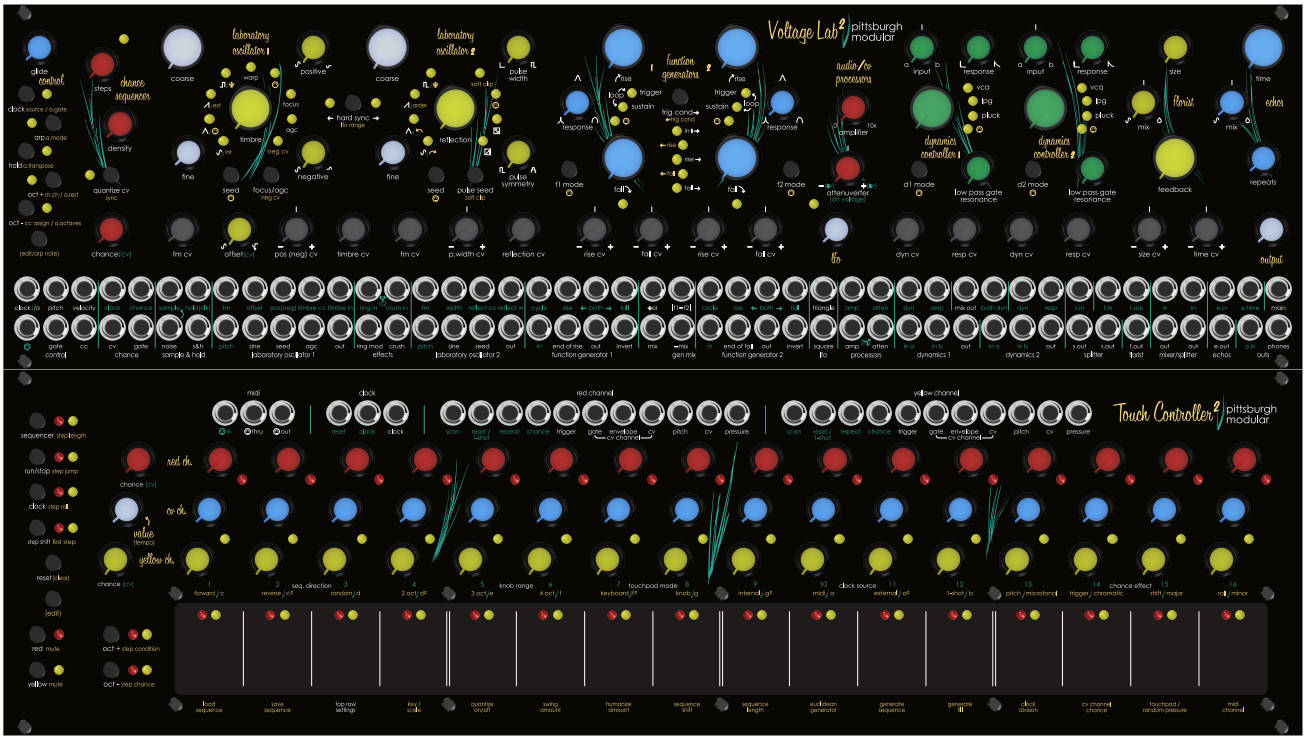


Voltage Lab 2 Electronic Musical Instrument Manual V1.0

Voltage Lab 2 Manual

Thank You!

Pittsburgh Modular
Voltage Lab 2 Design Team

Product Design: Richard Nicol
Analog Research and Engineering: Michael Johnsen
Sound Refinement and Calibration: Perry Willig
Prototyping: Ross Johnson
Firmware: Luna Sea Peaks(aka Luna Moth)
Executive Producer: Al Joelson
Layout and Design: Jongjian Cai
Firmware Support: Zhiwen Huang
Project Logistics: Alice Lai
Business Coordination: Danielle Nicol
Manual: Luna Sea Peaks, Richard Nicol,
with help from Jorb

Contents

1 Important Power Information

Please Read:

Please read the Pittsburgh Modular Voltage Lab 2 Synthesizer Guidebook completely before use and retain for future reference.

- Only use the DC power adapter provided by Pittsburgh Modular with Voltage Lab 2. Using an incorrect power adapter can cause permanent damage to Voltage Lab 2 and the power adapter.
- Voltage Lab 2 is an electronic device. Exposure to water will cause Voltage Lab 2 circuitry to short circuit and may cause permanent damage.
- Do not attempt to modify Voltage Lab 2. Tampering with the circuitry may cause permanent damage.
- Do not place heavy objects on Voltage Lab 2. The user interface is mounted on a PCB that can be damaged if stressed by excessive weight.
- Do not attempt to repair Voltage Lab 2. Please contact Pittsburgh Modular regarding malfunctions of any kind.
- Pittsburgh Modular is not responsible for any damage or loss caused by improper use of Voltage Lab 2.

IMPORTANT Eurorack Ribbon Cable Power Information:

The Pittsburgh Modular Voltage Lab 2 Synthesizer is a pair of Eurorack format synthesizer modules. The modules can be installed, rearranged, removed, and replaced in any compatible Eurorack case from Pittsburgh Modular, Cre8audio, or other manufacturers.

Do NOT remove the Pittsburgh Modular Voltage Lab 2 Synthesizer modules from any case while it is plugged in.

Do NOT plug or unplug the power ribbon cable from the Pittsburgh Modular Voltage Lab 2 Synthesizer modules or case while the case is plugged in.

The Pittsburgh Modular Voltage Lab 2 Synthesizer modules use standard 16 pin Eurorack ribbon cables to connect the module to a bipolar +/-12v power supply. Please pay very close attention to the orientation of the ribbon cable when adding and removing modules. The stripe on the ribbon cable marks -12 volt power. This stripe needs to line up with the -12 volt pins on the power supply and the -12 volt pins on the module. The Pittsburgh Modular Voltage Lab 2 Synthesizer modules include reverse polarity protection so they will not be damaged when plugged in incorrectly; however, as a general rule, failure to match up the pins correctly can result in damage to one or all the modules in a case. On Pittsburgh Modular and Cre8audio cases the positive and negative voltages are clearly labeled. On the Pittsburgh Modular Voltage Lab 2 Synthesizer modules, the power headers are clearly labeled and keyed to ensure a safe and proper connection.

2 Voltage Lab 2 Overview

Voltage Lab 2 Overview:

The Pittsburgh Modular Voltage Lab 2 is a cutting edge synthesis laboratory that offers a new palette of analog textures and waveforms to sonic researchers. Newly developed wave shaping capabilities paired with powerful synthesis tools, and a deep, performance oriented controller join together to create a complete sound design laboratory. This instrument has a very physical sound. The tones it creates feel natural and alive, with traditional waveforms becoming the seeds of unique new shapes and sounds that shift between analog physical modeling and more unfamiliar, abstract timbres.

The Voltage Lab 2 contains two independent 90hp sections: the Voltage Lab 2 Voice, and the Touch Controller 2. While they are designed to work together, with functions and I/O that complement each other, there are no pre-patched connections between the two sections. Certain button and jack labels are present in both sections, and it's important to remember they are totally separate. Each section has its own edit button, its own clock settings, and its own MIDI. No signals will be sent between the two sections unless you patch those connections in.

The Voltage Lab 2 signal path is divided into two types of signals: audio signals and control voltages. The audio signal is the sound that is produced. The audio signal path starts at an oscillator or other sound source. The audio signal is then patched through other functions used to shape the sound such as a wave folder or dynamics module.

Control voltages (CV) manipulate the audio signal in several different ways. Gates are represented by a high (5 volts) or low (<= 0 volts) control voltage. A gate can be generated using a pulse or square wave from an oscillator or modulation source, or by using the MIDI gate or clock output. A gate can be shaped using an Function Generator to control the attack, sustain, and release of the gate. The modified gate signal can then be sent to any CV input on Voltage Lab 2.

A second use for control voltages is as a modulation source. For example, a control voltage from the [MIDI Pitch Output] jack patched into the [Timbre CV Input] jack on the Laboratory Oscillator 1 module controls the depth of the wavefolder based on the midi note received. The LFO provides a separate low frequency oscillator that makes a perfect control voltage modulation source. Audio rate modulation signals also make a great CV source for oscillator FM (frequency modulation).

Voltage Lab 2 uses Eurorack standard 3.5mm TS mono jacks for all the patch points except for the midi jacks use a male 3.5mm TRS stereo MIDI Type A cable.

The Voltage Lab 2 interface does not distinguish between audio and control voltage signals. In theory, any output can be patched into any input. In practice, inputs respond best when patched to the expected signal type. However, experimentation can yield surprising results. The type of signal input and output of each jack is covered in the corresponding section.

2 Voltage Lab 2 Overview

Basic User Interface Information:

The interface utilizes a knob per function operation workflow.

Each of the buttons cover two functions. The function written below the button in WHITE is the main function that happens when the button is pressed.

Each section, the Voltage Lab 2 Voice and Touch Controller 2, has its own [EDIT] button.

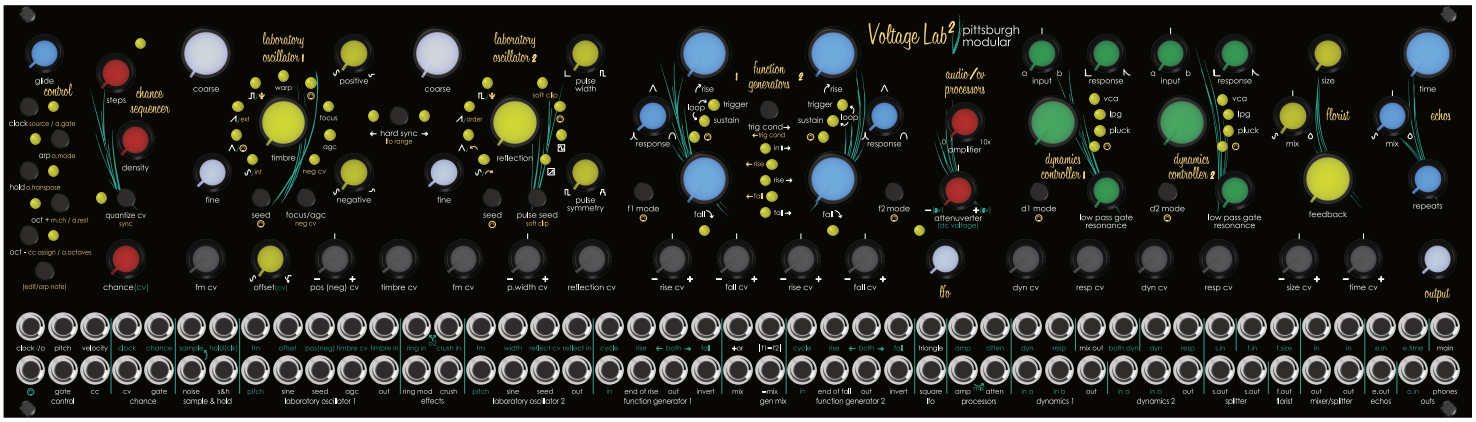
For any button in the Voice section, holding [EDIT/ARP NOTE BUTTON] (bottom left of the Control section) and pressing any button triggers the alternate function written below the button in YELLOW.

For any button in the Touch Controller section, holding [EDIT BUTTON] (3rd button from the bottom of the Controller section.) and pressing any button triggers the alternate function written below the button in YELLOW.

The Voltage Lab 2 is a fully modular instrument. Patch cables are needed to hear a sound.

Input Jacks are labeled with GREEN text and output jacks are labeled with WHITE text. The output volume knob can be patched using the output input [O.IN JACK] and patching out of the [MAIN OUT JACK] (bottom right of Output section) into a mixer or DAW.

3 Voltage Lab 2 Voice Modules



Control

The digital control module includes a MIDI to CV converter, tap tempo clock source, octave shifting, and a 32 step arpeggiator / sequencer.

Chance Sequencer

A digitally controlled random source generating evolving CV and gate signals.

Noise and Sample & Hold

Analog noise and fully patchable sample and hold section.

Laboratory Oscillator 1

Laboratory Oscillator 1 introduces Center Clipping to synthesis. Center Clipping unlocks independent control over the top and bottom of the waveform, allowing for detailed manipulation of harmonics and timbre without affecting pitch.

Laboratory Oscillator Interplay

The interplay between the two laboratory oscillators can be harnessed in several ways. Ring modulation, bit crushing, frequency modulation, and bi-directional hard sync are all available to create the widest possible range of sounds.

Laboratory Oscillator 2

Laboratory Oscillator 2 introduces Pulse Symmetry to synthesis. Pulse Symmetry creates a new type of pulse wave with the addition of a variable height step.

Function Generators

Multi-purpose modulation tools.

Audio / CV Processors and LFO

Two independent processors that can be summed together along with a simple dual range low frequency oscillator.

Dynamics Controllers

A modern interpretation of Don Buchla's famous "lopass" gate.

Signal Splitter and Signal Mixer/Splitter

Two utilities used to split and or mix audio and CV signals.

Audio Effects

The Florist is a flanger, chorus, springy-feedback, reverb-y, vibrato, robot sound generator with highly controlled feedback. Echos is a moody BBD delay that secretly moonlights as a low-fi vibe machine.

3 Voltage Lab 2 Voice Modules

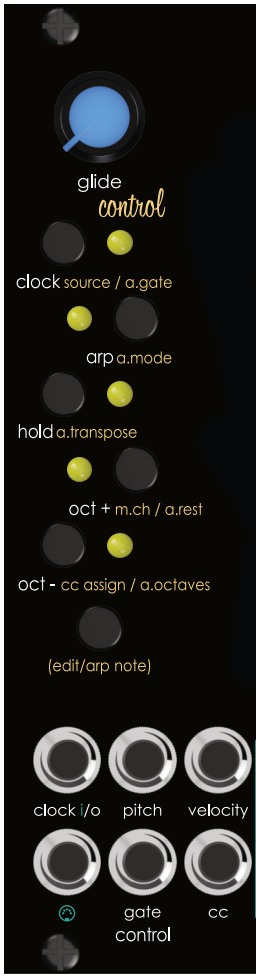
Control

Overview

The Control section in the Voltage Lab 2 controls several features. MIDI to CV converter, octave controller, clock source, arpeggiator & note sequencer, and additional MIDI settings. This section will cover each of these features in detail starting with the MIDI to CV converter but first let's discuss the user interface.

User Interface Conventions

Each of the buttons in the Control section perform multiple functions. The main function, written under each button in white, is performed by pressing the button. The secondary function, written under each button in yellow is performed by pressing and holding the [EDIT BUTTON] then pressing the desired button.



MIDI to CV Converter

The MIDI to CV converter allows the Voltage Lab 2 Voice to respond to digital MIDI messages from a controller or DAW by converting digital MIDI data into analog control voltages. Voltage Lab 2 utilizes the 1 volt per octave standard and responds to MIDI note on/off, MIDI note number 0-120, MIDI clock, MIDI clock start/stop, MIDI pitch bend, MIDI modulation or control change messages, and MIDI Velocity. By default, the MIDI channel of Voltage Lab 2 is set to omni, allowing the synthesizer to respond to all MIDI channels. The Voltage Lab 2 [MIDI INPUT JACK] uses a standard MIDI "Type A" TRS 3.5mm minijack for MIDI input.

Note pitch can be routed internally from the MIDI section to control the pitch of both oscillators. MIDI pitch control can be enabled or disabled for each oscillator independently. This allows for maximum flexibility when patching. To enable or disable MIDI pitch control for an Oscillator, press and hold the voice section's [EDIT BUTTON] then press the selected oscillator's [SEED BUTTON]. This will toggle MIDI pitch control on and off. The [GLIDE KNOB] adds portamento to the MIDI pitch creating smooth transitions between midi notes. Turning the [GLIDE KNOB] to the right increases the length of time it takes to slide from one not to the other.

The voice section's [OCTAVE UP BUTTON] and [OCTAVE DOWN BUTTON] are used to transpose the output of the MIDI pitch over a 7 octave range. Press [OCTAVE UP BUTTON] to shift notes up 1 octave and [OCTAVE DOWN BUTTON] to shift notes down 1 octave. Transposing the pitch only affects the pitch of oscillators with MIDI pitch control enabled.

Note on and note off information is converted to a 5v or 0v gate signal. Note on = 5v. Note off = 0v. The MIDI gate signal can be internally routed to the gate input of function generators 1 and 2. This allows these modules to be triggered by the MIDI Gate signal without the need for patch cables. The [HOLD BUTTON] forces the gate to remain high (on) after a MIDI note off message is received. The gate remains high until the hold function is disabled.

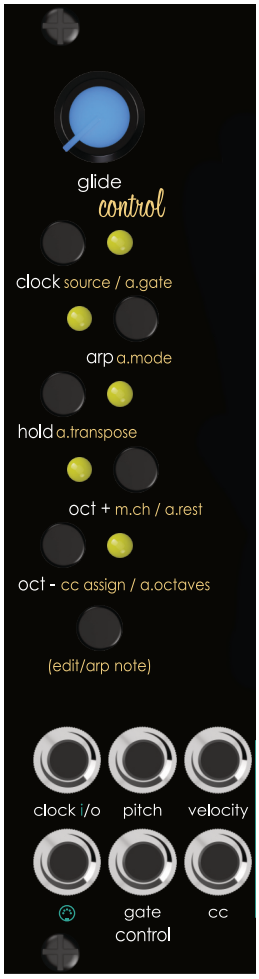
The MIDI Gate signal can be enabled or disabled for the each function generator independently. To enable or disable the MIDI gate signal, press and hold the voice section's [EDIT BUTTON] then press [F1 MODE BUTTON] or [F2 MODE BUTTON]. This will toggle MIDI gate signal to each function generator on and off.

3 Voltage Lab 2 Voice Modules

Control

Clock Source

The Control module utilizes 4 clock sources; internal tap tempo, external MIDI, external gate, and internal pseudo-random. The clock is used to advance the Arpeggiator and Sample and Hold. To select the clock source, press and hold the voice section's [EDIT BUTTON] then press the [CLOCK BUTTON] to cycle through the 4 choices. These options will display on laboratory oscillator 1's seed LED's, with the yellow text indicating each mode. Press once to check current mode. Press again to advance through the available options. The clock source can only be changed when arpeggiator mode is NOT active.



Clock Source Options :

Random Internal clock [Square LED]

External Gate [Saw LED]

External Midi [Triangle LED]

Internal [Sine LED]

Internal Tap Tempo Clock Source

The internal clock source utilizes the voice section's [CLOCK BUTTON] to modify the rate of the internal clock. Tap the voice section's [CLOCK BUTTON] to change the tempo of the clock. The internal clock rate is saved in memory and recalled when Taiga is powered on. The voice section's [CLOCK I/O JACK] functions as a clock output source in internal tap tempo clock mode. The voice section's [CLOCK I/O JACK] outputs a +5v 10ms gate signal.

External MIDI Clock Source

The external MIDI clock responds to MIDI start/stop messages and MIDI tempo from an external MIDI clock source. In external MIDI clock mode, the voice section's [CLOCK BUTTON] acts as a clock divider cycling through 4 available clock divisions. ÷ 1, ÷ 2, ÷ 4, ÷ 8. Set the MIDI clock division by pressing the voice section's [CLOCK BUTTON]. Press once to check current mode. Press again to advance through the available options. The MIDI clock division is saved in memory and recalled when Taiga is powered on. The voice section's [CLOCK I/O JACK] functions as a clock output source in External MIDI Clock mode. The voice section's [CLOCK I/O JACK] outputs a +5v 10ms gate signal.

External MIDI Clock Divider Options :

Divided by 8 [Square LED]

Divided by 4 [Saw LED]

Divided by 2 [Triangle LED]

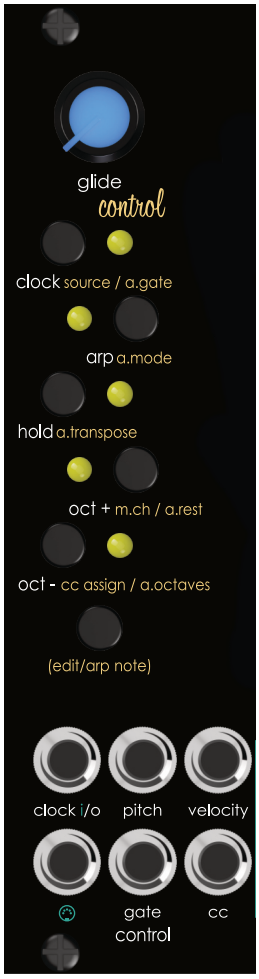
Divided by 1 [Sine LED]

3 Voltage Lab 2 Voice Modules

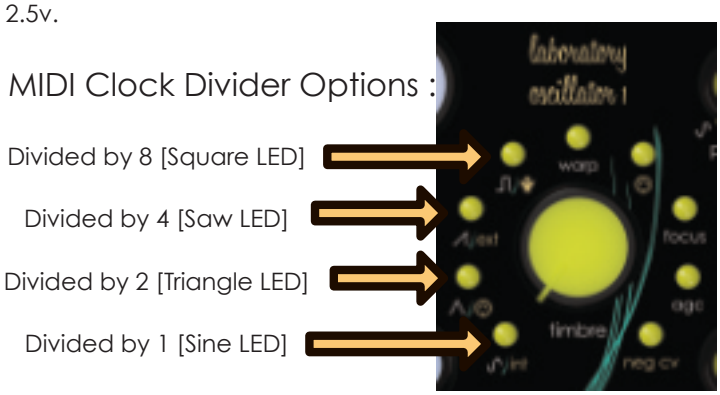
Control

External Gate Clock Source

The external gate clock uses an external gate signal to trigger the clock. In external gate clock mode, the voice section's [CLOCK BUTTON] acts as a clock divider cycling through 4 available clock divisions. ÷ 1, ÷ 2, ÷ 4, ÷ 8. Set the external gate clock division by pressing the voice section's [CLOCK BUTTON]. Press once to check current mode. Press again to advance through the available options. The external gate clock division is saved in memory and recalled when Taiga is powered on. The voice section's [CLOCK I/O JACK] functions as a clock input in External Gate Clock mode. The voice section's [CLOCK I/O JACK] triggers the clock with the rising edge of most waveforms that rise above 2.5v.



External MIDI Clock Divider Options :



Internal Pseudo-Random Clock Source

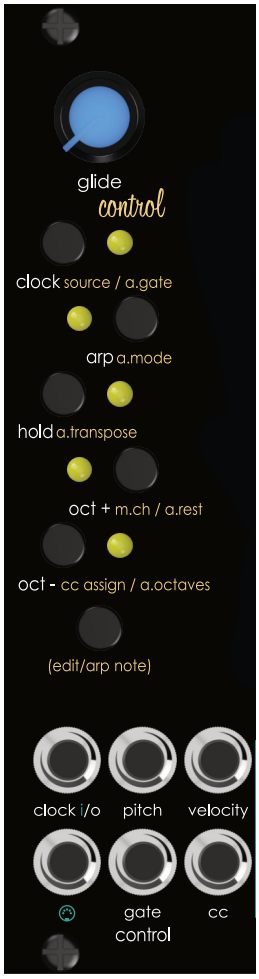
Internal random clock is based on the tap-tempo set by tapping the voice section's [CLOCK BUTTON], but randomly adds or subtracts up to 90% of the clock rate per step. The random clock is very sloppy and will not sync properly with anything.

3 Voltage Lab 2 Voice Modules

Control

Using the Note Sequencing Method

Enable arpeggiator mode by pressing the [ARP BUTTON]. Press the [HOLD BUTTON] to enable hold mode. Press and hold the voice section's [EDIT BUTTON]. Press keys on a MIDI keyboard one at a time to create a sequence of up to 32 steps. While holding the voice section's [EDIT BUTTON], press the voice section's [OCTAVE UP BUTTON] to add a rest. This note sequencing method automatically enables hold mode. To stop the arpeggiated sequence, press the [HOLD BUTTON].



Additional Arpeggiator Functions

The arpeggiator offers additional functions to enhance the active arpeggiated sequence: Hold, Transpose, Random, Arpeggiator Range, Arpeggiator Gate Length, and Random Sequence Generator.

Arpeggiator Hold

Enable the hold function by pressing the [HOLD BUTTON]. The Hold function allows the arpeggiator to cycle through the last set of selected notes after the selected notes have been released, or the voice section's [EDIT BUTTON] is released when using the sequencing input method. Disable the Hold function by pressing the [HOLD BUTTON].

Arpeggiator Transpose

Enable the Transpose function by pressing and holding the voice section's [EDIT BUTTON] then press the [HOLD BUTTON]. Transpose mode can only be enabled when arpeggiator mode and hold mode are active. The Transpose function allows an incoming MIDI note to transpose the active arpeggiated sequence. The sequence is transposed based on the first note of the arpeggiated sequence. Disable the Transpose function by pressing the [HOLD BUTTON].

Arpeggiator Randomize

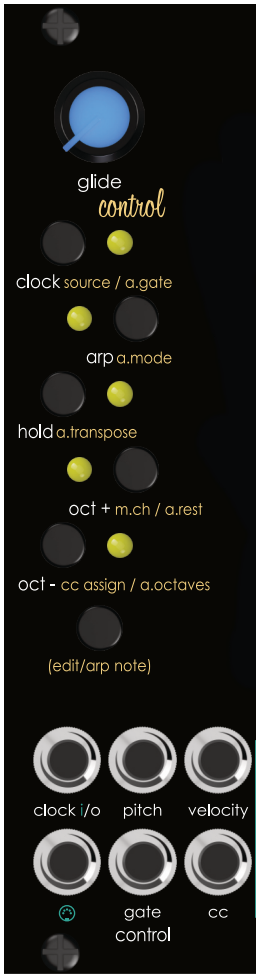
Randomize the playback order of the arpeggiated sequence by pressing and holding the voice section's [EDIT BUTTON] then pressing the [ARP BUTTON]. The Random function will randomly jump between the notes of the arpeggiated sequence. Disable Random by pressing and holding the voice section's [EDIT BUTTON] then pressing the voice section's [ARP BUTTON].

3 Voltage Lab 2 Voice Modules

Control

Arpeggiator Octave Range

The Arpeggiator Range function sets the number of octaves the active arpeggiated sequence will cycle through. The Arpeggiator Range can be set to 1, 2, or 3 octaves. Set the range by pressing and holding the voice section's [EDIT BUTTON] then pressing the [OCTAVE DOWN BUTTON] to cycle through 1 octave, 2 octaves, or 3 octaves. Press once to check current mode. Press again to advance through the available options. The arpeggiator range can only be changed when arpeggiator mode is active.



Arpeggiator Octave Range Options

Random Octave [Square LED]

3 Octaves [Saw LED]

2 Octaves [Triangle LED]

1 Octave [Sine LED]

Arpeggiator Direction

The Arpeggiator can operate in a few different modes, playing notes back in different orders. holding the voice section's [EDIT BUTTON] then pressing the [ARP BUTTON] will cycle between modes. press once to check current mode. Press again to advance through the available options. The arpeggiator mode can only be changed when arpeggiator mode is active.

Arpeggiator Mode Options :

Random [Square LED]

Order Played [Saw LED]

Descend [Triangle LED]

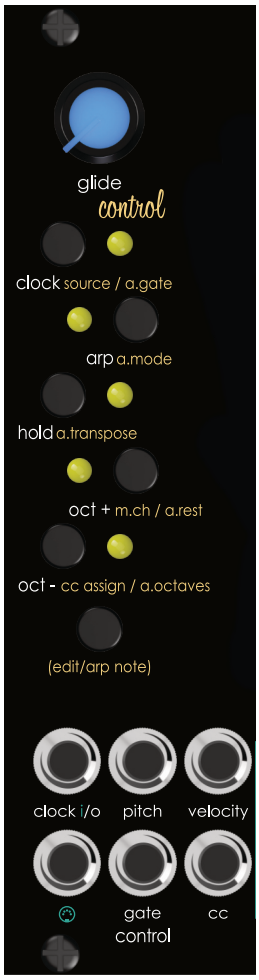
Ascend [Sine LED]

3 Voltage Lab 2 Voice Modules

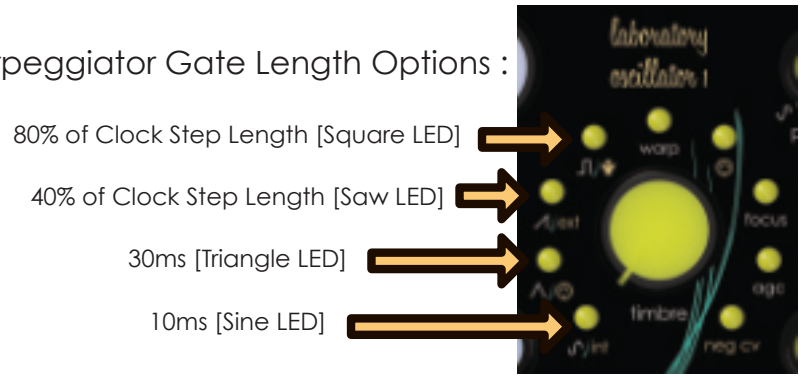
Control

Arpeggiator Gate Length

The Arpeggiator Gate Length function sets the amount of time the arpeggiator gate signal is high (on). Set the Arpeggiator Gate Length by pressing and holding the voice section's [EDIT BUTTON] while the Arpeggiator is active, then press the [CLOCK BUTTON] to cycle through the 4 lengths. Press once to check current length. Press again to advance through the available options. The arpeggiator gate length can only be changed when arpeggiator mode is active.



Arpeggiator Gate Length Options :



Random Sequence Generator

Generate a randomized sequence by pressing the [ARP BUTTON] to enable Arpeggiator mode. Next, press and hold the voice section's [EDIT BUTTON] then press the [HOLD BUTTON]. This will generate a sequence with a random length (1-32 steps), pseudo-random pitch values, and random velocities. The key of the sequence is based on the last incoming MIDI note. If no MIDI note has been played, the sequence will be based on the key of C. The notes of the sequence should mostly stick to the selected key. Major or minor will be randomly chosen. Randomized sequences can include rests.

3 Voltage Lab 2 Voice Modules

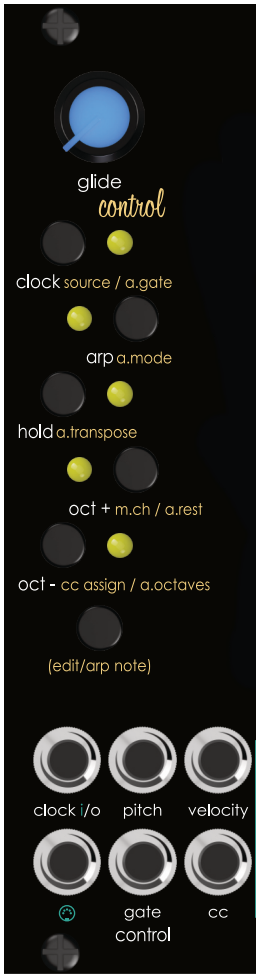
Control

Velocity Output

The [VELOCITY OUTPUT JACK] outputs a 0v to 5v DC voltage derived from MIDI note Velocity messages.

MIDI CC Output

The [CC JACK] outputs a 0v to 5v DC voltage based on incoming MIDI value of the assigned MIDI CC number or mod wheel.



As midi CC comes in, the amount will be displayed on the oscillator LEDs

To set the active MIDI CC number, press and hold the voice section's [EDIT BUTTON] and press the [OCT+ BUTTON]. The MIDI CC number will be assigned to the first CC number it receives via MIDI.

Control Section Input Jacks:

[Clock I/O JACK] Clock input jack when clock source is set to External Gate Mode. This jack is an output when the clock source is set to Tap Tempo Mode, External MIDI Mode, or Internal Pseudo-Random Gate Mode.

[MIDI JACK] A standard 3.5mm MIDI Type A TRS minijack for MIDI data input.

Control Section Output Jacks:

[PITCH JACK] Outputs 1 volt per octave CV signal for pitch based on MIDI or arpeggiator note on information.

[VELOCITY JACK] Outputs a 0v to +5v signal based on the incoming MIDI velocity information or selected Velocity Random Shift Register settings.

[GATE JACK] Outputs a 0v or +5v gate signal based on MIDI or arpeggiator note-on information.

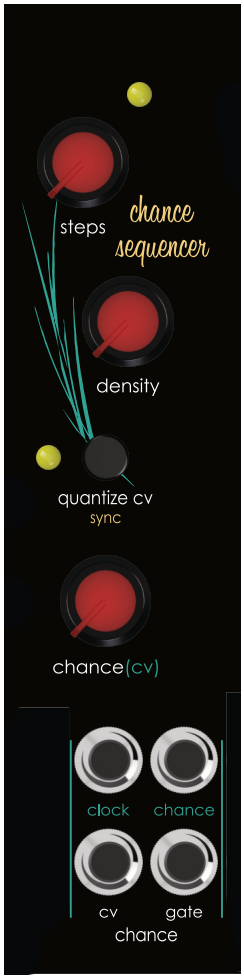
[CC JACK] Outputs a 0v to 5v signal based on the incoming midi CC messages.

3 Voltage Lab 2 Voice Modules

Chance Sequencer

Overview

Inspired by the random source on the Buchla Music Easel, the Chance Sequencer on the Voltage Lab 2 is a digitally controlled random source generating both gate and CV signals. The random generator functions similar to an analog, shift register wit up to 32 stages. When the clock signal triggers an update and the next register value is loaded, there is a chance it will evolve. Think of it like a step sequencer. The random generator cycles through the steps of the sequence and each time the sequencer jumps to the next step, there is a chance the value stored in that step will be replaced with a new value. The result is a random source that feels both random and evolutionary, with an ever evolving pattern cycle.



The [STEPS KNOB] sets the number of steps in the sequence 1-32, you can see this number displayed across the oscillator LEDs.

The [DENSITY KNOB] controls the potential that the Chance Sequencer will trigger.
Turning to the right increases the chance the sequencer will trigger. Chance increases for both triggering on the beat and also subdivisions.

The [CHANCE KNOB] controls two variables.
1. The % chance the sequencer step will update the saved value. Turning to the right creates a greater chance of change.
2. The range of change between the saved value and the new value. Turning to the right creates a greater chance of larger jumps in value between the saved value and the new value.

The [QUANTIZE CV BUTTON] will determine if the [CV JACK] will send out quantized 1v/oct notes or not. [EDIT BUTTON] + [QUANTIZE CV BUTTON] determines whether or not the Control Sequencer is in sync with the clock.

Chance Input Jacks:

[CLOCK JACK] External clock input Jack.

[CHANCE JACK] Chance CV input, attenuated with [CHANCE(CV KNOB].

Chance Output Jacks:

[CV JACK] Chance sequencer CV output.

[GATE JACK] Chance sequencer gate output.

3 Voltage Lab 2 Voice Modules

Noise and Sample & Hold

Noise

The transistor core analog noise source is pitched somewhere between pure white and pink noise. Perfect for percussion or adding a bit of edge to a sound. The output is around +/- 5v. The [NOISE JACK] is normalized to the Sample and Hold [SAMPLE JACK].

Sample and Hold

The Sample & Hold circuit samples the voltage patched to the [SAMPLE JACK] and outputs that voltage until a new sample voltage is taken. A sample is taken when the [HOLD(CLK) JACK] receives a positive gate or trigger. The sample source can be audio or CV. and HOLD that value when a gate input is high. The [HOLD(CLK) JACK] is normaled to the clock.

Sample & Hold Input Jacks:

[SAMPLE JACK] Sample input jack.

[HOLD(CLK) JACK] Hold input jack.

Sample & Hold Output Jacks:

[NOISE JACK] White noise output jack.

[S&H JACK] Sample and Hold output jack.

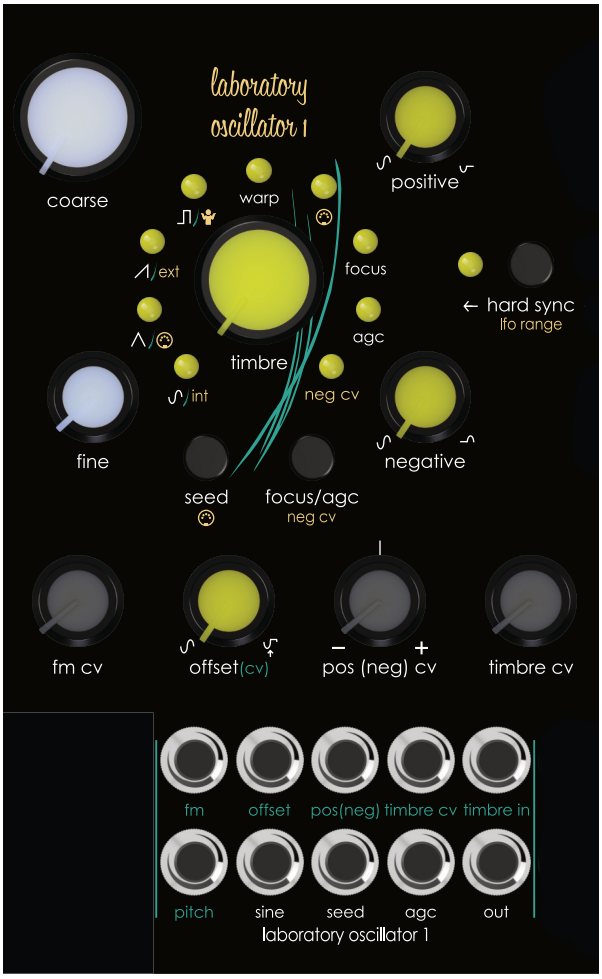
3 Voltage Lab 2 Voice Modules

Laboratory Oscillator 1

Overview

The sounds created by the Laboratory Oscillator 1 are the culmination of years of research and design. The unique wave shaping circuitry we have created is the foundation of our analog sound.

The unique sound of the Voltage Lab 2 starts with a refined version of our temperature stabilized, analog VCA saw wave oscillator core. The internal signal path of the Laboratory Oscillator 1 passes the core saw waveform through up to 8 wave shapers before reaching the output. The selected waveforms' name should be thought of as more of a guide to harmonic density than the definitive shape of the output wave. During the design phase, we began calling the initial clean geometric waveforms (sine, triangle, saw, square) seed waves because the shapes of the waveforms available at the output are very different than the internal source wave. As an example, if all the wave shaping is turned down, the output of the triangle wave looks more like a sine wave than the output of the sine wave on an oscilloscope. Because of the intensive wave shaping, the seed wave is simply one of several factors that determine the shape and sound of the output.

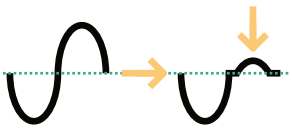


The internal signal path of the Primary Oscillator is more complex than most oscillators. All of the wave shapers before the wavefolder circuit are designed to manipulate the waveform in ways that allow it to interact with the wavefolder in interesting ways. Let's take a close look at each stage of the signal path in the order they occur.

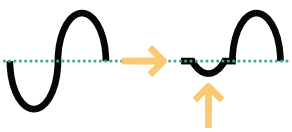
Center Clipping

Expanding on a concept mentioned but never implemented by Don Buchla, the Voltage Lab 2 introduces Center Clipping and Automatic Gain Control to analog synthesis.

Center Clipping is a method of shaping a waveform from the inside out. Independently pulling the top half or bottom half of a waveform toward the middle. The process looks like the waveform is sinking into the center of the wave, while the rest of the wave remains unchanged finally resulting in a half wave rectified or dual half wave rectified waveform. This process allows independent control over even and odd harmonics.



Positive Clipping

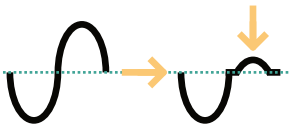


Negative Clipping

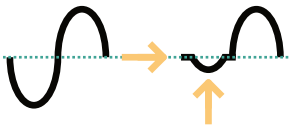
The complex wave shaping capabilities of Center Clipping come at a cost. Center Clipping is a destructive process that can dramatically reduce the amplitude of waveforms. Automatic Gain Control (AGC) is the process of attempting to restore the center clipped waveform by allowing the analog circuitry to guess what the waveform should look like. Results will vary.

Center Clipping and AGC output a complex set of voltage controllable waveforms perfect for further processing with a wave folder and/or filter.

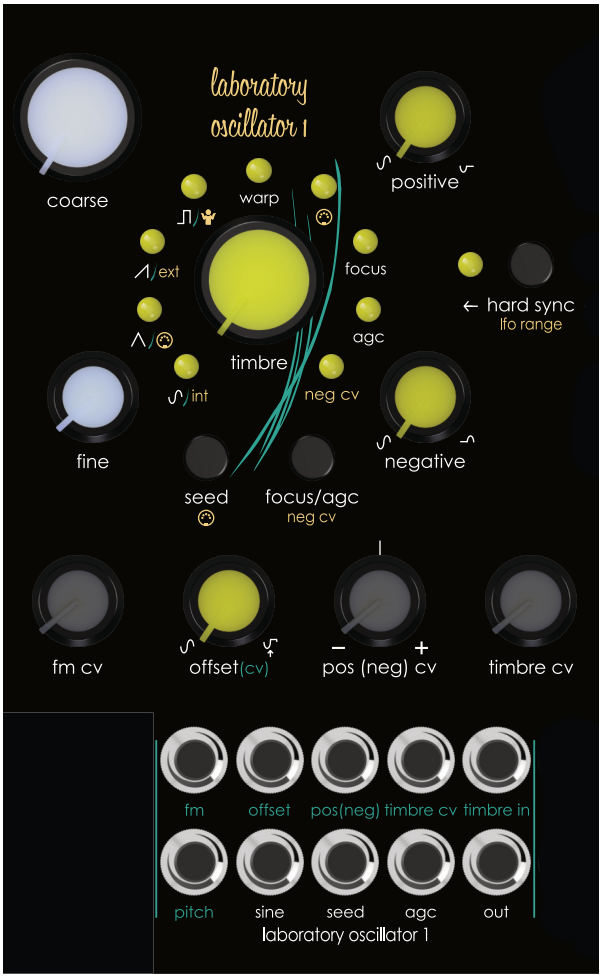
3 Voltage Lab 2 Voice Modules

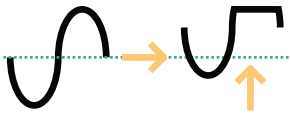


Positive Clipping



Negative Clipping





Waveform Offset

Laboratory Oscillator 1

Positive and Negative Control

The [POSITIVE KNOB] adjusts the height of the top half of the waveform, and the [NEGATIVE KNOB] adjusts the bottom half of the waveform. Positive only or Positive and Negative values can be modulated using the [POS (NEG) CV ATTENUVERTER]. Modulation of the Negative side can be switched in and out using [EDIT BUTTON] + [FOCUS/AGC BUTTON].

Waveform Offset

Center Clipping offers additional settings; [OFFSET KNOB] adds a positive offset to the waveform. This can be modulated using the [OFFSET KNOB] as an attenuator for the [OFFSET JACK]. This jack is normaled to 5v to allow for manual offset. Focus and AGC and be enabled or disabled using the [FOCUS/AGC BUTTON]. Focus recenters the waveform within the Center Clipping circuit. AGC stands for Automatic Gain Control and attempts to rebuild a full sized waveform based on the remaining waveform after adjusting the [POSITIVE KNOB], [NEGATIVE KNOB] and [OFFSET KNOB].

Focus

Focus is an internal process that removes DC offset from the Center Clipped waveform before it passes through the Automatic Gain Control circuit. The effect this has on the output strongly depends on the condition of the waveform passing through.

Select a Waveform

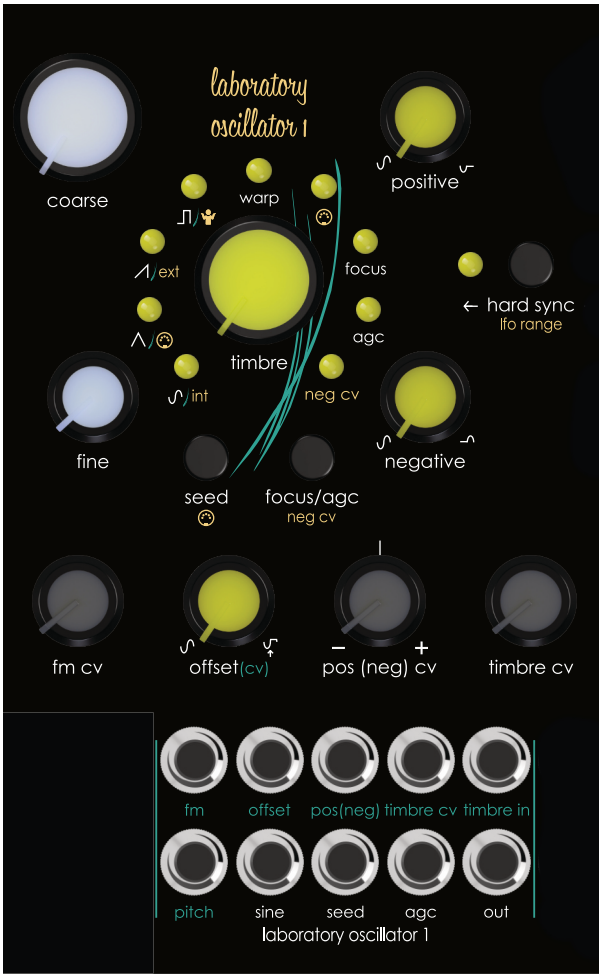
The [SEED BUTTON] selects the active waveform. Along with each standard wave, cycling through the waveforms offers a Warped version of each wave. Warp modifies the shape of the waveform without changing the harmonic content. This allows high harmonic waveforms like squares and saws to work with the wave folder.

Seed Waveform Options

Sine Wave [Sine LED]
Warped Sine Wave [Sine and Warp LED]
Triangle Wave [Triangle LED]
Warped Triangle Wave [Triangle and Warp LED]
Saw Wave [Saw LED]
Warped Saw Wave [Saw and Warp LED]
Square Wave [Square LED]
Warped Square Wave [Square and Warp LED]
Randomly Selected Waveform [All LEDs ON]

3 Voltage Lab 2 Voice Modules

Laboratory Oscillator 1



Warp

The warp circuit is the last step before the seed wave passes through the wavefolder. Warp mode changes the shape of the waveform without modifying the harmonic content or sound. This allows high harmonic content waveforms like the saw and square to interact strongly with the wavefolder. For lower harmonic content waveforms like sine and triangle, warp mode can be thought of like an analog wavetable creating an alternate version of each seed wave.

Wavefolder

The [TIMBRE KNOB] modifies a 6 stage wavefolder that adds additional harmonics to both simple and complex waveforms by amplifying and folding the waveform back in on itself. The [TIMBRE KNOB] controls the strength of the wave folder. Turning the knob to the right increases the depth and number of folds up to a maximum of 6 folds. The density and depth of the folds has a strong effect on the shape and sound of the seed wave. When using the [TIMBRE CV JACK] and [TIMBRE KNOB] the [TIMBRE KNOB] acts as the starting point for the external modulation control.

The [TIMBRE IN JACK] is the audio input to the wavefolder, patching into this overrides the oscillator's signal path into the wavefolder with an external audio signal. This means the second oscillator or any other audio signal can be patched through the wavefolder in place of oscillator 1.

3 Voltage Lab 2 Voice Modules

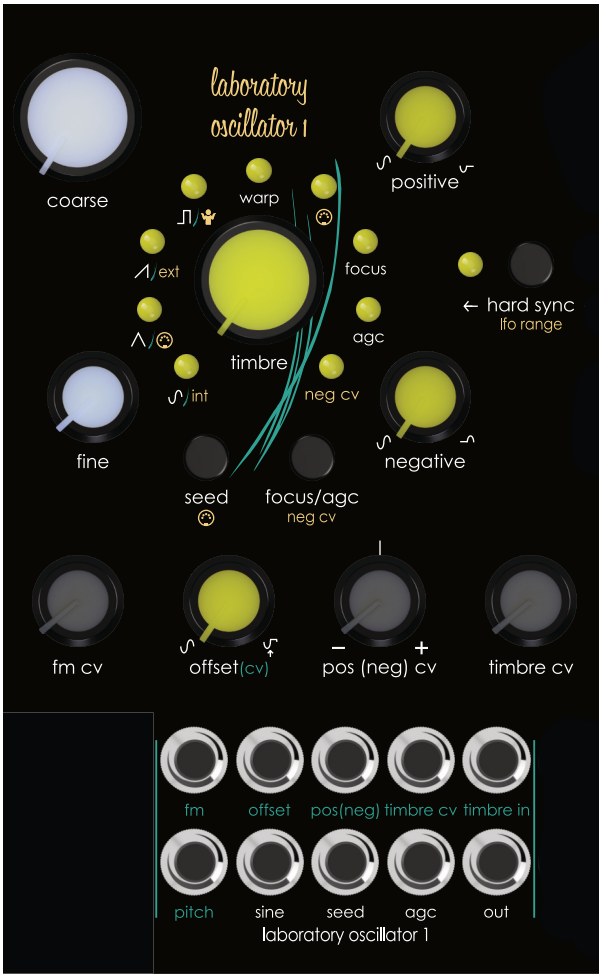
Laboratory Oscillator 1

MIDI Pitch Response

[EDIT BUTTON] + [SEED BUTTON] enables or disables MIDI pitch response. This also determines if the oscillator responds to the [OCTAVE UP BUTTON] and [OCTAVE DOWN BUTTON] in the voice control section.

Laboratory Oscillator 1 Input Jacks :

[PITCH JACK] 1 volt per octave pitch input jack.



[FM JACK] Linear frequency modulation input jack. Attenuated using the [FM CV ATTENUATOR].

[OFFSET JACK] Adds a positive or negative voltage offset to the waveform. Attenuated using the [OFFSET(CV) KNOB].

[POS(NEG) JACK] Center clipping modulation jack. Attenuverted using the [POS(NEG) CV ATTENUVERTER].

[TIMBRE CV JACK] Timbre modulation jack. Attenuated using the [TIMBRE CV ATTENUATOR].

[TIMBRE IN JACK] Audio input to the wavefolder, patching into this overrides the oscillator's signal path into the wavefolder with an external audio signal. This means the second oscillator or any other audio signal can be patched through the wavefolder in place of oscillator 1.

Laboratory Oscillator 1 Output Jacks :

[SINE JACK] Clean sine wave output jack.

[SEED JACK] Unprocessed selected seed wave.

[AGC JACK] Center Clipping and AGC modified version of the seed output, before the wave folder.

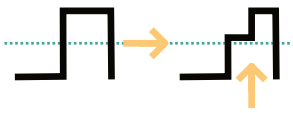
[OUT JACK] Wavefolder output.

3 Voltage Lab 2 Voice Modules

Laboratory Oscillator 2

Overview

Laboratory Oscillator 2 utilizes a refined version of our temperature stabilized, analog VCA saw wave oscillator core. The internal signal path passes the core saw waveform through up to 5 wave shapers before reaching the output.

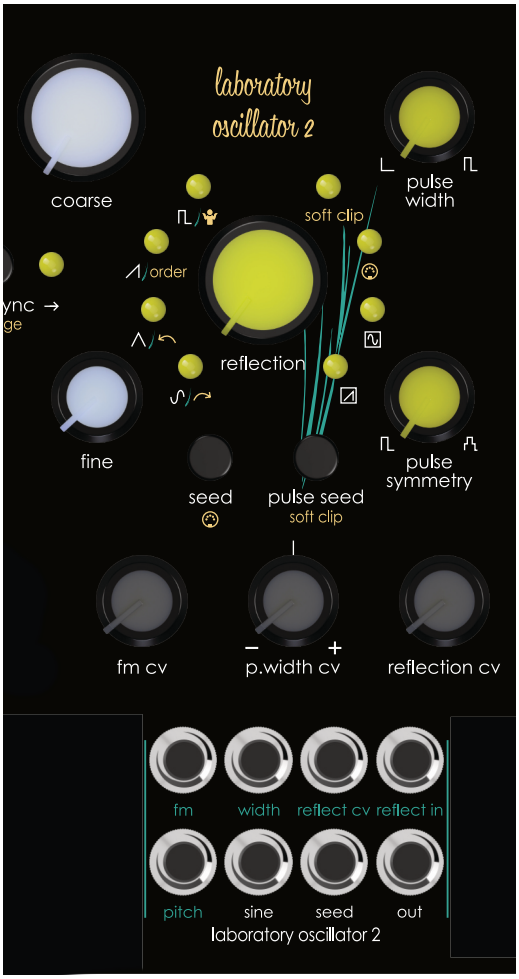


Pulse Symmetry

Pulse Symmetry

Laboratory Oscillator 2 introduces Pulse Symmetry to synthesis. Pulse Symmetry creates a new type of pulse wave with the addition of an adjustable step. Using an oscilloscope, the waveform looks like a set of stairs where both the pulse width and the height of the step can be adjusted.

The Pulse Seed determines the internal wave used to create the pulse wave, sine, saw, or both. Each wave results in a different pulse wave shape.



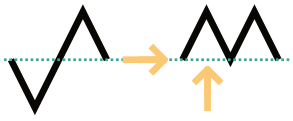
The [PULSE WIDTH KNOB] sets the pulse width. Pulse width can be modulated using the [P.WIDTH CV ATTENUVERTER] and [WIDTH JACK]. The [PULSE SYMMETRY KNOB] sets the height of the step.

The [PULSE SEED BUTTON] determines what waveform is used to create the pulse wave; sine, saw, or both. This impacts how pulse symmetry looks and sounds.

Reflection

The [REFLECTION KNOB] flips the bottom half of the waveform back onto the top half. The results are different for every waveform. Looking at an oscilloscope, a sine doubles in frequency, a saw morphs into a triangle, and a pulse symmetry wave gains additional complexity.

Reflection can be modulated using the [REFLECT CV JACK]. The [REFLECT IN JACK] is the audio input to waveform reflection. Patching into this overrides the signal path to waveform reflection with an external audio signal. This means the first oscillator or any other audio signal can be patched through wave reflection.



Reflection

Soft Clipping

Use [EDIT BUTTON] + [PULSE SEED BUTTON] to enable or disable soft clipping. Soft clipping smooths out the resulting waveform for a mellower sound.

3 Voltage Lab 2 Voice Modules

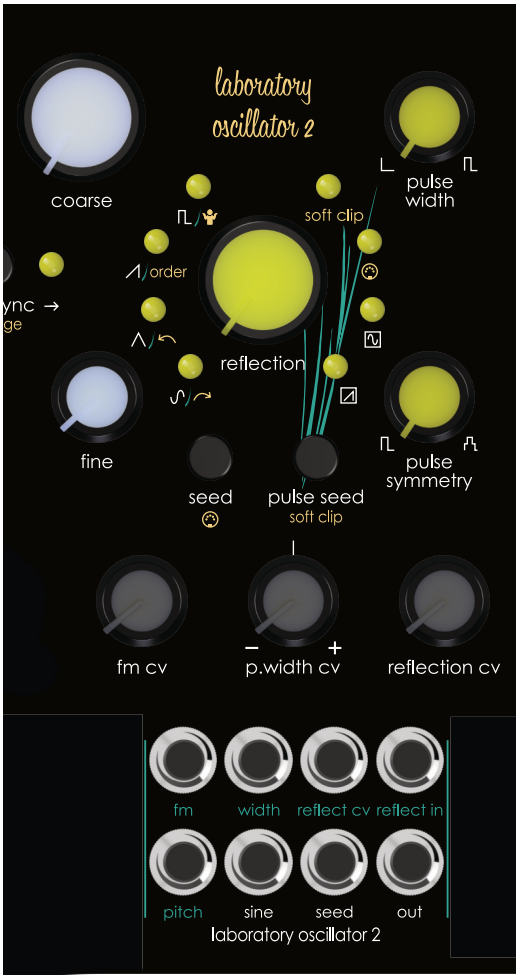
Laboratory Oscillator 2

Select a Waveform

The [SEED BUTTON] selects the active waveform.

Seed Waveform Options

1. Sine Wave [Sine LED]
2. Triangle Wave [Triangle LED]
3. Saw Wave [Saw LED]
4. Pulse Wave [Pulse LED]
5. Randomly Selected Waveform [All LEDs ON]



MIDI Pitch Response

[EDIT BUTTON] + [SEED BUTTON] enables or disables MIDI pitch response. This also determines if the oscillator responds to the [OCTAVE UP BUTTON] and [OCTAVE DOWN BUTTON] in the voice control section.

Laboratory Oscillator 2 Input Jacks :

[PITCH JACK] 1 volt per octave pitch input jack.

[FM JACK] Linear frequency modulation input jack. Attenuated using the [FM CV ATTENUATOR].

[WIDTH JACK] Pulse wide modulation input jack. Attenuverted using the [P.WIDTH CV ATTENUVERTER].

[REFLECT CV JACK] Reflection modulation input jack. Attenuated using the [REFLECTION CV ATTENUATOR].

[REFLECT IN JACK] Audio input to reflection, patching into this overrides the oscillator's signal path into reflection with an external audio signal. This means the first oscillator or any other audio signal can be patched through reflection in place of oscillator 2.

Laboratory Oscillator 2 Output Jacks :

[SINE JACK] Clean sine wave output jack.

[SEED JACK] Unprocessed selected seed wave.

[OUT JACK] Reflection output.

3 Voltage Lab 2 Voice Modules

Laboratory Oscillator Interplay

Overview

The interplay between the two laboratory oscillators can be harnessed in several ways. Ring modulation, bit crushing, frequency modulation, and bi-directional hard sync are all available to create the widest possible range of sounds.

Hard Sync

Hard Sync enables a "following" oscillator's period to be reset, or retriggered by a "lead" oscillator. Depending on the frequency relationship of the two oscillators and how the following oscillator is modulated, the resulting audio can emphasize higher harmonics while a base pitch is still present and discernible.

Hard Sync is set using the [HARD SYNC BUTTON], pressing this button will cycle between each oscillator synced to the other, or bidirectional simultaneous sync, where both oscillators are actively resetting each other.

Ring Modulator

A ring modulator outputs the sum and difference of Laboratory Oscillator 1 sine wave and modulation source. Depending on the frequency relationship of the two signals, ring modulation can emphasize harmonics or create harsh metallic sounds. The seed wave is patched through the x input and the modulation source is patched through the y input of the ring modulator circuit. Ring Modulation can act as a VCA if modulated with an envelope or LFO.

The Sine wave output of Oscillator 1 is always the audio input to the ring modulator, and its level is modulated by Oscillator 2, or an external signal patched to [RING IN JACK]. The [RING MOD JACK] output jack is the result of that modulation.

Bit Crusher

Bit crushing effectively limits the rate at which an audio signal "updates" to a new voltage. It might be helpful to think of it as a sample and hold circuit that can handle audio rate signals.

The main output of Oscillator 1 is always the audio input to the bit crusher, and by default Oscillator 2's seed out is our clock signal. Plugging a patch cable into the [CRUSH IN] jack will replace Oscillator 2 as the clock signal.

The processed audio can sound aliased, downsampled, or reminiscent of low-resolution digital audio.

Oscillator Effects Input Jacks :

[RING IN JACK] Ring modulator circuit's modulator input. Normaled to Oscillator 2 sine.

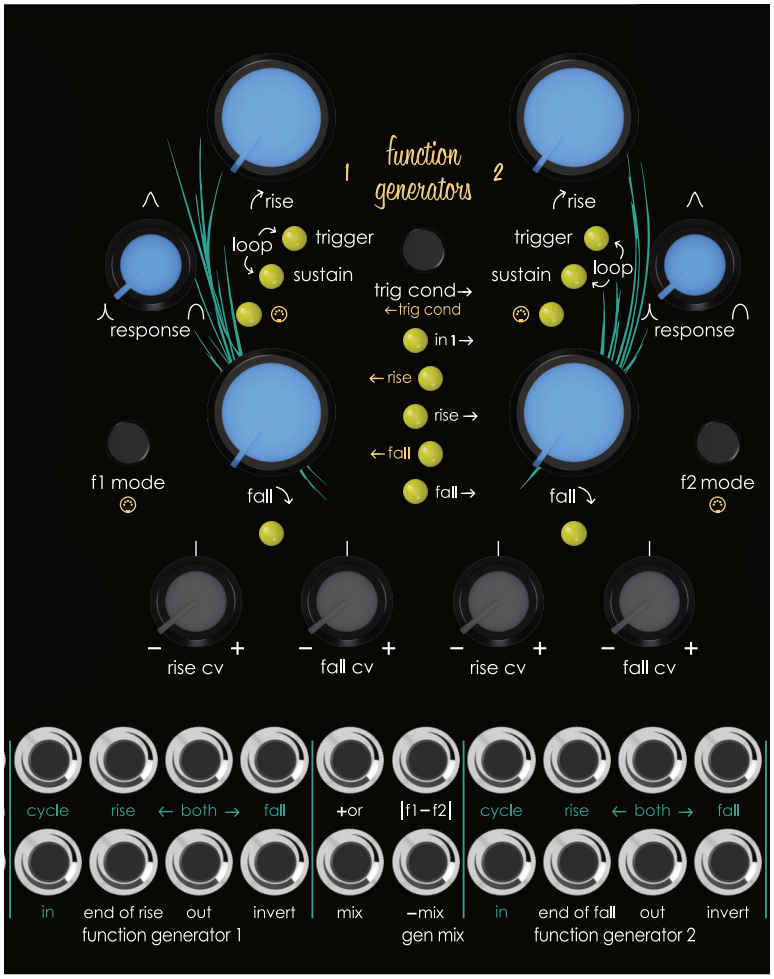
[CRUSH IN JACK] Bit Crush circuit's clock input. Normaled to Oscillator 2 seed.

Oscillator Effects Output Jacks :

[RING MOD JACK] Ring modulator output.

[CRUSH JACK] Bit crusher output.

3 Voltage Lab 2 Voice Modules



Function Generators

Overview

The flexibility of voltage controlled Function Generators allows them to serve many different purposes for sound design. This includes envelopes, LFOs, slew generators, envelope followers, and much more. The Voltage Lab 2 Function Generators can be intertwined for more complex results using trigger conditions and a dedicated mixer section offers four different versions of the combined outputs.

Duration and Shape

A Function Generator is a variable modulation source outputting between 0 and +5v. The shape of the output is created using two main controls, [RISE KNOB] and [FALL KNOB]. The [RISE KNOB] sets the amount of time the Function takes to reach 5v and the [FALL KNOB] sets the amount of time the Function Generator takes to return to 0v. These controls determine both the duration and shape of the Function Generator. A short rise with a long fall creates a saw-like wave. Matched rise and fall times will generate a triangle. The rise time and fall time can be modulated using the [RISE CV ATTENUVERTER] and [FALL CV ATTENUVERTER] along with the [RISE JACK], [BOTH JACK], and [FALL JACK]. The [RESPONSE KNOB] determines the linearity of the Rise and Fall stages from (full left) through linear (around 12 o'clock) to exponential (full right).

Function Generator Modes

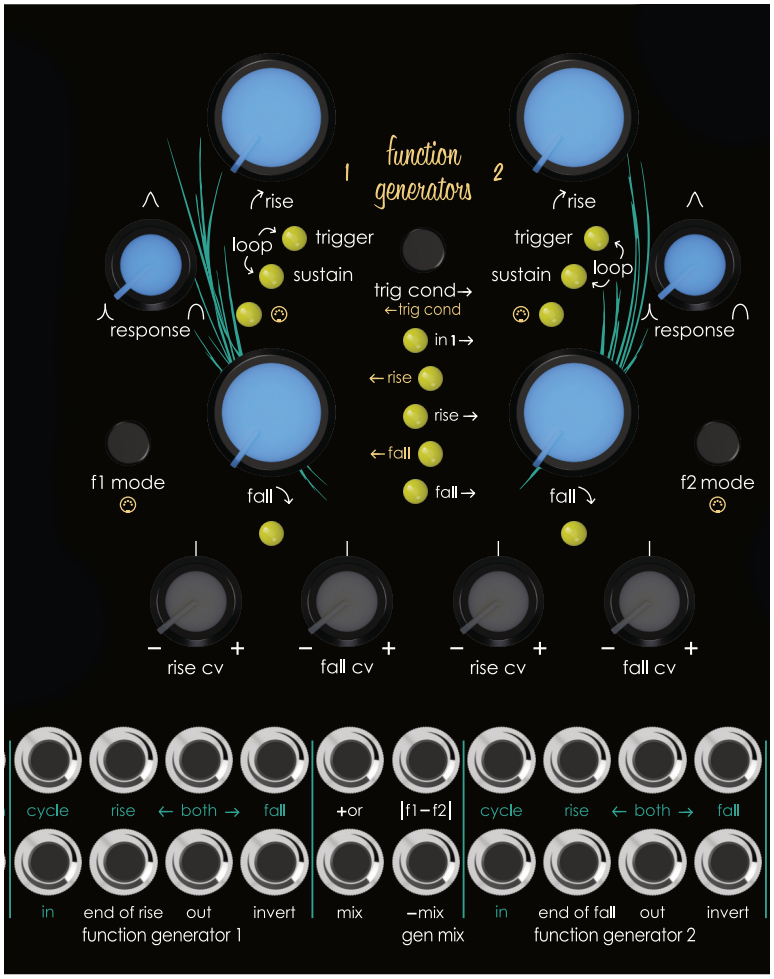
The Function Generators will respond to an incoming gate or CV signal differently based on the selected mode. There are 3 modes to choose from; Sustain Mode, Trigger Mode, and Loop Mode. Select the active mode using the [F1 or F2 MODE BUTTON]. Enable or disable MIDI note on triggering the Function Generator by pressing [EDIT BUTTON] + [F1 or F2 MODE BUTTON].

Sustain Mode

Sustain Mode allows the function generator to act as a three stage attack (rise), sustain, release (fall) envelope, a slew generator, an envelope follower. A gate or CV signal patched into the [IN JACK] initiates the rise stage, and the function generator will increase over time to 5v. Once the function generator has reached the end of the rise stage, the output is sustained as long as the gate signal patched into the [IN JACK] remains high. The fall stage is triggered once the incoming gate or CV signal drops to 0v, and the function generator will drop over time to 0v. The envelope generated in sustain mode can be retriggered at any time during the attack (rise), sustain, or decay (fall) stages.

The [END OF RISE GATE OUTPUT JACK] does not function in Sustain Mode.

3 Voltage Lab 2 Voice Modules



Function Generators

Trigger Mode

Trigger Mode can be used to create a two stage attack (rise), decay (fall) envelope, gate signal delay or clock divider. The internal circuitry responds differently than sustain mode when triggered. A gate or CV signal patched into the [IN JACK] over two volts initiates the rise stage, and the function generator will increase over time to 5v. Once the function generator reaches 5v, the fall stage is initiated, and the output will drop over time to 0v.

Some CV signals may trigger the Function Generator as long as the waveform has a sharp enough rising slope. In trigger mode, the function generator will not retrigger during the rise stage, however the envelope will retrigger during the fall mode. This quirk allows the function generator to work as a clock divider by adjusting the rise stage to skip over or miss a set number of incoming gate signals.

Loop Mode

Loop Mode is an extension of trigger mode and utilizes all the same feature set. To create the loop, the function generator uses the end of fall trigger created at the end of the cycle to retrigger the rise creating a voltage controllable low frequency oscillator or clock source.

Trigger Conditions

The pair of Function Generators can be used independently or linked together to create complex modulations. Trigger Conditions determine when the Function Generators trigger each other.

Assign how Function Generator 1 triggers Function Generator 2 by pressing the [TRIG CONDITION BUTTON]

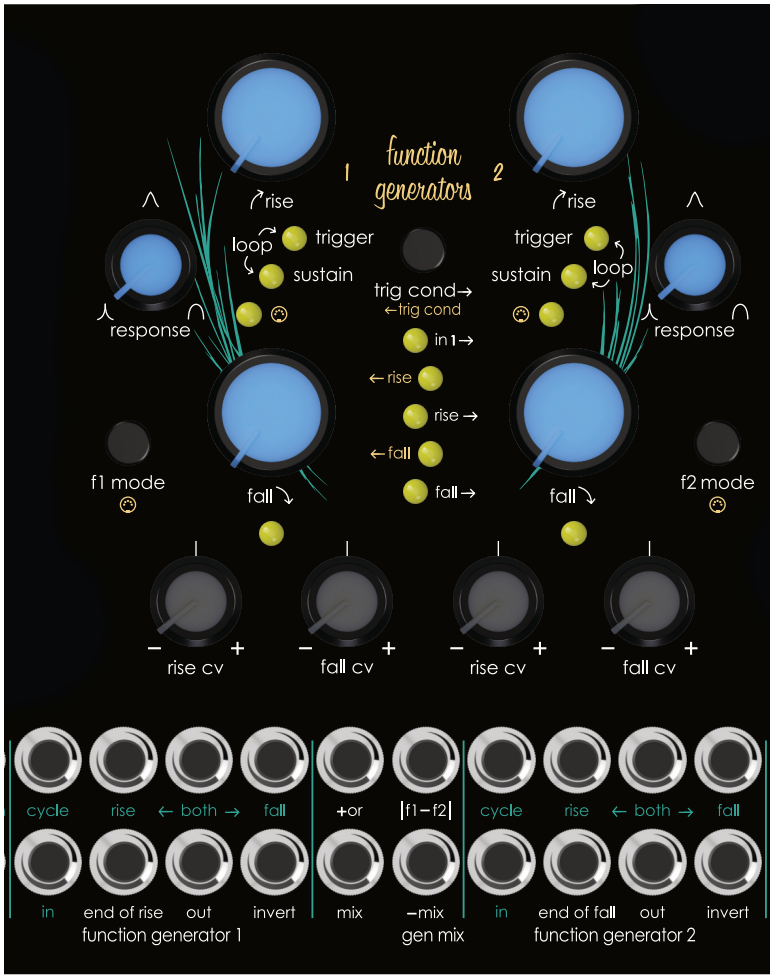
F1 Trigger Options

Trigger F2 when F1 receives a trigger
Trigger F2 at F1 end of rise
Trigger F2 at F1 end of fall
Or any combination of the above

Assign how Function Generator 2 triggers Function Generator 1 by pressing the [EDIT BUTTON] + [TRIG CONDITION BUTTON]

F2 Trigger Options

Trigger F1 at F2 end of rise
Trigger F1 at F2 end of fall
Trigger F1 at F2 end of rise and end of fall
Or any combination of the above



Function Generators

Generator Mix Outputs

The Function Generator section utilizes 4 different mixing circuits to combine the outputs of Function Generator 1 and Function Generator 2. Depending on the relationship between both function generators, these can generate more complex LFO's, multi-stage envelopes, or react to varied input signals in useful and unexpected ways.

Especially when combined with trigger conditions, the mixed outputs enable a radically deep interplay between the two function generators. The potential functionality, and valid use-cases are almost endless.

Function Generator Input Jacks :

[IN JACK] Function Generator input.

[CYCLE JACK] Sets the function generator to loop when a gate signal is present.

[RISE JACK] Rise time modulation input. Attenuverted using the [RISE CV ATTENUVERTER].

[BOTH JACK] Modulation input for both rise and fall. Attenuverted using the [RISE CV and FALL CV ATTENUVERTERS].

[FALL JACK] Fall time modulation input. Attenuverted using the [FALL CV ATTENUVERTER].

Function Generator Output Jacks :

[END OF RISE JACK] Trigger output that fires when the function generator completes its rise stage.

[OUT JACK] Function Generator main output, 0-5v.

[INVERT JACK] Function Generator Inverted output, 0-5v.

Function Generator Mix Output Jacks :

[+OR JACK] compares the output voltage of Function Generator 1 with the output voltage of Function Generator 2 and passes the output voltage of the Function Generator with the highest voltage.

[|F1-F2| JACK] outputs the voltage difference between the output voltage of Function Generator 1 and Function Generator 2.

[MIX JACK] sums the output voltage of Function Generator 1 with the output voltage of Function Generator 2.

The [-MIX JACK] outputs the inverted sum of the output voltage of Function Generator 1 with the output voltage of Function Generator 2.

3 Voltage Lab 2 Voice Modules

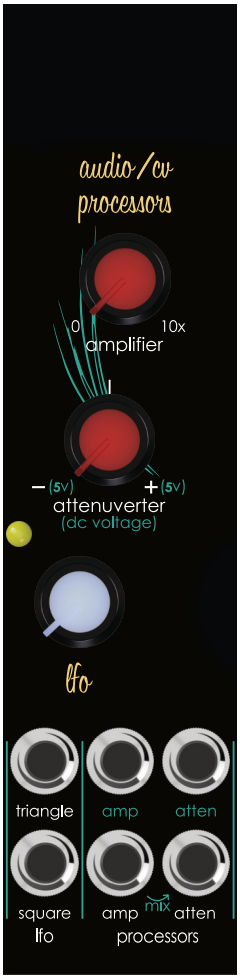
Audio / CV Processors

Overview

The audio / cv processors are two independent processors that can be summed together to expand their functionality. Together they can be used as a 2 channel mixer or single channel amplifier with positive or negative offset.

Amplifier

Amplifier is for audio signals only. The range is full attenuation to 10x amplification. The amplifier can be used to amplify external signal to eurorack modular levels or to overdrive eurorack level signals. Set output using the [AMPLIFIER KNOB]. [AMP INPUT JACK] and [AMP OUTPUT JACK] are used to patch in and out of the amplifier. If the [AMP OUTPUT JACK] is not patched, the output of the amplifier is mixed with the output of the attenuverter. This can be used for driving internal signals



Attenuverter / Static DC Voltage Source

The attenuverter is for both audio and CV signals. Set the output using the [ATTENUVERTER KNOB]. [ATTEN INPUT JACK] and [ATTEN OUTPUT JACK] are used to patch in and out of the attenuator. If the [ATTEN INPUT JACK] is not patched, the attenuator will output -5v to +5v DC.

Audio / CV Processors Input Jacks :

[AMP INPUT JACK] Amplifier input jack.

[ATTEN INPUT JACK] Attenuverter input jack.

Audio / CV Processors Output Jacks :

[AMP OUTPUT JACK] Amplifier output jack.

[ATTEN OUTPUT JACK] Attenuverter output jack.

LFO

The LFO module is an analog, dual range, low frequency oscillator with +/- 5 volt triangle and square wave outputs. Select between high and low range by holding down the voice module's [EDIT BUTTON] and pressing the [HARD SYNC BUTTON].

LFO Ranges:

High: 2 Hz to 500 Hz

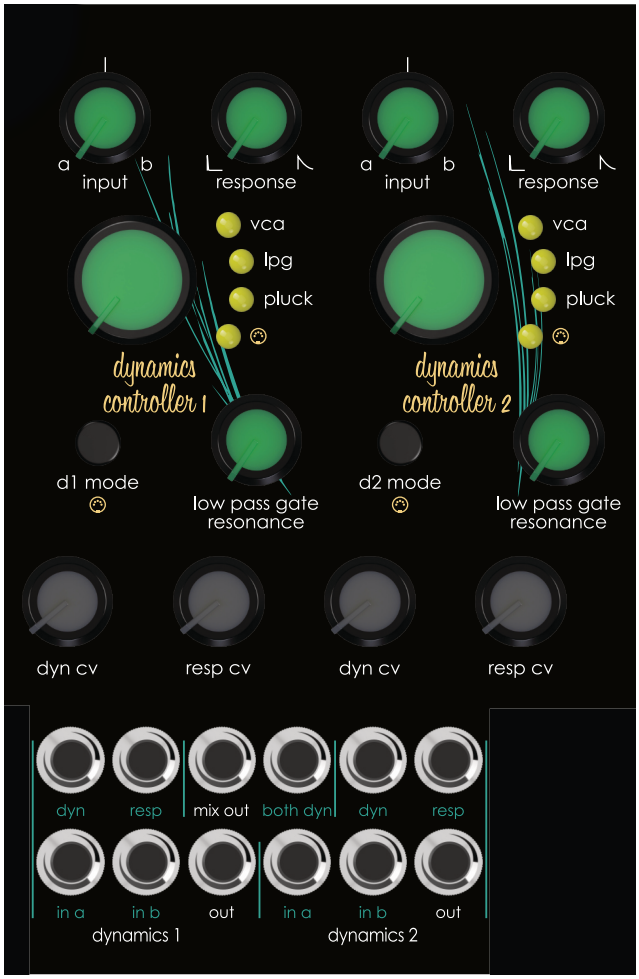
Low: 41 seconds to 5 Hz

LFO Output Jacks :

[TRIANGLE JACK] Triangle wave LFO output jack.

[SQUARE JACK] Square wave LFO output jack.

3 Voltage Lab 2 Voice Modules



Dynamics Controllers

Overview

The Voltage Lab 2 utilizes a pair of Pittsburgh Dynamics Controllers to bring additional depth and dimension to sounds by manipulating both amplitude and harmonic content simultaneously. The Dynamics Controller is a modern interpretation of Don Buchla's famous "lowpass" gate.

The lowpass gate circuit is unique in the way that it simulates the characteristics of the natural world. When used in lowpass gate mode, louder sounds contain more harmonic content and quieter sounds contain less harmonic content. This is not the case when using VCA mode. VCA mode simply changes the loudness of the sound without modifying the harmonic content. There is no reason that synthesizers need to simulate the real world but because of how it affects the harmonic content of sound, a lowpass gate sounds more organic or natural compared to a standard VCA.

The original lowpass gate was limited to a static response time that varied from unit to unit. This made each lopass gate a little different. The Dynamics Controllers in the Voltage Lab 2 expands on the original Don Buchla concept by adding a unique, [RESPONSE KNOB] allowing for customizable gate response times. The dynamics response time can be voltage controlled using the [RESP JACK] and [RESP CV KNOB]. The pluck response can be used with low pass gate mode.

The pluck response can be used with low pass gate mode. The pluck response uses a sharp gate or envelope signal to pluck or strike the Dynamics Controller while taking advantage of the Vactrol response to create a percussive sound with a natural decay. Select the mode by pressing the [D1 or D2 MODE BUTTON].

The [DYNAMICS KNOB] acts as a pass through for the incoming signal. Turn the [DYNAMICS KNOB] to the right to manually open up the dynamics controller and allow the incoming signal to pass. When using the [DYNAMICS CV JACK] and [DYN CV JACK], the [DYNAMICS KNOB] acts as the starting point for the level of the incoming signal.

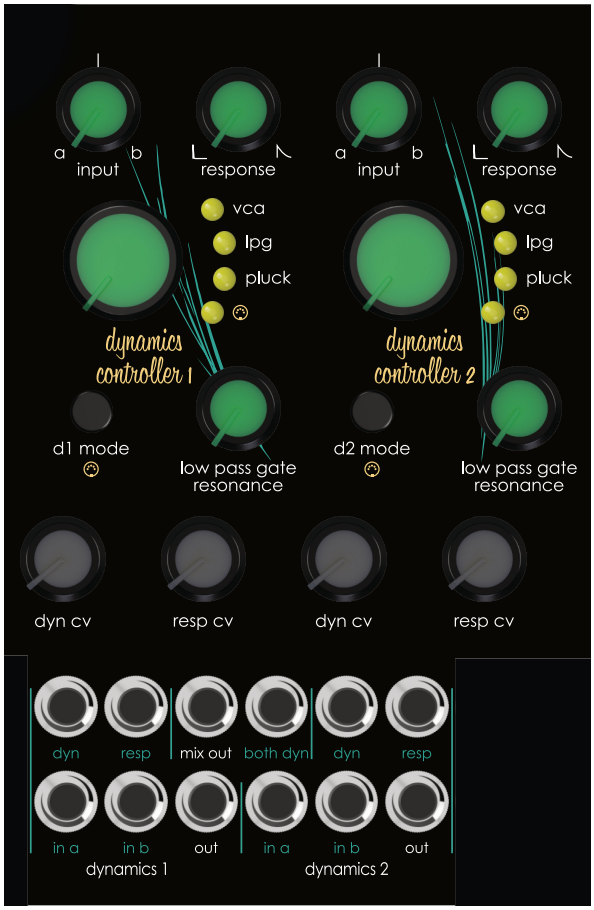
The [LOW PASS GATE RESONANCE KNOB] adjusts the amount of resonance added to the audio signal. This only works in low pass gate and low pass gate with pluck modes.

Enable or disable MIDI note on triggering the Dynamics Controller directly by pressing [EDIT BUTTON] + [D1 or D2 MODE BUTTON].

Dynamics Processing Modes

The Dynamics Controllers offer 3 distinct audio processing modes. VCA, low pass gate, and plucked low pass gate. Each mode creates a unique sound and feature set for signal processing. Cycle through all the available Processing Modes on each dynamics controller by pressing the [D1 MODE BUTTON] or [D2 MODE BUTTON].

3 Voltage Lab 2 Voice Modules



Dynamics VCA Mode

In VCA Mode the Dynamics controllers act as transparent voltage controlled amplifiers, only controlling the level of the input signal. In VCA mode, the [RESPONSE KNOB] has little effect on the incoming signal and the [LOW PASS GATE RESONANCE KNOB] has no effect on the incoming signal.

Dynamics Low Pass Gate Mode

The response of the low pass gate mode sits somewhere between a VCA and a filter and works well as a stand alone filter. The traditional description of a low pass gate is that it combines a VCA and filter together to allow the circuit to manage both amplitude and harmonic content. Turning down the [DYNAMICS KNOB] will lower the amplitude AND remove harmonics from the input signal. In Low Pass Gate mode, the [RESPONSE KNOB] will control gate response times, adding a decay to incoming signals. [LOW PASS GATE RESONANCE KNOB] will introduce a soft resonance response tuned to add weight to sounds without becoming overwhelming.

Dynamics Pluck Mode

Pluck response mode also functions as Low Pass gate; the dynamics controller is controlling amplitude AND harmonics, but the response to control signals into the [DYNAMICS CV JACK] is different to the standard low pass gate mode, and well suited to percussive sounds. In the pluck response mode, a sharp gate or envelope signal to the [DYNAMICS CV JACK] will create a percussive effect. Turn the [DYN CV KNOB] full left to hear just the plucked response. Turn the [DYN CV KNOB] to the right to blend the pluck response with the incoming CV or gate signal. The [RESPONSE KNOB] controls the decay time of the incoming [DYNAMICS CV JACK] signal.

Dynamics Controller A/B Mixer

Each dynamics controller has a two input mixer. The [INPUT KNOB] sets the balance between the A & B signals, and can work as an attenuator or mixer depending on how many signals are patched in.

Dynamics Controller Input Jacks :

[IN A JACK] Dynamics controller mixer input jack A.

[IN B JACK] Dynamics controller mixer input jack B.

[DYN JACK] Dynamics cv input. Attenuated using the [DYN CV ATTENUATOR].

[RESP JACK] Response CV input. Attenuated using the [RESP CV ATTENUATOR].

[BOTH DYN] Dynamics cv input to dynamics controllers 1 and 2. Attenuated using each [DYN CV ATTENUATOR].

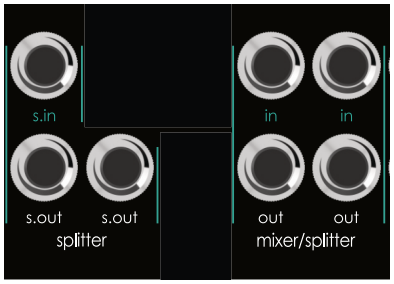
Dynamics Controller Output Jacks :

[OUT JACK] Dynamics controller output jack.

[MIX OUT JACK] Mixed output of dynamics controllers 1 and 2.

3 Voltage Lab 2 Voice Modules

Patching Utilities



Signal Splitter

The signal splitter is a simple one input, two output buffered multiple. This can be used to route audio into multiple places, or duplicate a modulation signal to control multiple destinations

Signal splitter Input Jacks :

[S.IN JACK] Input to the signal splitter.

Signal splitter Output Jacks :

2x [S.OUT JACK] Outputs of the signal splitter.

Signal Mixer / Splitter

The signal mixer and splitter is a two input, two output unity gain mixer paired with a buffered multiple. This can be used to mix 1 audio or CV signals and/or route a signal to multiple destinations

Signal splitter Input Jacks :

2x [IN JACK] Inputs to the signal mixer/splitter.

Signal splitter Output Jacks :

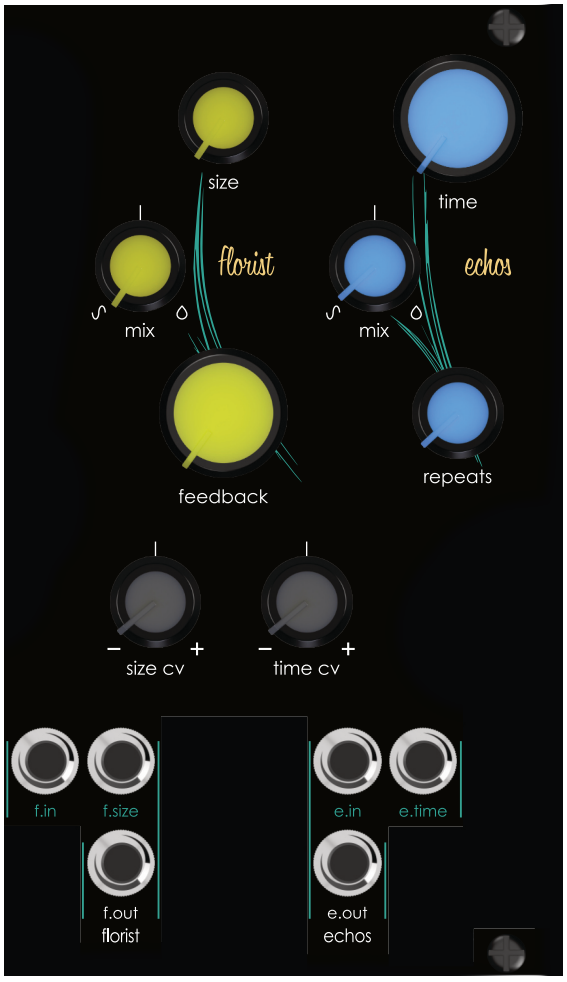
2x [OUT JACK] Outputs of the signal mixer/splitter.

3 Voltage Lab 2 Voice Modules

Audio Effects

Overview

The Voltage Lab Two includes a pair of our favorite analog, time based effects. The Florist is a flanger, chorus, springy-feedback, reverb-y, vibrato, robot sound generator with highly controlled feedback to maximize repeats before falling into self oscillation. Echos is a moody BBD delay that secretly moonlights as a low-fi vibe machine.



Florist

Florist utilizes a single BBD chip to produce a voltage controllable flanger, chorus, reverb effect. Delay time can vary from 5 ms to 29 ms. The delay time can be modulated using the [SIZE CV ATTENUVERTER] and the [F. SIZE JACK]. The feedback of the florist is highly controlled to allow for a high amount of feedback before the florist begins to self oscillate.

Echos

Echos utilizes a pair of 4,096 stage BBD chips to produce a voltage controllable analog delay signal. Clean delay time can vary from 15 ms to 410 ms. The delay time can be modulated or maximum delay time can be increased using the [TIME CV ATTENUVERTER] and the [E. TIME JACK], delay time maxes out at 960 ms but the increased time will add additional clock noise into the audio signal. The repeats of the echos are highly controlled to allow for a large number of repeats before the delay begins to self oscillate.

Audio Effects Input Jacks :

[F. IN JACK] Florist input jack.

[F. SIZE JACK] Florist size CV jack. Attenuverted using the [SIZE CV ATTENUVERTER].

[E. IN JACK] Echos input jack.

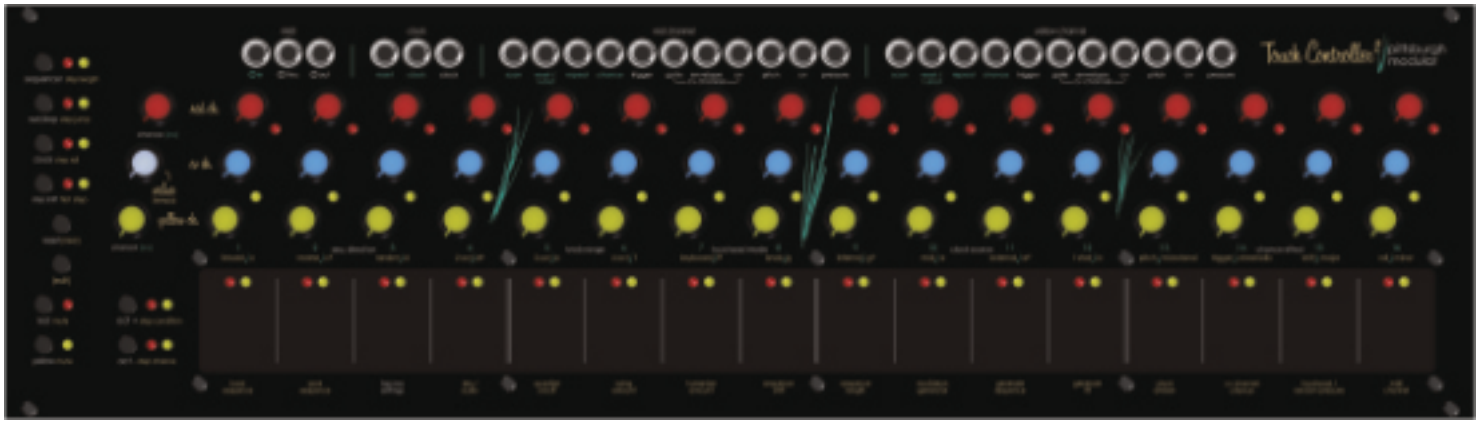
[E. TIME JACK] Echos time CV jack. Attenuverted using the [TIME CV ATTENUVERTER].

Audio Effects Output Jacks :

[F. OUT JACK] Florist output jack.

[E. OUT JACK] Echos output jack.

4 Voltage Lab 2 Touch Controller



Touch Controller Overview

The Touch Controller enables artists to blend traditional pitched performances with the freedom to openly experiment, creating a flexible playground for music creation. The Touch Controller provides a wide range of sequencing tools, which can be used to generate both quantized and unquantized control voltages, for a wide range of expressive musical possibilities.

The Touch Controller houses two independent channels, red and yellow, each functioning as either an expressive pressure sensitive touch keyboard, or as a deep, experimental, step sequencer.

When used as a touch keyboard, the capacitive touch pads can be played live, generating notes either in a scale like a piano, or with a custom scale controlled by the pitch knobs.

When used as a step sequencer, each channel of the Touch Controller offers step conditions, jumps, chance effects, generative sequencing, and a host of other tools that allow musicians to both create and interact with complex systems.

Or both at the same time! Using one channel as a sequencer while using the other as a keyboard enables a musician to play along to sequenced grooves. Or use both as a sequencer, and play sequenced grooves against each other. Or use both as a touch keyboard and lay out your own expressive paraphonic harmony controller. Or even explore some of the strange experimental live sequencing options that live in between these!

The options are wide, and the channel independence gives you control of a lot!

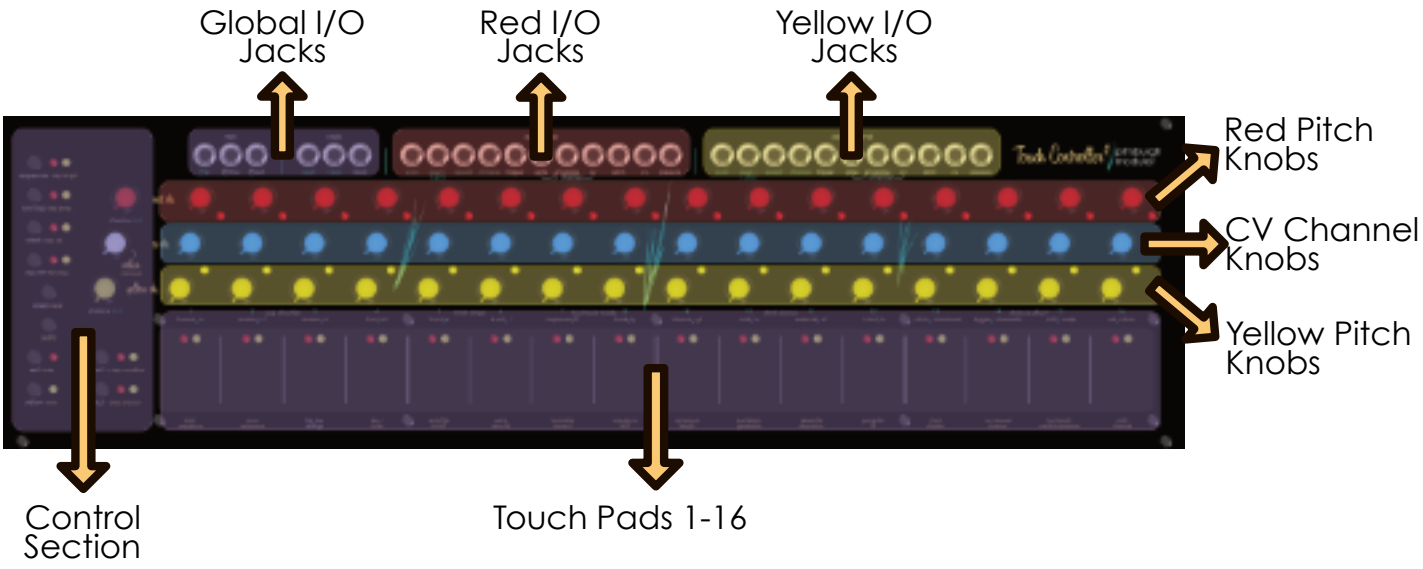
Both red and yellow channels share the blue CV channel knobs, but have their own independent outputs controlled by those knobs. The CV channel outputs generate a gate with variable length, an envelope with variable decay time, and an unquantized CV value with variable voltage. The state of each channel's dedicated CV channel outputs are determined by the channel's selected step or keyboard press and the position of the blue knob associated with that step.

Along with a host of random sequencing and generation tools, the touch controller provides a lot to learn and experiment with, allowing a musician to grow and learn with the instrument. Getting started with the Touch Controller is easy and intuitive, with a standard 16-step sequencer, but gives the musician room to go deep and bring in new features over time as you collect knowledge and learn all the components of the interface.

The Touch Controller 2 and Voltage Lab 2 Voice sections are fully independent.
Patch cables are needed to connect the Touch Controller to the Voice Modules.

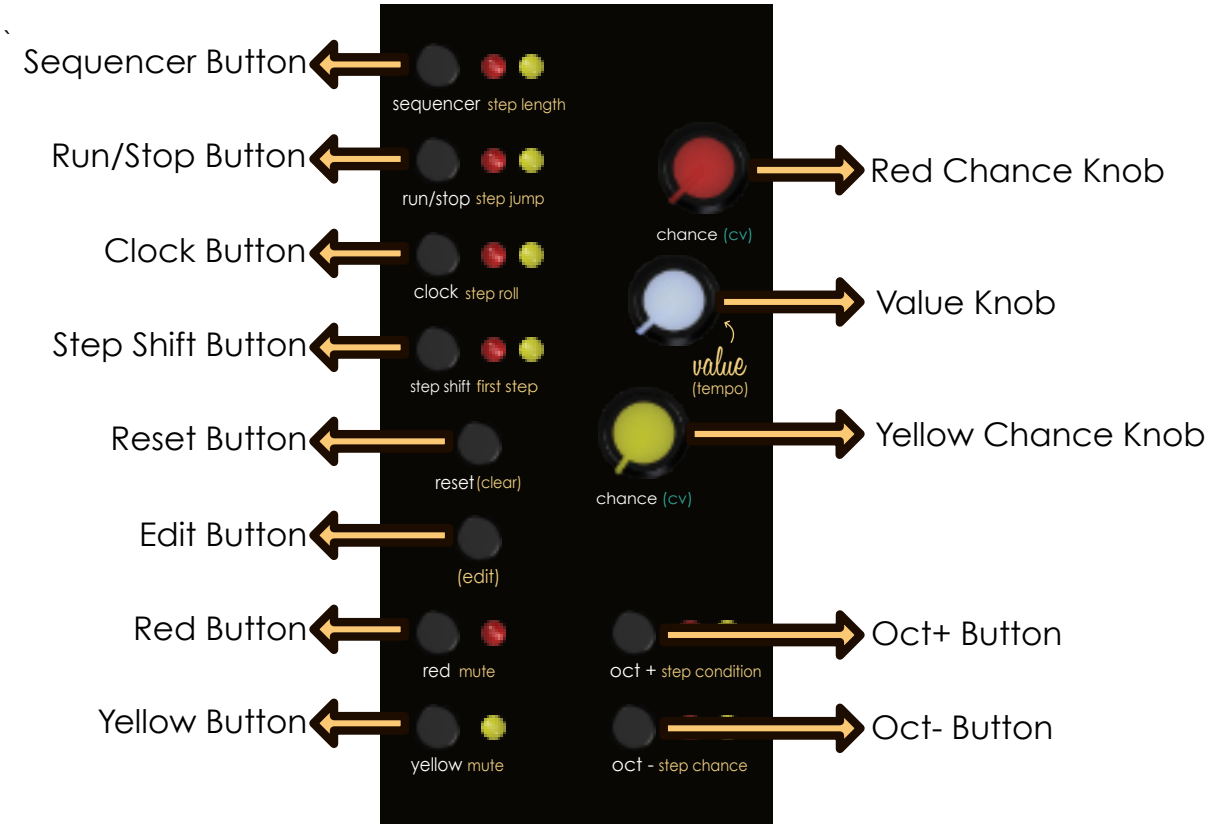
4 Voltage Lab 2 Touch Controller

Touch Controller Layout



Control Section

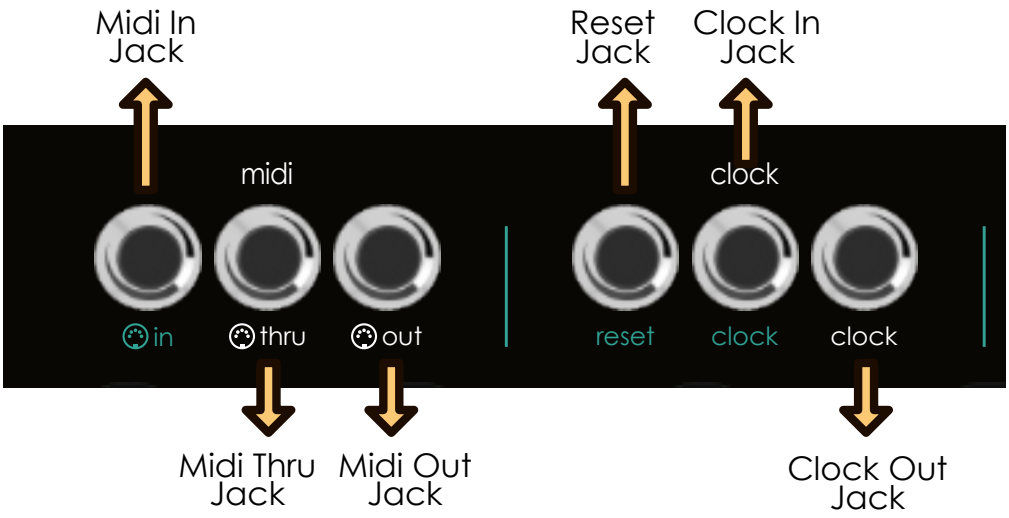
Holding the controller section's [EDIT BUTTON] and pressing any of the Touch Pads triggers the alternate function written under the Touch Pad in YELLOW or WHITE. Each of these functions will be described in detail below.



4 Voltage Lab 2 Touch Controller

Global I/O Jacks

Input Jacks are labeled with GREEN text and output jacks are labeled with WHITE text.



Inputs

MIDI In - A TRS Type A Midi Input that can be used for Midi Clock, Midi Start commands, and Midi Stop Commands.

Reset In - An analog input that will reset both channel's sequencers to step 1 when receiving a trigger or gate.

Clock In - An analog clock input for syncing the sequencers to an external clock.

Outputs

MIDI Thru - A TRS Type A Midi Output that parrots data from the MIDI In Jack.

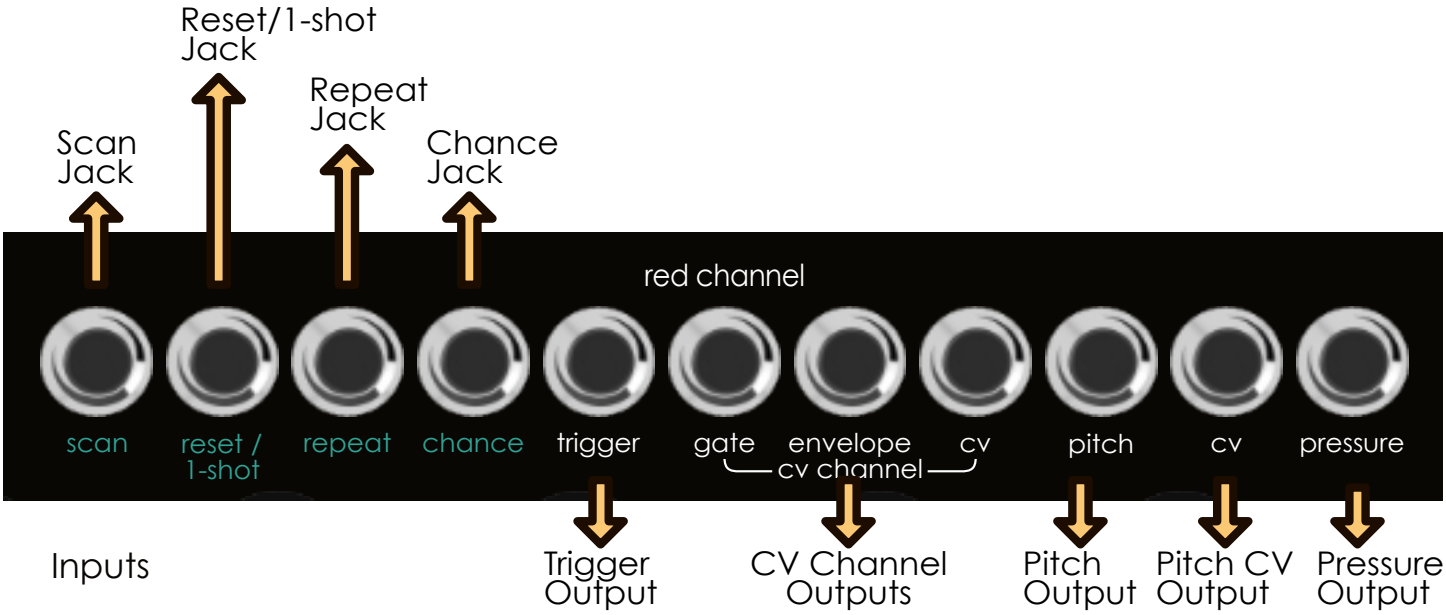
MIDI Out - A TRS Type A Midi Output that sends MIDI data from the touch controller for controlling other gear, or the VL2 Sound Module.

Clock Out - An analog clock output for syncing external hardware, or the VL2 Sound Module.

4 Voltage Lab 2 Touch Controller

Yellow and Red I/O Jacks

The Yellow and Red channel have the exact same I/O layout, but their behaviors are independent to each other.
The only exception to this is the CV Channel outputs, which share the blue CV Channel Knobs between both channels.



Scan Jack - A 0-5 Volt input that will "scan" through the available steps of the channel based on the CV.

Reset/1-Shot Jack - Resets the sequence to its first step; if 1-shot is on, will start a 1-shot(a single play through the sequence).

Repeat Jack - While high, hangs the sequence on the current active step, re-triggering the step. Once low, the sequence will continue on the step that "should" be active.

Chance Jack - A 5 volt-normaled CV Input to the Chance Knobs, giving CV control of the chance engine.

Outputs

Trigger Output - A 5v, 10 ms trigger output that sends whenever a note is triggered.

CV Channel

CV Channel Gate - A 5 volt gate output with gate length set by the CV Channel Knobs while sequencer mode is on, or held high while holding a Touch Pad while sequencer mode is off.

CV Channel Envelope - A percussive decay envelope with decay time set by the blue CV Channel Knobs.

CV Channel CV - A 0-5 volt CV output with level set by the blue CV Channel Knobs.

Pitch Output - An analog volt per octave quantized output with selectable scales and keys.

Pitch CV Output - A 0-5 volt unquantized output controlled by the Pitch Knobs.

Pressure Output - A 0-5 volt CV output set either by the pressure used when playing the pads, or set per step while sequencer mode is on.

4 Voltage Lab 2 Touch Controller

Getting Started

There are a few calibrations to be aware of when starting to use your touch controller.

Touch Pad Calibration

The response of capacitive touch surfaces is very sensitive to external conditions like humidity and temperature. To account for this, and to enable tuning of the pressure range that best fits your play style, we have included a calibration mode.

Press and hold [SEQUENCER BUTTON] + [RUN/STOP BUTTON] + [RED BUTTON] + [YELLOW BUTTON] to enter calibration mode, making sure to not touch the pads while doing this. The LEDs will blink twice to show calibration mode is active. Use the [VALUE KNOB] to set the sensitivity. Turning the [VALUE KNOB] full left is most sensitive. Turning the [VALUE KNOB] full right is least sensitive. The Touch Pad LEDs will show the active triggered steps. While pressing 3 or 4 pads at once and sliding up and down the keyboard to test, adjust the [VALUE KNOB] until the Touch Pad LEDs only show the steps you are touching, and you are happy with the responsiveness you're getting.

Knob Calibration

To account for the inherent 20% tolerance of potentiometers, the Touch Controller self-calibrates the ranges of its knobs over time to make sure they all have predictable and consistent behavior.

On first startup, and after a factory reset, it is recommended to turn all the knobs to their bottom, then play every step. Next, turn all the knobs to the top of their range and play every step. This will enable the computer to save all the calibrations.

If you don't, no worries! The CPU will learn all the calibration settings quickly in normal use.

Factory Resetting the Touch Controller

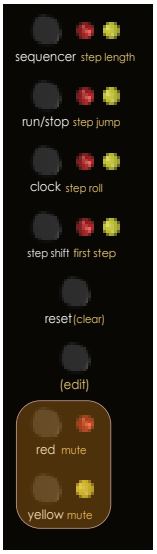
To perform a full factory reset of the touch controller, hold all 8 of the buttons along the left-most edge of the controller down for 5 seconds. The interface will flash at you, and when it does power cycle the unit to finish the reset.

After a factory reset, it is recommended to re-calibrate the knobs and touch pads on your touch controller.

4 Voltage Lab 2 Touch Controller

The Basics

Channel Selection



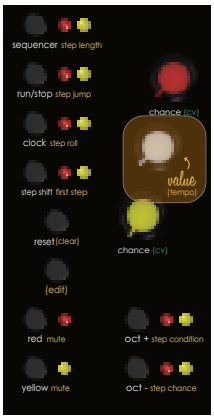
Each channel can be set up and controlled independently, and you choose which channel is being actively controlled with the [RED BUTTON] and [YELLOW BUTTON] found in the bottom left of the controller section. The LED next to each button indicates the active channel: red, yellow, or both. Hold one button and press the other to control both at the same time; even if they are in totally different states. One as a keyboard and one as a sequencer for example, or as two sequencers where one is running and the other is stopped.

It might be helpful to think of the red and yellow buttons as enabling controls to "pass-through" to each channel, no matter what state they're in.

With control of both channels active, touching a single touch pad might play a keyboard note for both channels, or enable steps in both sequences. It might turn one step on and another off, or play a note for one channel working as a keyboard, and disable a step on the other in sequencer mode. And it isn't just the touch pads; the same "pass-through" behavior is true for turning knobs, or pressing buttons.

It's important to pay close attention to which channels are actively selected.

The Value Knob

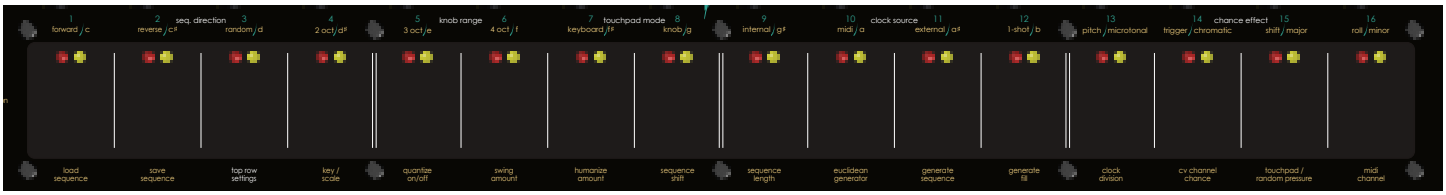


The Touch Controller interface is knob per function, every function is written on the panel with the exception of the white [VALUE KNOB]. The white [VALUE KNOB] is used to assign values to selected parameters.

Each of the buttons cover two functions. The function written below the button in WHITE is the main function that happens when the button is pressed. Holding the controller section's [EDIT BUTTON] (center left) and pressing any button triggers the alternate function written next to the button in YELLOW.

When the sequencer is disabled, the [VALUE KNOB] acts as an octave shift of up to 7 octaves for the active channel (Red, Yellow, or Both).

The Touch Pads



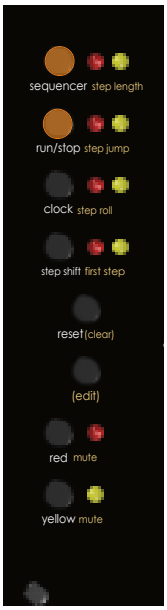
The [TOUCH PADS] are a set of16 pressure sensitive "buttons". They are used to turn on and off steps in knob mode, as a play surface in keyboard mode, or for editing settings. The [TOUCH PAD LEDS] are used to communicate information in the sub screens of the Touch Controller. The [TOUCH PADS] are important!

Holding the controller section's [EDIT BUTTON] and pressing any of the Touch Pads triggers the alternate function written under the Touch Pad in YELLOW or WHITE.

4 Voltage Lab 2 Touch Controller

The Basics

Sequencer Mode



Each channel of the Touch Controller can be used either as a sequencer or an expressive touch surface. To use a channel as a sequence, turn on sequencer mode by pressing the [SEQUENCER BUTTON]. The LEDs next to the [SEQUENCER BUTTON] tell you whether a Channel is in Sequencer Mode or not.

The behavior of sequencer mode is very different whether you are using Knob Mode or Keyboard Mode, which is a Top Row Setting.

In Knob Mode, use the [TOUCH PADS] to turn on or off steps in the sequence, and use the [PITCH KNOBS] to set the pitch of each step. Press the [RUN/STOP BUTTON] to start(or stop) the sequence running, and the sequencer will step through each step in order.

In Keyboard Mode, the touch pads will behave like a piano keybed, with a selectable key and scale. While the sequencer is running, you can play in a sequence and the touch Controller will save what you played. If you play something you don't like, you can always clear the bad step with the [CLEAR BUTTON].

Sequencer Mode Off

With sequencer mode off, you can play a channel as an expressive keybed using the [TOUCH PADS]. If in Keyboard Mode, the touch pads will order all the notes left-to right in ascending pitch, like a piano. If in Knob Mode, the pitch output for each touch pad will be controlled by the [PITCH KNOBS], letting you create your own custom scales.

Channel Independence

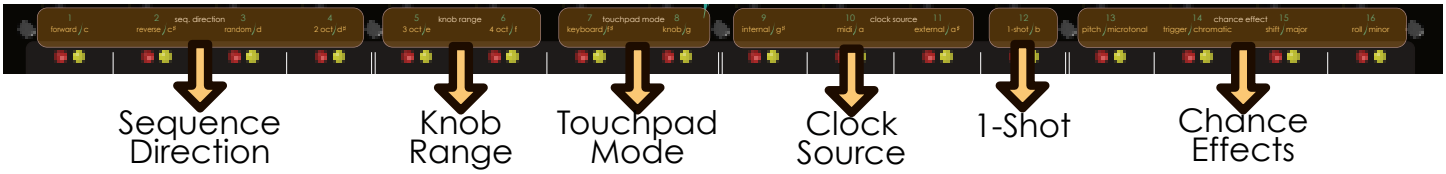
Each channel can have different settings for whether they're being used as a sequencer or as a keybed, and they can also disagree on whether they're in Keyboard Mode or Knob Mode.

Be intentional about which channel you're controlling.

4 Voltage Lab 2 Touch Controller

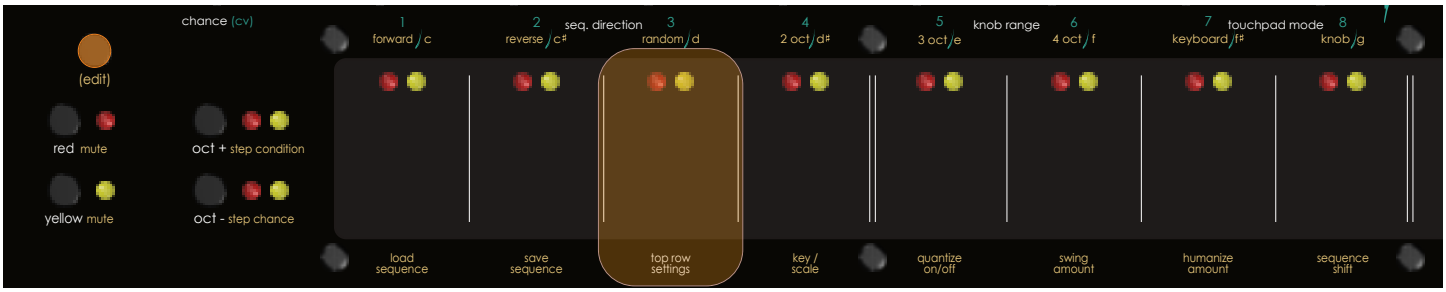
Accessing the Top Row Settings

Written above the Touch Pads are a collection of "Top Row Settings".



To access the Top Row Settings menu, press [EDIT BUTTON] + [TOUCHPAD 3] to enter Top Row Settings Mode. While continuing to hold the [EDIT BUTTON], pressing a corresponding touch pad will change the associated top row setting. Multiple top row settings can be changed at once, and the mode will remain active as long as the [EDIT BUTTON] is held down.

Aside from the clock source, the top row settings are separate between the Yellow and Red Channels. Pay attention to which channel you're controlling when editing these settings.



The settings you can edit from the top row are written in white. They are : seq. direction, knob range, touchpad mode, clock source, and chance effects.

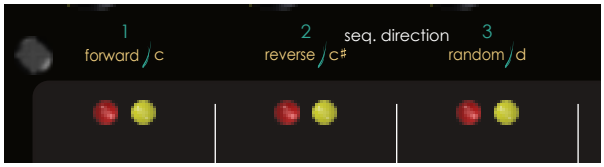
The WHITE text above the [TOUCH PADS] indicates the setting, and the YELLOW text below that indicates each possible option.

Multiple top row settings can be changed at once, and the mode will remain active as long as the [EDIT BUTTON] is held down.

4 Voltage Lab 2 Touch Controller

Top Row Settings

Sequence Direction



While in the top row settings menu, press [TOUCH PAD 1-3] to select the Sequence Direction for the active channel: Red, Yellow, or both.

Sequence direction determines the direction the sequencer runs, forward, reverse, or random.

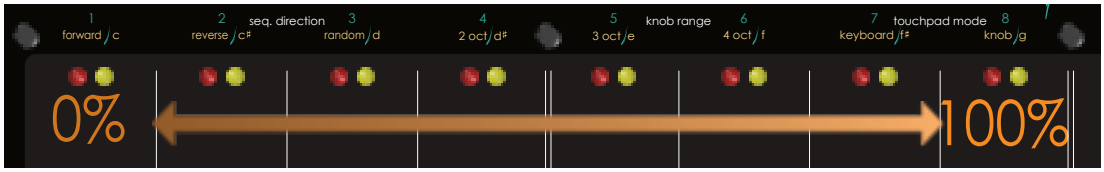
While in Forward sequence direction, the sequence will proceed left to right.
While in Reverse sequence direction, the sequence will proceed right to left.
While in Random sequence direction, the sequence will select steps based on an underlying randomness engine.
Random sequence direction has more to it than you might think.

DIRECTIONS
[TOUCH PAD 1] = Forward
[TOUCH PAD 2] = Reverse
[TOUCH PAD 3] = Random

Random Sequence Direction

When entering Random Sequence Direction, you might have noticed that the LEDs for [TOUCH PADS 1-8] lit up. This is because the random sequence direction is secretly one of a host of random generation tools available in the Touch Controller.

Random Sequence Direction is a Turing machine-style evolutionary randomness engine that keeps track of the order of all the steps in your sequence and morphs that order over time based on the morph chance. When you select Random Sequence Order, the LEDs display the percent chance that your sequence will morph when moving to the next step. If you're at 100%, then your sequence order is completely random.



If you touch the Data Knob after turning on Random Sequence Order, you can change this morphing chance. And you can set it all the way to zero if you want to lock in your sequence.

If you press [TOUCH PAD 3] again while this morph chance is displayed, you can reorder all of your steps left to right.

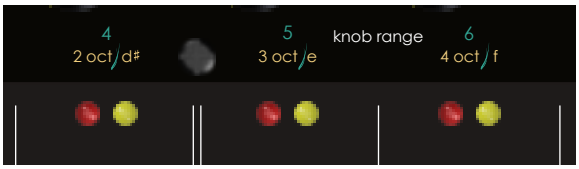
Some musicians might like to set the morph chance somewhere low, and run the sequence for a while, waiting to hear something they like. Then they can jump in and set the morph chance to zero and lock in their evolutionarily generated sequence.

Other musicians might enjoy to just ignore this altogether. If that's you don't worry! If you don't change the morph chance, Random Sequence Order will do what you think it does; play your steps in a completely random order.

4 Voltage Lab 2 Touch Controller

Top Row Settings

Knob Range

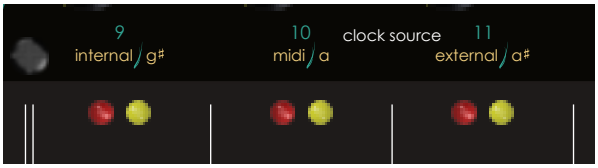


While in the top row settings menu, press [TOUCH PAD 4-6] to select the Knob Range for the active channel: Red, yellow, or both.

Knob range determines the number of available octaves that can be sequenced using the RED and YELLOW [PITCH KNOBS]

KNOB RANGES
[TOUCH PAD 4] = 2 octaves
[TOUCH PAD 5] = 3 octaves
[TOUCH PAD 6] = 4 octaves

Clock Source

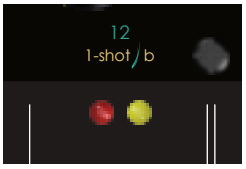


Press [TOUCH PAD 9-11] to select the Clock Source for the active channel: Red, yellow, or both.

Clock source sets the clock used to trigger the sequencer.

CLOCK SOURCE
[TOUCH PAD 9] = Internal Clock
[TOUCH PAD 10] = External MIDI Clock
[TOUCH PAD 11] = External Gate Clock

1-Shot



Press [TOUCH PAD 12] to enable or disable the 1-Shot for the active channel: Red, yellow, or both.

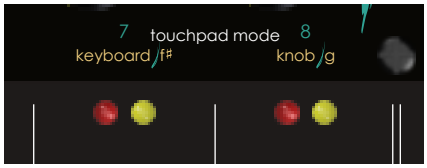
With the 1-Shot top row setting active, a channel will cycle through it's sequence once when a gate is sent to the red or yellow channel's [RESET / 1-SHOT JACK].

1-SHOT
[TOUCH PAD 12] = 1-Shot On/Off

4 Voltage Lab 2 Touch Controller

Top Row Settings

Keyboard Mode and Knob Mode



Press [TOUCH PAD 7-8] to select the Touch Pad Mode for the active channel: Red, yellow, or both.

In keyboard mode, the [TOUCH PADS] can be played as an expressive touch surface. The pitches output by the [TOUCH PADS] will be quantized based on the key and scale selected in the [KEY / SCALE SETTINGS].

With the sequencer on and playing, the pitches will get recorded into the sequence, allowing a user to play in sequences.

Knob mode uses the knob positions to determine the pitch of the [TOUCH PADS]. The notes available to the knob are based on the selected Key / Scale. See [KEY / SCALE SETTINGS] for how to change these settings.

TOUCH PAD MODE
[TOUCH PAD 7] = Keyboard Mode
[TOUCH PAD 8] = Knob Mode

In Keyboard Mode, the [VALUE KNOB] acts as an additional octave shift of up to 7 octaves for the active channel: Red, Yellow, or both.

Chance Effects

Top row settings for [TOUCH PAD 13-16] turn on and off Chance Effects.

The Chance Effects are another of the generative sequencing tools available in the Touch Controller, and we'll dive deep on them later. For now, maybe turn on a few chance effects, get a sequence running and see what happens when you turn up the chance knob; the results might be exciting, or they might be horrible! But either way, they're hopefully fun.

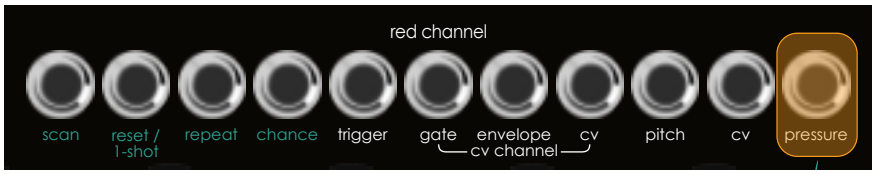
There are four chance effects: Pitch Chance, Trigger Chance, Shift Chance, and Roll Chance.
We'll cover these later in a few levels of detail.

CHANCE EFFECTS
[TOUCH PAD 13] = Pitch chance active
[TOUCH PAD 14] = Trigger chance active
[TOUCH PAD 15] = Shift chance active
[TOUCH PAD 16] = Roll chance active

4 Voltage Lab 2 Touch Controller

Playing Expressively with Pressure

The Pressure Outputs

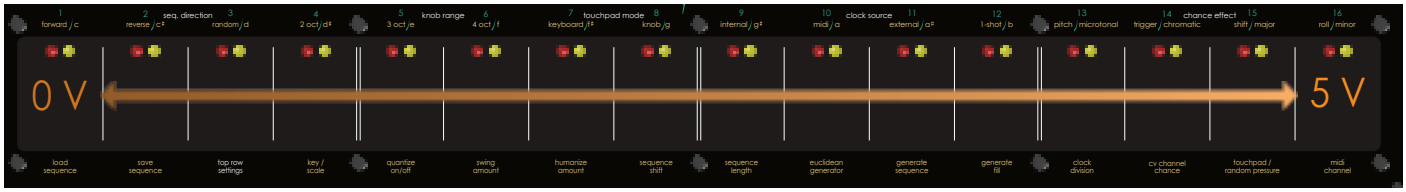


There are two [PRESSURE OUTPUTS] on the Touch Control, one per Channel. These pressure outputs are a 0-5 Volt CV modulation source that can be used to add expression to complex patches.

Their behavior is dependent on the settings of the sequencer channel. They can be: a live reading of touch pressure when playing the keybed, a stored per step value when using sequencer mode, or they can be controlled by a complex slewed modulation generation engine when in random pressure mode.

Patch pressure to your dynamics engine cutoff to modulate timbral depth and volume. Or Patch Pressure to your oscillators' timbre inputs to sculpt harmonic complexity. Or any other CV Input! Pressure is a great way to add complexity and depth to a patch, and make it shine.

Pressure While Sequencing in Knob Mode



While sequencer mode is active, Pressure is set and saved per step; each step is given a different static pressure value.

In knob mode, this value is set when turning on a step. If the musician holds down a [TOUCH PAD] and turns the [VALUE KNOB], a pressure will be assigned to the the step; that pressure will range from 0-5 Volts. To see the pressure being assigned, look at the [TOUCH PAD LEDS]; they will display the assigned pressure level.

Pressure While Sequencing in Keyboard Mode

While Sequencer Mode and Keyboard Mode are both on, the sequencer will save the pressure you play with while recording your sequence. The behavior and responsiveness of this recording have a lot to do with how you calibrated your pads. If you want a more expressive, sensitive interface, turn down your [TOUCH PAD] sensitivity.

Pressure While the Sequencer is Off

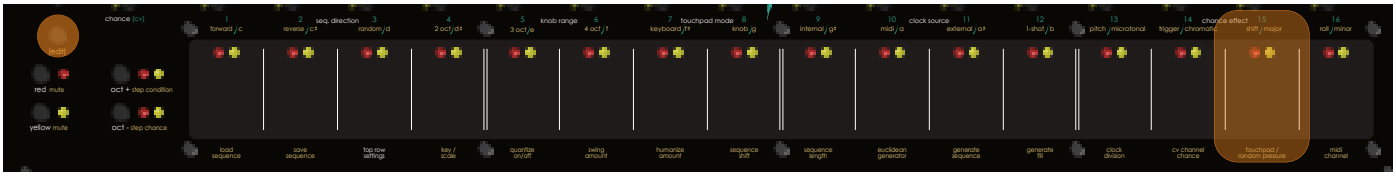
While Sequencer Mode is off, the pressure outputs will be dynamic, expressive, pressure sensitive outputs. The more of your finger is touching the [TOUCH PAD], the higher the voltage from the Pressure output. If you want a more expressive, sensitive interface, turn down your [TOUCH PAD] sensitivity.

I've been loving patching up complex expressive pads with pressure adding depth or tension or rhythm.

4 Voltage Lab 2 Touch Controller

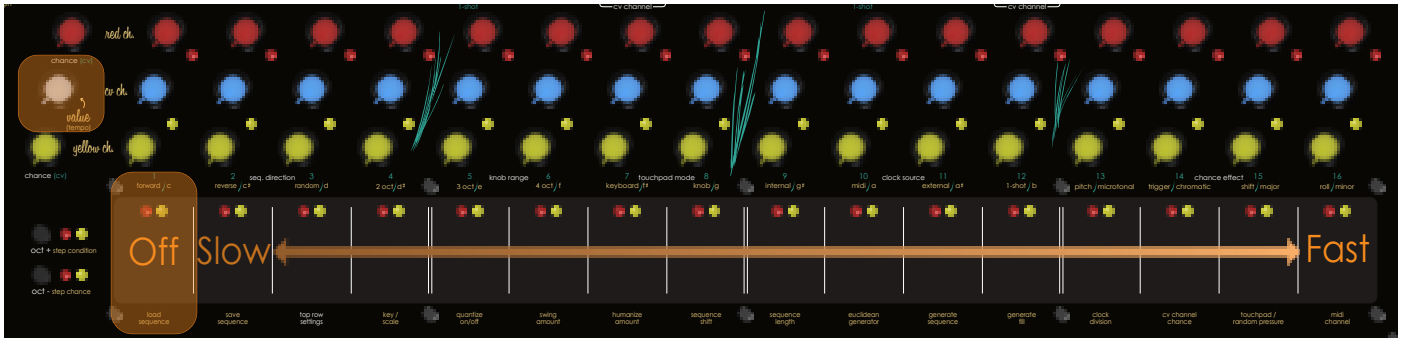
Playing Expressively with Pressure

Turning on Random Pressure



The Touch Controller has a generative pressure algorithm that can be used to control the pressure outputs if desired. To turn on Random Pressure, hold the [EDIT BUTTON] and press [TOUCH PAD 15] to show the Random Pressure Screen.

Random Pressure Speed



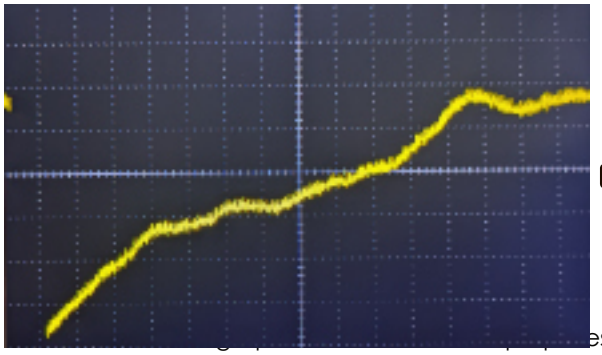
While the Random Pressure Screen is visible, use the [VALUE KNOB] or the [TOUCH PADS] to change the Speed Value.

Any time the Speed Value is anything but 0, Random Pressure is active. To turn off random pressure, set the Speed Value to 0 by pressing [TOUCH PAD 1] or turning the [VALUE KNOB] all the way down while in the Random Pressure Screen.

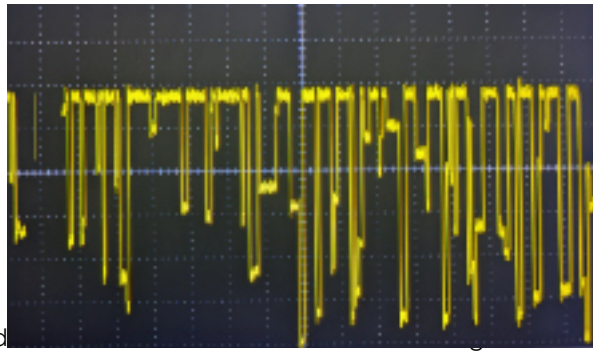
What is Random Pressure?

Random Pressure is a slew-y, hunting, sort of random unclocked LFO type of randomness engine. It randomly increments the rate of change of the pressure value based on the Speed Value selected. It can range anywhere from a really slow sort of gradual expression shift to a totally random audio rate noise output with a lovely, harsh, character.

Slow Random Pressure



Fast Random Pressure

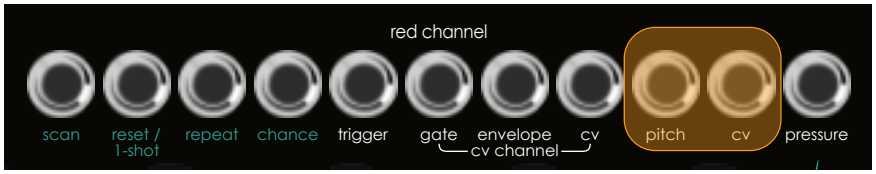


es only; they are at d

4 Voltage Lab 2 Touch Controller

Key and Scale

The Pitch Outputs

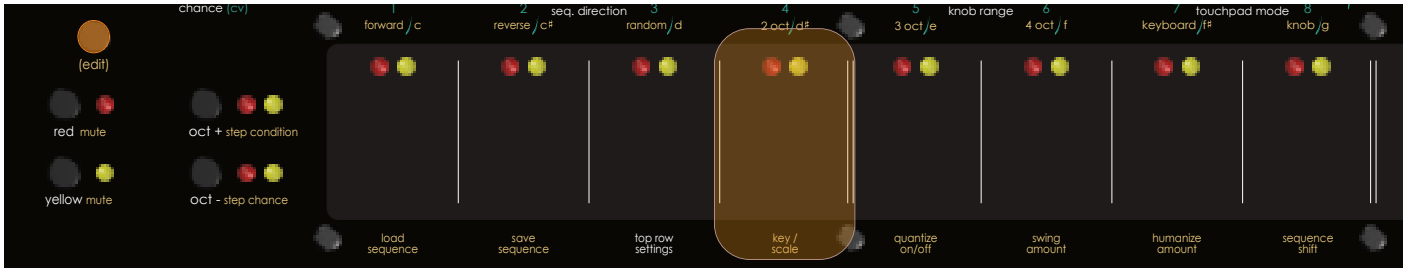


Each channel of the touch controller has two ways of outputting pitch: the [PITCH OUTPUT] and the [PITCH CV OUTPUT].

The [PITCH CV OUTPUT] is an unquantized 0-5 Volt output that is set using the [PITCH KNOBS]. This jack is hard-wired into the [PITCH KNOBS] and which knob is used is always determined by the active step. In Sequencer Mode, this is the last played step. With the sequencer off, the active step is always the last triggered note.

The [PITCH OUTPUT] is a quantized volt per octave output, with a nine octave range. Key and Scale are quantization settings that determine which notes this output will allow a user to play.

Selecting a Key and Scale



To select a Key and Scale, hold the [EDIT BUTTON] and press [TOUCH PAD 4] to enter the Key and Scale Menu.

In the Key and Scale Menu, [TOUCH PAD LEDS 1-12] are used to display the Key and [TOUCH PAD LEDS 13-16] are used to display the Scale.

Select a Key using [TOUCH PAD 1-12]. The Key is a transposing setting; it sets the root note of your key, and will shift all the quantized notes up or down so that their root uses the selected key. There are twelve available Keys from C to B.

Select a Scale using [TOUCH PAD 13-16]. The Scale determines which partials, or notes, in the key will be available to the musician. There are four available Scales: Micro-Tonal, Chromatic, Major, and Minor.

Note that the Yellow and Red Channels can have different keys to each other; wild harmonic possibilities abound!

4 Voltage Lab 2 Touch Controller

Key and Scale

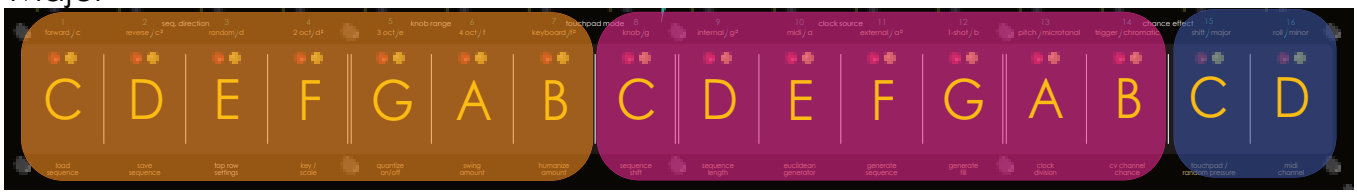
Chromatic, Major, and Minor Scales

Chromatic, Major and Minor Scales work how you'd expect! They give access to the notes that live inside their respective Scales. Here are the Notes assigned to the touch pads in Keyboard mode for all scales in the key of C:

Chromatic

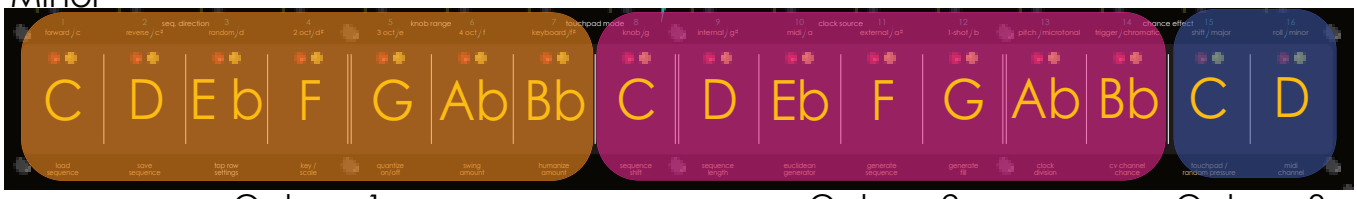
Octave 1 Octave 2

Major



Octave 1 Octave 2 Octave 3

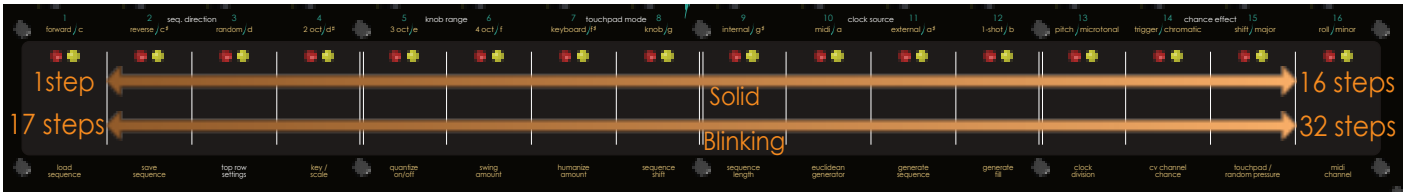
Minor



Octave 1 Octave 2 Octave 3

Microtonal Scales

The Microtonal Scale system for the Touch Controller is an equal temperament system. It divides the Octave into equal steps, or a number of notes per octave. After selecting Microtonal in the Key and Scale Screen, one of the [TOUCH PAD LEDS] will light up. This light communicates the number of divisions used for the key. If the light is solid, that is 1 through 16 notes per octave. If the light is blinking, that is 17-32 notes per octave. Use the [VALUE KNOB] while in the key/scale menu to change the number of microtonal divisions.



While playing in Keyboard Mode while using a Microtonal Scale, the notes will line up from left to right on the [TOUCH PADS] and you have access to the first 16 notes of the octave in Keyboard Mode. To access the next 16 notes, change the Keyboard Octave.

4 Voltage Lab 2 Touch Controller

Key and Scale

Knob Mode Key/Scale

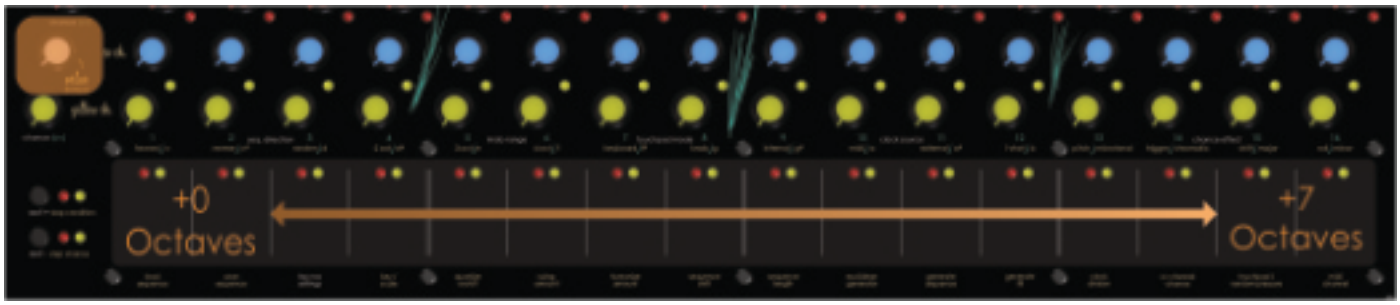
In knob mode, the pitch outputs will be a quantized reading from the [PITCH KNOBS]. To change the number of octaves available in a turn of the knob, change the Knob Range in the Top Row Settings.

The top and bottom of the knob will always be the root note of the Key selected.

Output Octave

The Output Octave is selected using the [OCT+ BUTTON] and the [OCT- BUTTON]. Output Octave is an octave offset transposition applied to the [PITCH OUTPUT] of the chosen channel. It is transposing and applies as a global setting, which means it will change the notes you have saved in your sequence in Keyboard Mode.

Keyboard Octave



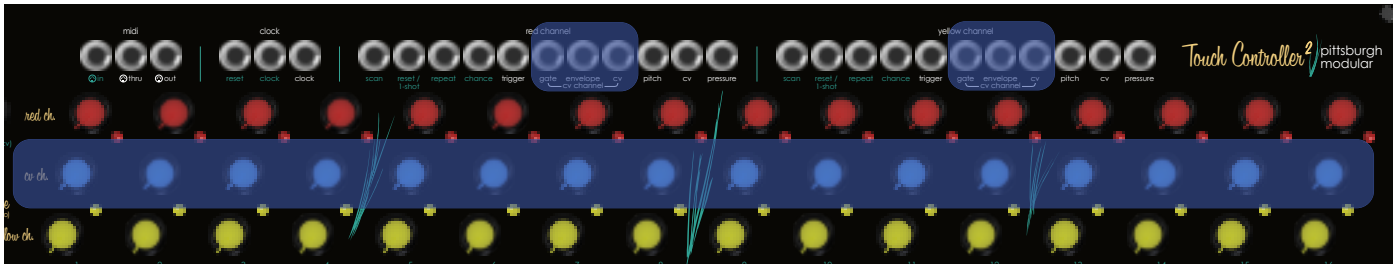
To give the user access to more octaves in keyboard mode without transposing any saved sequences, there is a Keyboard Octave offset. While in Keyboard Mode and not in any other menus, the [VALUE KNOB] can set the the Keyboard octave from 0 to 7 octaves.

It's helpful to think of this as shifting the [TOUCH PADS] to the right on a Piano

4 Voltage Lab 2 Touch Controller

Understanding the CV Channel

CV Channel Overview



The CV Channel is a tool for generating control voltages that can be easily and quickly set per step. The CV Channel can generate: gates of variable length ([CV CHANNEL GATE OUTPUT]), decay envelopes with variable decay time ([CV CHANNEL ENVELOPE OUTPUT]), and unquantized control voltages ([CV CHANNEL CV OUTPUT]).

The CV Channel has separate outputs per sequencer channel, and uses the [CV CHANNEL KNOBS] to control the step settings of those outputs.

Sharing Knobs

The Yellow and Red Sequencer Channels share the [CV CHANNEL KNOBS], which means there can only be one CV Channel Value per step number; step 1 of the Red Channel and step 1 of the Yellow Channel will have the Same CV Channel value. However, since the Red Channel and Yellow Channel can be on different steps, they can be looking at different [CV CHANNEL KNOBS] at any given moment; the Yellow and Red [CV CHANNEL OUTPUTS] behave independently, but share knobs.

Gate Outputs

The [CV CHANNEL GATE OUTPUTS] generate a 5 volt gate signal, that is high for a variable amount of time. In Sequencer Mode, the length of the gate will be set by the [CV CHANNEL KNOB] (from 10 ms to the clock step length) and the gate will trigger whenever a step triggers. With the Sequencer Off, the gate will trigger whenever a [TOUCH PAD] is pressed, and will stay high as long as any of the touch pads remain active.

Envelope Outputs

The [CV CHANNEL ENVELOPE OUTPUTS] generate a 5 volt percussive decay envelope, with decay time controlled by the [CV CHANNEL KNOB] of the step triggered, whether the sequencer is on or off.

CV Outputs

The [CV CHANNEL CV OUTPUTS] are a 0-5 volt static value set by the [CV CHANNEL KNOB] of the step triggered, whether the sequencer is on or off.

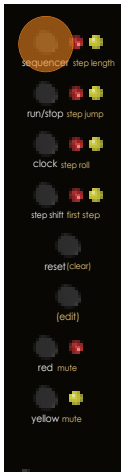
CV Channel Chance

CV Channel Chance applies randomization to the [CV Channel Knobs] when they are read by the channel. To set the CV Channel Chance, hold the [EDIT BUTTON] and press [TOUCH PAD 14] to enter the CV Channel Chance Menu then use the [VALUE KNOB] to set the CV Channel Chance for the active channel.

4 Voltage Lab 2 Touch Controller

Going Deep With the VL2 Sequencer

How it Works



The Touch Controller's Sequencer is two 16-Step CV sequencer that generates a wide range of quantized and un-quantized CV sources. Both channels of the sequencer share Clock Settings, but don't share a whole lot else!

There are a wide range of tools for sculpting rhythm and pitch; including per step settings, CV rhythm glitching tools, randomness engines, and timing settings that effect the whole sequence.

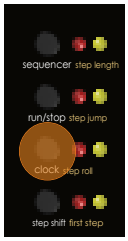
The beauty of the Touch Controller's Sequencer is in the wide world of interactions between all of its settings. Exploring and playing with the interactions is where it gets fun.

To enter sequencer mode, use the [SEQUENCER BUTTON] found at the top left of the touch controller.

Run/Stop

To start a sequence running, use the [RUN/STOP BUTTON]. You can start each of the two sequencers at different times and they don't ask to be on the same step; so if you want them lock stepped, make sure you're controlling both when you start them!

Setting the Tempo



In External Clock Mode and MIDI Clock Mode, the tempo is set by an external source: the [CLOCK IN JACK] or the [MIDI IN JACK] respectively.

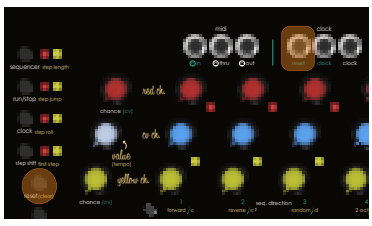
In Internal Clock Mode, the tempo is set using the [CLOCK BUTTON] located in the Controls Section. Tap the tempo in using this button to set your tempo.

Knob Mode vs Keyboard Mode

In Knob Mode, steps are sequenced by pressing the [TOUCH PADS], and the pitches are set by the [PITCH KNOBS].

In Keyboard Mode, steps are sequenced by playing live while the sequencer is running.

Global Resets



To reset both sequencers to their First Step, you can either press the [RESET BUTTON] or send a trigger or gate into the [GLOBAL RESET JACK]. The global resets don't lose time; your sequence will reset on the next clock pulse after you trigger a reset.

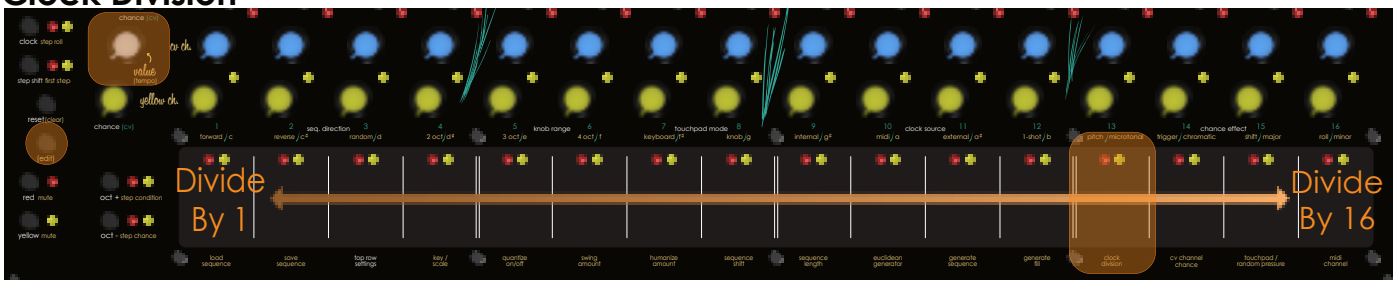
Channel Mutes

To Mute a channel, hold the [EDIT BUTTON] and press the Red or Yellow [CHANNEL BUTTON]. The [PITCH KNOB LEDS] for the muted channels will flash as long as the channel is muted.

4 Voltage Lab 2 Touch Controller

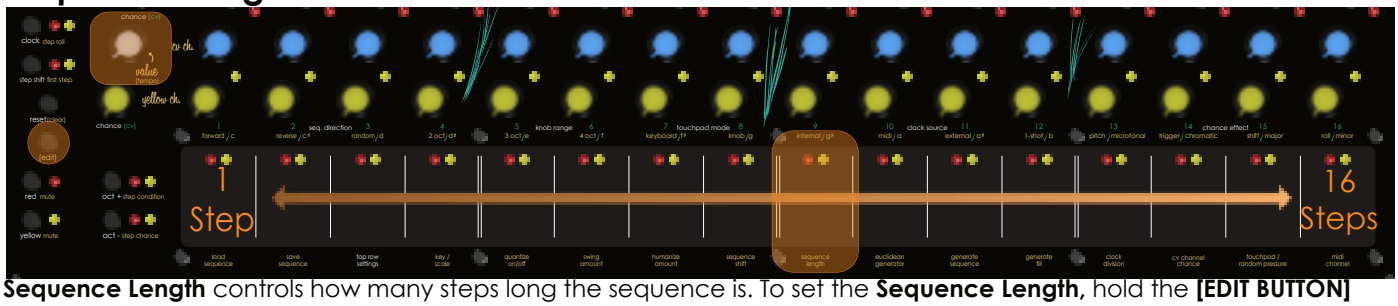
Sequencer Settings

Clock Division



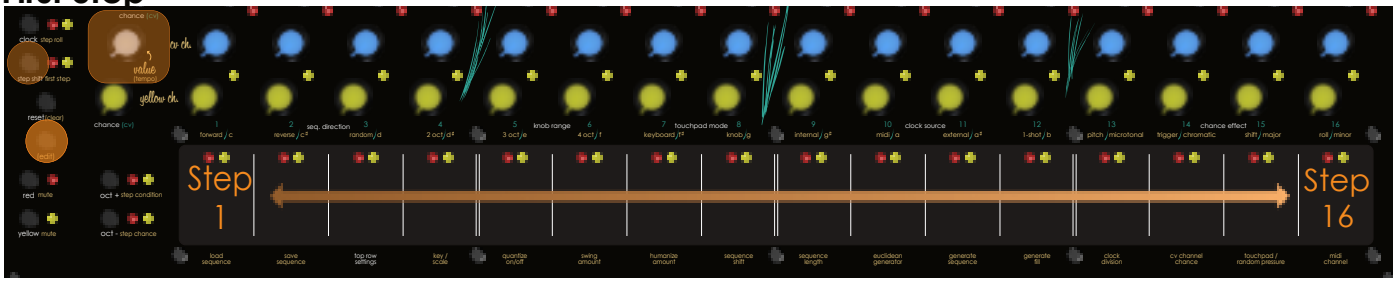
Clock Division controls how many clock pulses are equal to one step for the sequencer. To set the **Clock Division**, hold the **[EDIT BUTTON]** and press **[TOUCH PAD 13]** to enter the **Clock Division Menu**. Then use the **[VALUE KNOB]** or the **[TOUCH PADS]** to select a **Clock Division** from 1 to 16. The **Clock Division** of each sequencer is set separately

Sequence Length



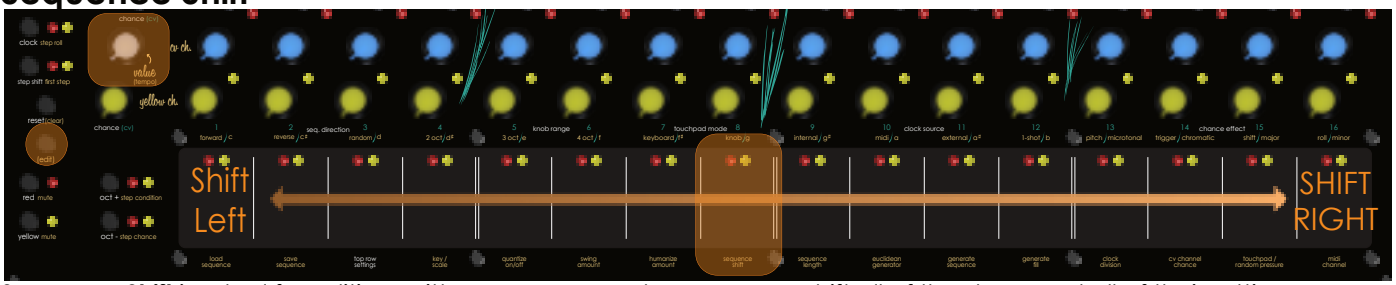
Sequence Length controls how many steps long the sequence is. To set the **Sequence Length**, hold the **[EDIT BUTTON]** and press **[TOUCH PAD 9]** to enter the **Sequence Length Menu**. Then use the **[VALUE KNOB]** or the **[TOUCH PADS]** to select a **Sequence Length** from 1 to 16. The **Sequence Length** of each sequencer is set separately.

First Step



First Step controls which step a sequence will start on when played, or reset. To set the **First Step**, hold the **[EDIT BUTTON]** and press the **[STEP SHIFT BUTTON]** to enter the **First Step Menu**. Then use the **[VALUE KNOB]** or the **[TOUCH PADS]** to select a **First Step** from 1 to 16. The **First Step** of each sequencer is set separately.

Sequence Shift



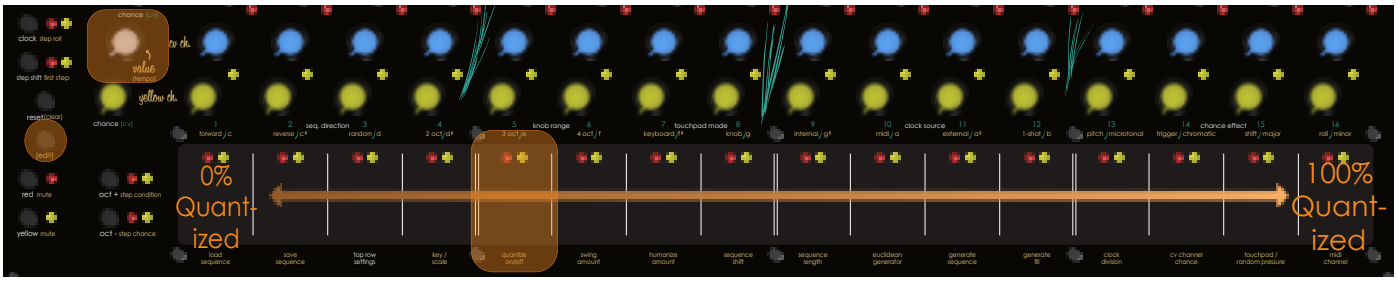
Sequence Shift is a tool for editing written sequences, where you can shift all of the steps, and all of their settings, around left to right. To use **Sequence Shift**, hold the **[EDIT BUTTON]** and press **[TOUCH PAD 8].** While holding the **[EDIT BUTTON]**, use the **[VALUE KNOB]** to shift your sequence, and the **[TOUCH PAD LEDS]** will show you your shifted sequence.

4 Voltage Lab 2 Touch Controller

Timing Effects

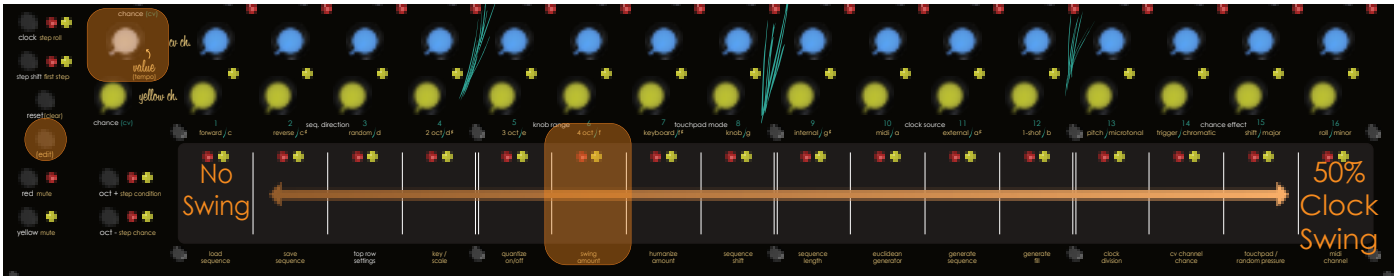
Timing Effects are settings that are assigned per channel, and used to adjust how the step are placed in time by the sequencer. There are three **Timing Effects: Quantize**, **Swing**, and **Humanize**.

Quantize



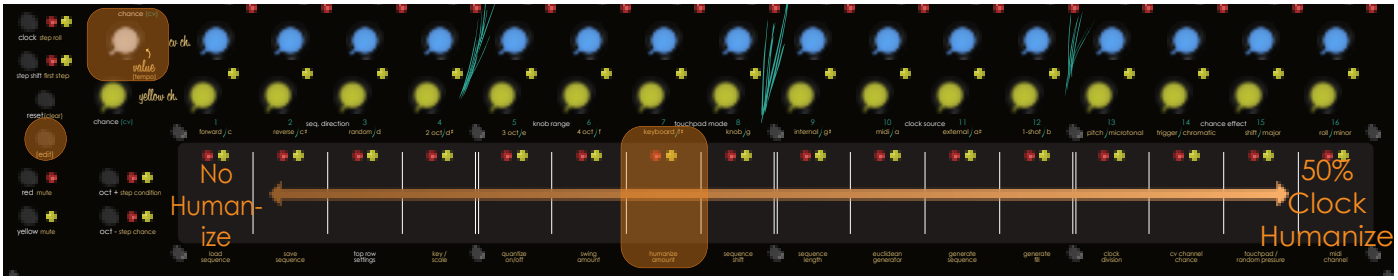
Timing Quantization reduces any **Step Shift** assigned to the steps of a sequence by a percentage amount, 0 to 100%. To set the **Timing Quantization,** hold the **[EDIT BUTTON]** and press **[TOUCH PAD 5]** to enter the **Quantize Menu**. Then use the **[VALUE KNOB]** or the **[TOUCH PADS]** to select a **Timing Quantization** from 0% to 100%.

Swing



Swing shifts the timing of every even-numbered step later in time. To set the **Swing,** hold the **[EDIT BUTTON]** and press **[TOUCH PAD 6]** to enter the **Quantize Menu**. Then use the **[VALUE KNOB]** or the **[TOUCH PADS]** to select a **Timing Quantization** from 0% to 100%.

Humanize



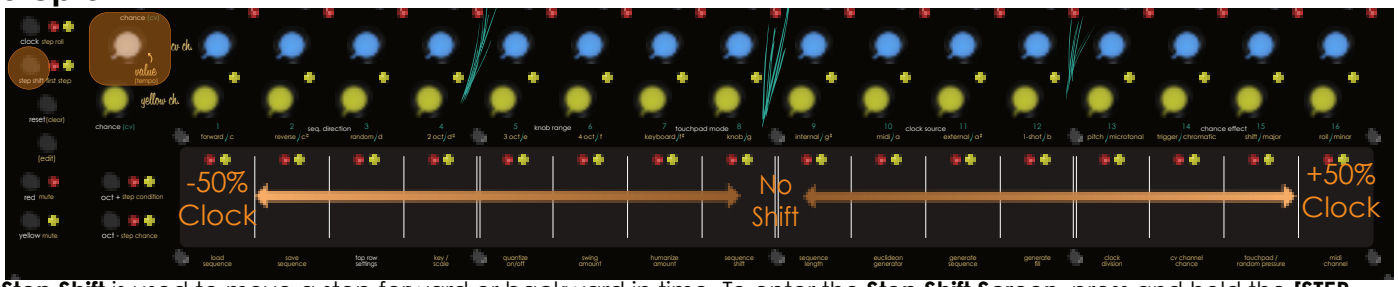
Humanize Timing adds random timing shifts to every step in a sequence. To set the **Humanize Timing,** hold the **[EDIT BUTTON]** and press **[TOUCH PAD 7]** to enter the **Humanize Timing Menu**. Then use the **[VALUE KNOB]** or the **[TOUCH PADS]** to select a **Humanize Timing Amount** from not humanize, up to − Clock of Humanization in either direction.

4 Voltage Lab 2 Touch Controller

Everything a Step Can Be

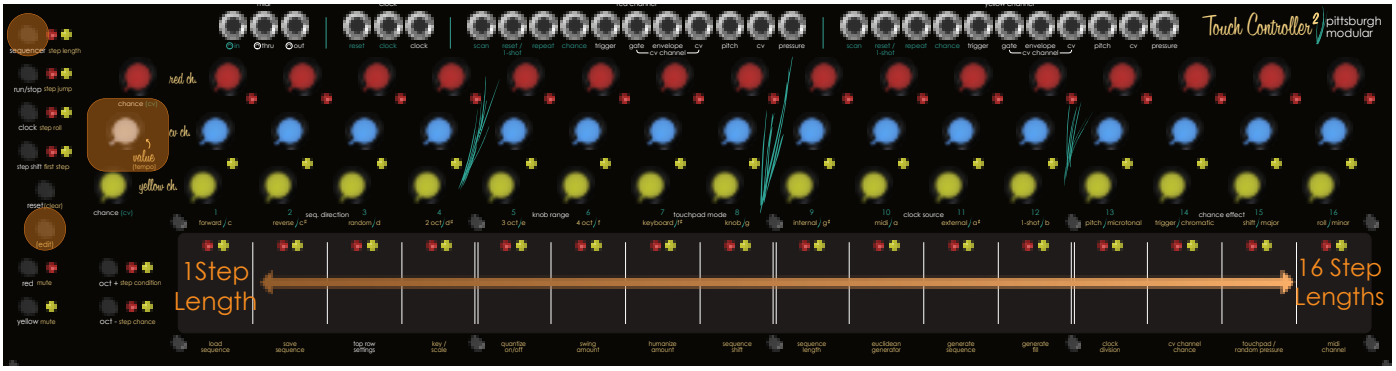
There are many tools that can be used to change the behavior of each individual step in a sequence. All of the **Step Effects** that can be applied are: **Step Shift, Step Length, Step Jump, Step Roll, Step Condition, and Step Chance**

Step Shift



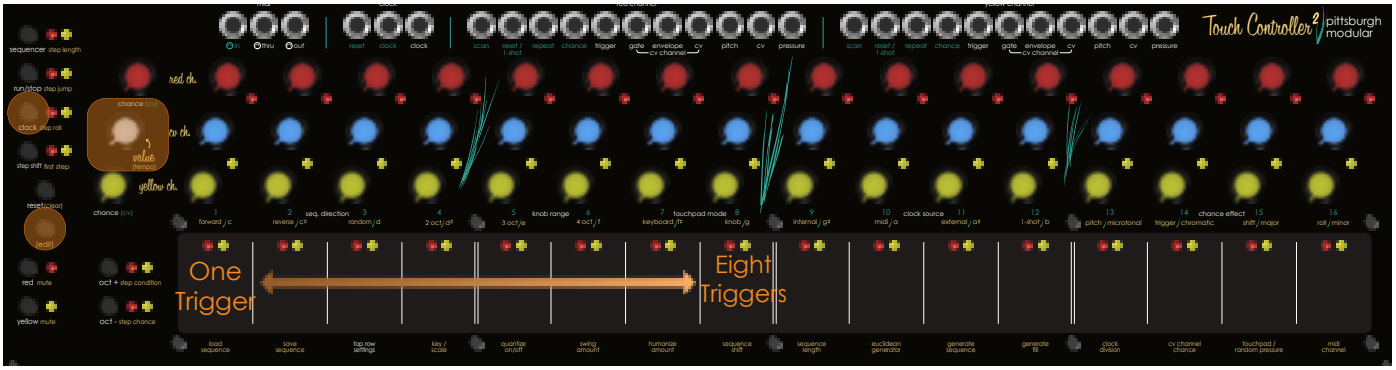
Step Shift is used to move a step forward or backward in time. To enter the **Step Shift Screen,** press and hold the **[STEP SHIFT BUTTON].** While in the **Step Shift Screen,** select the steps to add shift to using the **[TOUCH PADS]**, then turn the **[VALUE KNOB]** to assign a **Step Shift** to all the selected steps.

Step Length



Step Length is used to increase the length of a step by a number of clocks. The **Step Length** value is how many "Step Lengths" long the selected step is. To enter the **Step Length Screen,** press and hold the **[EDIT BUTTON],** then press the **[SEQUENCER BUTTON]** to enter the **Step Length Screen.** While in the **Step Length Screen,** select the steps to add Length to using the **[TOUCH PADS]**, then turn the **[VALUE KNOB]** to assign a **Step Length** to all the selected steps.

Step Roll



Step Rolls are a ratcheting effect, where a step will trigger more than once. The **Step Roll** value is how many times a step will trigger. Step rolls occur evenly spaced over the **Step Length.** To enter the **Step Roll Screen,** press and hold the **[EDIT BUTTON]**, then press the **[CLOCK BUTTON]** to enter the **Step Roll Screen.** While in the **Step Roll Screen,** select the steps to add Rolls to using the **[TOUCH PADS]**, then turn the **[VALUE KNOB]** to assign a **Step Roll** to all the selected steps.

4 Voltage Lab 2 Touch Controller

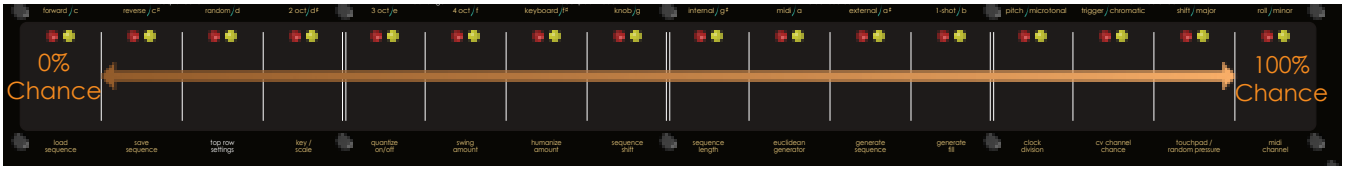
Everything a Step Can Be (Continued)

Step Condition

Step Condition skips playing steps based on the **Condition** applied to that step. To add **Step Conditions,** hold the **[EDIT BUTTON]** and press the **[OCT+ BUTTON]** to enter the **Step Condition Screen.** While in the **Step Condition Screen,** use the **[TOUCH PADS]** to select steps to apply conditions to, and use the **[VALUE KNOB]** to select the condition.

There are two types of **Step Conditions: Percentage Chance Conditions**, and **Repeat Counter Conditions**. When assigning **Step Conditions** with the **[VALUE KNOB],** the fist half of the knob assigns **Percentage Chance Conditions**, and the second half of the knob assigns **Repeat Counter Conditions.**

Percentage Chance Conditions



Percentage Chance Conditions operate on random number generation. The **Percentage Chance Condition** is the chance that an event will occur. **For Step Condition** this is the chance that the step will not play.

Repeat Counter Conditions

Repeat Counter Conditions will happen a number of times for every number of repeats. For example:

The **First** of every **Four Repeats;**

The Step will be skipped the first time of every four plays through the sequence.

The **Second** of every **Three Repeats;**

The Step will be skipped the second time of every three plays through the sequence.

The **Second, Third, and Fourth** of every **Four Repeats;**

The Step will be skipped the second, third and fourth time of every four plays through the sequence.

4 Voltage Lab 2 Touch Controller

Everything a Step Can Be (Continued)

Step Jump

Step Jumps cause the sequencer to jump from a step to different step in the sequence when triggered. They are a way of adding length and creating strange sequencing patterns to extend the Voltage lab past it's 16-step limitations.

To add a **Step Jump,** first hold the **[EDIT BUTTON]** and press the **[RUN/STOP BUTTON]** to enter the **Step Jump Screen.**
Next, press a **[TOUCH PAD]** to pick the step to jump from, then press a different **[TOUCH PAD]** to pick a step to jump to.
Finally, use the **[VALUE KNOB]** to assign a **Jump Condition.**

Jump Conditions work exactly like the **Percentage Chance Conditions** and the **Repeat Counter Conditions** explained above in the **Step Condition** section. They determine whether or not a Jump is performed, either as a percentage chance or based on how many repeats through the sequence have occurred.

Beware; it is possible to get yourself trapped in infinite jump loops from which one can never escape. Tread lightly. (You can always just turn off a bad recursive jump)

Step Pressure

Step Pressure controls the **[PRESSURE OUTPUTS]** when a step is triggered. To assign **Step Pressure,** use the **[VALUE KNOB]** while assigning steps in **Knob Mode** with the **Sequencer On**.

For all the other ways of assigning Step Pressure, look above at **"Playing Expressively with Pressure".**

4 Voltage Lab 2 Touch Controller

Chance Effects

What's a Chance Effect?

The **Chance Effects** are another of the generative sequencing tools available in the Touch Controller. They add randomization to Pitch, Rolls, Condition, and Shift for a step based on the state of the **[CHANCE KNOB]** when the step is triggered. While using one or both channels as a sequencer, chance effects can determine if a step will play as expected, or if it will randomly change.

Chance effects can control four different parameters; they can modify the Pitch of a step, mute a step with Trigger, Shift a step's timing, and add ratcheting with Roll.

Turning on Chance Effects

Which Chance effects are active can be set by holding **[EDIT BUTTON]** and pressing **[TOUCHPAD 3]** to enter top row settings, continuing to hold [EDIT BUTTON], then pressing touchpads 13, 14, 15, and 16 to toggle **Pitch**, **Trigger, Shift**, and **Roll**. Multiple can be active simultaneously.

[TOUCH PAD 13] = Pitch
[TOUCH PAD 14] = Trigger
[TOUCH PAD 15] = Shift
[TOUCH PAD 16] = Roll

Step Chance

Chance can be enabled or disabled on individual steps by holding **[EDIT BUTTON]** and pressing **[STEP CHANCE]**, continuing to hold **[EDIT BUTTON]**, and then pressing **[TOUCHPADS 1-16]** to enable or disable chance effects on that step.

The Chance Knobs and Inputs

The **Chance Effects** are controlled by a reading taken from the **[CHANCE KNOBS].** When nothing is patched into the **Yellow** or **Red [CHANCE INPUTS],** the chance value goes from 0% to 100%.

But there's a trick here! The **[CHANCE KNOBS]** are actually attenuators for the **[CHANCE INPUTS]** which are 0 - 5 volt CV inputs. This means you can patch CV into the **[CHANCE INPUTS]** and modulate the **Chance Amount** for some wildly fun behaviors!

On Musical Random

The **Chance Effects** operate on carefully sculpted chance ranges and behaviors that seek to give the feeling that more chance will make the results stranger, rather than more chance just meaning something happens more often; though it does often also mean that!

I've written out all of these chance scalings and behaviors later, but I don't recommend reading them; they're tremendously boring! However, be aware that chance is opinionated and will try to help you make listenable music.

4 Voltage Lab 2 Touch Controller

Pitch Chance

The pitch chance effect is responsive to the touch controller's assigned key and scale. Both the likelihood of a chance effect triggering, and how drastic of a change it will be are increased as you turn up the corresponding channel's [CHANCE KNOB], red or yellow.

The percent chance that a pitch change is triggered increases as the **[CHANCE KNOB]** is turned up, from 0-95%

As you turn up the **[CHANCE KNOB]**, the amount of pitch change is controlled in 3 "sectors", where the bottom sector is the bottom third of the knob(0-1.66 V), the middle sector is the middle third of the knob(1.66-3.33 V) and the top top sector is the upper third of the knob(3.33-5V). This can also be modulated with each channel's **[CHANCE CV IN JACK]**, in which case the **[CHANCE KNOB]** will act as an attenuator for the incoming signal.

As you move through the sectors, you gain access to different partials based on the assigned key and scale.

Pitch Chance Scalings

Chromatic:

- **Bottom Third of [CHANCE KNOB]:**
  - - 1 Oct 50% of the time
  - + 1 Oct 50% of the time
- **Middle Third of [CHANCE KNOB]:**
  - - 1 Oct 16% of the time
  - - 8 semitones(major third under) 17% of the time
  - - 5 semitones(perfect fifth under) 17% of the time
  - +4 semitones(major third over) 16% of the time
  - +7 semitones(perfect fifth over) 17% of the time
  - +1 Oct 17% of the time

Chromatic:

- **Upper Third of [CHANCE KNOB]:**
  - - 1 Oct 8% of the time
  - -9 semitone(minor third under) 9% of the time
  - - 8 semitones(major third under) 8% of the time
  - -7 semitones(perfect fourth under) 8% of the time
  - - 5 semitones(perfect fifth under) 7% of the time
  - -1 semitone(perfect seventh under) 8% of the time
  - +3 semitones(minor third over) 8% of the time
  - +4 semitones(major third over) 9% of the time
  - +5 semitones(perfect fourth over) 8% of the time
  - +7 semitones(perfect fifth over) 8% of the time
  - +11 semitone(perfect seventh over)9% of the time
  - +1 Oct 7% of the time

Major or Minor:

- **Bottom Third of [CHANCE KNOB]:**
  - Selects (major/minor) 3rds, fifths, and octaves with equal likelihood.
- **Middle Third of [CHANCE KNOB]:**
  - Selects (major/minor) 3rds, fifths, and octaves with equal likelihood.
- **Upper Third of [CHANCE KNOB]:**
  - Randomly selects a note in the key

Micro-tonal:

- **Bottom Third of [CHANCE KNOB]:**
  - Randomly adds or remove full octaves
- **Middle Third of [CHANCE KNOB]:**
  - Randomly adds or remove full octaves
- **Upper Third of [CHANCE KNOB]:**
  - Randomly picks any allowed note

4 Voltage Lab 2 Touch Controller

Trigger Chance

The rest chance effect will randomly skip note triggers based on a percentage chance determined by the position of each channel's **[CHANCE KNOB]**, maxing out at 95% chance. This can also be modulated with each channel's **[CHANCE CV IN]**.

Shift Chance

The shift chance effect will change the timing of a trigger, earlier or later than 'on-beat'.

Both the likelihood of a chance effect triggering, and how drastic of a change it will be are increased as you turn up the corresponding channel's **[CHANCE KNOB]**, red or yellow. This can also be modulated with each channel's **[CHANCE CV IN JACK]**, in which case the **[CHANCE KNOB]** will act as an attenuator for the incoming signal.

The percent chance that a shift is triggered goes up with the **[CHANCE KNOB]**, from 0-90%.

As you turn up the **[CHANCE KNOB]**, the shift amount is controlled in two sectors that determine the available timing shifts, the first sector uses the bottom two thirds of the knob(0-3.33V) and the second sector uses the top one third of the knob(3.33-5V). (Note calculations assume 1 beat = 1/8 note)

Shift Chance Scalings

Bottom Two Thirds of [CV KNOB] timings:

- -1 half beat(16th note) 40% of the time
- -1 quarter beat(32nd note) 10% of the time
- +1 quarter beat(32nd note) 10% of the time
- +1 half beat(16th note) 40% of the time

Top One Third of [CV KNOB] timings:

- -1 half beat(16th note)12% of the time
- -1 third of a beat(triplet 16th note) 13% of the time
- -1 quarter of a beat(32nd note) 12% of the time
- -1 sixth of a beat(triplet 32nd note) 13% of the time
- +1 sixth of a beat(triplet 32nd note) 13% of the time
- +1 quarter of a beat(32nd note) 12% of the time
- +1 third of a beat(triplet sixteenth note) 13% of the time
- +1 half beat(16th note) 12% of the time

4 Voltage Lab 2 Touch Controller

Roll Chance

The roll chance effect will cause a step to play multiple triggers, ratcheting over the course of a step's length.

Both the likelihood of a chance effect triggering, and how many retriggers will occur will increase as you turn up the corresponding channel's **[CHANCE KNOB]**, red or yellow. This can also be modulated with each channel's **[CHANCE CV IN JACK]**, in which case the **[CHANCE KNOB]** will act as an attenuator for the incoming signal.

The percent chance that a roll is triggered goes up with the **[CHANCE KNOB]**, from 0-90%.

Roll Chance Scalings

The number of possible re-triggers changes based on a given step's current step roll setting , and is controlled in two sectors. The bottom two thirds (0-3.33V) and the top one third (3.33-5V).

Roll Off

- Bottom Two Thirds of [CV KNOB]:
  - Applies 2,3,or 4 rolls with equal chance.
- Top Third of [CV KNOB]:
  - Applies a random roll 1-8 with equal probability

2 Rolls Set

- Bottom Half of [CV KNOB]:
  - 50% chance no roll, 50% chance 4 rolls
- Top Third of [CV KNOB]:
  - Applies 1,4,6,or 8 rolls with equal probability

3 Rolls Set

- Bottom Two Thirds of [CV KNOB]:
  - Applies 1 or 6 rolls with equal probability
- Top Third of [CV KNOB]:
  - Applies 1, 2, 4, 6,or 8 rolls with equal probability

4 Rolls Set

- Bottom Two Thirds of [CV KNOB]:
  - Applies 1, 2, or 6 rolls with equal probability
- Top Third of [CV KNOB]:
  - Applies a random roll 1-8 with equal probability

5 Rolls Set

- Bottom Two Thirds of [CV KNOB]:
  - Applies 1, 2, or 3 rolls with equal probability
- Top Third of [CV KNOB]:
  - Applies a random roll 1-8 with equal probability

6 Rolls Set

- Bottom Two Thirds of [CV KNOB]:
  - Applies 1, 2, or 3 rolls with equal probability
- Top Third of [CV KNOB]:
  - Applies a random roll 1-8 with equal probability

7 Rolls Set

- Bottom Two Thirds of [CV KNOB]:
  - Applies 1, 2, or 3 rolls with equal probability
- Top Third of [CV KNOB]:
  - Applies a random roll 1-8 with equal probability

8 Ratchets Set

- Bottom Two Thirds of [CV KNOB]:
  - Applies 1, 2, 4, or 6 rolls with equal probability
- Top Third of [CV KNOB]:
  - Applies a random roll 1-8 with equal probability

4 Voltage Lab 2 Touch Controller

Generating Sequences

Generate Sequence

The **Generate Sequence** tool is a rhythm generation tool that can be used in **Knob Mode** with **Sequencer On.**
It can be used to generate sequences of varying levels of complexity and with different sets of rhythmic opinions.

To generate a sequence, hold the **[EDIT BUTTON],** and press **[TOUCH PAD 11].** Next, select a **Generation Complexity** using the **[VALUE KNOB]** or the **[TOUCH PADS].** If the sequence is stopped, a sequence will generate as soon as you leave the screen. If the sequence is playing, the new sequence will be generated whenever the sequence next resets.

For Rhythm generation, there are four **Grooves** that select what kind of groove you want your rhythm to have.

You can generate: Un-Syncopated Grooves, Syncopated Grooves, Weirdo Grooves, and Math Grooves.

At the lowest complexity inside a **Groove**, you'll generate simple sequences that have the selected **Groove**. At the upper end of a **Groove**, you'll generate much more complex sequences with the same **Groove**.

Generate Sequence will generate: a **Rhythm**, **Step Pressures**, **Step Rolls**, **Step Shifts**, and **Step Conditions**

Euclidean Generator

The **Euclidean Generator** can be used to generate Euclidean Rhythms. To generate a Euclidean Rhythm, hold the **[EDIT BUTTON]** and press **[TOUCH PAD 10]** to enter the **Euclidean Generator Screen.** Then use the **[VALUE KNOB]** or **[TOUCH PADS]** to select one of the Euclidean Rhythm options. While selecting a Euclidean Rhythm, the rhythm you're generating will be shown to the screen to help you make an informed choice.

If the sequence is stopped, a Euclidean Sequence will generate as soon as you leave the screen. If the sequence is playing, the new Euclidean Sequence will be generated whenever the sequencer next resets.

Generate Fill

The **Generate Fill** function makes use of the **Chance Effects** to apply randomization to a sequence for one play through. When using the **Generate Fill** function, select a **Fill Complexity**, and the **Chance Effects** will use that **Fill Complexity** instead of the **[CHANCE KNOB]** to control the **Chance Level** of the chance effects until the sequence resets.

To generate a fill, hold the **[EDIT BUTTON]** and press **[TOUCH PAD 12]** to enter the **Generate Fill Screen.** Then use the **[VALUE KNOB]** or **[TOUCH PADS]** to select a **Fill Complexity.**

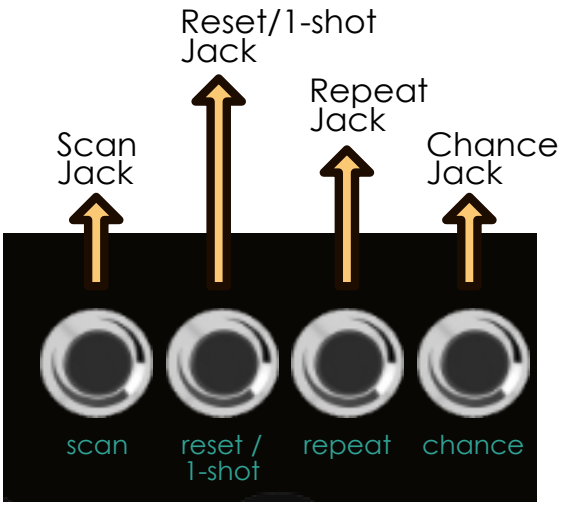
The next time the sequencer resets, the **Fill Complexity** will be used to control your **Chance Effects.**

I've enjoyed using the **Generate Fill** function live to create transitions in my music, giving one loop some weirdness to set up a big transition that I can reinforce elsewhere in my set up!

Note that the Generate Fill function will have no effect if none of your Chance Effects are on.

4 Voltage Lab 2 Touch Controller

Channel Inputs



Scan

The **[SCAN JACK]** is 0-5 Volt CV Input that will Scan through the steps of the sequencer, triggering steps as it reaches them. It can be used to add glitches to sequences, as a way to generate strange sequence timing behavior.

Reset/1-Shot

The **[RESET/1-SHOT JACK]** is a gate input that will reset the Sequencer to its **First Step**. If in **1-Shot Mode**, it will also trigger a 1-Shot.

Repeat

The **[REPEAT JACK]** is a gate input that will cause the sequencer to stop moving forward and instead repeat the currently active step until the gate goes low again. The sequencer will keep track of what the active step should have been, so you won't lose time when using the **[REPEAT JACK].**

Chance

The **Chance Effects** are another of the generative sequencing tools available in the Touch Controller, and we'll dive deep on them later. For now, ma

4 Voltage Lab 2 Touch Controller

Clear Tool

Clear Step Length

Hold the **[EDIT BUTTON]** and the **[RESET BUTTON]** and press the **[SEQUENCER BUTTON]** to set the current active **Sequence(s) Length** to 16.

Clear Step Jumps

Hold the **[EDIT BUTTON]** and the **[RESET BUTTON]** and press the **[RUN/STOP BUTTON]** to clear all **Step Jumps** for the current active sequence(s).

Clear Step Rolls

Hold the **[EDIT BUTTON]** and the **[RESET BUTTON]** and press the **[CLOCK BUTTON]** to clear all **Step Rolls** for the current active sequence(s).

Clear Step Shifts

Hold the **[EDIT BUTTON]** and the **[RESET BUTTON]** and press the **[STEP SHIFT BUTTON]** to clear all **Step Shifts** for the current active sequence(s).

Clear Mutes

Hold the **[EDIT BUTTON]** and the **[RESET BUTTON]** and press the **Yellow** or **Red [CHANNEL BUTTON]** to turn off **Channel Mute** for the pressed channel.

Clear Step Condition

Hold the **[EDIT BUTTON]** and the **[RESET BUTTON]** and press the **[OCT+ BUTTON]** to clear all **Step Conditions** for the current active sequence(s).

Clear Step Condition

Hold the **[EDIT BUTTON]** and the **[RESET BUTTON]** and press the **[OCT- BUTTON]** to clear all **Step Chances** for the current active sequence(s).

Clear a Step

Hold the **[EDIT BUTTON]** and the **[RESET BUTTON]** and press any of the **[TOUCH PADS]** to clear all **Step Values** associated with that step for the current active sequence(s).

4 Voltage Lab 2 Touch Controller

Load and Save

How to Save

To **Save** a Sequence, hold the **[EDIT BUTTON]** and press **[TOUCH PAD 2]** to enter the **Save Sequence Screen.** Next, press any **[TOUCH PAD]** to select a **Save Location**, and your sequence will be saved to that location.
The Red and Yellow channels have separate save files and can be Loaded and Saved separately.

How to Load

To **Load** a Sequence, hold the **[EDIT BUTTON]** and press **[TOUCH PAD 1]** to enter the **Load Sequence Screen.** Next, press any lit **[TOUCH PAD]** to select a **Load Location**. If the sequencer is running, the sequence will be loaded the next time the sequencer resets. If the sequencer is not running, the sequence will be loads immediately.

MIDI Channel

To select a **Midi Channel,** hold the **[EDIT BUTTON]** and press **[TOUCH PAD 16]** to enter the **MIDI Channel Screen.** Next, use the **[VALUE KNOB]** or **[TOUCH PADS]** to select a **MIDI Channel** for the current active Sequencer Channel(s).
Midi channels can be different for the Red and Yellow Channels.

A Note on Interactions

Settings are Meant to Play Well Together, and I was meant to be rich by now

With so many tools available, there are a wide range of interactions between modes and settings. Some of them will be lovely, others will be harsh, and some will manage to be boring! Exploring the complex interactions between the many tools often feels like an experiment, with unpredictable results. This exploration leads to building a broader understanding of the Touch Controller, and eventually the intuition of a scientist!

5 Factory Reset

Voltage Lab 2 Digital Settings Factory Reset:

Press and hold **[Octave Up Button]**, **[Octave Down Button]**, and **[Dynamics Mode Button]** for 5 seconds to reset all digital modes and functions to the default settings. This action can not be undone.

Touch Controller 2 Digital Settings Factory Reset:

Press and hold **[SEQUENCER BUTTON]**, **[RUN/STOP BUTTON]**, **[CLOCK BUTTON]**, **[STEP SHIFT BUTTON]**, **[RESET BUTTON]**, **[EDIT BUTTON]**, **[RED CHANNEL BUTTON]** and **[YELLOW CHANNEL BUTTON]** for 5 seconds to reset all digital modes and functions to the default settings. The interface will flash at you, and when it does power cycle the unit to finish the reset.
After a factory reset, it is recommended to re-calibrate the knobs and touch pads on your touch controller.

This action can not be undone.

To perform a full factory reset of the touch controller, hold all 8 of the buttons along the left-most edge of the controller down for 5 seconds.

After a factory reset, it is recommended to re-calibrate the knobs and touch pads on your touch controller.

6 Eurorack Specs

Voltage Lab 2

Panel size: 90hp.
Module depth: 31mm.
Power consumption: +12v: 750 mA, -12v: 650 mA. Does not require +5v. Includes reversed power polarity protection. Due to the complexity of this module, it requires a significant amount of power. Please use a clean, high quality power source for optimum performance.

Touch Controller 2

Panel size: 90hp.
Module depth: 30mm.
Power consumption: +12v: 250 mA, -12v: 150 mA. Does not require +5v. Includes reversed power polarity protection. Due to the complexity of this module, it requires a significant amount of power. Please use a clean, high quality power source for optimum performance.

7 Case Specs

Case Dimensions: 47.7 cm wide x 26.6 cm deep x 12 cm tall
Power Adapter: DC 15v 2400mA

8 Warranty

Warranty:

Pittsburgh Modular warrants to the original purchaser that this unit is free of defects in materials and workmanship under normal use and maintenance for a period of one (1) year from the date of original purchase. If the unit fails within the one (1) year period, it will be repaired, or replaced, at Pittsburgh Modular's option, at no charge, when returned prepaid to the Pittsburgh Modular Technical Service Center with proof of purchase – the sales receipt may be used for this purpose. Installation labor is not covered under this warranty.

Pittsburgh Modular reserves the right to change the method by which Pittsburgh Modular may provide warranty service, and any Pittsburgh Modular Product's eligibility to receive a particular method of service. Service will be limited to the options available in the country where service is requested. Service options, parts availability and response times may vary according to country. The original purchaser will be responsible for all shipping and handling charges. Customers that seek service in a country that is not the country of purchase must comply with all applicable import and export laws and regulations and be responsible for all custom duties, V.A.T. and other associated taxes and charges. For international service, Pittsburgh Modular may repair or replace Pittsburgh Modular Products and parts with comparable Pittsburgh Modular Products and parts that comply with local standards.

All replacement parts, whether new or re-manufactured, assume as their warranty period for only the remaining time of this warranty. This warranty does not apply to damage caused by improper use, accident, abuse, improper voltage service, fire, flood, lightning, or other acts of God, or if the product was altered or repaired by anyone other than Pittsburgh Modular Technical Service Center. Consequential and incidental damages are not recoverable under this warranty.

Some regions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply. This warranty gives you specific legal rights, and you may also have other rights, which vary by state and country No portion of this warranty may be copied or duplicated without the expressed written permission of Pittsburgh Modular. THIS WARRANTY IS NOT TRANSFERABLE.

9 Service and Contact Information

Please contact us for service or other information related to Voltage Lab 2 or any other Pittsburgh Modular product.

https://www.pittsburghmodular.com/contact