

# PS-20



## 1 Getting Started

The Cherry Audio PS-20 is a somewhat loosely interpreted emulation of the classic Korg MS-20 analog synthesizer. We've carefully modeled the unique tonality of its audio path, including super-accurate emulations of its distinctly raunchy highpass and lowpass filters, but once we got started, we couldn't stop... let's just say we added a LOT of additional functionality to this fun and sometimes-really-weird synth.

Intended as an affordable alternative to American mono synthesizers such as the Moog Minimoog and the ARP Odyssey, the original Korg MS-20 was released in 1978, selling for less than half the price of a Minimoog. With that in mind, it's full of design choices that are sometimes innovative, sometimes maybe dumb, and sometimes just plain off the wall. It's important to remember that in the 70s, typical analog synth features weren't yet completely established, so synth design was still in a sort of Wild West, or in this case, "Wild East" era.

Perhaps the most notable MS-20 feature is its grindy dual filters. In an era where the gold standard was the fat and velvety Moog ladder filter, the MS filters' easy-to-distort, screamy resonance couldn't have been more different. But their signature sound was the unintentional byproduct of a penny-pinching, as-few-components-as-possible design - the similarly crude low-parts-count VCA also contributed to their overdriven sound. The MS-20 wasn't hugely popular in its day, owing to an overall smaller synth market (Japanese instruments didn't really take off until the 80s), but as the years went on, people discovered the joys of this unique little monster, along with its baby sibling, the simplified MS-10. The MS-20 really hit its stride in the 90s when William Orbit used one all over Madonna's "Ray Of Light" record, and people began to scoop them up. Eventually the demand became large enough that Korg reissued the MS-20, first in a miniaturized version, and eventually with full-size editions.

Beside its unique filters, the MS-20's other famous feature is a modular-style patch panel, rarely seen in low-priced synths (well, at least in 1978). For most users, it's something of a mixed blessing, because it *appears* to add full modular-synth flexibility, but unfortunately lacks a fair amount of connectivity you'd want, such as a separate oscillator outputs and modulation inputs. Overall, its implementation can be pretty confusing, even to seasoned synthesists. At a glance, the Cherry Audio PS-20 patch panel appears very similar, but in actuality, we've reconfigured the patch panel considerably, adding desired ins and outs for all oscillators, filters, and VCAs, correcting the confusing terminology of the original, and throwing in a few extras to make it more fun and usable.

We've hot-rodged the rest of the synth with extras as well - most importantly, transforming the original mono instrument into a 16-note polyphonic beast. We've also added a unique three-channel, eight-step sequencer with flexible CV outs, enabling control of any patch panel parameter. Rounding things out are integrated effects including a beastly distortion, modulation echo with stereo spread, and a lush digital reverb with fantastic spring and plate emulations.

As a result, the PS-20 truly is one of the most unique instruments we've released. Between its sometimes unpredictable filter behavior, and the tremendous flexibility of its patch panel and sequencer, the creative possibilities are endless. Throughout its development cycle, even us jaded, lifelong synth nerds kept stumbling on crazy, "how the heck did I do that?!?" sound programming surprises. We think you'll dig PS-20 as much as we do... enjoy!

### **1.1.1 Technical Assistance**

Cherry Audio's unique online store and automatic updating should make operation a smooth experience, but if you run into any issues or have questions, you can discuss issues online at the Cherry Audio forums at:

<https://forums.cherryaudio.com/>

... or you can communicate directly with one of our surly and grumpy, scratch that... outgoing and friendly tech support staff at:

<https://cherryaudio.kayako.com/>

## 2 PS-20 Primer



At the most basic level, the original MS-20 has a relatively simple voice architecture: it's a monophonic (one-note-at-a-time) analog synthesizer with two oscillators mixed into highpass and lowpass filters in series (one after the other), then to a VCA, which is controlled by an envelope generator. There's also an additional simple envelope generator that normally modulates the pitch of both oscillators, and an LFO that controls both oscillator pitches and/or filter cutoff frequencies.

The MS-20 is more than just a basic monosynth - its voice architecture can be altered considerably by plugging cables into its semi-normalled patch panel section. In theory, the patch panel is a fantastic addition to an affordable, basic synthesizer, but it's where things get hazy for many users, because the original MS-20 patch panel is a bit confounding, even for experienced modular users. There are a couple of reasons for this:

- **Connectivity-** At a glance, it appears to be a sea of jacks, but in reality, it's missing a lot of the connectivity necessary for serious modular functionality. For example, it lacks audio outputs for each oscillator, and there are no separate inputs for the lowpass and highpass filters.
- **Terminology-** Some of the panel labels are confusing. Gate inputs and outputs are misleadingly labeled *Trigger*, and most users struggle with the *Total* modulation input concept.

Although PS-20's patch panel greatly resembles an original an MS-20, if you look closely, you'll see we've seriously altered it from the original. We've eliminated the *Total* modulation input and its attenuators, added a LOT of additional connectivity, and changed a number of the labels to make it much easier to understand. These changes radically transform its usability. Users with analog modular synth experience should have no trouble jumping right in. Of course, you can learn all about it in the [Patch Panel](#) section.

Besides its improved patching abilities, PS-20 also radically differs from the original synth by virtue of up to 16-note polyphony, as opposed to the mono voice structure of the original. This massive increase increases its musicality (and accounts for the "P" in PS-20).

We've also added a three-level, eight-step sequencer; that is, it's really three separate, synchronized sequencers, each with its own independent pitch and gate settings and outputs. This adds a whole new dimension to patches.

And finally, we've replicated the MS-20's uniquely weird External Signal Processor (ESP) section. The ESP has the ability to convert monophonic audio signals (routed inside a DAW via sidechaining) into pitch and gate CV signals. The tracking accuracy of the original was somewhat squirrely - we've improved it a bit in PS-20, but this inaccuracy adds to its charm (check out live YouTube vids of Goldfrapp's "Lovely Head" for a mind-blowing demonstration of the original MS-20's ESP section).

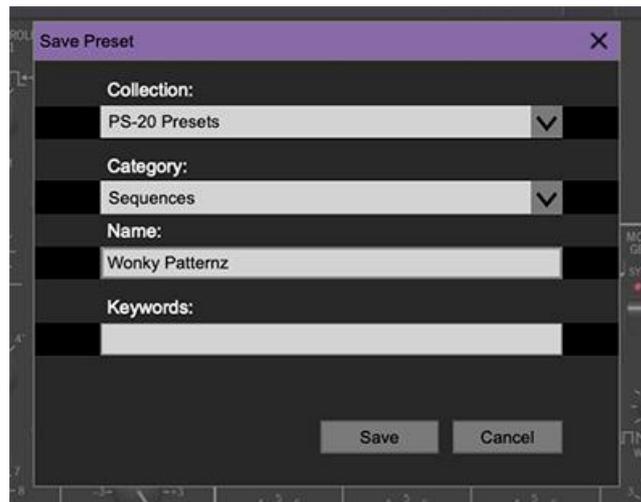
Like the MS-20 that inspired it, the PS-20 may not be the most straightforward or predictable synthesizer you'll ever encounter, particularly when the filters are screaming away and cutoff frequencies modulated. On the contrary, one often ends up with something different than expected, and herein lies its beauty, as the results are frequently more interesting than the original intention. This is what makes PS-20 so rewarding and fun to play. We hope you enjoy it as much as we have!

### 3 Top Toolbar and Preset Browser

The purple strip at the top of the PS-20 contains all of the preset loading and saving navigation, "under-the-hood" settings, zoom and focus control, and more.

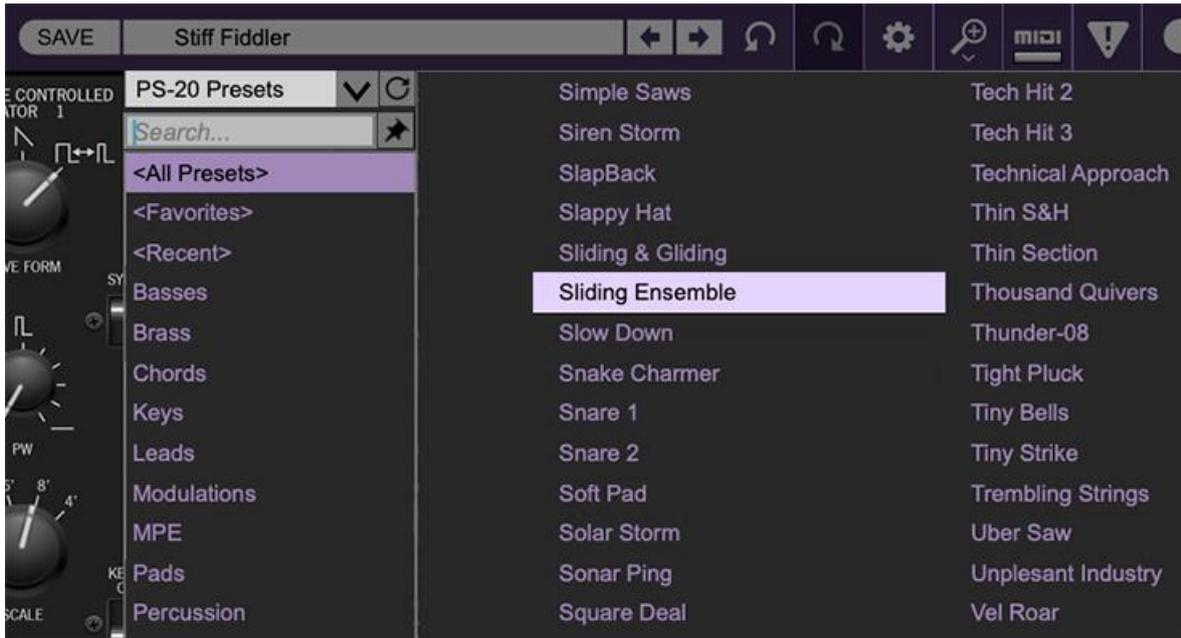


**New**- Opens a new blank patch preset. If an unsaved patch is currently open or you've modified an existing saved patch, a dialog asks if you'd like to save the patch in its current state. This greatly reduces the possibility of losing an edited unsaved patch.



**Save**- Use this to save patches. There are a couple of levels of hierarchy:

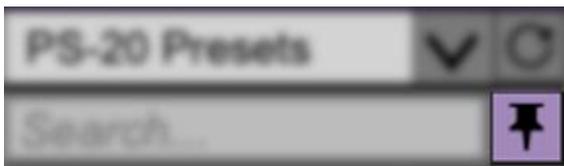
- **Collection**- This is the top level of organization, and contains entire "sets" of presets. The *PS-20 Presets* are the main included collection. We also include a *User Presets Collection* for storing your own presets, but you're free to create your own collections. To create a new collections, click in the *Collection* text field (where it says *User Presets* above) and type a name. User-created sounds can be freely saved to any collection; we like to "keep 'em sepa-rated" for organizational purposes.
- **Categories**- Within each *Collection* are a number of sound categories. As with collections, you're free to create as many categories as you like. To create a category, click in the *Category* text field of the *Save* dialog window and type a new category name.
- **Patch**- A patch is an individual sound. To save a patch, simply type the name in the *Name* field and click *Save*.
- **Keywords**- You can add descriptive words such as "huge," "noisy," "poly," etc., to patches to make them appear when terms are typed in the *Search* field. Use commas to separate multiple keywords entries.



**Browsing Patches-** Patches can be browsed by clicking the *<Select Preset>* field. To select a preset collection, click in the area that says *<All Collections>* or on the downward-facing arrow next to it.

Clicking on the left-side categories narrows down which patches are displayed.

- **<All Presets>** will show presets from all collections and categories.
- **<Recent>** displays recently used presets.
- **Refresh-** This is the circular arrow button to the right of the downward arrow; clicking this checks the Cherry Audio server for new or updated presets.



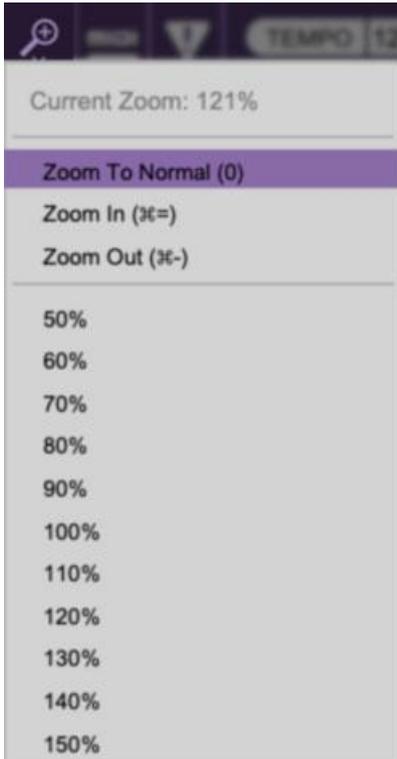
**Pin-** Clicking the push-pin icon locks the patch selection list open, allowing fast and easy browsing and auditioning of patches. Click the icon again to disable pin mode. when in pin mode, the up and down arrow keys can be

used to select patches.

**Preset- Step Back/Forward Arrows-** These step to the previous or next preset.

**Undo/Redo-** These circular arrows will undo or redo the last action. It remembers many steps, so if you really loused something up, keep on clickin'...

**Settings-** This is where user preferences for user interface, audio interfaces, user account, and more are configured. See the [Settings](#) section for full information.



**Zoom Magnifying Glass**- Click to resize the PS-20 interface window. Selecting *100%* returns the user interface to native size.

**MIDI tab**- Opens the MIDI controllers tab for configuring internal and hardware MIDI controls. See the [MIDI Controllers Setup and MIDI Tab](#) section for full information.

**MPE Tab**- Short for "MIDI Polyphonic Expression," PS-20 supports MPE, a specialized MIDI protocol enabling multidimensional controllers to control multiple parameters of individual notes. **The MPE Settings toolbar icon is only visible if *Settings>Interface>Enable MPE mode* is checked.** See the [Using MPE](#) section for full information.

**! (MIDI Panic)**- Click to send an all-notes-off message in case of, "make this freaking thing shut up?!?" stuck-note incidents.

**Tempo (Standalone Version Only)**- Displays PS-20's current internal tempo setting. PS-20's internal tempo affects the *Modulation Generator*, *Sequencer*, and the *Mod/Echo* sections when their corresponding *Sync* switches are in the up position. The tempo setting can be changed by moving the mouse up and down anywhere in the tempo section, or by double-clicking the number and entering the desired BPM value.

***The tempo display only appears in the standalone version of PS-20. VST, AU, and AAX plug-in versions receive tempo data from their host DAW app.***

**Cable Transparency**- Clicking the checkerboard icon displays the cable transparency slider. Slide this to the left for more transparent cables, or to the right for more opaque cables.

**Cable Color Select**- Click this to select the global cable color, i.e. the color of any newly patched cable. Clicking *Random* randomly chooses a color for each new cable.

**Show/Hide Cables-** Clicking this hides or shows all cables. It has no effect on sounds, and its status does not save with patches. Cables can also be shown or hidden using the key shortcuts [CONT-D] (Windows) or [⌘-D] (Mac).

**Special Cool Cable Color Select Feature-** The color of any existing cable can be changed by right-clicking in jack area. Right-clicking on a jack that doesn't have a cable plugged in will change the global cable color (i.e. the same as changing the color with the toolbar button).



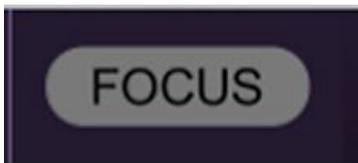
**QWERTY Musical Typing Keyboard-** Opens an onscreen keyboard allowing a standard QWERTY computer keyboard to be used for playing music notes. For more information, see [QWERTY Musical Typing Keyboard \(MTK\)](#) section.



**Help (?)** - Clicking this launches your web browser and opens the help document you're currently reading. (*Cheech and Chong voice*) So like, if you're already reading this, did you already find the ? button and or was it the other way around, man...

**Cherry Audio PS-20 Synthesizer logo-** Clicking this displays "about" information, and shows the version number and current registered user ID. We'll never tell what the Japanese writing says!

### 3.1 Focus

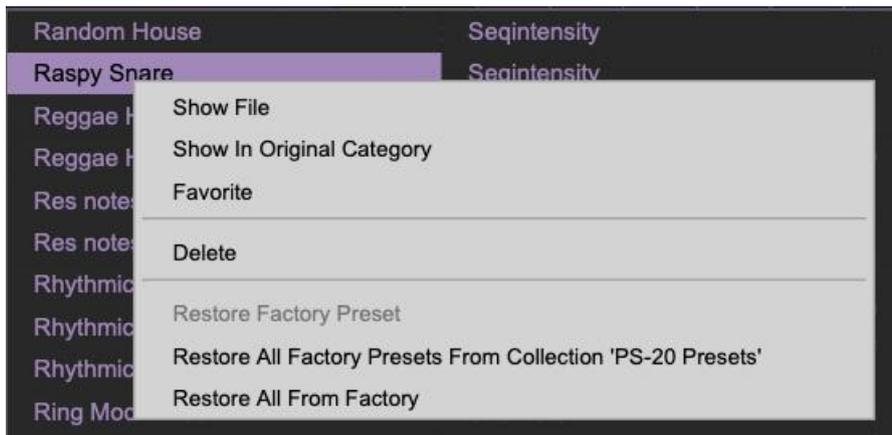


PS-20 packs a fairly large number of controls and jacks into a limited space. If you have limited screen real estate, the *Focus* button conveniently blows up PS-20's user interface to roughly twice its normal size within the current window size.

Unlike the *Zoom* "magnifying glass" function, *Focus* doesn't affect the current window size. By default, the patch panel section fills the current window, but the view can be scrolled vertically and horizontally with a mouse wheel, track pad, or Apple Mighty Mouse finger-scrolling. Or if you're the last person on earth still using a single-button mouse, scroll bars will appear at the window edges when in *Focus* mode.

Using *Focus* mode couldn't be easier - just click the *Focus* button the top menu bar. To return to standard view, click *Reset*. *Focus* can also be directly accessed with [CTRL]+click (Windows) or [CMD]+click (Mac) by clicking anywhere in the user interface. [CTRL]+click / [CMD]+click again will resume normal view.

## 3.2 Preset List Right-Click Functions



**Show File**- This displays the selected preset in the Mac or Windows folder containing it. This is useful for backing up or sending a preset file to another user.

**Show In Original Category**- Selects the preset within its category, i.e. the category will highlight in the left preset menu. The *Show In Original Category* command only displays if the preset was selected within the *<All Presets>*, *<Favorites>*, or *<Recent>* categories.

**Favorites**- Favorited presets will show in when the *<Favorites>* category is selected. A star will display next to the preset name. Right-click on the preset and reselect *Favorite* to un-favorite it.

**Delete**- Deletes the selected preset.

**Restore Factory Preset**- If one of the factory (i.e. not user) patches is edited and saved, selecting this command restores the patch to its unaltered "factory" setting. This menu will be grayed-out for user bank patches.

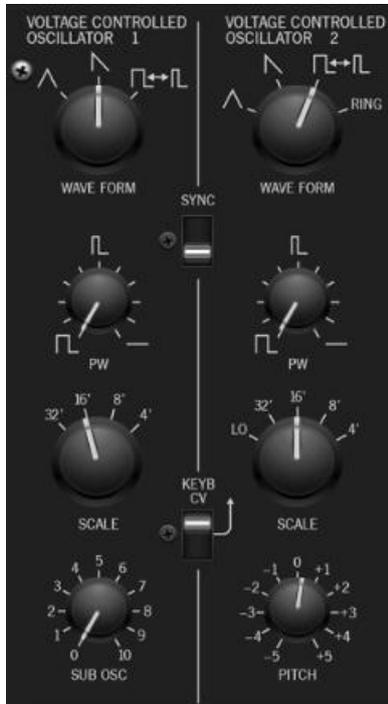
**Restore All Factory Presets From 'PS-20 Presets'**- If any patches from the "factory" PS-20 bank are edited and saved, selecting this command restores *all* of them to their unaltered factory setting. (BTW, we TOTALLY have a GIANT factory at Cherry Audio, because where else are you gonna put all those ones and zeros?)

**Restore All From Factory**- If any patches from the factory banks are edited and saved, selecting this command restores *all* of them to their unaltered factory setting. At the time of writing, the PS-20 bank mentioned above is the only factory bank, so this function and the *Restore All Factory Presets From 'PS-20 Presets'* above have the same effect.

**Show File**- This displays the selected preset in the Mac or Windows folder containing it. This is useful for backing up or sending a preset file to another user.

## 4 VCO 1 and 2

PS-20 includes two similar-but-slightly-different voltage-controlled oscillators. We'll abbreviate that to "VCO" because typing is like, hard.



**Wave Form-** Yes, we incorrectly split the word in half, just like the real thing. This selects the waveform for each oscillator. Both include triangle, saw, and variable-width pulse. VCO 2 adds a *Ring* position, short for ring modulation.

The simple(ish) definition of ring mod is that it multiplies two sound sources together, removes the input signals, and outputs only the sum and difference frequencies of the two sources. In practical terms, this usually translates to a rich harmonic spectra with lots of uneven harmonics. It's useful for clangorous bell sounds, and when the frequency of one of the oscillators is swept, makes a pretty impressive racket. Although VCO 1 is mixed with the VCO 2 when using ring mod, ring mod only makes use of the pulse wave, so selecting different VCO 1 waveforms will not affect sound (though changing VCO 1's pitch will).

**PW-** Sets the width of pulse waves, from a perfect square to a very narrow pulse. It has no effect on other waveforms. Also Morgan Fairchild's sexy nickname for movie-star version of Pee Wee Herman, but this only makes sense if you've seen "*Pee Wee's Big Adventure*."

**Range-** Sets the pitch range for each oscillator in octaves. These are at standard organ footage settings of 32', 16', 8', and 4'. VCO2 also includes a *Lo* setting, intended for using VCO 2 as an LFO mod source via the patch panel. When set to *Lo* mode, the *Pitch* knob essentially becomes an LFO speed control.

**Sub Osc (VCO 1 only)-** This is a square wave, one octave below the current *Scale* setting. It's super useful for beefing up sounds. Note that the waveform is unaffected by the *PW* setting.

**Pitch (VCO 2 only)-** Detunes VCO 2 by up to an octave up or down. This can be used to fatten up two oscillator patches by detuning a small amount, or for "building-in" a set interval. The panel markings say -5 to +5 - we're not exactly sure what that's supposed to correlate to, but all of our original MS-20 specimens have roughly the same range (perhaps they figured out that five semitones isn't really enough after they had the panels silkscreened).

**Sync-** This causes VCO 1 to force reset the start of VCO 2's waveform to the beginning of its cycle, resulting in the classic Cars "*Let's Go*" tearing harmonics sound (or No Doubt's "*Just A Girl*," for children of the 90s).

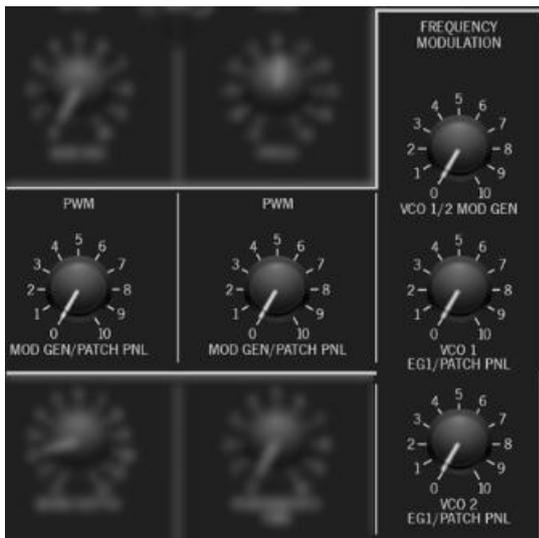
To most effectively hear sync, set VCO 1's *Scale* to 32' or 16', set its mixer level to zero, then turn up VCO 2, and manipulate the *Scale* and *Pitch* knobs. The easiest way to get "automatic" sweeps is to turn the *VCO 2 EG1/Patch Pnl* knob (in the Frequency Modulation section under the mixer) halfway up and set Envelope Generator 1's *Sustain* switch off, and *Attack* and *Release* times around 1 or 2.

**Keyb CV (VCO 2 only)**- Setting this to the down position disconnects the incoming keyboard CV signal. There are a couple of reasons you'd want to do this:

- If VCO 2 is being used as an LFO mod source, disabling the keyboard CV keeps the mod rate constant; otherwise the mod rate speeds up as you play higher up the keyboard.
- If the sequencer is being used to control pitches, and you don't want the sequence pattern to transpose as keys are played.

#### 4.1 VCO 1/2 Pulse Width Modulation and Frequency Attenuator Controls

These are the knobs located directly beneath the oscillators and mixer section. They set the amount of modulation signals routed to the VCOs either via the hardwired internal connections or from the patch panel mod input jacks when sources are plugged into them.



**PWM (VCO 1 and 2)**- This is short of for pulse width modulation. It varies the width of the oscillator pulse width and is the same as manually twirling the *PW* knob back and forth. Turning the knob up modulates the pulse width via the modulation generator or mod sources plugged into the patch panel oscillator *Freq* jacks.

**VCO 1/2 Mod Gen**- Sets the amount of frequency mod from the mod generator (LFO) saw/triangle/ramp wave. This affects both oscillators equally.

**VCO 1 EG 1/Patch Panel**- Sets the amount of frequency mod from envelope generator 1 or mod sources plugged into the patch panel VCO 1 *Freq* jack.

**VCO 2 EG 1/Patch Panel**- Sets the amount of frequency mod from envelope generator 1 or mod sources plugged into the patch panel VCO 2 *Freq* jack.

## 5 Mixer

PS-20's mixer section is a super-simple affair, with levels for each oscillator as well as white and pink noise. We switched things up a little here - the original MS-20's noise source is selected as a VCO 1 waveform. We felt it was limiting to essentially lose oscillator 1 when using noise, so we added a separate noise volume in the mixer section.



**VCO 1 / VCO 2 Level-** The *VCO 1 Level* and *VCO 2 Level* knobs adjust the volumes of each oscillator.

**Noise White/Pink level-** This is a bi-directional knob. Center position is off; turning the knob left increases the volume of white noise, turning it right increases the volume of pink noise.

In case you're not in the mood to wiki the difference between pink and white noise:

White noise is a random signal in which all frequencies across the frequency spectrum are represented equally, and is useful for wind and surf effects.

Pink noise is a random signal in which each octave across the frequency spectrum is represented equally. It tends to sound darker and bassier, and often works better as a mod source if you don't want total chaos.

Pink Taco was a mediocre, generic Mexican restaurant at the Hard Rock in Vegas, before it closed. For reasons I'll never comprehend, my friend Myke (yeah, he really spells it that way) always insisted on going there whenever he visited Vegas. I found Pink Taco not to be very useful for wind, surf, mod effects, or burritos.

## 6 Highpass and Lowpass Filter

PS-20's filters super accurately recreate the MS-20's signature raunchy distorted sound. As we've mentioned, their penchant for honky, screaming distortion wasn't so much an intentional "feature," so much as it was a byproduct of its simple, thrifty design ethic. We carefully A/B'd PS-20's filters with the coveted "version 35" filter of the original instrument, and we think you'll be delighted with its authenticity.



If you're not familiar with how filters work, a lowpass filter allows frequencies *below* the cutoff frequency setting to pass through, but blocks frequencies *above* the cutoff frequency. Highpass is the opposite of lowpass mode: high-frequency content remains, but low frequencies are removed as the cutoff frequency increases. The original MS-20 has the filters configured in series; that is, the signal goes through the highpass filter first, then through the lowpass filter. Combining these in series results in a bandpass filter - low and high frequencies are removed, while the middle frequencies pass through (i.e., a "band" of frequencies). Unlike the original instrument, we've included a Series/Split/Parallel mode switch that adds two extra filters configurations for additional sounds, because we're cool that way.

### 6.1 Highpass and Low Filter Main Controls

**HP Cutoff Freq-** Sets the cutoff frequency of the highpass filter. All frequencies *higher* than the current setting are allowed to pass through the filter, while frequencies *lower* than the cutoff setting will be attenuated at a rate of 6 dB per/octave.

**LP Cutoff Freq-** All frequencies *lower* than the current setting are allowed to pass through the filter, while frequencies higher than the cutoff setting will be attenuated at a rate of 12 dB per/octave.

**Peak (resonance)-** Emphasizes sound energy at and around the cutoff frequency by adding feedback from the filter's output back to its input. As the peak is increased, any modulations or knob twisting of the cutoff frequency becomes more pronounced and can create the classic "vowel-sound" this filter is known for. When turned up past seven or so, the filter begins to feed back enough to self-oscillate, sometimes like mad, so take extra precautions against speaker implosion, bleeding eardrums, and cat torture. On the other side of the cutoff frequency spectrum, PS-20's filters can create some major sub-rattling bass, just the thing if you're like Tigra and Bunny, and you like the-boom.

**Drive-** The *Drive* knobs allow control over filter distortion level. We recommend experimenting with them as they're really useful. At low settings, the filters clean up and sound decidedly un-MS-20ish, and of course at high settings, things get crazy. If you're using filter resonance to play musical notes (and you should), you'll want to crank the *Drive* up higher, particularly in combination with the *Keyb Track* switches.

### 6.1.1 Filter Drive knobs vs. Distortion effect

It's important to remember that PS-20 is inherently a polyphonic instrument. This means it has an independent highpass and lowpass filter for *every* voice (dependent upon the current *Max Voices* setting). As a result, the filters won't distort "against" one another. Conversely, the *Distortion* effect is a single distortion generator, so any time multiple chord notes are played through it, they'll be distorted as one entity. A good analogy would be to imagine the *Distortion* effect as if plugging an electric guitar into a single fuzz box and amplifier, and playing chords, whereas the filter *Drive* knobs would be equivalent to plugging each string of an electric guitar into its own independent fuzz box and amplifier - each note string (note) would cleanly distort with no interaction with the other strings (for a couple of minutes anyway, then the neighbors would call the cops on the crazy jerk playing six amplifiers at once).

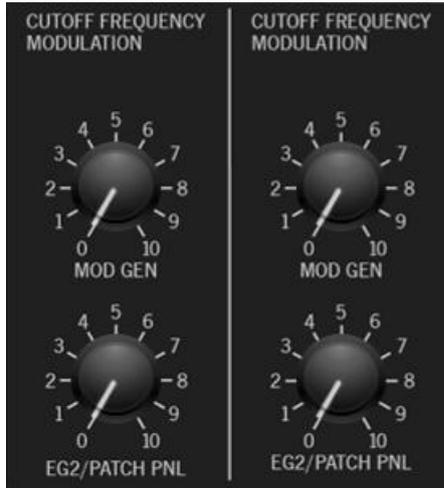
**Keyb Trk-** These internally patch the keyboard CV to positively modulate the cutoff frequency. This means that the cutoff frequencies rises as higher notes are played on the keyboard, in order to keep tonality consistent. At high resonance settings, it also allows the ringing resonant frequency to play in tune across the keyboard, though results can vary depending on drive settings.

**Series/Split/Parallel mode switch-** This configures how the signal flows through the highpass and lowpass filters as follows:

- **Series-** The signal from the mixer runs into the highpass filter, then to the lowpass filter, effectively creating a bandpass filter. This is how an original MS-20 operates.
- **Split-** VCO 1 is routed through the highpass filter and VCO 2 is routed through the lowpass filter. In this setting, the mixer only acts as a volume control for each oscillator; VCO 1 and VCO 2 are mixed together *after* the filters. The noise generator signal is routed to both filters
- **Parallel-** The mix of both of oscillators and noise is routed to the inputs of both filters, and their outputs are then mixed together.

It's worth clicking through all three positions when working on patches, as the results are often good. Differing cutoff and resonance settings in the three modes will create interesting filter responses, especially when the cutoff frequencies are modulated.

## 6.2 Cutoff Frequency Modulation Attenuator Controls



Sets the amount of modulation signals routed to the filters either via the hardwired internal MG triangle wave or from the patch panel *Cutoff Freq* mod input jacks when sources are plugged into them.

**Mod Gen-** Sets the amount of cutoff frequency mod from the mod generator (LFO) saw/triangle/ramp wave.

**EG2/Patch Panel-** Sets the amount of cutoff frequency mod from envelope generator 2 or a mod source plugged into the patch panel HP Filter and LP Filter *Cutoff Freq* mod input jacks.

## 7 Modulation Generator

PS-20 includes a low-frequency oscillator (LFO) that generates sub-audio range signals intended for modulation purposes. This is referred to as the modulation generator, or "MG." (Incidentally, MG automobile owners refer to it as an "oil puddle generator.")

### 7.1 Modulation Generator Controls



**Sync**- When the *Sync* switch is in the up position, MG speed will lock to host tempo when using PS-20 within DAW software, or to the current tempo in the top menu bar when using the standalone version.

**Mod Whl** - This is a really handy, but potentially confusing feature, so don't skim this section. If the slide switch is in the down/off position, the LFO is always "on." Its effects will be immediately audible if one of the *Mod Gen* knobs is turned up. Clicking to the up/on position enables control of modulator depth with an external keyboard controller mod wheel. If the mod wheel is all the way down, mod depth is zero. This makes setting up a mod wheel to add vibrato or wah effects super easy. If it seems like the modulation generator isn't working, check if the *Mod Whl* switch is engaged (or just push up the mod wheel).

**Frequency**- The *Frequency* knob sets the speed of the LFO, from 0.10 to 20 Hz (with *Sync* switch off) or from 8 beats up to 1/64th note triplets (*Sync* switch on).

**Wave Form**- Yes, we intentionally spelled that funky. This continuously varies the mod waveform shape. The mod generator simultaneously outputs pulse waves of varying widths and saw/tri/ramp waves. By default, the hard-wired mod routings use the saw/tri/ramp (i.e. the *Mod Gen* knobs in the *PWM Mod Gen*, *Frequency Modulation*, *Cutoff Frequency Modulation*, and *VCA Modulation* sections), but the pulse wave can be used by routing it in the patch panel section (more on this in the [Patch Panel](#) section).

Note that the saw/tri/ramp waves are bipolar (i.e. they oscillate above and below 0 V), which is most desirable for oscillator vibrato applications, and the pulse waves are unipolar (they oscillate from 0 to 5V), which is best for trills or octaves, because the bottom note stays constant.

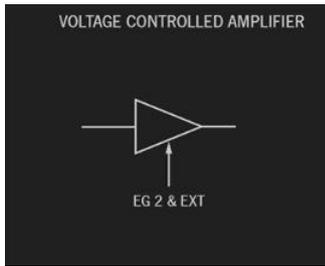
The LED beside it flashes at the current modulation frequency.

## 7.2 Modulation Generator Routing

The MG can be routed in a couple of ways. The easiest way is to turn up the aforementioned *PWM Mod Gen*, *Frequency Modulation*, *Cutoff Frequency Modulation*, and *VCA Modulation* Mod Gen knobs beneath the various sections. This routes the saw/tri/ramp wave; set the knob to center position for the most commonly used triangle wave.

For increased flexibility, both wave CV outputs are available in the patch panel section and can be routed to numerous destinations. The CV outs can even be used simultaneously with the hard-wired panel Mod Gen knob routings.

## 8 VCA



Outside of a modulation attenuator, PS-20's main VCA doesn't have any controls, per se, but it's helpful to understand its functionality.

VCA is an acronym for "voltage-controlled amplifier," which is a fancy way of saying, "volume knob, controlled by voltage." The sideways triangle on the panel is the standard schematic symbol for an amplifier.

The horizontal lines on either side indicate the signal flowing through it, and the EG 2 & Ext labels with upward arrow show the incoming voltage controlling the amount of signal flowing through. A simple analogy would be to think of the horizontal line as water flowing from left to right, and the control voltage from the bottom as a faucet that gets adjusted by the incoming control voltage.

The VCA is hardwired for control via EG 2, but it can also be controlled with EG 1 using its output in the patch panel, patched to the *VCA Amount* jack.

### 8.1 VCA Modulation Attenuator Control



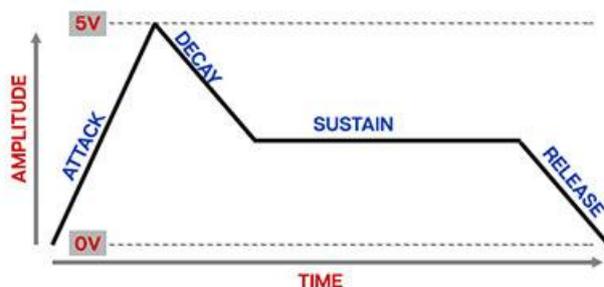
**Mod Gen/Patch Panel-** Sets the amount of modulation signal routed to the VCA either via the hardwired internal MG saw/triangle/ramp wave or from the patch panel *VCA Mod* input jack when a source is plugged into it.

## 9 Envelope Generator 1 and 2



The envelope generators accurately replicate the MS-20's dual envelope generators. In addition to their particular envelope curves and times, these include a couple of unique features.

If you're not familiar with the operation of envelope generators, here's an overview of a standard ADSR-style envelope generator:



When a gate voltage is sent to the envelope generator, it outputs a voltage that changes dynamically according to the settings of its four stages.

The *Attack* stage defines how long it takes for the output voltage to rise from 0 to 5 volts. Once the attack stage reaches 5V, it moves to the *Decay* phase, which defines how long it

takes to fall from 5V to the setting of the *Sustain* phase. Unlike the *Attack*, *Decay*, and *Release* phases, each of which define a time, *Sustain* simply sets the held voltage level following the *Attack* and *Decay* phases - this usually equates to the envelope output level while holding down a key on a keyboard controller. Finally, the *Release* knob defines the the length of time it takes for the voltage to fall back to 0V when the gate input voltage is removed (typically when you let go of a key on a keyboard controller).

Now that you're an ADSR envelope expert, let's go over the specifics of the PS-20 envelopes.

## 9.1 Envelope Generator 1

**Delay Time**- Delays the onset of the EG1's attack phase by up to about 10.5 seconds when gate is high.

**Attack Time** - Defines the length of time for voltage to rise from 0V to 5V when the gate voltage is applied. EG 1's maximum attack time is 30 seconds (!).

**Sustain switch**- When turned on, following the attack stage, this holds the output voltage at 5V until the key is released. In the off position, envelope one immediately moves from attack to release stage.

**Release Time**- Defines the length of time for voltage to fall from 5V to 0V when gate/key is released.

**Velocity Amount**- Allows keyboard velocity (i.e. how hard you hit the keys) to control overall envelope amount. The control works somewhat in reverse - at a setting of zero, the envelope is at "full blast" and keyboard velocity will have no effect. As the knob setting is increased, keyboard velocity will have a greater effect on the envelope, i.e. playing lighter will make notes quieter.

## 9.2 Envelope Generator 2

**Hold Time**- Turning this up holds the gate high when a key is momentarily struck for up to 22 seconds. This allows EG 2 to run through its stages without holding a key for the duration.

**Attack Time** - Defines the length of time for voltage to rise from 0V to 5V when the gate voltage is applied. EG 2's maximum attack time is 14 seconds.

**Decay Time**- Defines the length of time for voltage to fall from 5V to sustain level

**Sustain Level**- Sets the held voltage level of held notes following the decay stage.

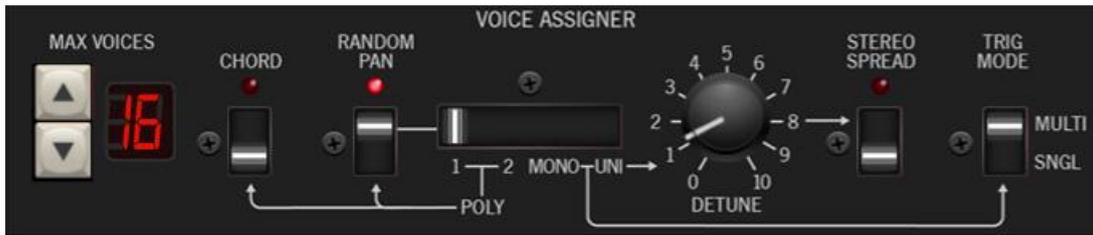
**Release Time**- Defines the length of time for voltage to fall from sustain level to 0V when gate is released.

**Release Time**- Defines the length of time for voltage to fall from 5V to 0V when gate/key is released.

**Velocity Amount**- Allows keyboard velocity (i.e. how hard you hit the keys) to control overall envelope amount. The control works somewhat in reverse - at a setting of zero, the envelope is at "full blast" and keyboard velocity will have no effect. As the knob setting is increased, keyboard velocity will have a greater effect on the envelope, i.e. playing lighter will make notes quieter.

**Gate LED**- The LED situated between the two envelopes illuminates when gate voltage is high, i.e. a key is pressed.

## 10 Voice Assigner and Pitch Settings



### 10.1 Voice Assigner Section

PS-20 can play up to 16 simultaneous polyphonic voices. The *Voice Assign* section regulates how the voices are played.

**Max Voices and LED display**- Sets and displays the maximum number of notes that can simultaneously play, from 2 to 16. Increase or decrease the total voices with the up/down arrow buttons.

**Random Pan**- Randomly distributes notes across the stereo field when in *Poly 1* or *Poly 2* mode. *Random Pan* has no effect if *Mono* or *Uni* mode is currently selected; the LED will turn off if *Mono* or *Uni* mode is chosen.

**Chord Memory**- Allows chords to be memorized and played with single keys. To memorize a chord, make sure *Poly 1* or *Poly 2* mode is selected, then click the slide switch. The LED flashes to indicate that it's in learn mode. To learn a chord, play up to 16 notes (this is limited by the current *Number Of Voices* setting); when the last note is released, the chord is memorized and the LED glows solid. To disable *Chord* mode, click the button again.

*Chord Memory and Max Voices*- The *Max Voices* setting automatically changes to the number of voices in the programmed chord. If the the *Max Voices* setting is reduced, notes are disabled. Chord notes will return as the *Max Voices* setting is increased.

Note that *Chord* mode isn't just for "chords" per se; it can be used for octaves, fifths, or any desired combination of notes.

### 10.2 Voice Assign Modes

- **Poly 1**- This the standard polyphonic mode. If the number of notes played exceeds the current maximum setting, it uses a sophisticated allocation scheme to steal the most recently played notes. In use, this means if you're holding a bass note with your left hand, it won't disappear while playing chords and melodies with your right hand.
- **Poly 2**- *Poly 2*'s allocation is optimized for use with PS-20's portamento (glide) function - it does an impressively good job of "knowing" which notes to glide from and to when holding notes while playing melodies (regardless of whether notes are played legato or separately).

- **Mono**- One note can be played a time with one voice sounding. *Max Voices* will change to *1* when *Mono* is selected. *Mono* mode is last-note priority - this means the most recently played note will always sound.
- **Unison**- One note sounds at a time with multiple voices will stacking according to the current *Max Voices* setting.

**Big Warning About MIDI MPE Mode:** PS-20 supports MIDI MPE mode, a fancy protocol that allows articulation of multiple parameters on a per-note basis (you'll know if you own an MPE-compatible controller). **If the Voice Assigner slide switch and Max Voices controls turn gray and don't seem to work, ensure that MIDI MPE mode isn't enabled** (*Settings* gear in the top purple menu bar, *Interface* tab, uncheck *Enable MPE Mode*.)

**Detune**- Randomly "spreads" the tuning of the oscillators when *Unison* mode is selected for super fat sounds.

**Stereo Spread**- Randomly distributes notes across the stereo image when the *Unison* mode is selected. It has no effect in *Poly 1*, *Poly 2*, or *Mono* mode, and the LED will shut off if they're selected with the *Stereo Spread* switch is on.

**Trigger Mode**- When *Multi* is selected, PS-20's envelopes will retrigger from the start every time a new key is pressed. If *Single* is selected, the envelopes will only retrigger if no other notes are currently held. *Single* mode is useful for emulating the sounds of some acoustic instruments - for example, the sound of plucking a note on a guitar, then sliding on the string to different notes without plucking again. *Multi* mode generally feels more responsive to play and is useful for more aggressive passages.

## 10.3 Pitch Settings



**Master Tune**- Tunes the entire instrument up or down by just over five semitones.

**Bend Depth**- Determines how PS-20 responds to incoming MIDI pitch bend data. The pitch bend range can be set from zero up to one octave.

**Portamento Time**- Also known as glide, *Portamento* causes notes to slide smoothly from one pitch to the next. Increasing the knob setting slows glide speed as it's increased. Portamento works in all voice modes; if you'd like to use it polyphonically, we recommend using *Poly 2* mode.

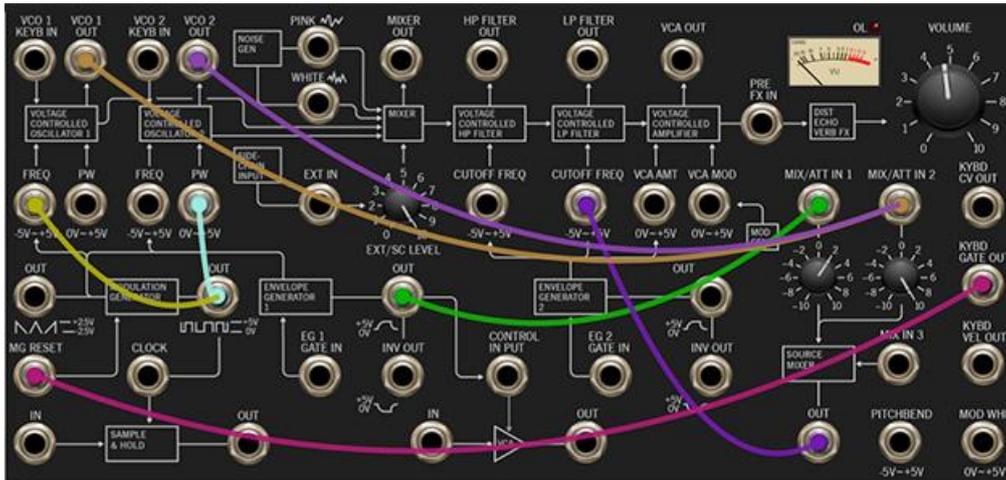
## 11 Output Section

PS-20's "output" section is so simple, it almost doesn't even warrant a manual section, but as long as we're typin'...



**Volume and output VU meter** - If you've made it this far, you'll know what the *Volume* knob does. Kidding aside, PS-20's volume range can vary a lot, so it's a good idea to watch the VU meter, particularly if the filter *Drive* knobs and/or *Distortion* effect is cranked up. The red meter LED will also glow when things are getting too hot.

## 12 Patch Panel Cables



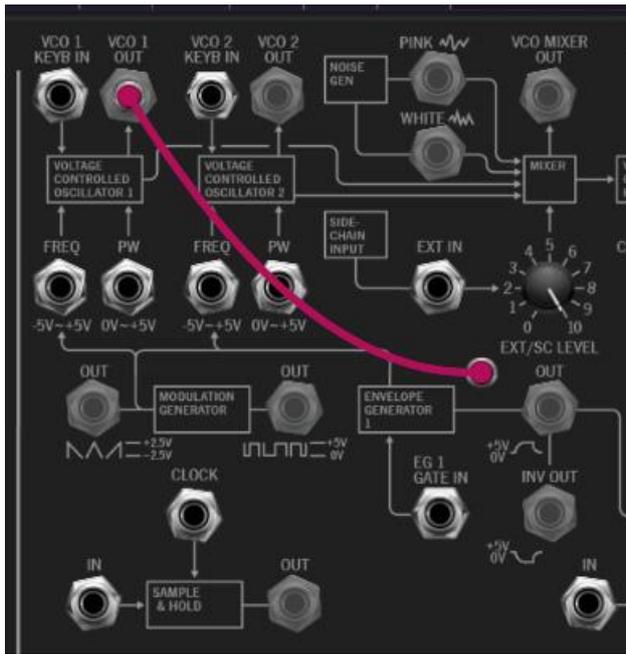
The original MS-20 patch panel is one of its greatest, yet misunderstood features. Though it added a lot of power and modular synth-like flexibility, it could be frustrating because it omitted a number of audio and modulation connections. Adding to this, it could be hard to understand due to its non-standard terminology, its "total" mod input, and the remote (relatively speaking) location of the mod attenuators.

Though PS-20's patch panel appears identical at a quick glance, it's actually quite different, and we've made a fair effort to address most of its flummoxing issues - mainly adding a number of connections and other features. As a result, PS-20 has almost all of the power and flexibility of a full modular synth. We've also changed some of the panel labels to reflect more familiar modern synth terminology, which should make it far easier to wrap your head around.

The patch panel makes use of the exact same highly refined cabling system used in our Voltage Modular instrument. We believe it's the slickest, most refined virtual synthesis cabling system on the planet, so patching cables is super easy and intuitive. It also has some great not-immediately-obvious features, so read on...

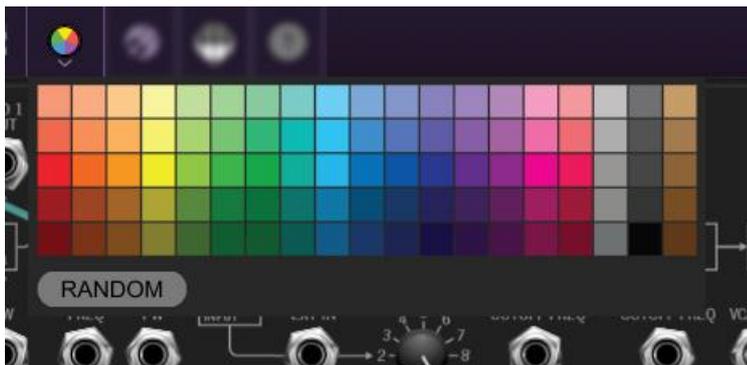
### 12.1 Basic Cable Operations

*Patching A Cable*- Simply click on a jack, drag the cable to the desired destination jack and release the mouse button, **but be aware of that unlike a hardware synth, all jacks are exclusively an input or an output**. To clarify this, when a jack is clicked and held to patch a cable, jacks *not* available as destinations are grayed out. For example, if you're patching a cable from an output jack, all other *output* jacks are temporarily grayed out. The same applies if you're patching a cable from an input jack- all other *input* jacks are grayed out.



In the screenshot above, the *VCO 1 Out* is being patched, causing all other output jacks to become grayed out, while all input jacks are potential destinations, thus their appearance remains normal.

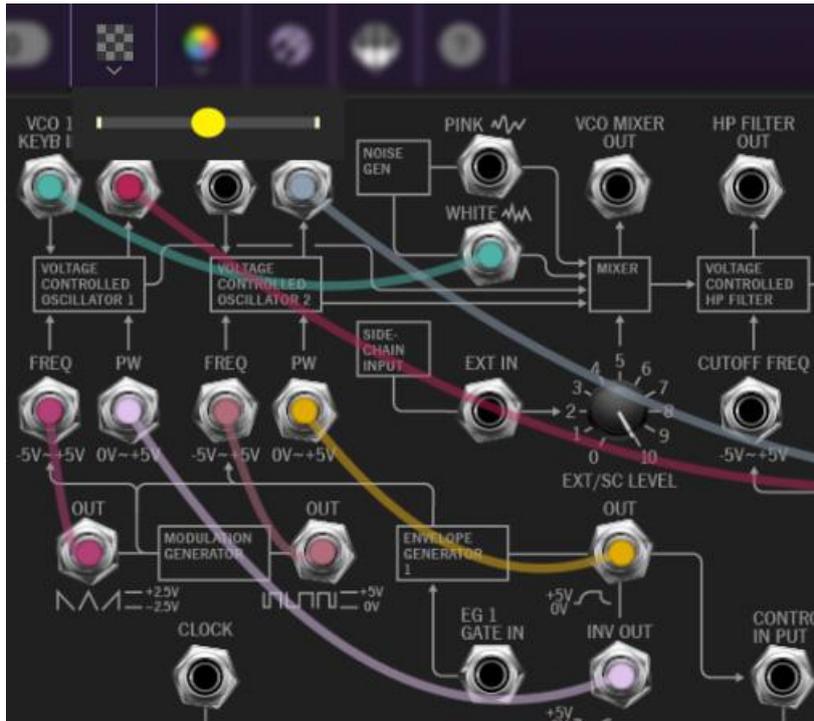
*Disconnecting A Cable-* Cables can be disconnected by grabbing one end of a jack and dragging it to any "not-a-jack" panel location, or by right-clicking on a jack and selecting *Disconnect Cables*.



*Selecting Cable Colors-* There are a couple of ways to select cable colors. The most obvious way is to click the color wheel in the top menu bar to reveal the color picker palette and select a global color. By "global," this means all newly patched cables will be the chosen color (or a random color, if *Random* is selected). Existing cables are not affected.

To change the color of an existing patched cable, right-click on one of the jacks it's connected to, then click a new color. This changes *only* that cable, and won't affect the global cable color in the top menu bar.

- **Super Handy "Pre-Patching" Cable Color Selection-** Right-clicking a jack that doesn't have a cable plugged in opens the color palette and changes the global color; the same as clicking the color selector in the top menu bar. This is convenient for specifying a cable color right before patching a new cable.



*Adjust Cable Transparency*- Clicking the checkerboard icon in the top toolbar displays the cable transparency horizontal slider. Slide this to the left for more transparent cables, or to the right for more opaque cables.

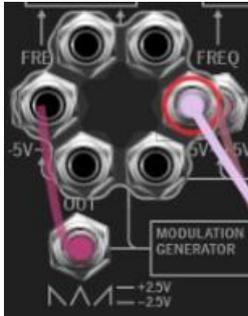


*Show/Hide Cables*- Clicking this hides or shows all cables. It has no effect on sounds, and its status does not save with patches. When cables are hidden, colored dots will still show in the jacks. Cables visibility can also be toggled with the key shortcuts [CTRL-D] (Windows) or [⌘-D] (Mac).

## 12.2 Advanced Cable Shortcuts and Tricks

Following are some not-so-obvious shortcuts that seriously speed up patching operations.

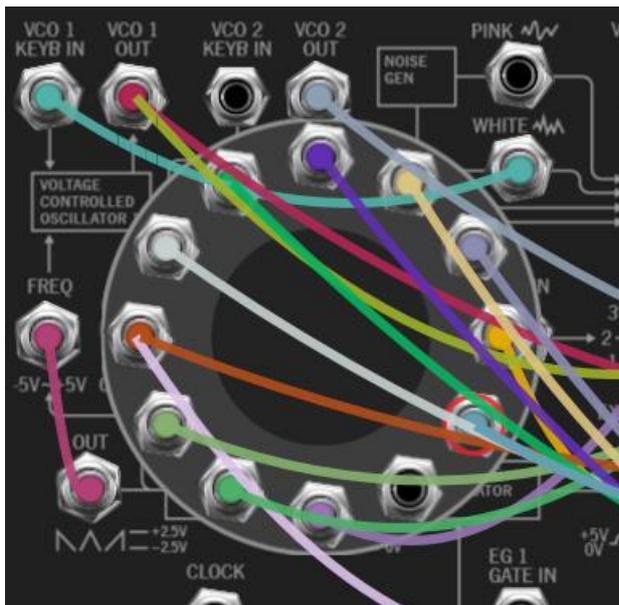
### 12.2.1 The Unlimited Mult Hiding Beneath Every Jack



Single-clicking on any input or output jack reveals a six-way multiple jack (aka, a "mult"), which is super convenient for routing (or mixing) multiple sources. The mult stays visible until a cable is routed, at which point it disappears.

The jack mult art animates when it opens or closes, but if you're one of those impatient, overcaffeinated types, the animation can be disabled by clicking the *Settings* gear icon in the top menu strip, clicking the *Cables* tab, and unchecking *Enable Animations For Jacks* (the

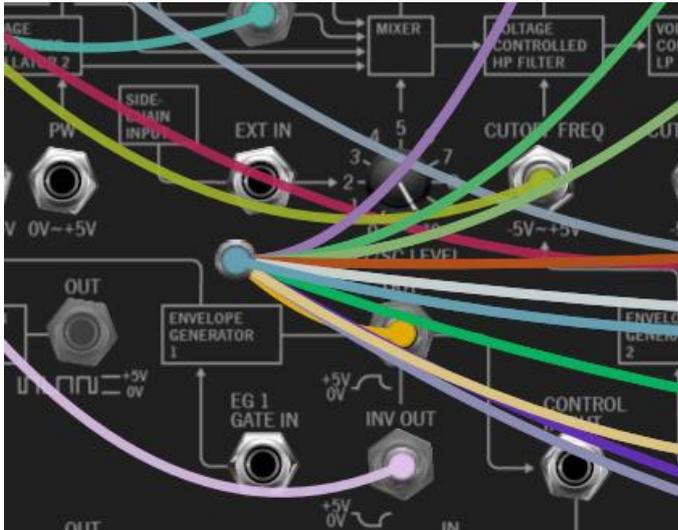
"impatient, overcaffeinated type" responsible for this pref is the author of this manual).



The integrated jack mults initially display six jacks, but if more than six connections are added, the "ring" grows and additional jacks appear and there's no limit to the number of mult jacks that can be added to a connection.

We designed this with Voltage Modular in mind, where the number of modules and cables can quickly get huge, but just know it's there if you need it.

### 12.2.2 Move or Unplug Multiple Cables Plugged Into A Single Jack



Multiple cables plugged into a single jack can be moved at the same time by holding the [SHIFT] key and clicking and dragging to a new destination.

This is also a super fast way to unplug multiple cables from a single jack if the mouse button is released in an "empty" area (i.e., not on a jack).

### 12.2.3 Rapidly Routing A Cable To Multiple Destinations

This one's not so obvious, but it's really handy. To patch cables from a single jack to multiple destinations, press and hold the [CTRL] key in Windows or the [⌘] key on Mac, click the source jack, then click as many destination jacks as desired and release the modifier key when you're done. This works with input or output jacks.

## 13 Using The Patch Panel



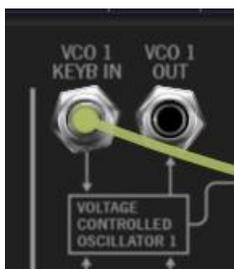
The Patch Panel may appear to be a terrifying mess of jacks, but we promise, it isn't too hard to understand, and unlike a fully modular synth, PS-20's semi-normalled connection scheme makes it easy to use only patching that you need, while leaving the rest of the instrument operating like a standard non-modular synth.

### 13.1 Semi-Normalled Connections

A self-contained, non-modular synthesizer, such as a Minimoog, is internally hard-wired. That is, the oscillators are permanently connected to the mixer inputs, the mixer outputs are connected to the filter inputs, and so on. A semi-normalled synth is similar, but there are jacks added to these connections throughout the instrument. With that in mind, semi-normalled is a short way of saying, "all sections are connected inside the synth, but plugging cables into the input jacks will interrupt internal connections and replace them with whatever is plugged into the jack." In the case of patch panel output jacks, plugging a cable in won't affect internal hard-wired connections, it just tacks on an additional output connection - this is known as "multing" from it.

Almost all of PS-20's input and output jacks are semi-normalled, and the panel names, dialog boxes, and arrows describe signal flow as well as their origin or destination in the circuit.

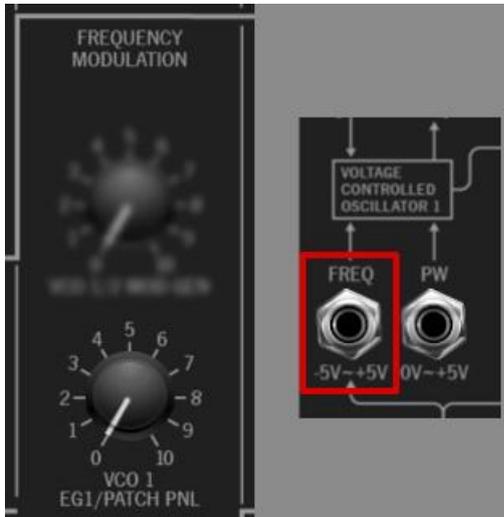
### 13.2 CV Ins Without Attenuators



Some of PS-20's CV inputs have direct connections to their mod destinations. Let's look at the first jack connection at the top left, *VCO Keyb In 1*. When nothing is plugged into the jack, the keyboard pitch CV feeds into VCO 1, as shown by the arrow going to the *Voltage Controlled Oscillator 1* box. If a cable is plugged into the jack, the keyboard pitch CV is disconnected and replaced by the cable plugged into this jack.

Because it has no attenuator, the mod amount is always at "full blast." In the case of a keyboard CV input, this is what you'd usually want, to insure that the keyboard plays in 1/2 step semitones across its range. If you'd like to control the amount of CV, signals can be routed through the patch panel mixer/attenuator (beneath the VU meter).

### 13.3 CV Ins With Attenuators (Important, so read this)



Many of PS-20's CV input jacks are routed to the front-panel attenuator knobs beneath the VCO's, mixer, VCF's, and Mod Generator prior to their destinations. All of the attenuator knobs do double-duty - if nothing is plugged into their corresponding mod jack inputs, they control the level of the hard-wired internal mod signal. The hard-wired mod signal is indicated in the attenuator name.

For example, the above image shows the *VCO1 EG1/ Patch Panel* attenuator in the *Frequency Modulation* section. If nothing is plugged into *Freq* CV input, the attenuator controls the amount of frequency mod from EG1. When a cable is plugged

into the *Freq* CV in jack, the internal EG1 routing is disconnected, and the attenuator controls the level of the cable plugged into the jack.

**If you've patched a CV source to a CV input and nothing appears to be happening, check that the appropriate attenuator is turned up.**

### 13.4 CV Outs



Now let's examine an output. Envelope Generator 1 is normally routed to VCO 1 and VCO 2 pitch (with its mod amount controlled by the *VCO 1 EG1/Patch Panel* and *VCO 2 EG1/Patch Panel* attenuators in the *Frequency Modulation* section beneath the Mixer). If a cable is plugged into the Envelope Generator 1 *Out* jack, its control signal can be routed to any other CV input. **Unlike a CV input jack, CV outs are multed, so plugging a cable in has no effect EG1's hard-wired internal connections.**

The table below describes all patch panel ins and outs. We've attempted to arrange the table in a sensible order, beginning with the VCO 1 connections at the top left.

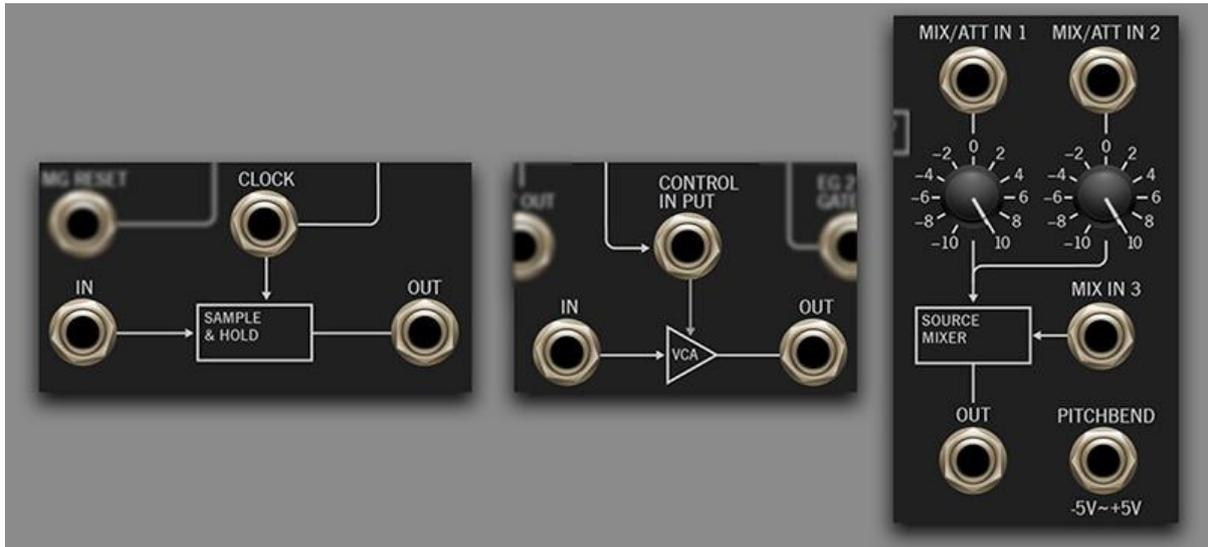
NAME	INPUT / OUTPUT	FUNCTION	NORMAL / ATTENUATOR
VCO 1 / KEYB IN	INPUT	pitch freq CV	–
VCO 1 / OUT	OUTPUT	audio output	–
VCO 1 / FREQ	INPUT	freq mod CV	FREQ MOD / VCO1 EG1/PATCH PANELPATCH PANEL
VCO 1 / PW	INPUT	pulse width mod CV	PWM / MOD GEN/PATCH PANEL
VCO 2 / KEYB IN	INPUT	pitch freq CV	–
VCO 2 / OUT	OUTPUT	audio output	–
VCO 2 / FREQ	INPUT	freq mod CV	FREQ MOD / VCO2 EG1/PATCH PANEL
VCO 2 / PW	INPUT	pulse width mod CV	PWM / MOD GEN/PATCH PANEL
MIXER / WHITE NOISE	OUTPUT	white noise audio output	–
MIXER / PINK NOISE	OUTPUT	pink noise audio output	–
MIXER	INPUT	sidechain input/external input	sidechain signal is normal
MIXER / MIXER OUT	OUTPUT	mixer audio output	–
SIDECHAIN INPUT / EXT IN	INPUT	sidechain/external signal input	–
HP FILTER / HP FILTER OUT	OUTPUT	highpass filter audio out	–
HP FILTER / CUTOFF FREQ	INPUT	highpass filter cutoff mod	CUTOFF FREQ MOD / EG2/PATCH PANEL
LP FILTER / LP FILTER OUT	OUTPUT	lowpass filter audio out	–
LP FILTER / CUTOFF FREQ	INPUT	lowpass filter cutoff mod	CUTOFF FREQ MOD / EG2/PATCH PANEL
VCA / VCA OUT	OUTPUT	VCA audio output	–
VCA / VCA AMT	INPUT	VCA CV mod (all voices)	–
VCA / VCA MOD	INPUT	VCA CV mod (active voices only)	VCA MODULATION / MOD GEN/PATCH PANEL

NAME	INPUT / OUTPUT	FUNCTION	NORMAL / ATTENUATOR
PRE FX IN	INPUT	post VCA, pre FX audio input	–
MOD GENERATOR / SAW/TRI/RAMP OUT	OUTPUT	mod generator saw/triangle/ramp output	–
MOD GENERATOR / PULSE/SQUARE OUT	OUTPUT	mod generator pulse/square output	–
MOD GENERATOR / MG RESET	INPUT	resets wave when gate or pulse is received	–
EG 1 / GATE IN	INPUT	envelope 1 gate input	–
EG 1 / OUT	OUTPUT	envelope 1 output	–
EG 1 / INV OUT	OUTPUT	envelope 1 output inverted	–
EG 2 / GATE IN	INPUT	envelope 2 gate input	–
EG 2 / OUT	OUTPUT	envelope 2 output	–
EG 2 / INV OUT	OUTPUT	envelope 2 output inverted	–
SAMPLE & HOLD / CLOCK	INPUT	clock input	normalised from mod generator pulse out
SAMPLE & HOLD / IN	INPUT	sample and hold input	–
SAMPLE & HOLD / OUT	INPUT	sample and hold output	–
AUX VCA / CONTROL INPUT	INPUT	aux VCA CV control input	normalised from EG 1 output
AUX VCA / IN	INPUT	aux VCA signal input	–
AUX VCA / OUT	OUTPUT	aux VCA signal output	–
PP MIXER / MIX/ATT IN 1	INPUT	mixer signal input w/inverting atten knob	–
PP MIXER / MIX/ATT IN 2	INPUT	mixer signal input w/inverting atten knob	–
PP MIXER / MIX/IN 3	INPUT	mixer signal input	–
PP MIXER / OUT	OUTPUT	mixer signal output	–
CONTROLLER / KYBD CV OUT	OUTPUT	pitch CV from USB/MIDI controller	–
CONTROLLER / KYBD GATE OUT	OUTPUT	gate CV from USB/MIDI controller	–

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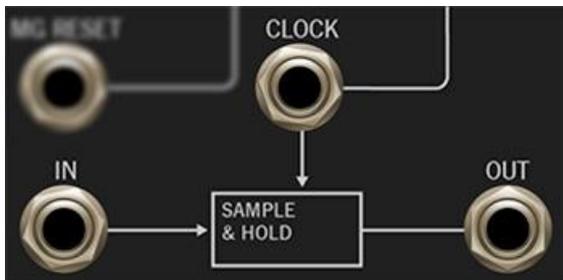
<b>NAME</b>	<b>INPUT / OUTPUT</b>	<b>FUNCTION</b>	<b>NORMAL / ATTENUATOR</b>
CONTROLLER / KYBD VEL OUT	OUTPUT	velocity CV from USB/MIDI controller	–
CONTROLLER / PITCHBEND	OUTPUT	pitch bend CV from USB/MIDI controller	–
CONTROLLER / MOD WHL	OUTPUT	mod wheel CV from USB/MIDI controller	–

## 14 Patch Panel Extras

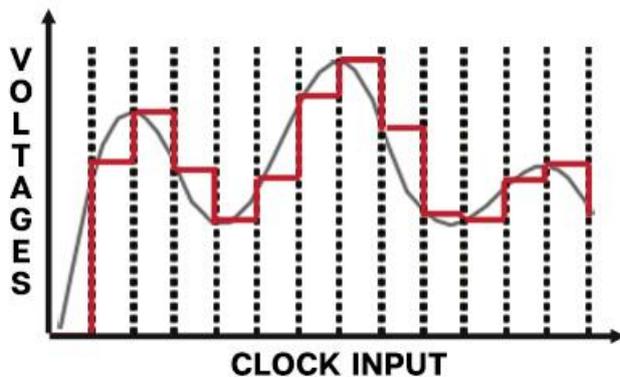


The patch panel primarily offers patch points for all standard synth components in the "knob" portion of PS-20's front panel. However, there are three additional sections that are only accessible via patch cords in the patch panel section.

### 14.1 Sample & Hold



Below we've illustrated how a sample & hold works to make its operation easier to understand. In the image below, the smooth gray line shows a continuous input signal. Each time the module is triggered by an incoming clock signal, the current voltage is "sampled" and "held" until the next trigger. The red line shows the stepped output signal.

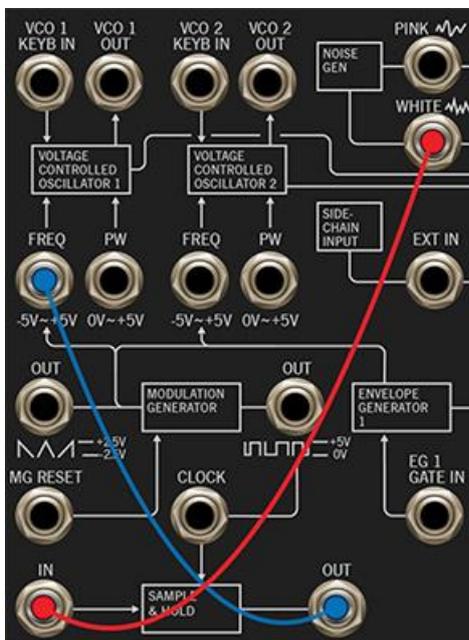


**In-** Patch incoming audio or control signals here.

**Control Input-** Patch a clock source here. By default, the *Clock* input is normalled from EG 1, but the connection can be overridden by patching any CV source to the *Control Input* jack. Typical clock sources would be the modulation generator, or one of the oscillators square or pulse wave outs.

**Out-** The "stepped" sample and hold output.

The most common use for a sample and hold is the familiar "random robot pitches" heard in a zillion sci-fi movies and 70s game shows (if you're old enough to remember *Tic-Tac-Doe* - how 'bout that Wink Martindale!?!). Requiring just two cables, this is a super easy patch to make with PS-20:



The *White Noise* output (red cable) provides our random voltage source, patched to the Sample & Hold *In* jack. The clock signal comes from the Modular Generator's pulse output, but no cable is needed because this is a normalled connection, as shown by the line to the *Clock* jack.

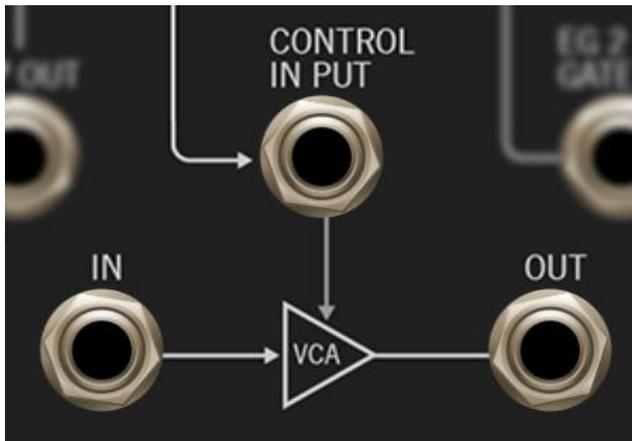
The Sample & Hold output then feeds its stepped, random signal to VCO 1's *Freq* Input.



You'll need to turn up the *VCO 1 EG1/Patch Panel* attenuator in the Frequency Modulation section to hear the Sample & Hold modulation.

Keep in mind that the Sample & Hold has more uses than the just pitch mod. Random mod can also be applied to filter cutoff or VCA modulation. Crazy pseudo-sequencer effects can be achieved by feeding its input with slow-moving saw, ramp, or triangle waves (try VCO 2 in *Lo* mode) and modulating VCO 1's pitch.

## 14.2 Auxiliary VCA



The patch panel section also includes a "bonus" auxiliary VCA. Its main purpose on the original MS-20 was to allow modulation generator amount to be controlled via EG 1 or with a mod wheel. But with PS-20's additional patch panel I/O, it's possible to use the auxiliary VCA to create complex, "dual voice" patches, typically in conjunction with one more sequencer layers.

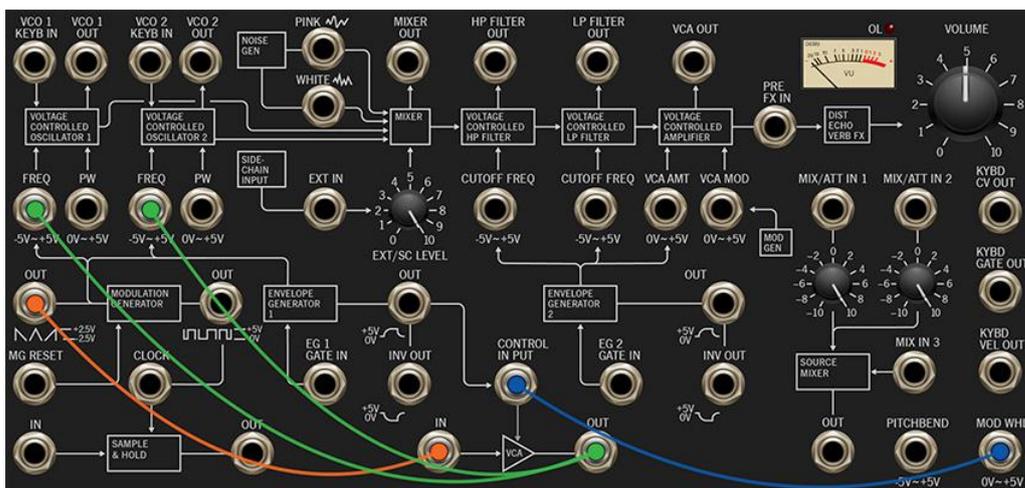
The auxiliary VCA works just like the main VCA described in the *VCA* manual section - it's essentially a volume knob, controlled by a CV.

**In-** Patch incoming audio or control signals here.

**Control Input-** Patch the CV to control level here. By default, the *Control Input* is normalled from EG 1, but the connection can be overridden by patching any CV source to the *Control Input* jack.

**Out-** The signal output.

Here's a patch that uses the mod wheel to control the amount of VCO vibrato:



The Modulation Generator saw/triangle/ramp output is patched to the auxiliary VCA *In* (orange cable), and the auxiliary VCA *Out* is multed to both VCO 1 and VCO 2's *Freq* mod inputs. The *Mod Wheel* output jack is then patched to the auxiliary VCA *Control* input (blue cable). In this way, the mod wheel regulates the signal flowing through the VCA, i.e. the amount of signal traveling from the mod generator to the oscillator frequency mod inputs.



Don't forget to turn up the *VCO 1* and *VCO 2 EG1/Patch Panel* attenuators in the Frequency Modulation section - these regulate the amount of signal received through the *VCO Freq* mod jacks.

### 14.3 Three-Input Source Mixer/Attenuator



We've added a three-input mixer/attenuator/inverter that's really handy. It can be used for mixing audio or control signals, or as a simple attenuator if a single signal is routed through it.

**Mix/Att In 1 and Mix/Att In 2 inputs and attenuators-** The first two inputs include bipolar attenuators - that is, at center position, they pass no signal. Turning to the right passes positive signal; turning to the left passes inverted signal.

**Mix In 3-** This is a positive, unity-level input.

**Out-** The mixed output of all three signals.

## 15 External Signal Processor

PS-20 includes a full recreation of the slightly bizarre and endlessly useful External Signal Processor section of the classic MS-20 synthesizer.

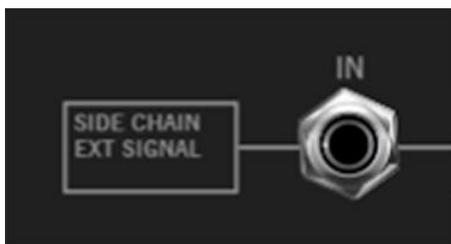


The External Signal Processor analyzes incoming audio and generates matching voltages for controlling oscillator pitch and envelope amplitude, letting you "play" Voltage Modular by singing, playing guitar, or any other monophonic signal source. PS-20's frequency converter has a much wider range than the original for increased functionality, while still retaining its inherent quirkiness.

### 15.1 Routing Signals To The External Signal Processor

"How the heck do I plug one of these external signals into it?" If you're using PS-20 within a DAW, audio signals can be routed via your DAW's sidechain input. This is usually derived from either input channels of audio hardware, or from existing DAW tracks. You may need to read the manual for your particular DAW (ick, another %^#! manual!) for specifics.

If PS-20 is being used in standalone mode, the sidechain input can be configured by clicking the *Settings* gear icon in the top purple menu bar, selecting *Audio/MIDI* (hey, I used to work there!), and clicking on the *Input* pop-up menu.



Once you've successfully routed the sidechain input signal, it will be normalised into the *External Signal Processor* (hence the little box that says *Side Chain Ext Signal* at the left).

### 15.2 Inputs, Outputs and Controls

**Signal Level, Peak LED**- Attenuates or amplifies incoming signal levels (up to +6 db) for optimum tracking performance; experiment with signal input level if tracking isn't working as desired. The overload *Peak* LED illuminates if the input signal is too loud (or if your car is running low on *PEAK* anti-freeze, formulated for your specific vehicle and needs.)

**In jack-** Plug audio signals in here. If nothing is plugged into the jack, the sidechain input signal is used.

**Amp Out jack-** The *Out* jack beneath the *Amp* icon outputs the the post-*Signal Level* audio. This can useful as a simple level booster for really quiet patches, or as another source of overdrive, in case you didn't tear it up enough using the filter *Drive* knobs and onboard Distortion effect.

**Band Pass Out jack-** This is the signal output after passing through the Low Cut Freq and High Cut Freq filters explained below.

**F>V (Freq >Volt) CV Out jack-** Outputs the pitch CV derived from the incoming signal, as well as any offset voltage added with the *CV Offset* control. This most commonly will be patched to the *VCO Keyb In* jacks or filter *Cutoff Freq* CV inputs. Don't ask what that funky doodad between the F and the V on the panel is, we have no idea.

**Env Out jack-** Outputs a continuous, dynamic voltage corresponding to the input signal level. The *Signal Level* knob will help to dial this in.

**Gate Out jack and LED indicator-** Outputs a constant 5V gate signal, dependent on the *Threshold Level* knob setting. The LED lights to indicate when a 5V gate voltage is present.

**Low Cut Freq-** This is a 12db per/octave, non-resonant highpass filter and forms the other half of the *Band Pass Filter* block. Its intended use is to remove extraneous low frequencies in order to aid in pitch tracking.

**High Cut Freq-** This is a 12db per/octave, non-resonant lowpass filter and forms half of the *Band Pass Filter* block. Its intended use is to remove extraneous high frequencies in order to aid in pitch tracking.

Though the lowpass and highpass filters aren't necessarily intended for modifying audio signals, they can certainly be used in this manner using the *Band Pass* output jack.

**CV Adjust-** Adds or subtracts up to 5V to the *F>V CV Out* jack. Typically this would be used as a tuning or transpose control when patched to an oscillator CV input. It's generally advisable to begin with *CV Adjust* at the *0* position.

For more consistent CV dynamics, patching the input signal through a compressor effect in DAW software prior to PS-20's sidechain input can be helpful.

**Threshold Level-** This sets the level at which a 5V gate voltage is output at the *Gate Out* jack. ***Threshold* has no effect on the *Env Out* jack voltage.**

## 16 Sequencer

PS-20 features a three-channel, eight-step sequencer - it actually is three completely independent eight-step sequencers, each with its own pitch and gate outputs. Each channel is color coded to make using it a snap.



**Channel Sel button and LED's-** Clicking the *Sel* button cycles through each of the three channels. Not only will the LED next to the button glow to indicate the current channel, the CV and *Range* knobs also change colors.

**Quantize 1/2/3-** When enabled for a channel, this rounds off voltage settings for the pitch voltage knobs to the nearest 1/12 volt, i.e. semitones. This tremendously simplifies creating in-tune melodies. **Quantization can be enabled or disabled independently for each channel;** clicking the *Quantize 1/2/3* button enables or disables quantization for the current channel, and PS-20 will remember settings regardless of which channel is currently being viewed.

**CV/Gate Enable Knobs 1-8 and LED-** Sets the voltage level (i.e. pitch) for each sequence step. If the *Quantize* switch is off, these will be fully variable; if the *Quantize* switch is on, they step in semitone increments. The pop-up tooltip flags will display the pitch. **Setting a pitch voltage knob to zero disables the gate voltage for that step**, effectively creating a "skip" step that doesn't trigger the envelope generators - this considerably increases the sequencer's musicality. **If a sequencer step isn't making any sound, make sure it's not set to zero.** The LED above each step illuminates to display the current sequencer step.

**Range-** Sets the range for the pitch voltage knobs to one, two, or five octaves. The *Range* can be set independently for each sequence channel; the knob will change colors to show the current channel.

**Gate Length-** Sets the duration of the gate voltage routed to the envelope generators. The percentage displayed in the pop-up tooltip flag refers to its length compared to the length of the step, for example, a setting of 50% would mean the gate voltage would last half the length of the step. This is displayed in percentage, because the actual time depends on the current *Rate* setting.

**Sync**- Enabling the *Sync* switch locks the sequencer's clock to either DAW project tempo (if PS-20 Voice is used within a DAW) or to the tempo setting in the top menu strip (if PS-20 is being used as a standalone app). When *Sync* is enabled, the *Rate* knob moves in steps from 8 beats, up to 1/64th-note triplets.

**Step**- Manually steps through the CV knob seq steps. The current step will jump back to 1 dependent on the *# Of Steps* control setting. The envelope gate voltage will be held high as when the *Step* button is held.

**Ext Step**- Enables sequence stepping with gate voltages. This essentially is the same as a clock input and can be used with the mod generator or VCO waves. (If you really want to make a mess, try running one of the VCO Out jacks into the Ext Step CV in with the oscillator running at audio-range frequencies.)

**Rate**- Adjusts sequencer play speed from 0.25 to 30 Hz (with *Sync* switch disabled).

**Start/Stop and LED**- Initiates playback or stops the sequencer. Playback always begins at step 1, regardless of current sequencer position. The LED flashes at the current rate when the sequencer is in play mode.

**Play Gate**- Puts the sequencer in play mode when a gate voltage is present. This is particularly useful when you'd like the sequencer to play while holding down a key on the keyboard - simply patch a cable from the *Kybd Gate Out* jack to the *Play Gate* CV in.

**Num of Steps**- Sets the overall length of the sequence pattern. A setting of one can be useful for simple "auto-repeat" note effects.



**CV 1, CV2, CV3 out jacks**- The output jacks for each channel of sequencer knob CV's.

**Gate 1, Gate 2, Gate 3 out jacks**- The output jacks for each channel of sequencer gate CV's.

## 16.1 Using The Sequencer

The PS-20 sequencer has no internally normalised connection, so you'll need to get your hands dirty and patch cables to use it. Because it's a classic analog-style CV sequencer, each channel is inherently mono in nature (i.e. capable of playing only one note at a time). With that in mind, we recommend setting the *Voice Assigner* section to either *Mono* or *Uni* mode if you'd like to play melodies. That said, it can certainly be used in number of ways in the poly modes, mainly to control the filters and other mod destinations.



The patch shown above is good starting point. It uses the first sequencer channel with *CV 1* patched to *VCO 1* and *VCO 2 Keyb In* jacks to control pitch, and the *Gate 1* jack patched to the *EG 2 Gate In* jack. Once you have it patched, click the *Start/Stop* button, and turn the knobs to hear varying pitches. You may want to experiment with pitch range and octaves using the *VCO Scale* knobs and sequencer *Range* knob, respectively.

The sequencer channels can be used to control any CV'able parameter, including filter cutoff, VCA level, and more. It's also possible to create multiple synced melodies with separate notes and rhythm, but this is a bit more advanced, as it requires using both envelope generators and the patch panel auxiliary VCA.

Because PS-20's filters are so resonant, they can essentially be used as extra oscillators - we definitely recommend experimenting with sequencer control of cutoff in order to create wild melodies.

## 17 Effects

PS-20 includes three great-sounding onboard effects - distortion, and modulation echo, and a reverb. It's really like having more, because the mod echo mod controls allow flanging, chorus, and combinations thereof.



Note that the order of the signal chain is as it appears on the front panel - Distortion>Mod/Echo>Reverb. This makes sense, because distortion almost always sounds awful following time-based effects.

### 17.1 Distortion



This one is super simple. Turn it on, crank up the knob and distort! As discussed in the [Highpass and Lowpass Filter](#) section, the *Distortion* effect is a single distortion generator, so any time multiple chord notes are played through it, they'll be distorted as a single entity. Conversely, the filter section *Drive* knobs overdrive each polyphonic note individually, so you won't hear (big word alert) intermodulation distortion between notes. Experiment!

**On/Off**- Enables and disables distortion effect.

**Dist**- Sets the overall amount of distortion. This guy can get pretty loud, so watch with levels - just keep an eye on the retro-cool VU meter, and adjust the master *Volume* knob if necessary.

### 17.2 Mod/Echo



**On/Off**- Enables and disables Mod/Echo effect.

**Sync**- Enabling the *Sync* switch locks the delays time to master tempo. When engaged, the *Time* knob snaps to note values ranging from 1/64th note triplet to 8 beats. *Sync* mode locks

to the tempo in the top toolbar when using the standalone version or the current project tempo when using the plug-in version in a DAW.

**Time knob / LED / digital display**- Sets delay time, from 1 to 2000 ms. If the *Sync* button is enabled, time settings snap to synchronized note values (see *Sync* switch above). The LED beside it blinky-blinks at the current rate.

**Feed Back**- Routes the output to the input to set the number of echo repeats.

**Dampen**- Attenuates high frequencies as the knob amount is increased. Not only does this create more natural sounding decays, it also reduces the "stacking" effect that occurs with high feedback levels.

**Mod controls**- These allow modulation of the delay time with an internal sine-wave LFO. The addition of time mod enables flanging and chorus effects as well as wilder, swooping pitch effects at more extreme settings.

- **Mod Rate**- Varies the speed of time modulation from 0.15 to 30 Hz.
- **Mod Depth**- Mod depth affects how much the time is varied by.

### 17.2.1 Creating Flanging and Chorus effects –

The primary purpose of the *Mod* controls are to allow flanging and chorus effects. Flanging and chorus are closely related; the difference is that flanging typically creates metallic and/or jet flyby "whooshing" sounds, whereas chorusing produces a gentle, mildly detuned doubling effect.

To create a flange, set the *Time* to 15ms or less, *Feedback* over 70%, slow *Mod/Rate*, *Mod/Depth* over 60%, and *Dry/Wet* to 50%.

To create a chorus effect, set the *Time* around 20ms, *Feedback* at 0, *Mod/Rate* around 0.60 Hz, *Mod/Depth* 6% (this is actually center knob position), and *Dry/Wet* to 50%. Click the *Spread* switch on for a nice stereo chorus.

**Spread**- Simultaneously subtracts and adds 10ms of delay time to the left and right channels respectively, creating a wide stereo effect. It also prevents echoes from "piling" up in the center of the image. Note that the subtracted and added delay effectively changes the overall delay time setting with each repeat, so long delays combined with high feedback settings can become noticeably off time. If you're using high feedback echoes with many synced repeats, we recommend disabling the *Spread* switch.

**Amount**- Balances the level of dry and wet signal. Setting the knob to the center position gives an equal 50/50 balance of wet and dry signal.

## 17.3 Reverb



**On/Off**- Enables and disables the reverb effect.

**Reverb Type**- Allows selection of spring- or plate-style reverbs.

**Decay**- Sets the overall length of reverb; the actual time varies for each type.

**Damp**- Attenuates high frequencies as the knob amount is increased for more natural reverb sounds.

**Amount**- Balances the level of dry and wet signal.

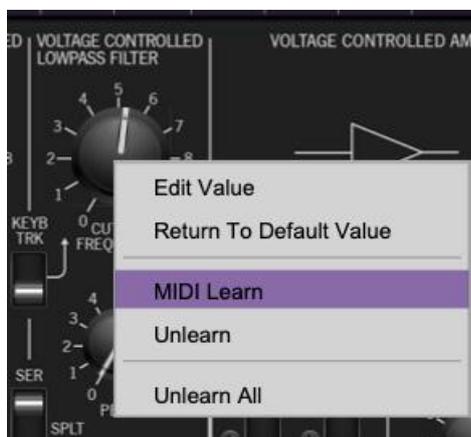
## 18 MIDI Controllers Setup and The MIDI Tab



Assigning internal and external hardware controls adds a whole new dimension of control and musicality to patches, and it's really easy to do. The MIDI Tab is where all controller assignments can be viewed and tweaked. First we'll show how to assign an external hardware controller to an PS-20 control, then we'll go over all parameters in the MIDI Tab.

### 18.1 Basic External Hardware Control Assignment

This is the quick, "I just want to assign a hardware control right now!," section. We recommend reading this entire section to best take advantage of PS-20's swift MIDI control assignments.

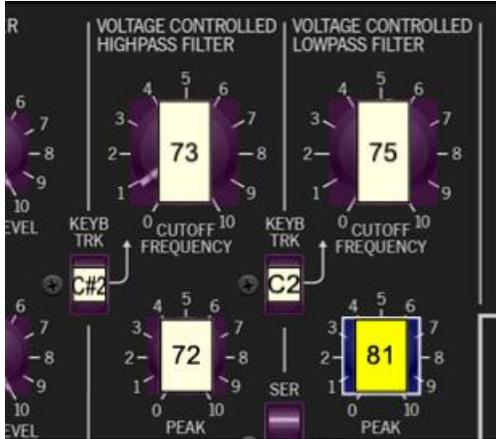


In this example, we'll assign a hardware slider control to lowpass filter's *Cutoff Frequency* knob (the filter on the right side).

Begin by right-clicking on the *Cutoff Frequency* knob in the Voltage Controlled Lowpass Filter section and selecting *MIDI Learn*. A transparent purple overlay appears over the knob indicating that it's in learn mode. Now move the desired hardware control device. The purple overlay disappears and the hardware control will move the onscreen knob.

If you change your mind (or accidentally put the wrong control into learn mode), learn mode can be aborted by right-clicking and selecting *Stop Learning*.

This is the basic procedure for assigning hardware controllers to almost any PS-20 control.



When in MIDI learn mode, any previously assigned controller numbers will show in squares. These indicate the MIDI continuous controller number of the assigned hardware control (these are also displayed in the *MIDI* library tab at left).

Once a MIDI controller has been assigned, in addition to real-time control of a PS-20 parameter, you'll also be able to record and play back controller data from a DAW.

## 18.2 The MIDI Tab



This is command central for all MIDI controller assignments. Here you'll be able to see information about all currently assigned controllers and adjust control ranges.

To view or hide the MIDI Tab, click the *MIDI* button in the top toolbar.

MIDI Learn						
Name	Type	Value	Min	Max	Curve	
Lowpass Filter - Peak	CC	81 (G...)				
Lowpass Filter - Keyb...	Note	C2				
Lowpass Filter - Cutoff...	CC	75 (S...)				
Highpass Filter - Peak	CC	72 (S...)				
Highpass Filter - Keyb...	Note	C#2				
Highpass Filter - Cutof...	CC	73 (S...)				

**MIDI Learn button**- This is almost exactly the same as enabling MIDI learn mode by right-clicking a control. Click the *MIDI Learn* button to enter learn mode (all controls turn purple).

Unlike right-clicking on specific knobs, where PS-20 automatically exits controller assignment mode, clicking the *MIDI Learn* knob "stays on" to enable assignment of multiple hardware controls.

This is handy for quickly assigning a bunch of knobs, sliders, or the buttons of a grid-style controller.

To assign multiple controls, click *MIDI Learn*, click an on-screen control, move the desired hardware knob or slider, continue clicking and assigning on-screen controllers until all desired controls are assigned, then click *Stop Learning* to exit learn mode. (Do we ever REALLY stop learning... oh, forget it.)

Remember that a single hardware knob/slider/button isn't limited to controlling just one parameter - a single hardware controller can simultaneously operate as many controls as you'd like. Combined with the MIDI Tab's controller range and inversion controls explained below, this can be a very powerful and customizable way to control parameters.

### 18.2.1 MIDI Tab Columns

**Name-** Displays the name of the parameter being controlled.

**Type-** There are five possible types of controller automation in PS-20:

- **Note-** Notes played on a MIDI keyboard controller, expressed as C-1 to G9
- **CC (MIDI Continuous Controller)-** The standard 128 MIDI controller numbers as defined in the MIDI spec. More specifically, these are the controllers transmitted by hardware knob and slider controls. MIDI CC's can be used to control parameters in real-time or recorded and played back within DAW software.
- **MMC (MIDI Machine Control)-** The MIDI control protocol for tape machine-style transport controls. Back in the dark ages, this was used to control wonky old Tascam and Fostex reel-to-reel monsters, but it's useful if your MIDI controller has tape-style transport control buttons.
- **Pressure-** Most modern keyboard controllers transmit controller data when keys are pressed and released as they're held down. The vast majority of keyboard controllers with aftertouch transmit "mono" aftertouch only; in other words, aftertouch data is the sum of all keys to one single data stream. Note that PS-20 only responds to mono aftertouch.
- **Key-** This allows keys of the computer QWERTY keyboard to act as button controls for PS-20's onscreen controls.

**Value-** Displays the specific automation controller. In the case of a *Note* this would show a MIDI note number (C-1 to G9, for a MIDI CC, this would be the MIDI CC controller number, etc. Clicking on the value opens a pop-up menu where all values are displayed and can be selected.

**Min-** Sets a limit on the lowest value any automation control can set a mapped controller to. This actually recalibrates the range of the automation controller to the remaining parameter range.

**Max-** Sets a limit on the highest value any automation control can set a mapped controller to. This actually recalibrates the range of the automation controller to the remaining parameter range.

**Curve**- These allow the customization of how incoming MIDI CC controls affect the movement of PS-20's onscreen controls, ranging from exponential to linear to logarithmic curves.

**Super Tricky Min-Max Tricks**- Not only can parameter ranges be limited via the *Min* and *Max* knobs, mapped control destinations can be completely inverted by setting the *Min* knob all the way up and the *Max* knob all the way down (or anywhere in between).

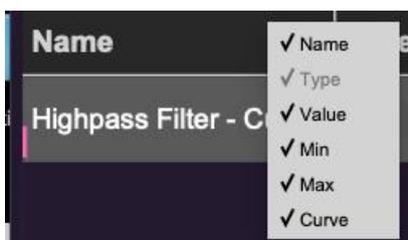
Limiting and inverting parameter ranges with the *Min/Max* controls is particularly useful when multiplexing a single hardware control to operate multiple parameters. Because *Min/Max*, range inversion, and *Curve* settings can be separately set for each onscreen control, the customization options are super flexible.



#### Example / Assign Controller to adjust highpass cutoff frequency from center to zero-

Assign the desired hardware knob or slider by right-clicking the Voltage Controller Highpass Filter knob, selecting *Learn* and moving the hardware knob or slider. Now click the *MIDI* button in the top purple menu strip to open the left-hand MIDI tab. In the *Highpass Filter - Cutoff Freq* column, set the *Min* value knob to 50%, and the *Max* knob to 0.0%. Minimum setting on the hardware control will set the onscreen *Cutoff Frequency* control to halfway, and increasing it will move the control toward zero.

### 18.3 MIDI Tab Column Configuration Right-Click Menu



Right-clicking anywhere in the top row (*Name*, *Type*, *Value*, etc.) displays the column configuration menu. Checking/unchecking these allows hiding and display of each column. This has no effect on assignments.

### 18.4 MIDI Tab Parameters Right-Click



Right-clicking on an assigned parameter opens the menu above.

**MIDI Learn**- This is used to change the controller assigned to a particular parameter.

**Unlearn**- Deletes the selected automation parameter.

**Unlearn All**- Deletes all controller assignments for the patch. PS-20 will display a warning dialog prior to deletion in order to thwart potential unlearn-related disasters.

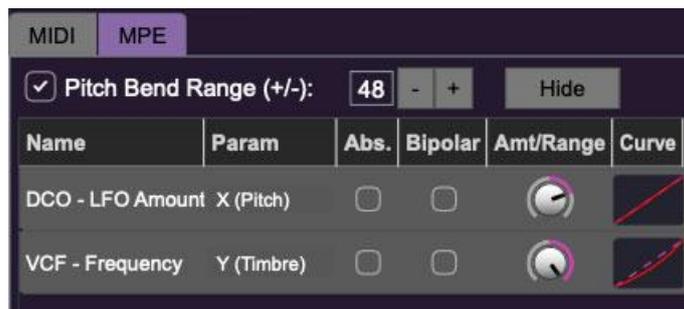
## 19 Using MPE

PS-20 supports MPE, short for "MIDI Polyphonic Expression." It's a specialized MIDI protocol enabling multidimensional controllers for controlling multiple parameters of individual notes. MPE specifies the MIDI messages used for three dimensions of control, regardless of how a particular controller physically expresses them. MIDI channel 1 is used as a master channel for global pitch bend, aftertouch, etc.; MPE utilizes MIDI channels 2-15 for the remaining controller data.



To enable MPE mode, MPE needs to be enabled in the Settings menu. Click the *Settings* gear icon in the top purple toolbar, then the *Interface* tab, then check the *Enable MPE mode* box. Exit out of the *Settings* window and click the *MPE* icon in the top tool bar.

### 19.1 MPE Control Tab



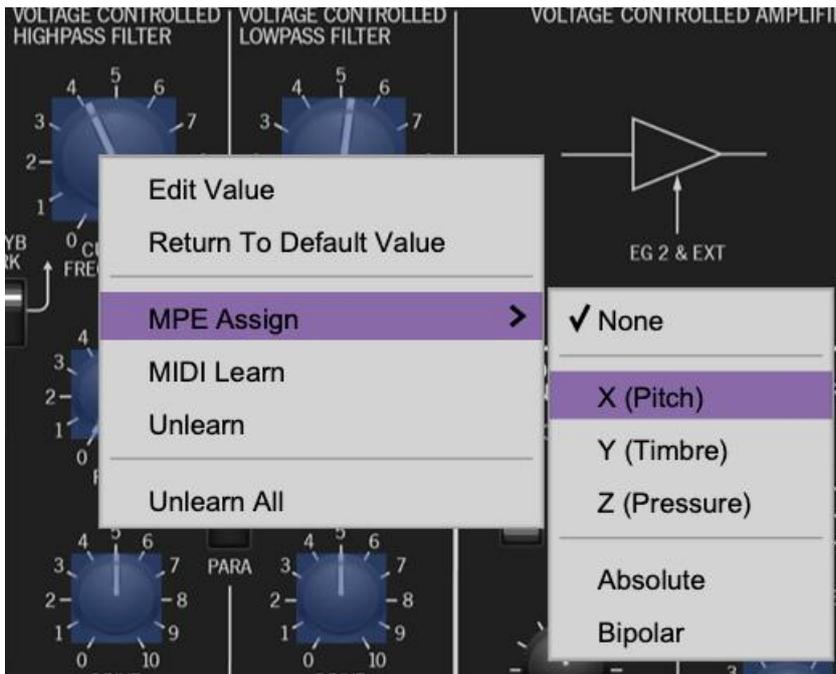
**Do not enable MPE mode if you're not using an appropriate MPE controller, as PS-20 won't play correctly with a standard USB MIDI controller.**

**Pitch Bend check box and Range controls-** At the top of the tab is a checkbox which enables pitch bend; to its right is the pitch bend range control. Its default setting is 48 semitones (four octaves). For best results you will need to match this number with your MPE controller's pitch bend setting (most MPE controllers default to 48 semitones).

**IMPORTANT:** If MPE mode is enabled, you must use a MPE controller set to "Lower Mode" to achieve full MIDI control. If you're using a non-MPE MIDI Controller, or the QWERTY Musical Typing keyboard, only one mono voice will trigger.



*Show/Hide Button* - Clicking the *Show* button in the MPE panel highlights all of the available MPE mappable control sliders for the PS-20 with blue overlays. Click the *Hide* button to hide them.



To map a control slider, right-click or [OPTION]+click (Windows) / [CONT]+click (Mac) the slider you wish to map. This reveals the controller mapping menu. Select *MPE Assign*.

Options are:

*X (Pitch)*  
*Y (Timbre)*  
*Z (Pressure)*

**Note:** Some MPE controllers such as the Roli Seaboard may have as many as five dimensions of expression. PS-20 utilizes the three standard three dimensions: *Pitch*, *Channel Pressure*, and *Timbre*. Also, not all MPE controllers are equipped with a master/global pitch bender.

Once mapped, the *Name* and *Parameter* will be visible in the MPE tab. A yellow square indicator (X,Y,Z) also appears atop each of the mapped controls.

### 19.1.1 MPE Tab Columns

*Name*- Displays the name of the parameter being controlled.

*Parameter*- Displays and allows selection of the three controller types: *X (Pitch)*, *Y (Timbre)*, and *Z (Pressure)*.

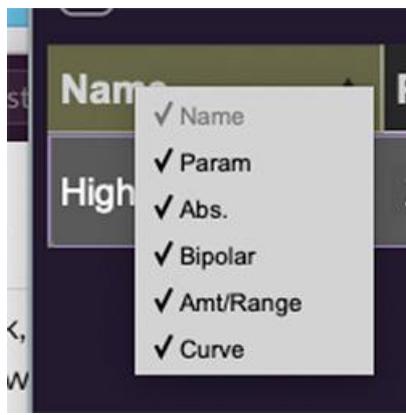
*Absolute*- Sets the *Amt/Range* of the controller to absolute or relative control.

*Bipolar*- Enables bipolar controller, i.e. the ability to add and subtract the parameter amount, as opposed to positive only.

*Amount/Range*- Sets the intensity of control range. If set to *Absolute* mode, two knobs appear for min/max settings.

*Curve*- These allow the customization of how controller data affect the movement of PS-20's onscreen controls, ranging from exponential to linear to logarithmic curves.

## 19.2 MPE Tab Column Configuration Right-Click Menu



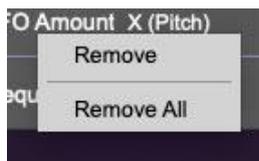
Right-clicking anywhere in the top row (*Name*, *Type*, *Value*, etc.) displays the column configuration menu.

*Auto-size This Column*- Automatically resizes so that all text in this column is visible.

*Auto-size All Columns*- Automatically resizes all columns simultaneously so that all text visible.

*Column View Filters*- Clicking any of these will hide or show the respective columns.

## 19.3 MPE Tab Parameters Right-Click



Right-clicking on an assigned parameter opens the menu above.

*Remove*- Deletes the selected MPE controller parameter.

*Remove All*- Deletes all MPE controller assignments for the patch. PS-20 displays a warning dialog prior to deletion in order to thwart potential disasters.

## 19.4 MPE Mappable Parameters

Below are all mappable PS-20 MPE parameters. Note that only polyphonic parameters (i.e. parameters that independently affect individual notes) can be mapped with MPE.

SECTION	PARAMETER
VOLTAGE CONTROLLED OSCILLATOR 1	PULSE WIDTH (PW)
VOLTAGE CONTROLLED OSCILLATOR 1	SUB OSC LEVEL
VOLTAGE CONTROLLED OSCILLATOR 2	PULSE WIDTH (PW)
VOLTAGE CONTROLLED OSCILLATOR 2	SUB OSC LEVEL
MIXER	VCO 1 LEVEL
MIXER	VCO 2 LEVEL
MIXER	WHITE/PINK NOISE LEVEL
FREQUENCY MODULATION	VCO 1/2 MOD GEN
FREQUENCY MODULATION	VCO 1 EG1 / PATCH PANEL
FREQUENCY MODULATION	VCO 2 EG1 / PATCH PANEL
VOLTAGE CONTROLLED HIGHPASS FILTER	CUTOFF FREQUENCY
VOLTAGE CONTROLLED HIGHPASS FILTER	PEAK
VOLTAGE CONTROLLED HIGHPASS FILTER	DRIVE
CUTOFF FREQUENCY MODULATION (HP FILTER)	MOD GEN
CUTOFF FREQUENCY MODULATION (HP FILTER)	EG2 / PATCH PANEL
VOLTAGE CONTROLLED LOWPASS FILTER	CUTOFF FREQUENCY
VOLTAGE CONTROLLED LOWPASS FILTER	PEAK
VOLTAGE CONTROLLED LOWPASS FILTER	DRIVE
CUTOFF FREQUENCY MODULATION (LP FILTER)	MOD GEN
CUTOFF FREQUENCY MODULATION (LP FILTER)	EG2 / PATCH PANEL
VCA MODULATION	MOD GEN / PATCH PANEL
ENVELOPE GENERATOR 1	DELAY TIME
ENVELOPE GENERATOR 1	ATTACK TIME
ENVELOPE GENERATOR 1	RELEASE TIME
ENVELOPE GENERATOR 1	VEL AMOUNT
ENVELOPE GENERATOR 2	HOLD TIME
ENVELOPE GENERATOR 2	ATTACK TIME
ENVELOPE GENERATOR 2	DECAY TIME
ENVELOPE GENERATOR 2	SUSTAIN LEVEL

SECTION	PARAMETER
ENVELOPE GENERATOR 2	RELEASE TIME
ENVELOPE GENERATOR 2	VELOCITY AMOUNT
PATCH PANEL	EXT / SIDECHAIN LEVEL

## 19.5 Popular MPE Controller Devices

Following is a list of popular MPE controllers as of 2021. We're sure your persistent Sweetwater rep is just dying to sell you one (and call 47 times to check, "...how those acoustic guitar case humidifiers are workin' out for ya?")

*Roli* - Seaboard

*Sensel* - Morph

*Expressive E* - Osmose

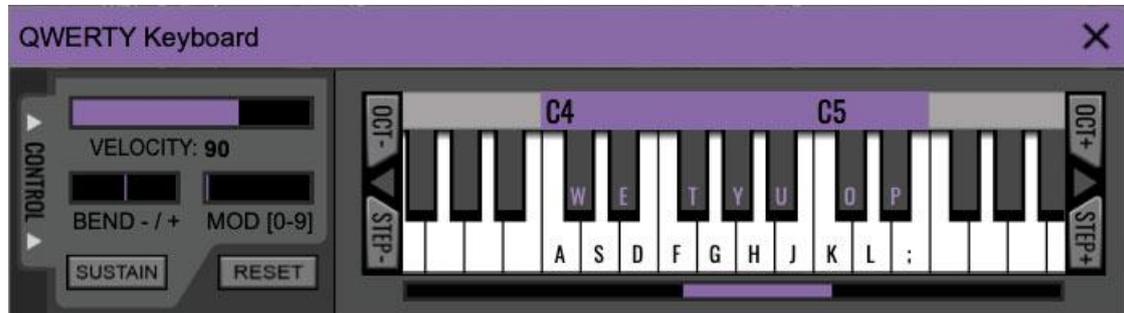
*Haken Audio* - Continuum Fingerboard

*Roger Linn Designs* - Linnstrument

*Artiphon* - Instrument 1

## 20 QWERTY Musical Typing Keyboard (MTK)

If you don't have a MIDI keyboard attached to your computer, the standard QWERTY computer keyboard can be used to play notes - we're pretty sure you've got one of those! We'll refer to this as the "MTK" because acronyms sound cool and I'm a lazy typist!



Following is a list of MTK keyboard modifiers and functions:



**Opening and Closing the MTK** - click the the circular keyboard icon in the top toolbar. To close the MTK, click the keyboard icon in the top toolbar, or click the X in the top right corner.

**Play Notes**- To trigger notes, simply press the corresponding computer keyboard key or mouse click the onscreen keys.

**Adjust Currently Visible MTK Range**- Slide the purple scroll bar horizontally to adjust the currently visible keyboard range.

**Adjust Overall Visible Keyboard Range**- Clicking and dragging the right edge of the MTK window allows the overall size of the window to be adjusted. This lets you view more or less of the onscreen keyboard. Note that the MTK window's borders cannot exceed the overall outside dimensions of the Eight Voice window.

**Shift Range Up/Down Octave**- Click the *Oct-* and *Oct+* buttons at the top left and right of the onscreen MTK. The current range is displayed above the keyboard.

**Shift Range Up/Down Semitone**- Click the *Step-* and *Step+* buttons at the bottom left and right of the onscreen MTK. The current range is displayed above the keyboard.

**Hide/View Controllers**- Clicking *Control* at the far left hides and displays velocity, bender, mod, and sustain control parameters. Hiding the control view makes more space available for the keyboard.

**Set Note Velocity**- Move the purple *Velocity* bar to adjust the output velocity of notes.

**Pitch Bend**- To pitch a note or notes, press the + or - computer keyboard keys while playing a note. Notes will bend up to an octave. Notes can also be pitchbent by clicking the mouse in the *Bend* area.

**Mod Wheel-** To add mod wheel modulation, press the number keys from 0-9 (above the character keys) while playing a note. The modulation amount will vary from none (0) to full modulation (9). Note that modulation will "stick" at the selected number; to disable modulation, click the 0 key. Mod can also be engaged by clicking the mouse in the mod bar area.

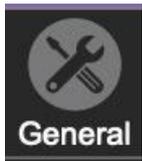
**Sustain-** The *Sustain* button mimics the functionality of a standard sustain pedal. Click the [TAB] key to engage sustain, or [SHIFT]+[TAB] to lock it. The *Sustain* button can also be engaged by mouse clicking it.

**Reset-** Initializes all MTK parameters including keyboard range and control parameters.

## 21 Settings

Clicking the settings gear opens a window with multiple tabs for configuring various "under-the-hood" settings. These are mostly set-and-forget kind of parameters - all the stuff you'll use most is on the front panel, where it should be!

### 21.1 General



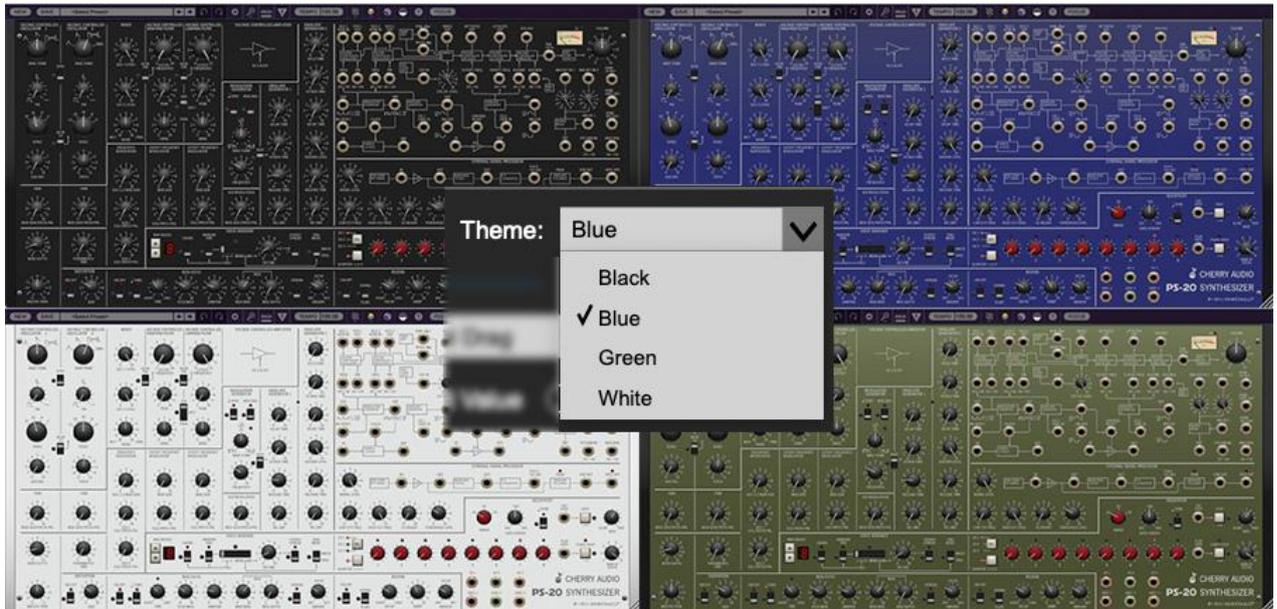
- **Add Undo For Control Changes With The Mouse**- Enabling this allows undo of knob, switch, and button adjustments. You'll want this on if you want the ability to undo all aspects of patch editing and programming.
- **Load Last Preset On Startup (Standalone Only)**- Automatically loads the last preset used when PS-20 standalone version is started.
- **Create A Log File For Usage**- This creates a text doc of all of PS-20's internal and routines during use. It is mainly intended for our tech staff should you experience any issues. Clicking *Show Log Folder* opens the folder containing PS-20 log file docs.
- **Preset Folder**- Displays the current location of PS-20's sound presets. This can be changed by clicking and typing in the field.
  - **Browse...** - Displays the current location of preset folder in the file manager.
  - **Set Default**- Sets the current displayed *Preset Folder* path as the default location
- **Clear Cache Files**- Deletes all log files, temporary sounds, and the image cache.

### 21.2 Interface



Allows customization of PS-20's user interface settings.

- **Reset To Default Window Size**- Resets the PS-20 workspace to default size. Use this to reset the window size if the window somehow becomes too large for your display and can't be resized.



- **Theme-** Allows selection of four different color schemes - *Black*, *Blue*, *Green*, or *White*.
- **Tooltip Delay-** Tooltips are those informative bits of text that pop up when hovering over a control (go ahead and try it, we'll wait...). The *Tooltip Delay* setting defines how long you must hover before the tooltip pops up.
- **Knob Movement-** Defines which how mouse movements related to turning onscreen knobs. It defaults to *Vertical Drag*, but can be changed to *Horizontal Drag*, or *Rotary Drag* if you're having trouble with your vintage Mazda.
- **On Control Double-Click-** Defines what happens when the mouse is double-clicked on a control. If *Edit Value* is selected, an exact number can be entered by typing the number and hitting [ENTER] or [RETURN]. If *Sets Default Value* is selected, double-clicking a control resets it to its default value.
- **Mouse Wheel Adjusts Control Value-** Enabling this lets you adjust knob, slider, and switch values by moving the mouse wheel. This works great with a standard mouse wheel, but you'll want to disable it if you're using an Apple Magic Mouse (which will move the control AND scroll the window).
- **Show Tooltips When Adjusting Controls With Mouse-** Displays parameter tooltips/values when the mouse is hovered over a control or as a control is moved with mouse button down.
- **Show Tooltips When Automating Controls-** Enabling this causes control tooltip flags to show when automation data is being received.
- **MIDI Program Changes Should Change Current Preset-** Allows MIDI program change messages to change PS-20 patches.
- **Ask To Save Modified Presets-** This opens a dialog window asking if you'd like to save changes if a patch has been edited and a new patch is selected. If you're the type that likes to click through presets and tweak a control here and there, it can be annoying to have a window pop-up asking if you'd like to save every time you switch presets - if you're that person, keep this off.
- **Remember MIDI Mappings For New Plug-in Instances-** When enabled, PS-20 remembers all MIDI Tab controller settings.

- **Enable MPE mode**- Short for "MIDI Polyphonic Expression," PS-20 supports MPE, a specialized MIDI protocol enabling multidimensional controllers to control multiple parameters of individual notes. The MPE Settings toolbar icon is displayed if *Enable MPE mode* is checked. See the [Using MPE](#) section for full information.

## 21.3 Account



Settings for your personal login information and account.

- **Email**- Displays the email address of the current login.
- **Update Login Info**- Clicking this opens the same email and password login screen you'll see when initially launching PS-20 and allows changes to be made.
- **View Account Settings**- This opens your personal account page on the Cherry Audio Store website containing information about modules purchased and more.

### Software Update

- We often fix bugs and make improvements; below are options defining how PS-20 handles updates.
- **Check For Update**- Click this to see if an updated version of PS-20 is available.

### Status:

- **Automatically Install Updates**- Updates are automatically downloaded and installed.
- **Ask Before Installing Updates**- By default, PS-20 automatically downloads new versions of modules when available. Checking this box defeats automatic updates and will ask if you'd like to install updates when they become available.
- 
- We'll never make changes that can potentially "break" existing patches but we recommend enabling *Ask Before Downloading Updated Modules* if you're using PS-20 for live performances or other "mission critical" situations.
- **Never Install Updates**- PS-20 never automatically installs updates.
- **Show Updates On Toolbar**- Checking this will display an icon in the toolbar next to the logo letting you know there's an update available.

**Show Notifications From Cherry Audio**- We occasionally will fire off in-app advertisements; disabling this checkbox will hide them. We hate repetitive, annoying ads as much as you, so we won't use this feature too often. When we do, it'll be for something super cool (like a killer sale), so we recommend leaving it on.

## 21.4 Cables



These preferences define how PS20's virtual patch cables behave.

- *Animate Cables*- When checked, PS-20's cables will bend and dangle like real cables. This makes everything sound better (not really, but it looks cool).
- *Move Cables Away*- When checked, hovering over a cable (or multiple cable spaghetti) will temporarily shift them out of the way to make it easier to see modules beneath.
- *3D Cables*- Checking this shades cables to appear more well, three-dimensional, No silly red and green glasses required.
- *Draw Shadow*- Causes cables to cast a shadow upon modules.
- *Cable Thickness*- Adjusts the thickness of all cables.
- *Transparent Cables*- This works in conjunction with the *Cable Transparency* button discussed previously.

*All Cables*- *Cable Transparency* slider affects all cables.

*All But Current Jack* - Hovering over a jack will make its cables opaque. If the *Cable Transparency* control is set to its maximum setting, *Transparent Cables* will have no effect.

- *Show Signal Animation*- Enabling this superimposes a stream of “marching ants” over cables displaying signal flow and direction. (They're easier to see at wider cable width settings.) The *Speed* slider adjusts the speed of display, but has no effect on signals.
- *Enable Animations For Jacks*- Selecting this shows a nifty little animation when a jack is clicked to use its built-in mult. If you're a high-strung weirdo (like me), unchecking this box disables the animation, which makes the mult pop up more quickly.

## 21.5 Audio/MIDI



Settings for audio and MIDI hardware input and output. **This tab is only visible in the standalone version of PS-20.**

- **Output**- Use this drop-down menu to choose a physical audio output source. This defaults to *Built-In Line Output*, i.e. your computer's onboard system audio, but you'll get better fidelity with an external professional audio interface. The biggest audible difference is usually reduced background noise or hum, but external audio

hardware also offers greater flexibility in terms of number of inputs and outputs and built-in mic or low-level instruments pres (i.e. electric guitars). These are especially useful if you're using PS-20's sidchain inputs to process sound. The *Test* button will produce a sine wave when clicked; this will help with troubleshooting, aka, "WHY THE HECK ISN'T THIS MAKING ANY NOISE?!?"

- **Sample Rate**- This sets PS-20's global sample rate. Lower sample rates offer better performance, but if you have a fast computer, high sample rates may offer slightly improved fidelity.
- **Audio Buffer Size**- As with any digital audio app, this defines performance vs. note latency, and will largely depend upon computer CPU speed. A professional external audio interface will almost always exhibit better performance than "built-in" system audio. Lower settings will result in less latency (in the form of faster response to notes played), but will increase the chances of audio gapping or crackling noise.
- **Active MIDI Inputs**- Displays all available MIDI input sources, i.e. keyboards, pad controls, MIDI knob/fader control surfaces, etc. Check boxes to enable one or more devices. If you're using a fader controller with touch-sensitive sliders (like a Mackie Control, for example) and PS-20 plays weirdo notes when you touch the faders, you can uncheck it here to stop that nonsense.