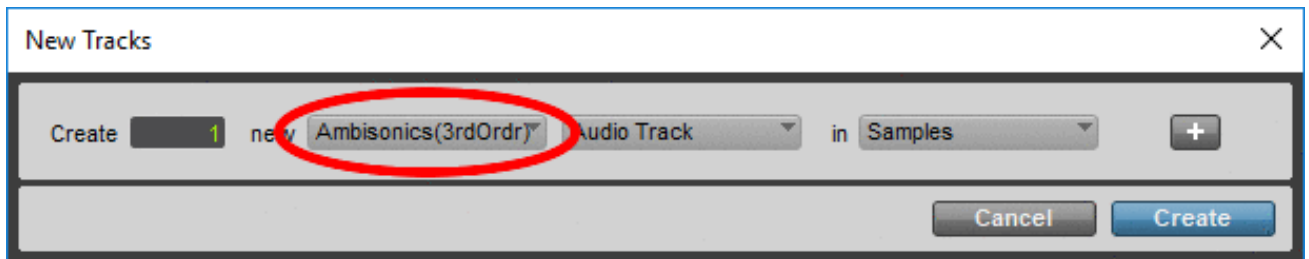
Like these plugins, Pro Tools normally uses the SN3D/ACN ambisonic format. You can convert from FuMa to SN3D using the O3A Injector - FuMa plugin.

2.4.4 Organising Projects

A recommended way to organise a project is to route all of your ambisonic material (panned or otherwise) to a single ambisonic "O3A Master" bus, set to third order ambisonics in much the same way as tracks (see above).

This gives a convenient place to bring the whole O3A mix together and send it to a number of tracks for visualisation (e.g. with O3A Visualiser or O3A Flare), metering and decoding for specific output formats.

For instance, you might create a "Stereo Decoding" track including the O3A 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.

2.5 Getting Started with Pyramix

This section gives an introduction to use of the VST2 version of the O3A plugins with Pyramix. We are assuming you know your way around Pyramix already and have configured it to find the VST plugins. Note that modern Pyramix requires the 64bit version of the plugins.
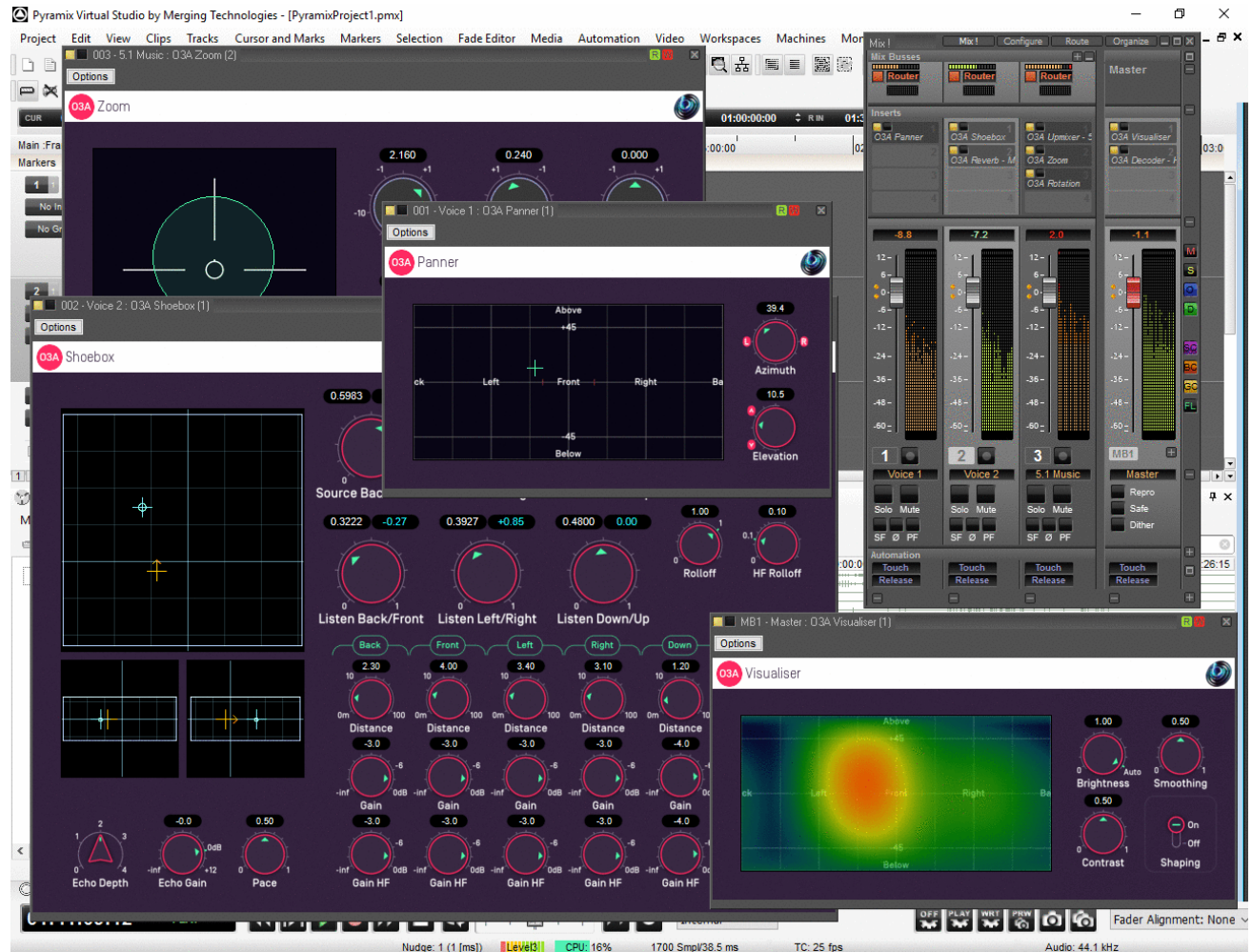
2.5.1 Setup

O3A streams are most easily handled using Multi Channel Strips (MCS). When creating these, set the channel count to 16 (or even more, e.g. for Hamasaki 22.2).
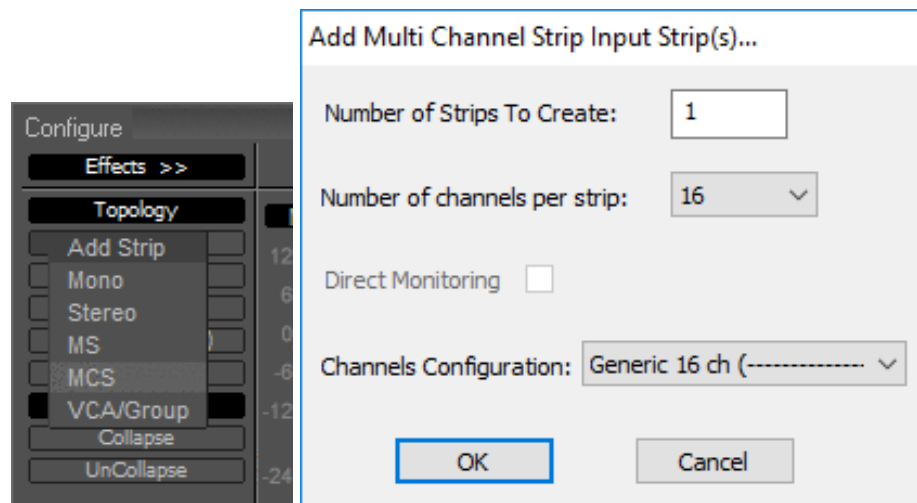
Custom 16 channel mix busses can also be used.

2.5.2 Mixing

Set mix busses to "Router" rather than "Pan" to ensure that the O3A plugins are determining the panning used.

In Pyramix, plugin user interface dials are set to the VST "linear" style, so drag up and down rather than around to change them.

Beyond this, plugins can be used much as you would expect!

2.6 Audio for Virtual Reality 360 Video

The O3A 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.

O3A streams contain third order SN3D/ACN (AmbiX), which uses 16 channels. This, or a subset of the channels, is directly compatible with many VR systems.

2.6.1 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 16 channel mix, or use O3A Decoder - O1A.

2.6.2 Google Jump Inspector

Google Jump Inspector can use the third order SN3D audio produced by these plugins directly.

2.6.3 Facebook 360 Video

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

The easiest way to reduce an O3A 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.
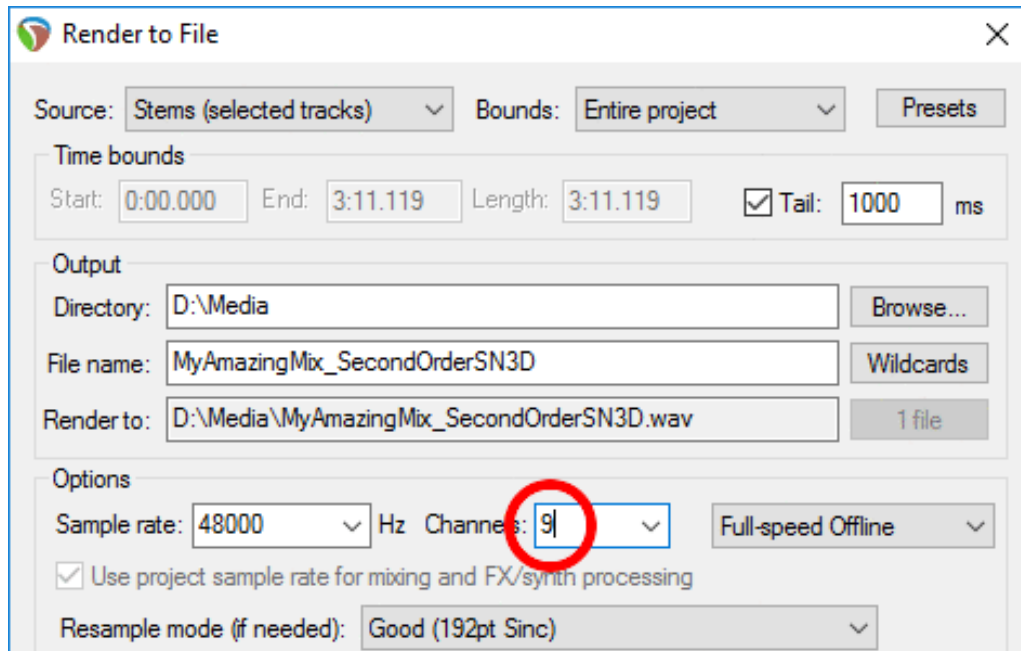
Once you have a nine channel second order file, this can be encoded using the Facebook FB360 Encoder (v1.3.0 or later). Select format "B-format ambiX 2nd order".
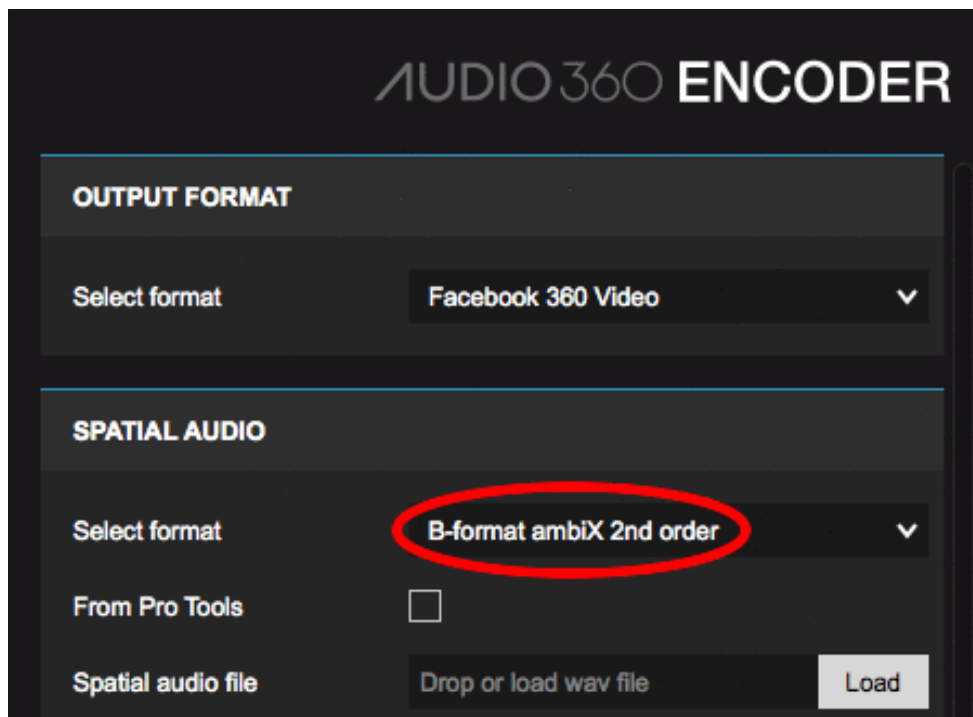
2.6.4 Rapture3D Universal

The Blue Ripple Sound Rapture3D Universal game/VR engine can render the third order SN3D audio used by these plugins directly.

2.6.5 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 O3A Decoder - Quad Binaural plugin from the O3A Decoding pack. This will typically give better final results than rotating the O3A stream and using a more conventional binaural decoder to generate the Quad Binaural.

2.7 Spotting A Common Issue

In many DAWs it is easy to forget to set your track or send channel counts to 16 at some point and end up trying to handle O3A 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 O3A 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 O3A needs 16 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 O3A needs 16 channels.

2.8 The License Manager

The Blue Ripple Sound License Manager application can be used to move license keys around between computers.
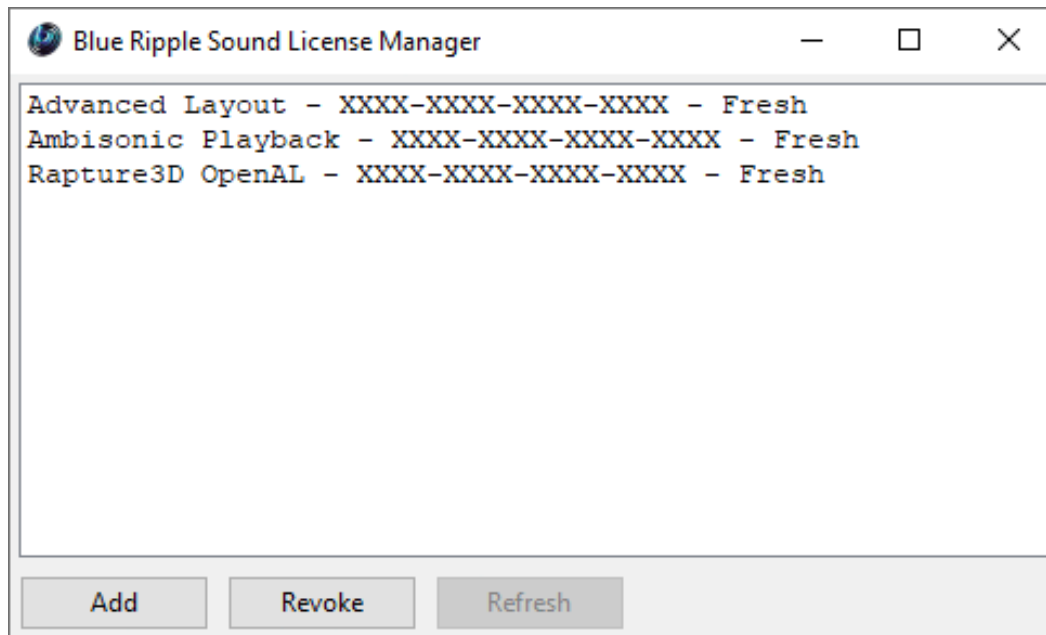
The application is generally available in the Start Menu on Windows, and in your installation directory, which is typically:

- `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.

2.9 Low Frequency Effects (LFE)

Some formats supported by the loudspeaker upmixer plugins have one or two LFE channels (e.g. the ".1" of 5.1). In these cases, LFE Gain controls allow the LFE to be added into the omnidirectional content of the mix.

It may not be appropriate to do this. The LFE content may literally be an effect and the main channels may contain the full bandwidth content of the mix. Here, there is no need to set the LFE Gain and it can be left at -inf dB. This is the default.

However, the LFE channel may have been used to carry low frequency content (rather than effects) that would otherwise cause clipping in the main channels. Then, the LFE channel needs to be injected into the mix to avoid losing low frequency content. In some cases, a gain of +10dB may be expected here; please check with the content provider.

2.10 Technical Requirements

2.10.1 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.

2.10.2 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 O3A 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 O3A plugins need at least 16 channels on each track, and some need more. Also, at the time of writing VST 2 shell plugins are not supported in Nuendo or Cubase.

2.10.3 AAX Host

The AAX plugins require Pro Tools Ultimate or Studio.

Due to channel and stem restrictions, not all plugins are supported in AAX. Please see the plugin descriptions for details.

2.10.4 PC Hardware

Please check your PC meets the following requirements:

- Intel Core i5 CPU or better, or Apple Silicon.
- 200MB of free disk space.

2.10.5 Permissions

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

2.10.6 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 O3A Upmixers - Loudspeaker Upmixers

3.1 O3A Upmixer - Quad
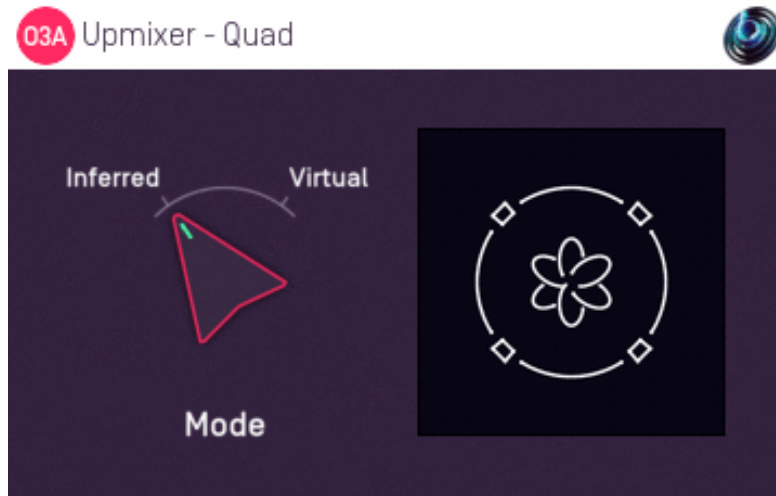
3.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.1.2 Audio

	Channels	Content
Input	4	Quad
Output	16	O3A

3.1.3 Controls

- Mode

3.1.4 Description

This plugin takes a four channel Quadraphonic (Quad) mix and converts it to third order ambisonics (O3A).

3.1.4.1 Channels

The channel ordering used is:

Channel	AAX/VST
1	Front Left
2	Front Right
3	Back Left
4	Back Right

3.1.5 Controls

3.1.5.1 Control: Mode

Three modes are supported, "Inferred", "Studio" and "Virtual". Generally, "Inferred" or "Studio" are recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Studio	This mode is optimised for use with material that has been mixed using 'pairwise' panning, for instance in Pro Tool's surround panner. The approach produces smooth transitions when sounds pass between speaker locations. In this mode, the corner layout is always assumed to be Square.
Virtual	This mode simply places each of the audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.2 O3A Upmixer - 5.1
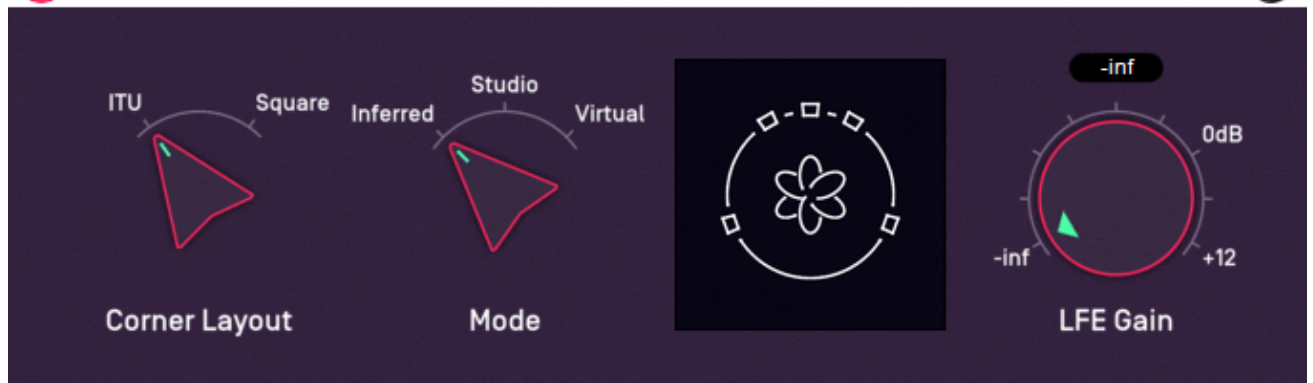
3.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.2.2 Audio

	Channels	Content
Input	6	5.1 Surround
Output	16	O3A

3.2.3 Controls

- Corners
- Mode
- LFE Gain

3.2.4 Description

This plugin takes a surround mix prepared for a 5.1 system and converts it to third order ambisonics (O3A).

3.2.4.1 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

3.2.5 Controls

3.2.5.1 Control: Corners

The corner layout lets you tell the processor how the 5.1 mix was prepared, as this can help the accuracy of the spatial imaging. ITU is the most common option.

Corner Layout	Description
ITU	In principle, the speakers of a 5.1 system should be set out using ITU angles. From front centre, this recommends front left and right speakers be at +30 or -30 degrees and side speakers be at +110 or -110 degrees. ITU layouts are common in studios and are a common way to mix 5.1.
Square	In practice, many 5.1 speaker systems are set up with the corner speakers set out in what is roughly a square and some mixes are put together on this basis. If you know that's the case, switch the corner layout to Square.

3.2.5.2 Control: Mode

Three modes are supported, "Inferred", "Studio" and "Virtual". Generally, "Inferred" or "Studio" are recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Studio	This mode is optimised for use with material that has been mixed using 'pairwise' panning, for instance in Pro Tool's surround panner. The approach produces smooth transitions when sounds pass between speaker locations. In this mode, the corner layout is always assumed to be Square.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.2.5.3 Control: LFE Gain

Audio from the LFE channel can be mixed into the output by setting this dial. It is added to the stream as an omnidirectional signal.

3.3 O3A Upmixer - 6.1
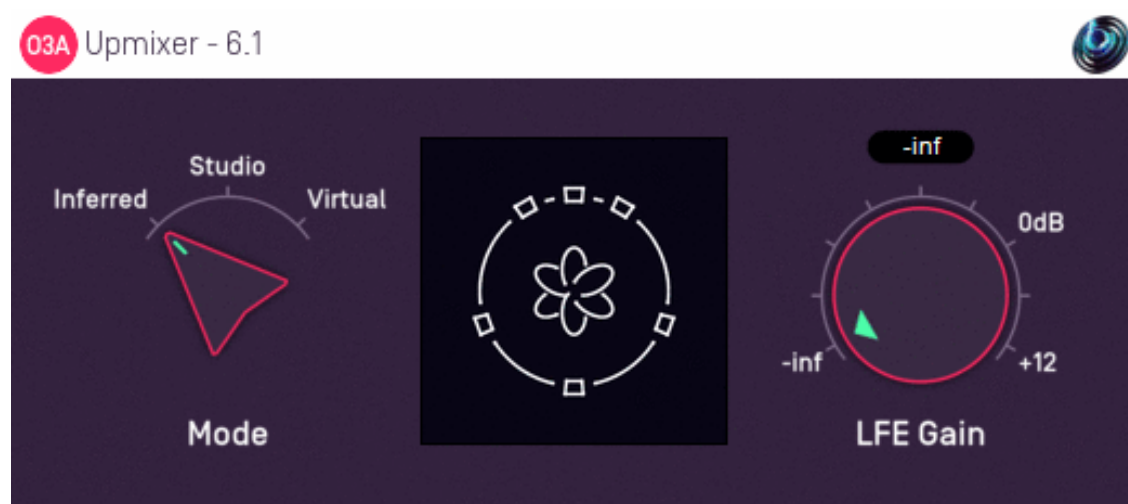
3.3.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.3.2 Audio

	Channels	Content
Input	7	6.1 Surround
Output	16	O3A

3.3.3 Controls

- Mode
- LFE Gain

3.3.4 Description

This plugin takes a surround mix prepared for a 6.1 system and converts it to third order ambisonics (O3A).

3.3.4.1 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	Surround Left	LFE
5	Surround Centre	Side Left
6	Surround Right	Side Right
7	LFE	Back Centre

3.3.5 Controls

3.3.5.1 Control: Mode

Three modes are supported, "Inferred", "Studio" and "Virtual". Generally, "Inferred" or "Studio" are recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Studio	This mode is optimised for use with material that has been mixed using 'pairwise' panning, for instance in Pro Tool's surround panner. The approach produces smooth transitions when sounds pass between speaker locations. In this mode, the corner layout is always assumed to be Square.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.3.5.2 Control: LFE Gain

Audio from the LFE channel can be mixed into the output by setting this dial. It is added to the stream as an omnidirectional signal.

3.4 O3A Upmixer - 7.1
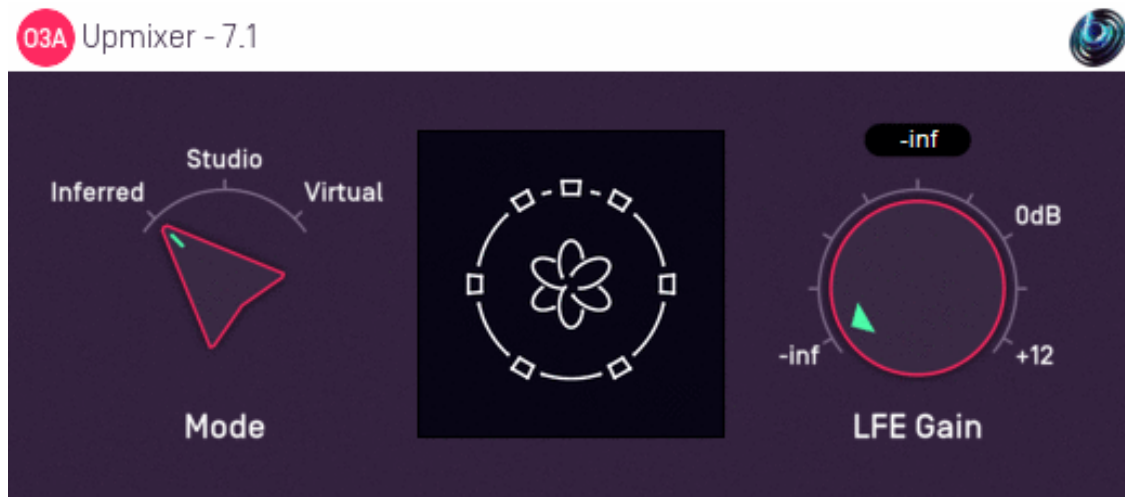
3.4.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.4.2 Audio

	Channels	Content
Input	8	7.1 Surround
Output	16	O3A

3.4.3 Controls

- Mode
- LFE Gain

3.4.4 Description

This plugin takes a surround mix prepared for a 7.1 system and converts it to third order ambisonics (O3A).

3.4.4.1 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 Side	LFE
5	Right Surround Side	Back Left
6	Left Surround Rear	Back Right
7	Right Surround Rear	Side Left
8	LFE	Side Right

3.4.5 Controls

3.4.5.1 Control: Mode

Three modes are supported, "Inferred", "Studio" and "Virtual". Generally, "Inferred" or "Studio" are recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Studio	This mode is optimised for use with material that has been mixed using 'pairwise' panning, for instance in Pro Tool's surround panner. The approach produces smooth transitions when sounds pass between speaker locations. In this mode, the corner layout is always assumed to be Square.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.4.5.2 Control: LFE Gain

Audio from the LFE channel can be mixed into the output by setting this dial. It is added to the stream as an omnidirectional signal.

3.5 O3A Upmixer - 7.1.2 (Dolby Atmos)

3.5.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.5.2 Audio

	Channels	Content
Input	10	7.1.2 (Dolby Atmos)
Output	16	O3A

3.5.3 Controls

- Mode
- LFE Gain

3.5.4 Description

This plugin takes a surround mix prepared for a 7.1.2 system and converts it to third order ambisonics (O3A).

7.1.2 is a standard mix format for beds in Dolby Atmos. It adds two ceiling channels to standard 7.1. **Please note that this plugin does not process Dolby Atmos bitstreams directly.**

3.5.4.1 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 Side	LFE
5	Right Surround Side	Left Surround Rear
6	Left Surround Rear	Right Surround Rear
7	Right Surround Rear	Left Surround Side
8	LFE	Right Surround Side
9	Left Top Surround	Left Top Surround
10	Right Top Surround	Right Top Surround

Please note that the channel ordering used by Dolby's Atmos RMU may differ. Also, the AAX order above is used when plugins interact with ProTools through the AAX software interface; other parts of ProTools may use a different default order, for instance when exporting to file.
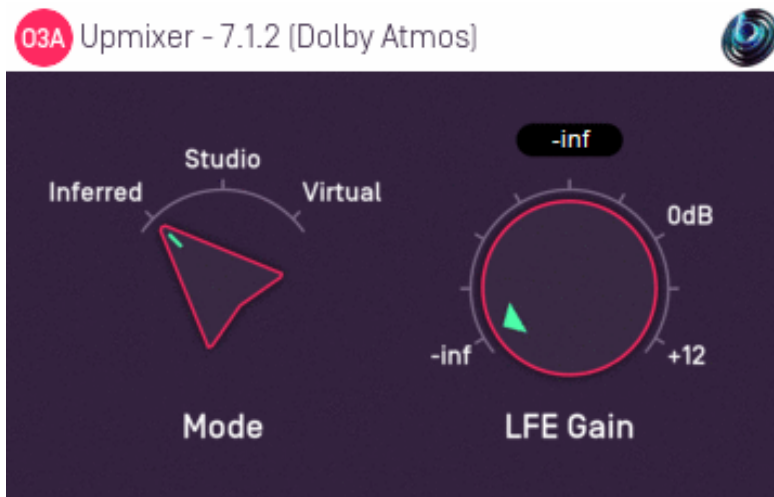
3.5.5 Controls

3.5.5.1 Control: Mode

Three modes are supported, "Inferred", "Studio" and "Virtual". Generally, "Inferred" or "Studio" are recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Studio	This mode is optimised for use with material that has been mixed using 'pairwise' panning, for instance in Pro Tool's surround panner. The approach produces smooth transitions when sounds pass between speaker locations. In this mode, the corner layout is always assumed to be Square.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.5.5.2 Control: LFE Gain

Audio from the LFE channel can be mixed into the output by setting this dial. It is added to the stream as an omnidirectional signal.

3.6 O3A Upmixer - 7.1.4
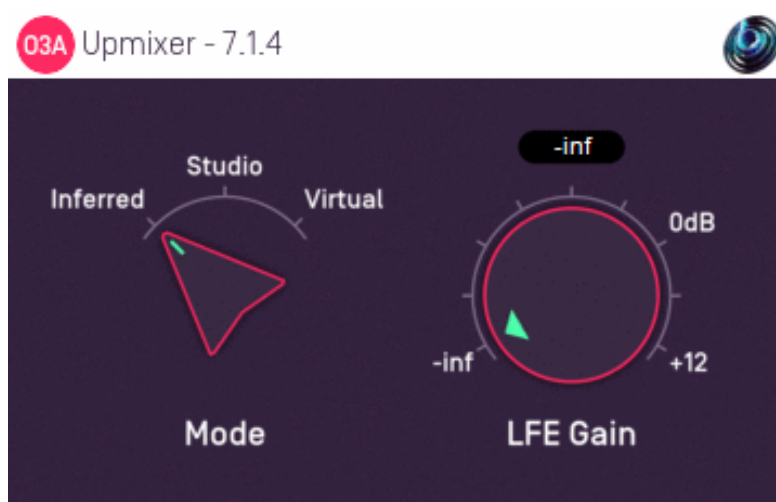
3.6.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.6.2 Audio

	Channels	Content
Input	12	7.1.4
Output	16	O3A

3.6.3 Controls

- Mode
- LFE Gain

3.6.4 Description

This plugin takes a surround mix prepared for a 7.1.4 system and converts it to third order ambisonics (O3A).

The AAX version of this specific plugin requires Pro Tools 2023.6 or later.

7.1.4 adds four ceiling channels to standard 7.1.

3.6.4.1 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 Side	LFE
5	Right Surround Side	Left Surround Rear
6	Left Surround Rear	Right Surround Rear
7	Right Surround Rear	Left Surround Side
8	LFE	Right Surround Side
9	Left Top Front	Left Top Front
10	Right Top Front	Right Top Front
11	Left Top Rear	Left Top Rear
12	Right Top Rear	Right Top Rear

3.6.5 Controls

3.6.5.1 Control: Mode

Three modes are supported, "Inferred", "Studio" and "Virtual". Generally, "Inferred" or "Studio" are recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Studio	This mode is optimised for use with material that has been mixed using 'pairwise' panning, for instance in Pro Tool's surround panner. The approach produces smooth transitions when sounds pass between speaker locations. In this mode, the corner layout is always assumed to be Square.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.6.5.2 Control: LFE Gain

Audio from the LFE channel can be mixed into the output by setting this dial. It is added to the stream as an omnidirectional signal.

3.7 O3A Upmixer - Auro-3D 9.1, 10.1, 11.1 and 13.1

3.7.1 Host Support

3.7.1.1 O3A Upmixer - Auro-3D 9.1

Host Type	Support
AAX	Yes, input mapped to 5.1.4
VST2	Yes

3.7.1.2 O3A Upmixer - Auro-3D 10.1

Host Type	Support
AAX	Yes, input mapped to 7.0.4
VST2	Yes

3.7.1.3 O3A Upmixer - Auro-3D 11.1

Host Type	Support
AAX	Yes, input mapped to 7.1.4
VST2	Yes

3.7.1.4 O3A Upmixer - Auro-3D 13.1

Host Type	Support
AAX	Yes, input mapped to 7.1.6
VST2	Yes

3.7.2 Audio

3.7.2.1 O3A Upmixer - Auro-3D 9.1

	Channels	Content
Input	10	Auro-3D 9.1 (mapped to 5.1.4 for AAX)
Output	16	O3A

3.7.2.2 O3A Upmixer - Auro-3D 10.1

	Channels	Content
Input	11	Auro-3D 10.1 (mapped to 7.0.4 for AAX)
Output	16	O3A

3.7.2.3 O3A Upmixer - Auro-3D 11.1

	Channels	Content
Input	12	Auro-3D 11.1 (mapped to 7.1.4 for AAX)
Output	16	O3A

3.7.2.4 O3A Upmixer - Auro-3D 13.1

	Channels	Content
Input	14	Auro-3D 13.1 (mapped to 7.1.6 for AAX)
Output	16	O3A

3.7.3 Controls

- Mode
- LFE Gain

3.7.4 Description

There are four O3A Upmixer plugins for processing Auro-3D surround mixes. These correspond to each of the Auro-3D 9.1, Auro-3D 10.1, Auro-3D 11.1 and Auro-3D 13.1 speaker layouts. They convert the mixes to third order ambisonics (O3A).

The AAX versions of these specific plugins require Pro Tools 2023.6 or later.

3.7.4.1 Channels

The channel orderings used for 9.1 use the following table. AAX is mapped to the 5.1.4 speaker layout.

Channel	AAX	VST
1	Front Left	Front Left
2	Front Centre	Front Right
3	Front Right	Front Centre
4	Surround Left	LFE
5	Surround Right	Surround Left
6	LFE	Surround Right
7	Height Front Left	Height Front Left
8	Height Front Right	Height Front Right
9	Height Rear Left	Height Rear Left
10	Height Rear Right	Height Rear Right

The other Auro-3D formats are:

Auro-3D 10.1	Auro-3D 11.1	Auro-3D 13.1	Channel Name
1	1	1	Front Left
2	2	2	Front Right
3	3	3	Front Centre
4	4	4	LFE
5	5	5	Surround Left
6	6	6	Surround Right
-	-	7	Back Left
-	-	8	Back Right
7	7	9	Height Front Left
8	8	10	Height Front Right
9	9	11	Height Surround Left
10	10	12	Height Surround Right
-	11	13	Height Front Centre
11	12	14	Top Ceiling

When these formats are mapped for AAX, no attempt is made to map to channels where they correspond. The channels simply appear in the order above. The AAX stem formats actually used are 7.0.4, 7.1.4 and 7.1.6.

If you are using the recommended "Inferred" mode, make sure you are using the right plugin for your content, rather than just patching to some of the channels of 13.1. This will give better results.

3.7.5 Controls

3.7.5.1 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.7.5.2 Control: LFE Gain

Audio from the LFE channel can be mixed into the output by setting this dial. It is added to the stream as an omnidirectional signal.

3.8 O3A Upmixer - IMAX 5.0, 6.0 and 12.0
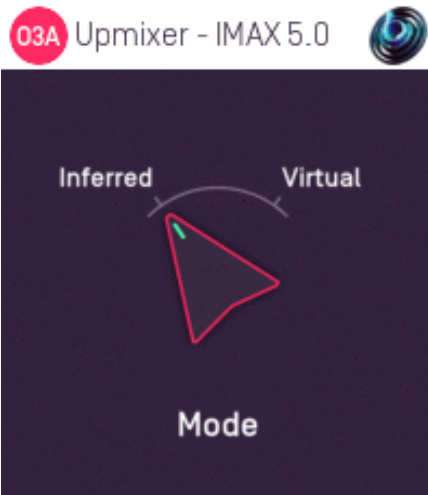
3.8.1 Host Support

3.8.1.1 O3A Upmixer - IMAX 5.0

Host Type	Support
AAX	Yes, input mapped to standard 5.0
VST2	Yes

3.8.1.2 O3A Upmixer - IMAX 6.0

Host Type	Support
AAX	Yes, input mapped to standard 6.0
VST2	Yes

3.8.1.3 O3A Upmixer - IMAX 12.0

Host Type	Support
AAX	Yes, input mapped to 7.1.4
VST2	Yes

3.8.2 Audio

3.8.2.1 O3A Upmixer - IMAX 5.0

	Channels	Content
Input	5	IMAX 5.0 (mapped to standard 5.0 for AAX)
Output	16	O3A

3.8.2.2 O3A Upmixer - IMAX 6.0

	Channels	Content
Input	6	IMAX 6.0 (mapped to standard 6.0 for AAX)
Output	16	O3A

3.8.2.3 O3A Upmixer - IMAX 12.0

	Channels	Content
Input	12	IMAX 12.0 (mapped to 7.1.4 for AAX)
Output	16	O3A

3.8.3 Controls

- Mode

3.8.4 Description

There are three O3A Upmixer plugins for processing IMAX surround mixes. These correspond to each of the IMAX 5.0, IMAX 6.0 and IMAX 12.0 speaker layouts. They convert the mixes to third order ambisonics (O3A).

The AAX version of the IMAX 12.0 plugin requires Pro Tools 2023.6 or later.

3.8.4.1 IMAX 5.0 Channels

The channel ordering used for IMAX 5.0 is as follows:

Channel	AAX	VST
1	Front Left	Front Left
2	Front Centre	Front Right
3	Front Right	Front Centre
4	Rear Left (mapped to Left Surround)	Rear Left
5	Rear Right (mapped to Right Surround)	Rear Right

For AAX, note that this is mapped to standard 5.0.

3.8.4.2 IMAX 6.0 Channels

Channel	AAX	VST
1	Front Left	Front Left
2	Front Centre	Front Right
3	Front Right	Front Centre
4	Rear Left (mapped to Left Surround)	Front Centre Overhead
5	**Front Centre Overhead (mapped to Centre Surround)**	Rear Left
6	Rear Right (mapped to Right Surround)	Rear Right

For AAX, note that this is mapped to standard 6.0, with the IMAX Front Centre Overhead channel mapped to the Centre Surround in standard 6.0 (i.e. at the back).

3.8.4.3 IMAX 12.0 Channels

Channel	VST
1	Front Left
2	Front Right
3	Front Centre
4	Front Centre Overhead
5	Rear Left
6	Rear Right
7	Side Left
8	Side Right
9	Overhead Front Left
10	Overhead Front Right
11	Overhead Rear Left
12	Overhead Rear Right

IMAX systems use speakers with wider bandwidth than typical cinema systems. No Low Frequency Effect (LFE) channel is used in the mix formats. Also note that the last two channels in IMAX 5.0 and 6.0 correspond to rear speakers, not side or surround speakers.

3.8.5 Controls

3.8.5.1 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.9 O3A Upmixer - Cube
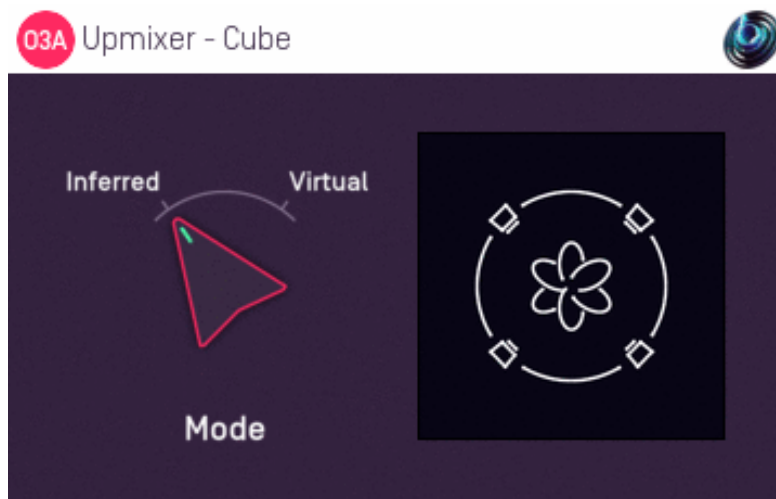
3.9.1 Host Support

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

3.9.2 Audio

	Channels	Content
Input	8	Cube (mapped to 7.1 for AAX)
Output	16	O3A

3.9.3 Controls

- Mode

3.9.4 Description

This plugin takes an eight channel mix designed to feed eight speakers set out at the corners of a cube and converts it to third order ambisonics (O3A).

3.9.4.1 Channels

The channel ordering used is:

| Channel	AAX/VST
1	Lower Front Left
2	Lower Front Right
3	Lower Back Right
4	Lower Back Left
5	Upper Front Left
6	Upper Front Right
7	Upper Back Right
8	Upper Back Left

3.9.5 Controls

3.9.5.1 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.10 O3A Upmixer - 22.2

3.10.1 Host Support

Host Type	Support
AAX	No
VST2	Yes

3.10.2 Audio

	Channels	Content
Input	24	Hamasaki 22.2
Output	16	O3A

3.10.3 Controls

- Mode
- LFE Gain

3.10.4 Description

This plugin takes a surround mix prepared for a Hamasaki 22.2 system and converts it to third order ambisonics (O3A).

3.10.4.1 Channels

The channel ordering used is:

Channel	VST
1	Front Left
2	Front Right
3	Front Centre
4	LFE Left
5	Back Left
6	Back Right
7	Front Left/Centre
8	Front Right/Centre
9	Back Centre
10	LFE Right
11	Side Left
12	Side Right
13	Top Front Left
14	Top Front Right
15	Top Front Centre
16	Top Centre
17	Top Back Left
18	Top Back Right
19	Top Side Left
20	Top Side Right
21	Top Back Centre
22	Bottom Front Centre
23	Bottom Front Left
24	Bottom Front Right

Note that 22.2 needs 24 channels in total, which is even more than the 16 that O3A normally needs. *Don't forget to check your DAW channel count.*

3.10.5 Controls

3.10.5.1 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.10.5.2 Control: LFE Gain

Audio from the LFE channels can be mixed into the output by setting this dial. It is added to the stream as an omnidirectional signal.

4 O3A Upmixers - Stereo Upmixing

4.1 O3A Upmixer - Stereo

4.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

4.1.2 Audio

	Channels	Content
Input	2	Stereo
Output	16	O3A

4.1.3 Controls

- Width
- Pan Law
- Upmixing
- Azimuth
- Elevation
- Roll

4.1.4 Description

This plugin takes a stereo stream and converts it to third order ambisonics (O3A), spreading it out dynamically over a region of the O3A soundfield set out in two opposite directions from a central point.

In other words, it paints the stereo image along a left-to-right "line" that can be moved around freely.

The centre and "left" directions can be set using the control surface, where the directions are indicated by crosshairs. The "right" direction moves accordingly.
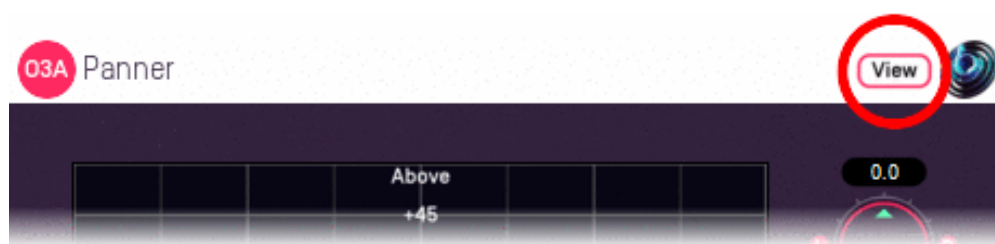
There are labels on the control surface to help you find left, right, above etc. However, if this still does not make any sense, you might want to see our page on the O3A Visualiser which lays out its viewing region in the same way.

This plugin places stereo material in a very definite spatial location or region. If you would like a more spatially spread result, another option is the O3A Stereo Ambience plugin. This is particularly relevant when placing "non-diegetic" material such as music into an ambisonic mix.

4.1.5 View Support

When used with O3A View Sync from the O3A 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 centre and left side directions are shown using green/blue and red crosses, similarly to the plugin display. A dotted line connects the left and right extent of the stereo image. Point at the centre or left side cross and hold the left mouse button to select it. Then, drag to set its azimuth and elevation.	The current centre and left side directions are shown using green/blue and red beams and crosses, similarly to the plugin display. A dotted line connects the left and right extent of the stereo image. Each VR controller moves one of the centre and left side directions 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.

4.1.6 Controls

4.1.6.1 Control: Width

When converting the stereo to O3A, this angle tells the processor how far apart the stereo speakers are understood to be. 60 degrees is the default and corresponds to standard stereo speaker placement. Angles from 0 to 270 degrees are available.

Increasing this angle has the effect of widening the stereo image.

Note that small angles effectively result in the input being summed to some extent and so will work less well with material not optimised for mono downmixing (e.g. panned using a -3dB pan law). You may also encounter a bass boost with wide angles because of the effective increase in source size. Best results will typically be achieved with angles between 30 and 90 degrees or so.

4.1.6.2 Control: Pan Law

Ideally, this should be set to be the same as the pan law used when the stereo mix was made. Normally this is -3dB for modern stereo mixes and -6dB for early stereo mixes intended to be mono-compatible. -4.5dB is midway in between.

In practice, this can normally be set to -3dB. If you then find that central sounds (typically vocals) are too quiet then set this to -4.5dB or -6dB.

4.1.6.3 Control: Upmixing

The underlying stereo upmixing algorithm is optimised for use with material that has been mixed using conventional panning techniques. It is not necessarily well-suited for other mixes.

This control determines how much of the output signal is provided by this upmixing algorithm. The rest of the output is provided by simply panning the left and right channels to the "hard" left and right of the region of space used for output.

With this control set to zero, this plugin is not unlike the O3A Panner - Two Channel plugin.

4.1.6.4 Controls: Azimuth and Elevation

Azimuth and Elevation control where the centre of the stereo image will be 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.

Effectively, this allows the upmixed stereo image to be moved around.

4.1.6.5 Control: Roll

The output of the upmixer is centred around the point given by the azimuth and elevation controls and with a width given by the width control. The roll control sets the *angle* of the output and can be used to rotate the stereo as a "line" around the centre point.

This control has an angle between -180 and +180 degrees. Increasing the value rotates the stereo image clockwise. A value of zero presents the stereo with the left to the left and the right to the right (from a vertical perspective).

5 O3A Upmixers - Ambience Plugins

5.1 O3A Mono Ambience
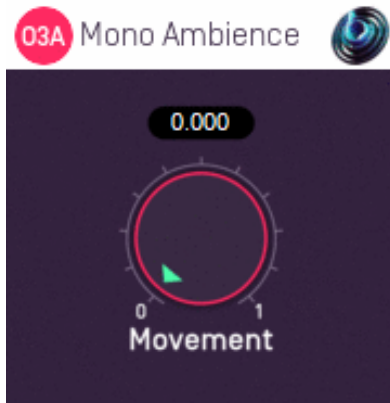
5.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

5.1.2 Audio

	Channels	Content
Input	1	Mono
Output	16	O3A

5.1.3 Controls

- Movement

5.1.4 Description

This plugin takes a mono stream and converts it to third order ambisonics (O3A). The sound is spread in different directions using a method which depends on frequency. This can produce an ambient O3A scene with sounds appearing to come from all directions.

Optionally, the sound components can be made to move in pseudo-random patterns. In general, we recommend movement only be used sparingly; it can be unsettling.

Be careful with this plugin. Because it spreads frequency content spatially, subsequent spatial manipulations can result in strong filtering effects.

5.1.5 Controls

5.1.5.1 Control: Movement

The movement control has a range from zero to one. A value of zero indicates no movement and the maximum value indicates maximum movement. The default is zero.

5.2 O3A Stereo Ambience
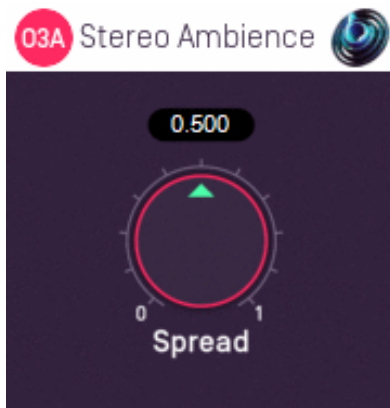
5.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

5.2.2 Audio

	Channels	Content
Input	2	Stereo
Output	16	O3A

5.2.3 Controls

- Spread

5.2.4 Description

This plugin takes a stereo stream and converts it to third order ambisonics (O3A). The stereo is spread over a range of directions using a method which depends on frequency. This can produce an ambient O3A scene with sounds appearing to come from all directions.

This is a rather different approach to the one taken by the O3A Upmixer - Stereo, which attempts to recreate the original stereo directivity.

Be careful with this plugin. Because it spreads frequency content spatially, subsequent spatial manipulations can result in strong filtering effects.

5.2.5 Controls

5.2.5.1 Control: Spread

When the spread is set to 0.0, the left channel is presented as if panned directly to the left (i.e. with an azimuth of +90 degrees) and the right channel directly opposite it, to the right.

Increasing the spread value causes sound to spread away from these directions. For each frequency, contributions from the left and right channels remain opposite.

When the spread is 0.5 (the default), sounds appear to come from all directions, but all frequencies from the left channel are still presented on the left and all frequencies from the right on the right.

Increasing the spread value above 0.5 causes overlap between the regions used by the left and right channels. When the spread reaches 1.0, both the left and right channels are distributed over the whole sphere.

6 O3A Upmixers - Other Formats

6.1 O3A Injector - First Order
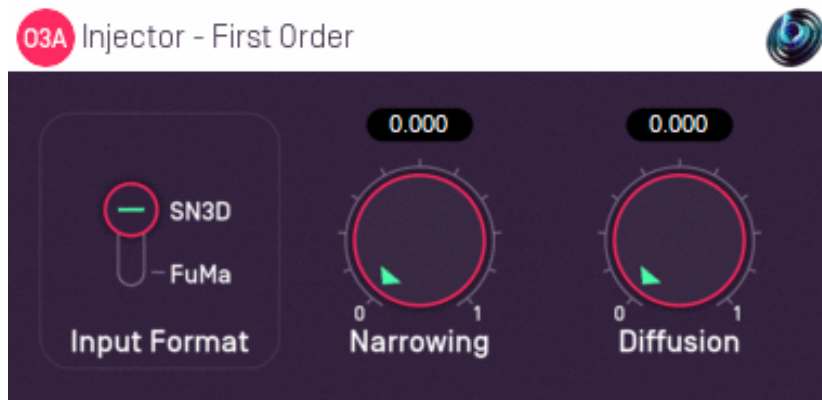
6.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

6.1.2 Audio

	Channels	Content
Input	4	First order B-Format ambisonics (SN3D/ACN O1A or FuMa, switchable)
Output	16	O3A

6.1.3 Controls

- Narrowing
- Diffusion
- Format

6.1.4 Description

This plugin is designed to make subtle modifications to four channel first order B-Format while injecting it into an O3A mix. It is intended for use particularly with recordings from first order B-Format microphones.

In general when we refer to B-Format we are referring to 16 channel third order ambisonic (O3A) B-Format, but this plugin is an exception. The first order ambisonic B-Format we are talking about here is less detailed and only uses four channels. The plugin supports two first order input formats, SN3D and FuMa. Please check which you have and set the switch accordingly.

The plugin does *not* perform conversion from A-Format to B-Format. If your microphone produces ambisonic A-Format, you will need to use software specific to your microphone to convert to B-Format before using this plugin.

After any input format conversion, the plugin has two independent processing stages:

1. Narrowing
2. Diffusion

For some material, neither stage is needed as four channel B-Format (in the SN3D/ACN format) maps naturally onto the first order components of the O3A stream. So, it is often fine not to use this plugin at all when injecting first order material into an O3A stream, or to use this plugin with both dials set to zero.

However, there is typically spatial detail missing in the first order material when it is used in a third order context and this missing detail has a subtle effect on how the material sounds, particularly when compared with third order material. Sounds are likely to differ in both "sharpness" and "envelopment". Also, first order material injected directly into a third order stream can sometimes introduce an audible antiphase "ghost" image in the direction opposite the original sound source, which can cause a blurred effect.

Both stages of this plugin can actually be achieved with other plugins (the O3A Order Amplifier and O3A Diffuser from the O3A Manipulators plugin library). This plugin is organised for convenience when working with four channel first order B-Format material.

It is worth noting that the O3A Harpex plugin can be used in place of this one. This uses an active algorithm which estimates original sound directions and uses these to synthesise third order material. For much material, this can produce far sharper imaging.

6.1.5 Controls

6.1.5.1 Control: Narrowing

Narrowing *reduces* the amount of spatial information that is used (it applies a gain reduction to the X and Y channels).

This can be useful to remove antiphase images in the opposite direction of sound sources, which are typically heard as a kind of blurring. These are often visible in the O3A Visualiser.

The narrowing control determines how much narrowing is applied. A value of zero leaves the stream unaffected and increasing it results in a less spatially detailed, but hopefully less blurred mix.

6.1.5.2 Control: Diffusion

The diffusion value controls a set of all-pass filters which are used to smudge the mix gently. This softens transients slightly.

Different all-pass filters are used in different directions, which disrupts an unnatural envelopment or "in-the-head" effect which can sometimes occur.

A zero value for this control leaves the stream unaffected. Higher values change the sense of envelopment, allowing the stream to become more spatially diffuse without changing sound directions.

6.1.5.3 Control: Format

The input format describes the first order ambisonics that is being fed into this plugin. Setting this incorrectly will give bad results. The options are:

- "SN3D" (in the ACN channel ordering) is the format used by the O1A and O3A plugins. It is used by some recent first order microphones and is sometimes known as "AmbiX".

- First order "FuMa" is the same as classic WXYZ B-Format, which dates back to the 1970's. It was used in versions of these plugins prior to version 2.0 and some hardware and software uses it, including a number of 3D microphones.

6.2 O3A Upmixer - Coincident Microphone
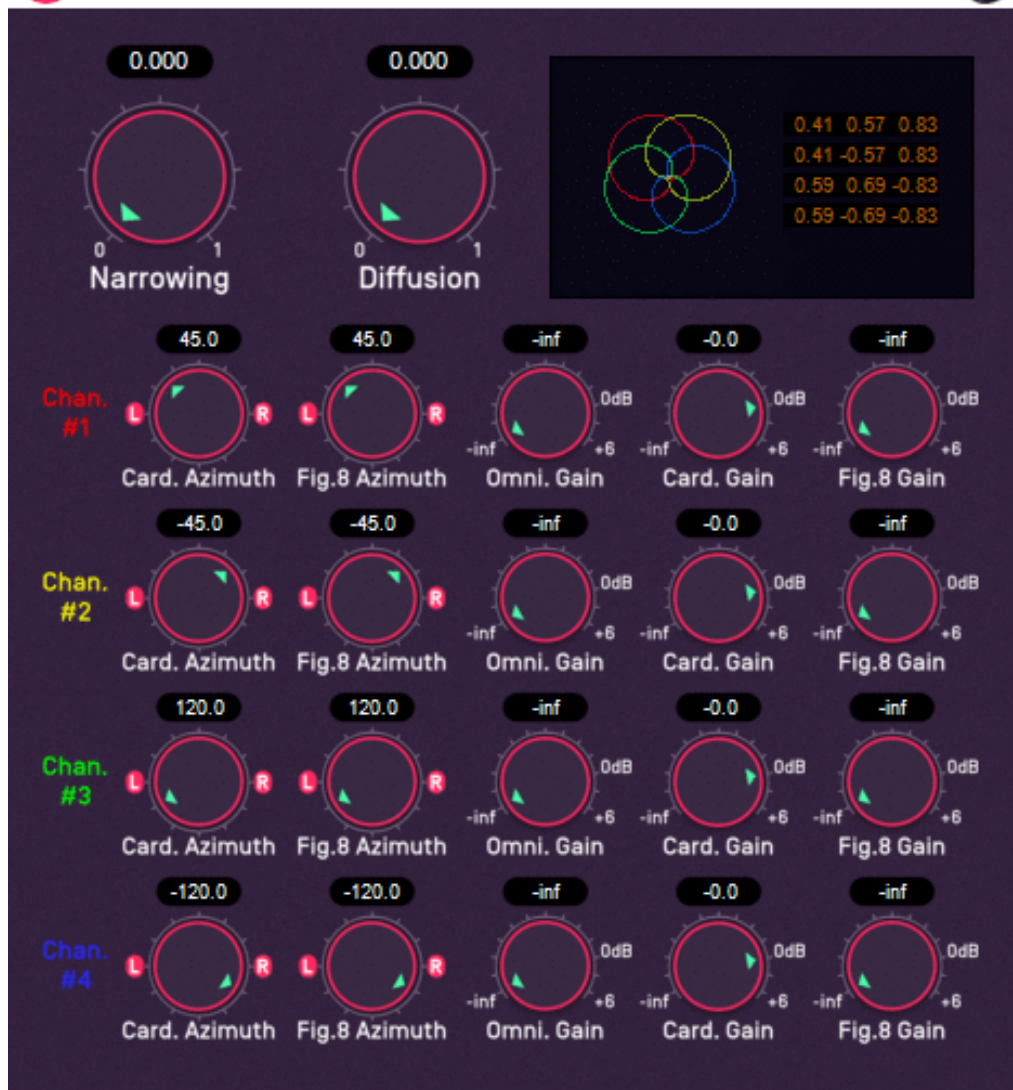
6.2.1 Host Support

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

6.2.2 Audio

	Channels	Content
Input	4	Microphone Channels (mapped to quad for AAX)
Output	16	O3A

6.2.3 Controls

- Narrowing
- Diffusion
- Card. Azimuth 1 - 4
- Fig.8 Azimuth 1 - 4

- Omni. Gain 1 - 4
- Card. Gain 1 - 4
- Fig.8 Gain 1 - 4

6.2.4 Description

This plugin is designed for use with recordings made with planar coincident surround microphones with more than two capsules. Examples include the Zoom H2 and Double M/S systems. The plugin uses a description of the spatial responses of the microphone capsules to convert the recordings to O3A. It takes advantage of a mathematical relationship between standard capsule responses and first order ambisonics.

Note that microphone capsules typically do not achieve their ideal responses and that errors vary between microphone capsules, even within the same microphone. These issues tend to be more significant with less expensive microphones and will reduce the quality of the resulting O3A stream. Unfortunately, this plugin cannot compensate for these issues!

The spatial response for three or four channels is built up from simple omnidirectional, cardioid and figure-of-eight responses, which are shown in a display panel. The plugin relies on the microphone capsules being effectively coincident (i.e. within millimetres of each other).

The plugin does not work with stereo microphones; you may wish to use the O3A Upmixer - Stereo plugin for this instead.

This plugin also is not designed to work with A-Format or B-Format ambisonic microphones (although these are also effectively coincident). A-Format microphones should come with software to convert their output to B-Format; this should be used. First order SN3D B-Format can be mixed directly into the O3A stream or processed with the O3A Harpex Upsampler, or the O3A First Order Injector which has the same narrowing and diffusion controls as are present here. We recommend the use of ambisonic microphones, as these pick up height information, producing a 3D soundfield rather than a 2D one.

This plugin needs to be used with care or it will produce strange results. **The channel spatial responses should describe the microphone(s), *not* how you would like to place sounds into the O3A scene.** Forgetting this can cause much confusion! We normally recommend you set the channel spatial responses carefully for your microphone and then save them somewhere safe so you only ever need to do this once. Then, when you use the plugin, provide all channels of the microphone recording directly to the plugin in the expected order, without changing the channel levels.

The plugin also includes some additional processing stages to help get the best out of your recordings. There are three stages in total:

1. First Order Matrixing
2. Narrowing
3. Diffusion

First, the plugin tries to find an optimal matrix derived from the channel spatial responses. This converts the input (the microphone recording) into first order horizontal-only B-Format. The matrix is shown in the display panel at the top right of the screen. The output of this stage is the first, second and fourth channel an O3A stream.

If the plugin cannot find an optimal matrix, for instance because there are fewer than three active microphone channels, or the microphone array is badly conditioned mathematically (e.g. because all capsules are facing forwards), then the matrix will not be shown and the output of the plugin will be silent.

After this, the first order B-Format can be processed with narrowing and diffusion stages in the same way as in the O3A First Order Injector plugin.

You can extract other polar patterns from the resulting O3A mix with the O3A Virtual Microphone plugin or use other O3A tools.

6.2.4.1 Setting the Microphone Up

To use this plugin, first set up the microphone responses in a way that matches the microphone you are using. This can be time-consuming, so save your settings once they are right so you can use them in the future. There are some presets available.

If the microphone channels correspond directly to simple capsule responses (omnidirectional, cardioid or figure-of-eight), you can simply set the gain for that response to 0dB and the others to -inf (off) and then point each response in the correct direction for its capsule.

For instance, the Zoom H2 in surround mode has four outputs corresponding to four cardioid response capsules, so this can be set up by setting all cardioid gains to 0dB and all other gains to -inf. The capsules can then be steered to the correct azimuths (+45, -45, +120, -120) using the cardioid azimuth controls. Other microphones with simple capsule responses such as hypercardioid or subcardioid can be modelled by mixing simple responses together (omni and figure-of-eight are usually easiest).

The Double M/S (or "Double Mid/Side" technique) typically uses a front-facing cardioid channel, a side-facing figure-of-eight channel and a rear-facing cardioid channel. A preset is available for this, but be careful about the actual capsules in use. Specifically, depending on the actual capsules you have chosen it may be necessary to change the channel cardioid responses slightly (for instance by mixing in some omni to produce a subcardioid response) and the relative channel levels may need tweaking.

Try to model your microphone(s) accurately. You might be tempted to tweak the channel responses to manipulate the results of this plugin, but you probably will not get what you expect because the plugin will compensate for your tweaks in ways which may not be intuitive. The channel spatial response parameters are intended to describe the actual microphone response, not what you wished it had been! If you want to modify the spatial balance of the mix, you are probably better off using plugins from the O3A Manipulators plugin library.

6.2.4.2 Tweaking Actual Recordings

After setting up the microphone accurately, listen to the results and tweak the narrowing and/or diffusion parameters if needed. Alternatively, the O3A Harpex Upsampler plugin can be used to sharpen the spatial image if it is available, in which case the narrowing and diffusion parameters should usually be left at zero.

We do not recommend making changes to the level of the individual channels of the recording before processing as the plugin relies on them being at the expected relative levels. Similarly, all channels need to be present or strange results will ensue!

After processing with this plugin you can apply O3A tools to the results, including surround decoders, for instance for 5.1. You can also extract other microphone responses using the O3A Virtual Microphone.

6.2.5 Controls

6.2.5.1 Control: Narrowing

This is the same as the narrowing control of the O3A First Order Injector plugin.

Narrowing *reduces* the amount of spatial information that is used (it applies a gain reduction to the X and Y channels).

This can be useful to remove antiphase images in the opposite direction of sound sources, which are typically heard as a kind of blurring. These are often visible in the O3A Visualiser.

The narrowing control determines how much narrowing is applied. A value of zero leaves the stream unaffected and increasing it results in a less spatially detailed, but hopefully less blurred mix.

6.2.5.2 Control: Diffusion

This is the same as the diffusion control of the O3A First Order Injector plugin.

The diffusion value controls a set of all-pass filters which are used to smudge the mix gently. This softens transients slightly.

Different all-pass filters are used in different directions, which disrupts an unnatural envelopment or "in-the-head" effect which can sometimes occur.

A zero value for this control leaves the stream unaffected. Higher values change the sense of envelopment, allowing the stream to become more spatially diffuse without changing sound directions.

6.2.5.3 Controls: Card. Azimuth 1 - 4

Four of these controls are present, one for each channel. Each indicates the azimuth (in degrees) of a contributing cardioid capsule response for the channel.

6.2.5.4 Controls: Fig.8 Azimuth 1 - 4

Four of these controls are present, one for each channel. Each indicates the azimuth (in degrees) of a contributing figure-of-eight capsule response for the channel.

6.2.5.5 Controls: Omni. Gain 1 - 4

Four of these controls are present, one for each channel. Each indicates the level of a contributing omnidirectional capsule response for the channel.

The gain range is from -30dB to +6dB.

6.2.5.6 Controls: Card. Gain 1 - 4

Four of these controls are present, one for each channel. Each indicates the level of a contributing cardioid capsule response for the channel.

Note that subcardioid and hypercardioid responses can be modelled using combinations of contributions of different capsule types (typically omni and figure-of-eight).

The gain range is from -30dB to +6dB.

6.2.5.7 Controls: Fig.8 Gain 1 - 4

Four of these controls are present, one for each channel. Each indicates the level of a contributing figure-of-eight capsule response for the channel.

Note that the polarity of a figure-of-eight response can be flipped by changing its azimuth by 180 degrees.
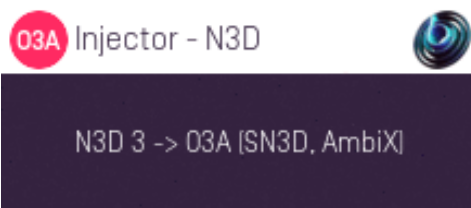
The gain range is from -30dB to +6dB.

6.2.6 Presets

Presets are available for this plugin:

- Double M/S
- Milab SRND360 (CF/LR/RR)
- Zoom H2

6.3 O3A Injector - N3D

6.3.1 Host Support

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

6.3.2 Audio

	Channels	Content
Input	16	N3D/ACN Ambisonic Audio (mapped to standard SN3D ambisonics for AAX)
Output	16	O3A

6.3.3 Description

This plugin imports a third order ambisonic mix prepared in other tools using the "N3D" convention. N3D is a close relative to SN3D, which is used natively by these plugins. The "ACN" channel ordering convention is typically used in both cases, and is expected by this plugin.

The conversion uses level changes only. You may want to use the O3A Visualiser to check that the results make sense.

In Pro Tools, as the N3D format is not supported directly, this plugin expects audio using the ordinary ambisonic stem format. Normally this should be encoded as O3A (i.e. SN3D/ACN), so we are "misusing" the format here.

N3D is used in MPEG-H 3D Audio.

6.3.3.1 Warning

Please be aware that N3D and SN3D are similar to each other, but not the same. Be **very** careful to convert where necessary as it may not be immediately obvious if mistakes are made. **Do *not* guess!** If you get this wrong it is likely to result in level, blurring or sharpening errors which may not be immediately obvious on simple decoders.

6.3.3.2 Other Conventions

Note that other plugins are available to convert to and from ambisonics using the FuMa convention. See O3A Decoder - FuMa and O3A Injector - FuMa.

6.3.3.3 Orders

This plugin expects third order N3D 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 O3A Injector - O1A or O2A plugins can be "misused" to increase the order of the N3D material as this is a rare case where a plugin will work correctly for both SN3D and N3D.

7 O3A Core - Panners

7.1 O3A Panner
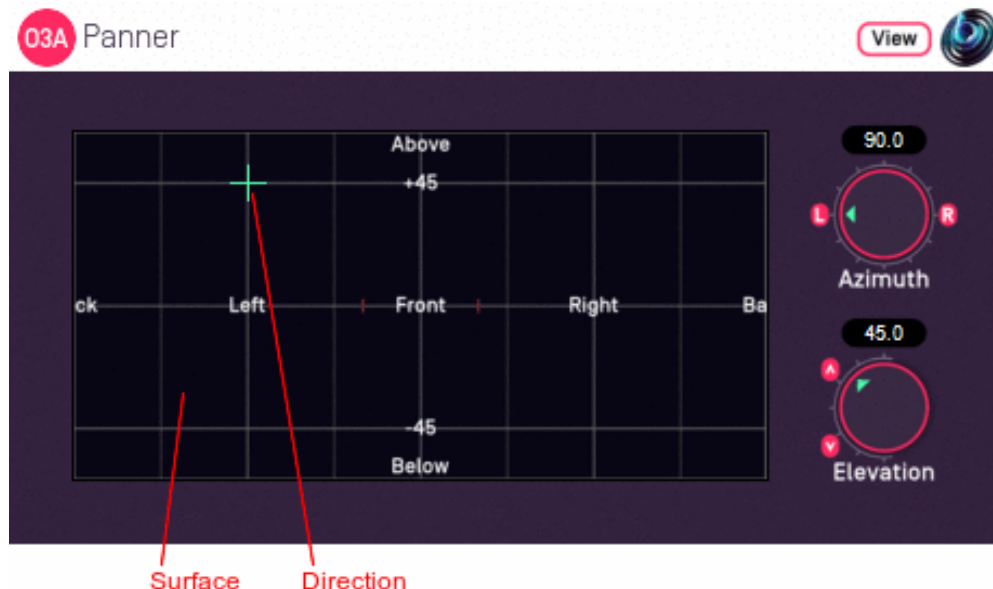
7.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

7.1.2 Audio

	Channels	Content
Input	1	Mono
Output	16	O3A

7.1.3 Controls

- Azimuth
- Elevation

7.1.4 Description

This O3A panner takes a mono sound and places it in a particular direction in a 3D O3A 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 O3A Visualiser which lays out its viewing region in the same way.

7.1.5 View Support

When used with O3A View Sync from the O3A 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.
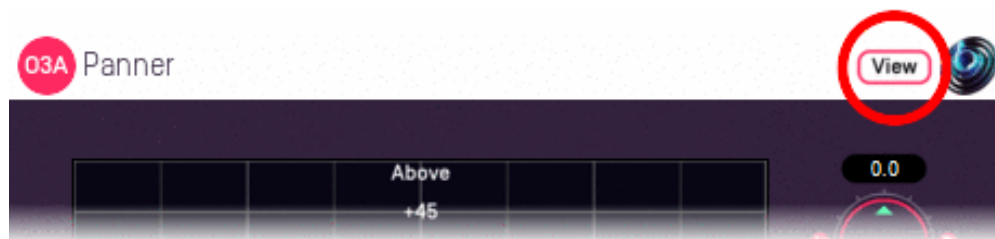
When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

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 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.

7.2 O3A Panner - Classic

7.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

7.2.2 Audio

	Channels	Content
Input	1	Mono
Output	16	O3A

7.2.3 Controls

- Azimuth
- Elevation

7.2.4 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.

7.2.5 View Support

When used with O3A View Sync from the O3A 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.

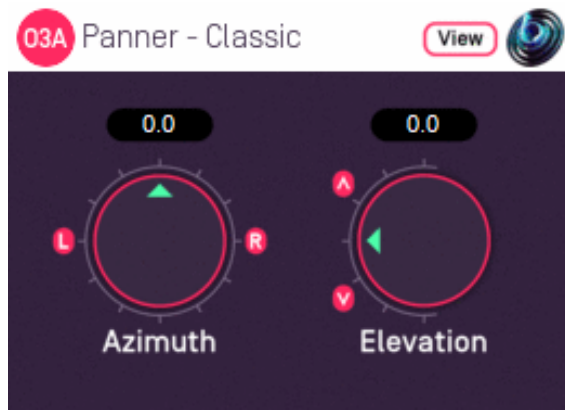## 7.2.6 Controls

7.2.6.1 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.

7.3 O3A Panner - Hemisphere
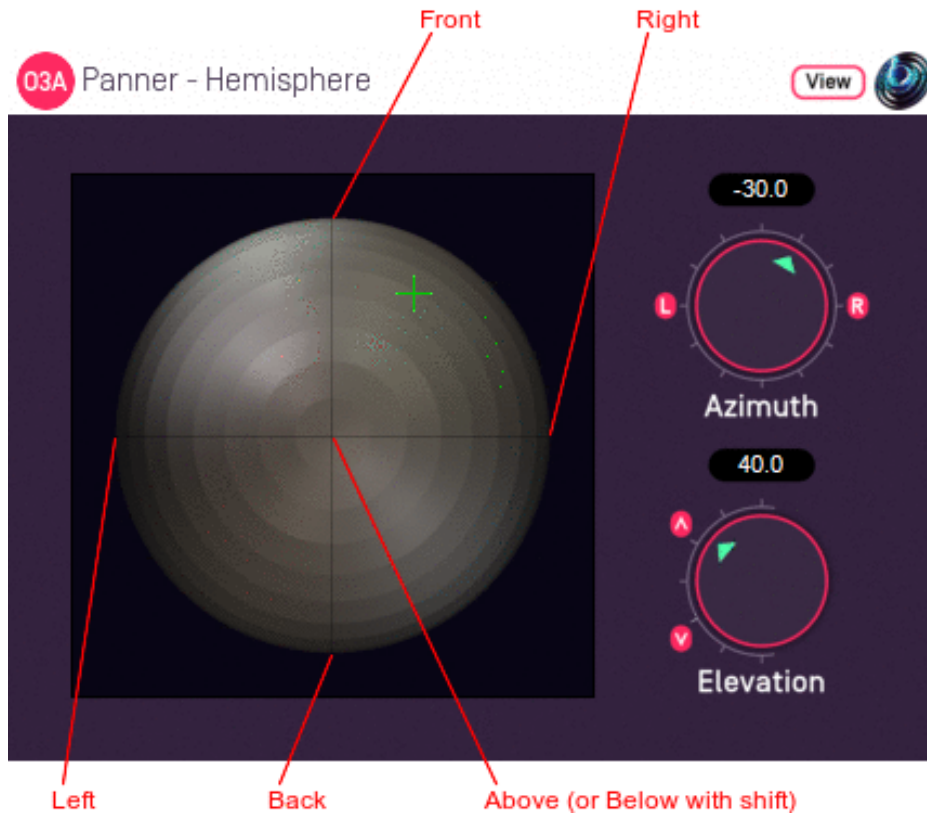
7.3.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

7.3.2 Audio

	Channels	Content
Input	1	Mono
Output	16	O3A

7.3.3 Controls

- Azimuth
- Elevation

7.3.4 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

7.3.5 View Support

When used with O3A View Sync from the O3A 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.
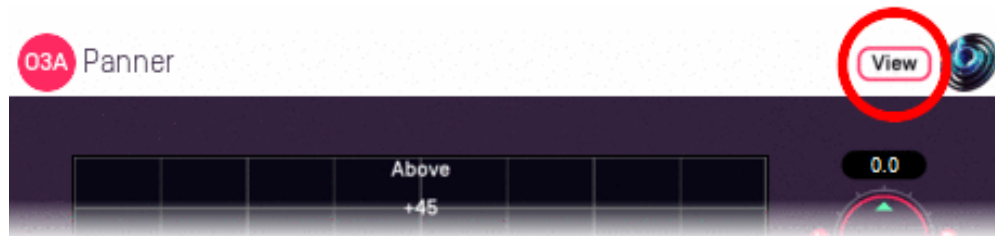
When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

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.

7.3.6 Controls

7.3.6.1 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.

7.4 O3A Panner - Large
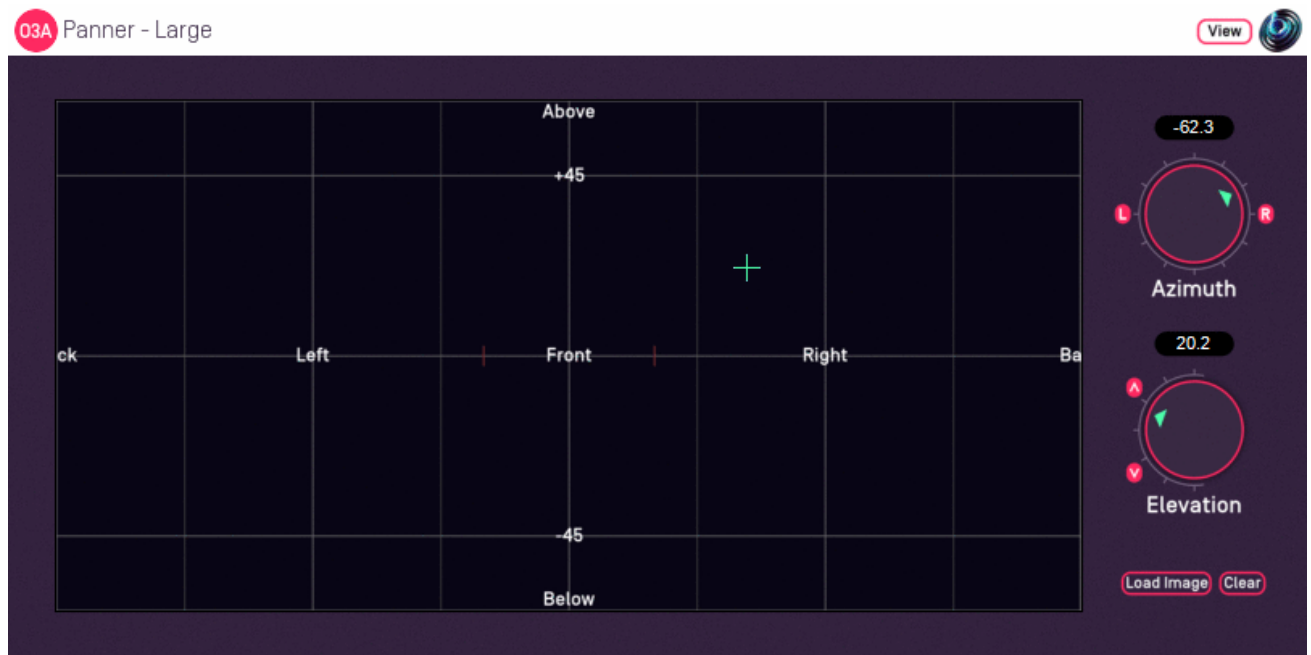
7.4.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

7.4.2 Audio

	Channels	Content
Input	1	Mono
Output	16	O3A

7.4.3 Controls

- Azimuth
- Elevation

7.4.4 Description

This O3A panner takes a mono sound and places it in a particular direction in a 3D O3A 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.

7.4.4.1 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.

7.4.5 View Support

When used with O3A View Sync from the O3A 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.

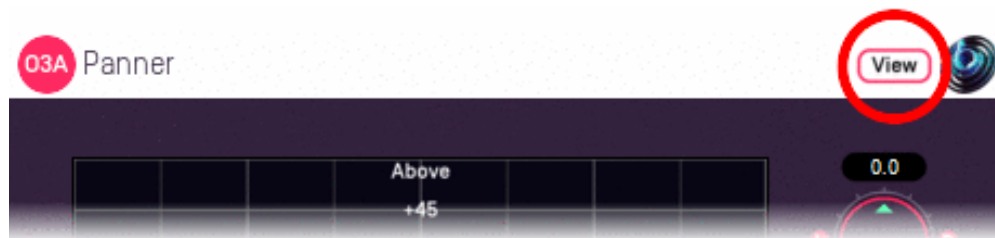| View Support	ViewVR Support
The current direction is shown using a cross.	The current direction is shown using a beam and cross.
Hold the left mouse button to set the azimuth and elevation.	Hold a VR controller trigger to set the azimuth and elevation.

7.4.6 Controls

7.4.6.1 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.

7.5 O3A Panner - Two Channel

7.5.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

7.5.2 Audio

	Channels	Content
Input	2	Stereo
Output	16	O3A

7.5.3 Controls

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

7.5.4 Description

This O3A panner takes two mono sound sources and places them in particular directions in a 3D O3A mix.

It can also be used as a simple way to upmix stereo to O3A. 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 O3A 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 O3A Visualiser which lays out its viewing region in the same way.

7.5.5 View Support

When used with O3A View Sync from the O3A 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 green/blue and red crosses, similarly to the plugin display. Point at one and hold the left mouse button to select it. Then, drag to set its azimuth and elevation.	The current panner directions are shown using green/blue and red beams and crosses, similarly to the plugin display. 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.

7.5.6 Controls

7.5.6.1 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).

7.5.6.2 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.

7.6 O3A Panner - Eight Channel
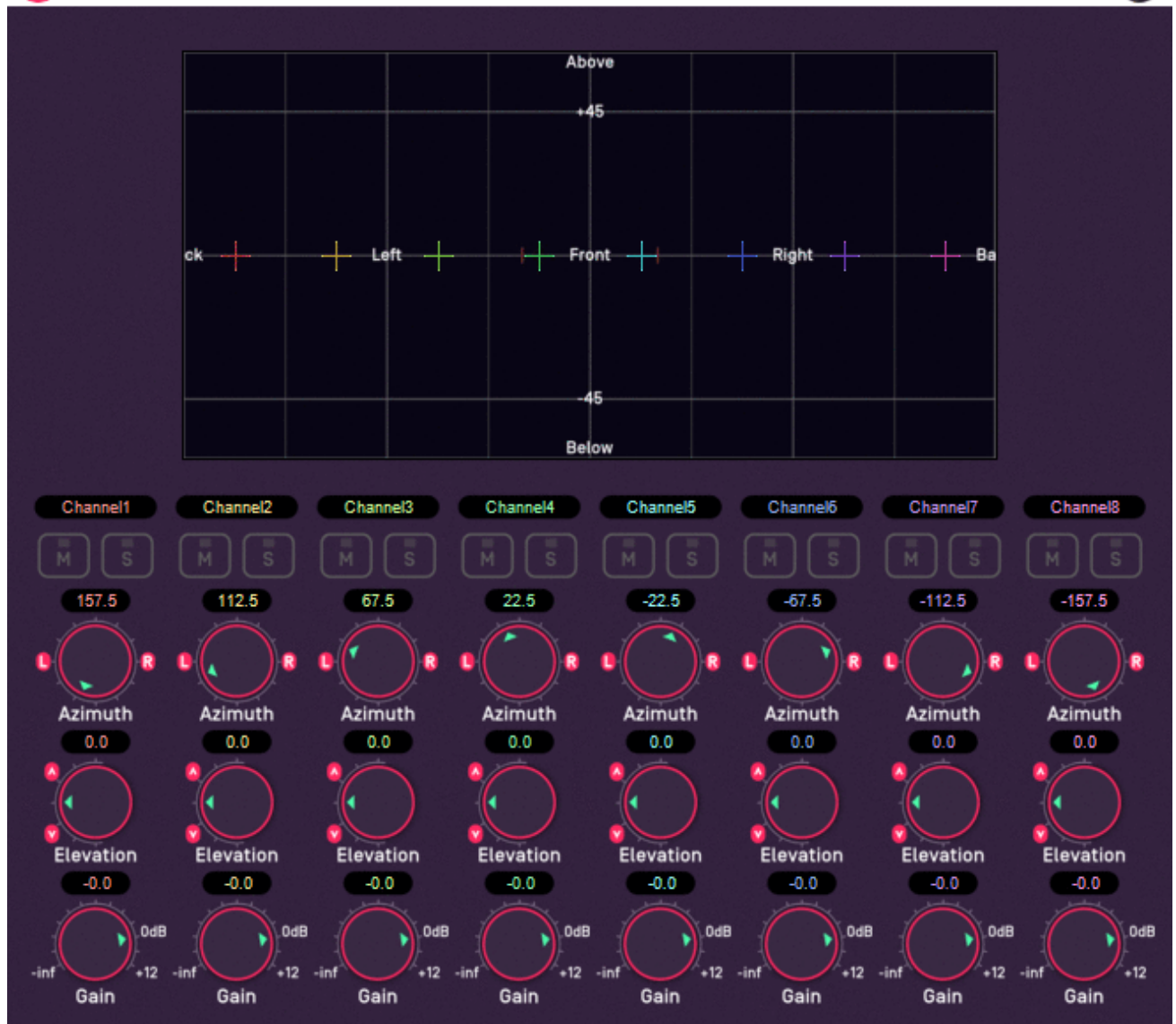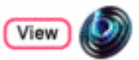
7.6.1 Host Support

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

7.6.2 Audio

	Channels	Content
Input	8	Eight channels of mono (mapped to 7.1 for AAX)
Output	16	O3A

7.6.3 Controls

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

- Mute 1 - 8
- Solo 1 - 8

7.6.4 Description

This O3A panner takes eight mono sound sources and places them in particular directions in a 3D O3A 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 O3A 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.

7.6.4.1 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.

7.6.4.2 Pro Tools Note

The AAX version of this plugin expects input as 7.1 audio, with the eight panning channels mapped from the 7.1 channels in the following order:

Index	Label
1	L
2	C
3	R
4	Lss
5	Rss
6	Lsr
7	Rsr
8	LFE

A simple way to use this plugin is to place it as the first plugin on a 7.1 track. Mono signals can then be sent from other tracks by addressing the individual channels of the track's 7.1 input bus. For instance, if the input bus is labelled "Panner8" then to send to the first panner channel, mono audio should be sent to "Panner8.L". To send to the second panner channel, "Panner8.C" and so on, through to "Panner8.LFE" for the eighth channel. Routing can be checked using the plugin's solo buttons in the usual way.

7.6.5 View Support

When used with O3A View Sync from the O3A 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. Point at one and hold the left mouse button to select it. Then, drag to set its azimuth and elevation.	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 controller trigger to select it and move the controller to set its azimuth and elevation.

7.6.6 Controls

7.6.6.1 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.

7.6.6.2 Controls: Gain 1 - 8

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

7.6.6.3 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.

7.6.7 Presets

Presets are available for this plugin:

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

8 O3A Core - Visualisers

8.1 O3A Visualiser
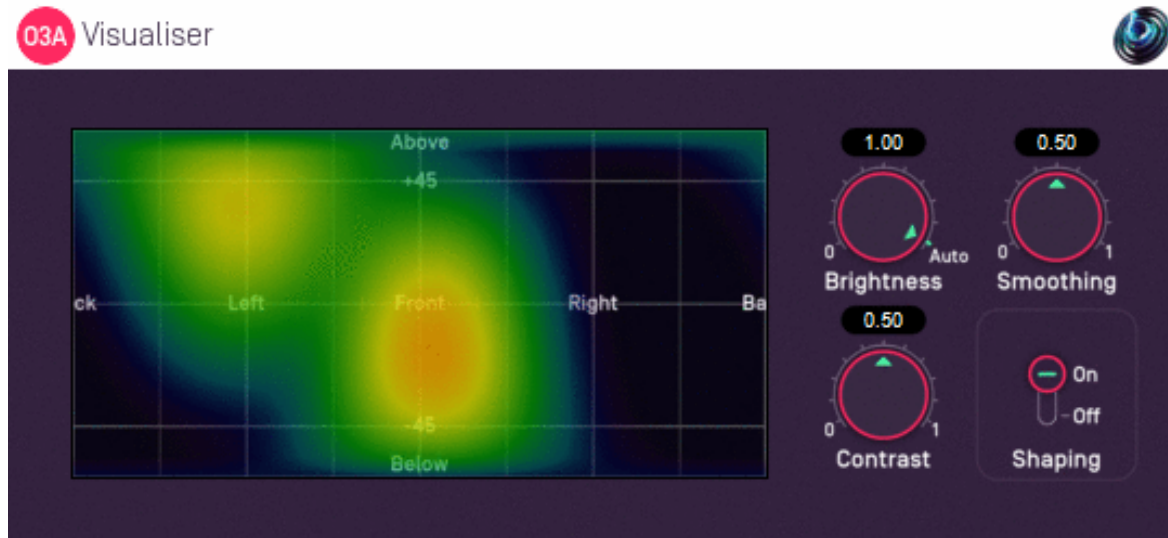
8.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

8.1.2 Audio

	Channels	Content
Input	16	O3A
Output	16	O3A

8.1.3 Controls

- Brightness
- Contrast
- Smoothing
- Shaping

8.1.4 Description

This plugin produces a view of an O3A 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 O3A 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 O3A 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 O3A 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 O3A View support. You might wish to consider O3A Flare.

8.1.5 Controls

8.1.5.1 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.

8.1.5.2 Control: Contrast

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

8.1.5.3 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.

8.1.5.4 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.

8.2 O3A Visualiser - Hemisphere

8.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

8.2.2 Audio

	Channels	Content
Input	16	O3A
Output	16	O3A

8.2.3 Controls

- Brightness
- Contrast
- Smoothing
- Shaping
- Viewpoint

8.2.4 Description

This plugin produces a view of an O3A 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 O3A effects chain.

The stream is shown using a two circular regions each showing a projection of a half of the directional components of the O3A 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 O3A 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 O3A Visualiser instead.

This plugin does not have O3A View support. You might wish to consider O3A Flare.

8.2.5 Controls

8.2.5.1 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.

8.2.5.2 Control: Contrast

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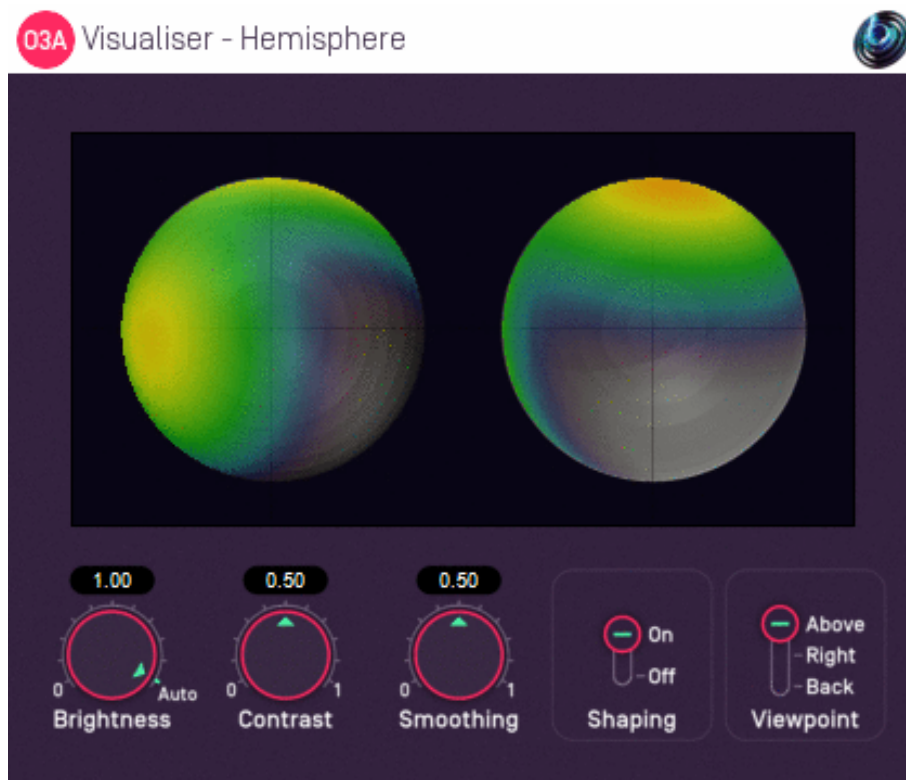
8.2.5.3 Control: Smoothing

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

8.2.5.4 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.

8.2.5.5 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.

8.3 O3A Colourizer
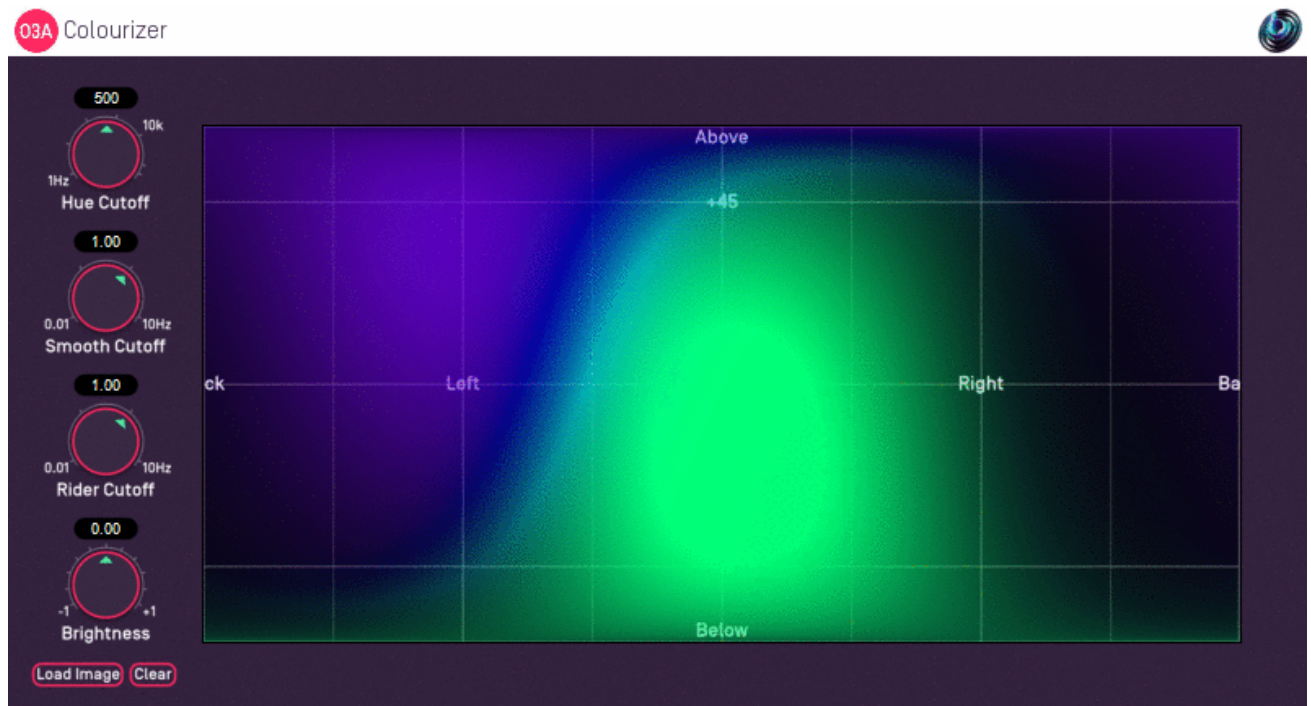
8.3.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

8.3.2 Audio

	Channels	Content
Input	16	O3A
Output	16	O3A

8.3.3 Controls

- Hue Cutoff
- Smooth Cutoff
- Rider Cutoff
- Brightness

8.3.4 Description

This plugin is a variant of the O3A Visualiser plugin. Like that plugin, it produces a view of an O3A 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 O3A effects chain.

Two significant differences between this and the O3A 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.

8.3.4.1 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.

8.3.5 Controls

8.3.5.1 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.

8.3.5.2 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.
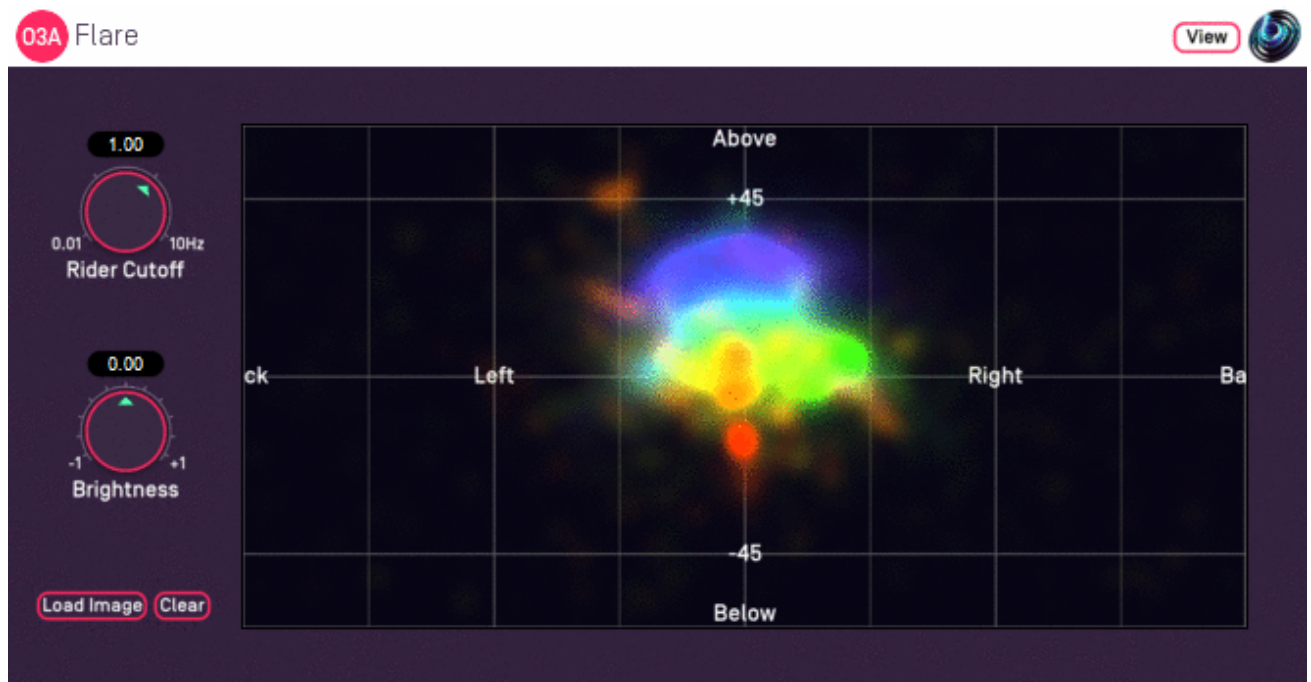
8.3.5.3 Control: Rider Cutoff

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.

8.3.5.4 Control: Brightness

This modifies the overall brightness of the image.

8.4 O3A Flare

8.4.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

8.4.2 Audio

	Channels	Content
Input	16	O3A
Output	16	O3A

8.4.3 Controls

- Rider Cutoff
- Brightness

8.4.4 Description

This plugin is a variant of the O3A Visualiser plugin. Like that plugin, it produces a view of an O3A 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 O3A effects chain.

Although this plugins uses the same layout, it uses substantially different processing to the O3A Visualiser and O3A 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.

8.4.4.1 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.

8.4.5 View Support

When used with O3A View Sync from the O3A 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.
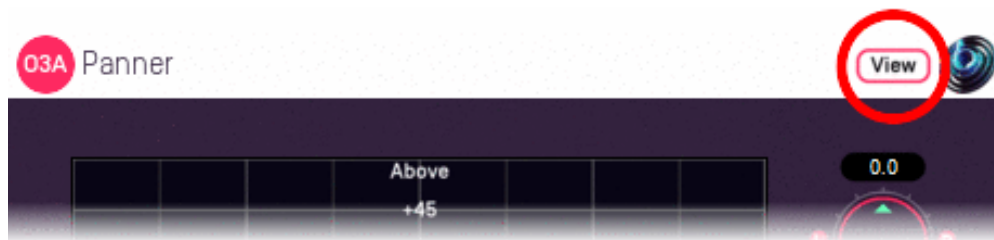
When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

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.

8.4.6 Controls

8.4.6.1 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.

8.4.6.2 Control: Brightness

This modifies the overall brightness of the image.

9 O3A Core - Rotation

9.1 O3A Look
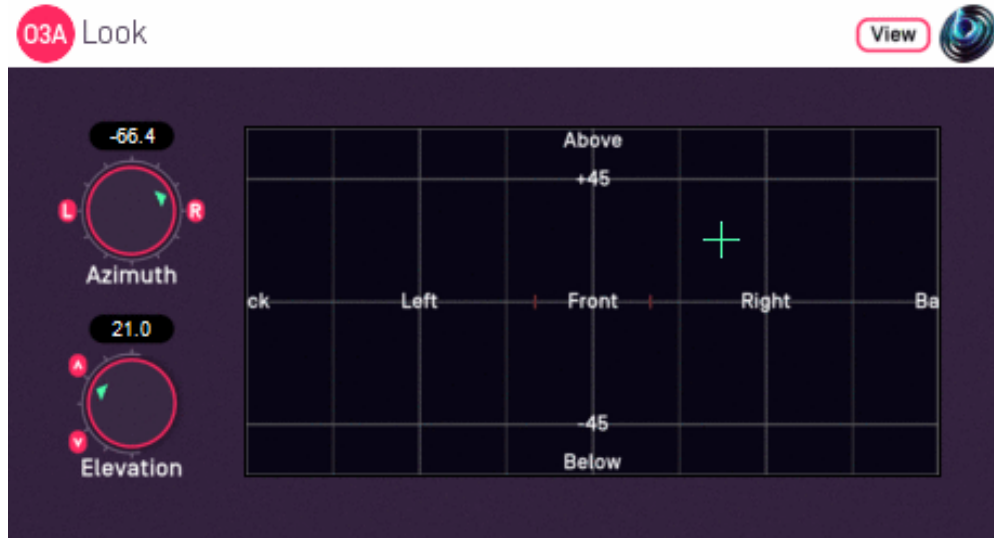
9.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

9.1.2 Audio

	Channels	Content
Input	16	O3A
Output	16	O3A

9.1.3 Controls

- Azimuth
- Elevation

9.1.4 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 O3A Panner). Sounds that were in this direction will be to the front after processing.

This is essentially an simplified (and inverted) version of the O3A 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).

9.1.5 View Support

When used with O3A View Sync from the O3A 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.

9.1.6 Controls

9.1.6.1 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.

9.2 O3A Rotation

9.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

9.2.2 Audio

	Channels	Content
Input	16	O3A
Output	16	O3A

9.2.3 Controls

- Yaw
- Pitch
- Roll
- Ordering

9.2.4 Description

This plugin rotates the entire O3A 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 O3A 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 O3A Look plugin, which is simpler to use but does not include a Roll control.

9.2.5 View Support

When used with O3A View Sync from the O3A 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: 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.

9.2.6.2 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.

10 O3A Core - Decoders and Converters

10.1 O3A Decoder - Stereo
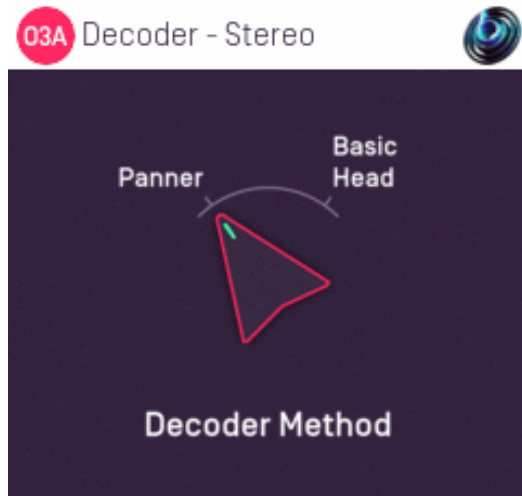
10.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

10.1.2 Audio

	Channels	Content
Input	16	O3A
Output	2	Stereo

10.1.3 Controls

- Method

10.1.4 Description

This plugin takes a third order ambisonics (O3A) 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 O3A Decoder - Headphones.

As another alternative to this plugin, you can use the O3A Virtual Microphone plugin to produce a stereo mix using a simple virtual stereo microphone.

10.1.5 Controls

10.1.5.1 Control: Method

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

Method	Description
Panner	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. 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.
Basic Head	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. **This is not a binaural decoder.** 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. For full binaural decoding, we recommend O3A Decoder - Headphones from the O3A Decoding library, O3A Decoder - VR Monitoring from the O3A View plugin library, or Rapture3D Advanced. Unlike most other O3A decoders, this decoder presents sounds from different directions at different levels. For instance, sounds to the front are louder than those behind.

10.1.5.2 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.

10.2 O3A Decoder - Mono

10.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

10.2.2 Audio

	Channels	Content
Input	16	O3A
Output	1	Mono

10.2.3 Description

This plugin takes a third order ambisonics (O3A) 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 O3A Virtual Microphone or O3A Beamer plugins.

10.3 O3A Decoder - 5.1 Basic

10.3.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

10.3.2 Audio

	Channels	Content
Input	16	O3A
Output	6	5.1 Surround

10.3.3 Description

This plugin takes a third order ambisonics (O3A) 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 O3A Decoding plugin library.

10.3.3.1 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.

10.4 O3A Decoder - FuMa
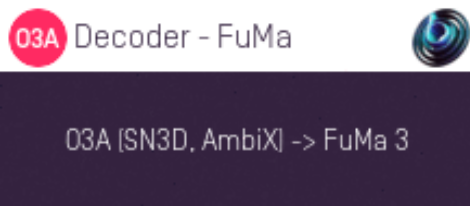
10.4.1 Host Support

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

10.4.2 Audio

	Channels	Content
Input	16	O3A
Output	16	FuMa Ambisonic Audio (mapped to standard SN3D ambisonics for AAX)

10.4.3 Description

This plugin takes a third order ambisonic mix prepared with these plugins (O3A) 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 O3A Injector - FuMa plugin.

In Pro Tools, as the FuMa format is not supported directly as a stem format, this plugin outputs audio using the ordinary ambisonic stem format. Normally this should be encoded as O3A (i.e. SN3D/ACN), so we are "misusing" the format here.

10.4.3.1 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 O3A Decoder - O1A or O2A 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.

10.5 O3A Injector - FuMa

10.5.1 Host Support

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

10.5.2 Audio

	Channels	Content
Input	16	FuMa Ambisonic Audio (mapped to standard SN3D ambisonics for AAX)
Output	16	O3A

10.5.3 Description

This plugin takes a mix in the FuMa ambisonic convention and converts it to third order ambisonics (O3A) 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.

You can convert back with the O3A Decoder - FuMa plugin.

In Pro Tools, as the FuMa format is not supported directly as a stem format, this plugin expects audio using the ordinary ambisonic stem format. Normally this should be encoded as O3A (i.e. SN3D/ACN), so we are "misusing" the format here.

10.5.3.1 Orders

This plugin expects third 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 O3A Injector - O1A or O2A 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.

10.6 O3A Decoder - O1A and O2A

10.6.1 Host Support

10.6.1.1 O3A Decoder - O1A

Host Type	Support
AAX	Yes
VST2	Yes

10.6.1.2 O3A Decoder - O2A

Host Type	Support
AAX	Yes
VST2	Yes

10.6.2 Audio

10.6.2.1 O3A Decoder - O1A

	Channels	Content
Input	16	O3A
Output	4	O1A

10.6.2.2 O3A Decoder - O2A

	Channels	Content
Input	16	O3A
Output	9	O2A

10.6.3 Description

These simple plugins take a third order (O3A) ambisonic mix and convert it to a lower resolution first order (O1A) or second order (O2A) mix. 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.

10.7 O3A Injector - O1A and O2A

O1A [SN3D, AmbiX] -> O3A [SN3D, AmbiX]
Warning: output has limited spatial detail.

10.7.1 Host Support

10.7.1.1 O3A Injector - O1A

Host Type	Support
AAX	Yes
VST2	Yes

10.7.1.2 O3A Injector - O2A

Host Type	Support
AAX	Yes
VST2	Yes

10.7.2 Audio

10.7.2.1 O3A Injector - O1A

	Channels	Content
Input	4	O1A
Output	16	O3A

10.7.2.2 O3A Injector - O2A

	Channels	Content
Input	9	O2A
Output	16	O3A

10.7.3 Description

These simple plugins take a lower resolution first order (O1A) or second order (O2A) mix and convert it to a third order (O3A) 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 third order include the O3A Injector - First Order plugin from the O3A Upmixers pack and the O3A 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.

11 O3A Core - Virtual Microphones

11.1 O3A Beamer
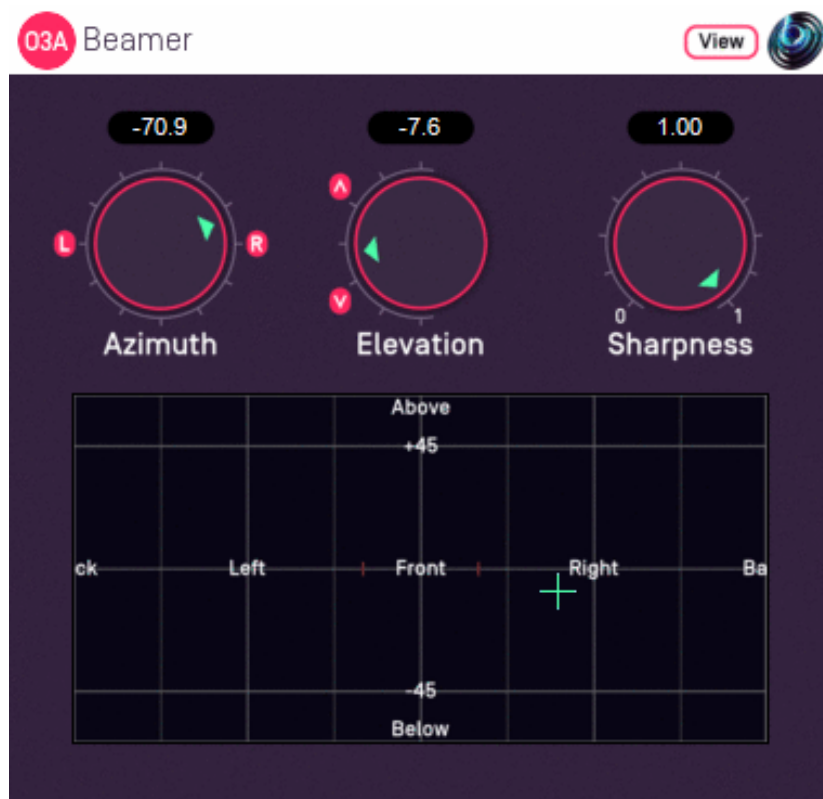
11.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

11.1.2 Audio

	Channels	Content
Input	16	O3A
Output	1	Mono

11.1.3 Controls

- Azimuth
- Elevation
- Sharpness

11.1.4 Description

The O3A Beamer extracts sound in a particular "beam" direction from a 3D O3A 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 O3A 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 O3A mix, you may also wish to read about the O3A Virtual Microphone.

11.1.5 View Support

When used with O3A View Sync from the O3A 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.
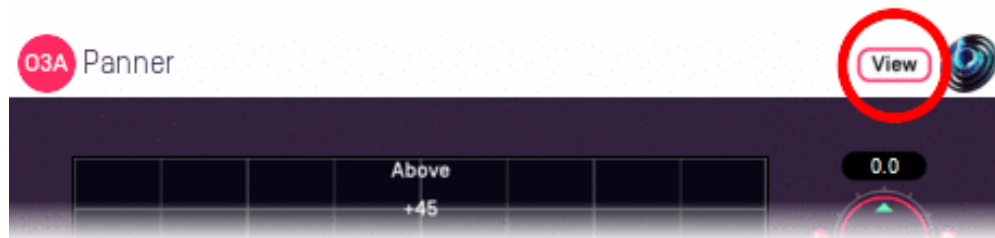
When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

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.

11.1.6 Controls

11.1.6.1 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.

11.1.6.2 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.

11.2 O3A Virtual Microphone
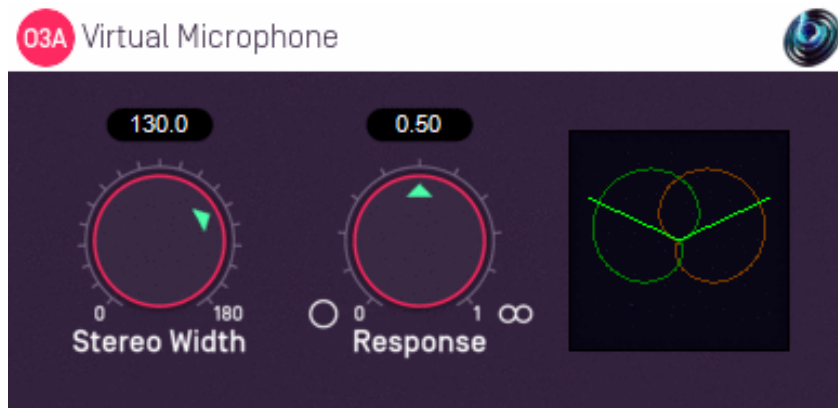
11.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

11.2.2 Audio

	Channels	Content
Input	16	O3A
Output	2	Stereo

11.2.3 Controls

- Stereo Width
- Response

11.2.4 Description

The O3A Virtual Microphone extracts a stereo image from a 3D O3A 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 O3A Rotation or O3A 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 O3A Decoder - Stereo.

If you are interested in extracting sounds in particular directions from an O3A mix, you may also be interested in the sharper response of the O3A Beamer plugin.

11.2.5 Controls

11.2.5.1 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.

11.2.5.2 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

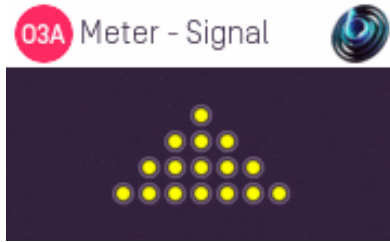For instance, 1.00 (figure-of-eight) should be used for Blumlein X-Y.

11.2.6 Presets

Presets are available for this plugin:

- Cardioids 130
- Cardioids 90
- Blumlein X/Y

12 O3A Core - Metering

12.1 O3A Meter - Signal

12.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

12.1.2 Audio

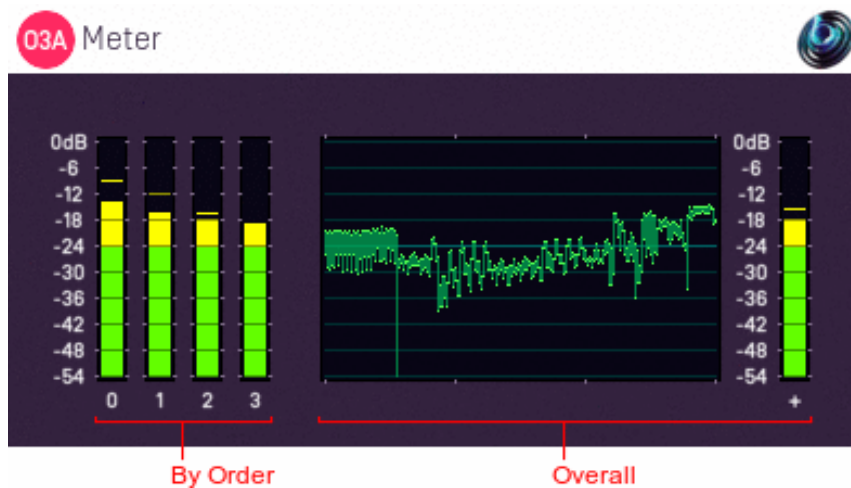|	Channels	Content
Input	16	O3A
Output	16	O3A

12.1.3 Description

This extremely simple plugin measures the signal peak in each of the 16 channels of an O3A 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.

12.1.3.1 Meters

Lights are shown for each of the 16 channels in O3A. 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 O3A, 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 16 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 16, and this plugin will usually make that obvious.

12.2 O3A Meter

12.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

12.2.2 Audio

	Channels	Content
Input	16	O3A
Output	16	O3A

12.2.3 Description

This plugin measures the sound level in an O3A stream. A breakdown by ambisonic order is provided, along with a history graph and the current overall level. Audio is passed through unchanged.

12.2.3.1 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. History min/max graph of overall level (all 16 channels).
6. Bar meter showing the overall current and peak level (all 16 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 O3A Meter - Karma plugin from the O3A Decoding

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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.

13 O3A Core - Soundfield Modification

13.1 O3A Gain
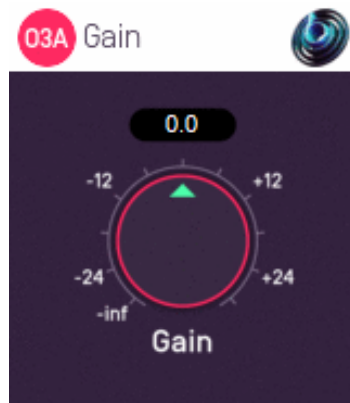
13.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

13.1.2 Audio

	Channels	Content
Input	16	O3A
Output	16	O3A

13.1.3 Controls

- Gain

13.1.4 Description

This trivial plugin applies a gain to the O3A stream. All channels of the stream are affected equally.

13.1.5 Controls

13.1.5.1 Control: Gain

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

13.2 O3A Spatial Delay

13.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

13.2.2 Audio

	Channels	Content
Input	16	O3A
Output	16	O3A

13.2.3 Controls

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

13.2.4 Description

This plugin delays a third order ambisonic (O3A) 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 O3A Rotation plugin and can be controlled by an external View application. The reflection, rotation and low pass filter appear *within*
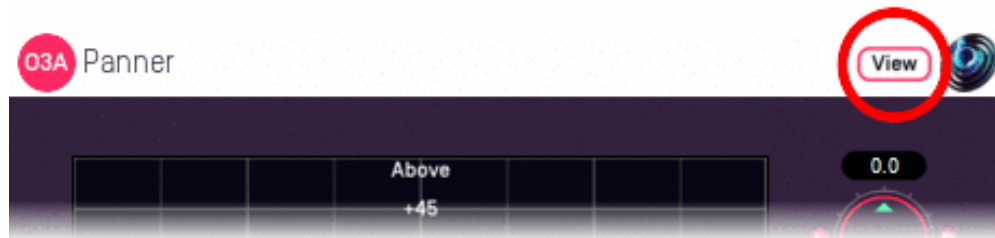
the feedback loop. The wet gain does not, applying only to the final output.

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

13.2.5 View Support

When used with O3A View Sync from the O3A 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.	The scene orientation is shown using a floating cube with matching marker beams on the cube and VR controllers.
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.	Rotate a VR controller into the chosen orientation and hold the trigger to set the four rotation controls. Full 3DOF is supported.

13.2.6 Controls

13.2.6.1 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.

13.2.6.2 Controls: Dry Gain and Wet Gain

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

13.2.6.3 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.

13.2.6.4 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.

13.2.6.5 Control: Reflection

This can be used to apply a fixed spatial reflection to the O3A 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.

13.2.6.6 Controls: Pitch, Roll and Yaw

A scene rotation is applied to the delayed O3A scene, in a similar way to the rotation used by the O3A 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.

13.2.6.7 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).

13.2.6.8 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.

14 Appendix: O3A Streams

14.1 What is an O3A Stream?

A third order ambisonic (O3A) stream is made up of 16 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 16 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 12 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 O3A stream, we find that it is normally best to use an O3A Visualiser or O3A Flare plugin.

14.2 What processing can I apply to an O3A stream?

As well as processing designed specifically for O3A 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 16 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 O3A stream with a conventional mono DSP algorithm you *must apply the same processing to all 16 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.

14.3 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.

14.4 How does O3A 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 O3A Core pack includes plugins to do this: O3A Decoder - FuMa and O3A Injector - FuMa.

14.5 Why Third Order?

These plugins are based on Higher Order Ambisonic (HOA) techniques, which in principle can run at any "order" of spatial detail. We could have made all these plugins work at different orders; once you have got as far as making the maths and DSP work at third order (16 channels) it is not hard to extend to (for instance) fifth order (36 channels). We decided to use third order as it provides a good balance between spatial detail, current practice and CPU load. And sticking to just one type of B-Format avoids all sorts of "wiring" headaches!

That said, if you have a serious need for even higher order algorithms, please get in touch.