ODDSOUND : MTS-ESP MASTER

User Guide
Version 1.11 (31 Oct 2022)

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Windows

- MTS-ESP Master works with Windows 7, 8, and 10, 32bit and 64bit.
- VST, VST3 and AAX are supported in both 32bit and 64bit hosts.
- Your graphics card must support OpenGL2. Most cards do support it but performance with integrated Intel integrated graphics may be poor.

Mac OS

- MTS-ESP Master requires OS X 10.7 or newer on Intel or ARM Mac.
- VST, VST3, AU and AAX are supported in 64bit hosts only.

How To Install On Windows

You need two files to install, the ODDSound MTS-ESP Suite installer and a licence file. Both are available from the Downloads page at **https://oddsound.com** whilst logged in. Note that there are separate 32-bit and 64-bit installers for Windows.

For a 30-day demo, click 'Demo' on the Downloads page to request a demo licence file to be emailed to you.

To install the license, double-click the license.reg file and this box will open:
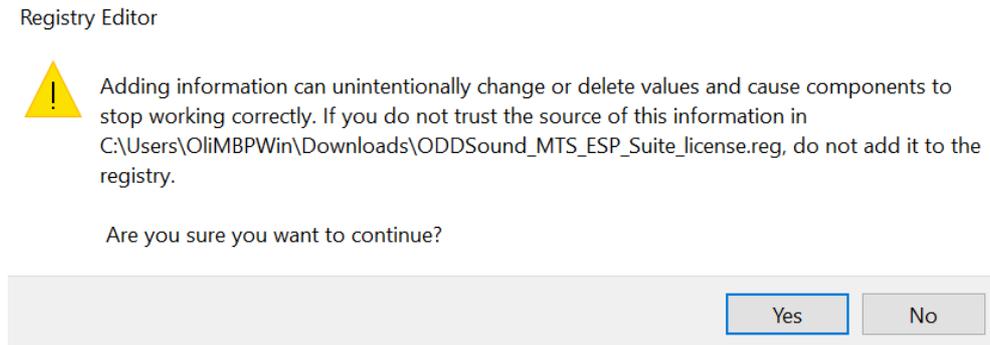
Click 'Yes' and the license will be installed.

Next unzip and double-click the installer to run it. It will look like this:
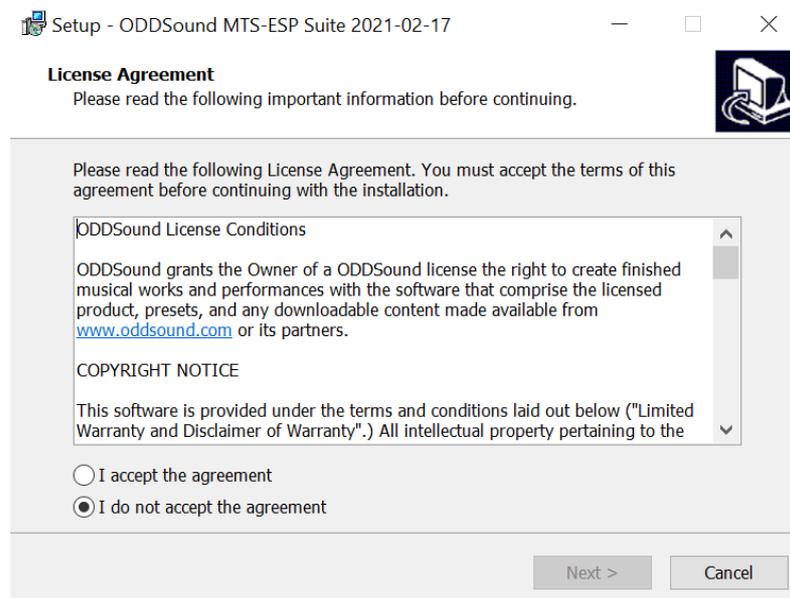
Accept the agreement and click 'Next' to get to the installation options:
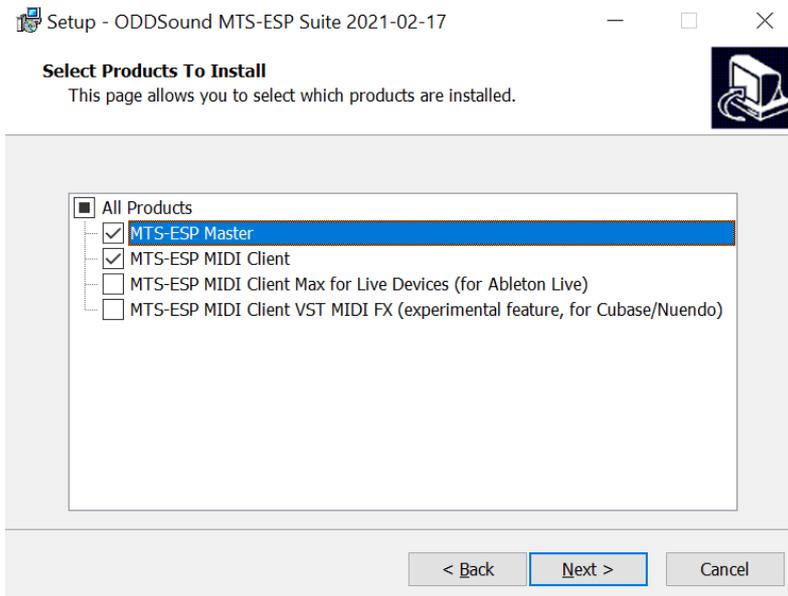
Select the components to be installed and click 'Next' to choose which plug-in formats to install:
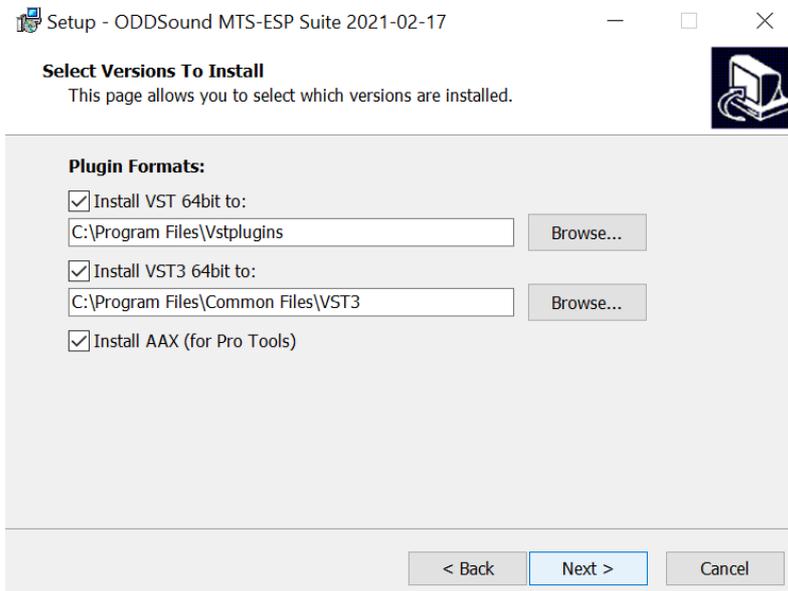
Enable the check boxes for the plug-ins formats to be installed. The VST location should be set to your VST plug-ins folder. The usual location for VST3 plug-ins is \Program Files\Common Files\VST3 but this can be changed if required.

If installing the MTS-ESP MIDI Client Max for Live devices, you will be prompted to select the location to install them to:
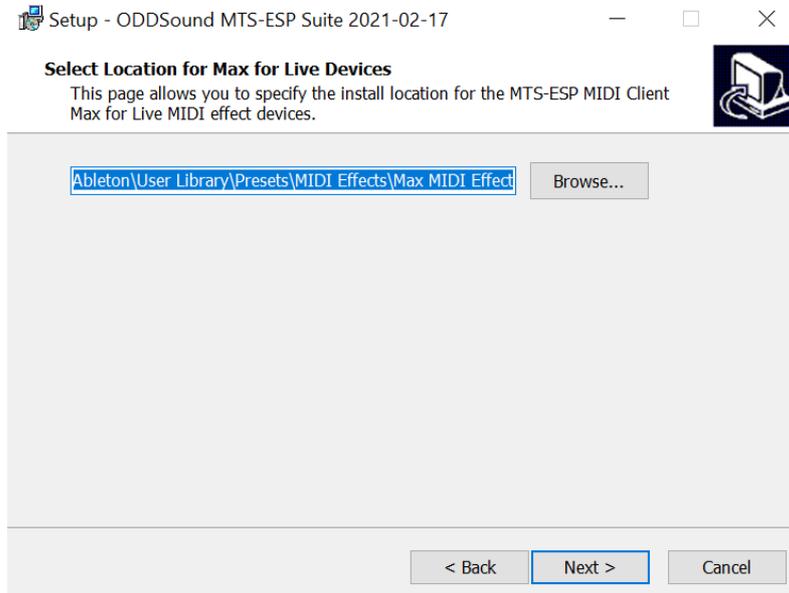
The default location is \Users\[username]\Documents\Ableton\User Library\Presets\MIDI Effects\Max MIDI Effect. If the Live User Library is located elsewhere you will need to edit the install location.

If installing the MTS-ESP MIDI Client VST MIDI FX for Cubase/Nuendo, you will be prompted to select the location to install it to:
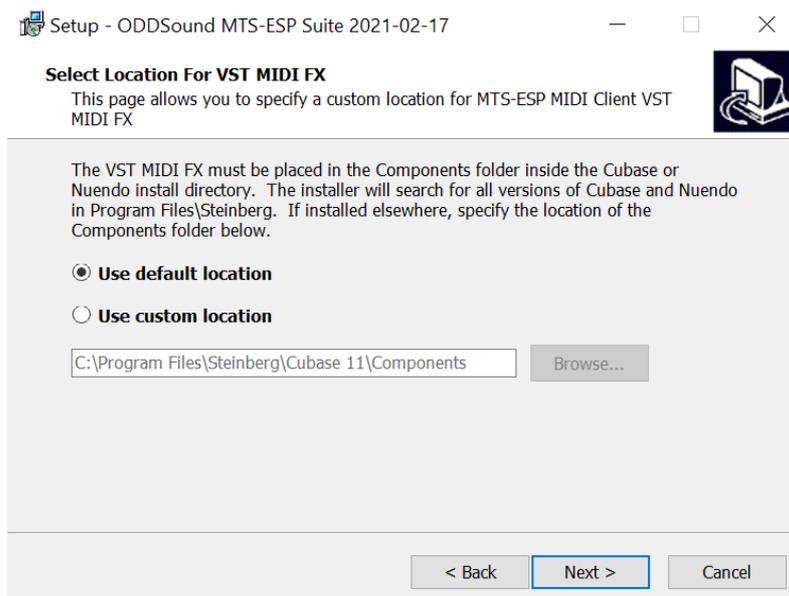
The VST MIDI FX must be installed in the 'Components' folder inside the Cubase/Nuendo install directory. This is usually found in \Program Files\Steinberg\ and, if that is where it is installed, simply select 'Use default location', otherwise specify the location with 'Use custom location'.

Once all options have been set, click 'Next' and 'Install' to install everything and then start/re-start your DAW to begin playing!

The first time you open MTS-ESP Master after installing or updating, it will automatically update the factory presets and resources. This may take a minute or two and the following message will appear at the bottom of the plug-in window whilst it is doing so:
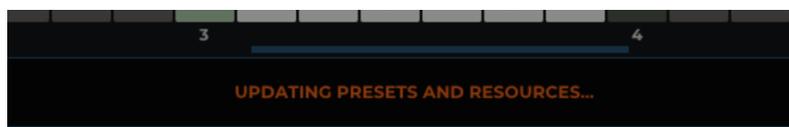
How To Install On OSX

You need two files to install, the ODDSound MTS-ESP Suite installer and a licence file. Both are available from the Downloads page at **https://oddsound.com** whilst logged in.

For a 30-day demo, click 'Demo' on the Downloads page to request a demo licence file to be emailed to you.

If using Safari, one or both of these files may be automatically unzipped after downloading. If not, double-click to decompress them so you get this:
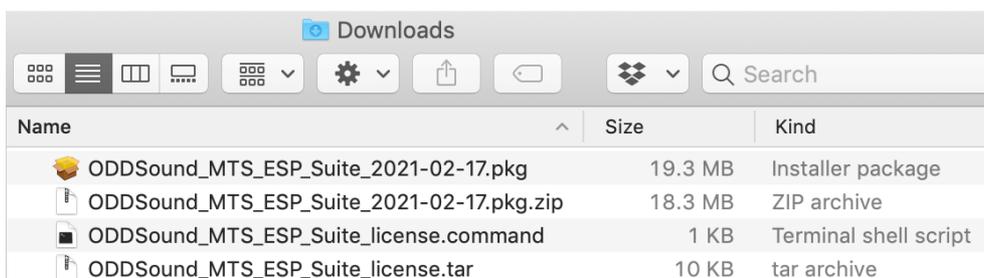
Right-click the 'license.command' file and select 'Open' to install the license. The license will install and you'll get the following message to confirm:
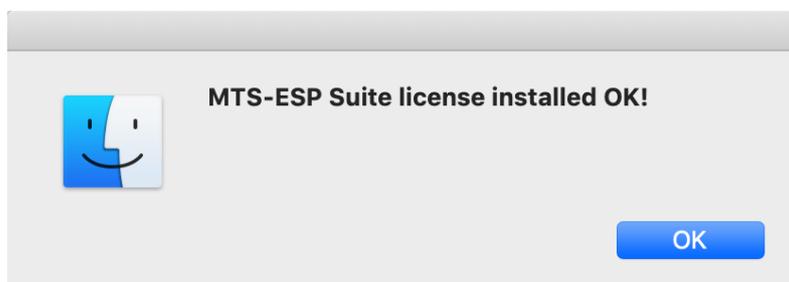
Right-click the installer .pkg file, select 'Open' and continue through installation to the 'Installation Type' page:
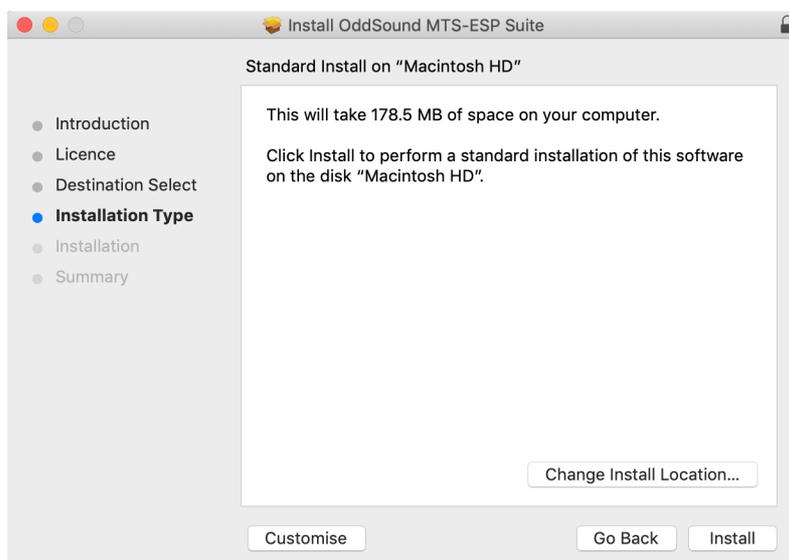
To select the components to install click 'Customise':
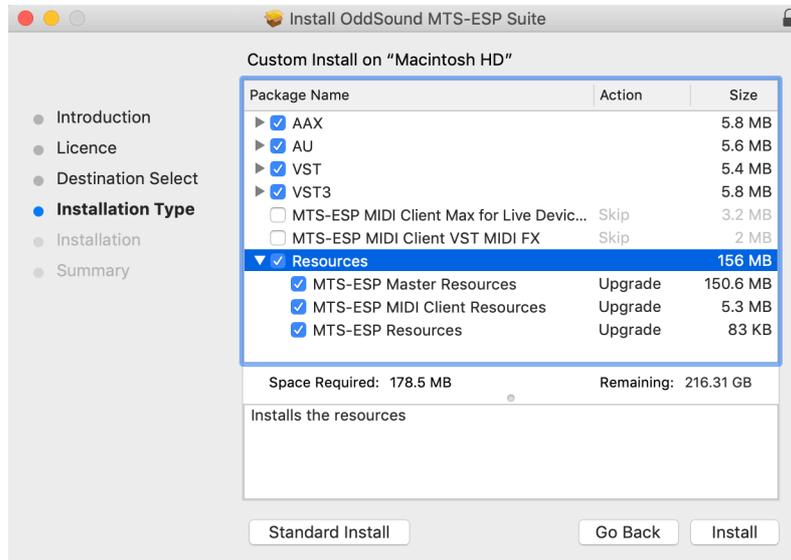
Note that if installing the MTS-ESP MIDI Client Max for Live devices, these must be installed into the Live User Library, the default location for which is /Users/[username]/Music/Ableton/User Library. If the User Library location is different from this, manually copy the Max for Live devices, plus the accompanying "MTS-ESP MIDI Client.vst" file, to the Live User Library after running the installer. Copy them from:

/Library/Application Support/ODDSound/MTS-ESP MIDI Client/Max for Live MIDI Effects

to the following folder inside the Live User Library:

User Library/Presets/MIDI Effects/Max MIDI Effect

MTS: "MIDI Tuning Standard". A part of the MIDI specification allowing for transfer of tuning data between MIDI devices using system exclusive (SysEx) messages. MTS-ESP continues to use this acronym as it is a software counterpart to MTS, allowing transfer of tuning data between plug-ins in a DAW session.

ESP: "Extrasensory perception". With the MTS-ESP system, the transfer of tuning data is automatic and invisible. The synths "just know" what frequencies to play!

MTS-ESP is a protocol for implementing centrally-controlled microtuning in virtual instruments. It allows the tuning of all synths in a DAW session to be set from a single source. This all happens automatically, with no setup required and no need to load tuning files separately into each synth.

Tuning updates in real-time, even whilst notes are held. This allows the possibility for seamlessly changing tuning on the fly, automating tuning changes during a composition and articulating the pitch of single notes.

A virtual instrument plug-in *must* support the MTS-ESP protocol for it to work automatically with this system. A list of plug-ins that support it can be found at **https://oddsound.com**.

The way MTS-ESP works is simple. A 'master' plug-in is one which defines the tuning. Its job is to tell the MTS-ESP system what frequency each MIDI note should play. There can only be one master connected to the system at any one time. A 'client' plug-in is one which follows that tuning (e.g. a synth or sampler). When a client plug-in plays a note, it repeatedly asks the MTS-ESP system for the frequency it should play, updating it in real-time if required. There is no limit to the number of clients that can connect.
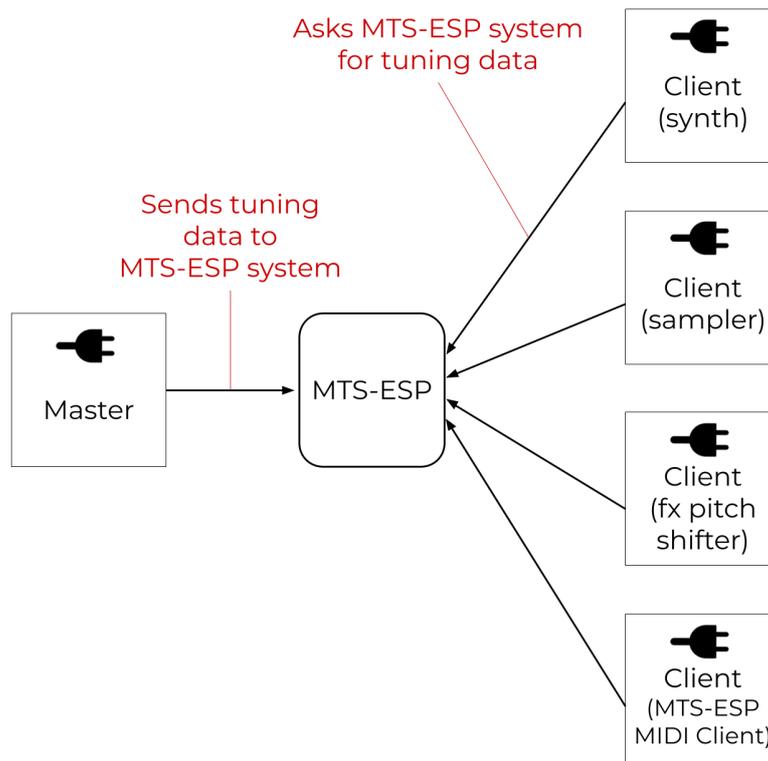
So what about plug-ins that don't support MTS-ESP, or hardware synths? They can be brought into use with the MTS-ESP system using the ODDSound MTS-ESP MIDI Client plug-in.

MTS-ESP MIDI Client acts as a bridge between the MTS-ESP system and MIDI. It is designed to sit before a synth and send MIDI messages to adjust its tuning. These can either be pitch bend messages or, for synths that support it, MTS SysEx messages.

Synths that support MPE (MIDI Polyphonic Expression) work particularly well when using pitch bend messages to adjust tuning, as each note can have a different amount of pitch bend applied with a very wide range (typically +/-48 semitones) and up to 15 note polyphony.
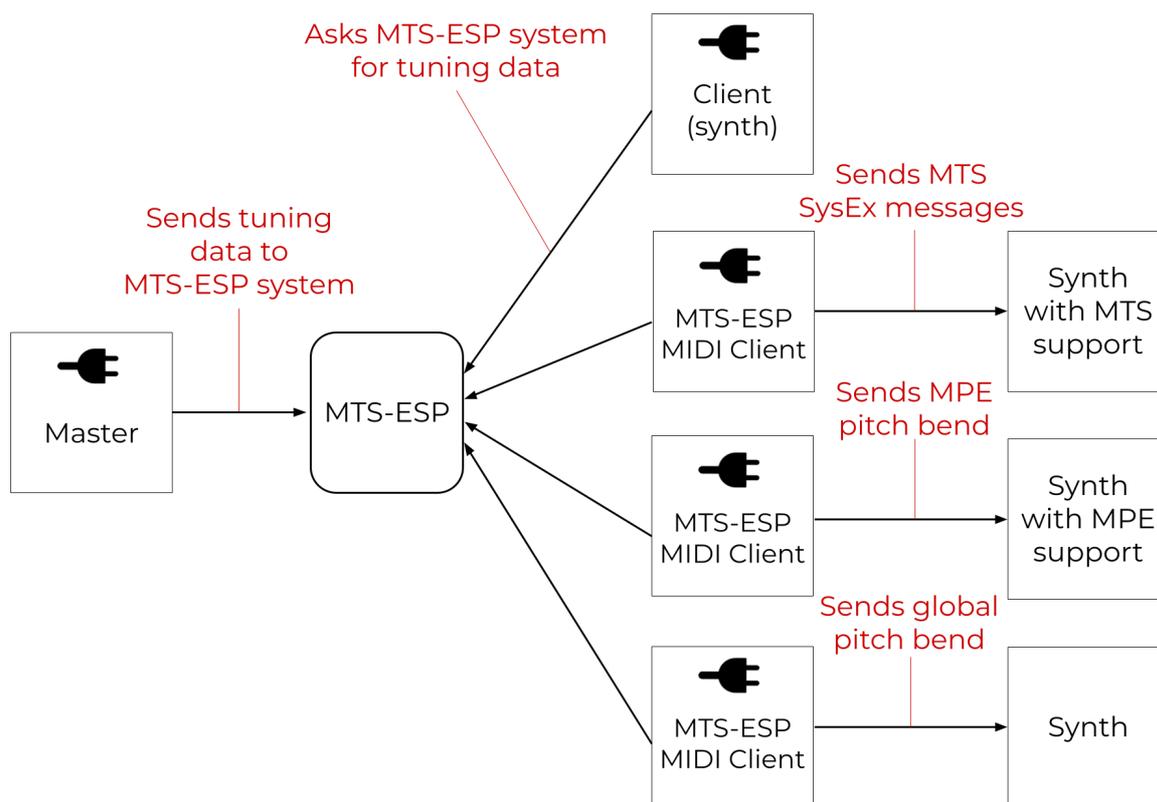
A separate manual is provided for the MTS-ESP MIDI Client plug-in containing further information on the MIDI retuning methods and their pros and cons, along with instructions on how to use it in most major DAWs.

IPC Support

MTS-ESP supports inter-process communication (IPC). Some hosts, including Bitwig, FLStudio, Reaper and Waveform, offer support for running plug-ins in separate processes and MTS-ESP connection will work if this is configured. This may be referred to as 'sandboxing' or 'bridging' depending on the DAW. Plug-ins running in completely separate applications on the same computer will also automatically connect.

If the process in which MTS-ESP Master is running crashes, the plug-in will not have a chance to deregister itself from the MTS-ESP system. On re-loading the plug-in or session you may see the following error message when opening the MTS-ESP Master UI:
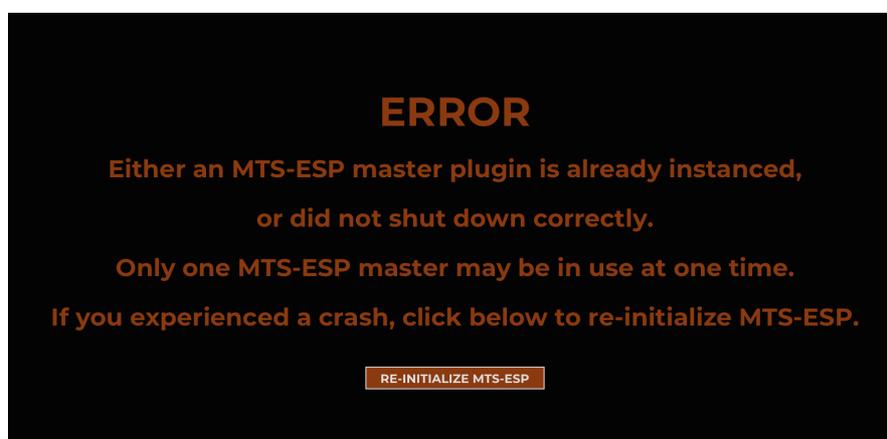
If no other MTS-ESP master plug-in is instanced in any running application then it is safe to click 'Re-initialize MTS-ESP' to allow the plug-in to register itself as master. Note that doing this will reset the connected client count, which may then show an incorrect number. Re-loading the session or DAW will correct the client count.

It is possible to disable IPC support. Whilst this should rarely be required, one use could be to be allow for multiple instances of MTS-ESP Master with different tunings. If a DAW supports plug-in sandboxing then multiple instances of a sandboxed hoster plug-in could be used to host separate instances of MTS-ESP Master along with one or more MTS-ESP client plug-ins. To disable IPC support locate the 'MTS-ESP.conf' file and open it in a text editor. Change the line 'ipc_support = 1' to 'ipc_support = 0', save the file and then restart all applications using MTS-ESP. The 'MTS-ESP.conf' file can be found in the following locations:

Win: Program Files\Common Files\MTS-ESP (or Program Files (x86)\Common Files\MTS-ESP for 32-bit library on 64-bit Windows)

OSX: Library/Application Support/MTS-ESP

ODDSound MTS-ESP Master, as it's name suggests, acts as a master plug-in in the MTS-ESP system. That is to say it defines the tuning which all MTS-ESP client plug-ins will automatically follow. It is designed to be the central place from which tuning is controlled in a microtonal composition setup. The possibilities it opens up, in combination with the MTS-ESP MIDI Client plug-in, include:

- Convert between different tuning file formats.
- Create new tuning systems, manually or algorithmically.
- Automatically update the tuning of plug-ins or MIDI devices that support MTS-ESP, MPE, MTS SysEx or even just MIDI pitch bend.
- Automate tuning changes across connected plug-ins and MIDI devices.
- Visualize tuning systems and compare them.
- Convert compositions from one tuning system to another.
- Use a Novation Launchpad as an isomorphic microtonal keyboard with chord memory.
- Create tunings by ear and tune instruments with the built in synth.

Existing tuning files in .scl or .tun format can be loaded with full support for keyboard mapping, compliant with the Scala .kbm format. A total of 128 scales can be loaded into MTS-ESP Master and switched between on the fly by clicking with the mouse, automating from within a DAW or using assigned MIDI messages.

MTS-ESP allows for seamlessly changing tuning in real-time and MTS-ESP Master leverages this by providing a set of controls, or 'Macros', for modifying tuning. These are capable of randomising, expanding, morphing, transposing, modulating, shifting and justifying a scale. They can be used as real-time tuning 'effects' in a composition or as parameters to transform an existing scale to come up with new ones, which can then be saved out.

As well as loading existing scales, MTS-ESP Master can be used to author new ones. Scale 'types' are available for creating scales defined by parameters, for example an equal temperament of n divisions of a period interval. The macros include a handy system for tuning a scale by ear using MIDI controllers too.

The Graph page gives a visual representation along with further information about a scale and looking over it can give a good indication of how a scale will sound before it is even heard. The graphs are also useful when editing scales as they allow intervals to be snapped to harmonics, steps of another scale or an integer number of cents or commas.

Controls and parameters that respond to mouse actions are coloured light blue.

If a parameter is in a table, the mousewheel scrolls the table and will not adjust the parameter value.

Hold Ctrl/Cmd whilst clicking a parameter to reset it to its default value.

When entering a value as text, both '.' and ',' are recognised as a decimal point.

If the value or text for a control has more characters than can be shown in the available space, it will be abbreviated with an ellipsis (…). In this case hover the mouse over the text to see the full value/text in a tooltip.

Interval Controls

Some parameters in MTS-ESP Master represent an interval, which may be displayed either as a ratio (i.e. "7/4" or "1.414") or an interval measure (i.e. "1200 cents" or "3.45 commas").

For the steps in the **Tuning Table (page 31)** and a few other parameters, it is possible to see both the ratio and interval measure at the same time. For all other interval parameters, there is a global setting to switch between ratio and interval measure, accessed from the **Display Menu (page 22)** in the **Menu Bar (page 21)**.

Ratios will be displayed either as an integer ratio (two integer numbers separated by a '/') or a decimal value with three decimal place accuracy. When entering a ratio as text, it is possible to enter either a single decimal number, or two numbers separated by a '/'.

MTS-ESP Master will always show an integer ratio where possible, either because a scale file loaded into MTS-ESP Master contains integer ratios, or an integer ratio is explicitly entered as text.

Some extra features for setting an interval as a ratio are available:

- Ratios can be entered as text either in fraction format (e.g. "3/2") or enumerated format (e.g. "2:3").
- A power of a ratio can be entered using '^' followed by an integer. The resulting ratio will be period-reduced so e.g. for a period of 2/1, entering "3/2^3" will give an interval of 27/16, or "3/2^-3" will give 32/27.
- It is possible to set an interval to a harmonic series ratio by entering 'h' followed by the number of the harmonic. The interval will be period-reduced so e.g. for a period of 2/1, entering "h3" will give an interval of 3/2. Enter 's' followed by a number for a sub-harmonic series ratio.
- It is possible to 'snap' a decimal format ratio (e.g. 1.51) to an integer ratio (e.g. 3/2) by right-clicking on it and selecting 'Snap to ratio'. This option will find the integer ratio with the lowest possible numerator and denominator, within the snapping constraints set in the **Setup page (page 75)**.

  The right-click menu also offers a list of best rational approximations within the limits set in the **Setup page (page 75)**. These are useful where minimising error is of most concern.

- Enter the text "phi" to use the golden ratio. This will work in combination with entering two values separated by '/'.

Interval measures are displayed with two decimal place accuracy. The interval measure can be set to either cents or commas. The comma interval can be set from the **Setup page (page 75)**.

Interval controls have a range of +/- 24000 cents or, as ratios, from 1/1048576 to 1048576/1. Two exceptions to this are the Snap To Ratio macro **Max Error** and global **Snap Max Error** parameters, which have a range of 0.01 cents to 1200 cents.

How We Express Intervals

An interval is the difference in pitch between two tones. We can express intervals as the ratio of one frequency to another reference frequency. The octave is a simple example. If two tones are sounded, one an octave above the other, the frequency of the upper tone will be double that of the lower tone. The ratio of the higher frequency to the lower frequency is 2-to-1, or 2/1, which is how we express the interval of an ascending octave.

Note that the actual frequency in Hz of the lower tone has not been given here because this rule applies to any frequency. Whatever the frequency of the lower reference tone, the frequency of the upper tone must be double to sound one octave above.

If the upper tone is defined as the reference, the interval, now a descending octave, can be expressed as 1/2, since the frequency of the lower tone is half that of the upper tone. A descending interval will always have a larger denominator than numerator. The descending equivalent of an ascending interval can easily be found by swapping the numerator and denominator, and vice versa.

If a tone sounds two octaves above another, its frequency will be four times that of the lower tone, since each octave jump requires a doubling of frequency and 2 × 2 = 4. An ascending two-octave interval can therefore be expressed as 4/1. This demonstrates that when combining intervals, ratios must be multiplied.

A quick glance at a ratio can suggest how consonant an interval may seem by how small the numbers are. A ratio of 1/1, implying two tones at exactly the same frequency i.e. the unison, is the most consonant, followed by 2/1 and 1/2 i.e. the octave. A ratio of 65536/59049 can be assumed to be not very consonant.

Intervals As Decimal Values

An interval may be expressed as a decimal number i.e. the result of dividing the numerator by the denominator (65536/59049 ≈ 1.1098). This may be preferable if the numerator and denominator values are very large (or even necessary if they are infinitely large!). MTS-ESP Master will automatically express intervals as decimal values with three decimal place accuracy if the numerator or denominator are so large that they cannot be represented using an unsigned 64-bit binary integer (i.e. greater than 18446744073709551615…it may seem unlikely but it can happen!).

If an interval is expressed as a decimal value, we are less able to quickly make any assumptions about consonance. The value may be very close to that of a small-number integer ratio, e.g. 1.501 is very close to 3/2 = 1.5 and our ears may perceive it as consonant. MTS-ESP Master provides options for converting a decimal ratio to an integer ratio that is close in value. Right click on any decimal interval ratio and select either 'Snap To Ratio' or choose from a list of integer ratios in the 'Best Approximations' sub-menu. The intention here is to provide a quick way of altering an interval so it is more consonant. This can even be applied to an interval that is already an integer ratio, converting it to another integer ratio that is close but has smaller numbers for the numerator and denominator. Some options relating to how MTS-ESP Master calculates nearby integer ratios are found on the **Setup page (page 75)**.

Cents…An Interval Measure Based On How We Perceive Pitch

Our ears perceive pitch logarithmically. If two tones are sounded, one three octaves above the other, we don't 'hear' a ratio of 8/1 (i.e. 2 × 2 × 2 = 8), even though that is the ratio of the frequencies. Instead our ears tell us that the higher tone is three octave steps up from the lower tone, or to put it another way, they tell us the number of times the frequency has been doubled is three.

To describe intervals in the way that we hear them, we need a logarithmic measure. The two we generally use are semitones and cents, one cent being 1/100th of a semitone. These measures are derived from the common 12-tone equal temperament scale, which divides the octave into 12 steps such that the interval between each step is the same. If thinking in ratios, we can say that the ratio value of a semitone multiplied by itself 12 times equals 2/1 (an octave). Then, working backwards, we can derive the actual semitone ratio value as $\sqrt[12]{2} \approx 1.0594$ (this can't be expressed as a nice integer ratio).

If a tone sounds three semitones above another, its frequency will be 1.0594 × 1.0594 × 1.0594 ≈ 1.1892 times that of the lower tone but, to save us having to multiply by 1.0594 in our heads, we can just stick with "three semitones" to express the interval. Using semitones both makes the math easier, as we can add instead of multiply to combine intervals, and reflects how we hear pitch.

In MTS-ESP Master we use cents instead of semitones for a finer degree of accuracy, but the logic is still the same. 1 semitone = 100 cents, and 1 octave = 12 semitones = 1200 cents. A cents value of 2400 represents two octaves i.e. 1200 + 1200.

Commas...A More Musically Useful Interval Measure

When dealing with just intonation (broadly, scales consisting of integer ratios), it may be more musically useful to use a different interval measure, since cents are derived from 12-tone equal temperament. A comma is a small interval that can be expressed as an integer ratio. Although technically this implies that there are a huge number of commas, in reality there will be specific comma(s) that apply best to a given tuning system.

MTS-ESP Master allows you to select from a few commonly used commas in the **Setup page (page 75)**, however you can also set a custom one. As a calculation example we'll use the first comma in the menu in MTS-ESP Master, 81/80, also known as the syntonic comma. If a tone sounds three of these commas above another, its frequency will be 81/80 × 81/80 × 81/80 = 531441/512000 ≈ 1.038 times that of the lower tone. 81/80 is equivalent to 21.51 cents, so 3 syntonic commas = 21.51 + 21.51 + 21.51 = 64.53 cents.

See **The Pythagorean Comma (page 37)** section for an example of picking and using a suitable comma.

The MTS-ESP Master GUI is divided into sections. A section may have one or two drop down menus, accessed by clicking on the icons at the top right of the section box. There are two types of menu:

- **File:** Contains options related to loading, saving and exporting data for a specific section.
- **Settings:** Contains options and settings specific to the section. Settings in these menus are saved with a preset or session, not globally.

Settings Menu

SCALE LIST

File Menu

Tables

The MTS-ESP Master GUI contains a number of tables. Where available, options relating to an individual row of a table are accessed by right-clicking on a row.

The mousewheel can be used to scroll a table. It cannot be used to adjust parameters in a table.

The **Scale List (page 25)** and **Macro List (page 53)** have a '+' icon below the last entry in the table which can be clicked to insert a new entry at the end of the list. This icon will disappear if the maximum number of allowed entries is reached.

The **Scale List (page 25)**, **Tuning Table (page 31)** and **Macro List (page 53)** allow multiple selection of table rows. Selected rows are highlighted green. Click on a row to select it. Ctrl/Cmd click a row to add or remove it from the selection. Shift-click a row to select a continuous range.

Entries in the **Scale List (page 25)** and **Tuning Table (page 31)** can be dragged and dropped. To do this, click on a selected row (not over a draggable parameter value), hold the left mouse button and drag to move the selected rows to the desired location. Text will appear next to the cursor to indicate what is being dragged.

The **Scale List (page 25)** and **Tuning Table (page 31)** support navigation and selection via the computer keyboard. Ensure keyboard input is enabled on the **Setup Page (page 76)** for this to work. Use the up, down, home and end keys to navigate the table or, in combination with the Shift key, for selection. Ctrl/Cmd+A will select all entries if the host allows this command through to the plug-in.

Bypass

Undo/Redo   Display Menu

| ODDSOUND   MTS-ESP MASTER | ↺ ↻ | SCALE | MACRO | GRAPH | SETUP | 🗎 👁 🎨 ⏻ |

Preset Menu

MIDI Client
Update
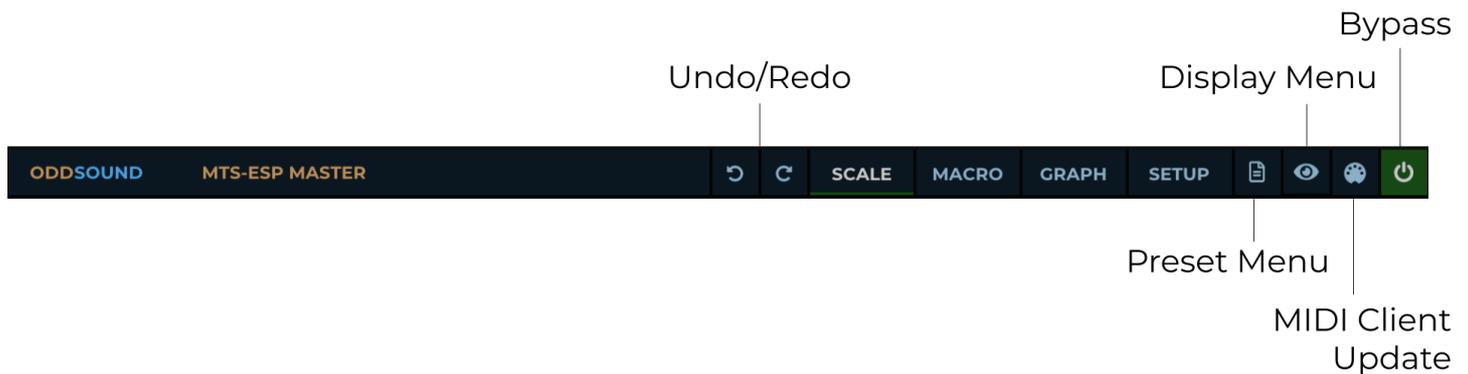
Undo/Redo

A full undo/redo for any parameter changes or actions on the UI, including loading of presets, scales, mappings and macro presets. The following are NOT included as steps in the undo/redo stacks:

- Any changes to parameters and settings on the **Setup page (page 75)**.
- Any options in the **Menu Bar Display menu (page 22)**.
- Any Display options in the **Tuning Table Settings (page 32)** or **Graph Settings (page 71)** menus.
- MIDI control assignment of **Bypass (page 23)** or any of the internal synth parameters.
- Any changes to parameters made via MIDI control or automation.

Scale

Click for the Scale page. This is the default view and contains:

- The **Active Scale box (page 29)** with information and settings relating to the current active scale.
- The **Scale List (page 25)**, showing the current loaded scales available for selection.
- The **Tuning Table (page 31)**, showing the tuning values for each step of the active scale.
- The **Keyboard (page 50)**, with controls for the internal synth and options for editing the mapping.

Macro

Click for the Macro page. The **Active Scale box (page 29)** and **Scale List (page 25)** are replaced with the **Macro (page 53)** control boxes, but the rest of the UI remains the same as for the Scale page. Macros controls can be used to modify a scale in real-time.

Graph

Click for the Graph page, which contains:

- A visual representation of the scale, selectable between **linear (page 69)** and **circular (page 70)**.
- Further information about the active scale.
- A list of generating intervals for the active scale.

Setup

Click for global setup options. Parameters on this page are stored globally and apply to all instances in all sessions. License and version number information is also found on this page.

Preset Menu

MTS-ESP Master presets save the following:

- All scales in the **Scale List (page 25)** (see the **Saving Scales (page 26)** for details on the information saved with a scale).
- All global macros.
- All settings in each section's **settings menu (page 20)**.
- All settings in the **Display Menu (page 22)**.
- Internal synth parameters.
- The current active scale.

Click the file icon in the **Menu Bar (page 21)** for preset load/save options:

- **Load preset…:** Load a .MasterPreset file.
- **Save preset…:** Save a preset as a .MasterPreset file. Preset files saved in the following locations will appear in the preset menu for quick selection:

  Win: Documents\OddSound\MTS-ESP Master\Presets

  OSX: Library/Audio/Presets/OddSound/MTS-ESP Master/Presets
  ~/Library/Audio/Presets/OddSound/MTS-ESP Master/Presets

- **Save as default:** Save the current state of MTS-ESP Master as default, which is loaded on instancing.
- **Reset to default:** Reset MTS-ESP Master to the saved default state.
- **Default preset folder (OSX only):** OSX offers two locations for saving plug-in presets: 'local', accessible by all users, and 'user', only accessible by the current logged in user:

  local: Library/Audio/Presets/

  user: ~/Library/Audio/Presets

  This option selects which of the above folders MTS-ESP Master defaults to when saving presets. Presets saved into the selected folder will appear in the top level of the Preset menu, whilst presets saved into the other will appear in a sub-menu.

Display Menu

This menu allows quick access to some display options:

- **Values:** Globally switch the display of interval parameters between ratio and interval measure. This setting applies only where ratio and interval measure are not displayed simultaneously. The interval measure may be either cents or commas, as per the **Interval Measure** setting described below.

  If a column in a table contains interval values which may be displayed as a ratio or interval measure, clicking the table column heading acts as a shortcut to switching this option. This includes:

- The Interval and Macro Adj. columns in the **Tuning Table (page 31)**.

- The Range column in the **Bend macro (page 55)** destination table.
- The Value column in the **Switch macro (page 56)** destination table.
- The Value column in the **Generating Intervals table (page 74)**.
- **Interval Measure:** Select the interval measure for displaying interval parameters to either cents or commas. The comma ratio can be set from the **Setup page (page 75)**.
- **Keyboard only:** Select this option to reduce the UI size so it shows only the **Keyboard (page 50)** section.
- **Expand table:** Select this option to expand the size of the **Tuning Table (page 31)** and hide the **Keyboard (page 50)** section.

MIDI Client Update

This button only appears when at least one instance of MTS-ESP MIDI Client is connected to MTS-ESP Master. Click to force all connected instances of MTS-ESP MIDI Client to update the tuning on the plug-ins/devices being retuned. It provides a single-click method of dealing with any potential MIDI tuning issues. Whilst in general, retuning of MTS-ESP MIDI Client instances is invisible and instantaneous, this button can be considered as a 'panic' or 'sync' button if things don't sound correct.

Bypass

Click to bypass MTS-ESP Master and return all connected clients to using 12-TET tuning. Right-click for MIDI learn options to assign a MIDI CC to Bypass. The MIDI CC assignment is stored globally and applies to all instances in all sessions.

A mouseover tooltip is provided at the bottom of the UI. Hover the mouse over a parameter to see information about its function. Click the 'X' at the right of the box to hide it. It can be re-enabled again from the **Setup page (page 75)**.

Connection Info

The number of connected clients is shown at the bottom of the plug-in window. ESP clients are any plug-ins loaded in a DAW session which support MTS-ESP. MIDI clients are instances of MTS-ESP MIDI Client. If retuning seems not to be working, check that clients are showing as connected here.
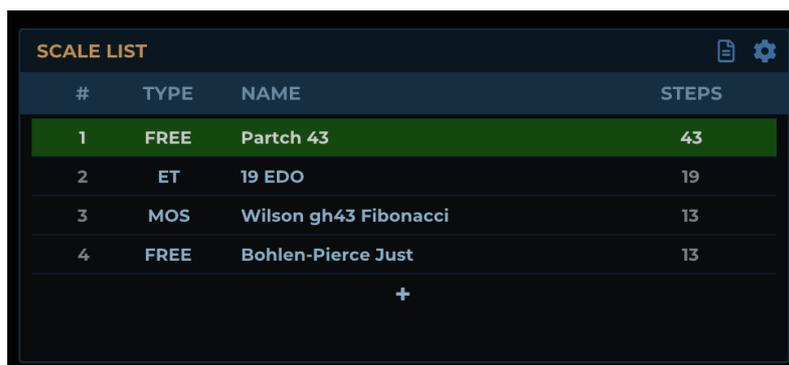
The Scale List can contain up to 128 scales. The current active scale is selected from those in the list either by clicking in the list or using MIDI note, program change or CC messages (this is described in **Selecting Scales Using MIDI (page 28)**). This allows for quick auditioning of different scales and the possibility to change scale during a composition.

The Scale List will always contain at least one scale, to ensure that there is a reference for tuning.

Loading Scales

There are four ways to add scales to the Scale List:

- Click the Insert icon beneath the last entry in the Scale List. This will add scales to the bottom of the Scale List.

    Supported file types are .scl, .tun and .MasterScale. For .scl files, MTS-ESP Master will automatically search the folder for a .kbm file with a matching name and, if found, load the mapping from it.

    In addition to the 'Load Files...' option, the Insert menu contains options to insert a new scale (see **Scale Types (page 36)**) or a copy of any scale in the list. Any scales saved into the following locations will also appear in the Insert menu, for quick selection:

    Win: Documents\OddSound\MTS-ESP Master\Scales

    OSX: Library/Audio/Presets/OddSound/MTS-ESP Master/Scales
          ~/Library/Audio/Presets/OddSound/MTS-ESP Master/Scales

- Right-click a row and use the Insert sub-menu. The same options are presented as when clicking the Insert icon, however this method allows for inserting scales either above or below the selected scale in the list.
- Drag any number of .scl, .tun or .MasterScale files from Explorer/Finder onto the Scale List. A highlight line will appear between the rows to show where the scales will be inserted in the list. Hold the cursor near the top or bottom of the Scale List to scroll whilst dragging files over.
- Click the Scale List file menu icon and select 'Load Folder...' to pick a folder and load all scale files contained within it, replacing all scales currently loaded into the list.

It is possible to load a .scl, .tun or .MasterScale file into an existing scale in the list. This will replace the scale data for that entry. To do this, make sure a single row is selected then right-click on it and select 'Load file...'.

Scale Type

The Type column in the Scale List shows the type of each scale, which can be changed at any time by clicking in the column to bring up a pop up menu showing the available types.

The default type is 'Free', which allows interval values and the number of scale steps to be freely edited. Any .scl or .tun files loaded into MTS-ESP Master will have their type set to 'Free'.

With all other types, the interval values and number of scale steps are determined using specific scale parameters and it is not possible to freely edit the **Steps (page 29)** parameter or individual intervals. A description of each type and its parameters are given in the **Scale Types (page 36)** section.

Renaming Scales

Scales in the Scale List can be renamed by double-clicking on a name and entering a new one, or right clicking on a row and selecting 'Rename...'.

Selecting Scales

To select the active scale, click its row in the Scale List. The text for the active scale will turn white. There can only be one active scale at any one time.

It is possible to select more than one scale in the Scale List. This does not mean that there are multiple active scales, but it does allow for multiple scales to be selected for re-ordering, exporting or deleting (see the following sections).

To select multiple scales, Ctrl/Cmd or Shift click on rows to add them to the selection. Selected rows are highlighted green, however only the row for the active scale will have white text so the active scale can still be distinguished.

Reordering Scales

Scales in the Scale List can be re-ordered by selecting one or more scales and then dragging the selection to a new position in the list. Click and hold anywhere on a selected row, then drag to the desired position. A highlight line will appear between the rows to show where the scales will be moved to. Hold the cursor near the top or bottom of the Scale List to scroll whilst dragging.

Duplicating Scales

Hold Alt whilst dragging as described in the above section to create copies of one or more scales in the Scale List.

Deleting Scales

Scales in the Scale List can be deleted by selecting one or more, then right-clicking on any selected row and choosing 'Delete' from the pop-up menu. Note that if you try to delete all scales in the list, the first one will remain as there must be at least one scale in the list to be the active scale and provide a tuning reference.

Saving Scales

MTS-ESP Master uses its own format for saving scales (.MasterScale). The following is stored with a scale:

- The scale name and description.
- The period and step intervals.
- Mapping and all mapping-related parameters.
- All scale macros and their values.
- The **Tuning Table (page 31)** ordering.
- Which steps are enabled for harmonic display on the graph page.
- Chords stored in the **grid controller chord memory (page 79)**.

There are two ways to save scales to .MasterScale files from the Scale List:

- Click the Scale List File menu icon and select 'Save all...'.
- Select one or more scales in the Scale List, right click on any selected row and select 'Save file(s)...'.

Exporting Scales

Scales can be exported from MTS-ESP Master to commonly used tuning file formats that can be imported into other software. There are three ways to export scales from the Scale List:

- Click the Scale List File menu icon and select a file format from the 'Export all...' sub-menu. The supported export file formats are .tun, .scl and .scl with an accompanying .kbm mapping file, which will be named the same as the .scl file. These options will export all scales in the Scale List to the selected location.

  A 'Bulk export' option allows exporting different formats to multiple locations with a single click (see the **Setup (page 76)** section).

- Select one or more scales in the Scale List, right click on any selected row and choose an option from the 'Export' sub-menu. The same options as described above are available.
- Select one or more scales in the Scale List, click and hold on any selected row and then drag the scales to an Explorer/Finder window. The format used when drag exporting is chosen on the **Setup page (page 76)**.

Applying Mapping To Scales

An 'Apply mapping' option is offered in the Scale List right click menu, to allow for a single mapping to be applied to any number of selected scales at one time. Any .kbm files saved in the following locations will be available to select from this sub-menu:

Win: Documents\OddSound\MTS-ESP Master\Mappings

OSX: Library/Audio/Presets/OddSound/MTS-ESP Master/Mappings
　　~/Library/Audio/Presets/OddSound/MTS-ESP Master/Mappings

Furthermore, the **Map Start (page 29)** and **Ref Note (page 29)** of the active scale can be copied to all other currently selected scales in the Scale List via options in the Scale List Settings menu.

Selecting The Morph Scale

If a **Scale Morph macro (page 59)** is in use and has **Morph Scale (page 60)** set to 'Selector', an extra column will appear in the Scale List allowing you to select the morph scale. A dot will appear in the row for the current morph scale. Click in the Morph column on any row to set the morph scale. See the **Macro (page 59)** section for further info on morphing scales.
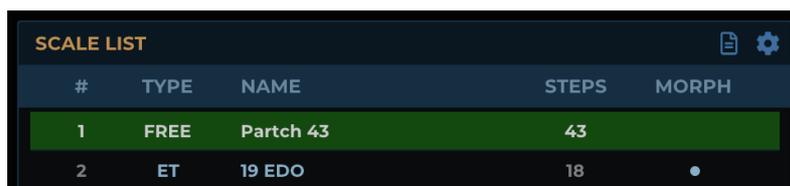
Selecting Scales Using MIDI

It is possible to select both the active scale and the morph scale using MIDI note, CC or program change messages. Settings for assigning these are accessed by clicking the Scale List Settings menu icon.

Note that options for the morph scale are only available when a **Scale Morph macro (page 59)** is in use and has **Morph Scale (page 60)** set to 'Selector' (i.e. when the Morph column is showing).

The following MIDI assignment options are available for both the active scale and the morph scale:

- **Note-On:**
    - Channel: Select the MIDI channel on which the MTS-ESP Master will listen for scale select note messages. An 'Any channel' option is available. Using a specific channel allows the full keyboard range to be used for playing notes on one channel whilst notes on another can select scales.
    - Range start/end: Set the range of MIDI notes to be used for scale selection.
    - Map Range Start To Scale 1: When off, the MIDI note number will select the corresponding scale number in the Scale List offset by one i.e. MIDI note 0 selects scale number 1, MIDI note 1 selects scale 2 etc.

        When on, the first note in the selected MIDI note range selects scale 1 and assignment continues contiguously from there.

- **CC:** Select a MIDI control change number to select scales. The CC value corresponds to the scale number in the Scale List offset by one i.e. a value of 0 selects scale number 1, a value of 1 selects scale 2 etc.
- **Program Change:** Use MIDI program change messages to select scale. The program change value corresponds to the scale number in the Scale List offset by one i.e. a value of 0 selects scale number 1, a value of 1 selects scale 2 etc.
- **Increment/Decrement:** These sub-menus allow specific MIDI CC messages, e.g. from buttons on a MIDI controller, to be assigned to increment or decrement the selected scale. Both a CC number and value must either be chosen via the menu or learned.

MIDI assignments can be learned by selecting 'Learn…' (or 'Relearn…' if already assigned) and sending MIDI data to MTS-ESP Master. It will detect the type of MIDI message and make an assignment accordingly.

When learning from a note-on message, the note value will be set as the Range Start and Channel will be set to 'Any channel'. Range end must be set manually from the menu.

When learning, it is possible to cancel learning without making an assignment by selecting 'Cancel learn' from the Scale List Settings menu.

Whilst listening for a MIDI message to learn from, the scale number ('#') or 'Morph' table heading will flash green. If assigned, they will light solid green.

MIDI assignment can be removed by selecting 'Unlearn' from the Scale List Settings menu.

Active and morph scale MIDI assignments are stored with a preset or session, not globally.

Using key switches to select scales: By assigning note-on messages to select the active scale, you can use the lowest keys on your MIDI keyboard for on-the-fly scale switching. You will need to make sure that MIDI data from your keyboard controller is routed to MTS-ESP Master. Set the note range start and end to the lower and upper keys that you wish to use for scale switching, then enable the 'Map range start to scale 1' setting. You can drag scales around in the scale list to re-order them if you wish to change the selection order.
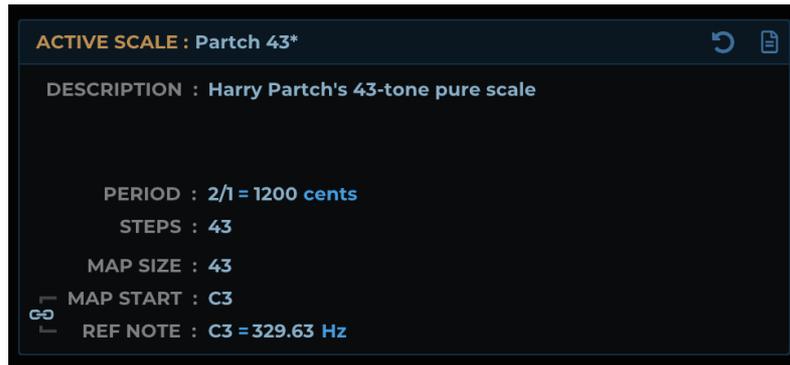
This section contains the most important parameters relating to the active scale:

- **Scale Name:** This is displayed at the very top of the section. Double-click to set a new name. If the scale's type is set to 'Free' and it has been edited from its saved state, an asterisk '*' will appear next to the scale name, both here and in the **Scale List (page 25)**.

- **Scale Description:** A second text parameter with up to three lines available for a more detailed description of the scale. Double-click to edit.

- **Scale Parameters:**
  - **Period:** Set the interval at which the scale pattern repeats. This is shown both as a ratio and interval measure (e.g. "2/1" and "1200 cents" for an octave). If the active scale's type is set to 'Free', alt-dragging on either value will stretch/compress the whole scale.
  - **Steps:** The number of steps in the scale (e.g. 12 steps for 12-TET). MTS-ESP Master supports scales with up to 2048 steps.

- **Mapping Parameters:**
  - **Map Size:** Set the number of MIDI notes over which the scale is mapped.
  - **Map Start:** Set the starting MIDI note for the mapping. The mapping will repeat above and below the start note at a key interval determined by **Map Size**. The Map Start for the active scale can be quickly copied to any number of scales in the Scale List via options in the **Scale List Settings menu (page 27)**.
  - **Ref Note:** Assign a frequency to a specific MIDI note to use as the basis for calculating the frequency of all other notes (e.g. A4 = 440Hz). The Ref Note for the active scale can be quickly copied to any number of scales in the Scale List via options in the **Scale List Settings menu (page 27)**.

- **Link Ref Note To Map Start:** Click the link icon to set the reference note to the same as the map start note. When linked, changing one will automatically change the other.

> The reference note MUST be set to a mapped MIDI note. If any changes to scale mapping result in the reference note not being assigned to a scale step, MTS-ESP Master will automatically set the reference note to the next lowest available mapped note or, in the case there is none lower, the next highest.

Resetting A Scale

A reset button in the Active Scale box header is available if scale type is set to 'Free'. If the scale parameters, intervals or mapping are edited this will light up and can be clicked to return the scale to its saved state.

Active Scale File Menu

The Active Scale File menu contains options for loading, saving and exporting the active scale:

- **Load file…:** Select a file to load into the active scale and replace the existing scale data. Supported formats are .scl, .tun and .MasterScale.
- **Save:**
    - **Save to active scale:** Save any changes to the active scale. This updates the default state referenced when resetting any parameters, tunings or mapping.
    - **Save to new scale:** Save the active scale to a new scale in the **Scale List (page 25)**. The new scale will be inserted below the active scale but is not automatically selected as the active scale.
    - **Save to new scale and reset intervals:** As above, but additionally reset all intervals and the number of steps in the active scale back to their default saved values.
    - **Save to new scale and reset mapping:** As the 'Save to new scale' option, but additionally reset the mapping and all mapping-related parameters to their saved default state.
    - **Save to new scale and reset intervals and mapping:** A combination of the two options above.
    - **Save file…:** Save the active scale to a .MasterScale file.
- **Export:** Export the active scale to a .tun or .scl file. See the **Scale List Exporting Scales (page 27)** section for further information on exporting.
- **Bulk Export:** Bulk export the active scale using the locations and formats set in the Bulk Export Locations table on the Setup page (see the **Setup (page 76)** section).

Keeping the **Ref Note** and **Map Start** linked is often the best way of working, however if the reference note is initially set differently to the map start note, enabling link will shift the pitch of all notes. To avoid this, hold Alt whilst clicking the link icon to maintain the current frequency of the map start note, setting it as the new reference frequency.

If scale type is set to 'Free' from any other type, the scale will be flagged as edited. Remember to select 'Save to active scale' if you wish to update the default state for the scale.

TUNING TABLE						
STEP ▼	KEY	RATIO	CENTS	FREQ	INTERVAL	MACRO ADJ
TONIC	C3	1/1	0.00	329.63	-	-
1	C#3	81/80	21.51	333.75	81/80	-
2	D3	33/32	53.27	339.93	55/54	-
3	Eb3	21/20	84.47	346.11	56/55	-
4	E3	16/15	111.73	351.60	64/63	-

Columns

The tuning table shows the following information for each step of the active scale:

- **Step number:** This denotes the ordering of the scale steps. A star will appear next to the step number if the interval has been edited from its saved value. If MIDI note data is routed into MTS-ESP Master, a circular marker will appear to the left of the step number for any currently playing steps.
- **Key:** The MIDI note(s) in the mapping range which a step is assigned to, if any.
- **Ratio:** The step interval expressed as a ratio. MTS-ESP Master will display an integer ratio where possible, else a decimal value with 3 decimal place accuracy.
- **Interval Measure:** The step interval expressed in cents or commas (as set in the **Display Menu (page 22)**), displayed with 2 decimal place accuracy.
- **Frequency:** The frequency of the step as it would be in the mapping range. The value shown includes any adjustments to step frequency as a result of macro processing.
- **Interval:** The interval between a step and the next lowest numbered step. This can be displayed either as a ratio or interval measure, click the Interval column heading to switch.
- **Macro adjust:** This column will be hidden if there are no macro controls, otherwise it shows the effect of any macros on each step interval. It can be displayed either as a ratio or interval measure, click the Macro Adj column heading to switch. It can be configured to show the resulting step interval after any macro processing, or the deviation from the original step interval (see the **Tuning Table Settings Menu (page 32)** section).

Sorting

The tuning table can be sorted by clicking on the headings as follows:

- **Step:** Sort the Tuning Table by step number.
- **Key:** Sort the Tuning Table in order of mapped notes. Multiple entries will appear for any steps that are mapped to more than one note. Any unmapped steps will appear at the end of the list.
- **Ratio, Interval Measure:** Either of these will sort the table in order of interval size.

Click a heading a second time to switch the sort direction.

The Interval and Macro Adj headings do not sort the table but rather switch the global interval display option between ratio and interval measure (see the **Menu Bar Display Menu (page 22)** section).

Editing Values

If the active scale type is set to 'Free', values in the tuning table can be edited by clicking and dragging or double-clicking to enter values as text. Ratio, Interval Measure, Frequency and Interval are different values that essentially describe the same parameter, i.e. the step interval. Editing one will adjust all others accordingly.

Multiple rows in the tuning table can be selected by Ctrl/Cmd or Shift clicking. With multiple rows selected it is possible to adjust multiple step intervals at the same time. The change in value will be applied to all selected steps. This will have a different effect depending on whether the value being edited is linear (ratio or frequency) or logarithmic (interval measure).

When setting a step interval as text it is possible to set it relative to another step interval as follows:

- For ratios, enter a step number (or 'P' for the period) followed by '*' and then a ratio (either a single decimal number or two numbers separated by '/') to multiply an existing step interval by a ratio.
- For interval measure and frequency values, enter a step number (or 'P' for the period, for interval measure values only) followed by '+' or '-' and then a decimal number to add or subtract from the interval measure or frequency value of another step.

Resetting The Table

A reset button in the Tuning Table box header is available if scale type is set to 'Free'. If any intervals in the Tuning Table are edited from their saved values, or the number of scale steps is changed, this will light up. Click to reset the number of scale steps and all step intervals back to the saved values.

Tuning Table Settings Menu

Display Options:

- **Display Macro Adjustments As:** This option applies to the macro adjustments column, which is hidden if no macros have been added. The options are:
    - Absolute: Show the resulting step intervals after macro processing.
    - Difference: Show the deviation from the original step intervals after macro processing.

Scale Options:

- **Rearrange scale in increasing pitch order:** This will reorder the steps of the scale such that step interval size always increases with step number.
- **Delete unmapped steps:** This will remove any unmapped steps from the scale.
- **Delete duplicate steps:** This will remove any steps which have the same interval.
- **Invert scale:** This will alter all step intervals such that the interval pattern of the scale is inverted.
- **Approximate scale:** This is a sub-menu allowing selection of any other scale in the **Scale List (page 25)** which has a smaller number of steps than the active scale. The number of steps in the active scale will be reduced to equal the number of steps in the scale selected from the menu, keeping only the intervals closest to those in the selected scale.

> **Entering Intervals Relative To Another Step Example:** If step 1 of the scale is set to 8/7 and you wish to set step 6 to a just perfect fifth (i.e. 3/2) above, enter "1*3/2" in the ratio column for step 6.
>
> This expression also works with the 'h' and 's' syntax for harmonics and subharmonics. For example, if the period is set to 2/1 you could enter "1*h3" to achieve the same result, since a period-reduced 3rd harmonic (3/1) equates to 3/2.
>
> If you wish to set step 6 to a 12-TET tempered perfect fifth (700 cents) above, enter "1+700" as the cents value for step 6.
>
> See the **Interval Controls (page 17)** section for some other syntax tricks available when entering intervals as text in the Tuning Table.

MIDI Options:

See the 'Process MIDI Files' section for a description of these options.

Macro Options:

- **Create New:** The options in this sub-menu allow you to create a new **Bend (page 55)** or **Switch (page 56)** macro for all edited steps. The edited step intervals are reset to their default values after the macro is created. Using these options a scale can be edited, then a macro control quickly created which moves a scale between its edited and default states.
- **Add To Existing:** The options are the same as for 'Create New' however they apply to existing **Bend (page 55)** or **Switch (page 56)** macros, if any have been created, otherwise these options are unavailable.

Tuning Table Right-Click Menu

Right click on any row in the Tuning Table for options that apply to the selected step(s). The following options will be available where appropriate:

- **Insert Step:** Insert a new scale step either before or after the selected step. The interval for the new step will be set mid-way between the two steps according to one of two options:
  - Mid ratio/frequency: Use the middle ratio value between the two steps (linear).
  - Mid cents/commas: Use the middle cents/commas value between the two steps (logarithmic). This option corresponds to how the ear perceives pitch.
- **Delete Step:** Remove all selected steps from the scale.
- **Reset Step:** Reset the intervals of all selected steps to their stored values. The step number for any edited steps will have a '*' next to it.
- **Invert Ratio:** This swaps the numerator and denominator of the interval or, put another way, divides 1 by the interval ratio. Period reduction/expansion is then applied to keep the inverted ratio within the period range.
- **Snap To Ratio:** This snaps selected step intervals to the nearest integer ratio with the lowest possible numerator and denominator, within the snap constraints set on the **Setup page (page 75)**.
- **Best Approximations:** This sub-menu offers a list of best rational approximations within the snap constraints set on the **Setup page (page 75)**.
- **Set As Ref Freq:** Set the frequency displayed for the selected step as the reference frequency.
- **Set Mode From Selected Step:** Adjust the intervals such that the interval pattern is rotated to start from the selected step.

Creating An Equal Temperament Approximation Of A Just Intonation Scale: One way to use the Approximate Scale feature is to quickly create an approximation of a just intonation scale from an equal temperament. First load the just intonation scale into the **Scale List (page 25)**. Next add a new **Rank 1 ET (page 38)** scale, set **Divisions (page 38)** as desired (it must be greater than the number of steps in the just intonation scale) and then set the scale type to Free. When scale type is set to Free you will be able to access the **Approximate Scale (page 32)** sub menu from the **Tuning Table Settings menu (page 32)** and select the just intonation scale. The number of steps will be reduced to match the just intonation scale which will likely result in some unmapped keys, so load or select a mapping preset from one of the **Keyboard menus (page 50)** after doing this.

After approximating a scale, you can see how much it deviates from the original scale by going to the graph page and selecting the original scale as the reference scale. If the **Circle Graph (page 70)** is selected, select '**Scale Labels (page 72)**->Difference' from the **Graph Settings menu (page 71)** to see the difference intervals next to the nodes.

- **Macro options:**
  - **Create New Macro...:** Create a new **Bend macro (page 55)** with the selected steps as destination steps. If the interval for any selected step has been edited from its saved value, it will be reset and the difference will be set as the range for that destination step.

    Dragging selected steps to the **Macro List (page 53)** acts as a shortcut for this option.

  - **Create New Switch Macro...:** Create a new **Switch macro (page 56)** with the selected steps as destination steps. If the interval for any selected step has been edited from its saved value, it will be reset and the edited will be assigned to macro value 1.

    Dragging selected steps to the **Macro List (page 53)** with the Alt key held acts as a shortcut for this option.

  - **Add To Existing Macro...:** Add selected steps as destinations to any existing **Bend (page 55)** or **Switch (page 56)** macro.

    If the interval for any selected step has been edited from its saved value, it will be reset and, for **Bend macros (page 55)**, the difference will be set as the Range, else for **Switch macros (page 56)** the edited value will be assigned to the current macro value.

    If the existing macro already has one of the selected steps as a destination, the step will be added a second time, as it is entirely valid for a **Bend (page 55)** or **Switch (page 56)** macro to have repeat entries for the same step in its destination list.

Tuning Line

A small tuning line is displayed at the bottom of the Tuning Table. The scaling is logarithmic, so markers that are the same distance apart are the same number of cents or commas apart.

Markers are shown as the step number, or 'T' for tonic or 'P' for period. If markers are close enough together such that their labels would overlap, they are shown as circular nodes instead.

Click a marker to select it. The Tuning Table will automatically scroll to the corresponding row. Ctrl/Cmd click markers to add or remove them from the selection and Shift click to select a consecutive range of markers. The selection in the Tuning Table will follow.

Drag selected markers left or right to edit step intervals. Hold Shift whilst doing so for fine adjust (or broad adjust if fine adjust is set as default - see the **Setup (page 76)** section).

Right click a marker to remove a step from the scale, or double-click in empty space on the line to add a new step.

If MIDI note data is routed into MTS-ESP Master, the markers for any currently playing steps will have light blue vertical lines.

If the active scale type is not set to 'Free', the markers on the tuning line will be grey and cannot be freely dragged.

Exploring The Modes and Inverted Modes Of A Scale: A quick way to find new scales is to explore the modes and inverted modes of a scale. The '**Set Mode From Selected Step (page 33)**' option rotates the interval pattern to start from the selected step. Repeatedly doing this on step 1 will eventually cycle through all modes. If you like a particular mode, you can save it as a new scale in the **Scale List (page 25)** by selecting '**Save To New Scale (page 30)**' from the **Active Scale File menu (page 29)**.

After going through the modes of a scale, you can invert it with the '**Invert Scale (page 32)**' option in the **Tuning Table Settings menu (page 32)** and repeat the process. Inverting reverses the interval pattern such that e.g. the interval between the tonic and step 1 swaps with the interval between the last step and the period. The same applies to other pairs of intervals moving in towards the middle of the scale. Inverting *doesn't* mean that the scale is reversed on a keyboard i.e. high notes at the bottom and low notes at the top.

Process MIDI Files
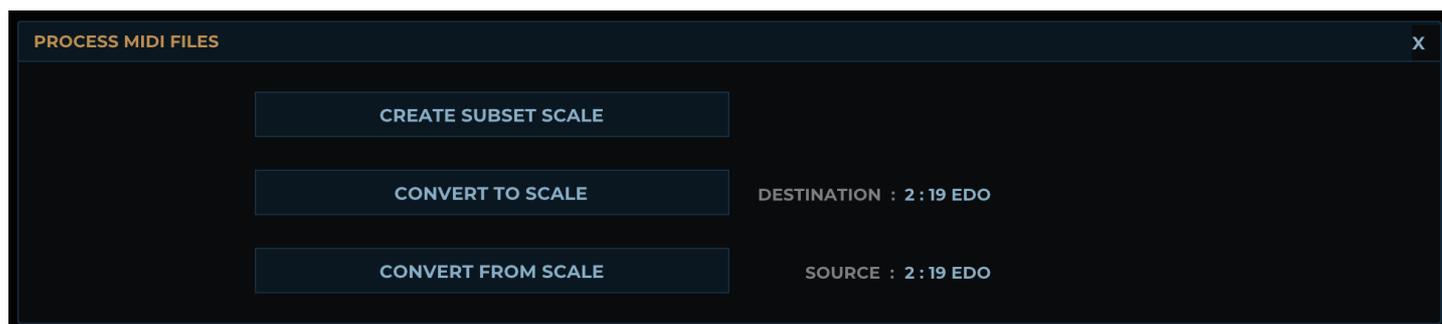
MTS-ESP Master can process MIDI files, adjusting note values in the MIDI data. This allows an existing composition to be translated to a different tuning or for unused notes to be removed from a scale, handy for making scales with many notes easier to work with.

There are two main features, 'Create subset from MIDI files' and 'Convert MIDI files from scale'. These can be accessed from the **Tuning Table settings menu (page 32)**, or by dragging and dropping MIDI files onto the middle box.

- **Create subset from MIDI files:** This will examine the MIDI files and create a new subset scale in the **Scale List (page 25)** which contains only the played steps in the active scale. The active scale will then automatically switch to the new subset scale. Additionally, MTS-ESP Master will create copies of the imported MIDI files, adjust the note numbers such that they will sound exactly the same when played using the new subset scale.

- **Convert MIDI Files To Scale:** This option can be used to convert MIDI files that were created with the active scale to be played with another in the **Scale List (page 25)**. MTS-ESP Master will create copies of the MIDI files, adjusting each note number so that it plays the frequency nearest to its original pitch. The active scale will automatically switch to the chosen destination scale when using this option.

- **Convert MIDI Files From Scale:** This option can be used to convert MIDI files that were created with a different scale to be played with the active scale. The original scale must be loaded into the **Scale List (page 25)**. MTS-ESP Master will create copies of the MIDI files, adjusting each note number so that it plays the frequency nearest to its original pitch.

After selecting one of the above options, the MIDI icon in the top left of the middle box will turn light blue, indicating that a new set of processed MIDI files is available. Either click and drag the MIDI icon to drag-export the MIDI files to a DAW or Explorer/Finder, or left-click the icon to open a file browser and select a location to save.

After exporting, the MIDI icon will turn a darker blue to indicate that MIDI has been exported but still exists in temporary storage, so you can drag or export the last processed MIDI files again if required.

Exported MIDI files will retain their original names, so make sure to select a different location from where they were loaded to avoid overwriting the original files when exporting.

A scale can be set to one of a number of types. The 'Free' type allows the number of scale steps and step intervals and to be set freely.

The other types, as detailed in this section, use specific parameters and rules to define the number of scale steps and step intervals. For any of these types, the central box shows the parameters that define the scale, however it is still possible to view the **Tuning Table (page 31)** using the drop-down menu next to the heading at the top left of the box.

When one of these types is selected, the **Steps (page 29)** parameter, the values in the tuning table and the nodes and labels on the graphs will turn grey to indicate that they cannot be edited. Any options in the **Tuning Table (page 32)** and **graph (page 71)** menus which edit the scale will not be available.

The following parameters are available for all scale types detailed in this section:

How To Apply A Mode Pattern:
Using 12-TET as an example (0 cents, 100 cents, 200 cents...etc.), a mode pattern of "2" will pick every second step, giving a scale comprising 0, 200, 400, 600, 800 and 1000 cent steps. A mode pattern of "2 3" will pick every second then third step giving a scale comprising 0, 200, 500, 700 and 1000 cent steps. A mode pattern of "2 2 1 2 2 2 1" will give the diatonic major scale.

- **Auto Map:** It is possible that editing scale parameters will change the number of scale steps and therefore require the keyboard mapping to be adjusted. **Auto Map** allows a specific mapping preset to be applied whenever the number of steps changes, to save this having to be done manually. When an Auto Map preset is selected, the **Map Size (page 29)** parameter is disabled and editing mapping via the **Keyboard (page 50)** is not allowed. If a mapping is loaded via the **Keyboard File menu (page 52)** or selected from the **Keyboard Settings menu (page 50)**, **Auto Map** will automatically be set to OFF.
- **Apply Mode:** This applies a repeating mode pattern to the generated intervals. The mode pattern is entered as a series of space-separated integers. The integers define the number of generated intervals that are skipped. To clear the mode pattern enter blank text and press enter.

How Scales Are Made

A common way to create scales is using generators. A generator is an interval that, considered as a ratio, is multiplied or divided either by itself or other generators to create scale steps.

12-tone equal temperament has a single generator ratio of 1.0594 (see **Cents...An Interval Measure Based On How We Perceive Pitch (page 18)** to see where this value comes from). We can define any step in 12-tone equal temperament by repeatedly multiplying this ratio by itself, e.g. step 7 = 1.0594^7 = 1.4983. In this case it is easier to think of the generator being 100 cents, then we can repeatedly add the generator to itself instead of multiplying: step 7 = 100 × 7 = 700 cents.

A scale can have more than one generator. If we have generators of 100 and 150 cents, we can add them together to create a scale step at 250 cents, half-way between a 12-TET major second and minor third, an interval we don't normally hear in modern western music.

One of a scale's generators is usually designated the 'period'. This is the interval at which the scale repeats and is commonly set to the octave i.e. 2/1.

12-tone equal temperament can be considered to have a period of an octave (i.e. 2/1 or 1200 cents) and a generator of 100 cents. While it's convenient to think of 2/1 as the period and it holds true that the scale repeats every octave, it is not technically a generator as it can itself be generated from the 100 cents generator.

Scale steps are generated using 3/2, repeatedly multiplying it by itself: 3/2, 9/4, 27/8, 81/16 etc. With the exception of 3/2, these intervals are all greater than 2/1, which is not what we want for our scale. We want the intervals to increase in size from the unison (1/1) to the octave (2/1) but not exceed the octave. This is where the period comes into play. If a ratio exceeds the period, we can 'period reduce' the interval by repeatedly dividing it by the period ratio until it is somewhere between 1/1 and the period. With a period of 2/1 this is equivalent to repeatedly transposing down an octave. For our Pythagorean intervals this now gives us 3/2, 9/8, 27/16, 81/64 etc. We can arrange these intervals in order of size to get the final scale.

It is also possible to divide a ratio by itself to generate intervals. This will create the reciprocal of the above pattern i.e. 2/3, 4/9, 8/27, 16/81 etc. These intervals are all less than 1/1 and therefore descending. They must be repeatedly multiplied by the period ratio (i.e. transposed up an octave) until they are somewhere between 1/1 and 2/1, giving 4/3, 16/9, 32/27, 128/81 etc.

The Rank 2 scale type in MTS-ESP Master can be used to create a Pythagorean scale if **Generator (page 38)** is set to 3/2 and **Period (page 29)** (in the **Active Scale box (page 29)**) set to 2/1. The **Up (page 38)** and **Down (page 38)** parameters determine how many times the generator is multiplied (**Up (page 38)**) and divided (**Down (page 38)**) by itself to create steps for the scale. The steps are automatically multiplied or divided by the period to keep them within the period range and also automatically sorted in increasing size order. Select the 'User Guide Examples' preset from the **Preset Menu (page 22)** in the **Menu Bar (page 21)** and select scale 1, 'Pythagorean 12', for an example of a 12 step Pythagorean scale.

Period (page 29) and **Generator (page 38)** can be set to any interval you like and the **Up (page 38)** and **Down (page 38)** parameters adjusted to determine the number of steps in the resulting scale. If the generator is set to an integer ratio, keeping the **Up (page 38)** and **Down (page 38)** parameters set to the same value, or as close as possible, will result in the simplest possible integer ratios for the scale steps (i.e. lower numbers for the numerator and denominator).

The Pythagorean Comma

We have seen that with the Pythagorean tuning system we can create scale steps by repeatedly multiplying by 3/2 and period reducing. If we continue to do this then we will eventually get the ratio 531441/524288 = 1.01632 = 23.46 cents. This small interval is known as the 'Pythagorean comma' and is available to select as one of the commonly used commas for the **Comma Ratio** on the **Setup page (page 75)**.

To see why using this comma may be useful as an interval measure select it as the **Comma Ratio**, then from the **Display Menu (page 22)** in the **Menu Bar (page 21)**, set Interval Measure to Comma and select Commas as the global interval display.

Select the 'User Guide Examples' preset from the **Preset Menu (page 22)** in the **Menu Bar (page 21)** and select scale 2, 'Pythagorean 13'. Compared with scale 1 'Pythagorean 12', **Down (page 38)** is set to 6 and a new step is added in the middle of the scale. Steps 6 and 7 are very close together, separated by an interval equalling exactly one Pythagorean comma. Switch to view the **Tuning Table (page 31)** and look down the Interval column to see this (click the Interval column heading to switch display of the intervals between ratios and commas).
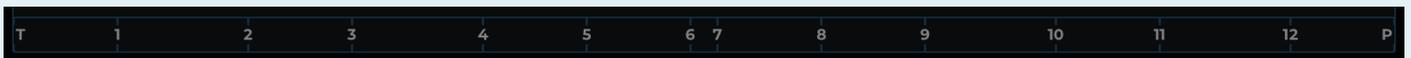
Steps 6 and 7 are so close together compared with the rest of the steps that it would seem to make sense to view them as alternative options for a single step and just pick one of them. Indeed shifting an interval up or down by a comma can be thought of as picking an alternative just intonation interval for a step and may produce a more consonant chord in certain instances. Try setting MTS-ESP Master's internal synth **Wave (page 50)** to saw, then play a major triad chord starting on step 11, going up to step 3 and then up to step 6 or 7. Switch between 6 and 7, listening for a change in consonance. Step 7 should seem the more consonant choice. Next try playing a major triad starting on step 6 or 7, going up to step 11 and then up to step 1. Switching between 6 and 7 should now reveal step 6 as the more consonant option.

Later on we will see how to use a macro to switch a step interval between two values, which in this case would make it possible to use a 12 step scale that maps nicely to a piano keyboard but still allow access to the more consonant version of both chords.

Rank 1 ET (Equal Temperament)

This divides a larger interval (the period) into a number of equally sized intervals, such that the interval between any two adjacent steps is constant. The period is set from the **Active Scale box (page 29)**, therefore this type has just a single parameter:

- **Divisions:** Set the number of equally sized intervals that make up the scale.

Rank 2

This uses a generator interval to create scale steps. The generator ratio is repeatedly multiplied or divided by itself and the resulting intervals from each multiplication or division are period-reduced to form the scale. Three parameters are available:

- **Generator:** Set the generator interval either as a ratio or interval measure.
- **Up:** Set the number of times the generator ratio is multiplied by itself to generate scale steps.
- **Down:** Set the number of times the generator ratio is divided by itself to generate scale steps.

Rank 2 MOS (Moment Of Symmetry)

This also uses a generator interval to create scale steps, however MTS-ESP Master calculates and allows you to only select from the scale sizes that will produce a MOS scale for the given period and generator intervals. A MOS scale is one in which all step spans except for the period come in two different interval sizes.

- **Generator:** Set the generator interval either as a ratio or interval measure value.
- **Steps:** Set the number of scale steps. Either click for a drop-down menu or use the mousewheel to select.
- **Up:** Set the number of times the generator ratio is multiplied by itself to generate scale steps.
- **Down:** Set the number of times the generator ratio is divided by itself to generate scale steps.

  The **Up** and **Down** parameters are linked such that the size of the generator chain is always equal to the number of scale steps minus 1. If the number of scale steps is changed, the **Up** and **Down** parameters will be automatically adjusted.

- **Secondary MOS Size:** This parameter allows creation of a secondary MOS scale derived from the MOS scale defined by the above parameters.

  The secondary MOS is created from a generator chain, however at one link in the chain the generator may be replaced by the disjunction. The disjunction is the interval between the upper end of the MOS generator chain and the next highest period. The **Up**/**Down** parameters determine the position of the disjunction in the chain, such that it is one greater than the **Up** value. The size of the generator chain is one less than the **Secondary MOS Size**, so the **Up** value must be at least 2 less than the **Secondary MOS Size** for the disjunction to be used in the chain and provide a variation in the resulting secondary MOS scale.

- **Mode:** This sets the mode of the secondary MOS scale, essentially rotating the interval pattern.

Moment Of Symmetry (MOS) And Secondary MOS scales

We can continue to use the Pythagorean tuning system to show an example of a MOS scale. Select the 'User Guide Examples' preset from the **Preset Menu (page 22)** in the **Menu Bar (page 21)** and select scale 3, 'Pythagorean MOS', for an example of a 7 step Pythagorean MOS scale. Switch to viewing the **Tuning Table (page 31)** and look down the Interval column (if necessary, click the Interval column heading to switch from displaying interval measures to ratios). You will see only two different interval sizes in the column, 9/8 (five of them) and 256/243 (two of them). Switch back to the Scale Parameters and set **Up (page 38)** to 7, then have another look at the Interval column in the **Tuning Table (page 31)**. You will now see three different interval sizes (there is now a 2187/2048 interval there). With **Up (page 38)** set to 6 the scale is a MOS scale but with **Up (page 38)** set to 7 it is not.

A MOS scale is one in which all step spans except for the period come in two different interval sizes, with the relative number of different interval sizes being coprime (in the above example the interval counts, 5 and 2, are coprime). It's not necessary to stall over this definition as MTS-ESP Master has a **Rank 2 MOS scale type (page 39)** which takes care of making sure the scale you're defining is definitely a MOS scale. The reason for using a MOS scale over any old Rank 2 scale is that the resulting scale is likely to sound more cohesive, so you may prefer to start experimenting with the **Rank 2 MOS type (page 39)** before the **Rank 2 type (page 38)**.

Select the 'User Guide Examples' preset from the **Preset Menu (page 22)** in the **Menu Bar (page 21)** and select scale 4, 'Pythagorean Secondary MOS'. The parameters that define a **Rank 2 scale (page 38)** are all present, but now there is a **Steps (page 39)** parameter. You are no longer allowed to independently set the **Up (page 39)** and **Down (page 39)** parameters. Instead they are linked and limited so that the scale size always equals the **Steps (page 39)** parameter. For given **Period (page 29)** and **Generator (page 39)** intervals, MTS-ESP Master calculates the scale sizes that will produce MOS scales and allows you to select only from these.

There are also two extra parameters, **Secondary MOS Size (page 39)** and **Mode (page 39)**, that allow you to create a secondary MOS scale, based on the MOS scale defined by the other parameters. A secondary MOS scale uses a subset of steps from a MOS scale to create new scales and, unlike a primary MOS scale, may have more than two distinct interval sizes between its steps.

With the 'Pythagorean Secondary MOS' example scale, the MOS scale is created by repeatedly multiplying the generator by itself to generate 6 steps. Prior to any period reducing the intervals will be 3/2, 9/4, 27/8, 81/16, 243/32, 729/64. The **Secondary MOS Size (page 39)** determines how many of these intervals, starting with the lowest, are used to create the subset for forming secondary MOS scales. The higher ones are discarded and the rest are period reduced to form the final subset.

The subset is itself a secondary MOS scale. The **Mode (page 39)** parameter rotates the interval pattern of the subset to create further secondary MOS scales, much like using the **Set Mode From Selected Step (page 33)** option in the **Tuning Table right-click menu (page 33)**.

For further reading, a great introduction to MOS scales by Kraig Grady can be found at **http://www.anaphoria.com/wilsonintroMOS.html**.

Rank 3

GENERATOR	RATIO	UP	DOWN	COEFF A	COEFF B	PERIOD COEFF
1	3/2	2	2	-	0 (g2)	0
2	5/4	1	1	-	0 (g1)	0

AUTO MAP : **CHROMATIC CONTINUOUS**   APPLY MODE : -

This uses two generator intervals to create scale steps. The parameters are presented in a table as follows:

- **Generator:** The number of the generator.
- **Ratio/Interval Measure:** The generator interval. Click the column heading to switch between displaying ratios and interval measures.
- **Up:** Set the number of times the generator ratio is multiplied by itself to generate scale steps.
- **Down:** Set the number of times the generator ratio is divided by itself to generate scale steps.
- **Coeff A:** If enabled, the generator interval will be linked to either the other generator's interval, the period or both, such that editing one will cause the other(s) to adjust.

  To enable linking for a generator, either **Coeff B** or **Period Coeff** need to be set to a value other than 0. The parameter values can then be read across from the **Coeff A** column as coefficients in a formula that defines the linking (with intervals considered logarithmically):

  (**Coeff A** × target gen interval) + (**Coeff B** × other gen interval) = **Period Coeff** × period interval

  For example if generator 1 has **Coeff A** set to 3, **Coeff B** set to 5 and **Period Coeff** set to 2, this defines the rule:

  (3 × generator 1) + (5 × generator 2) = 2 × period

  With a period of 1200 cents, entering a value of 200 cents for generator 1 will automatically set generator 2 to (2 × 1200 - 3 × 200) ÷ 5 = 360 cents.

  Linking a generator effectively reduces the rank by 1. It can only be enabled for one of the generators, otherwise the rank would be reduced to 1 and it would not be possible to freely edit either of the generators. If one generator is linked, the **Coeff A**, **Coeff B** and **Period Coeff** parameters for the other will be disabled. One exception to this is allowed, which is linking both generators to only the period, allowing mixing of steps from two different equal temperaments.

- **Coeff B:** Set the coefficient for the other generator in the linking formula. The other generator's number is specified in brackets after the parameter value as a visual reminder.
- **Period Coeff:** Set the coefficient for the period in the linking formula i.e. the number of periods equal to the specified generator combination.

Pitch Space

A scale can be said to exist in a pitch space. A pitch space contains all the possible intervals that can be created from the generators. We can give pitch space a number of dimensions, equalling the number of generators. We can also give it a finite size by specifying the maximum number of times we can multiply or divide by each generator, thus defining a 'lattice'.

As discussed in **How Scales Are Made (page 36)**, 12-tone equal temperament technically has a single generator of 100 cents. We can represent this scale on a single line, moving along it by a distance representing 100 cents to get from one interval to the next.

For the Pythagorean tuning system we need a two-dimensional lattice, since there are two generators (including the period). Starting from a known point representing the tonic, multiplying by the generator (3/2) moves upwards one position on the lattice, dividing moves downwards one. Similarly multiplying by the period (2/1) moves rightwards one position and dividing moves leftwards one. We can place a Pythagorean interval on the lattice by counting the number of times we multiply or divide by each generator to create it.
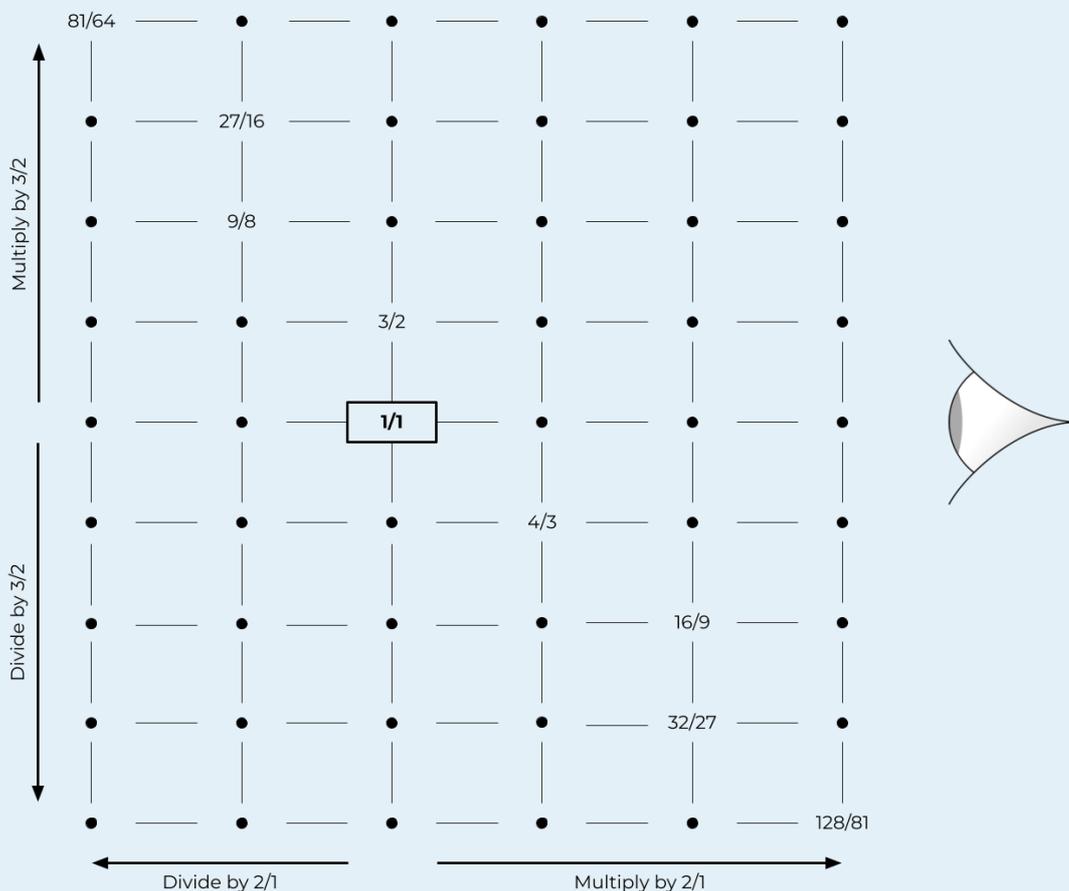
In practice it is uncommon to use the period when visualising pitch space, since it is assumed that the role of the period in creating scale steps is *only* in period reducing intervals so that they fall between 1/1 and the period interval. We can get a simpler, one-dimensional view of this pitch space by 'viewing' it from the side instead of the top (indicated by the eye to the right of the lattice above, and set out horizontally below):
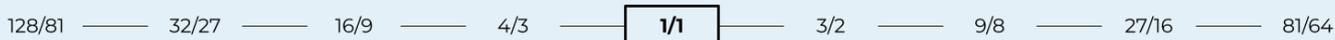
This allows us to add another generator and thus a third dimension to the pitch space, but view it as an easier-to-understand and more compact two-dimensional lattice. To add another generator in MTS-ESP Master we need to use a **Rank 3 scale (page 41)**. Select the 'User Guide Examples' preset from the **Preset Menu (page 22)** in the **Menu Bar (page 21)** and select scale 5, '5-Limit'. This expands the Pythagorean tuning system, which has no prime numbers greater than 3 in its ratios, to a 5-limit tuning system i.e. no prime numbers greater than 5. The new generator is 5/4 (a just major third), giving us the following lattice:
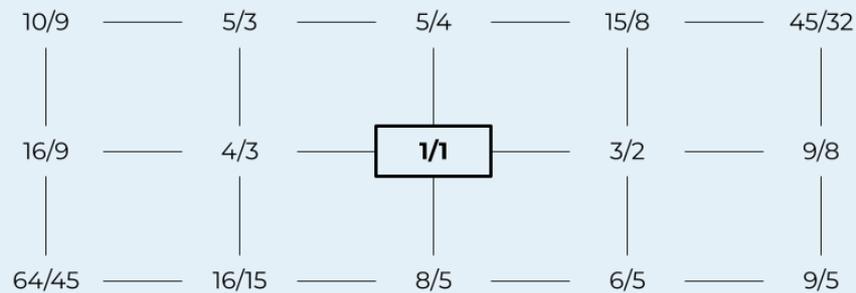
MTS-ESP Master adds all intervals in the defined lattice to the scale, sorting them in order. As **Up (page 41)** and **Down (page 41)** are increased the number of steps grows exponentially and the scale might become difficult to work with. Therefore the Rank 3 scale type might be best used to create a collection of intervals from which to create smaller scales. There are a few ways this can be done in MTS-ESP Master, including:

- Using a **Mode Pattern (page 36)**.
- **Approximating another scale (page 32)** .
- **Creating a subset from MIDI files (page 35)** .
- Setting the scale type to 'Free' and manually removing steps.
- Using the **Rank 3 PB scale (page 45)** type instead, which algorithmically selects a set of intervals from the defined pitch space to form a potentially coherent scale.

Another use for a **Rank 3 scale (page 41)** may be to morph a scale from its own pitch space to another in real-time using a **Scale Morph macro (page 59)**.

Linking Generators, Tempering And Rank

As well as being able to freely set a generator interval, the **Rank 3 scale (page 41)** type allows you to define a generator interval in terms of the other generator intervals, including the period. In other words it allows 'tempering'. This is what the three parameters to the right of the generator table are for.

With **Coeff A (page 41)** disabled for both generators you can set each generator interval freely. To enable **Coeff A (page 41)**, set either the **Coeff B (page 41)** or **Period Coeff (page 41)** to a value other than 0. Select the 'User Guide Examples' preset from the **Preset Menu (page 22)** in the **Menu Bar (page 21)** and select scale 6, '12-TET Link'. The linking automatically sets generator 1 to 100 cents (click on the generator interval column heading to switch between ratios and interval measures), just as with 12-tone equal temperament, and with **Up (page 41)** set to 11 we have all the steps from the 12-tone equal temperament chromatic scale. The generator interval is greyed out indicating it cannot be freely edited, since its value is now dependent on the period interval. Edit **Period (page 29)** and you will see the generator interval automatically adjust.

The **Coeff B (page 41)** parameter includes generator 2 in the calculation of generator 1s interval. As a common example we'll look at Meantone temperament. Select the 'User Guide Examples' preset from the **Preset Menu (page 22)** in the **Menu Bar (page 21)** and select scale 5, '5-Limit'.
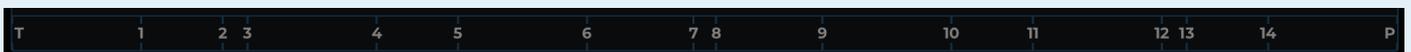
When looking at the scale in the **Tuning Line (page 34)**, you'll see there are three pairs of steps that are very close together (2-3, 7-8 and 12-13). If we could pick just one for each of these, we would have a 12-tone scale that maps nicely to the piano keyboard. Set **Comma Ratio** to 81/80 (syntonic comma) on the **Setup page (page 75)**, then from

the **Display Menu (page 22)** in the **Menu Bar (page 21)**, set Interval Measure to Commas and select Commas as the global interval display. Look down the Interval column in the **Tuning Table (page 31)** and see that two of these interval pairs are separated by exactly one comma.

The comma can be obtained using the generators: (3/2 × 3/2 × 3/2 × 3/2) ÷ 5/4 = 81/20. After period reducing this becomes 81/80, which is two octaves down from 81/20. This tells us that creating an interval by going up four generator 1s, then down by generator 2, is very close to two octaves.

We can use the **Coeff A (page 41)** parameter to say that 'up by four generator 1s and down by generator 2' actually equals two octaves, thus making the comma 'disappear'. Select scale 7, 'Meantone'. Reading the parameter values across the row in MTS-ESP Master we can infer the formula:

(4 × generator 1) + (-1 × generator 2) = 2 × period

The linking has reduced the 15 scale steps of the '5-Limit' scale down to 13 steps. There is still one pair of steps that is close together, 6-7 in the middle, as with the Pythagorean tuning example in **The Pythagorean Comma (page 37)**, although they are a little further apart now. At the expense of consonance, we have reduced the number of alternative steps we need to choose from to map nicely to a piano keyboard. Such is the aim of this 'tempering' process and here we have created a meantone temperament, 'quarter comma meantone' to be exact, since generator 1 interval has been reduced by a quarter of a comma.

We can adjust the distance between steps 6 and 7 by editing either generator interval (hold shift for fine-adjust, or enable fine-adjust as the default on the **Setup page (page 76)**), moving through the range of Meantone temperaments. Note that it is possible to set either generator freely and, when you do so, the other will automatically adjust, since the linking formula must be obeyed. Likewise adjusting **Period (page 29)** will automatically adjust both generator intervals. Set generator 1 interval to 3/2 (you can double click to enter this as text) and notice that we get a scale equivalent to example scale 2 'Pythagorean 13' that we referred to in **The Pythagorean Comma (page 37)**.

Technically our rank 3 scale has one less generator now, since the linking formula states that one generator can be created from some combination of the other generator and the period. The 'rank' of a scale is equal to the number of generators, including the period, however any generators that are linked or, put another way, any commas 'tempered' out, reduce the rank by 1, so the rank is now effectively 2.

With the **Rank 3 scale (page 41)** type, MTS-ESP Master doesn't allow the rank to be reduced all the way to 1 by linking both generators to each other, as this would require the generator intervals to be set to fixed values and they would not be able to be freely edited. However, in the above example, if generator 1 interval is specifically set to 700 cents the gap between step 6 and 7 closes entirely and we get 12-tone equal temperament, which is rank 1.

Rank 3 PB (Periodicity Block)

GENERATOR	RATIO	POSITION	MULTIPLY	COEFF A	COEFF B	PERIOD COEFF
1	3/2	0.00	1	4	-1 (g2)	-
2	5/4	0.00	1	2	-1 (g1)	-

SHAPE : PARALLELOGRAM
TEMPER : OFF
AUTO MAP : CHROMATIC CONTINUOUS   APPLY MODE : -

This uses two generator intervals to create a scale from a periodicity block defined by two intervals of equivalence.

- **Generator:** The number of the generator.
- **Ratio/Interval Measure:** The generator interval. Click the column heading to switch between displaying ratios and interval measures.
- **Position:** Shift the position of the periodicity block to include a different set of intervals. 1/1 is always guaranteed to be inside the block.
- **Multiply:** This acts as a multiplier for the **Coeff A** and **Coeff B** coefficients. Increasing this adds more steps to the resulting scale.
- **Coeff A:** Unlike with the **Rank 3 scale (page 41)** type, **Coeff A** is always enabled for both generators. **Coeff A** and **Coeff B** set the coefficients used in determining the intervals of equivalence that define the periodicity block. For example if generator 1 has **Coeff A** set to 3, **Coeff B** set to 5, then the interval given by:

  (3 × generator 1) + (5 × generator 2)

  is period-reduced to form an interval of equivalence.

- **Coeff B:** Set the coefficient for the other generator in determining an interval of equivalence. The other generator's number is specified in brackets after the parameter value as a visual reminder.
- **Period Coeff:** If **Temper** is enabled for a generator (see below), this sets the coefficient for the period in the linking formula i.e. the number of periods equal to the specified generator combination.
- **Shape :** Set the shape of the periodicity block between a parallelogram or a choice of two hexagons. 'Hexagon +' creates a hexagon using the sum of the two intervals of equivalence whereas 'Hexagon -' uses the difference.
- **Skew:** If **Shape** is set to one of the hexagon options, this skews the shape of the hexagon. 50% is the default and a good starting point.
- **Hex Position:** The hexagonal shape is defined by three intervals, the two intervals of equivalence and their sum (Hexagon +), or difference (Hexagon -). This parameter positions the hexagon along the sum/difference vector.
- **Temper:** This allows linking of the two generator ratios, as with the **Rank 3 scale (page 41)** type. Only one of the generators can be chosen to define the linking formula, allowing the rank to be reduced to 2 but not 1. **Period Coeff** will be enabled for the selected generator and linking works as described for the **Rank 3 scale (page 41)** type.

Using A Periodicity Block To Limit The Size Of A Rank 3 Scale

In **Pitch Space (page 42)** we saw that the **Rank 3 scale (page 41)** type creates a two-dimensional lattice of intervals, with the **Up (page 41)** and **Down (page 41)** parameters determining the size of the lattice. A periodicity block is essentially a shape placed over that lattice such that any intervals inside it are included in the scale and those outside are left out:

125/72	125/96	125/64	375/256	1124/1024	3375/2048	10125/8192
25/18	25/24	25/16	75/64	225/128	675/512	2025/1024
10/9	5/3	5/4	15/8	45/32	135/128	405/256
16/9	4/3	**1/1**	3/2	9/8	27/16	81/64
64/45	16/15	8/5	6/5	6/5	27/20	81/80
256/225	128/75	32/25	48/25	36/25	27/25	81/50
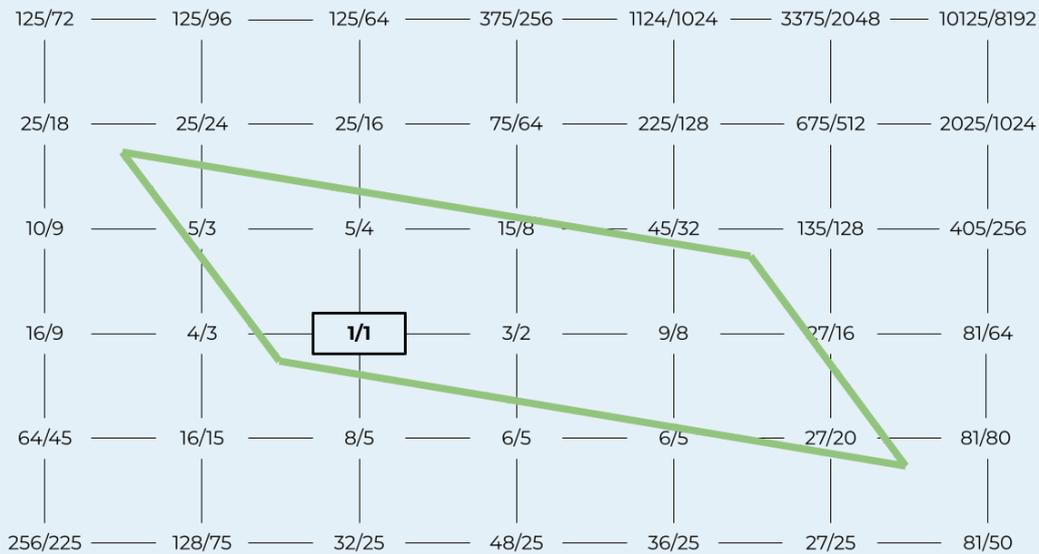
In **Linking Generators, Tempering And Rank (page 43)** we looked at an example '5-Limit' Rank 3 scale with 15 steps (before tempering), which had three pairs of steps very close together. Using a periodicity block can be seen as imposing a choice on which step to keep from each of those pairs. The resulting scale has less steps and no steps very close together, which may be easier to work with.

The shape of the periodicity block is determined by the **Multiply (page 45)**, **Coeff A (page 45)**, and **Coeff B (page 45)** parameters. **Coeff A (page 45)** and **Coeff B (page 45)** define an 'interval of equivalence'. If two intervals on the lattice are separated by this interval, only one of them will be present in the resulting scale.

In the 'Meantone' example scale from **Linking Generators, Tempering And Rank (page 43)**, generator 1 has set **Coeff A (page 41)** to 4 and **Coeff B (page 41)** to -1, which defines an interval of:

interval of equivalence = (4 × generator 1) + (-1 × generator 2)

We can draw a line on the lattice representing the interval of equivalence (note that all intervals in the lattice and the interval of equivalence are expressed in period-reduced form). The line extends four steps across and one step down, forming the bottom of the periodicity block in the previous image.
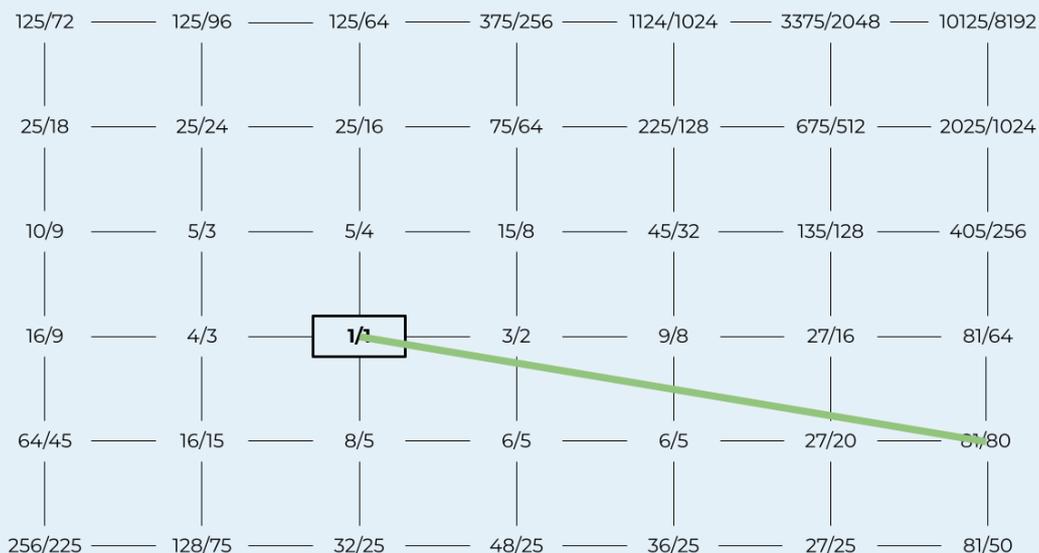
125/72	125/96	125/64	375/256	1124/1024	3375/2048	10125/8192
25/18	25/24	25/16	75/64	225/128	675/512	2025/1024
10/9	5/3	5/4	15/8	45/32	135/128	405/256
16/9	4/3	**1/1**	3/2	9/8	27/16	81/64
64/45	16/15	8/5	6/5	6/5	27/20	81/80
256/225	128/75	32/25	48/25	36/25	27/25	81/50

Select the 'User Guide Examples' preset from the **Preset Menu (page 22)** in the **Menu Bar (page 21)** and select scale 8, 'Periodicity Block Example'. The settings for generator 2 define another interval of equivalence:

interval of equivalence = (2 × generator 2) + (-1 × generator 1)

Note that **Coeff A (page 45)** is the coefficient for generator two in the above formula. Drawing the line representing this interval on the lattice gives us the left hand-side of our periodicity block, as well as the final shape:

125/72	125/96	125/64	375/256	1124/1024	3375/2048	10125/8192
25/18	25/24	25/16	75/64	225/128	675/512	2025/1024
10/9	5/3	5/4	15/8	45/32	135/128	405/256
16/9	4/3	1/1	3/2	9/8	27/16	81/64
64/45	16/15	8/5	6/5	6/5	27/20	81/80
256/225	128/75	32/25	48/25	36/25	27/25	81/50
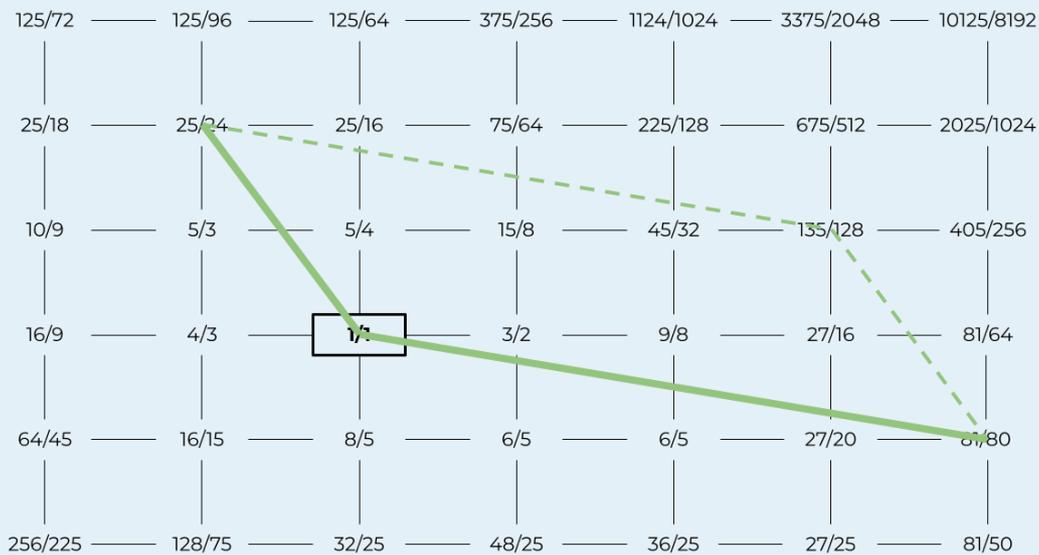
A problem here is that the corners of the block fall exactly on interval points on the lattice, making it difficult to tell if the corner intervals are inside or outside the block. Shifting the position of the block slightly removes this ambiguity:

125/72	125/96	125/64	375/256	1124/1024	3375/2048	10125/8192
25/18	25/24	25/16	75/64	225/128	675/512	2025/1024
10/9	5/3	5/4	15/8	45/32	135/128	405/256
16/9	4/3	1/1	3/2	9/8	27/16	81/64
64/45	16/15	8/5	6/5	6/5	27/20	81/80
256/225	128/75	32/25	48/25	36/25	27/25	81/50

Now we can see there are exactly 7 steps inside the block to form our scale. The **Position (page 45)** values in MTS-ESP Master shift the block around like this and alter the set of intervals included in the scale. The ranges of the **Position (page 45)** parameters are limited such that the 1/1 ratio will always be inside the block and, regardless of what they are set to, the number of scale steps will not change.

After playing with this scale you may feel limited by having only 7 steps. This is where the **Multiply (page 45)** parameter comes in. It acts as a multiplier to the **Coeff A (page 45)** and **Coeff B (page 45)** values in the corresponding row, stretching the block to include more intervals. Setting generator 2's **Multiply (page 45)** to 2 doubles the length of the left and right sides and also the number of steps in the scale (it has been shifted to keep it on the lattice):

125/72	125/96	125/64	375/256	1124/1024	3375/2048	10125/8192
25/18	25/24	25/16	75/64	225/128	675/512	2025/1024
10/9	5/3	5/4	15/8	45/32	135/128	405/256
16/9	4/3	**1/1**	3/2	9/8	27/16	81/64
64/45	16/15	8/5	6/5	6/5	27/20	81/80
256/225	128/75	32/25	48/25	36/25	27/25	81/50
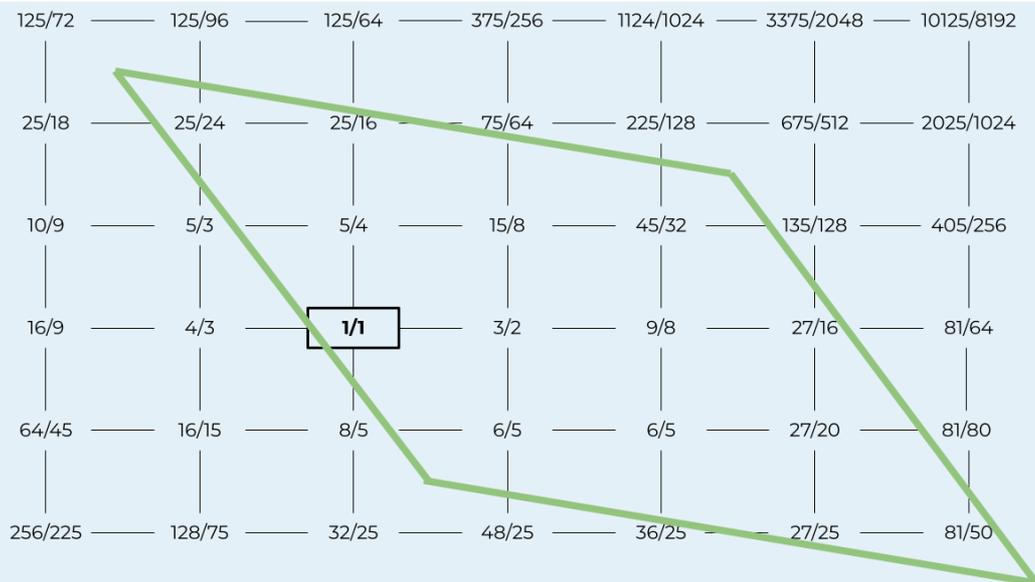
Another way of modifying the selected set of intervals is to cut up and rearrange the parallelogram shape. This works well for creating hexagons and the **Shape (page 45)** parameter does exactly this, giving you a choice of 2 possible hexagons:

125/72	125/96	125/64	375/256	1124/1024	3375/2048	10125/8192
25/18	25/24	25/16	75/64	225/128	675/512	2025/1024
10/9	5/3	5/4	15/8	45/32	135/128	405/256
16/9	4/3	**1/1**	3/2	9/8	27/16	81/64
64/45	16/15	8/5	6/5	6/5	27/20	81/80
256/225	128/75	32/25	48/25	36/25	27/25	81/50

125/72	125/96	125/64	375/256	1124/1024	3375/2048	10125/8192
25/18	25/24	25/16	75/64	225/128	675/512	2025/1024
10/9	5/3	5/4	15/8	45/32	135/128	405/256
16/9	4/3	**1/1**	3/2	9/8	27/16	81/64
64/45	16/15	8/5	6/5	6/5	27/20	81/80
256/225	128/75	32/25	48/25	36/25	27/25	81/50

If using a hexagonal block, two additional parameters are available. **Skew (page 45)** skews the shape of the hexagon, stretching or compressing it. **Hex Position (page 45)** is a third position control, working with the other two to move the shape over the lattice. The default values of 50% for **Skew (page 45)** and 0 for **Hex Position (page 45)** are a good starting point but try experimenting with them to create different scales.

In creating a periodicity block, we are essentially defining two commas with the **Coeff A (page 45)** and **Coeff B (page 45)** parameters. Moving the block with the **Position (page 45)** parameters adjusts individual scale intervals up/down in steps dictated by these commas.

Since commas are small intervals, the best choice of values for **Coeff A (page 45)** and **Coeff B (page 45)** will be those that create small intervals (after period reducing). Thinking in cents is easier for this. With generator 1 set to 3/2 (≈702 cents) and generator 2 to 5/4 (≈386 cents), we can see that:

(4 × 702) + (-1 × 386) = 2422 cents

which is close to two periods (2 × 1200 = 2400 cents), making 4 and -1 good choices for coefficients with these generators. Similar calculations can be experimented with for any given period and generator intervals to find good options for coefficients. When working with typical just intervals for the generators and period, as we have been doing here, you can probably save the calculating and find suitable coefficients from commas that have already been found (see **http://en.xen.wiki/w/Comma**).

For some excellent further reading on periodicity blocks we recommend this article by Paul Erlich: **http://www.tonalsoft.com/enc/f/fokker-gentle-1.aspx**.
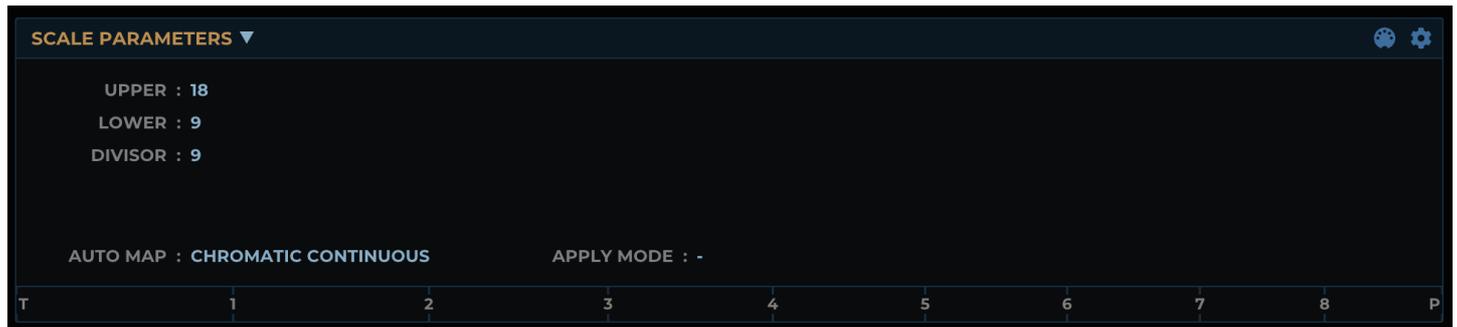
Harmonic Series

This uses period-reduced harmonic and subharmonic series intervals to generate a scale.

- **Upper:** Set the upper harmonic number from which to generate scale steps.
- **Lower:** Set the lower harmonic number from which to generate scale steps.

  MTS-ESP Master will clamp the **Upper** and **Lower** values such that upper is always greater than or equal to lower.

  Negative values for **Upper** and **Lower** indicate subharmonics (i.e. -4 for the fourth subharmonic).

  As an example, values of **Upper**=5 and **Lower**=-3 will form a scale by period-reducing the intervals 1/3, 1/2, 1/1, 2/1, 3/1, 4/1, and 5/1.

  Any duplicate intervals, or any equal to the period or 1/1 are automatically removed.

- **Divisor:** This sets the value of the denominator in the generated harmonic series intervals or, for subharmonic intervals, the value of the numerator. In the above example **Divisor** was set to 1.

  Use this parameter to create a scale from a section of the harmonic or subharmonic series. For example, to create a scale using the intervals between harmonics 9 to 18, set **Upper**=18, **Lower**=9 and **Divisor**=9. This will generate a scale using the intervals 9/9 (1/1), 10/9, 11/9, 12/9 (4/3), 13/9, 14/9, 15/9 (5/3), 16/9, 17/9 and 18/9 (2/1).

  To create a scale using the intervals between subharmonics 9 to 18 (the reciprocal of the above example), set **Upper**=-9 and **Lower**=-18 and **Divisor**=18. This will generate a scale using the intervals 18/18 (1/1), 18/17, 18/16 (9/8), 18/15 (6/5), 18/14 (9/7), 18/13, 18/12 (3/2), 18/11, 18/10 (9/5) and 18/9 (2/1).
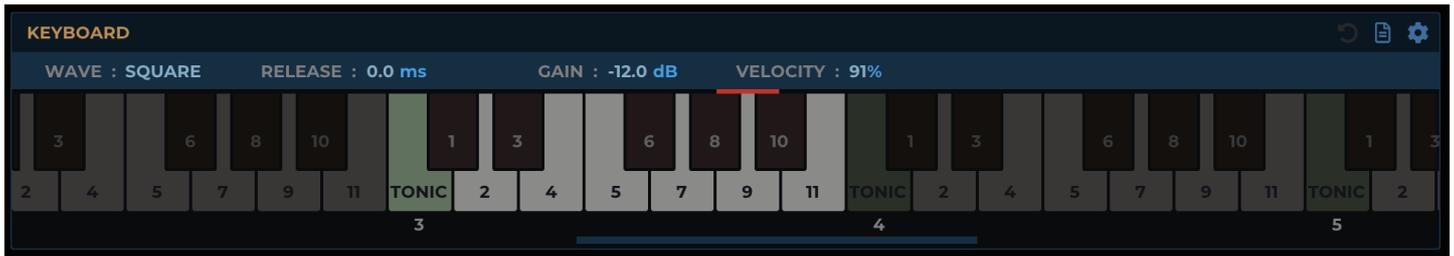
The Keyboard box contains parameters for the MTS-ESP Master internal synth and also allows the mapping for the active scale to be edited.

Internal Synth

MTS-ESP Master has a basic internal synth for auditioning scales and to aid tuning external instruments. Click on the keyboard keys or send MIDI notes into MTS-ESP Master to trigger the synth. The following synth parameters are available:

- **Wave:** Set the waveform to 'Off' to mute the internal synth.
- **Release:** Set the amplitude envelope release time.
- **Gain:** Set the output level.
- **Velocity:** Set the output level velocity sensitivity. At 0% note velocity will have no effect over output level.

The internal synth responds to CC64 (sustain), CC120 value 0 (all sound off) and CC123 value 0 (all notes off).

Scrolling and Zooming

The keyboard can be scrolled and zoomed using the scroll bar below it. Drag left/right to scroll and up/down to zoom. The mousewheel can also be used to scroll or, whilst holding Shift, to zoom. Alt-click the scroll bar to set the map start key to the left edge of the Keyboard box.

Keyboard octave number labels are shown below the keyboard. The octave numbering format can be chosen in the **Setup page (page 75)**.

Key Latch

Alt-click on a keyboard key to latch it on. Left-click with no modifiers to latch it off. This feature allows a chord to be held whilst intervals are adjusted.

Mapping

The keyboard display shows the mapping for the active scale as follows:

- **Mapping Range:** The mapping range is determined by the **Map Start (page 29)** and **Map Size (page 29)** parameters and is shown as a group of highlighted keys on the keyboard.
- **Map Start:** The map start key is coloured green. The mapping repeats at a key interval determined by the **Map Size (page 29)** and the start key for each repeat is also coloured green.
- **Reference Note:** This is indicated by a red marker above the corresponding keyboard key.
- **Step Labels:** If the keyboard is sufficiently zoomed in, a label will be shown on each key showing which step of the scale it is mapped to.

The quickest way to map a scale step to a key is to drag it from the **Tuning Table (page 31)** to a key within the mapping range. It is also possible to drag a step to a key outside the mapping range, in which case the mapping range will automatically be extended.

If multiple steps in the **Tuning Table (page 31)** are selected and dragged to the keyboard, they will be mapped to a continuous range of keys. Hold Alt whilst dragging multiple steps to map to either only white or only black keys, depending on which key the cursor is over.

Right click on a key for the following mapping options:

- **Map To Step…:** Explicitly select a scale step to map the key to. This option is only available for keys in the mapping range.
- **Remove Mapping:** Set a key to be unmapped. This option is only available for mapped keys in the mapping range.
- **Set Map Start:** Set **Map Start (page 29)** to the selected key.
- **Set Reference Note:** Set **Ref Note (page 29)** to the selected key. This option is only available for mapped keys.

The Keyboard Settings menu contains a number of options to quickly set the mapping using either all available keys (chromatic), just the white keys or just the black keys, with the following options:

- **Continuous:** Only available for chromatic mapping, this repeats the mapping starting on the key immediately after the mapping range.
- **Restart after:** The steps are mapped continuously but the mapping is repeated starting on the key <n> keyboard octaves above the map start key.
- **Divide between:** The steps are split between <n> octaves of the keyboard. The mapping in each octave is continuous, with any unmapped keys at the top of the octave. The mapping is repeated starting on the key <n> keyboard octaves above the map start key.
- **Spread over:** Each step is repeated on consecutive keys as evenly as possible over <n> octaves of the keyboard, so that the mapping range is completely filled. The mapping is repeated starting on the key <n> keyboard octaves above the map start key.

An option to clear all mappings is available in the Keyboard Settings menu. This will remove all except for the reference note, which must always be set to a mapped key to provide a reference for calculating frequencies.

Quickly Mapping A Scale: Of the available mapping options, 'Map Chromatically->Continuous' will probably be the most frequently used as it leaves no keys unmapped. The 'restart' and 'divide' options may be more useful if mapping a scale that doesn't have 12 steps to a piano keyboard. A scale with 14 steps could map well to only the white keys over two keyboard octaves by selecting 'Map To White Keys->Restart After->2 Octaves'.

Using The 'Spread Over' Mapping Option To Modulate Tonal Complexity: The 'spread over' mapping option, in combination with automating the active scale, could be used to modulate the tonal complexity of a musical pattern. Take any scale and create some copies of it in the **Scale List (page 25)**. For each copy remove one or more steps, then arrange the scales in order of step size (you can drag scales about in the **Scale List (page 26)** to reorder them). Apply the same 'spread over' mapping preset to each scale. You can do this quickly by shift-selecting the range of scales in the **Scale List (page 26)**, then right-clicking on one and selecting e.g. 'Apply Mapping->Mapping Preset->Map Chromatically->Spread Over->1 Octave'.

In this case, if a scale has less than 12 steps, MTS-ESP Master will map it over a keyboard octave by repeating notes such that the spread is as even as possible, leaving no key unmapped. Loop a pattern (using an arpeggiator could work well) and switch through the scale copies to increase or decrease the tonal complexity of the pattern.

Resetting Mapping

A reset button in the Keyboard box header is available if scale type is set to 'Free'. If any changes are made to the mapping, including changes to the **Map Size (page 29)**, **Map Start (page 29)** or **Ref Note (page 29)** parameters, it will light up. Click to reset the mapping and all related parameters to those saved with the scale.

Loading And Saving Mappings

MTS-ESP Master can import and export mappings using the .kbm (Scala keyboard mapping) file format. Click the Keyboard File Menu for import and export options. Any .kbm files saved in the following locations will be available to select from this menu too:

Win: Documents\OddSound\MTS-ESP Master\Mappings

OSX: Library/Audio/Presets/OddSound/MTS-ESP Master/Mappings
        ~/Library/Audio/Presets/OddSound/MTS-ESP Master/Mappings

Linear KBM format:
An option to export a linear .kbm file is available. Linear .kbm files contain only the map start and reference note information. When imported, all steps of the scale to which a linear .kbm is applied will be mapped in increasing order, without gaps, from the map start key given in the file. This can be useful for quickly setting the **Map Start (page 29)** and **Ref Note (page 29)** parameters of multiple scales of different sizes via the **Scale List (page 27)** right-click menu.

Macros bring the idea of 'dynamic' tuning to life, a set of controls that can modify tuning in real-time. They are found on the Macro page, accessed by clicking the **Macro** button in the **Menu Bar (page 21)**. Macros can be used as tools for creating new scales by modifying existing ones or, since macros can be automated or controlled via MIDI, they can be used as controls for modifying scales in real-time during a composition. For example, with a macro, a single interval can be bent or switched to a new value, a scale can be 'de-tempered' by moving all intervals towards nearby integer ratios, or a whole composition can be morphed into a new tuning system. They also provide a handy way to 'tune' scale intervals by ear with MIDI CC messages.

Initially there are no macro controls, they must be added by clicking the '+' icon in the Macro box. A menu will appear to select the type of macro to create. The type determines how the macro changes a scale. The type of a macro can be changed after creating it. New macros are always added at the bottom of the list.

Depending on its type, a macro may affect just a single step or an entire scale. A detailed description of each macro type is given further on in this section.

Global And Scale Macros

A selector in the Macro box header switches between displaying Global and Scale macros. Global macros are available regardless of which scale is selected as the active scale. They always operate on the active scale.

Scale macros are stored with a specific scale, along with their value. If a new active scale is selected, any scale macros stored with it will be loaded.

The Macro List

The Macro box displays the macro controls in a list with the following columns:

- **Number:** Macros are always ordered in the list by number. When automating a macro from a host DAW, it can be identified by its number. Rearranging macros in the list is not supported, as this could result in host automation being applied to the wrong macro, however macro copy and paste operations are provided (see below).
- **Type:** This shows the macro type. Click for a menu allowing a different type to be selected. The settings for each type are remembered when switching between types.

  A special **Bypassed (page 55)** type allows the effect of a macro to be ignored. If bypassed, a '-' will show in the Type column and the row will turn grey. It is possible to quickly toggle between the current type and **Bypassed (page 55)** either by double clicking the macro number or Alt-clicking on the macro type.

- **Value:** For most macro types this is displayed as a horizontal slider, however for the **Switch (page 56)**, **Reference Frequency Step (page 59)** and **Transpose (page 63)** types it is shown as an integer value.

- **MIDI:** This column shows the current MIDI assignment for each macro. Click for a menu with MIDI assign options which allow you to assign a macro to the following types of MIDI message:
    - Velocity
    - Step Velocity (**Bend (page 55)** and **Randomise (page 57)** macro types only)
    - Pitch Bend
    - Aftertouch
    - Control Change (0 - 127)
    - 14-bit Control Change (0/32 - 31/63)
    - Note-on (**Switch (page 56)** and **Transpose (page 63)** macro types only)

MIDI assignments can be learned by selecting 'Learn…' (or 'Relearn…' if already assigned) and sending MIDI data to MTS-ESP Master. It will detect the type of MIDI message and make an assignment accordingly.

When assigning a **Switch (page 56)** or **Transpose (page 63)** macro to note-on messages, it is possible to specify a MIDI channel and key range that it will respond to. When learning from a note-on message, the note value will be set as the Range Start and Channel will be set to 'Any channel'. Range end must be set manually from the menu.

Increment/decrement options are available for the **Switch (page 56)**, **Reference Frequency Step (page 59)** and **Transpose (page 63)** macro types, allowing specific MIDI CC messages, e.g. from buttons on a MIDI controller, to be assigned to increment or decrement the macro value. Both a CC number and value must either be chosen via the menu or learned.

Whilst learning, the controls in the Macro List row will flash green. Learn may be cancelled without making an assignment by selecting 'Cancel learn'. A MIDI assignment can be removed by selecting 'Unlearn'.

- **Operator:** Where available, this selects whether the macro is applied positively, negatively or bidirectionally (where the 0 position is in the centre).

Click on any row in the Macro List to select a macro and view its settings in the Macro Settings box to the right. The text in the row of the currently selected macro will turn white and the row will highlight green.

As with the **Scale List (page 25)**, multiple macros can be selected by Ctrl/Cmd or Shift clicking on rows. This allows removing multiple macros at the same time (see below). All selected rows will highlight green however only the row whose settings are displayed in the Macro Settings box will have white text, so it can still be distinguished.

Right click on a row in the Macro List for the following options:

- **Delete:** Remove the macro(s) from the list. Be aware that any host automation may now apply to a different macro, as the macros are always ordered continuously starting from 1.
- **Copy:** Copy all settings for the selected macro. This is not available when multiple macros are selected.

    It is possible to create a new copy of an existing macro at the bottom of the list from the 'Copy of' sub-menu when clicking the '+' icon.

- **Paste:** Paste settings to the selected macro. This is not available when multiple macros are selected.

Macro Types

There are a number of different macro types, each with a different set of parameters that define how the scale will be altered. The parameters are shown in the Macro Settings box. Click on a row in the Macro List to view and edit the settings for a macro. The number and type of the currently selected macro is shown at the top of the Macro Settings box.

The following types are available:

Bypassed

This is a special type allowing the effect of a macro to be ignored. It is possible to quickly toggle between any other type and Bypassed from the Macro List either by double clicking a macro number or Alt-clicking on the macro type.

Bend

This macro type allows the scale step intervals to be smoothly transitioned to a different value. The Macro Settings box contains a table with a list of destination steps and corresponding ranges i.e. the target amount by which steps will be bent.

To add a destination step, click the '+' icon in the table and select a step from the popup menu. Alternatively, drag one or more selected rows from the Tuning Table onto the Macro Settings box.

A new Bend macro can be quickly created by dragging one or more steps from the **Tuning Table (page 31)** to the Macro List box.

When dragging steps from the **Tuning Table (page 31)**, any steps which have been edited from their saved values will be reset and the difference will be set as the range.

Multiple steps can share the same range. Click on a step number in the destination list and select any number of steps from the popup menu.

Ranges can be displayed either as ratios or interval measures. Click the Range column heading to switch.

Using a Bend Macro To Morph Between Two Versions Of A Scale

When a scale's type is set to 'Free', you can freely edit the step intervals. If you make some edits, you can quickly create a Bend macro that morphs between the edited and original versions. You can then audition your changes as a track is playing, or even automate changes during a piece of music.

After editing a scale, go to the **Tuning Table Settings menu (page 32)** and under '---Macro---' select '**Create new (page 33)**->Create new bend macro for all edited steps and reset->Scale'. We have chosen the 'Scale' option here because the macro we are creating will likely only apply in the context of the active scale. This adds it to the list of macros stored with the scale, as opposed to the global macros that are always available regardless of which scale is selected.

Click the Macro tab and click **Scale** at the top of the Macro Settings box to see the newly created macro. The edits you made to the scale intervals have now been transferred to this macro and the steps in the scale reset to their saved values. Move the macro slider to the right to morph to the edited version and to the left to go back to the original version.

If you decide that you prefer the edited version and are not even interested in keeping the original version, you can click undo to revert all changes up to and including the point where you created the macro. Alternatively you can move the macro all the way to the right and then from the **Macro Settings menu (page 68)** select '**Apply to scale and reset (page 68)**->Scale macros only'.

Switch

MACRO : GLOBAL : SCALE					MACRO SETTINGS : GLOBAL 1 : SWITCH	
#	TYPE	VALUE	MIDI	OP	STEP	VALUE (RATIO)
1	SWITCH	2	-		3	default (21/20)
		+			25	40/27
						+

This macro type allows any number of scale step intervals to be switched between up to 128 different values. For this type, the macro value is displayed in the Macro List as an integer number instead of a horizontal slider.

The Macro Settings box contains a table with a list of destination steps. The Value column shows the step interval(s) assigned to the current value of the macro.

By default, the step intervals stored with the scale are assigned to all macro values and there will be no effect when changing the macro value. This is indicated in the Value column by the text "default" followed by the interval in brackets.

To assign a different interval to a macro value, first set the macro value, then edit the interval in the Value column in the Macro Settings box. Now, whenever the macro is set to that value, that interval will override the one in the **Tuning Table (page 31)**. To return to using a default interval, Ctrl/Cmd click on an interval in the Value column in the Macro Settings box.

Intervals can be displayed either as ratios or interval measures. Click the Value column heading to switch.

To add a destination step, click the '+' icon in the Macro Settings box and select a step from the popup menu. Only one destination step is allowed per row, but the step number for any existing destination row can be changed after it has been added.

Destination steps can also be added by dragging one or more selected rows from the **Tuning Table (page 31)** onto the Macro Settings box. When dragging, any step intervals which have been edited from their saved values will be reset and the previous edited interval will be assigned to the current macro value.

It is also possible to quickly create a new Switch macro by dragging one or more selected steps from the **Tuning Table (page 31)** to the Macro List box with the Alt key held down. Any step intervals which have been edited from their saved values will be reset and the previous edited interval will be assigned to macro value 1.

A scale step can only be altered by one Switch macro. This rule matters when a step is assigned to more than one Switch macro, or assigned more than once to a single Switch macro. If the macro values are set such that more than one assignment is set to a non-default value, the interval for the step will be chosen using these rules:

- Global Switch macros take priority over Scale Switch macros.
- Higher numbered Switch macros take priority over lower numbered ones.
- Destinations lower down in the list take priority over any above that are assigned to the same step.

The Switch macro may be controlled using MIDI note-on messages. A 'Map range start to zero' option is offered in the MIDI assignment menu. When disabled, the MIDI note number will directly set the macro value i.e. MIDI note 0 sets it to 0, MIDI note 1 sets it to 1 etc. When enabled, the first note in the selected MIDI note range sets the macro value to 0 and assignment continues contiguously from there.

Using a Switch Macro To Select Between Alternative Options For A Step Interval

In **The Pythagorean Comma (page 37)** we saw a 13 step Pythagorean scale of which steps 6 and 7 were separated by a Pythagorean comma, close enough that they could be considered alternative options for the same step. A 13 step scale maps awkwardly onto a piano keyboard so instead we can create a 12 step scale and use a Switch Macro to switch the interval for step 6 between the two alternatives in the 13 step scale.

Select the 'User Guide Examples' preset from the **Preset Menu (page 22)** in the **Menu Bar (page 21)** and select scale 1, 'Pythagorea 12'. Set **Comma Ratio** to the Pythagorean Comma on the **Setup page (page 75)** and set the interval measure to commas in the **Display menu (page 22)**.

Select the Macro page and set the middle box to show the **Tuning Table (page 31)**. Since the Switch macro that we are creating will likely only make sense in relation to this scale, we can select **Scale** at the top of the Macro Settings box, to show the list of macros stored with the active scale. Hold Alt/Option and drag step 6 from the **Tuning Table (page 31)** to the **Macro List (page 53)** box. When you let go of the mouse button a new Switch macro will be created, assigned to step 6. For a Switch macro, the macro value is shown as a number in the **Macro List (page 53)**, not a slider.

For each value of the macro (up to 127) we can set a different interval for step 6. We're only interested in one other interval and in this example we're going to set the macro up so that when it's value is 127, it switches to that other interval. The reason is that MIDI controllers with buttons usually toggle between 0 and 127 and we might want to assign a button to do the switching.

Set the macro value to 127. In the Macro Settings box, ensure the Value column is showing commas (click the column heading to switch if not), then double-click the interval value and edit it by subtracting 1 from the integer part (the value to the left of the decimal point). Now when the macro value is 127, step 6 will be reduced by a comma, i.e. the 'alternative' interval from the 'Pythagorean 13' example scale. You can now assign a button on a MIDI controller to switch the interval for step 6.
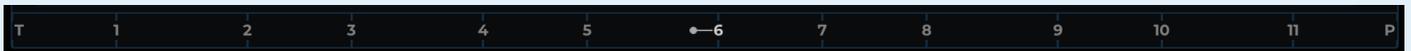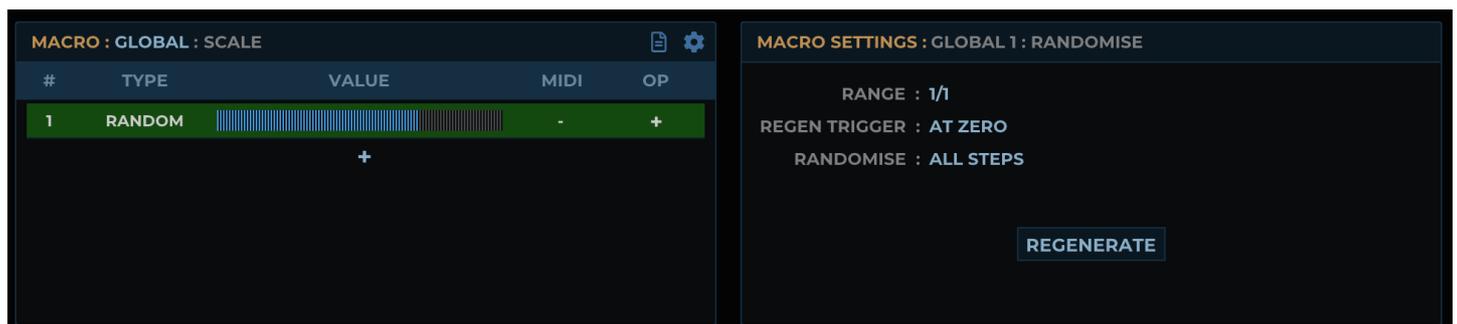
Randomise

This macro type can be used to adjust any number of scale step intervals by a random amount. The following parameters are available:

- **Range:** This sets the maximum amount by which a step interval can be randomised. The value can be shown as a ratio or interval measure, switched via the **Display Menu (page 22)** in the **Menu Bar (page 21)**.
- **Regenerate:** When clicked, this button generates a new set of random interval adjustments.
- **Regen Trigger:** This allows regeneration to be triggered automatically, with the following options:
  - Off: Regeneration only happens when the **Regenerate** button is clicked.
  - At Zero: Regeneration automatically happens when the macro value is at zero or, if the operator is set to '+/-', passes through zero.

- MIDI: Regeneration happens when a specified MIDI note or CC message is received. If assigned to a CC, the CC value must be 127 to trigger regeneration. A 'Learn...' option is available and the parameter will flash green whilst MTS-ESP Master is listening for a MIDI event to learn from. A 'Channel' option is provided to allow MTS-ESP Master to listen to events only on a specific MIDI channel. This is not set automatically when learning a control and must be set explicitly from the menu.

- **Randomise:** This selects which scale steps should be randomised, with the following options:
  - All Steps: All scale steps, excluding the period.

  - All Steps + Period: All scale steps, including the period.

  - Select Steps: If selected, a **Steps** parameter will appear. Click this for a drop down menu from which any number of scale steps can be individually selected. It is also possible to select one or more steps in the **Tuning Table (page 31)** and drag them onto the Macro Settings box to quickly set the selected steps.

Using Velocity To Randomise The Tuning Of Individual Steps

It is possible to assign keyboard velocity to a macro so that the macro value adjusts in response to how hard a key is pressed (you'll need to make sure MIDI data is routed into MTS-ESP Master for this). The **Bend (page 55)** and **Randomise (page 57)** macros can be set up so that they only affect individual steps, not the entire scale. For these macro types MTS-ESP Master offers the option of responding to velocity *only* if the played note is assigned to a specific chosen step. In this example we'll set up the macros so that when a key is pressed, the velocity determines the amount of randomisation just for the step which that key is assigned to.

Add a new macro to the list. If you select **Global** at the top of the Macro List box the macros we create will be available regardless which scale is selected and we can try the randomisation out on different scales. Set **Range** and **Regen Trigger** as desired, then set **Randomise** to 'Select Steps' and **Steps** to 'step 1'. In the Macro List box, click in the MIDI column and assign the macro to 'Step Velocity->Step 1'. Also set the operator to '+/-', which means that a velocity of 64 can be used to bypass any randomisation. Now we have a macro that will randomise step 1 whenever a key is pressed that is mapped to step 1. Add a new macro to the list and select 'Copy Of->Macro 1'. For the new macro, set **Steps** to 2 and the MIDI assignment to 'Step Velocity->Step 2'. Continue to do this for as many steps as there are in the scale, so that now when you play notes into MTS-ESP Master, each step is randomised only when a note assigned to it is received.

To save having to set macros up like this ever again, you can save the whole list as a macro preset from the **Macro List File menu (page 67)**.

Reference Frequency Bend

MACRO : GLOBAL : SCALE				
#	TYPE	VALUE	MIDI	OP
1	REF FREQ		-	+/-
		+		

MACRO SETTINGS : GLOBAL 1 : REFERENCE FREQ
RANGE REL : **1200.00** cents
RANGE ABS + : **329.63 Hz**
RANGE ABS - : **-164.81 Hz**

This macro type allows for smooth adjustment of the reference frequency. It can be viewed as a global pitch bend control, which will move the pitch of all notes up/down by the same amount. The three parameters available are all different representations of the same underlying value and are therefore linked. Changing one will change the others.

- **Range Relative:** Set the maximum range of the macro as an interval relative to the original reference frequency. The interval can be displayed as a ratio or interval measure, switched via the **Display Menu (page 22)** in the **Menu Bar (page 21)**.
- **Range Absolute +ve:** Determine the range of the macro by setting the upwards difference in absolute frequency i.e. the number of Hz the reference frequency will be increased.
- **Range Absolute -ve:** Determine the range of the macro by setting the downwards difference in absolute frequency i.e. the number of Hz the reference frequency will be decreased.

Reference Frequency Step

MACRO : GLOBAL : SCALE				
#	TYPE	VALUE	MIDI	OP
1	REF STEP	2	-	
		+		

MACRO SETTINGS : GLOBAL 1 : REF FREQ STEP
STEP INTERVAL : **81/80**

This macro type allows the reference frequency to be transposed up/down in steps by a given step interval. A typical use case would be to set the interval to a comma ratio and use it to automate comma pumps during a composition.

- **Step Interval:** Set the step interval. The interval can be displayed as a ratio or interval measure, switched via the **Display Menu (page 22)** in the **Menu Bar (page 21)**.

Scale Morph

MACRO : GLOBAL : SCALE				
#	TYPE	VALUE	MIDI	OP
1	MORPH		-	
		+		

MACRO SETTINGS : GLOBAL 1 : SCALE MORPH
MORPH TYPE : **NOTE FREQ**
MORPH MODE : **EQUIVALENT**
SHIFT : **50.00** cents
MORPH SCALE : **SELECTOR**

This macro type allows the smooth morphing of one scale to another. The following parameters are available:

- **Morph Type:** This is the first of two parameters that determine how the morph is performed.

- Step Interval: The step interval values are morphed to match those in another scale.
- Note Freq: The frequency of each MIDI note is morphed to match the MIDI note frequencies defined by another scale.

  Since the 'Note Freq' morph type operates on note frequencies rather than step intervals, the effects of this macro cannot be shown in the **Tuning Line (page 34)** or **graphs (page 69)**.

- **Morph Mode:** This is the second of the two parameters that determine how the morph is performed.
  - Equivalent: If **Morph Type** is set to 'Step Interval', each scale step interval will morph to the interval for the equivalent numbered step in the other scale.

    If the scale being morphed to has fewer steps, the intervals of the higher numbered steps in the original scale will not change.

    If **Morph Type** is set to 'Note Freq', the frequency of each MIDI note will morph to the frequency defined for it by the other scale.

  - Nearest: If **Morph Type** is set to 'Step Interval', each scale step interval will morph to the interval closest in value from the other scale.

    If **Morph Type** is set to 'Note Freq', the frequency of each MIDI note will morph to the nearest frequency of any MIDI note as defined by the other scale.

    In either case, it is possible that more than one key may end up playing the same pitch.

- **Shift:** This is only available when **Morph Type (page 59)** is set to 'Note Freq'. It shifts the reference frequency of the scale being morphed to, allowing it to be 'tuned' to the active scale. The interval can be displayed as a ratio or interval measure, switched via the **Display Menu (page 22)** in the **Menu Bar (page 21)**.

- **Morph Scale:** This determines the scale that will be morphed to.
  - Selector: With this option a 'Morph' column will appear in the **Scale List (page 25)**, allowing a morph scale to be selected. A dot will appear next to the current morph scale. Click in the **Morph column (page 27)** to select a different morph scale. The morph scale may also be selected using MIDI note, CC or program change messages.

    It is possible to create multiple Scale Morph macros that use the morph scale selector, however only one morph scale can be selected, which all of them will follow.

  - Fixed: If this option is selected, a **Scale** menu will appear, allowing a specific scale to be selected. The macro will always morph to this scale.

    If the selected scale is removed from the **Scale List (page 25)**, the macro will automatically be set to morph to the next lowest numbered scale.

Endless Scale Morphing

With a single **Scale Morph macro (page 59)** it is possible to endlessly morph through any number of scales during a composition. To set this up add a new **Scale Morph macro (page 59)** to the **Global Macro List (page 53)**, setting **Morph Type (page 59)** to 'Note Freq', **Morph Mode (page 60)** to 'Equivalent' and **Morph Scale (page 60)** to 'Selector'.

Return to the Scale page and notice that there is now a 'Morph' column to the right of the **Scale List (page 25)**, with a blue marker next to one of the scales. This marker denotes the morph scale i.e. the scale that will be transitioned to by moving the macro slider right. You can click in the column to set a different scale as the morph scale.

At this point it might be useful to assign a knob or slider on a MIDI controller to the **Scale Morph macro (page 59)** to save you having to switch back and forth between the Scale and Macro pages. With that done, start with the macro at zero and, as notes are playing, increase until it is at maximum. Select a different active scale in the **Scale List (page 25)**, you should not hear a change as at this point the note frequencies are determined only by the morph scale. Now move the macro back to zero and you will hear a morph back into the newly selected active scale.

Click in the morph column to select a new morph scale and morph to it. You can now set a new active scale and morph back into yet another different scale. Continuing like this you can endlessly morph between different scales.

When working like this you will probably want to automate the selected active and morph scales, which can be done via host automation, or by assigning MIDI messages from the **Scale List Settings menu (page 28)**.

Expand/Contract
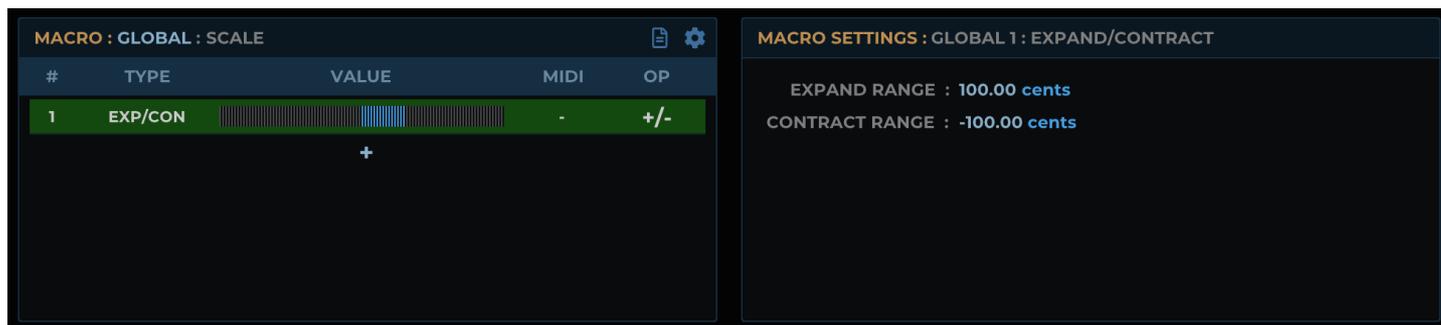
This macro type expands or contracts the scale i.e. multiplies or divides all step intervals, including the period, by the same ratio. Separate expansion and contraction ratios are provided.

- **Expand Range:** Set the maximum ratio by which all scale steps are multiplied when the macro operator is set to '+', or the macro value is positive when set to '+/-'. This parameter is not available when the macro operator is set to '-'.

- **Contract Range:** Set the maximum ratio by which all scale steps are divided when the macro operator is set to '-', or the macro value is negative when set to '+/-'. This parameter is not available when the macro operator is set to '+'.

Both parameters can be displayed as a ratio or interval measure, switched via the **Display Menu (page 22)** in the **Menu Bar (page 21)**.

Snap To Ratio

This macro type smoothly shifts scale step intervals to the nearest integer ratio with the lowest possible numerator and denominator. The available parameters determine how the nearest integer ratio is calculated.

For certain parameter settings it may not be possible for MTS-ESP Master to calculate an integer ratio e.g. if the error is set very low. It may also be that a step interval is already an integer ratio that satisfies the constraints. In either case, the step interval will remain unchanged when the macro value changes.

- **Prime Limit:** Set the largest prime number to be used in calculating the numerator and denominator of the snapped ratios.
- **Max Error:** Set the maximum permissible deviation from the current step intervals when calculating snapped ratios. This determines the limit beyond which intervals will be left alone. The value can be displayed as a ratio or interval measure, switched via the **Display Menu (page 22)** in the **Menu Bar (page 21)**.
- **Max Tenney Height:** Set the maximum allowed Tenney height for the calculated ratios. Tenney height for a ratio is calculated as $\log_2$(numerator * denominator) and can be used to limit the size of the integer numbers that make up a ratio. This may be set to 'Off' for no limit on Tenney height.
- **Compound Limit:** Set the maximum number of primary ratios of which the snapped ratio may comprise. A primary ratio is one which appears in the tonality diamond for the selected prime limit.
- **Snap:** This selects which scale steps should be snapped, with the following options:
    - All Steps: All scale steps, excluding the period.
    - All Steps + Period: All scale steps, including the period.
    - Select Steps: If selected, a **Steps** parameter will appear. Click this for a drop down menu from which any number of scale steps can be individually selected. It is also possible to select one or more steps in the **Tuning Table (page 31)** and drag them onto the Macro Settings box to quickly set the selected steps.
- **Prime Table:** This table contains a list of all primes up to and including the selected prime limit. It allows individual primes to be included or excluded from the snapped ratios. It also allows setting of a minimum and maximum limit for the exponent of each prime in the snapped ratios. Drag in the Min and Max columns to set an exponent limit. Note that it is not possible to set max lower than min. A '-' symbol indicates no limit, Ctrl/Cmd-click a value to return it to this state. A reset icon is available above the table which will enable all primes and clear all exponent limits.

    With the Snap To Ratio macro, a menu icon is available at the top right of the Macro Settings box with options to copy all macro snap parameters, including those in the prime table, to or from the snap parameters on the **Setup page (page 75)**.

Transpose

MACRO : GLOBAL : SCALE

#	TYPE	VALUE	MIDI	OP
1	TRANS	7	-	

+

MACRO SETTINGS : GLOBAL 1 : TRANSPOSE

MODE : TRANSPOSE + MODULATE
ADAPTIVE TUNING : ON
ALLOW DRIFT : ON
RESET DRIFT TRIG : OFF
DRIFT : 0.00 cents

RESET DRIFT

Exploring The Modes Of A Scale With The Transpose Macro: In Exploring The Modes and Inverted Modes Of A Scale (page 34) we suggested exploring the modes of a scale as a way of finding new scales to work with, by repeatedly using the Set mode from selected step (page 33) option in the Tuning Table right-click menu (page 33) on step 1 of a scale. The Transpose macro can make that process a bit quicker, and automatable too.

Add a Transpose macro (page 63) and set **Mode** to ‘Steps Only’. Increase the macro value from 0 to the number of scale steps to move through all the modes of the scale. Above this you’ll start going round the modes again so it may be best to stick to the range limited by the number of steps.

When working in 12-TET, transposing is a simple matter of moving notes up/down by a given number of semitones. The pitch changes but the intervals between each MIDI key don't. The same cannot be said to happen for a non-equal scale, therefore some different options for transposition are offered. This macro does one or both of two things, depending on the transpose mode:

- Adjust the reference frequency.
- Adjust the step intervals, effectively rotating the interval pattern of the scale in the fashion of modal rotation.

The macro value is displayed as an integer value ranging from -64 to +63, representing the number of steps to transpose by. To become familiar with the different modes it is recommended to use a non-equal scale with a chromatic mapping (select ‘Map Chromatically’->‘Continuous’ from the Keyboard Settings menu (page 50)).

Transpose Mode: Four modes for transposition are available as follows:

- **Transpose:** This mode adjusts both reference frequency and step intervals. The effect is that the frequency of each key is shifted by <n> steps, where n is the macro value.
- **Mode Rotate:** This mode adjusts the step intervals only. It emulates the effect of rotating a scale’s interval pattern such that different modes of a scale can be explored. A macro value of 1 corresponds to the mode pattern starting on step 1, 2 to the mode pattern starting on step 2 and so on up to the number of scale steps, then it wraps around.
- **Modulate:** This mode adjusts both reference frequency and step intervals and can be seen to ‘modulate’ a scale, or shift the tonic, useful when using a non-equal scale. The macro value determines which scale step will be the tonic, with a value of 1 corresponding to step 1, 2 for step 2 and so on up to the number of scale steps, then it wraps around. For example, with a 12 step scale mapped chromatically starting on C, to modulate to G set the macro value to +7 (G is 7 steps above C).

  When using this mode, the keyboard key step labels (page 50) and the note names/numbers in the Key column of the Tuning Table (page 31) will change to reflect the current tonic. The keyboard key step labels will turn red to indicate modulation away from the original tonic.
- **Transpose And Modulate:** This mode adjusts the reference frequency only, the effect of which is like a combination of the ‘Transpose’ and ‘Modulate’ modes. The reference is shifted by <n> steps where n is the macro value. This is analogous to always playing a piano keyboard in the key of C and using a transpose function to change key rather than actually playing the fingerings for different keys.

Adaptive Tuning: This setting is available when the Transpose Mode is set to 'Modulate' or 'Transpose And Modulate' and can be set to one of two options:

- **Off:** Adjusted scale intervals are used to modulate, i.e. the scale intervals resulting from the adjustments performed by any lower-numbered macros in the macro list, if there are any. Otherwise the original scale intervals are used to modulate.
- **On:** The original scale intervals are always used to modulate, regardless of any macro adjustments to scale intervals. This allows the 'Modulate' and 'Transpose And Modulate' modes to be leveraged for adaptive tuning (see **Tuning Up 12-TET: Adaptive Just Intonation With The Transpose Macro (page 65)**).

Allow Drift: This setting is available when the Transpose Mode is set to 'Modulate' or 'Transpose And Modulate'. If set to 'On', the reference frequency is adjusted to ensure there is no pitch shift in the new tonic note when modulating.

The following settings are available when the Transpose Mode is set to 'Modulate' or 'Transpose And Modulate' and Allow Drift is set to 'On':

Reset Drift Trig: This allows resetting of the reference frequency drift to be triggered automatically, with the following options:

- Off: Resetting only happens when the **Reset Drift** button is clicked.
- At Zero: Resetting automatically happens when the macro value is at or passes through zero.
- MIDI: Resetting happens when a specified MIDI note or CC message is received. If assigned to a CC, the CC value must be 127 to trigger resetting. A 'Learn…' option is available and the parameter will flash green whilst MTS-ESP Master is listening for a MIDI event to learn from. A 'Channel' option is provided to allow MTS-ESP Master to listen to events only on a specific MIDI channel. This is not set automatically when learning a control and must be set explicitly from the menu.

When **Allow Drift** is set to 'On' and the macro value is changed by dragging with the mouse, drift is only calculated at the end of the drag (when the mouse button is released), to prevent drift from repeatedly accumulating whilst dragging. When controlling via MIDI, drift is calculated after each MIDI message is received. It is therefore recommended to use MIDI notes, or buttons assigned to send specific CC values, rather than a slider or knob, to control the Transpose macro in this case.

Drift: This shows the current reference frequency drift, i.e. the deviation of the current tonic note from its interval in the active scale. Drift can be displayed relative to any other scale in the list, which may be useful in e.g. comparing drift to an equal tempered scale. Click the drift value to select a scale.

Reset Drift: Click to reset the reference frequency drift.

The Transpose macro may be controlled using MIDI note-on messages. Two extra options are available for this in the MIDI assignment menu for this macro:

- Map Zero To Key: Select which MIDI note number in the selected note range will set the macro value to 0. Keys above this in the selected range will increase the macro value, keys below it will decrease the macro value.
- Use Lowest Played Note: This setting determines what happens if multiple keys in the selected range are pressed. If disabled, the most recently pressed key will set the macro value. If enabled, the lowest held key will set the macro value.

Tuning Up 12-TET: Adaptive Just Intonation With The Transpose Macro

Working with just intonation (JI) allows us to use intervals related to the harmonic series that sound more consonant, however problems can arise when modulating, such as tonic drift, where moving through a certain chord sequence may result in a slightly sharper or flatter tonic. Adaptive just intonation offers a way round this. Tempered intervals are used to modulate, however scale intervals are adjusted so that they are always just, relative to the current tonic.

The **Transpose macro (page 63)** 'Modulate' mode can be leveraged for adaptive tuning. To see this in action, select the Adaptive JI Full Keyboard preset from the **Preset Menu (page 22)** in the **Menu Bar (page 21)**. When trying this preset out, make sure the Filter Control Notes option is set to 'Off' in the MIDI section on the **Setup page (page 76)**. This preset has MIDI note messages mapped to the Transpose macro for adjusting the tonic, so make sure MIDI data is routed into MTS-ESP Master. To start off with, you may wish to try this preset out with the MTS-ESP Master's built-in synth.

The preset includes six scales, the first being 12-TET and the others being various JI interpretations of it. Keep 12-TET as the active scale. There are also two macros in the **Macro List (page 53)**. The first is a **Scale Morph macro (page 59)** which is used to morph the 12-TET scale to one of the just versions. Choose which JI scale you wish to use by clicking in the **Morph column in the Scale List (page 27)**, setting the target Morph Scale.

The second macro is a Transpose macro with **Mode (page 63)** set to 'Modulate' and **Adaptive Tuning (page 64)** set to 'On'. The macro's value determines how many steps the scale is modulated by. Because **Adaptive Tuning (page 64)** is set to 'On', modulation will be calculated using the original (tempered) scale intervals, not the adjusted (just) scale intervals as a result of using the morph macro above.

The Transpose macro is set up to respond to MIDI note messages, such that the lowest held note determines the tonic. The Scale Morph macro is mapped to the mod wheel and adjusting this allows you to move continuously from 12-TET, at zero, to JI, at maximum.

First try playing a chromatic scale from middle C up to the C above, one note at a time. Notice that regardless the value of the morph macro slider (or mod wheel position), there is no change in pitch of the played notes, they remain in 12-TET.

Next make sure the Scale Morph macro (or mod wheel) is at maximum and play any major triad in root position. It will sound as a harmonic 4:5:6 chord regardless of which note you start on, because the Transpose macro is set up to modulate according to the lowest played note. Move the mod wheel whilst holding a chord to move between tempered and just tuning.

With this set up you can write notes into the MTS-ESP Master track to control modulation of a composition and use mod wheel automation to vary the amount of justification. This technique is not just limited to equal temperaments and their just counterparts as in this example either. The scales in the list could be replaced with any scales you like for some wild experimentation.

Priority Adjuster

This macro type can only be selected as a Global macro. It allows adjustment of a step interval that is currently being played via MIDI. Which step gets adjusted is determined using priority rules set by the user (first played, highest, 2nd lowest etc.). In this way any chord may be held and the same set of macros used to fine-tune each individual note of the chord.

MIDI note data must be routed into MTS-ESP Master for this macro type to have any effect.

This macro type is unique in that it has the option to directly edit the step intervals, instead of being used to calculate a temporary adjusted value (see below). As such it can be a useful tool for authoring and editing scales, allowing for efficient workflow when tuning by-ear.

The following parameters are available:

- **Priority:** Set the priority rule used to determine which playing step should be adjusted:
    - Last: adjust the last played step.
    - First: adjust the first played step.
    - Low: adjust the step assigned to the lowest played MIDI note.
    - High: adjust the step assigned to the highest played MIDI note.

- **Priority Num:** Set the number used with the priority rule. For example, '2nd' would choose the step assigned to the 2nd to last played key, or the 2nd lowest played key etc.

- **Range:** Set the maximum amount by which the macro will adjust the step interval. The value can be displayed as a ratio or interval measure, switched via the **Display Menu (page 22)** in the **Menu Bar (page 21)**.

- **Pickup:** This determines when the macro will start to adjust an interval after any change in the held keys as follows:
    - At Zero: The macro value must return to zero, or pass through it if the macro operator is set to '+/-', before it will adjust a step interval.
    - Moved: The macro will have no effect on a step interval until its value is changed.
    - Off: This option is only available when **Adjust Mode** is set to 'Temporary' (see below). The macro will immediately apply an adjustment to a step interval when the held keys are changed.

- **Adjust Mode:**
    - Permanent: The macro adjustment is applied directly to the intervals stored with the scale, thus editing the scale itself.

        Any adjustments made in this way are stored in the undo stack. A new undo entry is added any time the held keys are changed.

    - Temporary: The macro adjustment is applied as a temporary adjustment to the stored step interval, as with all other macro types.

        With this adjust mode, a Priority Adjuster macro may be used as a pitch bend control for an individual scale step, selected using the priority rules.

Tuning A Scale By Ear With Priority Adjuster Macros

A key feature of the Priority Adjuster macro is the ability to set up some knobs or sliders on a MIDI controller and use them to tune individual scale steps by ear.

In the global **Macro List (page 53)**, create a priority adjuster macro and set **Priority** to 'Last', **Priority Num (page 66)** to '1st', **Range (page 66)** to 100 cents, **Pickup (page 66)** to 'At Zero' and **Adjust Mode (page 66)** to 'Permanent'. Additionally set the operator to '+/-' in the Macro List and assign a MIDI control to it.

Play any single note on the keyboard and sweep the MIDI control, it will have to pass through zero before it has any effect, to avoid the interval 'jumping' to match the position of the control. Look at the **Tuning Table (page 31)** and watch the interval for the playing step change. When the key is released the step interval will remain at its new value. With **Adjust Mode (page 66)** set to 'Permanent', this is the only way that a macro can ever directly edit intervals in the **Tuning Table (page 31)**. If you're unhappy with the change just click undo. Try again with a different key using the same process with that same macro.

Next try playing a chord, pressing one key after the next. The macro will adjust the last pressed key. Try playing the same chord but pressing the keys in a different order and you will see the macro adjust a different step. In this way, a priority adjuster macro can be used to tune individual notes of a chord using a MIDI controller.

It is possible to use a second priority adjuster macro for finer adjustments. Create a copy of the existing one and set its **Range (page 66)** to 10 cents and assign it to a different knob or slider on your MIDI controller. Now when you play a key, you can use the first control to make a coarse adjustment and the second to make a finer adjustment. Any number of macros can be used with varying ranges in this way.

Another use of multiple priority adjuster macros is to be able to tune all the different notes of a chord whilst it is being held. Remove the fine adjust macro, then go back to the first macro and set **Priority (page 66)** to 'Low'. Create two copies and, for the three macros, set **Priority Num (page 66)** to '1st', '2nd' and '3rd' respectively. Play a triad and sweep the controls. The first will adjust the step assigned to the lowest note, the second will adjust the step assigned to the middle note and the third, the step assigned to the highest note. On releasing the chord, all adjustments can be reverted using undo. An undo step is logged every time the held keys change.

Macro Processing Order

Macros are generally processed in series i.e. the original scale intervals are passed to the first macro in the list which adjusts any as necessary, then passes the adjusted values to the next for processing and so on.

This means that, for example, if a **Snap To Ratio macro (page 62)** follows an **Expand/Contract macro (page 61)**, the expanded intervals will be snapped to integer ratios, not the original scale intervals.

Scale macros are always processed before global macros.

One exception to macro processing order is the **Switch macro (page 56)**. If any are present they will be processed first, regardless of their position in the **Macro List (page 53)** or whether they are Scale or Global macros. These will adjust the scale step intervals before any other macro processing is applied. See the **Switch macro (page 56)** section for details regarding the processing order of different Switch macros.

Loading And Saving Macros

A list of macros may be saved and loaded as a macro preset. Options for saving and loading are found in the Macro File menu.

When loading and saving macros, the Global/Scale selector determines whether the Global or Scale macros are being loaded or saved. On loading, any existing macros in the list will be replaced. If a set of macros containing **Priority**

Adjuster macros (page 66) is loaded as Scale macros, the Priority Adjusters will be ignored.

Macro presets are stored with the extension .MasterMacros. Any .MasterMacros files saved in the following locations will be available to select from the Macro File menu:

Win: Documents\OddSound\MTS-ESP Master\Macro Presets

OSX: Library/Audio/Presets/OddSound/MTS-ESP Master/Macro Presets
      ~/Library/Audio/Presets/OddSound/MTS-ESP Master/Macro Presets

Macro Settings Menu

The macro settings menu contains options that affect all macros or, optionally, only the Global or only the Scale macros.

- **Reset Macro Values:** Reset all macro control values to 0.
- **Bypass Macros:** Bypass all macros.
- **Unbypass Macros:** Unbypass all currently bypassed macros.
- **Apply To Scale And Reset:** Apply the current macro adjustments to the active scale step intervals and reset all macro control values to 0.
- **Apply To New Copy:** Create a new copy of the active scale in the **Scale List (page 26)** with the current macro adjustments applied to the step intervals.
- **Apply To New Copy And Reset:** As above, but also reset all macro control values to 0.

When using a Scale Morph macro with **Morph Type** set to 'Note Freq', if macro adjustments are applied to the active scale or a new copy, a scale will be created that has a tuning for each MIDI note i.e. 127 steps.

The Graph Page is accessed by clicking the **Graph** button in the **Menu Bar (page 21)**. This page shows a visual representation of the scale along with other more detailed information.

Two different visual representations of the scale are available: linear and circular. Use the drop-down menu at the top left corner of the Graph box to switch between them

Line Graph

This shows the active scale steps, along with other information, as markers along a horizontal line. The scaling is logarithmic, so markers the same distance apart are the same number of cents/commas apart.

A legend on the left hand side indicates the information shown in each row of the line graph:

- **Macro Adjustment:** Any macro adjustments to scale steps are shown as small grey nodes, connected with lines to the corresponding scale step in the row below.

- **Active Scale:** Shows step number markers for each step of the active scale, or 'T' for tonic and 'P' for period. If markers are close enough together such that their labels would overlap, they are shown as circular nodes instead.

  Click a marker to select it. Ctrl/Cmd click markers to add or remove them from the selection and Shift click to select a consecutive range of markers.

  Drag a marker left or right to edit a step interval. Hold Shift whilst doing so for fine adjust (or broad adjust if fine adjust is set as default…see the **Setup (page 76)** section). Hold Alt to toggle snap whilst dragging. Steps can be snapped either to harmonics, interval measures or reference scale intervals (see the **Graph Settings menu (page 71)** section).

  Right click a marker to remove a step from the scale, or double-click in empty space on the Active Scale line to insert a new step.

  If MIDI note data is routed into MTS-ESP Master, the markers lines for any currently playing steps will highlight light blue.

  If the active scale type is set to anything other than 'Free', the markers for the active scale will turn grey and cannot be edited via the graph.

- **Harmonics/Interval Measure:** This legend label acts as a selector for this row, selecting between showing harmonics or an interval measure scale.

  When set to show harmonics, position the mouse over the row and small triangle markers will appear beneath each scale step. Click the triangle markers to select which steps harmonics harmonics are shown for. The triangles for selected steps will remain highlighted light blue. Click them again to deselect. Ctrl/Cmd click

anywhere on the row to deselect all steps so that no harmonics are displayed. See the **Graph Settings menu (page 71)** section for further options relating to display of harmonics.

Note that, unless it is set to 'Reference Scale', the 'Snap To' option in the **Graph Settings menu (page 71)** will automatically follow the Harmonics/Interval Measure selector.

- **Reference Scale:** This allows another scale from the **Scale List (page 25)** to be selected and shown below the active scale for comparison. Click below the 'Reference Scale' legend to open a popup menu for selecting the reference scale, or 'None' for no reference scale.

The line graph can be scrolled and zoomed using the scroll bar beneath it. Drag left/right to scroll and up/down to zoom. The mousewheel can also be used to scroll or, whilst holding Shift, to zoom. Alt-click the scroll bar to reset zoom.

A tooltip will appear below the line graph either when hovering over any marker, or when one or more active scale steps are selected. This includes when hovering over macro adjust nodes, harmonic markers and reference scale step markers. Values relating to the marker under the cursor are displayed. In the case of a selected active scale step the tooltip values can also be edited, indicated by them being coloured light blue.

Circle Graph
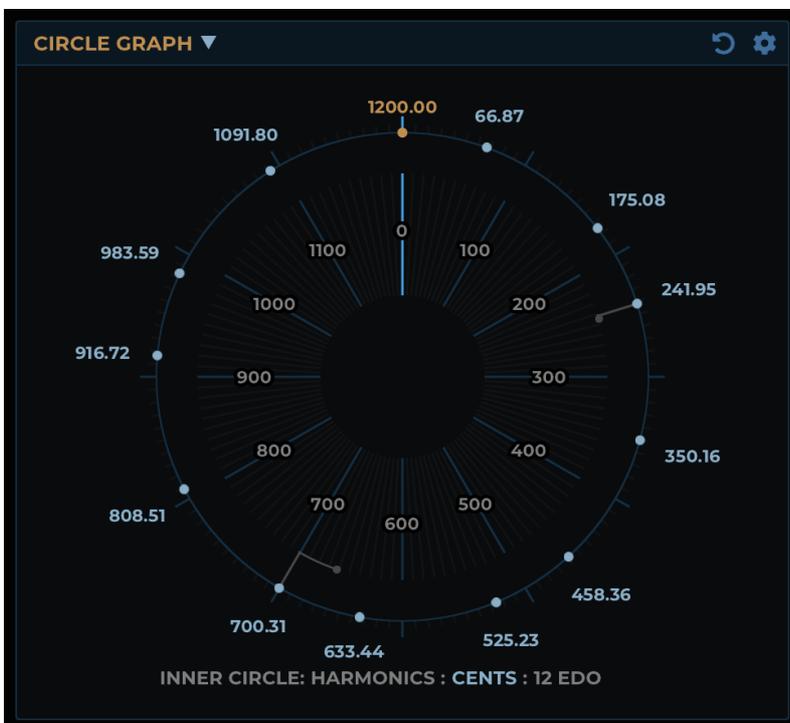
This shows the active scale steps, along with other information, as markers around a circle. The scaling is logarithmic, so markers that are the same angle apart are the same number of cents/commas apart.

Active Scale:

The active scale is shown as a series of nodes around the circle. Where space is available, a number is displayed next to a node showing either the step number, the step interval, or the interval between the step and the nearest marker in the inner circle (see below and the **Graph Settings menu (page 71)** section).

Click an active scale node to select it. Ctrl/Cmd click nodes to add or remove them from the selection and Shift click to select a consecutive range of steps.

> **Comparing A Scale To An Equal Temperament:** The graphs in MTS-ESP Master allow you to compare any scale with another, using the reference scale. A common use example would be comparing a scale to an equal temperament.
>
> To do this create a **Rank 1 ET (page 38)** scale in the Scale List and set **Divisions (page 38)** as required, then re-select the scale you want to compare as the active scale. Select the Graph page, switch to the Circle Graph and set the Rank 1 ET scale as the reference scale (right click anywhere on the graph background to pop up a menu). Under '---Display---' in the **Graph Settings menu (page 71)** select 'Scale Labels->Difference' to see the intervals between the scale steps and the equal temperament steps labelled around the graph. Remember you can switch between ratios and interval measures from the **Display Menu (page 22)** in the Menu Bar.

Drag a node around the circle to edit a step interval. Hold Shift whilst doing so for fine adjust (or broad adjust if fine adjust is set as default - see the **Setup (page 76)** section). Hold Alt whilst dragging to toggle snap. Steps can be snapped either to harmonics, interval measures or reference scale intervals (see below and the **Graph Settings menu (page 71)** section).

Right click a node to remove a step from the scale, or double-click on the circle circumference to add a new step.

If the step labels are set to show step intervals, Alt-Ctrl/Cmd click on a node to edit an interval as text.

If MIDI note data is routed into MTS-ESP Master, currently playing steps are indicated with small light blue lines extending outward from the active scale nodes.

If the active scale type is set to anything other than 'Free', the markers for the active scale will turn grey and cannot be edited via the graph.

Macro Adjustments:

Any macro adjustments are shown as small grey nodes just inside the circle circumference, connected with lines to the corresponding scale step node.

Inner Circle:

The inner region of the circle graph can be set to show line markers for either harmonics, interval measures or a reference scale, picked from any other scale in the **Scale List (page 25)**. Right click anywhere on the circle graph to pop up a menu and select an option, including which scale should be the reference scale. Clicking on the legend below the graph also switches the inner circle display. Double click the reference scale name to pop up a menu and select a different one.
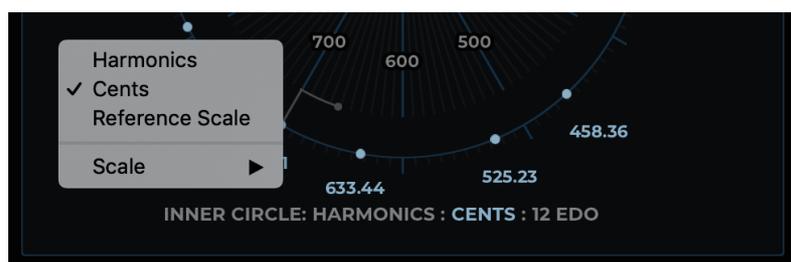
The 'Snap To' option in the **Graph Settings menu (page 71)** will automatically follow the display selection for the inner circle.

When set to show harmonics, position the mouse over the inner circle and small triangle markers will appear inside of each scale step. Click the triangle markers to select which steps to show harmonics for. The triangles for selected steps will remain highlighted light blue. Click them again to deselect. Ctrl/Cmd click anywhere on the inner circle to deselect all steps so that no harmonics are displayed. See the **Graph Settings menu (page 71)** section for further options relating to display of harmonics.

When set to show interval measures or a reference scale, the markers in the inner circle will highlight if any active scale step matches the marker position.

Labels for the reference scale markers can be set to display either step number or step interval value (see the **Graph Settings menu (page 71)** section).

Graph Settings Menu

Snap Options:

- **Enable Snap:** When enabled, dragging nodes will snap to the markers set using the **Snap To** option (see below). Hold Alt for un-snapped drag. When disabled, hold Alt whilst dragging to temporarily enable snap.

- **Snap To:** Select the values to snap to from the following options:
    - Harmonics: snap to any currently displayed harmonics, excepting those for the dragged step.
    - Interval Measure: snap to cents/commas scale markers.
    - Reference Scale: snap to the reference scale intervals.

For the line graph, this option will automatically follow the 'Harmonics/Interval Measure' selector, unless 'Reference Scale' is selected. For the circle graph, this option will automatically follow the inner circle display.

Display Options:

- **Harmonics:** This sub-menu contains the following options relating to the display of harmonics:
    - Show Harmonics Period Reduced: If enabled, harmonic ratios will be period reduced so they appear between the tonic and period markers. If disabled, some harmonics may not be visible in the graph range.
    - Harmonics Follow Macro Adjustments: If enabled, the harmonic markers for a scale step will appear shifted accordingly as the result of any macro adjustment applied to the step interval.
    - Show Harmonic Type: Set whether harmonics, sub-harmonics or both are displayed. Harmonic markers are blue and sub-harmonic markers are red.
    - Select Harmonics To Show: A sub-menu with options for selecting which harmonics to show as follows:
        - None: Show no harmonics.
        - All: show all harmonics from 1 (fundamental) to 99.
        - All from 1 to...: Show all harmonics from 1 to any selected harmonic number up to 99.
        - All primes from 1 to...: Show all prime number harmonics from 1 to any selected harmonic number up to 97.
        - Select individual harmonics: Select individual harmonics from a list of the first 99.
    - Auto-show harmonics for steps: In addition to manually clicking the triangles to select which steps harmonics are shown for, it can be done automatically in two ways:
        - Playing: If selected and MIDI notes are sent to MTS-ESP Master, harmonics are shown for any currently playing step.
        - Selected: Harmonics are shown for any selected step in the active scale.
- **Display Macro Adjustments As:** This option is available for the line graph only. It sets the display of macro adjustment values in the graph tooltip between:
    - Absolute: Show the resulting step intervals after macro processing.
    - Difference: Show the deviation from the original step intervals after macro processing.
- **Circumference Is Period:** This option is available for the circle graph only. It dictates how the graph behaves if a step interval falls outside the period range. If enabled, the node is wrapped around the circle and one revolution of the circle always represents the period ratio. If disabled, the distance around the circle represents the interval between the highest and lowest scale steps and therefore no nodes get wrapped around.
- **Scale Labels:** This option is available for the circle graph only. Set the value displayed next to the active scale nodes between:
    - Step number: Show the scale step number.
    - Interval: This can be shown as a ratio or interval measure, switched from the **Display Menu (page 22)** in the **Menu Bar (page 21)**. When selected, Alt-Ctrl/Cmd click on a node to set the interval as text.
    - Difference: Show the interval between the step and the nearest marker in the inner circle. This can be shown as a ratio or interval measure, switched from the **Display Menu (page 22)** in the **Menu Bar (page 21)**.
- **Ref Scale Labels:** This option is available for the circle graph only. Set the value displayed on the reference scale markers between:
    - Step number: Show the reference scale step number.
    - Interval: This can be shown as a ratio or interval measure, switched from the **Display Menu (page 22)** in the **Menu Bar (page 21)**.

Scale And Macro Options: These are the same as those found in the **Tuning Table Settings menu (page 32)**.

Using The Graphs To Find Consonant Intervals

When a scale's type is set to 'Free' you can freely edit the step intervals, however you may find just dragging them around doesn't produce consonant results quickly. The graphs allow you to snap step intervals to harmonic ratios which can be a better way to find consonant intervals and experiment with just intonation.

On the Graph page set the graph to show harmonics, then mouse over the graph to show the triangle harmonic markers. Click one to show harmonics for that step. Blue markers will appear indicating the harmonic intervals (or red for subharmonics if enabled), with greater brightness for lower numbered (more consonant) harmonics. Select '**Enable Snap (page 71)**' from the **Graph Settings menu (page 71)** so that when you drag active scale steps they snap to the harmonic intervals. Remember you can always revert any changes by clicking undo.

You may not want to edit scale steps but just view which steps of a scale will sound most consonant when building chords. When viewing the harmonics for the root step of a chord you can quickly see which other scale steps are close to its harmonics.

Active Scale Info Box

This box contains information about the active scale:

- **Scale Name:** This is displayed at the very top of the section. Double-click to set a new name.
- **Period:** Set the interval at which the scale pattern repeats. This is shown both as a ratio and interval measure. If the active scale's type is set to 'Free', alt-dragging on either value will stretch/compress the whole scale.
- **Steps:** The number of steps in the scale. MTS-ESP Master supports scales with up to 2048 steps.
- **Prime Limit:** If a scale consists entirely of integer ratios then the prime limit will be displayed.
- **Max Variety:** This displays the maximum number of interval sizes per step span found in the active scale.
- **Mean Variety:** This displays the mean number of interval sizes per step span found in the active scale.
- **Propriety:** This displays the Rothenberg Propriety for the active scale as one of three possible values:
    - Strictly proper: For a given step span, all interval sizes are greater than those for all smaller step spans.
    - Proper: For a given step span, all interval sizes are greater or equal to those for all smaller step spans.
    - Improper: For a given step span, at least one interval size is exceeded in size by one from a smaller step span.

- **Interval:** This will only display values when MIDI notes are routed into MTS-ESP Master and more than one note is held. It displays the interval between the held notes. The values can be displayed as ratios or interval measures, switched from the **Display Menu (page 22)** in the **Menu Bar (page 21)**.

  When set to display ratios and the scale consists entirely of integer ratios, the interval will be displayed as an extended ratio (e.g. 4:5:6 for a just major triad) or, if the numbers can be made smaller by doing so, an inverted extended ratio (e.g. 9/(9:7:6) for a just triad using 9/7 as the third).

Generating Intervals

GENERATING INTERVALS			
#	VALUE (RATIO)	MAX PRIME	SPAN
1	5/3	5	4
2	7/3	7	4

This box contains a list of generating intervals for the active scale.

Neither the .scl or .tun scale file formats have a documented way of storing the original generators used to create the intervals they contain, however it is possible to analyse the intervals between all consecutive scale steps to create a set of small intervals from which all intervals in the scale can be generated. For example, 12-TET will show a single generating interval of 100 cents from which all scale values can be generated (100+100=200 cents, 100+100+100=300 cents etc.).

MTS-ESP Master will attempt to calculate the generating intervals whenever a scale is loaded or edited, however some constraints are placed on the calculations to prevent them taking too long. This can happen when a scale contains one or more very small intervals between consecutive steps, in the order of fractions of a cent.
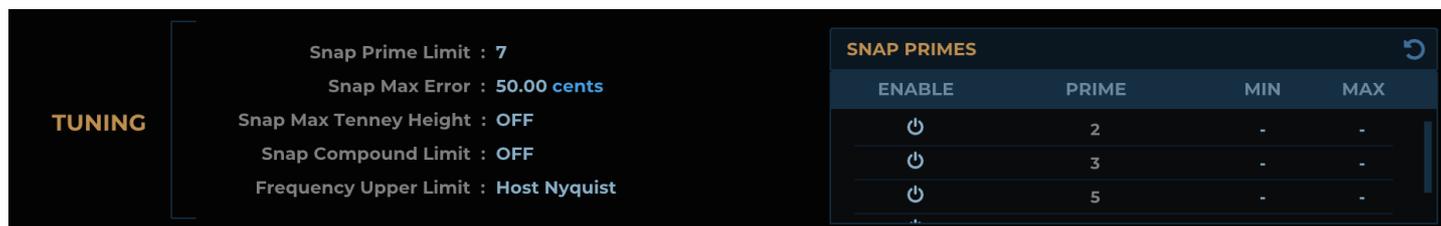
How To Read Extended Ratios:

An extended ratio is a way of presenting the intervals between the notes of a chord. For a just major triad the intervals between the notes are 5/4 from tonic to major third and 6/5 from major third to fifth. Notice the value 5 functions as the numerator in the first ratio and the denominator in the second. If we write these in 'enumerated' format we get 4:5 and 5:6. Combining these into a single expression gives us 4:5:6.

An inverted extended ratio can be read in a similar way but the enumerated intervals that make it up are inverted. The example 9/(9:7:6) can be read as two intervals 9/9:9/7 and 9/7:9/6 which are then reduced to give the integer ratios 9/7 and 7/6. The "9/" at the start indicates that all values in the extended ratio are 'under' 9. MTS-ESP Master will automatically display an extended ratio as inverted if the numbers that comprise it are smaller than those in the non-inverted equivalent.

The generating intervals are shown with a span, which denotes the size of each generator's dimension in pitch space (see **Pitch Space (page 42)**).

Generating intervals are displayed in order of interval size from smallest to largest and may be displayed as ratios or interval measures. Click the Value column heading to switch.

A special case exists if a scale consists entirely of integer ratios. The generating intervals are calculated using prime factors and displayed as period reduced prime harmonic ratios in increasing prime limit order.

Tuning Options

- **Snap Prime Limit:** Set the largest prime number to be used in calculating numerator and denominator when snapping an interval to an integer ratio.

- **Max Error:** Set the maximum permissible deviation from the current interval when snapping to an integer ratio. If this error is exceeded, the interval will be left unaltered.

- **Max Tenney height:** Set the maximum allowed Tenney height when snapping an interval to an integer ratio. The Tenney height of a ratio is calculated as $\log_2$(numerator × denominator) and can be used as a limit on the size of the integer numbers that make up a ratio. This may be set to 'Off' for no limit on Tenney height.

- **Compound Limit:** Set the maximum number of primary ratios of which a snapped ratio may comprise when snapping an interval to an integer ratio. A primary ratio is one which appears in the tonality diamond for the selected prime limit.

- **Frequency Upper Limit:** Set an upper limit when calculating frequencies for MIDI notes. It is possible that frequencies above Nyquist may be generated, which may not be expected in some client plug-ins.

- **Snap Primes Table:** This table contains a list of all primes up to and including the selected snap prime limit. It allows individual primes to be included or excluded from the snapped ratios. It also allows setting of a minimum and maximum limit for the exponent of each prime in the snapped ratios. Drag in the Min and Max columns to set an exponent limit. Note that it is not possible to set max lower than min. A '-' symbol indicates no limit, Ctrl/Cmd-click a value to return it to this state. A reset icon is available above the table which will enable all primes and clear all exponent limits.

Display Options
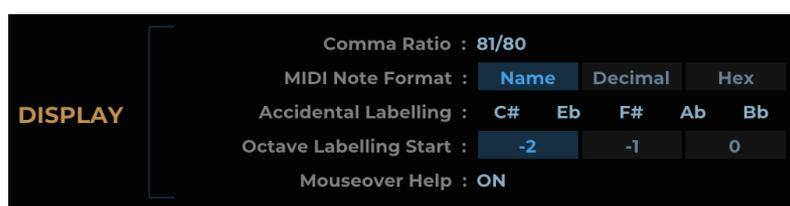
- **Comma Ratio:** Set the comma ratio used when the interval measure is set to commas in the . A few common ratios are available to select from the drop-down menu, or a custom ratio can be entered.

- **MIDI Note Format:** Set the display format for MIDI note numbers from either note name, decimal value or hexadecimal value.

- **Accidental Labelling:** Set whether keyboard accidental note names use sharps or flats when **MIDI Note Format** is set to note name.

- **Octave Labelling Start:** Set whether keyboard octaves are labelled starting at -2, -1 or 0.

- **Mouseover Help:** Set whether the mouseover help tooltip is displayed at the bottom of the plug-in window.

File Options
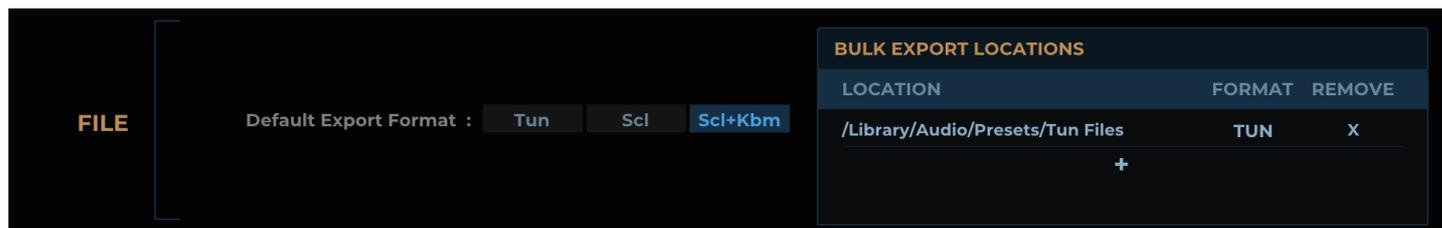
- **Default Export Format:** Set the file format used when dragging scales from the **Scale List (page 25)** to Explorer/Finder to export them. Options are .tun, .scl or .scl with accompanying .kbm.
- **Bulk Export Locations:** Set the locations and file formats used when exporting a scale via the 'Bulk Export' option. This allows for a scale to be exported to multiple locations using different formats with a single click, placing them in any default folders in which other plug-ins or software may automatically search for tuning files. Click the '+' icon to add new folders to the list.

Mouse And Keyboard Options
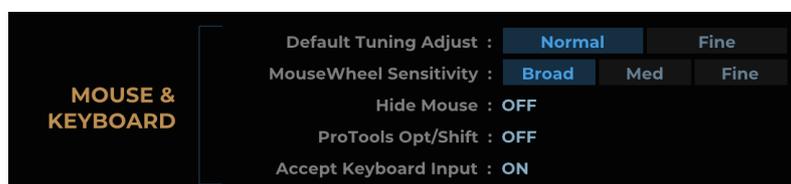
- **Default Interval Adjustment:** Set the default drag/mousewheel adjustment of interval parameters to either 'Normal' or 'Fine'. Holding Shift whilst dragging or mousewheeling will temporarily select the other option.
- **MouseWheel Sensitivity:** Set the mousewheel sensitivity for adjusting parameters.
- **Hide Mouse:** Set whether the cursor is hidden when dragging parameters or graph nodes.
- **Pro Tools Opt/Shift:** Set keyboard modifiers to work as in Pro Tools (Alt/Opt for reset to default and Ctrl/Cmd for fine-adjust).
- **Allow Keyboard Input:** Set whether the plug-in will respond to computer keyboard input, for navigation and selection in the **Scale List (page 25)** and **Tuning Table (page 31)**.

MIDI Options
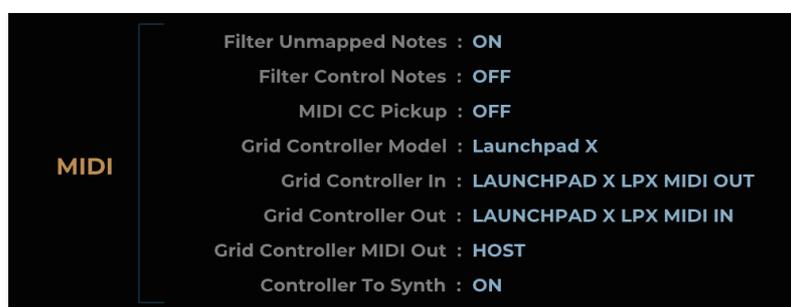
- **Filter Unmapped Notes:** Set whether unmapped notes will be filtered out by any connected clients. If set to 'Off', unmapped notes will play the frequency of the next lowest mapped key.
- **Filter Control Notes:** Set whether MIDI notes assigned to active scale select, morph scale select or a **Switch macro (page 56)** will be filtered out by any connected clients. This setting respects the MIDI channel options for the above control assignments.
- **MIDI CC Pickup:** If set to 'On' and a CC is assigned to a macro control, the CC value must reach or pass through the current value of the macro before it will have any effect. Note that MIDI CC Pickup will work after the value of

a macro control is edited using the mouse but not after editing via host automation.

- **Grid Controller Model:** MTS-ESP Master includes a script for the Novation Launchpad allowing it to be used as a microtonal keyboard and chord player. Full details are found in the **Grid Controllers (page 78)** section. All Launchpad models are supported and the appropriate model should be selected from this menu.

- **Grid Controller In:** Set the input port for the grid controller. This should be set to the following for each of the available models:
    - Launchpad MkI, Mk2, Mini Mk1, Mini Mk2: output port
    - Launchpad Pro: MIDI In 2
    - Launchpad X: MIDI In
    - Launchpad Pro Mk3: MIDI In
    - Launchpad Mini Mk3: MIDI In

- **Grid Controller Out:** Set the output port for the grid controller. This should be set to the following for each of the available models:
    - Launchpad MkI, Mk2, Mini Mk1, Mini Mk2: output port
    - Launchpad Pro: MIDI Out 2
    - Launchpad X: MIDI out
    - Launchpad Pro Mk3: MIDI out
    - Launchpad Mini Mk3: MIDI out

- **Grid Controller MIDI Out:** Set the destination for notes generated by the grid controller:
    - HOST: Notes are sent out of the plug-in and must be routed to the required destination/plug-in within the host software.
    - MIDI out port: Select any available MIDI output port. This includes virtual ports, such as the IAC Driver on OSX, which may be used to route MIDI back into the host and easily control the device or plug-in on whichever track is currently selected in the host software.

- **Controller To Synth:** Set whether the grid controller will trigger the MTS-ESP Master internal synth.

MTS-ESP Master includes a script for the Novation Launchpad allowing it to be used as a microtonal keyboard and chord player. See the **Setup (page 76)** section for information on the supported Launchpad models and how to set them up. The layout and function is the same for all supported models, with the exception of the Launchpad Pro Mk3 (see below):
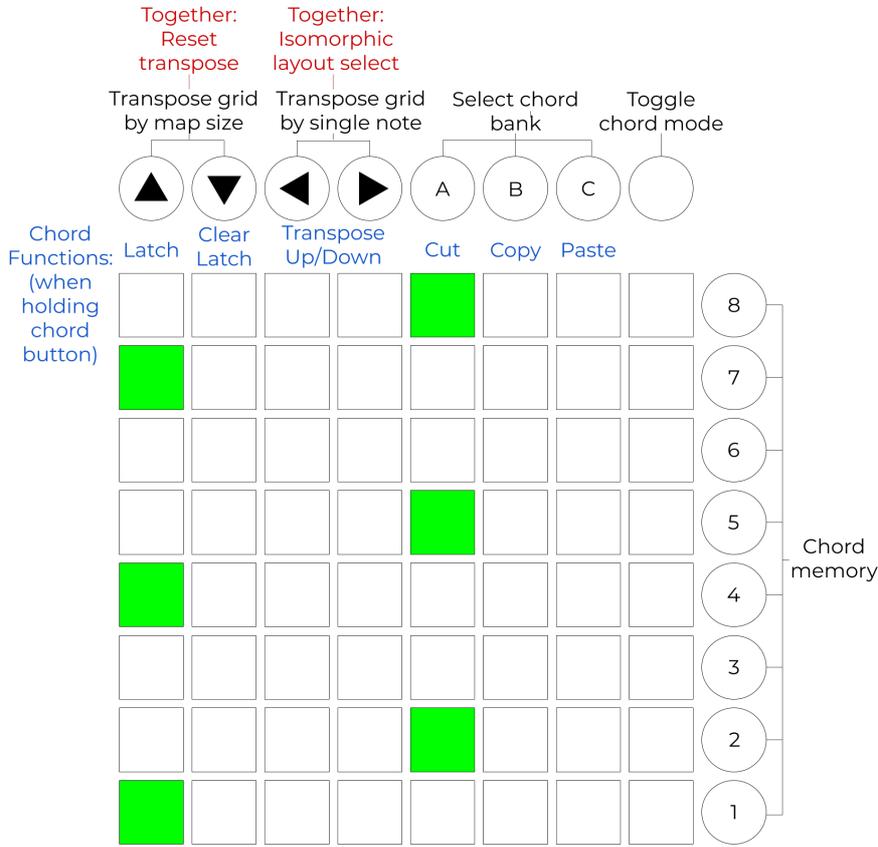
The Launchpad Pro Mk3 has the arrow buttons in a different place, so the top row of buttons is configured differently as follows:
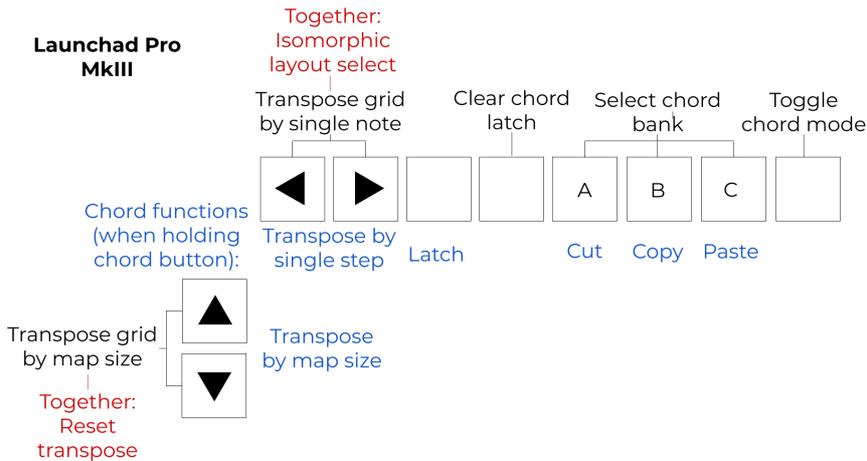
Note Grid

The 8x8 note grid is used to trigger notes. The map start key in each octave is coloured green.

Any currently playing notes, including notes routed into MTS-ESP Master from the host, are lit up in yellow.

Use the up/down buttons to transpose the grid by <n> MIDI notes, where <n> is the **Map Size (page 29)**. Use the left/right buttons to transpose the grid by a single note. Red pads in the grid indicate the lower and upper ends of the MIDI note range, or unmapped notes.

Press the up and down buttons simultaneously to reset the map start key to the bottom left of the grid.

Isomorphic Layout

Press the left and right buttons simultaneously to set the isomorphic layout. With them held, press any pad on the grid, then release the arrow buttons.

The x and y coordinates of the selected pad determine how notes are laid out on the grid, with the bottom left pad corresponding to (1,1). The x coordinate sets the number of MIDI notes between each pad in the left/right direction, from 1 to 8. The y coordinate sets the number of MIDI notes between each pad in the up/down direction, again from 1 to 8.

For a sequential layout, where the left-most note in a row comes immediately after the right-most note in the row below it, select the top left pad i.e. (1,8). Other layouts may serve better for exploring chords, by reducing the distance between pads to a small cluster. For example with 12-TET using a (4,7) layout, a major triad can be played with three pads connected in an 'L' shape.

The isomorphic layout setting is saved per scale.

Chord Memory

The Launchpad script contains a chord memory that can be used to store and trigger chords.

Each of the eight buttons to the right of the grid represents a chord memory location. There are three banks of chord memory locations, switched using buttons 5-7 at the top of the Launchpad.

Press and hold one or more notes in the grid, then press a chord memory button to save them as a chord. With a chord memory button held, pressing pads in the grid will add or remove notes from the chord. After releasing the chord memory button, press it again to trigger all notes in the chord played together. Chord memory buttons which have notes stored will light up.

To transpose a chord, hold a chord memory button and use the left/right arrows to transpose up/down by a single note. On the Launchpad Pro Mk3, the up/down arrows can also be used to transpose the chord by <n> notes, where <n> is the **Map Size (page 29)**.

Chords can be cut, copied and pasted between locations using the three chord bank select buttons whilst a chord memory button is held. This also works when multiple chord memory buttons are held, for example holding two chord memory buttons to play two chords at the same time and then pressing the second chord bank select button (copy) will copy the contents of both chords to the paste buffer, which can then be pasted to a single empty chord memory location, thus combining the chords.

The chords are stored per scale in MTS-ESP Master and will be recalled with a preset or DAW session.

Chord Mode

It is possible to access all three chord memory banks from the 8x8 grid, allowing them to be played simultaneously and, on some Launchpad models, with velocity sensitivity.

Press the right-most button above the note grid to enter chord mode. It will light red to indicate chord mode is active. The bottom three rows of the grid will light showing all 24 chord memory locations. Any pads which have a chord stored in them will light bright, the rest will be dimmer. Press the pads to trigger chords.

The upper five rows of the grid remain functioning as a note grid, as described in the Note Grid section.
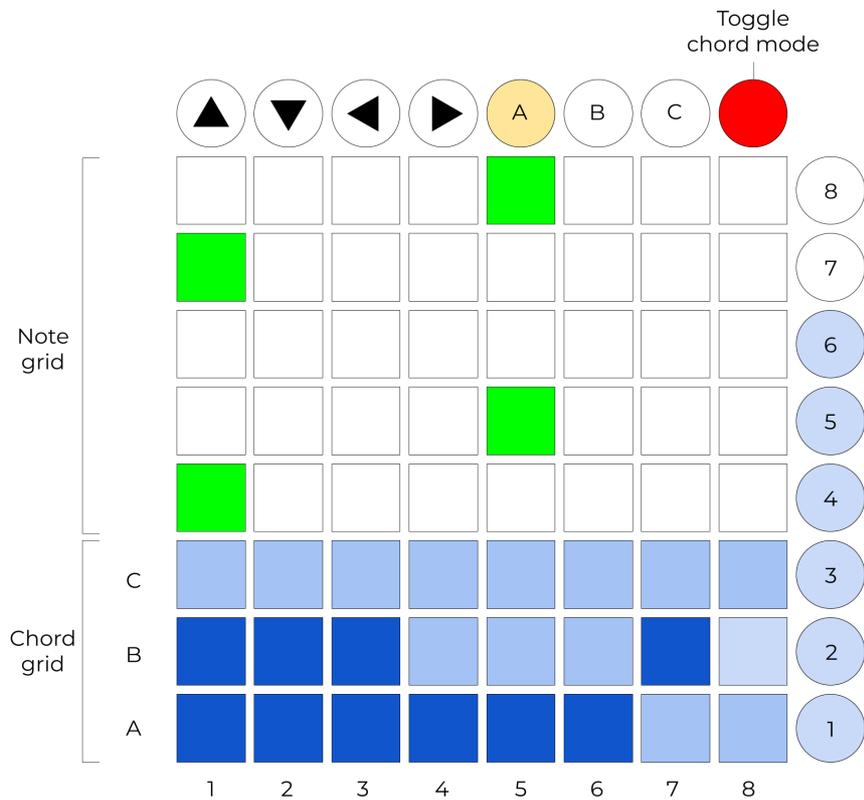
Chord Latch

It is possible to latch a chord, so that pressing any pad in the note grid will play a transposition of the latched chord. Hold any chord memory button or, if in Chord Mode, any chord pad in the grid, then press the up arrow to latch the selected chord (for Launchpad Pro Mk3, press button 3 at the top marked 'session').

To clear the latch, press and hold any chord memory button or chord pad and then press the down arrow. For Launchpad Pro Mk 3, simply press button 4 at the top (marked 'note') to clear the latch, without any need to hold a chord memory button or chord pad first.