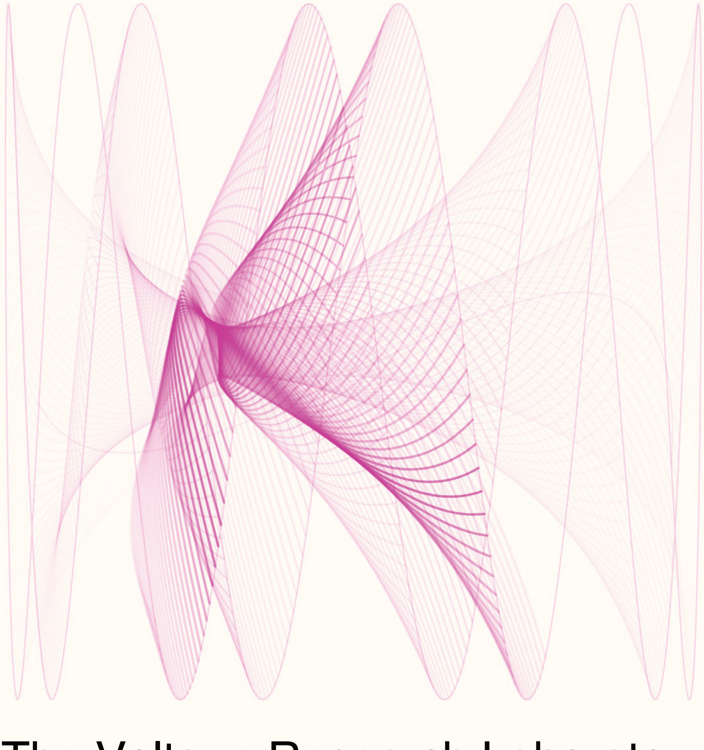


The Voltage Research Laboratory Encyclopedia Voltage Lab Manual

Thank you!

Thank you for purchasing the Voltage Lab. Your interest and investment in this unique instrument helps support innovative, boutique synthesizer design. I am extremely proud of the Voltage Lab. This instrument showcases the unique vision for analog synthesis that Michael and I share.

The organic sound of the Voltage Lab starts with two groundbreaking circuits. The wave shaping chain and Warp circuit in the Primary Oscillator and the analog Vactrol emulation circuitry in the Dynamics Controllers. The wave shaping chain and Warp circuit allow us to manipulate waveforms with analog circuitry like never before creating harmonically complex sounds with depth and life. The Dynamics Controllers in the Voltage Lab have pushed far beyond their origin as a descendant of Don Buchla's Low Pass Gate circuit to become a powerful signal processor with an organic sound and unique features. It is these two circuits plus quite a lot more that gives the Voltage Lab it's distinct voice.

The Voltage Lab sounds different because Michael and I have designed every section of this instrument with the goal of pushing analog forward and exploring our new world of organic analog synthesis. Thanks to everyone who has decided to join us on this journey. I hope you will love this instrument as much as we do.

Enjoy,
Richard Nicol
Founder I Product Design
Pittsburgh Modular Synthesizers

Voltage Research Laboratory Team

Product Design: Richard Nicol
Analog Engineering: Michael Johnsen
Logistics: Michael Importico
Fine Tuning: Perry Willig
Prototyping: Ross Johnson
Coordination: Danielle Nicol

Important Information

Read Instructions: Please read the Voltage Research Laboratory manual completely before use and retain for future reference.

- **IMPORTANT Ribbon Cable Power Information:**
  The Lifeforms Voltage Lab is a eurorack format synthesizer module. The module can be installed, rearranged, removed, and replaced in any compatible eurorack enclosure from Pittsburgh Modular or other manufacturers. The Lifeforms Voltage Lab uses a standard 10 to 16 pin eurorack ribbon cable 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 -12v. This stripe needs to line up with the -12v pins on the power rail and the -12v pins on the module. The Lifeforms Voltage Lab includes reverse polarity protection so it 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 a Pittsburgh Modular enclosure power rail, the -12v pins are clearly labeled. On the Lifeforms Voltage Lab module, the positive side of the pin connector is on top, and the negative sides of the pin connector is on the bottom so the red stripe should be toward the bottom of the module.

- Turn off and unplug the power from the case before removing the Eurorack power header attached to the Voltage Lab module. Failing to turn off the power before removing the Eurorack power header can damage the Voltage Lab module.

- The Voltage Lab is an electronic device. Exposure to water will cause the Voltage Lab circuitry to short circuit and may cause permanent damage.

- Do not attempt to modify the components of the Voltage Lab. Tampering with the circuitry may cause permanent damage.

- Do not place heavy objects on the Voltage Lab. The user interface is mounted on a PCB that can be damaged if stressed by excessive weight.

- Do not attempt to repair the Voltage Lab. Please contact Pittsburgh Modular regarding malfunctions of any kind.

- Pittsburgh Modular is not responsible for any damage or loss caused by improper use of the Voltage Lab.

The Voltage Lab Manual Revision 0

Table of Contents

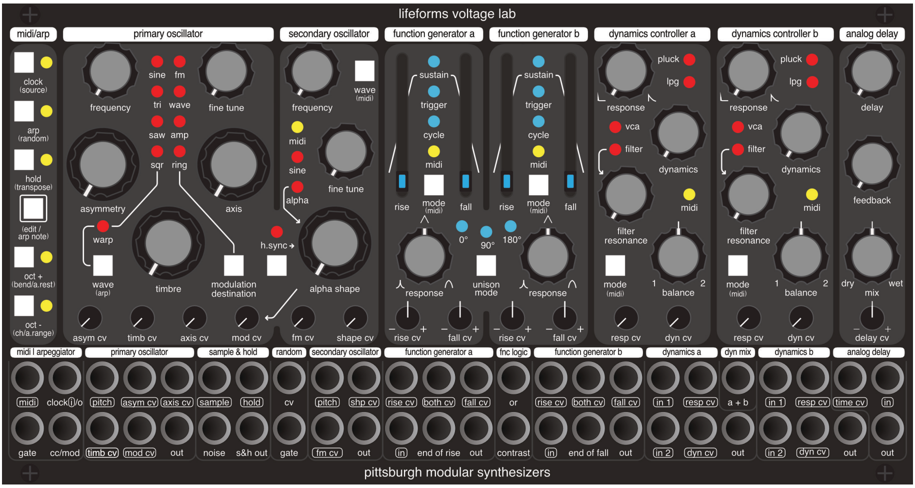
User Interface Controls

1. MIDI Clock Button (Clock Source)
2. MIDI Arpeggiator Button (Random)
3. MIDI Hold Button (Transpose)
4. MIDI Edit Button (Arpeggiator Note)
5. MIDI Octave + Button (Bend/Arp Rest)
6. MIDI Octave - Button (MIDI Ch./Arp Range)
7. Primary Frequency Knob
8. Primary Fine Tune Knob
9. Primary Asymmetry Knob
10. Primary Axis Knob
11. Primary Timbre Knob
12. Primary Wave Button (Arp Division)
13. Primary Modulation Destination Button
14. Primary Asymmetry CV Trimmer
15. Primary Timbre CV Trimmer
16. Primary Axis CV Trimmer
17. Primary Modulation CV Trimmer
18. Secondary Frequency Knob
19. Secondary Wave Button (MIDI Enable)
20. Secondary Fine Tune Knob
21. Secondary Alpha Shape Knob
22. Secondary Hard Sync Button
23. Secondary FM CV Trimmer
24. Secondary Alpha Shape CV Trimmer
25. Function A Rise Slider
26. Function A Fall Slider
27. Function A Mode Button (MIDI Enable)
28. Function A Response Curve Knob
29. Function A Rise CV Trimmer
30. Function A Fall CV Trimmer
31. Function B Unison Mode Button
32. Function B Rise Slider
33. Function B Fall Slider
34. Function B Mode Button (MIIDI Enable)
35. Function B Response Curve Knob
36. Function B Rise CV Trimmer
37. Function B Fall CV Trimmer
38. Dynamics A Response Knob
39. Dynamics A Dynamics Knob
40. Dynamics A Filter Resonance Knob
41. Dynamics A Input Balance Knob
42. Dynamics A Mode Button (MIDI Enable)
43. Dynamics A Response CV Trimmer
44. Dynamics A Dynamics CV Trimmer
45. Dynamics B Response Knob
46. Dynamics B Dynamics Knob
47. Dynamics B Filter Resonance Knob
48. Dynamics B Input Balance Knob
49. Dynamics B Mode Button (MIDI Enable)
50. Dynamics B Response CV Trimmer
51. Dynamics B Dynamics CV Trimmer
52. Delay Time Knob
53. Delay Feedback Knob
54. Delay Mix Knob
55 Delay Time CV Trimmer

User Interface Patch Bay

56. MIDI Adapter Cable Input Jack
57. MIDI Gate Output Jack
58. MIDI Clock Input/Output Jack
59. MIDI Control Change / Modulation Output Jack
60. Primary Pitch Input Jack
61. Primary Timbre CV Input Jack
62. Primary Asymmetry CV Input Jack
63. Primary Modulation CV Input Jack
64. Primary Axis CV Input Jack
65. Primary Output Jack
66. Sample & Hold Sample Input Jack
67. Noise Output Jack
68. Sample & Hold Hold Input Jack
69. Sample & Hold Output Jack
70. Random CV Output Jack
71. Random Gate Output Jack
72. Secondary Pitch Input Jack
73. Secondary FM CV Input Jack
74. Secondary Alpha Shape CV Input Jack
75. Secondary Output Jack
76. Function A Rise CV Input Jack
77. Function A Input Jack
78. Function A Both Rise and Fall CV Input Jack
79. Function A End Of Rise Gate Output Jack
80. Function A Fall CV Input Jack
81, Function A Output Jack
82. Function Logic Mixer Or Output Jack
83. Function Logic Mixer Contrast Output Jack
84. Function B Rise CV Input Jack
85. Function B Input Jack
86. Function B Both Rise and Fall CV Input Jack
87. Function B End Of Rise Gate Output Jack
88. Function B Fall CV Input Jack
89, Function B Output Jack
90. Dynamics A Input 1 Jack
91. Dynamics A Input 2 Jack
92. Dynamics A Response CV Input Jack
93. Dynamics A Dynamics CV Input Jack
94. Dynamics Mix Output Jack
95. Dynamics A Output Jack
96. Dynamics B Input 1 Jack
97. Dynamics B Input 2 Jack
98. Dynamics B Response CV Input Jack
99. Dynamics B Dynamics CV Input Jack
100. Delay Time CV Input Jack
101. Dynamics B Output Jack
102. Delay Input Jack
103. Delay Output Jack

Module Overview



The Lifeforms Voltage Lab Eurorack synthesizer module is a completely different type of analog synthesizer, where every function of the instrument has been influenced by the behaviors and systems of the natural world. Wildly experimental and extremely deep, the Lifeforms Voltage Lab module is a sonic playground created to explore the natural systems and lesser known fringes of analog synthesis.

The Voltage Lab module is more than a simple collection of tools and functions, it is a unique organic analog modular synthesizer designed to reward deep experimentation and encourage the creation of unique sonic systems. Let’s dig in.

Interface Conventions

The Voltage Lab module is not pre-patched. There is no predefined signal path scientifically determined by Richard or Michael to be the best, most musical route. The instrument is wide open because wild experimentation does not happen on a closed course. That said, there are some user interface and general patching conventions that need to be understood to achieve the best results.

Patch Points
The Voltage Lab uses Eurorack standard 1/8” mono jacks for all the patch points except for one. The MIDI INPUT JACK (56) uses an included male 1/8” stereo to female MIDI din cable. The cable looks and feels different than all of the other patch cables so it can be easily picked out of a drawer or bag or where ever adapter cables are kept.

Input jacks have an outline around their name. Output jacks do not. The one exception to this rule is the MIDI CLOCK IN/OUT JACK (58). Depending on the selected clock source, the jack can function as an input or an output. That is why just the “i” is outlined.

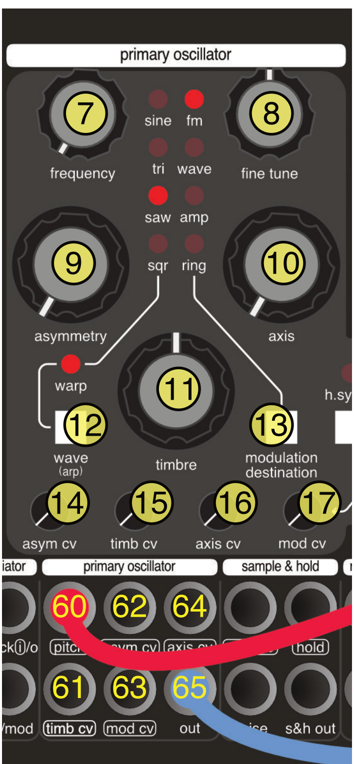
The Voltage Lab interface does not distinguish between audio, CV, and gate signals. In theory, any output can be patched into any input. In practice, inputs respond best when patched to the expected signal type. However, experimentation can yield surprising results. The type of signal input and output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

LED Colors
The Voltage Lab uses 3 different LED colors. Yellow, Red, and Blue. Yellow represents MIDI. The MIDI section and MIDI link indicator LEDs for each section are yellow. The Red and Blue LEDs are used to distinguish different sections of the instrument. The Oscillators and Dynamics Controllers use Red LEDs and the Function Generators use Blue LEDs.

Trimmer Pots
The small Trimmer Pots directly above the patch bay are CV attenuators and attenuverters. These Pots control the amount of control voltage patched into a function. Each Trimmer Pot has a corresponding CV Input Jack.

Button Functionality
Almost all the Buttons have 2 functions. A main function clearly labeled below and a sub-function printed in parentheses. To access the sub-function, hold down the MIDI EDIT BUTTON (4) before pressing the button of choice. The main function and sub-function of each button is covered in the corresponding section.

Manual Soundtrack Patch



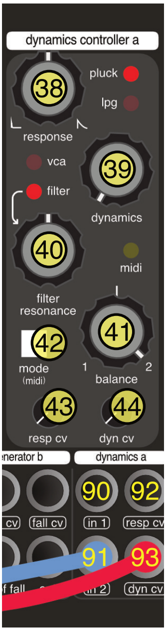
Basic Manual Soundtrack Patch

The Voltage Lab is an amazing instrument, but without the help of a few patch cables, the sound remains locked inside. Before we take a close look at each section of the Voltage Lab, let's put together a quick self running patch for a bit of inspiration. Consider this the soundtrack to the manual.

Step 1: Oscillator Setup
This will get the Primary Oscillator controls setup for the patch. Turn the PRIMARY FREQUENCY KNOB (7) full left. Press the PRIMARY WAVE BUTTON (12) until the Saw and Warp LEDs are lit up. Turn the ASYMMETRY KNOB (9) and AXIS KNOB (10) full left. Press the MODULATION DESTINATION BUTTON (13) until the FM LED is lit up. Make sure the MOD CV TRIMMER (17) is turned full left. Turn the TIMBRE KNOB (11) to about 12 o'clock.

Background Tip! The output of the Secondary Oscillator is normalized to the MOD CV TRIMMER (17). Turning up the MOD CV TRIMMER (17) will allow the Secondary Oscillator to modulate the Primary Oscillator using the selected modulation destination.

Basic Manual Soundtrack Patch Example (2 of 3)



Step 2: Patch the Oscillator to Dynamics Controller
Patch the PRIMARY OSCILLATOR OUPUT JACK (65) into the DYNAMICS CONTROLLER A IN 2 JACK (91).

Background Tip! We are patching into input 2 of the Dynamics Controller so the DYNAMICS CONTROLLER BALANCE KNOB can act like a standard volume knob. Turning it to the right adds more signal from input 2. If we use input 1 instead, the knob works in reverse.

Step 3: Dynamics Controller A Setup
This will get the Dynamics Controller A controls setup for the patch. Turn the RESPONSE A KNOB (38) to about 12 o'clock. Turn the DYNAMICS A KNOB (39) full left. Turn the FILTER RESONANCE A KNOB (40) to about 12 o'clock. Turn the BALANCE A KNOB (41) to about 5 o'clock. Press the DYNAMICS CONTROLLER A MODE BUTTON (42) until the Filter and Pluck LEDs are lit.

Background Tip! Filter mode is acting as both the filter and VCA in this patch. The filter mode frequency cutoff of the Dynamics Controller goes low enough for the filter to act as both filter and VCA. A more in-depth explanation of the filter mode is available in the Dynamics Controller section.

Step 4: Patch the Dynamics Controller to Analog Delay
Patch the DYNAMICS A OUTPUT JACK (95) into the DELAY INPUT JACK (102).

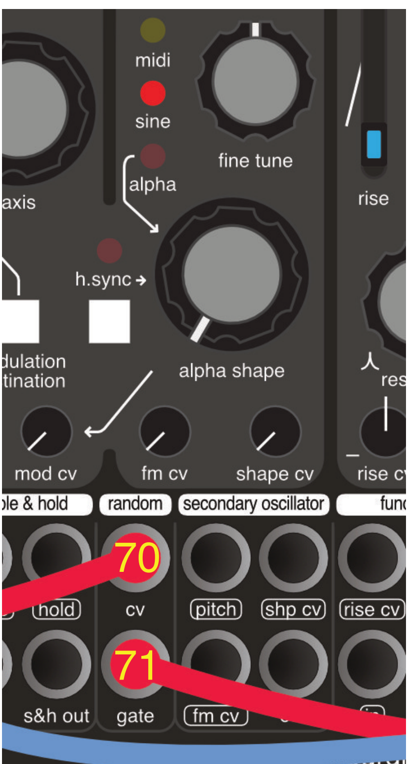
Background Tip! Analog delay makes every patch better!!!

Step 5: Analog Delay Setup
This will get the Analog Delay controls setup for the patch. Turn the DELAY KNOB (52) to 3 o'clock. Turn the FEEDBACK KNOB (53) to 3 o'clock. Turn the MIX KNOB (54) to 1 o'clock.

Background Tip! Delay time ranges between 16ms and 340ms.

Step 6: The Analog Delay is the Output
The DELAY OUTPUT JACK (103) is the output of this patch. Patch it to a mixer, audio interface, amp, powered speaker, or anything else that can amplify electronic audio.

Basic Manual Soundtrack Patch Example (3 of 3)



Step 7: Patch the Random CV and Random Gate
Patch the RANDOM CV OUTPUT JACK (70) into the PRIMARY OSCILLATOR PITCH INPUT JACK (60). Patch the RANDOM GATE OUTPUT JACK (71) into the DYNAMICS A CV INPUT JACK (93).

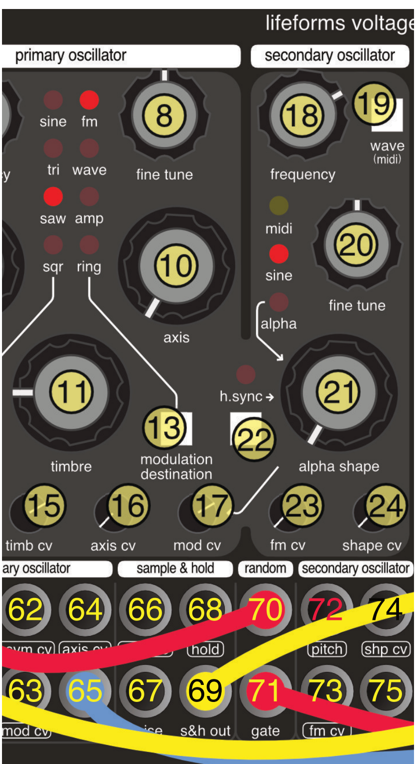
Background Tip! There is more to the random generator than meets the eye. The output is based around a 6 stage shift register evolving sequence generator. Read more about this in the Random Tools section at the end of the manual.

The MIDI CLOCK BUTTON (1) sets the tempo of the random generator. Tap the MIDI CLOCK BUTTON (1) to change the tempo of the output.

If everything was patched up correctly, the Voltage Lab should be pseudo-randomly plucking away. If not, look over each step to ensure controls are set properly and patch cables are inserted into the correct jacks.

At this point, the basic patch is finished. but use this as a starting point for experimentation. Adding modulation to the RESPONSE A KNOB (38), TIMBRE KNOB (11), and DELAY KNOB (52) will add depth and variation to the patch. The next section covers adding modulation to the Basic Manual Soundtrack patch.

Manual Soundtrack Modulation Examples (1 of 3)



Modulation creates a more interesting patch by allowing it to evolve over time. This patch guide builds on the Basic Manual Soundtrack patch by adding 4 points of modulation.

Frequency Modulating the Primary Oscillator

Step 1: Primary Oscillator Setup
Turn the TIMBRE KNOB (11) to about 9 o'clock. Adjust the MOD CV TRIMMER (17) to around 2 o'clock.

Background Tip! The MODULATION CV INPUT JACK (63) of the Primary Oscillator is internally normalized to the output of the Secondary Oscillator. This is one of the few normalized connections in the Voltage Lab and is represented by an arrow pointing from the Secondary Oscillator to the MOD CV TRIMMER (17).

Step 2: Secondary Oscillator Setup
Turn the SECONDARY FREQUENCY KNOB (18) to around 2 o'clock. Press the SECONDARY WAVE BUTTON (19) until just the Sine LED is lit up. Press the H.SYNC BUTTON until the H.Sync LED is off. If the MIDI Led is lit, press and hold the MIDI EDIT BUTTON (4) then press the SECONDARY WAVE BUTTON (19) to disable midi response for the Secondary Oscillator.

The Secondary Oscillator should be frequency modulating the Primary Oscillator. Experiment with the Secondary Oscillator frequency, wave shape, and H.Sync to understand how different settings affect the sound of the Primary Oscillator.

Manual Soundtrack Modulation Examples (2 of 3)

Modulating the Primary Oscillator Timbre Control

Modulate the Primary Oscillator Timbre using a Function Generator in Trigger Cycle Mode to create an LFO.

Step 1: Oscillator Setup
Modify the basic patch by turning the PRIMARY TIMBRE KNOB (11) to about 9 o'clock. Set the PRIMARY TIMBRE CV TRIMMER (15) to around 2 o'clock.

Background Tip! When using modulation to control a knob, the knob becomes the offset or starting point that the modulation builds on.

Step 2: Patch the Function Generator A to Primary Oscillator
Patch the FUNCTION A OUTPUT JACK (81) into the PRIMARY TIMBRE CV INPUT JACK (61).

Step 3: Function Generator A Setup
This sets up Function Generator A as an LFO. Set the FUNCTION A RISE SLIDER (25) and FUNCTION A FALL SLIDER (26) to around 40%. Press the FUNCTION A MODE BUTTON (27) until Trigger and Cycle are illuminated. Turn the FUNCTION A RESPONSE CURVE KNOB (28) to 12 o'clock.

Background Tip! Adjust the Rise and Fall sliders to change the frequency of the LFO.

Manual Soundtrack Modulation Examples (3 of 3)

Modulating the Dynamics Controller Response Control

Modulate the Response time of the Dynamics Controller using a Function Generator in Trigger Cycle Mode to create an LFO.

Step 1: Dynamics Controller Setup
Modify the basic patch by turning the DYNAMICS A RESPONSE KNOB (38) full left. Set the DYNAMICS A RESPONSE CV TRIMMER (43) full right.

Background Tip! Modulating the Response Knob is a great way to change the feel of a sound.

Step 2: Patch the Function Generator B to Dynamics Controller A
Patch the FUNCTION B OUTPUT JACK (89) into the DYNAMICS A RESPONSE CV INPUT JACK (92).

Step 3: Function Generator B Setup
This sets up Function Generator B as an LFO. Set the FUNCTION B RISE SLIDER (32) and FUNCTION B FALL SLIDER (33) to around 40%. Press the FUNCTION B MODE BUTTON (34) until Trigger and Cycle are illuminated. Turn the FUNCTION B RESPONSE CURVE KNOB (35) to 12 o'clock.

Background Tip! Adjust the Function Generator Response Knob to change the response curve and shape of the LFO.

Modulating the Delay Time Control

Modulate the Delay time of the Analog Delay using Sample and Hold.

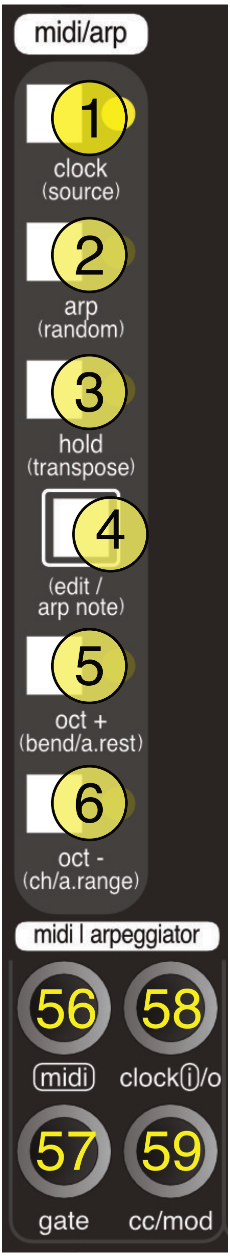
Step 1: Analog Delay Setup
Modify the basic patch by turning the DELAY TIME KNOB (52) to 12 o'clock. Set the DELAY TIME CV TRIMMER (55) TO 1 o'clock.

Background Tip! The DELAY TIME CV TRIMMER is an attenuverter. 12 o'clock is the off position. Turning to the right adds positive modulation and turning to the left adds negative modulation.

Step 2: Patch the Sample and Hold to the Delay Time CV
Patch the SAMPLE & HOLD OUTPUT JACK (69) into the DELAY TIME CV INPUT JACK (100).

Background Tip! Because the Sample & Hold outputs a bipolar signal, it can modulate both positively and negatively.

MIDI / Arpeggiator Module



Module Overview

The MIDI / Arpeggiator Module in the Voltage Lab 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 MIDI / Arpeggiator section perform multiple functions. The main function, written under each button, is performed by pressing the button. The secondary function, written under each button in parenthesis is performed by pressing and holding the MIDI EDIT BUTTON (4) then pressing the desired button.

MIDI to CV Converter Overview

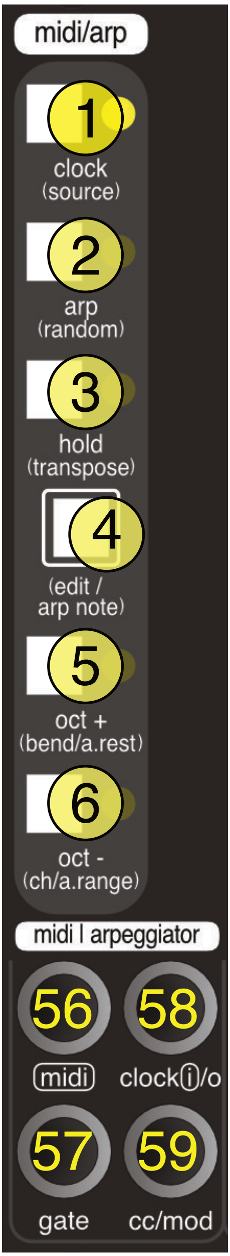
The MIDI to CV converter allows the Voltage Lab to respond to digital MIDI messages from a controller or DAW by converting digital MIDI data into analog control voltages. The Voltage Lab utilizes the 1 volt per octave standard and responds to MIDI not on/off, MIDI note number 0-127, MIDI clock, MIDI clock start/stop, MIDI pitch bend, and MIDI modulation or control change messages. By default, the MIDI channel of the Voltage Lab is set to omni, allowing the synthesizer to respond to all MIDI channels. The MIDI ADAPTER CABLE INPUT JACK (56) uses the supplied stereo ⅛" to 5 pin DIN connector to connect a traditional 5 pin MIDI cable.

MIDI to CV Converter Pitch

Note pitch is routed internally from the MIDI section to control the pitch of the Primary Oscillator. MIDI pitch control is hardwired to the Primary Oscillator, meaning that the Primary Oscillator always responds to MIDI pitch signals.

MIDI pitch control can be enabled or disabled for the Secondary Oscillator. This allows for maximum flexibility when patching the Secondary Oscillator. To enable or disable MIDI pitch control for the Secondary Oscillator, press and hold the MIDI EDIT BUTTON (4) then press the Secondary Oscillator PRIMARY WAVE BUTTON (12). This will toggle MIDI pitch control on and off.

MIDI / Arpeggiator Section (2 of 8)



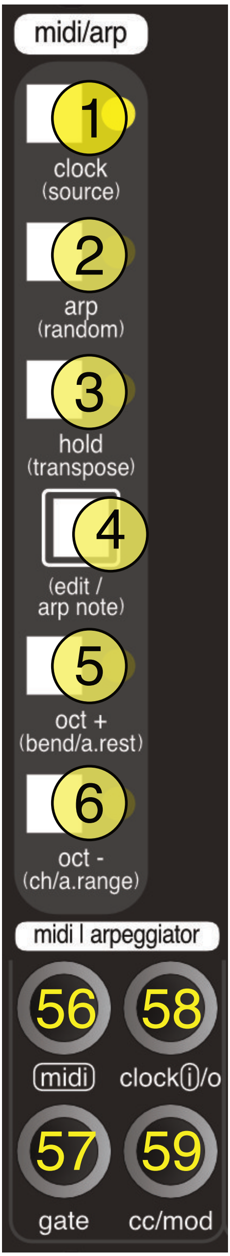
The Octave + and Octave - buttons are used to transpose the output of the MIDI pitch over a 5 octave range. To transpose the output of the MIDI pitch, press the OCTAVE - BUTTON (6) or OCTAVE + BUTTON (5). Transposing the pitch always affects the pitch of the Primary Oscillator. If MIDI pitch is enabled for the Secondary Oscillator, transposing the pitch will affect the Secondary Oscillator also.

MIDI to CV Converter Gate
Note on/off information is converted to a 5v gate signal. Note on = 5v. Note off = 0v. The MIDI gate signal is internally routed to the gate input of several modules. Function Generator A, Function Generator B, Dynamics Controller A, and Dynamics Controller B. This allows these modules to be triggered by the MIDI Gate signal without the need for patch cables. The MIDI Gate signal can be enabled or disabled independently for each module. To enable or disable the MIDI gate signal, press and hold the MIDI EDIT BUTTON (4) then press the MODE BUTTON (19, 27, 34, 42, 49) of the corresponding module. This will toggle MIDI gate signals for the selected module on and off. Additionally, the MIDI / Arpeggiator section has a dedicated MIDI GATE OUTPUT JACK (57) available for patching.

MIDI Note Reset
Reset the current MIDI note to note 0. This comes in handy when switching between MIDI and CV pitch control. The internal MIDI to CV converter is hard wired to the Primary Oscillator so the frequency of the Primary Oscillator is always offset by the last MIDI note received. The MIDI Note Reset clears the last MIDI note received to allow the Primary Oscillator to access to the full frequency range using the PRIMARY PITCH INPUT JACK (60), MIDI OCTAVE + BUTTON (5) and MIDI OCTAVE - BUTTON (6).

To Reset the MIDI note, press and hold the MIDI EDIT BUTTON (4) then press the Secondary Oscillator SECONDARY HARD SYNC BUTTON (22). The pitch of the Primary Oscillator will jump to the reset note. If the Secondary Oscillator MIDI Mode is enabled, the frequency of the Secondary Oscillator will jump to the reset note as well.

MIDI / Arpeggiator Section (3 of 8)



Clock Source Overview

The MIDI/Arpeggiator module utilizes 3 clock sources: internal tap tempo, external MIDI, and external gate. The clock is used to advance the arpeggiator and the random modulation source. To select the clock source, press and hold the MID EDIT BUTTON (4) then press the MIDI CLOCK BUTTON (1) to cycle through the 3 choices.

Clock Source Options

Tap Tempo Mode = ARPEGGIATOR LED
External MIDI Mode = HOLD LED
External Gate Mode = ARPEGGIATOR & HOLD LED

Internal Tap Tempo Clock Source

The internal clock source utilizes the MIDI CLOCK BUTTON (1) to modify the rate of the internal clock. Tap the MID CLOCK BUTTON (1) to change the tempo of the clock. The internal clock rate is saved in memory and recalled when the Voltage Lab is powered on. The MIDI CLOCK INPUT/OUTPUT JACK (58) functions as a clock output source in Internal Tap Tempo Clock mode. The MIDI CLOCK INPUT/OUTPUT JACK (58) outputs a 5v 40ms gate signal.

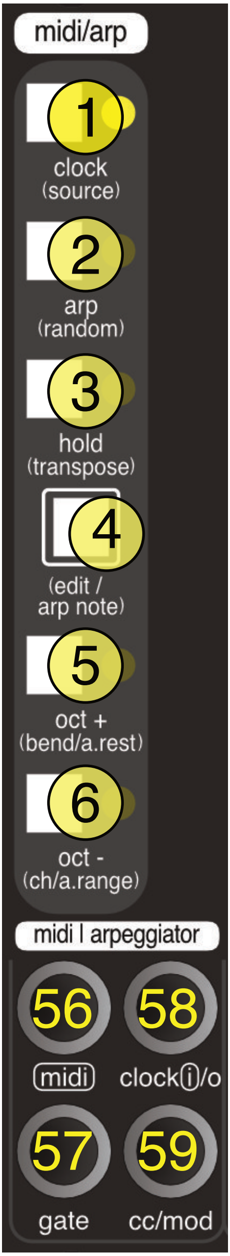
External MIDI Clock Source

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 MIDI CLOCK BUTTON (1) acts as a clock divider cycling through 6 available clock divisions. ÷ 1, ÷ 2, ÷ 4, ÷ 8, ÷ 16, ÷ 32. Set the MIDI clock division by pressing the MIDI CLOCK BUTTON (1). The MIDI clock division is saved in memory and recalled when the Voltage Lab is powered on. The MIDI CLOCK INPUT/OUTPUT JACK (58) functions as a clock output source in External MIDI Clock mode. The MIDI CLOCK INPUT/OUTPUT JACK (58) outputs a 5v 40ms gate signal.

External Midi Clock Divider Options

÷ 1 = ARPEGGIATOR LED
÷ 2 = HOLD LED
÷ 4 = ARPEGGIATOR & HOLD LED
÷ 8 = ARPEGGIATOR & HOLD & DOWN LED
÷ 16 = ARPEGGIATOR & HOLD & UP LED
÷ 32 = ARPEGGIATOR & HOLD & DOWN & UP LED

MIDI / Arpeggiator Section (4 of 8)

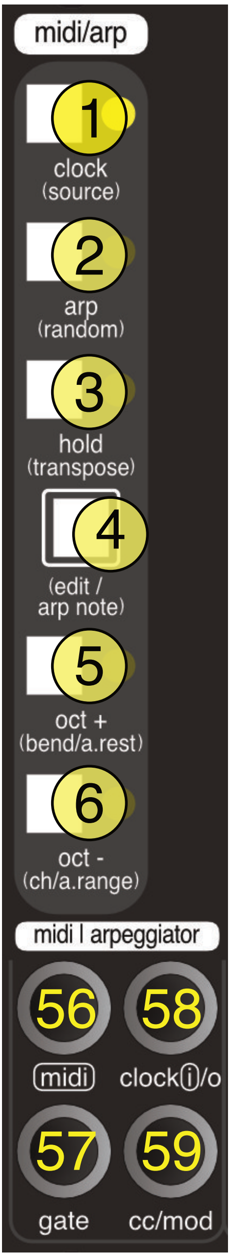


External Gate Clock
The external gate clock uses an external gate signal to trigger the clock. In external gate clock mode, the MIDI CLOCK BUTTON (1) acts as a clock divider cycling through 6 available clock divisions. ÷ 1, ÷ 2, ÷ 4, ÷ 8, ÷ 16, ÷ 32. Set the external gate clock division by pressing the MIDI CLOCK BUTTON (1). The external gate clock division is saved in memory and recalled when the Voltage Lab is powered on. The MIDI CLOCK INPUT/OUTPUT JACK (58) functions as a clock input in External Gate Clock mode. The MIDI CLOCK INPUT/OUTPUT JACK (58) triggers the clock with the rising edge of most waveforms that rise above 2.5v.

External Gate Clock Divider Options

÷ 1 = ARPEGGIATOR LED
÷ 2 = HOLD LED
÷ 4 = ARPEGGIATOR & HOLD LED
÷ 8 = ARPEGGIATOR & HOLD & DOWN LED
÷ 16 = ARPEGGIATOR & HOLD & UP LED
÷ 32 = ARPEGGIATOR & HOLD & DOWN & UP LED

MIDI / Arpeggiator Section (5 of 8)



Arpeggiator & Note Sequencer

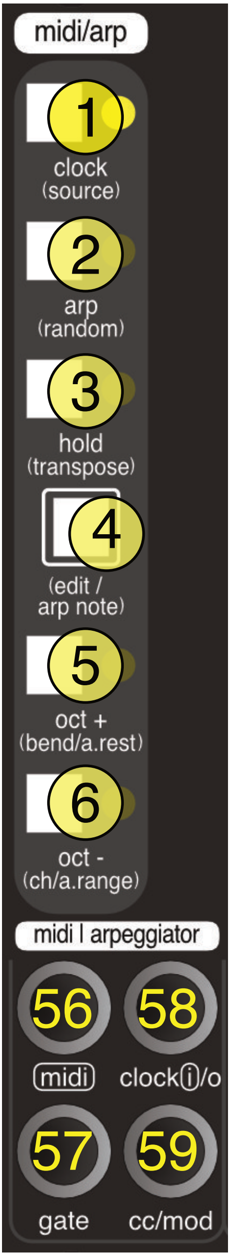
Arpeggiator mode outputs a monophonic pitch and gate signal. Arpeggios up to 16 notes are available when multiple keys are pressed at once or added to the arpeggiator sequence. The arpeggiator offers two key input modes. The first is the standard arpeggiator input method of pressing and holding multiple MIDI controller keys at once. The second method allows notes to be sequenced one at a time, allowing for the insertion of rests and the use of the same note multiple times. The arpeggiator cycles through the selected notes at the rate of the active clock source. The set of selected notes resets when the arpeggiator receives a MIDI note off message (key released) or the MIDI HOLD BUTTON (3) is released when using the sequencing input method. Sounds confusing but it's simple to do.

Entering An Arpeggiated Sequence Using Standard Arpeggiator Input Method

Enable arpeggiator mode by pressing the MIDI ARPEGGIATOR BUTTON (2). Press and hold keys on a MIDI keyboard. The arpeggiator will cycle through the depressed keys in the order they were pressed. Playing the notes in this order is sometimes called "as played". To stop the arpeggiated sequence, release one or all of the depressed keys.

Entering An Arpeggiated Sequence Using the Note Sequencing Method

Enable arpeggiator mode by pressing the MIDI ARPEGGIATOR BUTTON (2). Press and hold the MIDI EDIT BUTTON (4). Press keys on a MIDI keyboard one at a time to create a sequence of up to 16 steps. Press the MIDI OCTAVE + BUTTON (5) to add a rest. This note sequencing method automatically enables hold mode. To stop the arpeggiated sequence, press the MIDI HOLD BUTTON (3).



Additional Arpeggiator Functions

The arpeggiator offers 6 additional functions to enhance the active arpeggiated sequence: hold, transpose, random, arpeggiator range, and random sequence generator.

Hold Function
Enable the hold function by pressing the MIDI HOLD BUTTON (3). The hold function allows the arpeggiator to cycle through the last set of selected notes after the selected notes have been released, or the MIDI EDIT KEY (4) is released when using the sequencing input method. Disable the hold function by pressing the MIDI HOLD BUTTON (3).

Transpose Function
Enable the transpose function by pressing and holding the MIDI EDIT BUTTON (4) then press the MIDI HOLD BUTTON (3). Transpose mode can only be enabled when hold mode is 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 MIDI HOLD BUTTON (3).

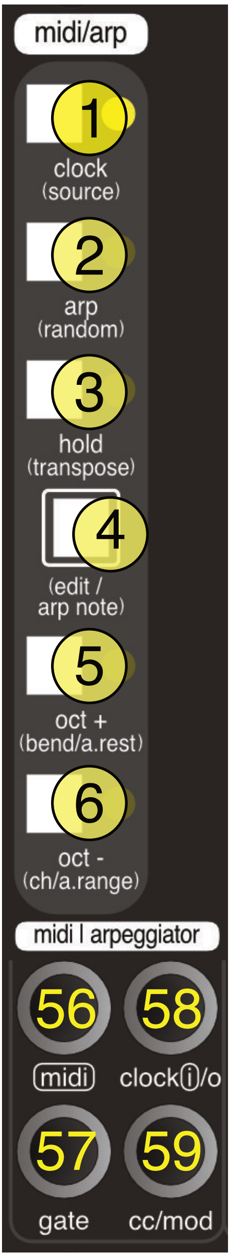
Random Function
Randomize the arpeggiated sequence by pressing and holding the MIDI EDIT BUTTON (4) then pressing the MIDI ARPEGGIATOR BUTTON (2). The random function will randomly jump between the notes of the arpeggiated sequence. Disable random by pressing and holding the MIDI EDIT BUTTON (4) then pressing the MIDI ARPEGGIATOR BUTTON (2).

Range Function
The range function sets the number of octaves the active arpeggiated sequence will cycle through. The range can be set to 1, 2, or 3 octaves. Set the range by pressing and holding the MIDI EDIT BUTTON (4) then pressing the MIDI OCTAVE - BUTTON (6) to cycle through 1 octave, 2 octaves, or 3 octaves.

Arpeggiator Octave Range Options

1 Octave Range = ARPEGGIATOR LED
2 Octave Range = HOLD LED
3 Octave Range = ARPEGGIATOR & HOLD LED

MIDI / Arpeggiator Section (7 of 8)



Arpeggiator Clock Divider and Gate Randomizer
The arpeggiator utilizes an independent clock divider that allows it to operate at independent divisions of the active clock or probability. Arpeggiator clock divisions include ÷ 1, ÷ 2, ÷ 3, ÷ 4, ÷ 8, voltage controlled division, 30% chance, and 60% chance. To set the arpeggiator clock division press and hold the MIDI EDIT BUTTON (4) then press the PRIMARY WAVE BUTTON (12) to cycle through the available arpeggiator clock divisions.

Arpeggiator Clock Divider Options

÷ 1 = SINE LED
÷ 2 = SINE & TRIANGLE LED
÷ 3 = SINE & TRIANGLE & SAW LED
÷ 4 = SINE & TRIANGLE & SAW & SQUARE LED
÷ 8 = SINE & TRIANGLE & SAW & SQUARE & WARP LED

Voltage Controlled Clock Division = SINE & TRIANGLE & SAW & SQUARE & WARP & FM & WAVE & AM & RING LED

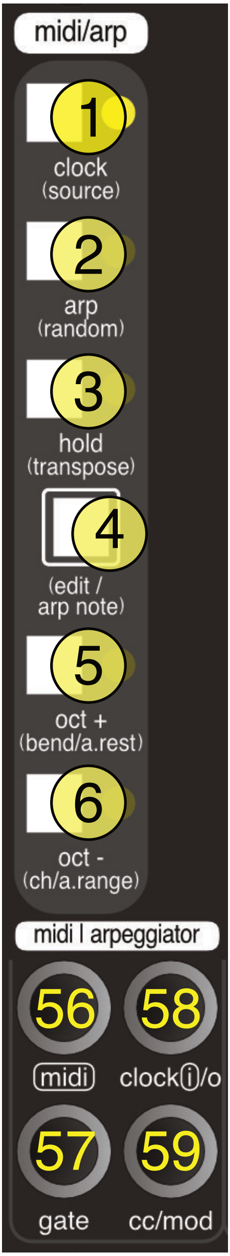
30% Chance the Arpeggiator Advances = SINE & WAVE & SAW & RING LED

60% Chance the Arpeggiator Advances = FM & TRIANGLE & AM & SQUARE

Voltage Controlled Clock Division
The voltage controlled arpeggiator division mode is controlled using the PRIMARY MODULATION CV INPUT JACK (63) and PRIMARY MODULATION CV INPUT TRIMMER (17). Because the voltage controlled arpeggiator division mode shares the PRIMARY MODULATION CV INPUT JACK (63) and PRIMARY MODULATION CV INPUT TRIMMER (17) with the Primary Oscillator, think of this feature as an easter egg. It would have been nice to include a dedicated input jack with dedicated trimmer but the space was not available.

Random Arpeggiator Trigger Chance
The arpeggiator gate randomizer advances the arpeggiator with either a 30% or 60% chance. Also, when a gate randomizer mode is selected, the MIDI CONTROL CHANGE / MODULATION OUTPUT JACK (59) outputs a slewed, random 0v to 5v control voltage that updates independently of the arpeggiator.

MIDI / Arpeggiator Section (8 of 8)



Random Arpeggiation Generator
Generate a randomized arpeggiated sequence by pressing the MIDI ARPEGGIATOR BUTTON (2) to enable arpeggiator mode. Next, press and hold the MIDI EDIT BUTTON (4) then press the MIDI HOLD BUTTON (3). This will generate a random arpeggiated sequence with a random length (1-16 steps) and random pitch values.

Additional MIDI Settings

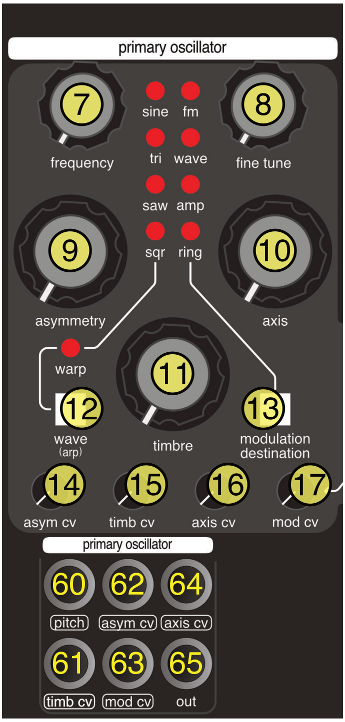
The MIDI response can be customized by changing the following settings. The following settings can only be changed when arpeggiator mode is NOT active.

MIDI CC
The MIDI CONTROL CHANGE / MODULATION OUTPUT JACK (59) outputs a 0v to 5v DC voltage based on the assigned MIDI CC number. This jack can be assigned to a MIDI keyboard mod wheel or any assignable controller. The MIDI modulation jack can also be assigned to a MIDI CC number used by a DAW for modulation. To set the active MIDI CC number, press and hold the MIDI EDIT BUTTON (4). The active MIDI CC number can only be changed when arpeggiator mode is NOT active. While the MIDI EDIT BUTTON (4) is pressed, the MIDI section assigns the active MIDI CC number based on the last incoming MIDI CC message it receives. Simply move a mod wheel or engage an input source on a MIDI controller to assign that MIDI CC number to the MIDI CONTROL CHANGE / MODULATION OUTPUT JACK (59). The MIDI CC number is saved in memory and recalled when the Voltage Lab is powered on.

MIDI Channel
The Voltage Lab can be assigned to MIDI channel 1-16 or omni. To set the MIDI channel, press and hold the MIDI EDIT BUTTON (4). The MIDI can only be changed when arpeggiator mode is NOT active. Pressing the MIDI OCTAVE - BUTTON (6) will cycle through MIDI channel numbers. The MIDI channel is saved in memory and recalled when the Voltage Lab is powered on.

Pitch Bend
There are 4 options for the pitch bend range. 2 semitones (+/- 2 notes), 4 semitones (+/- 4 notes), 8 semitones (+/- 5th), 12 semitones (+/- 1 octave). To set the MIDI pitch bend range, press and hold the MIDI EDIT BUTTON (4). The pitch bend range can only be changed when arpeggiator mode is NOT active. Press the MIDI OCTAVE + BUTTON (5) to cycle through MIDI pitch bend options. The MIDI pitch bend range is saved in

Primary Oscillator Modules



Module Overview

The sounds created by the Primary Oscillator are the culmination of years of research and design. The additive wave shaping circuitry we have created is the foundation of our organic analog synthesis concept.

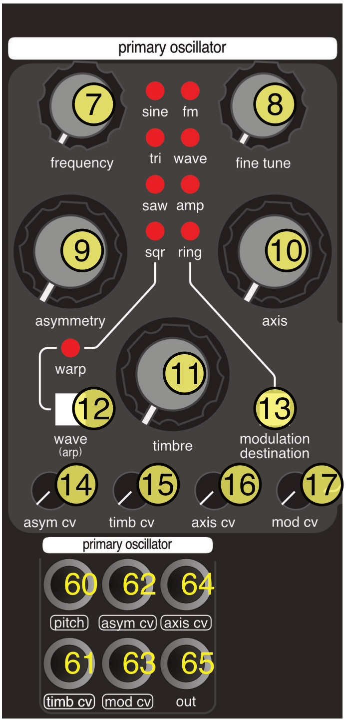
The unique sound of the Voltage Lab starts with a refined version of our temperature stabilized, analog VCA saw wave oscillator core. The internal signal path of the Primary Oscillator passes the core saw waveform through up to 5 additive wave shapers before reaching the output. Waveform names should 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. The waveform passes through up to 5 wave shapers on its way to the output. All of the wave shapers before the wave folder circuit are designed to manipulate the waveform in ways that allow it to interact with the wave folder in different ways. Let's take a close look at each stage of the signal path in the order they occur.

Midi Control

The Primary Oscillator is hardwired to the Voltage Lab internal midi bus and always responds to midi note changes and the MIDI OCTAVE + BUTTON (5) and MIDI OCTAVE - BUTTON (6). Midi pitch, MIDI OCTAVE + BUTTON (5), and MIDI OCTAVE - BUTTON (6) can be used simultaneously with the analog PRIMARY PITCH INPUT JACK (60) volt per octave input jack.

Primary Oscillator Section (2 of 5)



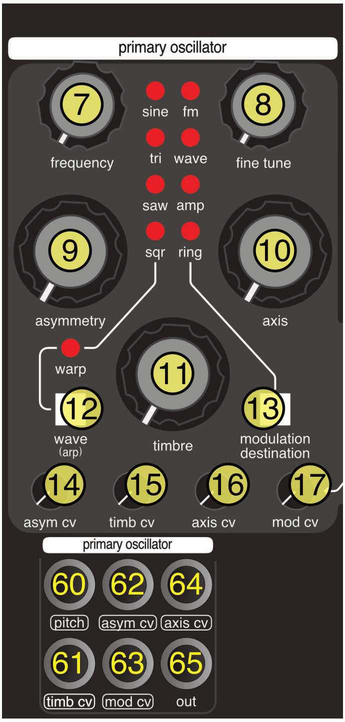
Oscillator Core

The core of the Primary Oscillator manages linear frequency modulation, midi note pitch response, octave switching, and volt per octave pitch tracking to generate a frequency stable saw wave. Cycle through all the available modulation sources by pressing the PRIMARY MODULATION DESTINATION BUTTON (13).

Primary Modulation Destination Options

1. Not Active (Not perfectly off. A small amount of FM may bleed through depending on the modulation source)
2. FM - Linear Frequency Modulation
3. Wave - Active Seed Wave Selection
4. Amp - Amplitude Modulation
5. Ring - Ring Modulation
6. FM & Wave - Linear Frequency Modulation and Active Seed Wave Selection
7. FM & Amp - Linear Frequency modulation and Amplitude Modulation)
8. FM & Ring - Frequency Modulation and Ring Modulation

Primary Oscillator Section (3 of 5)



Seed Waveforms

The saw wave generated by the oscillator core is used as raw material to create the other basic geometric waveforms. Triangle and square waves are shaped directly from the saw wave and the sine wave is created by further shaping the triangle wave. Two versions of each waveform are available. The standard version and a warped version. In addition, 2 combined waveforms are available. The first combines the sine and saw waves and the second combines the triangle and square. Cycle through all the available seed waves, including warped versions by pressing the PRIMARY WAVE BUTTON (12).

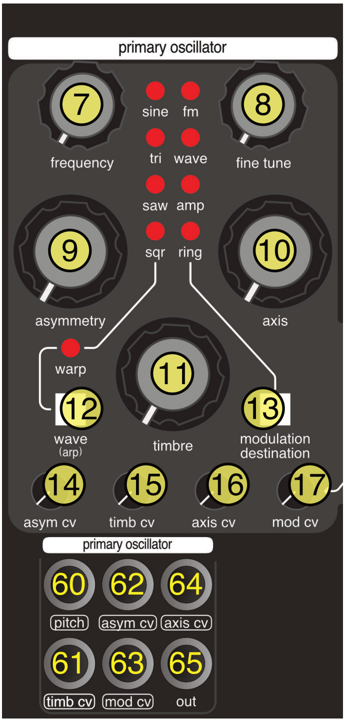
Seed Waveform Options

1. Sine Wave
2. Warped Sine Wave
3. Triangle Wave
4. Warped Triangle Wave
5. Saw Wave
6. Warped Saw Wave
7. Square Wave
8. Warped Square Wave
9. Sine & Saw Wave
10. Warped Sine & Saw Wave
11. Triangle & Square Wave
12. Warped Triangle & Square Wave

Selection of the seed wave can be voltage controlled by pressing the PRIMARY MODULATION DESTINATION BUTTON (13) and selecting the WAVE setting. The PRIMARY MODULATION CV INPUT JACK (63) AND PRIMARY MODULATION CV TRIMMER (17) set the depth of the incoming modulation source. The seed wave is selected based on the incoming voltage between 0 and 5 volts. A sine wave is selected with 0 volts. The remainder of the seed waves are triggered in order as voltage is added up to 5 volts.

Normalized Modulation CV
The PRIMARY MODULATION CV INPUT JACK (63) is normalized to the output of the Secondary Oscillator. Meaning without using a patch cable, the Secondary Oscillator will modulate the selected Primary Oscillator modulation destination. Patch into the PRIMARY MODULATION CV INPUT JACK (63) to override the internal routing.

Primary Oscillator Section (4 of 5)



Asymmetry

Once a seed wave is selected, the waveform passes through the asymmetry shaper. Asymmetry is achieved using a voltage controlled half wave rectifier.

As the PRIMARY ASYMMETRY CONTROL KNOB (9) is turned to the right, the bottom half of the waveform is squared off creating even harmonics. Unless the wave folder PRIMARY TIMBRE CONTROL KNOB (11) or PRIMARY TIMBRE CV INPUT JACK (61) are shaping the seed wave, adding asymmetry to the seed wave has a mild effect on the sound. The asymmetry created by the half wave rectifier allows the wave folder to react differently to the seed wave. When using the PRIMARY ASYMMETRY CV INPUT JACK (62) and PRIMARY ASYMMETRY CV TRIMMER (14) the PRIMARY ASYMMETRY CONTROL KNOB (9) acts as the starting point for the external modulation control.

Axis

After the Asymmetry circuit, the waveform is sent to the axis shaper. Axis is a voltage controlled DC offset.

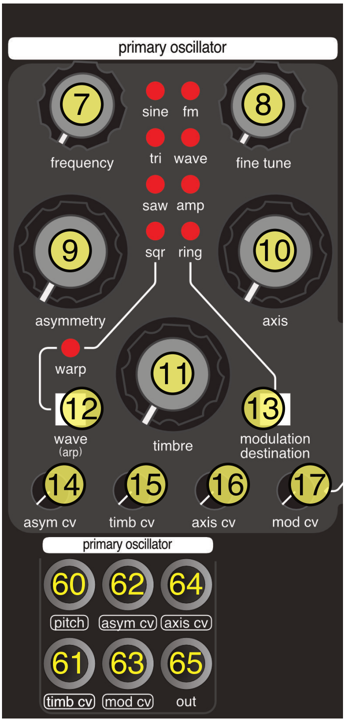
Turning the PRIMARY AXIS CONTROL KNOB (10) to the right shifts the seed wave positively along the x axis. The PRIMARY AXIS CV INPUT JACK (64) can shift the seed wave positively and negatively depending on the control voltage used. Offsetting the seed wave before it passes through the wave folder changes the response of the wave folder. The Axis control has very little effect on the sound unless the wave folder PRIMARY TIMBRE CONTROL KNOB (11) or PRIMARY TIMBRE CV INPUT JACK (61) are shaping the seed wave.

Warp

The warp circuit is the last step before the seed wave passes through the wave folder. 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 wave folder. 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.

Cycle through all the available seed waves, including warped versions by pressing the PRIMARY WAVE BUTTON (12).

Primary Oscillator Section (5 of 5)



Timbre

The last wave shaper in the signal path is the wave folder. The wave folder adds additional harmonics to both simple and complex waveforms by amplifying and folding the waveform back in on itself.

The PRIMARY TIMBRE CONTROL KNOB (11) controls the strength of the wave folder. Turning the PRIMARY TIMBRE CONTROL KNOB (11) 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 affect on the shape and sound of the seed wave. When using the PRIMARY TIMBRE CV INPUT JACK (961) and PRIMARY TIMBRE CV TRIMMER (15) the PRIMARY TIMBRE CONTROL KNOB (11) acts as the starting point for the external modulation control.

Output

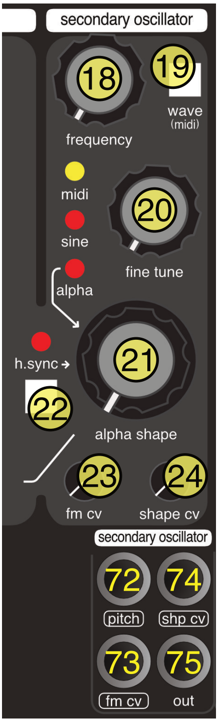
The output of the wave folder can be further processed by enabling amplitude modulation or ring modulation.

Enable amplitude modulation or ring modulation by pressing the PRIMARY MODULATION DESTINATION BUTTON (13) and selecting either AM (amplitude modulation) or RING (ring modulation). The PRIMARY MODULATION CV INPUT JACK (63) and PRIMARY MODULATION CV TRIMMER (17) set the depth of the incoming modulation source.

Amplitude Modulation
Amplitude modulation adds a voltage controlled amplifier to the end of the Primary Oscillator signal path. We embedded a single channel of our high quality Dual VCA eurorack module into the oscillator signal path. This VCA can be utilized for everything from simple tremolo effects to acting as the main signal path VCA.

Ring Modulator
The ring modulator included in the Primary oscillator adds a host of classic effects and modulation possibilities to the Primary Oscillator. A ring modulator outputs the sum and difference of the seed wave and modulation source. The seed wave is patched through the x input and the modulation source is patched through the y input of the ring modulator circuit.

Secondary Oscillator Module



Module Overview

Compared to the Primary Oscillator, the secondary oscillator offers a simplified feature set sharing the same temperature stabilized, analog VCA saw wave oscillator core paired with a unique set of wave shaping and output options.

Midi Control
Midi control of the Secondary Oscillator is optional. This allows the secondary oscillator to respond to midi note changes and the MIDI OCTAVE + BUTTON (5) and MIDI OCTAVE - BUTTON (6). The Midi pitch, MIDI OCTAVE + BUTTON (5), and MIDI OCTAVE - BUTTON (6) can be used simultaneously with the analog SECONDARY PITCH INPUT JACK (72) volt per octave input jack. To enable or disable the Secondary Oscillator midi response, press and hold the MIDI EDIT BUTTON (4) then press the SECONDARY WAVE BUTTON (19). The yellow MIDI LED will illuminate to show that midi response is active.

Oscillator Core
The core of the Secondary Oscillator manages linear frequency modulation, hard sync, octave switching with midi pitch integration, and volt per octave pitch tracking to generate a frequency stable saw wave. Linear frequency modulation (FM) can be voltage controlled by using the SECONDARY FM CV INPUT JACK (73). The SECONDARY FM CV TRIMMER (23) sets the depth of the incoming modulation source. Hard Sync to the Primary Oscillator is enabled using the SECONDARY HARD SYNC BUTTON (22).

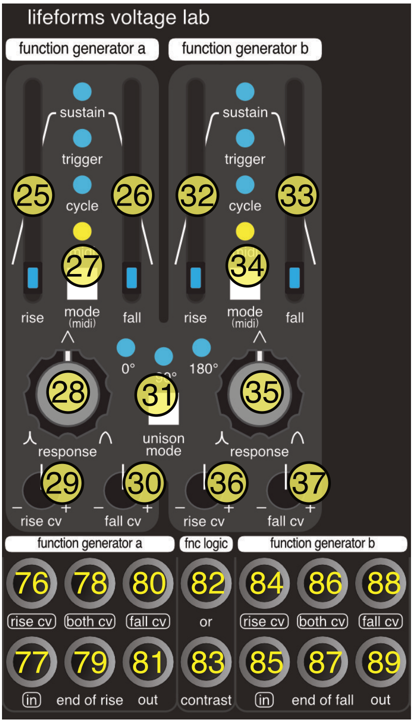
Waveforms
The saw wave generated by the oscillator core is used to create sine and triangle waveforms. The triangle wave passed through a voltage controlled wave shaper to morph between a triangle and square wave. The waveform generated by this wave shaper is called the alpha wave. Turning the SECONDARY ALPHA SHAPE KNOB (21) to the right morphs the triangle wave into a square wave. When using the SECONDARY ALPHA SHAPE CV INPUT JACK (74) and SECONDARY ALPHA SHAPE CV TRIMMER (24) the SECONDARY ALPHA SHAPE KNOB (21) acts as the starting point for the external modulation control.

The output of the Secondary Oscillator sine wave and alpha wave is +/- 5v. Perfect for use as a modulation source. The sine wave and alpha wave mix output adds the two waves together creating a +/- 10v waveform.

Cycle through all the selectable waveforms by pressing the SECONDARY WAVE BUTTON (19).

Secondary Oscillator Waveform Options
1. Sine Wave
2. Alpha Wave
3. Sine & Alpha Wave

Function Generator Modules



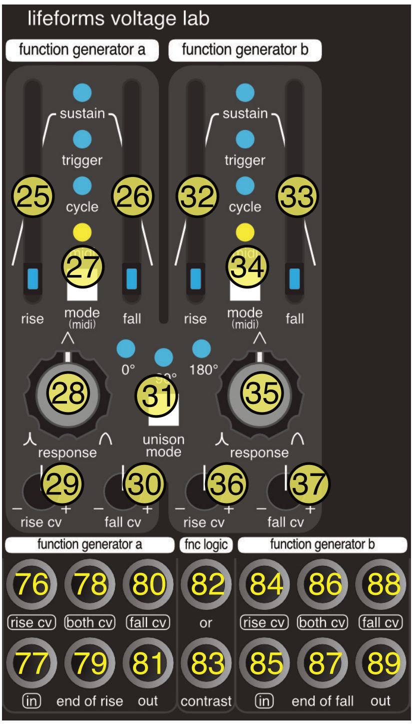
Module Overview

A true multi-function utility module, the Function Generator can be utilized in many different ways to fit the needs of a patch. The Voltage Lab includes a pair of Function Generators to manage multiple tasks at once. How to patch the Function Generator as an envelope generator, a voltage controlled LFO, a slew generator, a gate signal delay, envelope follower, a clock source, voltage controlled clock divider, and complex modulation source will be covered below.

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, FUNCTION RISE SLIDER (25, 32) and FUNCTION FALL SLIDER (26, 33). The FUNCTION RISE SLIDER (25, 32) sets the amount of time the Function takes to reach 5v and the FUNCTION FALL SLIDER (26, 33) 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.

Midi Control
Midi control of the Function Generators is optional and can be assigned to each Function Generator independently. Midi control triggers the Function Generators with midi note on/off messages. To enable or disable the Function Generator midi response, press and hold the MIDI EDIT BUTTON (4) then press the FUNCTION MODE BUTTON (27, 34). The corresponding yellow MIDI LED will illuminate to show that midi response is active.

Function Generator Section (2 of 4)



Response 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
Sustain Mode allows the function generator to act as an attack (rise), sustain, release (fall) envelope, a slew generator, an envelope follower. A gate or CV signal patched into the FUNCTION INPUT JACK (77, 85) initiates the rise stage. 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 FUNCTION INPUT JACK (77, 85) remains high. The fall stage is triggered once the incoming gate or CV signal drops to 0v. The envelope generated in sustain mode can be retriggered at anytime during the attack (rise), sustain, or decay (fall) stages. The FUNCTION A END OF RISE GATE OUTPUT JACK(79) does not function in Sustain Mode.

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. The rise stage of trigger mode is triggered with a gate or trigger signal patched into the FUNCTION INPUT JACK (77, 85) over 2 volts. 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.

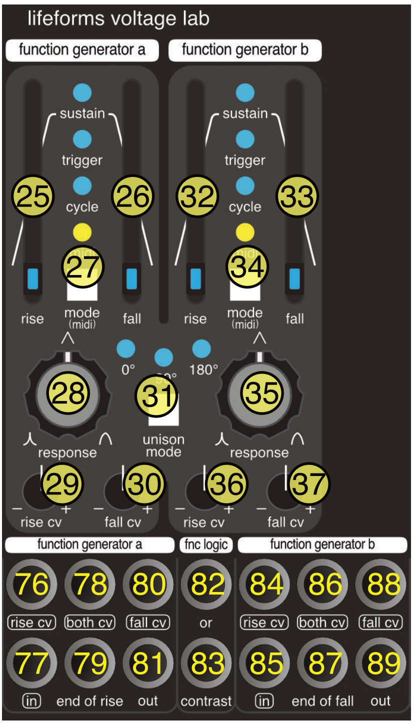
Cycle Mode
Cycle Mode is an extension of trigger mode and utilizes all the same feature set. To create the loop, the function generator uses the end of fall trigger created at the end of the cycle to retrigger the rise creating a voltage controllable low frequency oscillator and clock source.

Cycle through the three modes by pressing the FUNCTION MODE BUTTON (27, 34).

Function Generator Options

1. Sustain Mode
2. Trigger Mode
3. Cycle Mode

Function Generator Section (3 of 4)



Response Curve

The FUNCTION RESPONSE KNOB (28, 35) determines the linearity of the Rise and Fall stages from logarithmic through linear to exponential. Turning the FUNCTION RESPONSE KNOB (28, 35) full left creates a logarithmic response. At 12 o'clock the response is linear. Turning the FUNCTION RESPONSE KNOB (28, 35) beyond 12 o'clock creates an exponential response.

Unison

The pair of Function Generators can be used independently or linked together to create complex modulations. Unison mode assigns how Function Generator B is triggered by Function Generator A. Three options are available. 0 degrees, 90 degrees, and 180 degrees.

0 Degrees
0 degrees triggers Function Generator B at the beginning of the Function Generator A Rise stage. This results in both Function Generators triggering simultaneously.

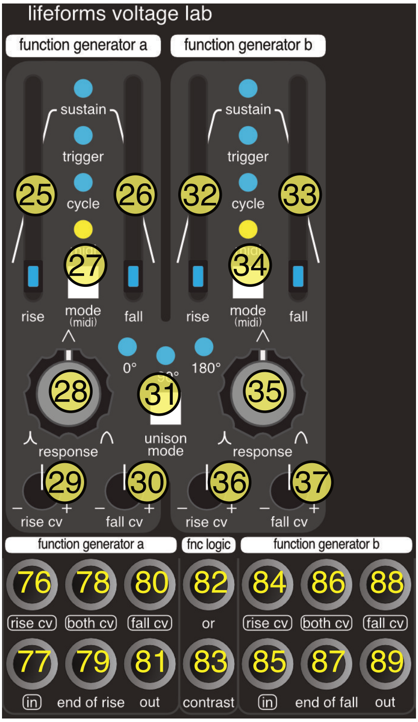
90 Degrees
90 degrees triggers Function Generator B at the end of the Function Generator A Rise stage. The Rise stage is complete when the Function Generator reaches 5 volts.

180 Degrees
180 degrees triggers Function Generator B at the end of the Function Generator A Fall stage. If Function Generator A is in Cycle Mode, after the initial trigger, 0 degrees and 180 degrees share the same trigger signal because the start of the Rise stage is triggered by the End of Fall trigger.

Cycle through the modes by pressing the FUNCTION B UNISON MODE BUTTON (31).

Unison Mode Options
1. Off
2. 0 Degrees
3. 90 Degrees
4. 180 Degrees
5. 0 & 90 Degrees
6. 90 & 180 Degrees
7. 0 & 180 Degrees
8. 0 & 90 & 180 Degrees

Function Generator Section (4 of 4)



Voltage Control of Rise and Fall Times

Voltage control over the Rise time, Fall time, and both Rise and Fall time are independently available for Function Generator A and Function Generator B.

A CV signal can be patched to the FUNCTION RISE CV INPUT (76, 84), FUNCTION FALL CV INPUT (80, 88), or FUNCTION BOTH CV INPUT (78, 86). Patching into the FUNCTION RISE CV INPUT (76, 84) passes signal to the FUNCTION RISE CV TRIMMER (29, 36). Patching into the FUNCTION FALL CV INPUT (30, 37) passes signal to the FUNCTION FALL CV TRIMMER (30, 37). Patching into the FUNCTION BOTH CV INPUT (999, 999) passes signal to both the FUNCTION RISE CV TRIMMER (29, 36) and the FUNCTION FALL CV TRIMMER (30, 37). The FUNCTION RISE CV INPUT (76, 84), FUNCTION FALL CV INPUT (80, 88), and FUNCTION BOTH CV INPUT (78, 86) can be used simultaneously.

The RISE CV TRIMMER (29, 36) and FALL CV TRIMMER (30, 37) are attenuverters. That means the incoming signal is off when the trimmer is set to the 12 o’clock position. Turning the attenuverter to the right passes the original signal through. Turning the attenuverter to the left passes an inverted version of the original signal through. Turning the RISE CV TRIMMER (29, 36) or FALL CV TRIMMER (30, 37) to the right will increase the amount of CV passed through to the Rise stage or Fall stage. Turning the RISE CV TRIMMER (29, 36) or FALL CV TRIMMER (30, 37) to the left will increase the amount of inverted CV passed through to the Rise stage or Fall stage. Locating the exact off position of an attenuverter can be difficult. The easiest wave to remove the CV signal from the signal path is to simply remove the patch cable patched into the FUNCTION RISE CV INPUT (76, 84), FUNCTION FALL CV INPUT (80, 88), or FUNCTION BOTH CV INPUT (78, 86).

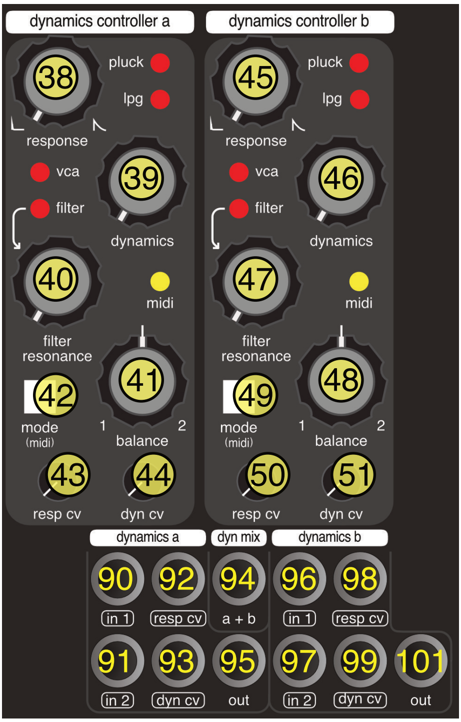
Logical Outputs

The Function Generator section utilizes two different logical mixing circuits to combine the output of Function Generator A and Function Generator B.

The OR OUTPUT JACK (82) compares the output voltage of Function Generator A with the output voltage of Function Generator B and passes the output voltage of the Function Generator with the highest voltage.

The CONTRAST OUTPUT JACK (83) outputs the voltage difference between the output voltage of Function Generator A and Function Generator B.

Dynamics Controller Modules



Module Overview

The Dynamics Controllers play a large part in shaping the output of the Voltage Lab by utilizing a unique processing circuit that adds dimension to the sound. The Voltage Lab includes a pair of identical Dynamics Controllers for signal processing. The Dynamics Controller is a modern interpretation of Don Buchla's famous "lopass" gate. The lowpass gate circuit is unique in the way that it simulates the characteristics of the natural world. When used in filter mode or 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.

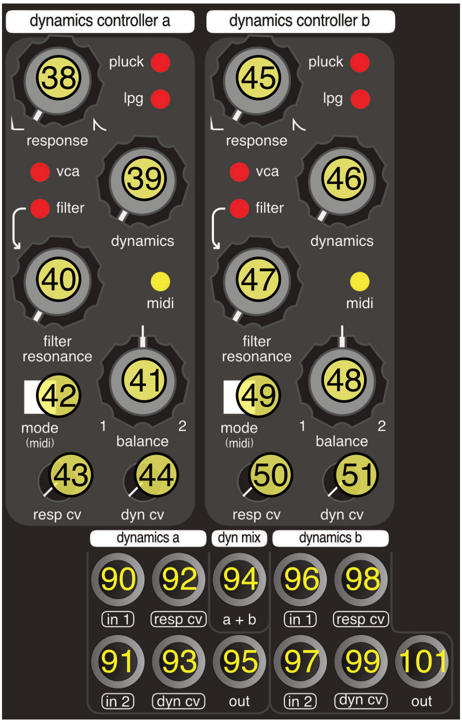
The original lowpass gate was limited to a static response time that varied from unit to unit. This made each lowpass gate a little different. The Dynamics Controllers in the Voltage Lab expands on the original Don Buchla concept by adding a unique, DYNAMICS RESPONSE KNOB (38, 45) allowing for customizable gate response times. The dynamics response time can be voltage controlled using the DYNAMICS RESPONSE CV INPUT JACK (92, 98) and DYNAMICS RESPONSE CV TRIMMER (43, 50).

The pluck response can be used with filter and low pass gate modes. 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. Filter Mode and Low Pass Gate Mode respond differently to the pluck circuit. Low Pass Gate Mode responds with a tighter percussive strike closely matching the response of Don Buchla's original low pass gate circuit. Filter Mode responds with a fuller percussive response.

Midi Control

Midi control of the Dynamics Controllers is optional and can be assigned to each Dynamics Controller independently. Midi control triggers the Dynamics Controllers with midi note on/off messages. To enable or disable the Dynamics Controller midi response, press and hold the MIDI EDIT BUTTON (4) then press the DYNAMICS MODE BUTTON (42, 49). The corresponding yellow MIDI LED will illuminate to show that midi response is active.

Dynamics Controller Section (2 of 8)



Processing Modes

The Dynamics Controller offers 3 distinct audio processing modes. VCA, Filter, and Low Pass Gate. Each mode creates a unique sound and feature set for signal processing. Cycle through all the available Processing Modes, including plucked versions by pressing the DYNAMICS MODE BUTTON (42, 49).

Dynamics Controller Processing Modes

1. VCA Mode
2. Filter Mode
3. Plucked Filter Mode
4. Low Pass Gate Mode
5. Plucked Low Pass Gate Mode

VCA Mode

In VCA Mode the Dynamics Controller acts as a transparent voltage controlled amplifier. The DYNAMICS RESPONSE KNOB (38, 45) and DYNAMICS FILTER RESONANCE (40, 47) knobs have no effect on the incoming signal. Plucked Response is also not available.

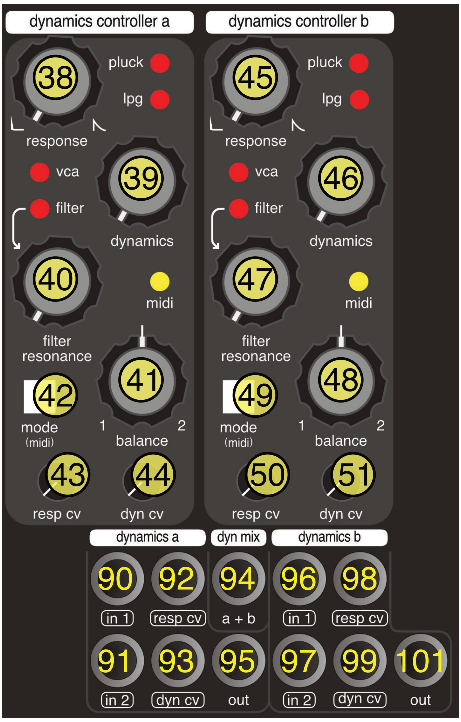
The DYNAMICS KNOB (39, 46) acts as a pass through for the incoming signal. Turn the DYNAMICS KNOB (39, 46) to the right to manually open up the VCA and allow the incoming signal to pass. When using the DYNAMICS CV INPUT JACK (93, 99) and DYNAMICS CV TRIMMER (44, 51), the DYNAMICS KNOB (39, 46) acts as the starting point for the incoming signal.

The INPUT BALANCE KNOB (41, 48) sets the level of the incoming signals and can work 3 different ways depending on which inputs are used. A signal is patched into DYNAMICS INPUT 1 JACK (90, 96). Turning the INPUT BALANCE KNOB (41, 48) to the left increases the input signal level. A signal is patched into DYNAMICS INPUT 2 JACK (91, 97). Turning the INPUT BALANCE KNOB (41, 48) to the right increases the input signal level.

A signal is patched into DYNAMICS INPUT 1 JACK (90, 96) and DYNAMICS INPUT 2 JACK (91, 97). The INPUT BALANCE KNOB (41, 48) acts as a balance control. Turning the knob to the left weighs the output toward Input 1. Turning the knob to the right weighs the output toward Input 2. Setting the INPUT BALANCE KNOB (41, 48) at 12 o'clock creates an even mix of DYNAMICS INPUT 1 JACK (90, 96) and DYNAMICS INPUT 2 JACK (91, 97).

Patching a CV signal into the DYNAMICS CV INPUT JACK (93, 99) and adjusting the DYNAMICS CV TRIMMER (44, 51) controls the level of the signal sent to the DYNAMICS

Dynamics Controller Section (3 of 8)



Filter Mode

The Filter Mode of the Dynamics Controllers is unique in range and response. The filter uses a conical Sallen-Key filter core to create a resonant 2-pole low pass filter with a warm and smooth response over the entire audio range. The response curve of the filter core in implemented in a way that allows it to remove all audible frequencies and eliminate the need for a VCA.

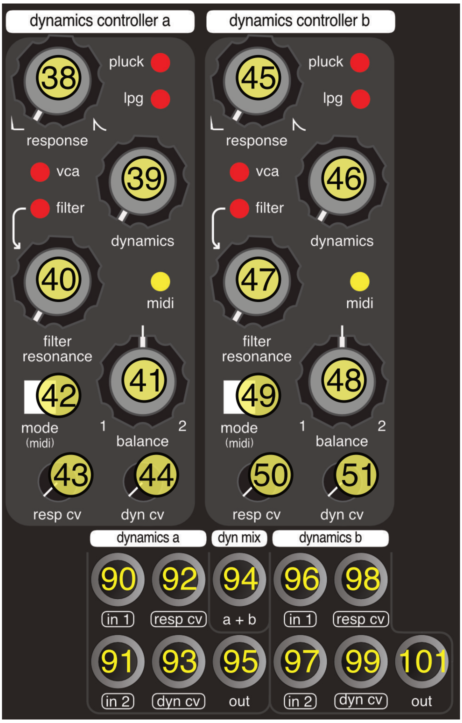
The Dynamics Controllers have been tuned in a way that traditional Low Pass Gate Mode effects can be achieved using the Filter Mode. Incorporating the ability to pluck the filter with variable response time, smooth resonance, and full frequency range sweep create an organic and unique dynamics manager.

Pluck Response
Utilize a sharp gate or envelope signal to pluck or strike the Dynamics Controller in a percussive way. Pluck uses the DYNAMICS CV INPUT JACK (93, 99) but bypasses the DYNAMICS CV TRIMMER (44, 51) to create the percussive effect. Turn the DYNAMICS CV TRIMMER (44, 51) full left to hear just the plucked response. Turn the DYNAMICS CV TRIMMER (44, 51) to the right to blend the pluck response with the incoming CV signal.

The DYNAMICS RESPONSE KNOB (38, 45) controls the decay time of the incoming DYNAMICS CV INPUT JACK (93, 99) signal. In Filter Mode, this control uses analog circuitry to expand the response of the Vactrol component used in Don Buchla’s original low pass gate circuit creating a musically pleasing organic envelope. The response curve of a Vactrol creates a natural sounding envelope to shape sounds. However, each Vactrol is limited to a single response and no Vactrol responds the same. That’s a problem. Emulating the response characteristics of the Vactrol with analog circuitry offers precise and reproducible control over the response of the Dynamics Controller. Turning the DYNAMICS RESPONSE KNOB (38, 45) to the right increases the decay time. When using the DYNAMICS RESPONSE CV INPUT JACK (92, 98) and DYNAMICS RESPONSE CV TRIMMER (43, 50), the DYNAMICS RESPONSE KNOB (38, 45) acts as the starting point for the incoming signal.

The DYNAMICS KNOB (39, 46) controls the filter sweep and acts as a pass through for the incoming signal. Turn the DYNAMICS KNOB (39, 46) to the right to manually open up the Filter, adding back harmonics and allowing the incoming signal to pass. When using the DYNAMICS CV INPUT JACK (93, 99), the DYNAMICS KNOB (39, 46) acts as the starting point for the incoming signal.

Dynamics Controller Section (4 of 8)



The DYNAMICS FILTER RESONANCE CONTROL KNOB (41, 48) adjusts the amount of resonance added to the audio signal. Turning the DYNAMICS FILTER RESONANCE CONTROL KNOB (41, 48) to the right increases the resonance.

The INPUT BALANCE KNOB (41, 48) sets the level of the incoming signals and can work 3 different ways depending on which inputs are used.

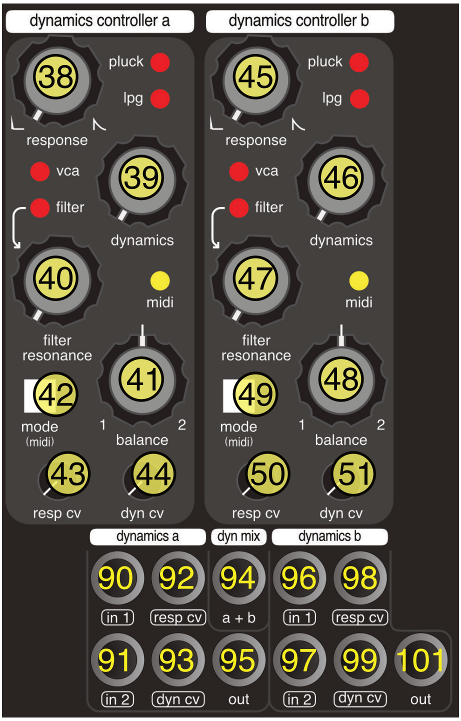
A signal is patched into DYNAMICS INPUT 1 JACK (90, 96). Turning the INPUT BALANCE KNOB (41, 48) to the left increases the input signal level.

A signal is patched into DYNAMICS INPUT 2 JACK (91, 97). Turning the INPUT BALANCE KNOB (41, 48) to the right increases the input signal level.

A signal is patched into DYNAMICS INPUT 1 JACK (90, 96) and DYNAMICS INPUT 2 JACK (91, 97). The INPUT BALANCE KNOB (41, 48) acts as a balance control. Turning the knob to the left weighs the output toward Input 1. Turning the knob to the right weighs the output toward Input 2. Setting the INPUT BALANCE KNOB (41, 48) at 12 o'clock creates an even mix of DYNAMICS INPUT 1 JACK (90, 96) and DYNAMICS INPUT 2 JACK (91, 97).

Patching a CV signal into the DYNAMICS CV INPUT JACK (93, 99) and adjusting the DYNAMICS CV TRIMMER (44, 51) controls the level of the signal sent to the DYNAMICS OUTPUT JACK (95, 101) Increasing the incoming CV will increase the output level.

Dynamics Controller Section (5 of 8)



Low Pass Gate Mode

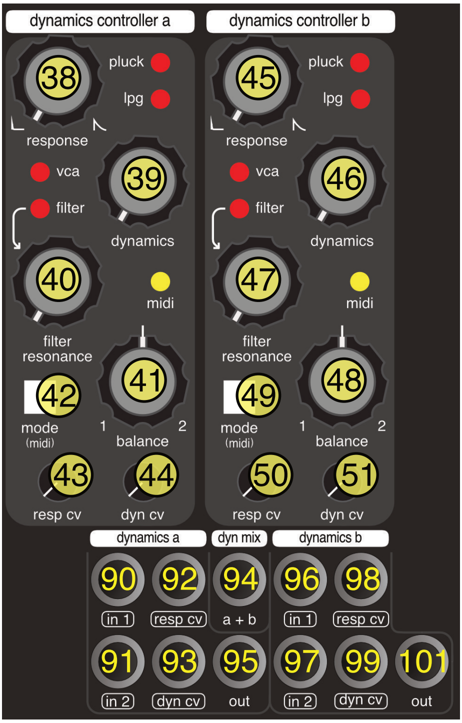
The response of the Low Pass Gate Mode sits somewhere between VCA Mode and Filter Mode. The traditional description of a low pass gate is that it combines a VCA and filter together to allow the circuit to manage both amplitude and harmonic content. Removing harmonics as the low pass gate closes and adding back the harmonics as it opens. The way it achieves this is by creating a non-conical “1½ pole” filter. The second pole of the filter moves in such a way that changes the response of the pole from low pass to more of a bandpass response creating a softer response. The response of the low pass gate is implemented in a way that allows it to remove all audible frequencies and eliminate the need for a VCA.

Pluck Response
Use a gate, trigger, or envelope signal to pluck or strike the Dynamics Controller in a percussive way. Pluck uses the DYNAMICS CV INPUT JACK (93, 99) but bypasses the DYNAMICS CV TRIMMER (44, 51) to create the percussive effect. Turn the DYNAMICS CV TRIMMER (44, 51) full left to hear just the plucked response. Turn the DYNAMICS CV TRIMMER (44, 51) to the right to blend the pluck response with the incoming CV signal.

The DYNAMICS RESPONSE KNOB (38, 45) controls the decay time of the incoming DYNAMICS CV INPUT JACK (93, 99) signal. This control uses analog circuitry to closely emulate the response of the Vactrol component used in Don Buchla’s original low pass gate circuit. The response curve of a Vactrol creates a natural sounding envelope to shape sounds. However, each Vactrol is limited to a single response and no Vactrol responds the same. That’s a problem. Emulating the response characteristics of the Vactrol with analog circuitry offers precise and reproducible control over the response of the Dynamics Controller. Turning the DYNAMICS RESPONSE KNOB (38, 45) to the right increases the decay time. When using the DYNAMICS RESPONSE CV INPUT JACK (92, 98) and DYNAMICS RESPONSE CV TRIMMER (43, 50), the DYNAMICS RESPONSE KNOB (38, 45) acts as the starting point for the incoming signal.

The DYNAMICS FILTER RESONANCE CONTROL KNOB (41, 48) does not add traditional resonance to the signal, instead it adds a high frequency snap to the audio output. Turning the DYNAMICS FILTER RESONANCE CONTROL KNOB (41, 48) to the right increases the high frequency snap.

Dynamics Controller Section (6 of 8)



The INPUT BALANCE KNOB (41, 48) sets the level of the incoming signals and can work 3 different ways depending on which inputs are used.

A signal is patched into DYNAMICS INPUT 1 JACK (90, 96). Turning the INPUT BALANCE KNOB (41, 48) to the left increases the input signal level.

A signal is patched into DYNAMICS INPUT 2 JACK (91, 97). Turning the INPUT BALANCE KNOB (41, 48) to the right increases the input signal level.

A signal is patched into INPUT BALANCE KNOB (41, 48) and DYNAMICS INPUT 2 JACK (91, 97). The INPUT BALANCE KNOB (41, 48) acts as a balance control. Turning the knob to the left weighs the output toward Input 1. Turning the knob to the right weighs the output toward Input 2. Setting the INPUT BALANCE KNOB (41, 48) at 12 o'clock creates an even mix of DYNAMICS INPUT 1 JACK (90, 96) and DYNAMICS INPUT 2 JACK (91, 97).

Patching a CV signal into the DYNAMICS CV INPUT JACK (93, 99) and adjusting the DYNAMICS CV TRIMMER (44, 51) controls the level of the signal sent to the DYNAMICS OUTPUT JACK (95, 101) Increasing the incoming CV will increase the output level.

Mix Output

The Dynamics Controller section includes an DYNAMICS MIX OUTPUT JACK (94) that combines the outputs of both Dynamics Controllers.

Analog Delay Module

Module Overview

The Analog Delay utilizes a pair of 4,096 stage BBD chips to produce a voltage controllable analog delay signal. Clean delay time can vary from 16ms to 340ms. The maximum delay time can be increased using the TIME CV INPUT (999), delay time maxes out at 465ms but the increased time comes at the cost of fidelity and a bit of high frequency clock noise bleed.

The name BBD stands for bucket brigade device in reference to a line of people passing buckets of water to quickly extinguish a fire. Each stage of a BBD chip contains a single capacitor. Pairing two chips together creates a chain of 8,192 capacitors. Like the water buckets, an audio signal is passed from capacitor to capacitor within the BBD chips once every clock step. A slower clock produces a longer delay and a faster clock produces a shorter delay.

Delay time

Delay time is set by adjusting the DELAY TIME KNOB (52). Turning the knob to the right increases the delay time. Delay time can be voltage controlled by patching into the DELAY TIME CV INPUT JACK (100) and adjusting the DELAY TIME CV TRIMMER (55). The DELAY TIME CV TRIMMER (55) is an attenuverter. That means the incoming signal is off when the trimmer is set to the 12 o'clock position. Turning the attenuverter to the right passes the original signal through. Turning the attenuverter to the left passes an inverted version of the original signal through. Turning the DELAY TIME CV TRIMMER (55) to the right will increase the amount of CV passed through to the delay time. Turning the DELAY TIME CV TRIMMER (55) to the left will increase the amount of inverted CV passed through to the delay time. Locating the exact off position of an attenuverter can be difficult. The easiest wave to remove the CV signal from the signal path is to simply remove the patch cable patched into the DELAY TIME CV INPUT JACK(100).

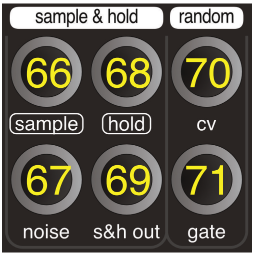
Feedback

The DELAY FEEDBACK KNOB (53) sets the amount of repeats created by the delay. Turning the DELAY FEEDBACK KNOB (53) full left will produce 1 repeat. Turning the knob to the right increases the number of repeats until the delay begins to self-oscillate.

Output Mix

The DELAY MIX KNOB (54) acts as a balance control between the dry incoming signal and the wet delayed signal. Turning the DELAY MIX KNOB (54) to the left weighs the output toward the dry signal. Turning the DELAY MIX KNOB (54) to the right weighs the output toward the wet signal. In theory, setting the DELAY MIX KNOB (54) at 12 o'clock creates an even mix of the wet and dry signals. In reality, the tolerance of the potentiometer, waves shape, and dry signal level all influence the location of an even 50/50 mix.

Random Tools Modules



Module Overview

The Random Tools section contains 3 distinct synthesis tools. Noise, Sample & Hold and Random.

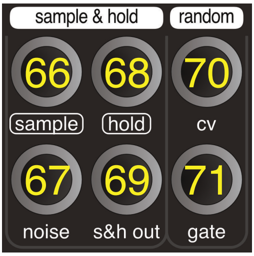
Noise

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 OUTPUT JACK (67) is normalized to the SAMPLE & HOLD HOLD INPUT JACK (68).

Sample & Hold

The Sample & Hold circuit samples the voltage patched to the SAMPLE & HOLD SAMPLE INPUT JACK (66) and outputs that voltage until a new sample voltage is taken. A sample is taken when the SAMPLE & HOLD HOLD INPUT JACK (68) receives a positive gate or trigger. The sample source can be audio or cv.

Random Tool Modules (2 of 2)



Random

Inspired by the random source on the Buchla Music Easel, the complex random generator on the Voltage Lab is a digitally controlled random source generating both gate and CV signals. The random generator functions similar to an analog, 6 stage shift register. 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 6 step sequencer. The random generator cycles through the 6 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 6 step pattern cycle.

Random Density
The density of the CV and gate outputs can be cycled between 5 density levels and voltage control. Press and hold the MIDI EDIT BUTTON (4) then press the PRIMARY MODULATION DESTINATION BUTTON (13) to cycle through the available random density levels.

Random Density Options

10% Initial Chance = SINE LED
20% Initial Chance = SINE & TRIANGLE LED
30% Initial Chance = SINE & TRIANGLE & SAW LED
50% Initial Chance = SINE & TRIANGLE & SAW & SQUARE LED
70% Initial Chance = SINE & TRIANGLE & SAW & SQUARE & WARP LED

Voltage Controlled Random Density = SINE & TRIANGLE & SAW & SQUARE & WARP & FM & WAVE & AM & RING LED

Voltage Controlled Random Density
The voltage controlled random density mode is controlled using the PRIMARY MODULATION CV INPUT JACK (63) and PRIMARY MODULATION CV INPUT TRIMMER (17). Because the voltage controlled random density mode shares the PRIMARY MODULATION CV INPUT JACK (63) and PRIMARY MODULATION CV INPUT TRIMMER (17) with the Primary Oscillator, think of this feature as an Easter egg. It would have been nice to include a dedicated input jack with dedicated trimmer but the space was not available.

More Information

Eurorack Specs

Panel size: 48hp.
Module depth: 35mm.
Power consumption: +12v 525mA, -12v 400mA. Does not require +5v. 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.

Warranty

For a period of one year after the date of original purchase, the Lifeforms Voltage Lab manufactured by Pittsburgh Modular Synthesizers LLC, is warranted to function properly and be free of defects in materials and workmanship. Should a factory installed hardware fail during the warranty period, contact Pittsburgh Modular Synthesizers LLC. We will repair it (or at our option, replace it) at no charge, and pay the cost of shipping it back to you. This warranty is void if in our opinion the Lifeforms Voltage Lab has been damaged by accident, mishandled, altered, improperly serviced, or repaired by the customer where such treatment has affected its performance or reliability. This includes but is not limited to damage related to incorrectly attaching power ribbon cables. In the event of such misuse/abuse by the customer, costs for repairs plus two-way shipping costs will be borne by the customer. Products found defective should be returned to the factory carefully packed, as the customer will be responsible for freight damage. Incidental or consequential damages or costs incurred as a result of product malfunction are not the responsibility of Pittsburgh Modular Synthesizers LLC.

Service and Contact Information

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

www.pittsburghmodular.com/contact

Pittsburgh Modular Synthesizers