Virtual Mix Room

User Guide

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Chapter 1 – Introduction

1.1 Welcome

Thank you for choosing Waves. In order to get the most out of your Waves processor, please take the time to read through this manual.

We also suggest you become familiar with www.waves.com/support. There you will find an extensive answer base, the latest tech specs, detailed installation guides, new software updates, and current information on licensing and registration.

By signing up at www.waves.com, you will receive personalized information on your registered products, reminders when updates are available, and more.

1.2 Product Overview

The Waves Nx Virtual Mix Room plugin is a virtual monitoring tool that allows you to hear the ideal acoustics of a high-end mix room – inside your headphones.

When you monitor on headphones, Nx allows you to experience your mix in the spatial context of a highly optimized studio control room, with either a stereo or a surround speaker configuration. It lets you judge mix depth, panning, stereo image, balance and reverb with confidence, giving you an accurate representation of how your headphone mix will translate to speakers. Paired with your favorite headphone set, it will provide you a good and reliable reference point for your mix.

Nx is a binaural processing plugin. It uses state-of-the-art mathematical modeling of human psychoacoustics to achieve a natural, immersive and transparent spatial sound over headphones. For enhanced realism, Nx can also track your head movements in real time.

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1.3 Components

Nx has several components to support different input channel settings: mono, stereo, 5.0, 5.1, 7.1 surround and Ambisonics B-format (1st order AmbiX). The output of Nx is always a binaural stereo signal containing all the mix channels in their virtual positions, and playing to the L and R channels of your headphones:

Each of the surround components, as well as the Ambisonics component, has two versions – one with the same number of input and output channels (though only the L and R outputs are playing audio), and one with only two output channels:

Nx contains these components:

- Mono to Stereo
- Stereo to Stereo
- 5.0 to Stereo
- 5.0 to 5.0 (only L and R outputs play audio)
- 5.1 to Stereo
- 5.1 to 5.1 (only L and R outputs play audio)
- 7.1 to Stereo
- 7.1 to 7.1 (only L and R outputs play audio)
- 1st order AmbiX Ambisonics-to-Stereo (on Quad channels)
- 1st order AmbiX Ambisonics-to-Quad (on Quad channels, only L and R outputs play)

See Appendix A at the end of this user guide for more information on the inputs/outputs of the surround components.

Chapter 2 – Quick Start Guide

1. Since Nx is a monitoring-only plugin, insert only <u>one</u> instance of NX plugin on your master buss (not on individual tracks). Make sure that the plugin is bypassed when you later bounce the mix.

2. Open the plugin, and the head tracking application will automatically open as well. This application can use your computer's camera or the Nx Head Tracker to track your head movements. The application will automatically initiate the camera tracking, scan for Nx Head Tracker device/s, and connect to them if any are found. The plugin will automatically detect that the camera or the Nx Head Tracker is active and connect to it. You can also select manually which one to work with. (Please refer to chapter 4 for more details on the head tracking application.)

   Basic instructions for good camera tracking:
   (a) Make sure there is enough light in the room to enable a tracking rate of at least 20 frames per second. Webcams generally have a tracking rate of up to 30 fps. The optimal rate is anywhere between 25 and 30 fps.
   (b) Be no more than 5-6 feet away from the camera (optimal distance varies by camera)
   (c) Move no further than 30 degrees left or right relative to the camera.

   Basic instructions for connecting an Nx Head Tracker:
   (a) Have your system's Bluetooth turned on.
   (b) Open the Nx Virtual Mix Room plugin.
   (c) Power up the Nx Head Tracker:
   Mac: The head tracking application will automatically connect to the Nx Head Tracker.
   Windows: Pair the Nx Head Tracker in your system's Bluetooth settings. The head tracking application will then automatically connect to the Nx Head Tracker.
   (d) Select the Nx Head Tracker in the Tracking Device menu of the Nx Virtual Mix Room plugin.
   (e) Mount the Nx Head Tracker on the top of the headphone arc with the logo side facing forward. L and R on the Nx Head Tracker device should correspond to L and R on your headphones. Inaccurate positioning of the Nx Head Tracker will result in inaccurate head tracking.

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3. Now move your head around, and see the virtual head in the GUI of the Nx Virtual Mix Room move in sync with you. Note that in many DAWs, you will need to play audio first in order for the virtual head to start moving.

4. Decide where you want to be located, and press the Sweet Spot button in the Head Tracking section, on the left side of the Nx plugin interface. This will now be your center position in the Virtual Mix Room.

5. Listen to the audio you're playing. Take a few minutes to let your ears adjust to the effect. Listen to a good reference you're familiar with.

   The default values of the plugin's controls are a good place to start. We recommend you wait a bit before you start playing with the Room Ambience and Speaker Position knobs.

6. To get the most out of Nx, it is highly recommended that you set the values in the Head Modeling section to your own individual head measurements. For detailed information on how to do this and why, read below.

   If you choose not to enter your individual head measurements, it is recommended that you stick with the default values, which are the average for the human population. Radical departures from the recommended values will seriously distort the effect.

7. A tip on using Nx for surround monitoring on your regular headphones:

   Each Nx surround option (5.0, 5.1, 7.1) has two different versions – surround-to-surround and surround-to-stereo. For example, when you open Nx on a 5.1 surround session, you can either choose either regular 5.1 component, or the 5.1-to-Stereo component.

   If you just want to route surround audio to your stereo headphones, the simplest way to do this is to choose the surround-to-stereo component (5.1-to-Stereo or 5.0-to-Stereo).

   If you do not want to change the routing settings of your existing session, use the surround-to-surround component (5.1-to-5.1 or 5.0-to-5.0). You will then need to route the L and R channels to your headphones, either from the I/O settings of your DAW or from an external patch.

Chapter 3 – Interface and Controls

3.1 Interface

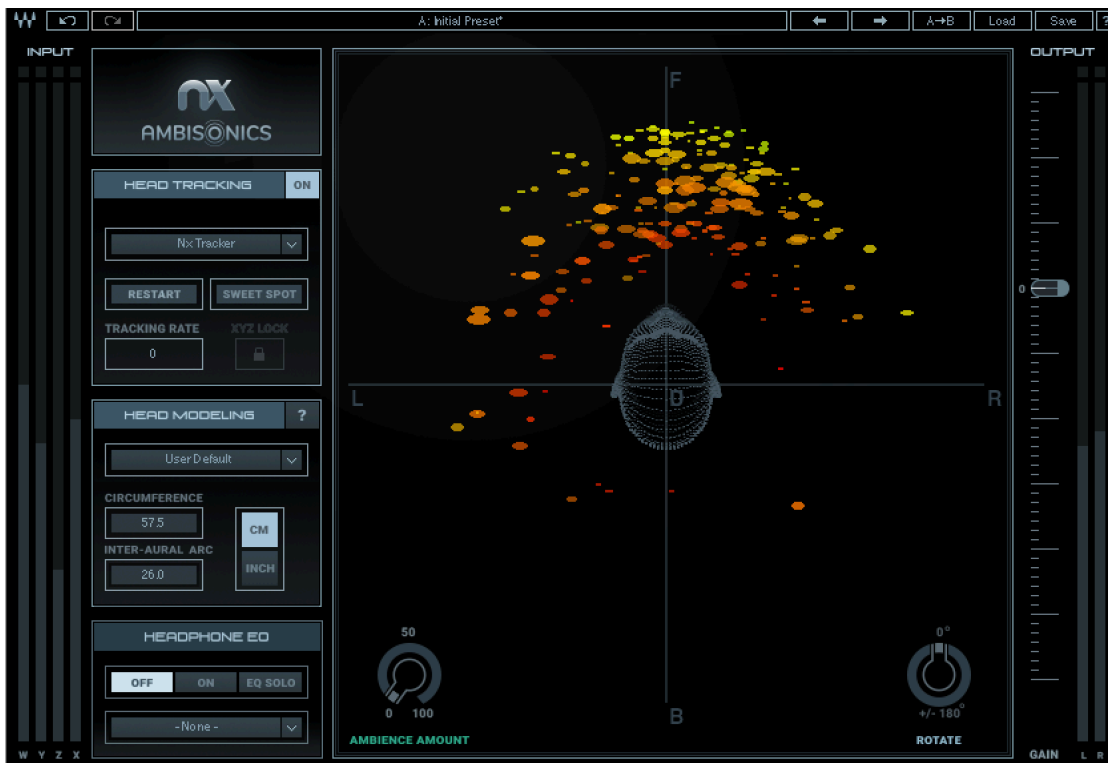### 7.1 Surround Component

5.1 Surround Component

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5.0 Surround Component

Stereo Component

Mono Component

Ambisonics 1ˢᵗ order AmbiX Component

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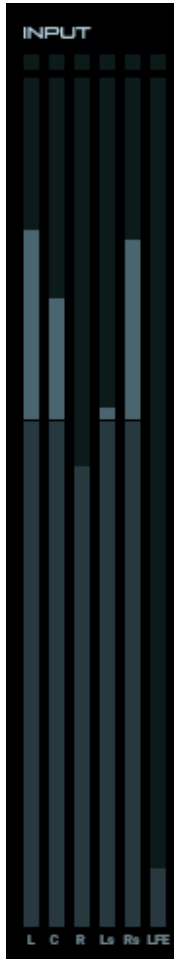
3.2 Controls

INPUT METERS

These meters indicate your input levels. The number of meters varies according to the Nx component you are using: mono, stereo, 5.0, 5.1, 7.1 or Ambisonics.

Nx 5.1 Surround   **Nx Stereo**   **Nx Ambisonics**

The format of the component is reflected in the number of input meter channels, as show here.
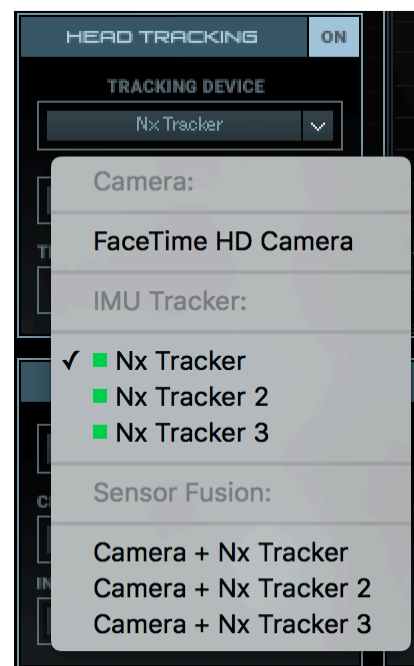
HEAD TRACKING

Use this section to control the head tracking application that works in conjunction with the Nx plugin.

TRACKING ON/OFF – Toggles the head tracking on and off. In off mode, the simulated image returns to the center position without tracking the listener's real-world location.

TRACKING DEVICE – Here you can select one of several tracking device options to use:

- **Camera** – Use the camera for head tracking.
- **Nx Head Tracker** – Use an Nx Head Tracker (selectable when an Nx Head Tracker device is available).
- **Sensor Fusion** – Use the camera and one of the available Nx Head Trackers together. In this mode, the Nx Head Tracker's speed and increased accuracy are combined with the camera's ability to track your head along the X,Y,Z axes, and the total tracking rate is increased to up to 80 fps, giving you the best of both worlds.
  Please note: The Sensor Fusion mode can be used by only one person at a time: that is, the camera must be aimed at the same person wearing the Nx Head Tracker.

You can have several instances of the Nx Virtual Mix Room plugin with a different tracking device for each instance. This will enable you to have several Nx listeners with individual head tracking for each in the same session. Note that each Nx Virtual Mix Room plugin needs to be routed to a separate headphone output per listener; a simple headphone split will not work for this use case.

RESTART – Clicking this button restarts the head tracking application. Use it to reopen the head tracking application in case it has been closed, or restart the application in case it is not functioning correctly.

SWEET SPOT – Clicking this button tells the head tracking application to refer to your head position at the moment of clicking as your center position, or your "sweet spot."

Each time you start the system or change either your position or the camera's, you can reset your sweet spot. Hold your head centered, look straight forward, and click the button to let the system know where your sweet spot is.

The Sweet Spot button will blink until you click it once and set your sweet spot – just a reminder!

TRACKING RATE – Indicates the rate of head tracking in frames per second (fps). The optimal rate is:
Camera: 25-30 fps
Nx Head Tracker: 35-50 fps
Sensor Fusion: 45-80 fps

XYZ LOCK (mono, stereo, and surround components) – Locks the movement of the virtual head on the XYZ axes (left/right, forward/back, up/down). When this button is pressed, Nx will represent only your head rotations. This means you will remain in the virtual "sweet spot" even if you move sideways, forward/back, or up/down. XYZ Lock applies only to Camera Tracking, since Nx Head Tracker does not track motion on the X, Y, or Z axes

## VIRTUAL MIX ROOM WINDOW (Mono, Stereo, and Surround)
This Virtual Mix Room window represents your head movements and the position of the virtual speakers. When head tracking is on, you will see the virtual head moving in coordination with your actual head movements.

Double-clicking a speaker icon will mute and unmute it. The icon will become darker when the speaker is muted. Speakers are unmuted be default.
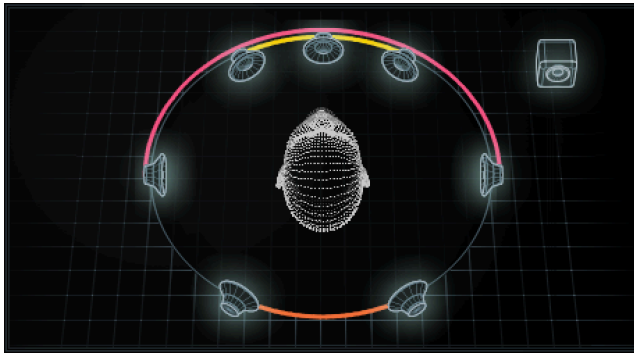
Clicking-and-dragging one of the L or R speakers will symmetrically change the width of the speakers' spread, also affecting the Speaker Position knob below the head position graph.
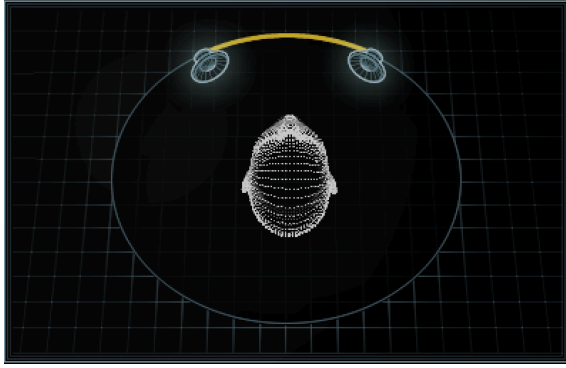
Virtual Mix Room – Stereo
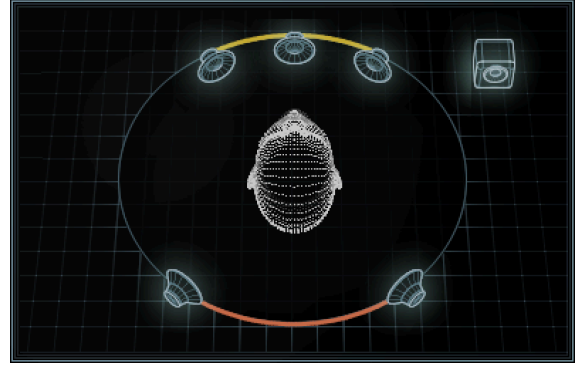
Virtual Mix Room – 5.1 Surround

Virtual Mix Room – 7.1 Surround

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VIRTUAL MIX ROOM WINDOW (Ambisonics Component)

Ambisonics is a four-channel format that is capable of recording and reproducing a full 360° sphere of sound around the listener. This format is commonly used for VR and 360 video experiences.

The Nx Ambisonics component has a four-channel quad input. It's input channels are not used in the traditional quad configuration L,R,Ls,Rs. Instead they are used for streaming Ambisonics audio (W,Y,Z,X) in to the plugin. The plugin supports first–order Ambisonics in the AmbiX format.

The Nx Ambisonics component will decode the incoming Ambisonics channels and process them in to binaural stream for headphone monitoring.

In the Virtual Mix Room Window, you will see, instead of speakers, a spatial meter with colored dots representing the direction of sounds in the Ambisonics channels. The different colors represent different frequencies:
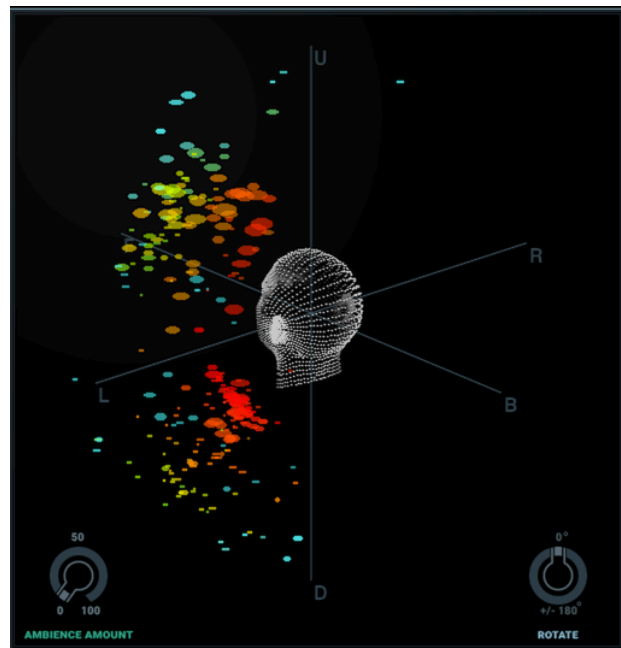
Red: Lows

Orange: Low Mids
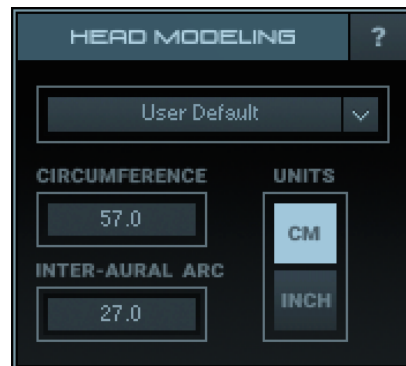
Yellow: High Mids

Light Blue: Highs

Click and drag on the meter to can change the view perspective. This helps you understand the 3D positioning of the sounds.

Alt+Click resets the view to the default top view

HEAD MODELING

Here you can personalize the psychoacoustic effect of Nx by entering your individual head measurements – your head circumference, and the semi-circumference from ear to ear over the back of your head. Nx is a binaural effect, so it factors these parameters to calculate the inter-aural delays, filters and gains for each ear. These are used to approximate your individual Head-Related Transfer Function (HRTF). The default settings are based on average data for the adult human population, but because these parameters can vary widely between individuals, it is advised to adjust them to your personal dimensions. This will ensure optimal experience with Nx.

Please note: Entering values completely unrelated to your personal head measurements will heavily distort the effect. If you do not enter your individual measurements, it is advised that you use the default values.

CIRCUMFERENCE – Enter your head circumference in either centimeters or inches. To find your head circumference, use a measuring tape to measure the longest distance around your head – over the back of the head, around your ears and around your eyebrows.
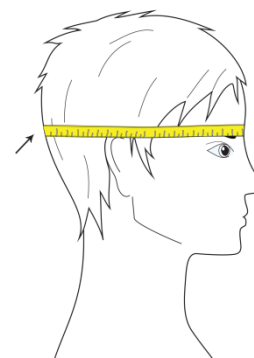
Default: 55 cm / 21.6 in (average for the adult human population)
Range: 35 to 75 cm / 13.8 to 29.5 in

INTER-AURAL ARC – Enter your inter-aural arc : the distance from ear to ear around the back of your head, on a horizontal plane parallel to the floor.
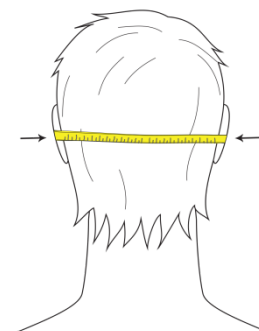
Default: 25 cm / 9.8 in (average for the adult human population)
Range: 15 cm to 40 cm / 5.9 to 15.8 in

UNITS – Choose whether to enter your head measurements in centimeters or inches.

USER/FACTORY DEFAULT –

When you first use the plugin, it loads with generic default values (see above). You can also save your own head measurements as presets by clicking on the arrow at the right-hand side of this control.
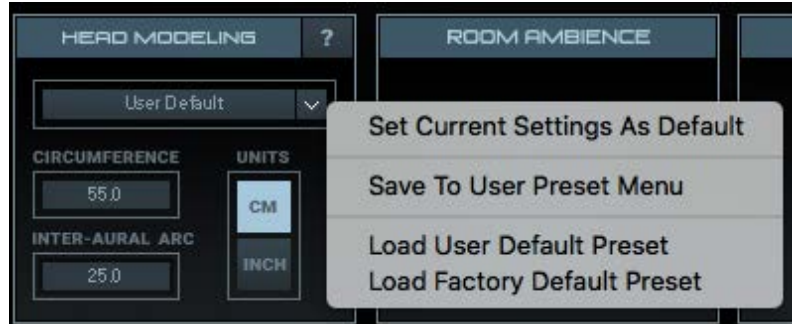
Save as many user presets as you want, and select one of them to be your User Default.

Please note: The parameters in this section are completely separate from the main presets that are accessible from the Top Toolbar. They are saved and loaded under a dedicated preset system that is only accessible through the drop-down menu at the top of the Head Modeling section.

"?" help button – Clicking the "?" button will open a help tab with information on how to measure the above parameters. The "?" help button will blink as long as you do not enter your individual head measurements or open the plugin with User Default in place.

ROOM AMBIENCE

Determines the amount of room ambience, that is, the amount of simulated reflections added to the signal.

AMOUNT – Increasing the amount of room ambience increases your sense of distance from the source. Decreasing the amount results in a more focused sound.
Range: 0 (off) to 100
Default: 17
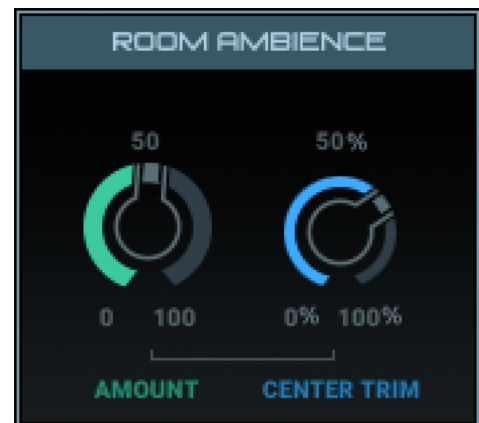
CENTER TRIM (Surround components only) – Allows you to reduce room ambience from the Center speaker only. This is useful in situations where you want spatial sound for the L, R and rear speakers but a more focused sound for elements in the Center, such as dialogue.

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Range: 0% (off) to 100% (equal amount as the other speakers)

Default: 100%

SPEAKER POSITION

This section lets you control the position of the speakers in the Virtual Mix Room. The Mono component has only one Speaker Position knob – Rotate. The Stereo component also has a Front knob for controlling the width of the L and R spread. The Surround components have an additional Rear knob for controlling the width of the rear L and R spread.

FRONT (Stereo and Surround components only) – Controls the spread of the front speakers, ranging from 0 degrees (all speakers directly in front of you) to 180 degrees (L and R speakers extending all the way to your left and to your right). The default is 60 degrees, where the L and R speakers form an equilateral triangle with your head. Normally when you mix for stereo, this will be the ideal position

Range: 0° to 180°

Default: 60° (recommended for stereo mixing)

REAR (Surround components only) – Controls the spread of the rear speakers.

Range: 0° to 180°

Default: 5.1 component = 90°

       7.1 component = 60°

       (both within ITU standards)

SIDE (7.1 components only) – Controls the spread of the side speakers.

Range: 0° to 360°

Default: 180° (ITU standard)

ROTATE – This continuous cyclic knob rotates the entire room around you.

Range: -180° to +180°

Default: 0°

In the surround components, all default speaker positions are set according to the ITU standard.

OUTPUT METERS

No matter which Nx component you are using, you will always see two output meters, representing the binaural sound as it reaches the L and R channels of your headphones.

Range: -24 dB to 12 dB
Default: 0 dB

Please note: Nx can introduce clipping at the output even when fed with a signal whose levels are controlled by a limiter. In such cases, use the output gain fader to reduce the output.

HEADPHONE EQ

The Headphone EQ section provides EQ correction curves for specific headphone models. These curves are based on precision headphone measurement data provided by www.headphone.com. The Nx EQ curves are designed to correct model-specific irregularities in the frequency response of the of headphones. This results in a more transparent starting point for monitoring and mixing.

Use this feature only if you are working with one of the specific headphone models provided in the menu. Otherwise, we recommend that you leave it off.
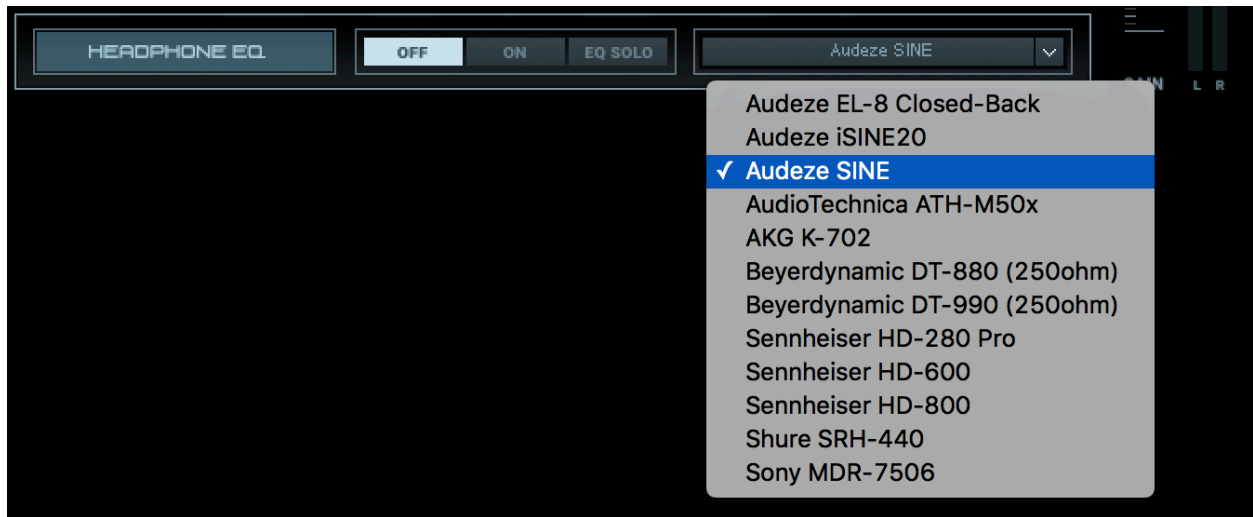
SELECT MENU – Select a correction curve for a specific headphone model.

**OFF** (default) **–** Turns the headphone EQ section off.

ON – Turns the headphone EQ section on. This engages EQ correction curve processing for the selected headphone model.

EQ SOLO – Bypasses all spatial binaural processing, leaving active only the EQ correction. Use this if you are interested in hearing the signal with EQ correction only, without any additional Nx processing.

Chapter 4 – The Head Tracking Application

All head tracking (whether using the camera or the Nx Head Tracker device) is managed by a dedicated head tracking application. The application opens and closes automatically when you open and close the Nx Virtual Mix Room plugin. To enable head tracking, the application needs to stay open as long as you are working with the plugin. If the application is closed, head tracking will stop. This will not affect the plugin itself or your DAW in any way: you can simply restart the head tracking application and re-establish the head tracking. By default, the application will open with camera tracking turned on and with the "Automatically Connect" preference selected in the Bluetooth tab.

4.1 Camera Tab
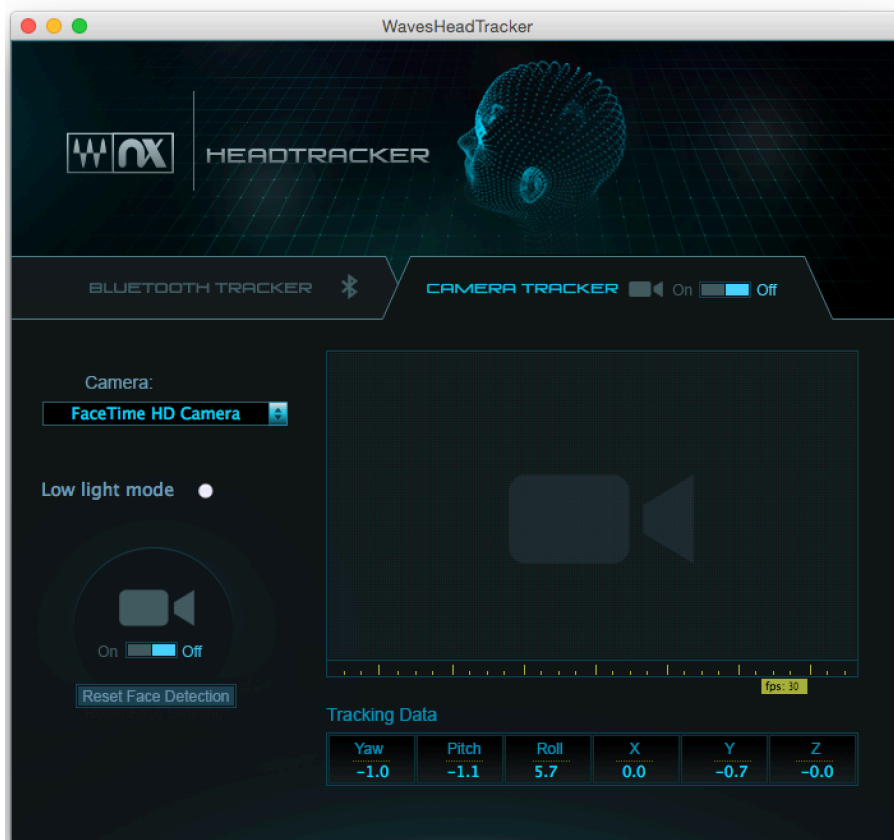
- **On/Off** switch – This will let you turn the camera tracking on for tracking, or off to save on CPU resources.
- **Camera** menu – Choose a camera to track with if you have more than one connected to the computer.
- **Reset Face Detection -** This control will reset the face detection algorithm. It is advised to press the "Reset Face Detection" button whenever you change users or if you suspect that the tracking sensor is not tracking you optimally.
- **Low Light Mode –** This control is available only when you are working with a "FaceTime HD" camera built in to some Mac computers. This mode will darken the picture and increase the fps in poor lighting conditions.

4.2 Bluetooth Tracker Tab

- **Device List –** This list shows all available Nx Head Tracker devices, and indicates their status (Connected, Disconnected, Connecting, Unavailable). Up to 7 Nx Head Tracker devices can be detected and connected simultaneously.

- **Connect (check box) – Check or uncheck this box in order** to connect or disconnect an Nx Head Tracker device that appears in the device list.

- **Refresh Device List –** This control will erase the list and rescan for Nx Head Tracker devices.

- **Automatic Connect –** This control is On by default. When On, the application will create a connection automatically with any Nx Head Tracker device it detects. When Off, the application will automatically detect Nx Head Tracker devices and add them to the list, but the user will have to initiate the connection using the connect button in the list. It is advised to select Off when there are several available Nx Tackers on different systems, in order to have better control of which system works with each Nx Head Tracker.

- **Open Bluetooth Settings** (Windows only) – This will open the system Bluetooth settings window. In Windows, you must first pair the Nx Head Tracker in your system's Bluetooth settings before the head tracking application can detect it.

- **Rename –** This lets you rename your Nx Head Tracker device. Renaming is permanent. The device will advertise itself with the new user-defined name.
  1. Click the "Rename" button. A text box will open.
  2. Enter a new name for the Nx Tracker device, up to 15 characters, and click OK.
  The device will restart itself and reconnect automatically with the new user-defined name. This process can take up to 20 seconds to complete.

- **Identify –** This control will make the Nx Head Tracker device blink white. This is helpful to identify a certain device among several.

- **Update –** This initiates firmware updates to the Nx Head Tracker device. A message in red text will appear when a firmware update is available.
  1. If a firmware update is available, click "Update." A dialogue box will open; follow its instructions to complete the update procedure."
  2. When using Windows, you will first need to pair a secondary device called "Nx Update" (in the Bluetooth settings menu) before proceeding with the update.

4.3 Connecting the Nx Head Tracker

Mac:

1. Open the Nx Virtual Mix Room plugin.
2. Got to the Bluetooth tab in the head tracking application.
3. Power on the Nx Head Tracker. Make sure your computer's Bluetooth is on and that it supports BLE (Bluetooth Low Energy).
4. The Nx Head Tracker device will automatically be recognized and added to the list of devices. Mark the Connect check box. See the numbers under Tracking Data start to change as the Nx Head Tracker moves.
5. In the Nx Virtual Mix Room plugin, under the Tracking Device menu, select the Nx Head Tracker. The head in the plugin will start to move according to the Nx Head Tracker.
6. Connect the Nx Head Tracker to the top-center of the headphone arc, with the Nx logo facing forward (the L and R icons at the sides of the Nx Head Tracker device should correspond to the L and R of your headphones). Inaccurate positioning of the Nx Head Tracker will result in inaccurate head tracking.

Windows

1. Open the Nx Head Tracker plugin.
2. Go to the Bluetooth tab in the head tracking application.
3. Power on the Nx Head Tracker. Make sure your computer's Bluetooth is on and that it supports BLE (Bluetooth Low Energy).
4. Open your computer's Bluetooth settings and pair it with the Nx Head Tracker. Once paired, the Nx Head Tracker device will automatically be recognized and added to the list of devices. Mark the Connect check box. See the numbers under Tracking Data start to change as the Nx Head Tracker moves.
5. In the Nx Virtual Mix Room plugin, in the Tracking Device menu, select the Nx Head Tracker. The head in the plugin will start to move according to the Nx Head Tracker.
6. Connect the Nx Head Tracker to the top-center of the headphone arc, with the Nx logo facing forward (the L and R icons at the sides of the Nx Head Tracker device should correspond to the L and R of your headphones). Inaccurate positioning of the Nx Head Tracker will result in inaccurate head tracking.

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Appendix A – Inputs/Outputs in the Surround Components

5.0 Surround Component – 5 inputs / 2 outputs

Input 1 – Left mix channel

Input 2 – Center mix channel

Input 3 – Right mix channel

Input 4 – Left surround channel

Input 5 – Right surround channel

Output 1 - Left headphone channel

Output 3 – Right headphone channel

Outputs 2/4/5 – No audio

* Note: output channels may vary according to the host's surround channel configuration

5.1 Surround Component – 6 inputs / 2 outputs

Input 1 – Left mix channel

Input 2 – Center mix channel

Input 3 – Right mix channel

Input 4 – Left surround channel

Input 5 – Right surround channel

Input 6 – Subwoofer speaker channel (post-bass management)

Output 1 - Left headphone channel

Output 3 – Right headphone channel

Outputs 2/4/5/6 – No audio

* Note: output channels may vary according to the host's surround channel configuration

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7.1 Surround Component – 8 inputs / 2 outputs

Input 1 – Left mix channel

Input 2 – Center mix channel

Input 3 – Right mix channel

Input 4 – Left surround channel

Input 5 – Right surround channel

Input 6 – Left surround rear channel

Input 7 – Right surround rear channel

Input 8 – Subwoofer speaker channel (post-bass management)

Output 1 - Left headphone channel

Output 3 – Right headphone channel

Outputs 2/4/5/6/7/8 – No audio

Ambisonics Component (1st order AmbiX) – 4 inputs / 2 outputs

Input 1 – W channel

Input 2 – Y channel

Input 3 – Z Channel

Input 4 – X Channel

Output 1 - Left headphone channel

Output 2 – Right headphone channel

* Note: output channels may vary according to the host's surround channel configuration

Ambisonics Component (1st order AmbiX) – 4 inputs / 4 outputs

Input 1 – W channel

Input 2 – Y channel

Input 3 – Z Channel

Input 4 – X Channel

Output 1 – Left headphone channel

Output 2 – Right headphone channel

Outputs 3/4 – No audio

Appendix B – Troubleshooting Guide

Problem	Possible Solutions
Head does not move in GUI – no tracking	1. Verify head tracking is 'on' in plugin GUI. 2. Check if tracker app is running. 3. Play audio through the plugin (plugin on CPU). 4. Check tracking rate box in plugin GUI.
Head tracking application is not running	1. Restart head tracking through the plugin. 2. Inactivate/reactivate plugin.
Low tracking rate in the head tracking app (<20 fps) **(Camera)**	1. Improve lighting conditions. 2. In MacBook only, select "low light" mode in the tracker app. 3. Point the camera up slightly, for a brighter frame. 4. Make sure that your face is well lit and not shadowed
Low tracking rate in plugin GUI (<20 fps) **(Camera)**	1. Check the tracking rate in the head tracking app. 2. Verify audio buffer size is 1024 samples or lower.
Head tracking app often loses track of your head **(Camera)**	1. Position the camera closer and straight in front of your face. 2. Remove sunglasses, hat or anything covering your face. 3. Improve lighting conditions. 4. Stay within +/-30 degrees off the center of the camera. 5. Make sure you're no further than 5-6 feet away from camera.
Nx Head Tracker will not connect	1. Make sure your computer's Bluetooth is turned on 2. Make sure your computer's Bluetooth is at least BT4.0 and supports BLE. 3. Make sure the head tracking application is running 4. Make sure the Nx Head Tracker device is on and with a good battery. 5. Windows only – Make sure the Nx Head Tracker is paired to your computer in the system Bluetooth settings menu.
Nx Head Tracker loses connection and doesn't move smoothly	1. Try using a new battery. 2. Try to have the Nx Head Tracker and the Bluetooth receiver closer together. 3. If you are using a BT-USB dongle on a desktop, connect the dongle on the front panel, or on an extension for better BT reception.
Nx Head Tracker is tracking my movements but in wrong directions	1. Make sure the Nx Head Tracker is mounted on the top of the headphone arc with the logo side facing forward (t L & R on the Nx Head Tracker should correspond to L & R on your headphones). Inaccurate positioning of the Nx Head Tracker will result in inaccurate head tracking.

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Audio is not externalized enough, the virtual positions are not clear	1. Verify your headphones' L/R placement and routing. 2. Verify that Nx is inserted at the last summing buss in the signal flow, with no other channels bypassing it. 3. Verify that head tracking is working. 4. Set the Sweet Spot. 5. Increase the room ambience. 6. Mute/unmute individual virtual speakers by double-clicking on them and listening to their position. 7. Measure and set your personal Head Modeling parameters. 8. Make sure the head modeling section is set to your individual measurements or to the factory default settings. Unreasonable head size settings can ruin the spatial effect.
No communication between the head tracking app and the plugin	1. Close the head tracking app, inactivate and reactivate the plugin.
Head tracking shows some latency	1. Try to increase the tracking rate, optimally up to 30 fps. 2. Try to lower the buffer size. 3. In some DAWs, to run in the user-set buffer size, Nx need to be on the master buss or on a live input AUX path.