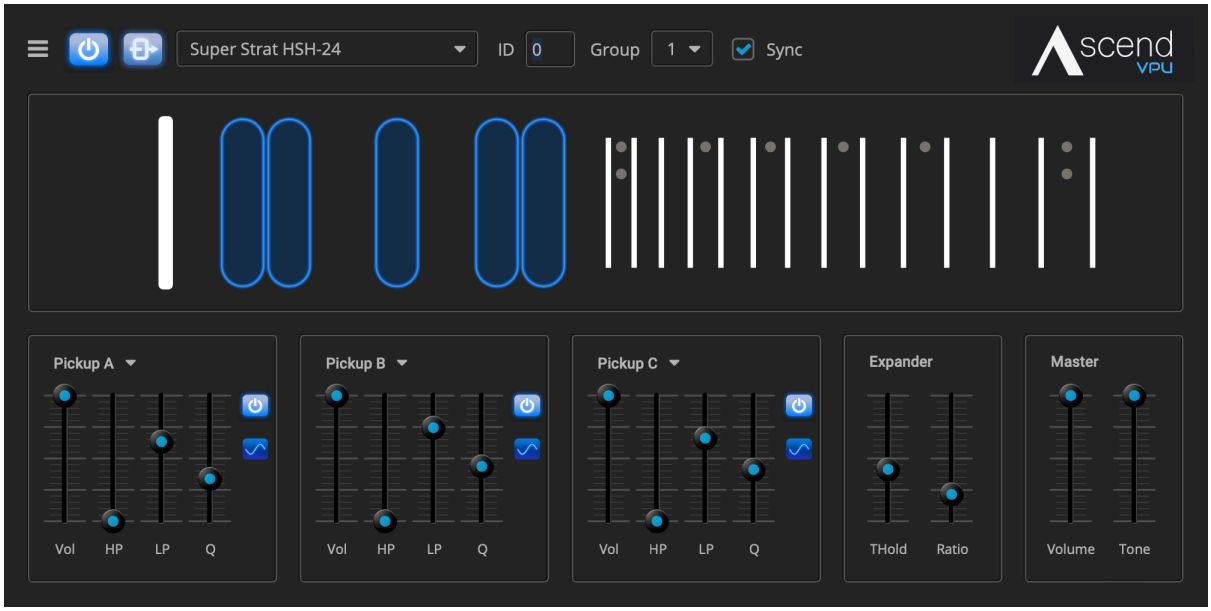
Version 1.1.1

January 2021

Ascend VPU is an audio plugin for modeling the sonic characteristics of electric guitar pickups. Given a multichannel pickup with a wide and flat frequency response such as the Nu Multichannel pickup, or the Roland-GK divided pickup, it is possible to reproduce the frequency response of various pickup positions (bridge, middle, neck) without actually moving the pickup. The technical details are elaborated in the five part *Virtual Pickups* series: Part1, Part2, Part3, Part4 and Part5.

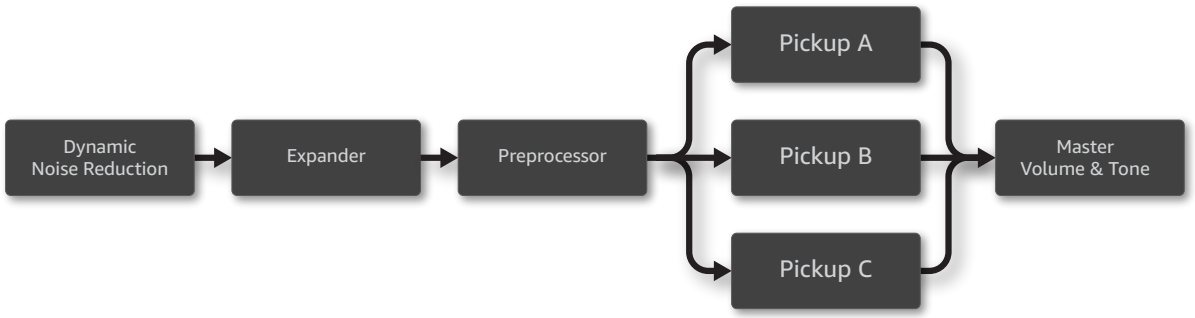
Main GUI

The Ascend VPU (Virtual Pickup) plugin presents a user interface for up to 3 pickups. The pickups can be configured as single-coil, double-coil, or empty. They can be positioned anywhere from the nut to the 12th fret, and slanted up to ±36 degrees. Each pickup has its own volume control, a high-pass filter, a low-pass resonant filter, enable/disable switch and phase switch.



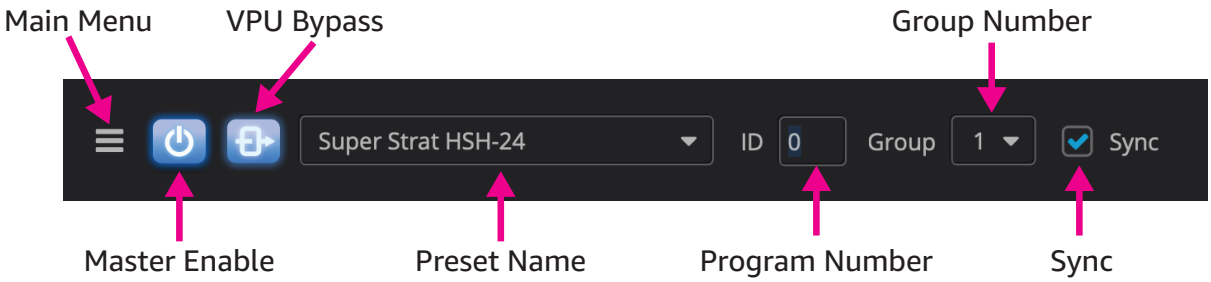
The Ascend VPU is designed for multichannel pickups and serves as an insert audio plugin processor for each track or channel (one for each string) with provisions for syncing the control settings for all channels.

System Diagram

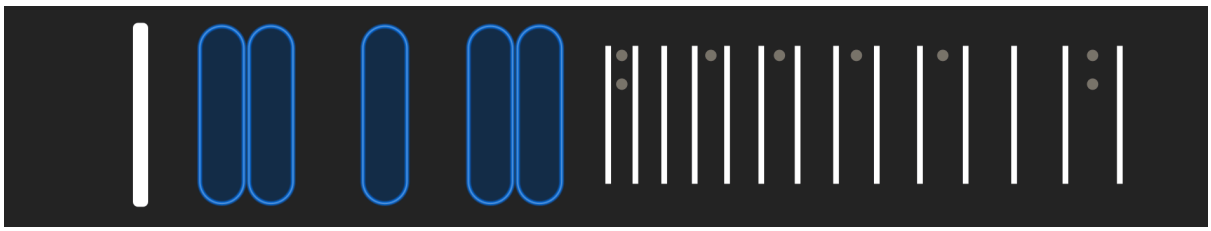


GUI Elements

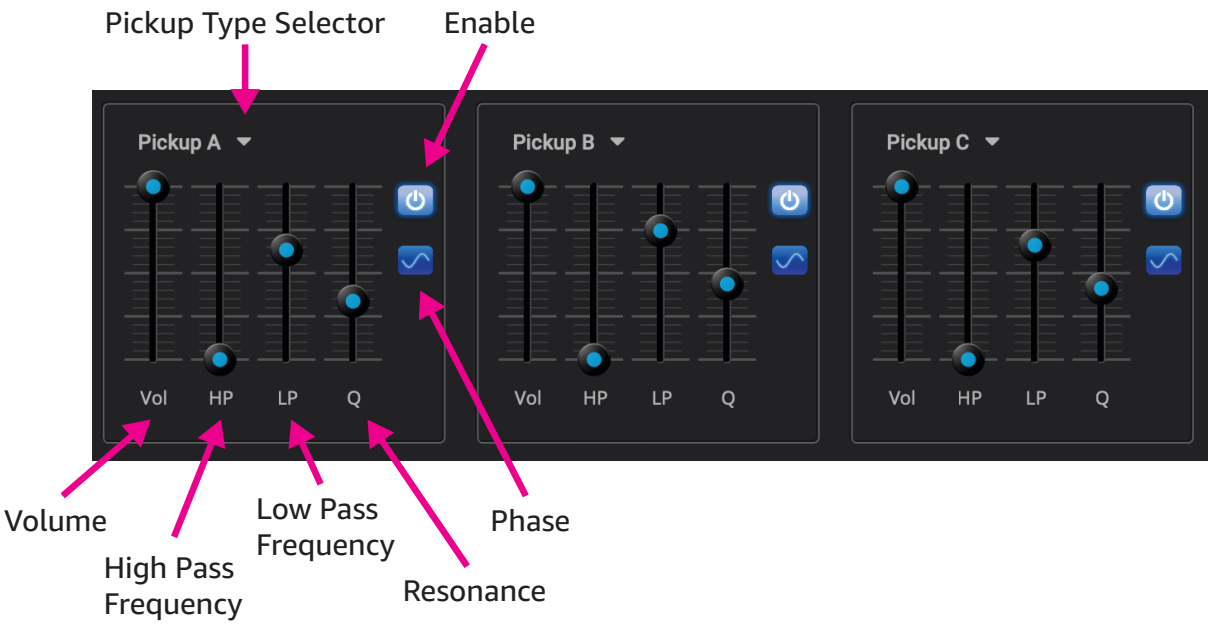
Header



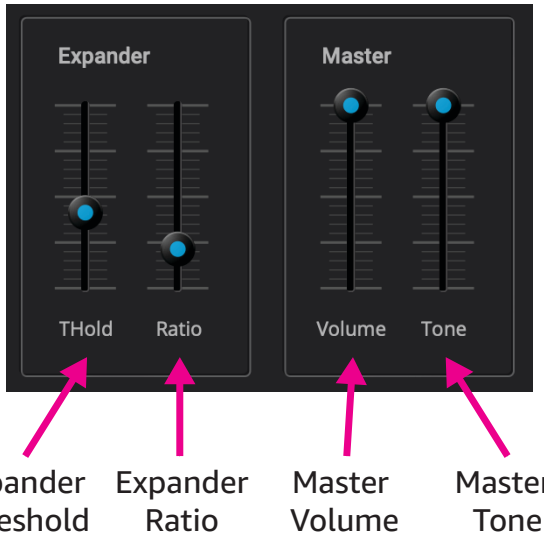
Virtual Pickup Placement



Virtual Pickup Controls

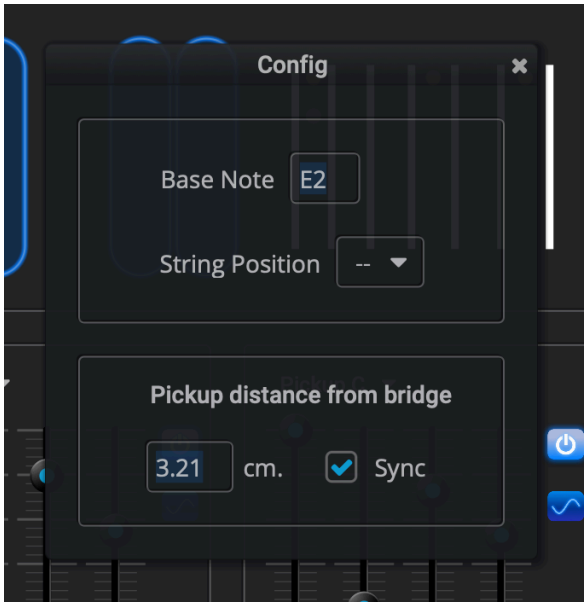


Downward Expander and Output Section

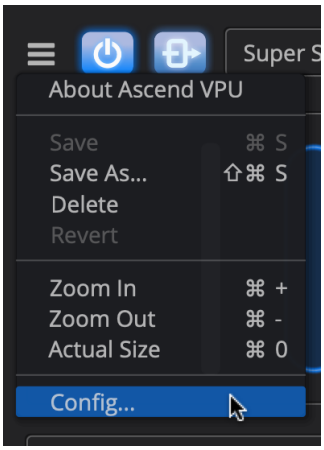


Configuration

For proper operation, you will need to set some parameters. On first launch of the plugin, you will be presented with the Configuration window. This is a one-time setup and needs to be done for all tracks or channels in your DAW where the plugins are inserted.



The Configuration window may also be opened any time via the Main Menu ☰ → "Config…" (right image):



Before anything else, the **Base Note** and **String Position** should be set.

- The base note specifies the lowest frequency of the string for a particular track or channel where the plugin is inserted. The possible values for **Base Note** are from **C1** to **B4**.

- The string position ranges from 1 to N, where N is the number of strings). Ascend VPU can accommodate from **1 to 12 strings**. On a standard guitar, the low-E string is position 1 while the high-E string is position 6.

For example, the base notes and positions for a standard 6-string guitar are:

E2	1
A2	2
D3	3
G3	4
B3	5
E4	6

Pickup distance from bridge is the actual multi-pickup position relative to the bridge in centimeters. For this configuration, you will need to measure the distance from the bridge to the middle of the multichannel pickup. The **Sync** checkbox allows you to set all inserted Ascend VPU plugins to the same position, all at once (assuming that the main UI sync is also set for a group; See Sync and Groups section).

✏️ Configuring the **Pickup distance from bridge** is optional (default set at 3.21 cm). Failing to set this will not cause any adverse effects. Setting this properly, however, will yield more accurate results with the Preprocessor (see Preprocessor section).

💡 In some cases, the pickups may not be equidistant from the bridge. Disabling sync will give you the freedom to have independent pickup positions. You can even use this feature to take the string's intonated bridge position into account, giving slight position variations.

Master Enable and VPU Bypass

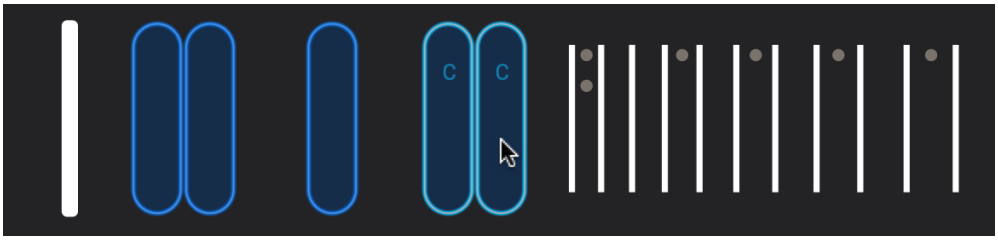
The Master Enable switches the entire Ascend-VPU plugin on or off. The VPU Bypass switches only the virtual pickups on or off, without bypassing Dynamic Noise Reduction, the Preprocessor, the Expander and the Master Output Section. These switches are synchronized across all inserted plugins (see Sync and Groups).

💡 The result of the Preprocessor (see Preprocessor section) alone (without the virtual pickups), is very rich, sweet and pleasing —very much like an acoustic guitar. You get all the full sonic range. The quality of the result is very useful in

and of itself. This can be achieved by bypassing the VPU by switching on the VPU Bypass switch.

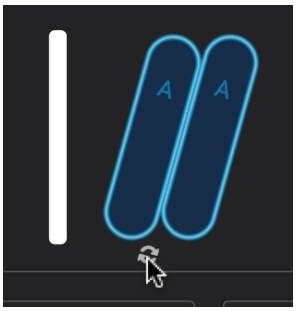
Repositioning the Pickup

The pickups can be repositioned by dragging left or right. When hovering over a pickup, it will be highlighted and its label (A, B or C) will show so you know which pickup you are moving.



Slanting the Pickup

The pickups can be slanted up to ±36 degrees. Hovering at the area near the bottom of the pickup will reveal the rotator tool that can be used to rotate the pickup and have it slanted at an angle. Option/Alt + Clicking the rotator tool will reset the slant.



Pickup Type

Each of the pickups can be configured as single-coil, double-coil, or empty. The pickup type can be selected from the dropdown menu beside the pickup name:

Pickup Sliders

Control	Function	Range
Vol	Pickup volume.	0% to 100%
HP	12dB/oct high-pass filter.	16Hz to 2kHz. Bypassed if lower than 16.1Hz.
LP	Resonant 12dB/oct low-pass filter.	15Hz to 20kHz. Bypassed if higher than 19.9kHz.
Q	Low-pass filter resonance.	0.1 to 10.

Switches

Control	Function
Enable switch	Pickup enable/disable.
Phase switch	In-phase or out-of-phase select.

✏️ The high-pass filter, along with the volume slider make the phase switch more usable. If a pickup is out of phase, mixing it with another pickup cancels out certain frequencies. The result is a thin, squawky sound with a dramatic decrease in volume. Without the high-pass filter and the individual pickup volume control, the straight out-of-phase sound is sonically unusable. The high-pass filter prevents the low frequencies from cancelling out, giving the two pickup mix more low-end body. With the high-pass filter off, the volume control blends from outright squawky to anywhere in between. Both controls provide interesting combinations.

Mouse Shortcuts

For power-users, these mouse shortcuts make editing faster:

Mouse shortcut	Function
Double click	Pickup on/off
Shift + double click	Phase invert

Mouse shortcut	Function
Option/Alt + double click	Toggle single/double coil
Shift + drag	Pickup volume (relative movement)
Option/Alt + drag	Low-pass filter (relative movement)
Shift + Option/Alt + drag	Low-pass Q (relative movement)
Option/Alt + Click rotator tool	Reset pickup slant

Dynamic Noise Reduction

The Ascend VPU incorporates a dynamic noise reduction filter that takes effect on lower level signals for minimizing broadband noise (hiss). A moving average filter, best suitable for minimizing random white noise, is inserted at the input. When the signal goes below +12dB the expander threshold (see below), the moving average filter output is cross-faded with the raw input. This noise reduction scheme works well for guitar signals due to the natural decay of high frequencies as the string oscillation decays. The filter is very transparent. You will not ever notice that it is there.

Dynamic noise reduction, along with the expander, are very effective in minimizing noise, such that you will not need a noise gate further down the effects chain. Moreover, it should be noted too, that the virtual pickups themselves also inherently contribute to noise reduction due to the averaging effect of the comb filters (see *Virtual Pickups* series: Part1, Part2, Part3, Part4 and Part5).

Preprocessor

The actual multichannel pickup installed would have its own comb notches that impart its own color. The Preprocessor incorporates a feedback comb filter that negates this effect. The inverse comb filter, part of the preprocessor, compensates for this. The feedback comb filter's spectrum is the inverse of the pickup's spectrum. Part 3 of the Virtual Pickup Series provides technical details about the feedback comb filter. In addition, the preprocessor includes a bass boost to compensate for the natural low-frequency roll-off from the first peak, towards DC.

✏️ You will have to configure the Pickup distance from bridge (see Configuration section) for the FB Comb filter to take effect.

Expander

The downward expander serves two purposes: as an effect for dynamics control and as a means for noise and cross-talk minimization. The Expander is applied after dynamic noise reduction.

The expander adjusts the gain when the signal falls below the threshold, attenuating the signal. With the typical ***1:n*** notation for expanders. For every dB below the threshold, the signal is attenuated by ***n*** dB. For example, with a ratio of 4:1, 1dB below the threshold is attenuated by 4dB.

1. **THold**: Expander threshold. This can be set from -20dB to -90dB.
2. **Ratio**: Expansion rate is controlled by the ratio. This can be set from 1:1 minimum to 1:15 maximum.

As a dynamics control effect, the downward expander can be used to decrease the perceived sustain of the decaying signal. If the expander is used as such, the threshold is set at a sufficiently high level at which point you want it to take effect, attenuating the signal at a faster rate than normal.

For cross-talk minimization control, the threshold is set somewhere above the cross-talk level. For noise minimization control, the threshold is typically set somewhere above the noise floor.

✏️ Hum is not an issue with the Nu pickups. Low impedance coils are a lot less susceptible to electrostatic noise. The more important issue is hiss (broadband noise) introduced by the active electronics (the preamplifier). The hiss (-124 dBV for the Nu pickup) is so much well below the hum level (-113 dBV for the Nu pickup) and is below human perception, ... until you push the gain. That's the real battle. Unlike other input sources such as microphones, guitar pickups sit in a precarious place in the signal path before high gain stages (compressors, distortions, overdrives, preamps, etc.), which can potentially push the gain to extreme levels. Moreover, the noise adds up for each channel used.

Master

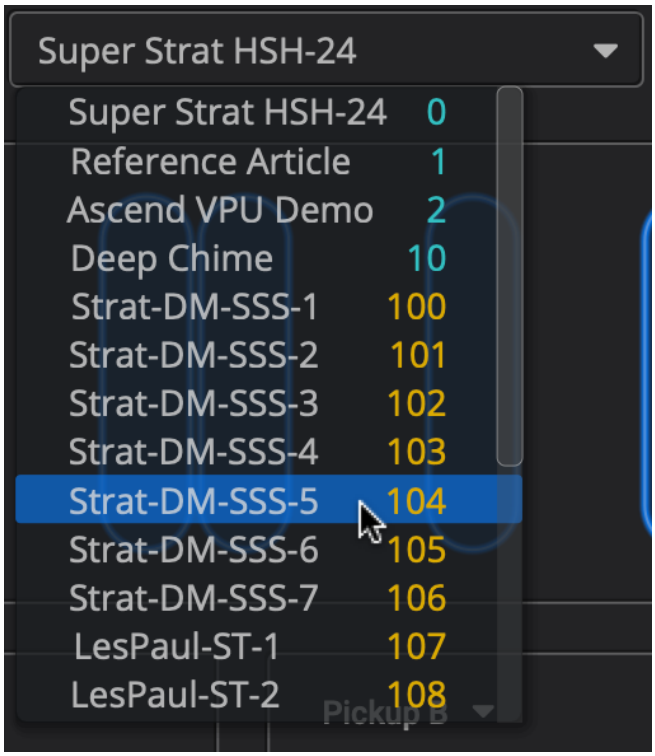
Control	Function	Range
Volume	Master volume for all pickups.	0% to 100%
Tone	Master tone for all pickups. This filter emulates the tone filter installed in a typical electric guitar. Tone is basically a 6dB/oct low-pass filter.	200Hz to 10Khz. Bypassed if higher than 9.9kHz.

Presets

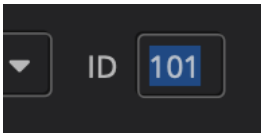
There are a couple of factory presets that you can use to start with. A preset is identified by its name and a MIDI program ID (a number from 0 to 127). Preset names and IDs are unique.

Preset Selection

Factory and user presets can be recalled using the Preset Name dropdown menu:



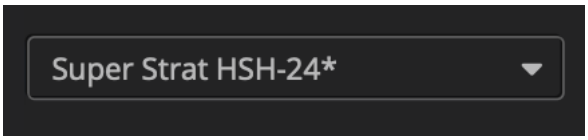
The preset IDs at the right of the preset name are either blue or gold. Blue preset IDs are user-defined, while gold preset IDs are factory presets. Presets can also be recalled by ID using the Program Number text box at the right of the Preset Name dropdown menu:



You can use the up and down arrows on the keyboard to cycle through presets. Better yet, you should be able to link a MIDI controller to Ascend-VPU's program change control parameter. For example, you can use foot controllers to switch presets, or the Cycfi CV-switch, which generates MIDI program change.

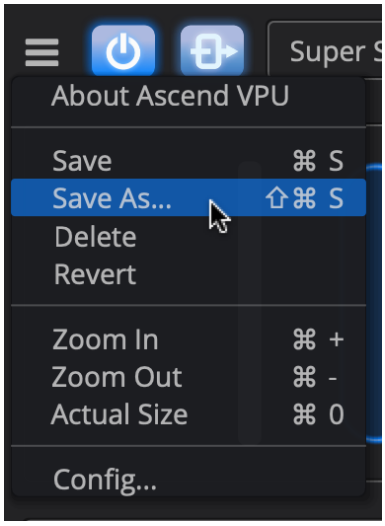
> **Note**: Refer to your DAW's user's manual on how to link a MIDI parameter to Ascend-VPU's program change control parameter. Each DAW has its own way of mapping MIDI controls to plugin controls.

Once a preset has been edited (by adjusting the controls), there will be an asterisk at the end of the name. The asterisk indicates that the preset has been edited:

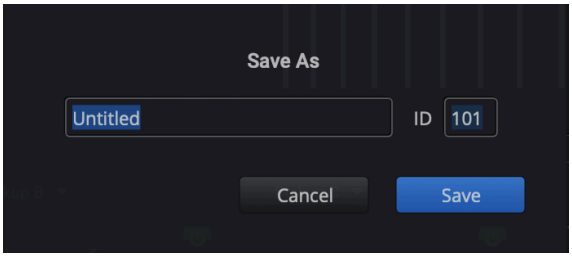


Saving Presets

Edited user presets can be saved. Edited factory presets cannot be saved. Instead, edited factory presets can be "saved-as" a user-preset with a different (unique) preset name and ID. Saving (are saving-as) a preset can be done via the main menu ☰ → "Save", or ☰ → "Save As":



A grayed-out Save menu item indicates that the current edited preset is a factory preset that cannot be saved. After selecting the "Save As…" menu item, you will be presented with a dialog box asking for a preset name and ID:



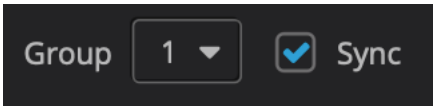
Both the name and the ID must be unique. If there is a clash in ID or name with a user-preset, you will be asked for confirmation if you want to overwrite the user-preset. Factory presets, on the other hand, cannot be overwritten. You will see an error message if you attempt to overwrite a factory preset.

Deleting and Reverting Presets

The main menu ☰ also offers menu items for deleting and reverting presets. Reverting a preset will restore its original settings. Deleting a preset will remove it from the list of presets.

Sync and Groups

A difficulty with using multichannel plugin effects that are inserted into individual, but separate DAW tracks or channels, is the tedious task of having to edit each separate plugin so that each will have the same settings. The Ascend VPU plugin provides a way to synchronize the settings of all inserted plugins such that editing one inserted plugin of the same group (more on groups later) will synchronize the settings of the others of the same group. For example, moving the slider of one plugin will also move the same slider of the others. This is possible by setting the Sync checkbox (at the top right of the GUI, image below).



The Group ID, which can be set using the dropdown menu from 1 to 10, allows you to group together a set of inserted Ascend VPU plugins, such that the settings are synchronized only for inserted plugins of the same group. For example, you can have a group of 6 plugins, assigned to ***group 1***, inserted for high-gain, and another set of 6 plugins, assigned to ***group 2***, inserted for clean. Adjusting the settings for group 1 will only affect all plugins assigned to group 1, and the not for group 2.

Not all controls are synchronized. The parameters that are synchronized are:

1. Pickup position
2. Pickup slant
3. Pickup type
4. Pickup enable/disable
5. Pickup phase
6. Pickup volume (Vol)
7. High-pass filter frequency (HP)
8. Low-pass filter frequency (LP)
9. Low-pass filter resonance (Q)
10. Preset ID
11. Master Volume
12. Master Tone
13. Master Enable
14. VPU Bypass

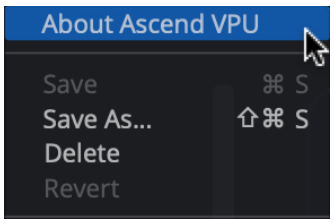
Each inserted plugin will always have unique settings for some parameters. The unique parameters that are not synchronized are:

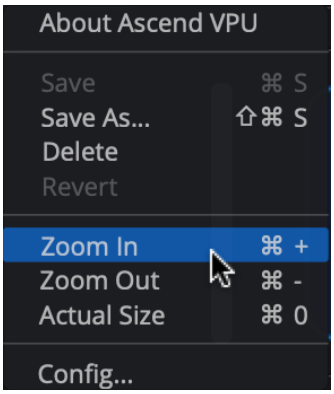
1. Expander threshold (THold)
2. Expander Ratio (Ratio)
3. Base Note
4. String Position
5. Pickup distance from bridge

Miscellaneous

About Ascend VPU

Information about the plugin, such as version and copyright, is provided by the About Ascend VPU menu item from the main menu ☰:



Resizing the UI

The plugin window may be resized using the Zoom In, Zoom Out, and Actual Size menu items from the main menu ☰: