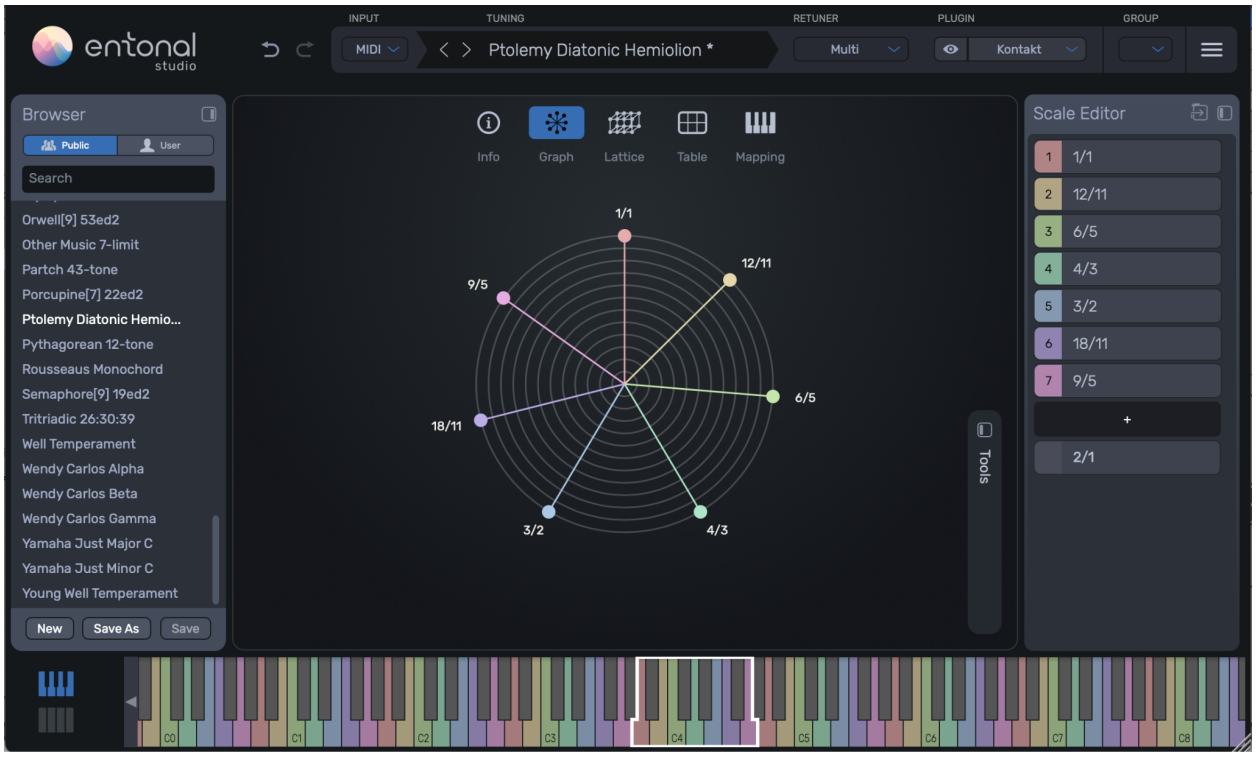
nodeaudio

entonal studio



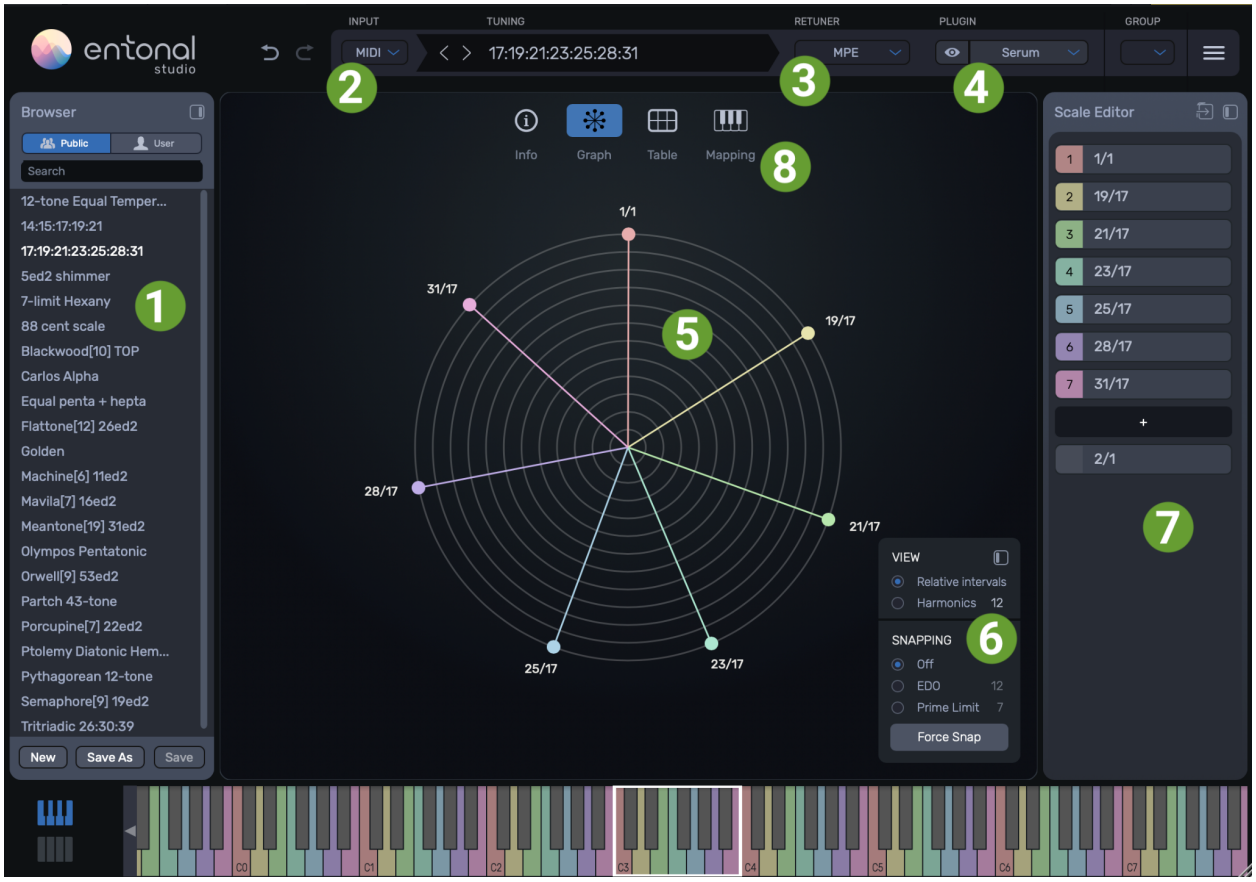
User Manual

Version 1.1

Revision 2

Last Updated: 4th May 2023

Entonal Studio Quick Start



(1) Browser
Choose a tuning or temperament from the list to get started.
(Read more in the Browser section)

(2) Input
Select from MIDI or MPE input, and define the pitch bend range
(Read more in the Input section)

(3) Retuner
Output your tuning as MIDI (using pitchbend), MPE, Multichannel or MTS-ESP Master.
(Read more in the Retuner section)

(4) Plugin (output) [instrument version only]
Choose the Simple Synth or add a plugin of your own. Hosted synths will load within the Entonal Studio window if its window size is large enough. Otherwise they will appear in their own window. Use the eye icon to open the synth again if mislaid.
(Read more in the Output section)

Making it Work
If your chosen tuning doesn't seem to be playing on your destination instrument, a common solution is to ensure you have the correct **Retuner** type set in Entonal Studio, and that the instrument's input is also set accordingly. For example, you can't use the MPE Retuner mode with a synth that isn't MPE compatible.

(5) Radial Graph
Visualise the notes of your tuning, move spokes to retune a note. Snap spokes to ratios or custom equal divisions in the options panel **(6)**.
(Read more in the Radial Graph section)

(7) Scale Editor
Add new notes, enter exact note values.
(Read more in the Scale Editor section)

(8) Mapping Editor
Enter exact values for notes (as ratios, cents, EDO degrees and mathematical equations) Add new notes, define the repeating interval.
(Read more in the Mapping Editor section)

Entonal Studio Plugin Types

Entonal Studio comes in 8 flavours on a Mac, and 6 on Windows and Linux. Choose the most appropriate for your Digital Audio Workstation and use case.

For a unified instrument with plugin hosting:

- Entonal Studio VST
- Entonal Studio VST3
- Entonal Studio Audio Unit (Mac only)
- Entonal Studio Standalone

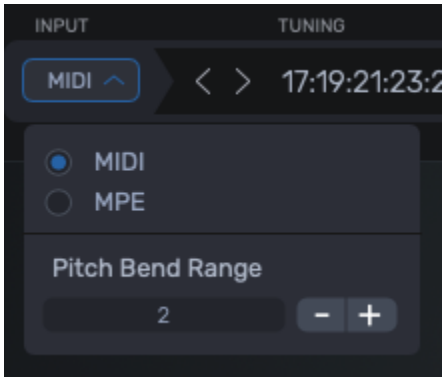
For processing MIDI before sending to an instrument:

- Entonal Studio MIDI Effect VST
- Entonal Studio MIDI Effect VST3
- Entonal Studio MIDI Effect Audio Unit (Mac only)
- Entonal Studio MIDI Effect Standalone

Input, Output, Retuner Types and Loading Plugins

Successful retuning in Entonal Studio requires the correct Input and Output types to be set.

Input



Input Type
The **Input** dropdown menu selection tells Entonal Studio the type of note data input to expect from your DAW or connected MIDI keyboard – standard **MIDI** or **MPE**.

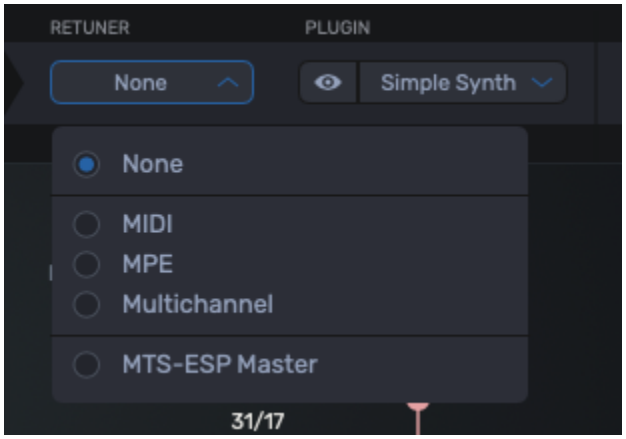
Input Pitch Bend Range
This option, in the same menu as the above, determines the amount of pitchbend your DAW or MIDI controller's pitchbend control will take over your scale's notes.

With this value, you set how many scale steps a full excursion of the input pitchbend control (up or down) will move each playing interval.

With non-equal tunings, Entonal Studio handles pitchbend based on scale steps, no matter how large or small the gap in frequency between the two notes. So with a MIDI Input set to a **Pitch Bend Range** of 2 (as is traditional), moving the pitchwheel exactly halfway will bend all playing notes to the next step of the scale – no matter how close or far that step is for different notes.

For example, holding two notes and pitchbending while using the preset scale 5ed2 Shimmer might result in one note bending by just 20 cents and the other note bending by 220 cents.

Retuner Type

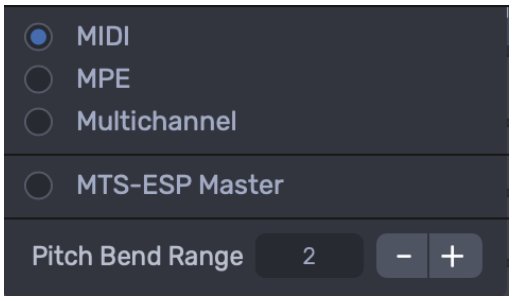


To the right of the toolbar is a dropdown menu labelled **RETUNER**. From this dropdown menu you can select the output signal of Entonal Studio. Choose from **MIDI**, **MPE**, **Multichannel**, **MTS-ESP Master** or **None**.

This selection should be chosen based on the capabilities of your destination synth or instrument, or its chosen input type. If Entonal Studio isn't retuning your instrument, this menu should be your first port of call when troubleshooting.

MIDI

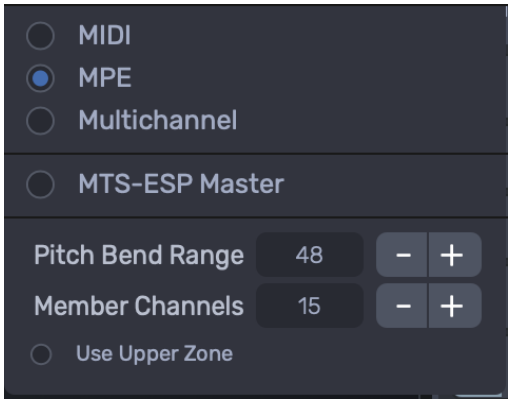
This setting should be used for instruments that do not support MPE. The instrument will be forced to be monophonic. This means it can work well for bass or lead sounds, but won't work if you want to play multiple notes at the same time.



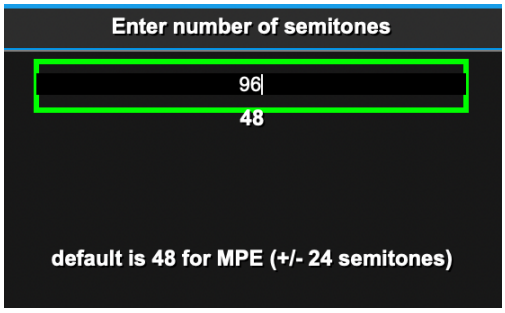
It's important to ensure that the pitch bend range matches the pitch bend range in your instrument.

MPE

This is the most common and flexible retuner type. It allows full polyphonic retuning, meaning you can play multiple notes at the same time while having each note tuned to your chosen scale. It requires that the instrument being tuned supports MPE, and that MPE is switched on the instrument.



Additionally, the MPE pitch bend range setting must match that in your instrument. Most MPE instruments have this set to +/-48 semitones, which is the default in Entonal Studio. However some plugins have this set to a different value, for example Serum defaults to +/-24 semitones.



Serum's MPE pitch bend range setting

Multichannel

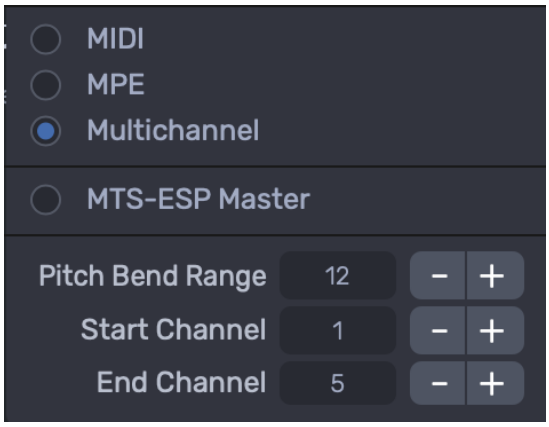
This setting is useful for multi-timbral instruments, i.e. those that support multiple "patches" or sounds that can be played in different MIDI channels. An example of such an instrument is Native Instruments' Kontakt.

With the example of Kontakt, you will need to create multiple instances of the same instrument within a rack. Each one will automatically be assigned a new MIDI channel. Let's say you want to be able to play up to 5 notes at a time (5 note polyphony). You would need to add 5 instances of your chosen instrument into your rack:

Kontakt will then automatically increment the MIDI channel number. Here we are looking at the last instance which is set to MIDI channel 5.

We then need to ensure that the pitchbend range matches that in Entonal Studio. You can check this by clicking on the "PB range" control in your Kontakt instrument.

Here we can see the range is +/-12 semitones. So we need to set this to be the same in Entonal Studio.

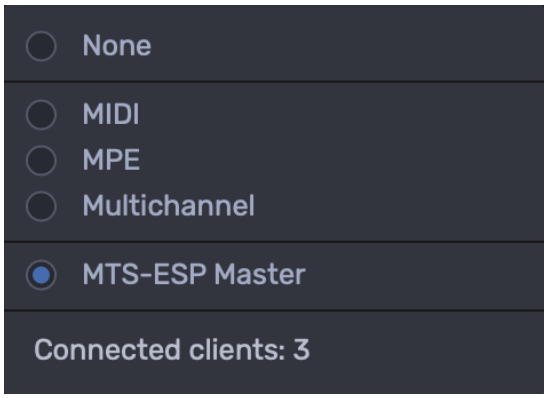


Here we have set the pitch bend range to 12.

We also need to ensure the start and end channels match our rack in Kontakt. In this case we are using channels 1 to 5. If this is not set correctly we will get missing notes when playing.

MTS-ESP Master

In MTS-ESP Master mode, Entonal Studio will transmit the current tuning to any plugin loaded in your DAW session that supports MTS-ESP. Therefore you do not need to have an instance of Entonal Studio for each instrument plugin you want to retune. Please note that the MIDI Effect version of Entonal Studio does not support MTS-ESP.



In order to use MTS-ESP retuning, load the instrument version of Entonal Studio onto one track in your DAW, and set the retuning mode to MTS-ESP Master.

You will then see the number of connected client plugins.

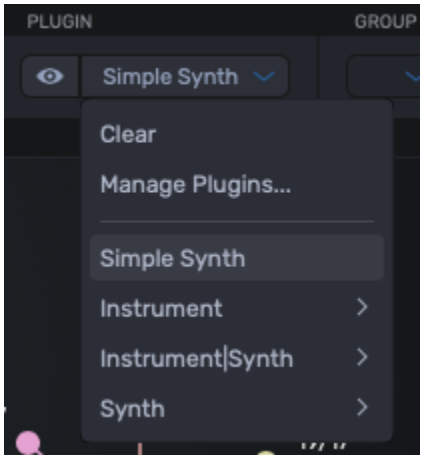
Entonal Studio will now be able to control the tuning of all the connected plugins.

There are two limitations when using MTS-ESP retuning:

1. It is not possible to see which note intervals are playing on connected client plugins.
2. There is only one global tuning. It is not possible to have more than one MTS-ESP tuning within a DAW project.

Output (Plugin menu)

Hosting and Displaying Plugins



On the very far right of the instrument version of Entonal Studio toolbar you can manage which synth is being hosted. You can use either the built in Simple Synth, or load a third party synthesiser. To view your currently loaded instrument click the  icon.

If the Entonal Studio window size is large enough, a selected plugin instrument will load within it. In order to access Entonal Studio once again, click the close button at the top right of the plugin window, or onto the greyed-out Entonal Studio window. If the Entonal Studio window size is too small when loading a particular plugin, it will load in a separate window.

You can detach a plugin hosted within Entonal Studio into its own window using the button in the top-right, and reattach it using the same button when in its own window (reattaching works when the Entonal Studio window size is large enough to house the plugin.

Manage Plugins

Entonal Studio can host third party virtual instruments allowing you to make any MIDI pitchbend or MPE-compatible instrument microtonal. To manage which instruments are available from within Entonal Studio, click the Plugin selector in the top right hand corner of the UI and select **Manage Plugins...** from the dropdown menu.

This will open a new window displaying every plugin you have installed on your device.

To load a specific instrument in Entonal, locate the instrument in this list and activate the instrument by clicking in the **Enabled** column. You can do this to as many instruments as you like.

With your desired instrument(s) enabled, close this window. Now when you open the Simple Synth drop down menu, all the instruments you enabled will be available for you to select.

Select the synth you would like to use, Entonal Studio is now hosting the plugin.

Simple Synth

Simple Synth is Entonal Studio's built-in single oscillator synthesizer. It comes with three waveshapes, a snappy ADSR envelope, tone control and even a simple delay unit.

Select the waveshape using the **Shape** dropdown menu. Choose from either Sine, Tri/Saw or Square. Find the ADSR envelope just below the **Shape** menu. Use the **Attack**, **Decay**, **Sustain** and **Release** of the envelope using the corresponding dials.

Turn the **Tone Control** dial clockwise to introduce harmonics into the sound. When the dial is set to 0.00 only the pure wave you have chosen with the oscillator will sound. Introduce delay into your Simple Synth patch with the Delay section. Set the **Feedback** and **Delay Time** with the corresponding sliders.

The **Volume** knob sets the overall level of your synth patch whilst the **Mix** knob controls the Dry/Wet balance of your patch. The wet signal is the part with the delay effect applied.. Setting the dial to 0.00 means only the dry signal will play and setting the dial to 1.00 means only the wet delay signal will play.

Views

You can quickly switch between the various workspaces in Entonal Studio using the buttons labelled **Info**, **Graph**, **Table, Lattice** and **Mapping** at the top of the main workspace

Info

The **Info** window displays information about the currently selected scale. Here you will find the scale's **name**, **description**, **author**, and both **radial graph** and **linear** visual representations of the scale with interval values between each note.

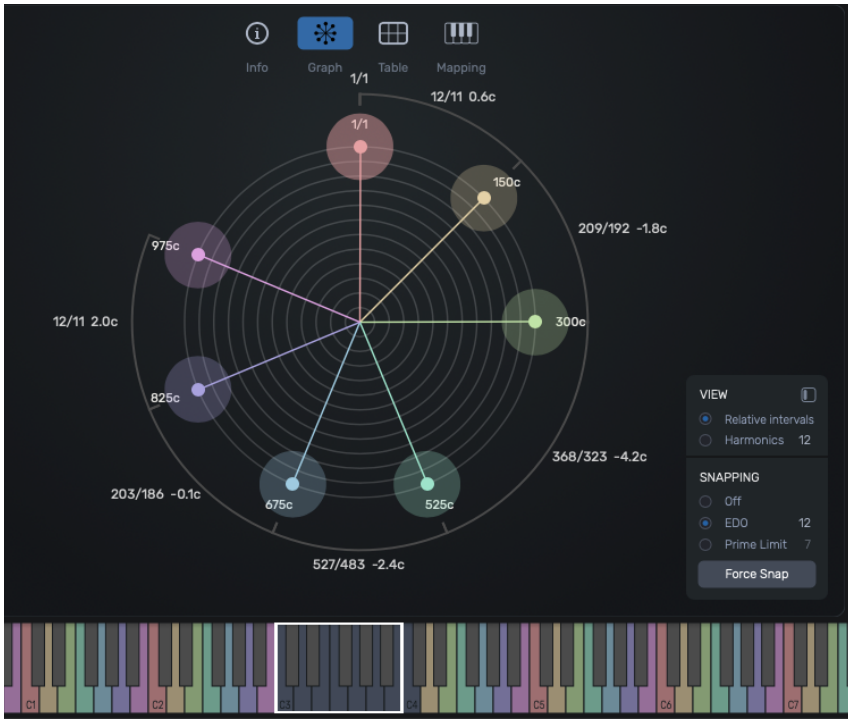
Radial Graph

The **Radial Graph** can be the easiest, most immediate way to alter tunings in Entonal Studio. Each note on the Radial Graph represents an interval in your scale. Clicking and dragging the dot on the end of each note allows you to change the tuning of that interval.

Tuning of a note is always calculated from the scale's root note (1/1). This is A = 440Hz by default, but you can reset this to C in the Mapping Editor.

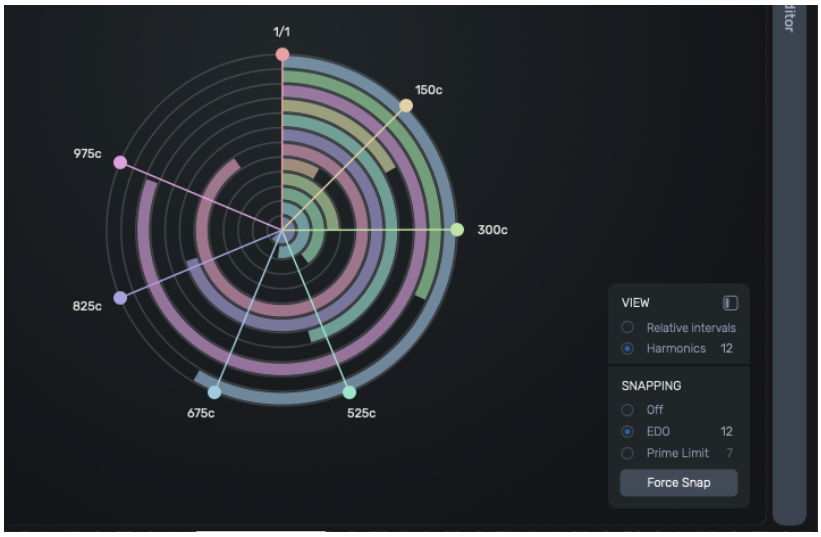
In the bottom right-hand corner of the Radial Graph workspace is a small **tools pane** with more ways to visualize and discover intervals.

View – Relative Intervals



Each interval is displayed with its relationship to the root note as standard. With this option activated, when two intervals are held down, the relative interval between them is displayed on a new line between them. This can be used to explore the relationships between different parts of a scale. It can also be used to design certain intervals within a scale.

View – Harmonics

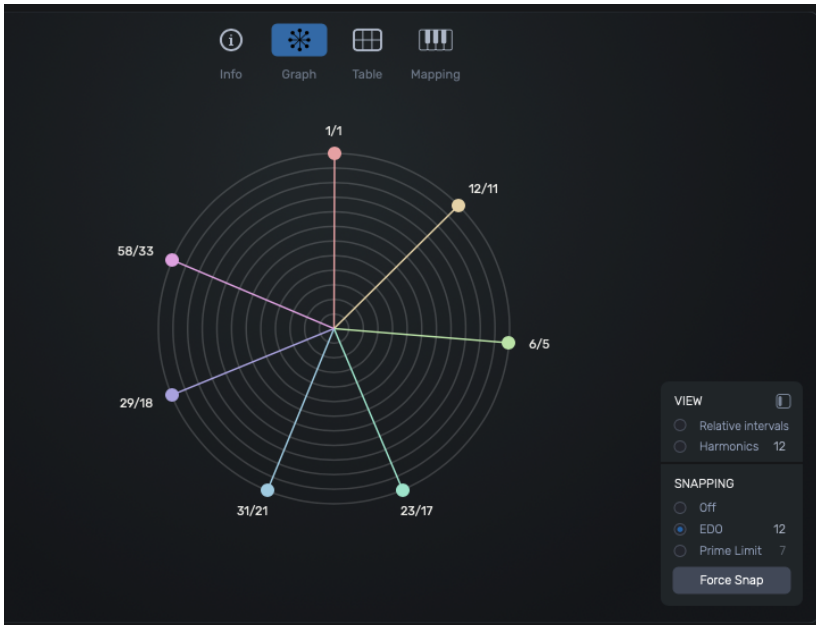


With this option activated, the first non-octave harmonics of the root note are displayed, starting from the outer ring. This lets you see visually how close intervals are harmonically related to your root note. For example…

- The outer ring lines up with an interval of 3/2, representing the second harmonic (3/1) and not the first (2/1), which matches the root and octave.
- The next ring lines up with an interval of 5/4, representing the fourth harmonic (5/1) and not the third (4/1), which matches the root and octave.
- The exact harmonics displayed varies depending on the repeating interval set in the Scale Editor

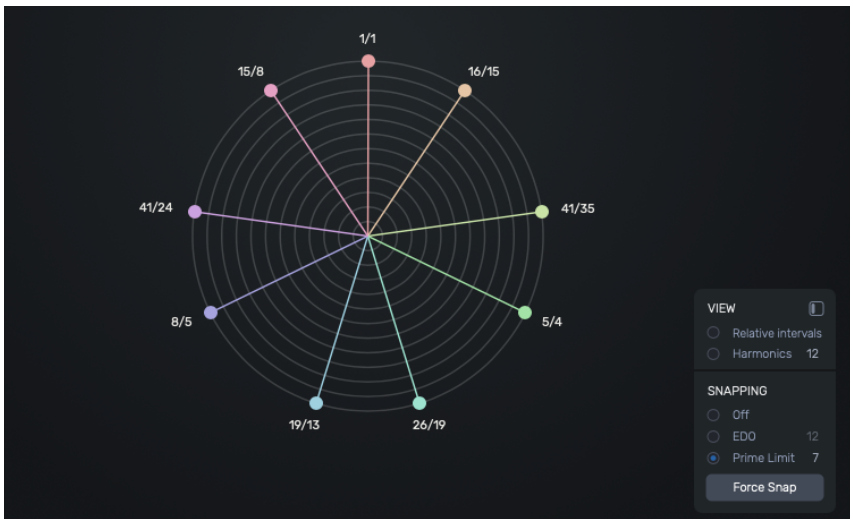
The number of harmonics represented spans from 5 to 64. This is selectable by entering a value next the the Harmonics selector, or using the slider that appears here.

Snapping – EDO



With this option activated, intervals will snap to equal octave divisions, with the number of divisions set using the number next to the selector. If the octave is set to a value other than 2/1, the new value will be divided by the number of divisions set.

Snapping – Prime Limit

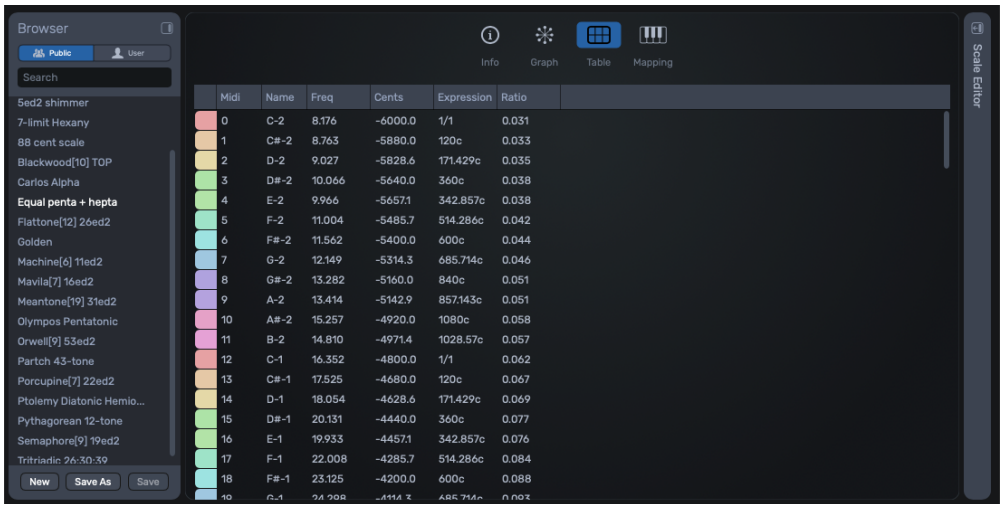


With this option activated, intervals will only snap to ratios composed of numbers up to the value entered. For example, with Prime Limit set to 7, snapped ratios will include 3/2, 7/4, 5/3, etc; but will not include 11/8, 14/5, 25/11, etc.

Force Snap

This button will snap all intervals in a scale to the current snap setting. This is useful, for instance to convert a scale with intervals in cents to their nearest ratio values.

Table



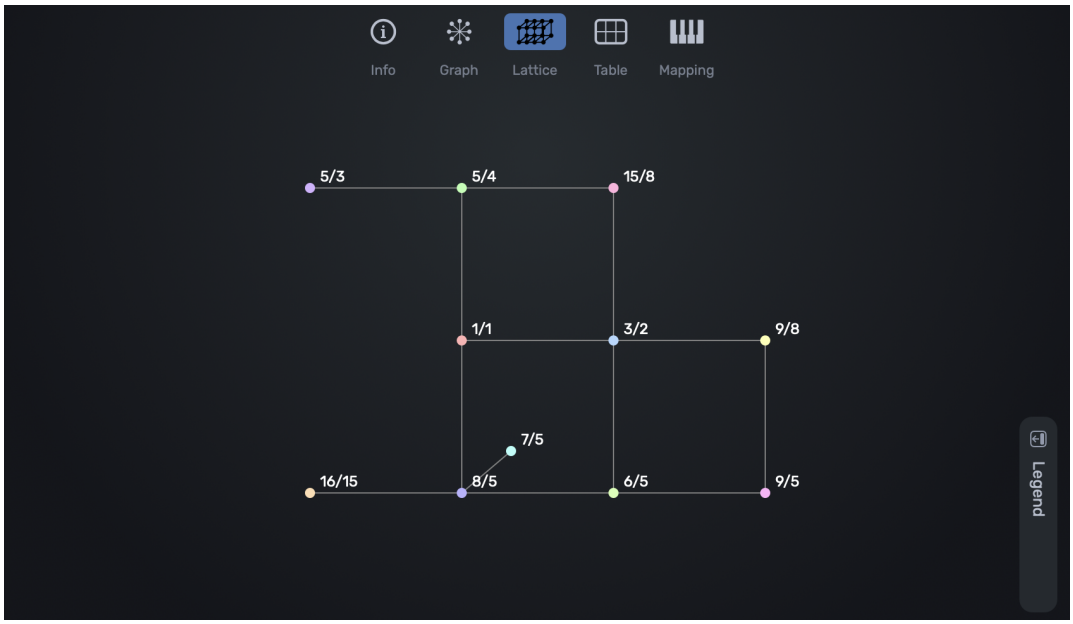
Clicking the button labeled **Table** in the top left-hand corner of the main work area switches Entonal Studio's main window to Table view.

In the Table view you can see information about each of the 128 MIDI notes, with lowest notes (from C-2) at the top to the highest notes (up to G8) at the bottom. Information includes…

- **MIDI** note number
- Note **Name**
- **Freq**uency (in Hz)
- **Cents** difference from the reference note (as set in the Mapping Editor)
- **Expression** that derives the note (as written in the Scale Editor)
- **Ratio**

With non standard tunings, the number of notes in the scale can vary and so an octave won't necessarily be mapped across 12 notes. Table view allows you to identify the pitch associated with each key on your MIDI keyboard quickly.

Lattice



The Lattice View is designed to provide users with a visually appealing and intuitive representation of musical notes and their relationships. It is a method originally developed by Adrian Fokker, and later extended by Erv Wilson, John Chalmers and more recently Kraig Grady.

Overview

The Lattice View is a multi-dimensional representation of the harmonic relationships between musical notes, with each dimension representing a specific prime factor. Each point within the lattice corresponds to a particular note, and the connections between these points symbolise the harmonic intervals between the notes. This relationship between prime factors and harmonic intervals is fundamental to understanding the underlying structure of the Lattice View.

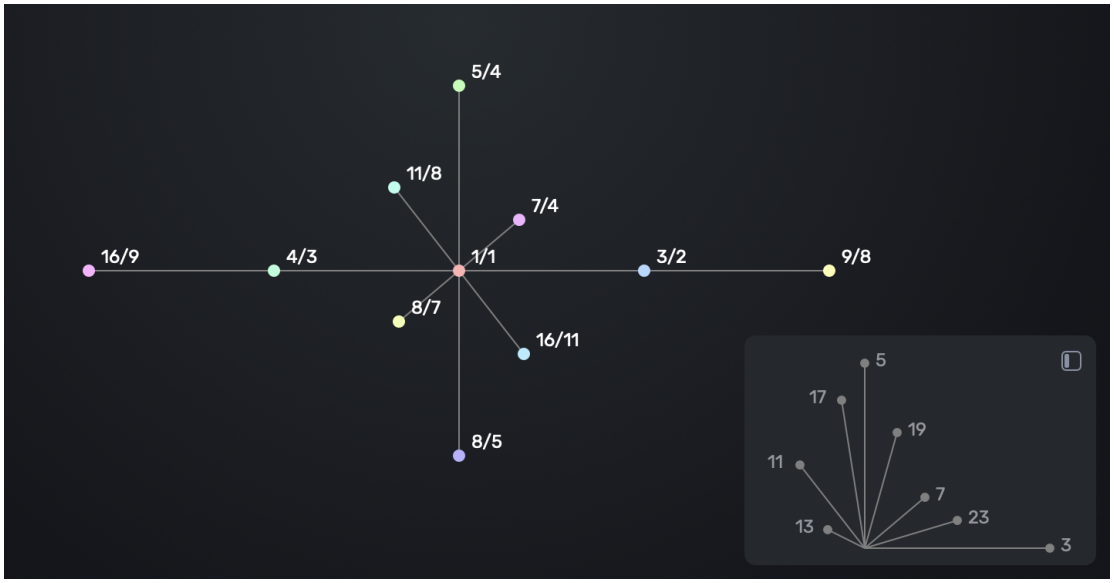
Prime factors play a crucial role in defining the harmonic relationships between musical notes. When the frequency ratio of a musical interval is expressed as a product of prime numbers, these prime numbers correspond to the dimensions of the Lattice View. In essence it allows us to see the different types of intervals that exist in a scale. Each interval will have a unique angle and distance between points, and each harmonic structure will have a unique shape.

For example, a major triad is always an “L” shape - in the screenshot above, 1/1 5/4 and 3/2.

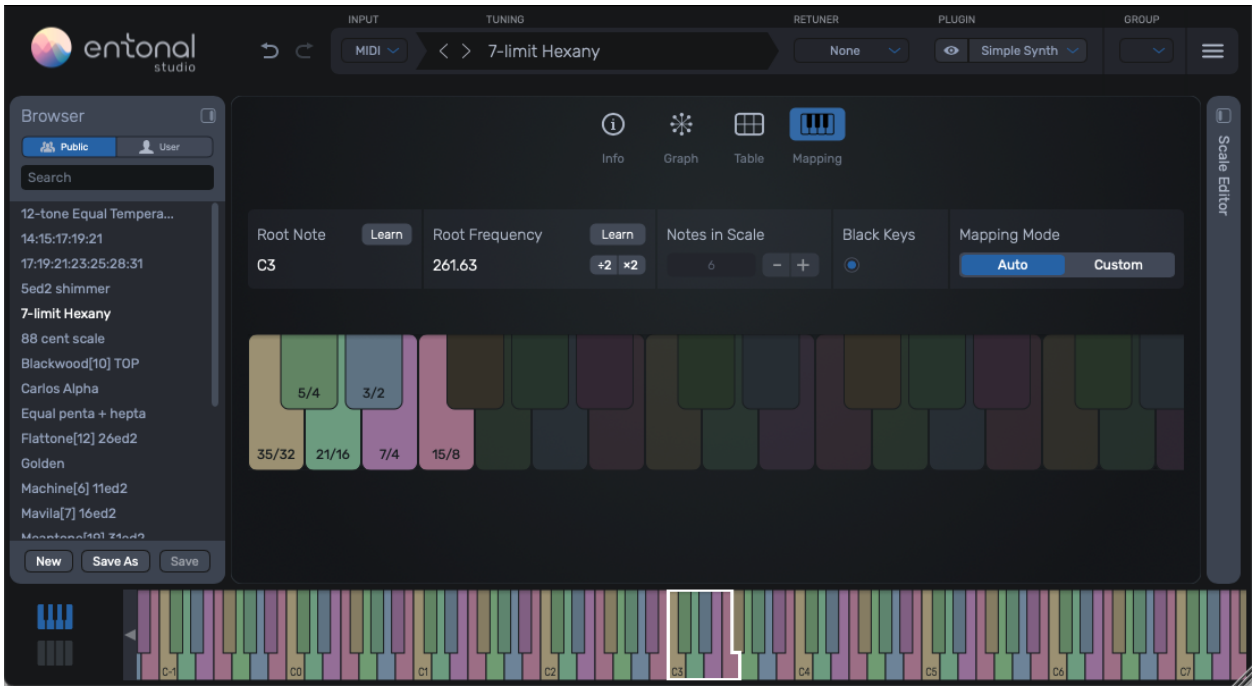
Components

The Lattice View consists of the following key components:

1. **Lattice Points**: Each point in the lattice represents a specific note. The position of a point is determined by its prime step coordinates, which are based on the prime factors of the frequency ratio of the note. The points respond to mouse clicks to hear the corresponding note, and also light up when their note is played.
2. **Harmonic Connections**: The connections between the lattice points represent the harmonic intervals between the notes. These connections help users visualise the harmonic structure and relationships between notes in a given tuning system.
3. **Lattice Legend**: The Lattice Legend provides an overview of the prime step coordinates used in the lattice. It displays the corresponding prime numbers and their positions in the lattice. The legend can be minimised and maximised for better visibility and ease of use.

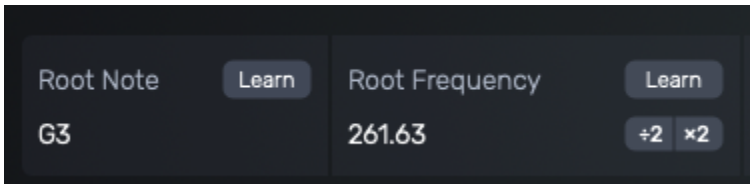


Mapping Editor



Clicking the button labeled **Mapping** in the top right-hand corner of the main work area opens the mapping workspace. From here you can control how your scale is mapped across the MIDI keyboard – whether you're using your DAW's piano roll or an external hardware controller. This is particularly useful for scales that don't have the traditional 12 notes per octave.

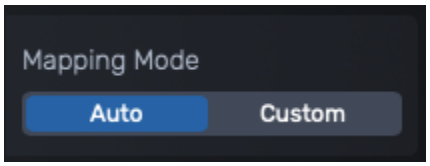
Setting the Root Note and Root Frequency



Set which MIDI note the root note of your scale will be mapped to with the **Root Note** parameter. Click the **Learn** button then send a MIDI message to Entonal Studio to set this manually.

To retune the entire scale to a reference other than 261.63Hz, you can set the frequency of Middle C with **Root Frequency**. You can double or halve the Root Frequency quickly using the **x2** and **/2** buttons.

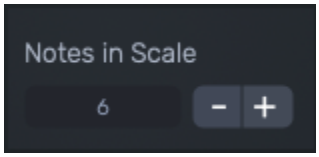
Mapping Mode and Notes in scale



Select how your scale maps to input notes. In **Auto** mode, Entonal Studio will automatically map notes following the number of notes set in the Scale Editor. For example, if your tuning has nine notes before the octave, the scale will be mapped from C to G# and then repeat again from A.

Using the **Custom** Mapping Mode, you can define the number of notes in the scale independent of the Scale Editor settings. In custom mapping mode, you can map any interval to any key. Drag notes from the Scale Editor, or right-/ctrl-click on a mapping key to select an interval, or set it to Unmapped.

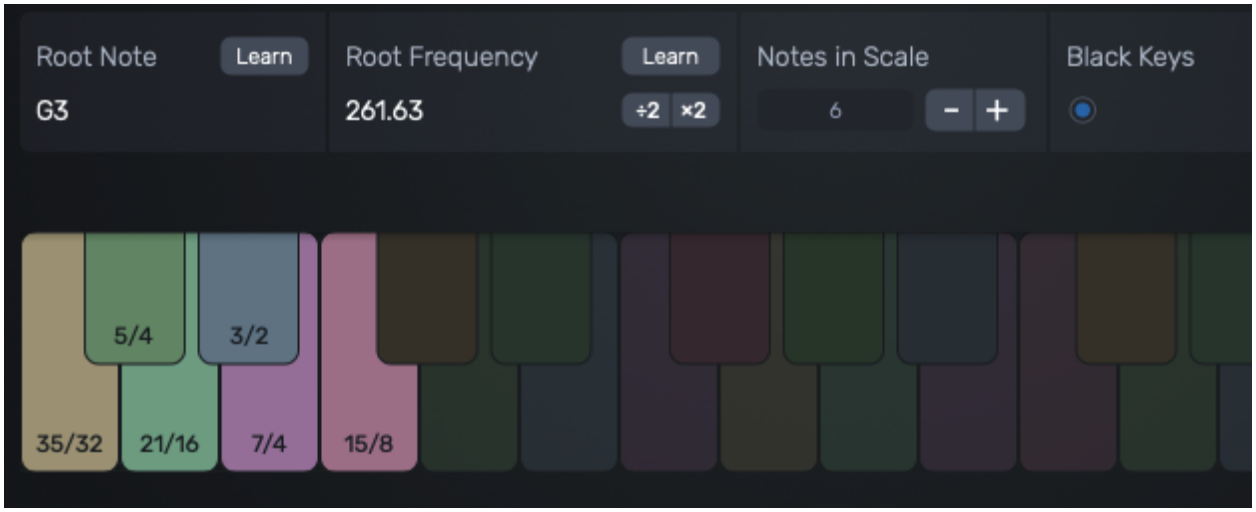
Custom Mapping Mode also allows you to select the number of **Notes in scale**.



The **Notes in scale** control can be useful for forcing a tuning to repeat at the same note on a 12-note keyboard. When working with a tuning with less than 12 notes, setting Notes in scale to 12 will fill the remaining space with unmapped notes and ensure the tuning repeats at the Root Note.

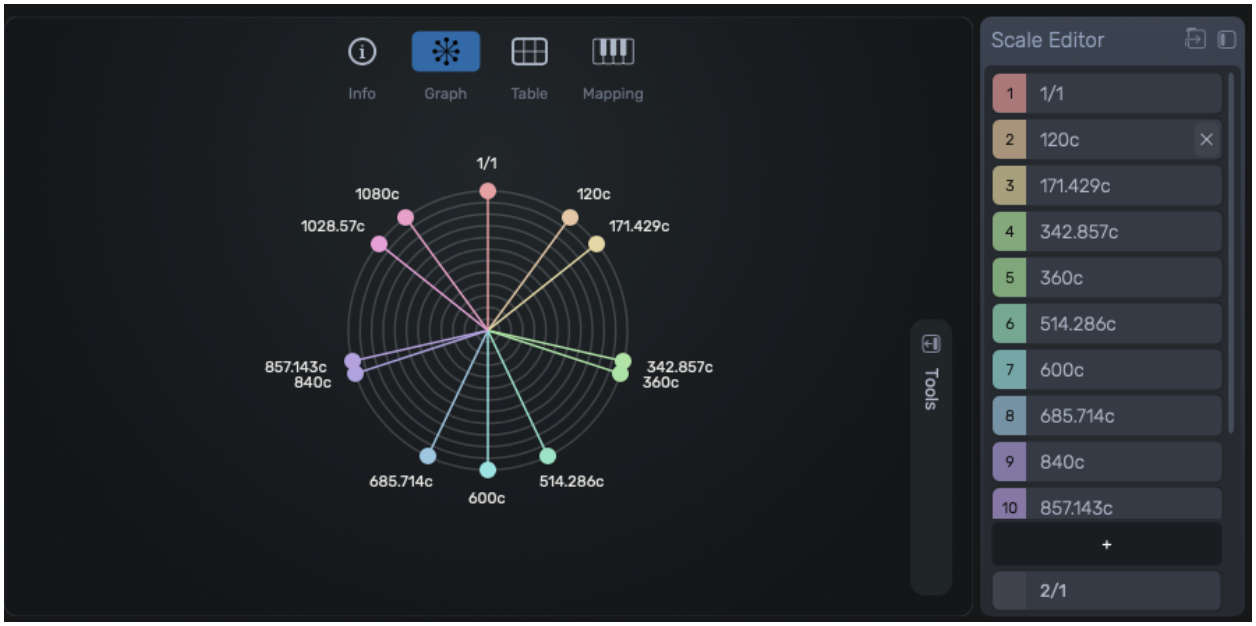
Unmapped notes do not trigger any sound when played.

Black Keys



Finally, set whether or not you want to include the black keys in your keyboard mapping using the **Black keys** switch. With this deactivated, only the white notes of your traditional MIDI keyboard will be used as input by Entonal Studio.

Scale Editor



The Scale Editor allows you to add notes to your scale, and alter tunings of notes in cents, ratios, EDO degrees or mathematical expressions with a maximum 192 notes per octave.

The Scale Editor is accessed by clicking the light grey bar on the right hand side of the UI labelled Scale Editor.

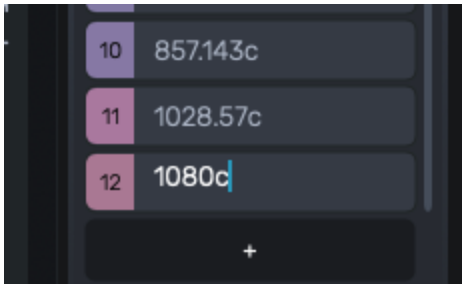
Once opened, the Scale Editor displays a list of the notes in your scale. Notice the colour of each note corresponds to the colour of the note on the Radial Graph.

Adding and Removing notes in the Scale Editor

Add more notes to the scale with the **+** button at the bottom of the list. Hovering over a note in the list displays an **X**, click this to remove a note from the scale.

You can only add a single new note at a time. Before adding a second new note, values must be entered for the first.

Editing notes in the Scale Editor



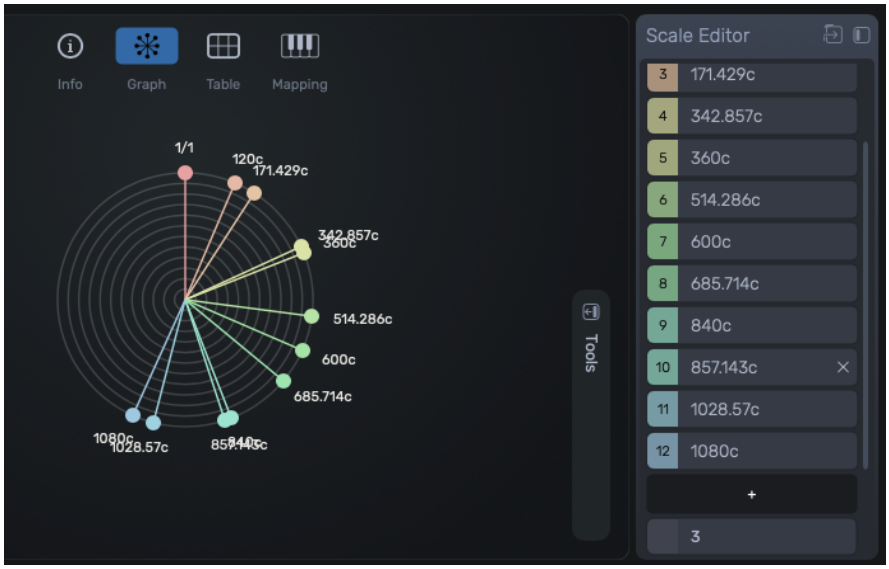
Edit the tuning of each note by selecting the text representing the tuning, and typing a new tuning in either cents, ratios, EDO degrees, mathematical expressions or numbers.

Examples of valid intervals:

- **Cents:** 748.20
- **Ratio:** 5/4
- **EDO:** 5\12
- **Math:** =2^(6/12)
- **Number:** 1.33

Selecting the repeating interval (octave, tritave, etc)

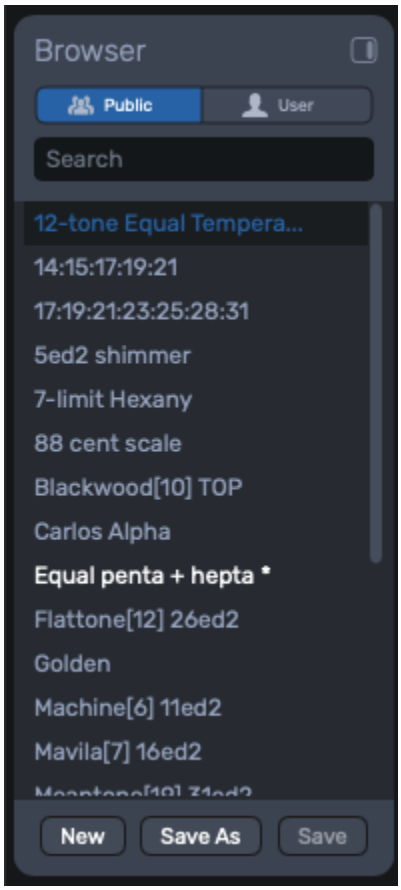
Most traditional scales repeat at the octave, a ratio of 2/1. That is, when a note's frequency reaches twice the root note's, these two notes are said to be the same, and the other notes of the scale lie between these two. The repeating interval is shown below the other notes of the scale, and below the + sign for adding new notes. It is set at **2** by default (an octave).



You can set a scale to repeat at non-octave intervals, for example repeating the scale at **3** (the tritave). This field can also accept custom input in the same way as scale notes (as above).

Scale Browser and Importing and Exporting Scales

Scale Browser



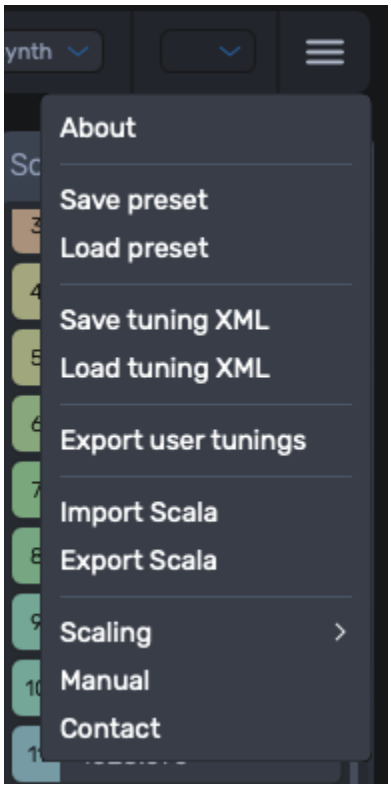
On the left hand side of Entonal Studio's UI is the scale **Browser**. The Browser has two tabs, **Public** and **User**.

In the **Public** tab are the scales that come with Entonal Studio by default. Select scales by clicking on them in the browser window, or move through the scales using the arrow buttons in the toolbar.

The **User** tab displays any scales you've created yourself. To create a new scale click the **New** button at the bottom of the Browser window. Select either an **Empty** scale or an **Equal Temperament** scale, or **Create from Scala file**.

Save a new scale, or an edited pre-existing scale, by clicking the **Save As** button. If you make further edits to a user scale, save it using the **Save** button

Importing and Exporting Scales

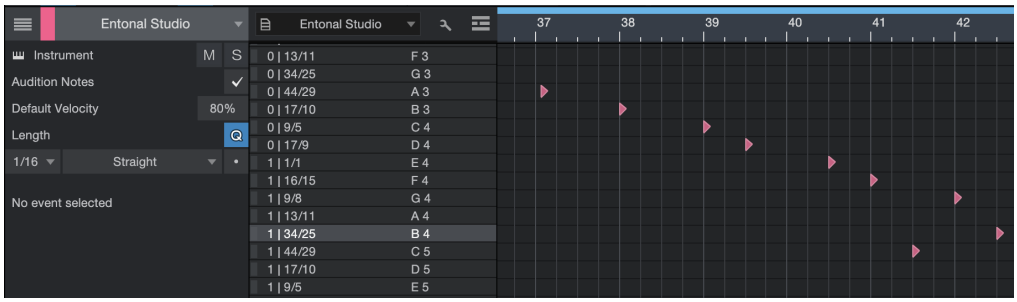


You can export scales for other users, and import other users scales with Entonal Studio. All import and export options can be found in the dropdown menu in the very top right hand corner of the UI.

You can export and import scales as **Preset**, **XML** and **Scala** files. Preset files contain the entire plugin state including synth settings. Tuning XML represents the tuning, including the Scale and Mapping.

MIDI Note Names

The Entonal Studio plugins provide MIDI note names to hosts that support this feature.



The following DAWs have been tested to support this: **Bitwig Studio**, **FL Studio** and **Studio One**.

Currently this requires the VST2 version of Entonal Studio to be loaded.

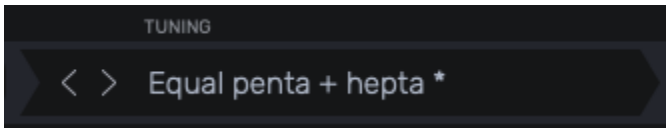
Global Controls

At the top of the Entonal Studio interface, you will find several global controls.

Undo and Redo

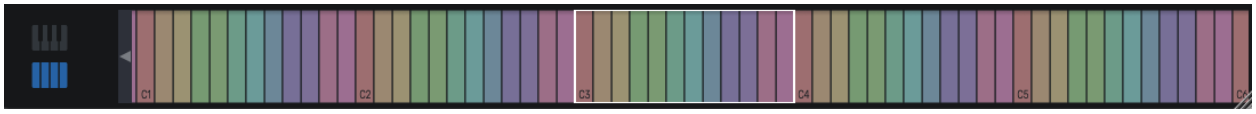
On the far left of the toolbar you will find **Undo** and **Redo** buttons.

Scale Quick-Load



The readout in the centre of the toolbar displays the name of your currently selected scale. You can use the left and right arrows to quickly scroll through scales without loading the preset browser.

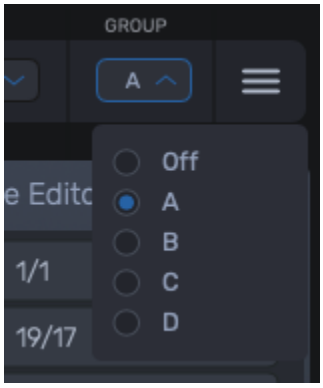
Keyboard and Keyboard Type



At the bottom of the plugin, a virtual keyboard shows your note input into Entonal Studio. When the input type is set to MIDI, this displays as a traditional 12-note keyboard. When the Input type is set to MPE, this displays as a Seaboard-style MPE keyboard.

The buttons to the left of this keyboard let you switch between a traditional keyboard layout with black notes or white-notes-only layout.

Using Groups



Entonal Studio allows you to define up to four groups of instances of the plugin in one DAW project. When multiple instances of Entonal Studio are in the same group, any adjustments made in one plugin will automatically be made in its siblings.

When Groups are useful
This can be useful for retaining the same tuning between instruments, for harmonising parts on different channels, or playing both chords and melodies in the same tuning between different tracks. By grouping these instances of Entonal Studio, you can experiment with tuning changes knowing that these changes will be reflected in all grouped instances.

How to Group instances of Entonal Studio
To add an instance of Entonal Studio to a group, open its Group dropdown menu in the top right hand corner of the UI. From here you can assign Entonal Studio to group **A**, **B**, **C**, **D** or select **Off** to turn off groups for this instance.

Note: Groups only work properly when all instances of Entonal Studio are running as the same type – eg, all VST2 instances or all Audio Units MIDI Effect instances.