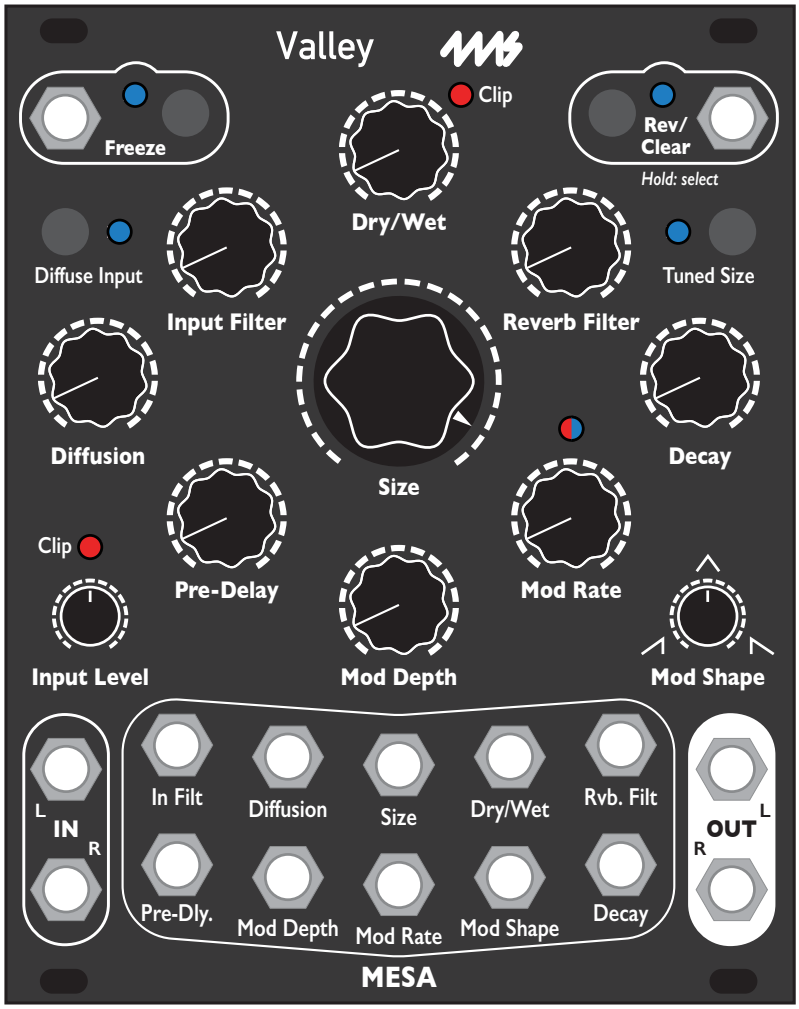
Mesa

4ms Company + Valley Audio



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4mscompany.com/mesa

Table of Contents

Features....5
Getting Started....7

Theory of Operation

The Dattorro Algorithm....8
Input Stage....8
Reverberation Tank....9
Modulation....10
Diagram....11

Jacks and Controls

Audio Jacks....12
CV and Gate Jacks....13
Input and Mixing....14
Reverb Tank Parameters....16
Rev/Clear Button....18
Freeze Button....19
Modulation....20

Tips and Tricks

Reverb Tips....22
Creative Uses....25

System

Upgrading Firmware....28
Listen IO Connections....29
Electrical and Mechanical Specifications....30
Acknowledgements....31

Mesa is a high-fidelity stereo plate reverb Eurorack module developed by Valley Audio and 4ms. It’s based on Valley Audio's beloved Plateau module for VCV Rack and uses the Dattorro plate reverb algorithm at its core. **Mesa** faithfully recreates the original algorithm and sonic character while introducing some new features and a streamlined hardware interface designed specifically for modular synthesis.

Running at 96 kHz with 64-bit double-precision processing, **Mesa** delivers exceptional clarity and depth, transforming dry, lifeless patches into rich, spacious soundscapes without sacrificing musical control. Whether adding dimension to a simple voice, creating expansive ambient environments, or exploring experimental sound design, **Mesa** provides the lush, multi-dimensional character that has made the Dattorro plate reverb a modern classic.

Mesa offers deep access to the reverb engine itself. Shape the virtual plate with controls for **Size**, **Diffusion**, and **Decay.** Play with **Pre-Delay** to simulate large spaces or adjust echo timing, and control the tone with independent input and reverb filters. Four internal modulation LFOs continuously animate the delay network, suppressing ringing while adding subtle movement, chorusing, pitched echoes, swirling textures, and evolving atmospheres. Extensive CV control allows nearly every parameter to be animated and integrated into modular patches.

Mesa includes several unique performance features that extend beyond conventional reverb. **Hold** freezes the reverb buffer into an infinitely sustaining, continuously evolving pad. **Reverse** reverses the input into the reverb tank, produce unworldly backwards reverb effects. **Clear** instantly purges the reverb tank for dramatic gated effects or to

reset complex feedback. **Tuned Mode** retunes the delay network and all-pass filters for exponential pitch CV tracking, transforming the reverb into a playable resonator capable of melodic and harmonic textures.

With automatic mono-to-stereo normalization, a switchable input diffusion stage, dedicated hardware controls, and the same acclaimed algorithm that made Plateau a favorite among VCV Rack users, **Mesa** is equally at home as a pristine studio-quality reverb, an ambient soundscape generator, or a gateway to entirely new sonic territory.

Features

Reverb

- Lush stereo plate reverb based on the Dattorro (1997) algorithm
- Stereo inputs and outputs with automatic mono-to-stereo normalization
- **Size** control adjusts the overall delay time and perceived room size, from tight ambiences to massive, evolving spaces
- **Diffusion** control ranges from distinct echoes to dense, smooth reverberation
- Switchable **Input Diffuser** stage smears and diffuses signals before entering the reverb tank for softer attacks and spread out density
- Independent **Input Filter** and **Reverb Filter** controls shape the tone of both the source signal and reverberation
- **Pre-Delay** provides up to 500ms of delay before the signal enters the reverb network
- **Decay** control ranges from short reflections to expansive, slowly evolving reverberant clouds
- **Dry/Wet** mix control for balancing the original and processed signals

Modulation

- Four internal modulation LFOs continuously modulate delay times to suppress ringing, reduce metallic artifacts, and add organic movement
- **Mod Depth** sets the amount of modulation, from imperceptible motion that prevents ringing to vibrato and chorus swooshes
- **Mod Shape** morphs continuously from rising sawtooth to triangle to falling ramp
- Slightly offset LFO rates create rich stereo movement and evolving textures. **Mod Rate** controls the overall speed of movement

Special Functions

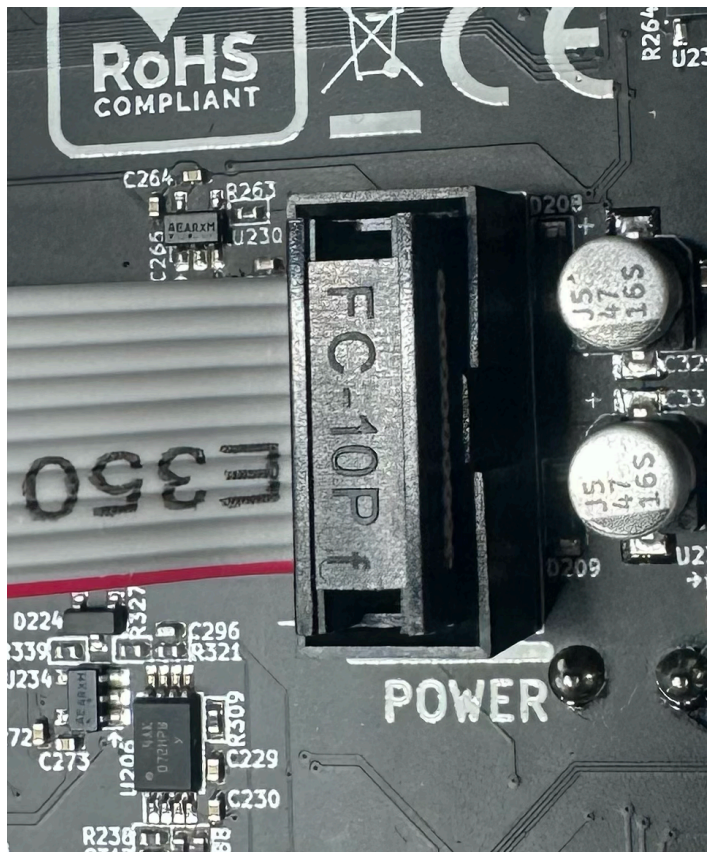
- **Freeze (Hold)** sets decay to infinity, capturing and sustaining the current reverb state as a continuously evolving pad
- **Reverse** plays the incoming audio backwards into the reverb tank, creating reverse swells
- **Clear** instantly purges the reverb buffer. Useful for gated reverb effects or resetting complex feedback textures
- **Tuned Mode** shortens and tunes the delay network and all-pass filters for accurate exponential pitch tracking, allowing the reverb to function as a pitched, playable resonator
- Input and reverb clipping lights monitor signal levels throughout the processing chain
- **Input Level** knob provides gain adjustment from -∞ to +2.4 dB before the reverberation stage

Getting Started

Plugging in your Mesa

1. Power off your Eurorack system.
2. A 10-to-16-pin ribbon cable is included. Attach the 10-pin end to the **Mesa** with the red stripe towards the bottom of the module (matching the white stripe and the words “POWER” and “-12V” written on the PCB). Attach the other end to a 16-pin Eurorack power header on your power supply distribution system, making sure the red stripe matches the -12V side on the power distribution board.
3. Using the included M3 screws (or other screws that fit your rails) securely attach the **Mesa** to the rails of your case.
4. Power on your Eurorack system.

*Note: **Mesa** is reverse-polarity protected, but incorrectly connecting any module can damage any other module on the power bus.*



Theory of Operation

The Dattorro Algorithm

Mesa is based on the digital plate reverb algorithm described by Jon Dattorro in his 1997 paper "Effect Design Part 1: Reverberator and Other Filters." This algorithm digitally simulates the behavior of a physical plate reverb (a large suspended steel plate used in professional recording studios since the 1950s) to add reverb to recordings. While the **Mesa** adds many features that a plate reverb cannot do (reverse effect, infinite decay, clearing/gating, variable diffusion, etc.), it's important to understand the basic concepts of the core algorithm.

The algorithm works in two stages: an input stage and a reverberation tank.

Input Stage

On the **Mesa**, the input signal has a gain control set by the **Input** Level knob. A clipping light indicates if this stage is clipping.
Next, the input signal is optionally reversed (if Reverse mode is enabled), passed through the input filters (**Input Filter** knob/CV), and then pre-delayed (using the **Pre-Delay** knob/CV). If **Diffuse Input** is enabled, the signal is then passed through a series of all-pass filters that smear it in time, creating a diffuse, spread-out signal before the reverb begins.

Reverberation Tank

The reverberation tank is the heart of the algorithm. It consists of two parallel chains of all-pass filters and delay lines, which feed into each other in a cross-coupled loop. This looping structure causes the signal to be continuously re-diffused and re-filtered, building up the dense, complex reflection pattern.

The **Decay** control determines how much of the signal is attenuated each time it passes through the tank. A long decay means the signal loses very little energy on each pass, sustaining for a long time. A short decay loses more energy, and the reverb fades quickly.

The **Reverb Filter** applies low-cut and high-cut filtering to the signal inside the tank. This shapes the tone of the reverb as it decays. Filtering out high frequencies creates warmer, darker reverbs, and filtering out low frequencies creates lighter, airier ones.

The four delay lines and four all-pass filters have different sizes which have been carefully chosen to produce a rich reverb. The left and right output signals are extracted from different tap points in the tank, producing a naturally wide stereo reverb.

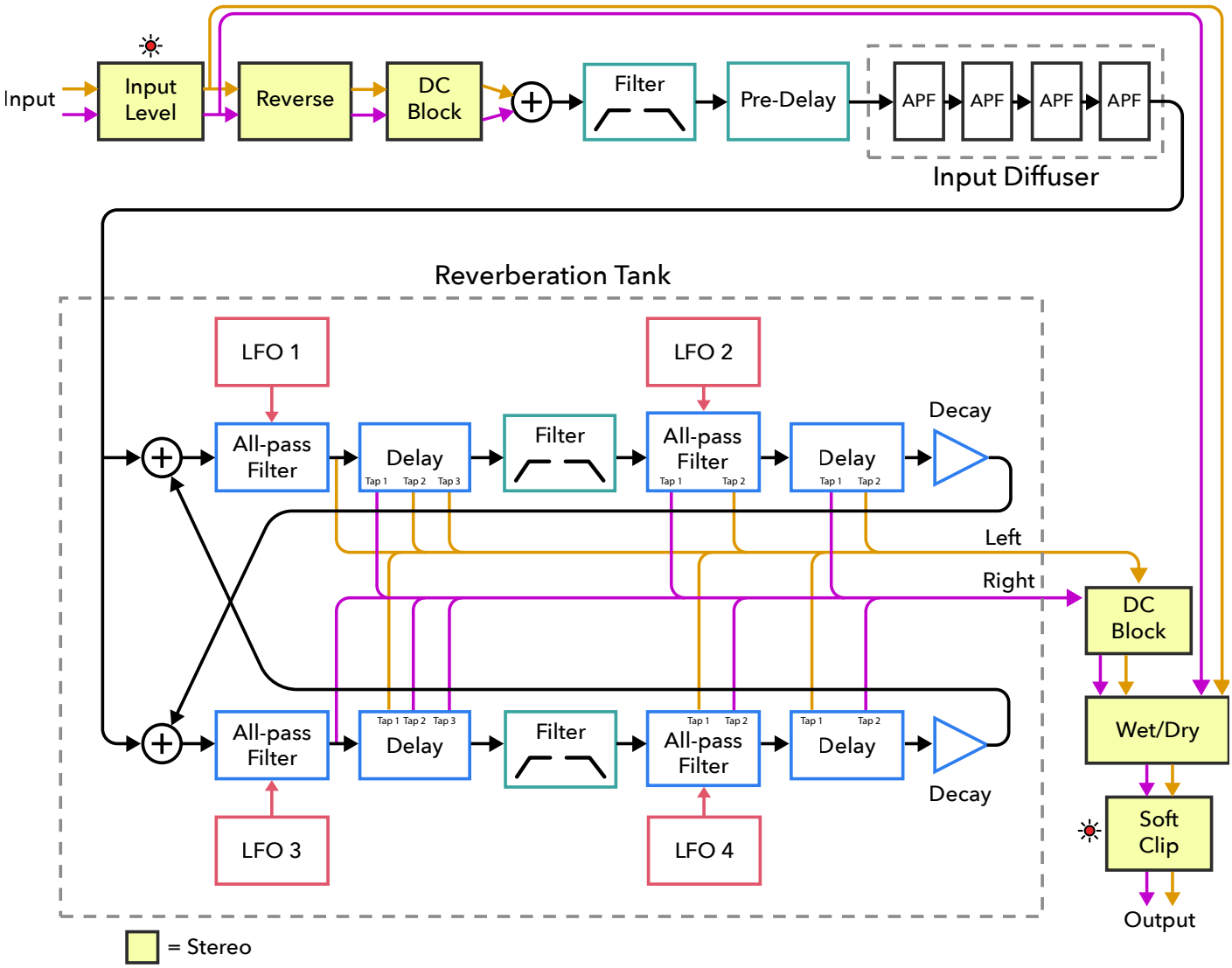
Modulation

Dattorro's original research found that without modulation, resonant ringing artifacts build up in the reverberation tank over time, producing unpleasant metallic overtones. To combat this, **Mesa** uses four low-frequency oscillators (LFOs) tuned to different periods that subtly modulate the delay times of the all-pass filters in the tank.

This serves two purposes. First, the modulation continuously shifts the resonant frequencies of the reverb, preventing any single frequency from building up and ringing. Second, the slowly changing reflection pattern causes the reverb tail to evolve in a natural, organic way — exactly as a real room does, where air currents and imperfect surfaces prevent a perfectly static reverb.

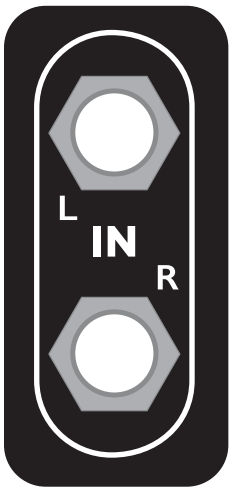
With moderate **Mod Depth** and **Mod Rate** settings, the modulation is subtle and simply keeps the reverb clean and alive. With higher settings, the pitch shifting becomes audible, producing a shimmering, chorus-like quality within the reverb.

Diagram


Input
Input Level
Reverse
DC Block
Filter
Pre-Delay
APF
APF
APF
APF
Input Diffuser
Reverberation Tank
LFO 1
LFO 2
All-pass Filter
Delay
Tap 1 Tap 2 Tap 3
Filter
All-pass Filter
Tap 1 Tap 2
Delay
Tap 1 Tap 2
Decay
Left
Right
DC Block
Wet/Dry
Soft Clip
Output
All-pass Filter
Delay
Tap 1 Tap 2 Tap 3
Filter
All-pass Filter
Tap 1 Tap 2
Delay
Tap 1 Tap 2
Decay
LFO 3
LFO 4
= Stereo

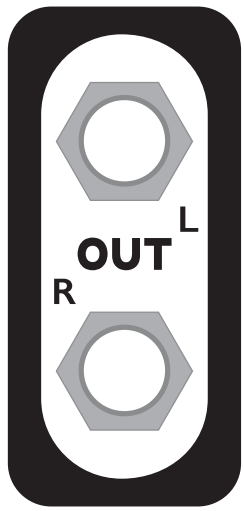
Jacks and Controls

Audio Jacks



Patch any audio source into the **Left In** jack and optionally the **Right In** jack. If you have a mono signal, patch into either input.

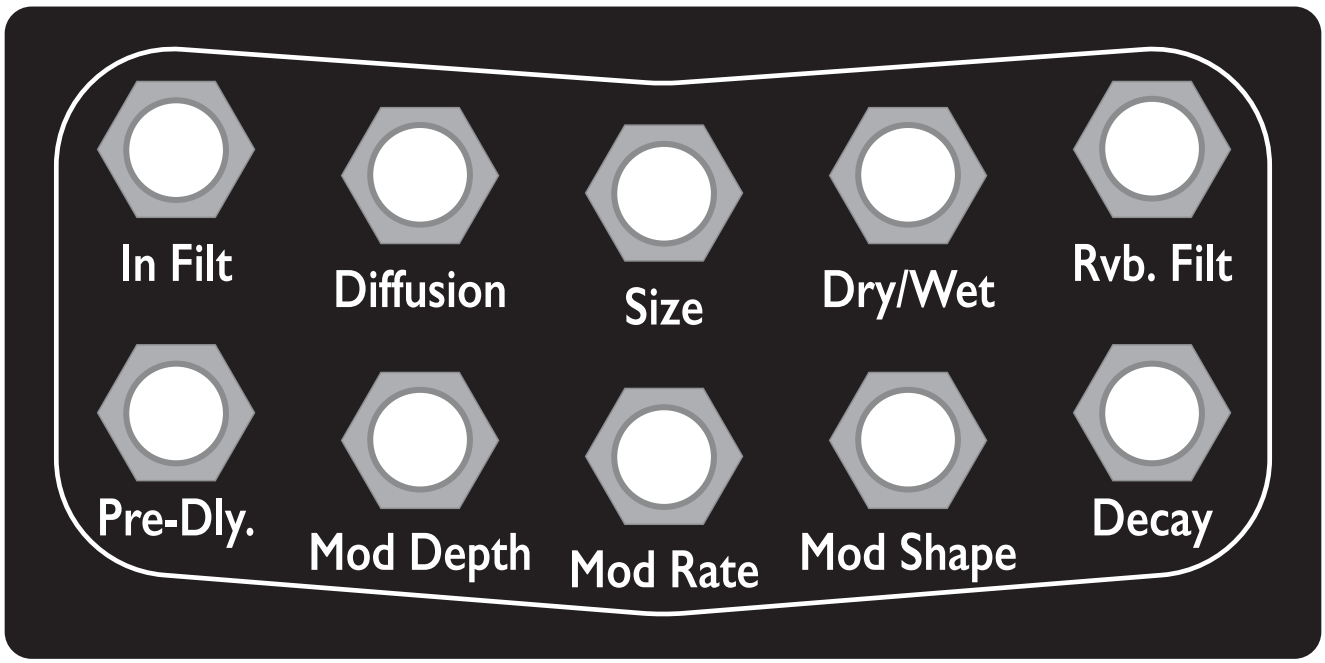
The reverb outputs are always stereo, appearing at **Left Out** and **Right Out**.



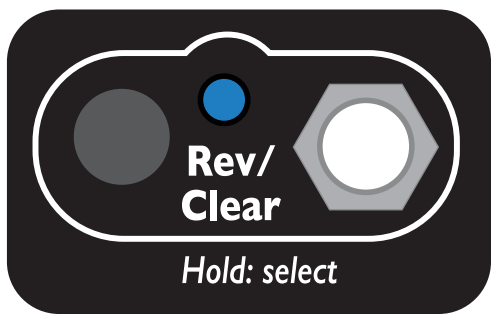
The audio input jacks respond to audio in the range of about -9.6V to +9.6V, and the outputs can produce about the same level. You can adjust the input level with the **Input Level** knob (see *Input and Mixing* section).

CV and Gate Jacks

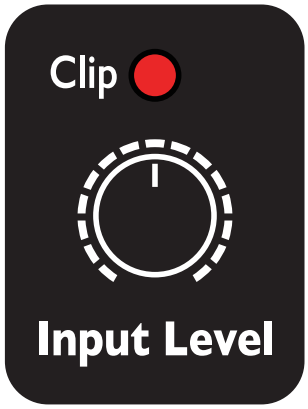
All CV inputs respond to a -5V to +5V range and are summed with their corresponding knob positions. For example, with the knob at 0%, applying between 0V and +5V to the CV jack will be the same as turning the knob to 100% with no CV. If the knob is all the way up at 100%, then applying -5V will be the same as turning the knob to 0% with no CV.



The two gate inputs, **Freeze** and **Rev/Clear**, have a threshold of about 2V.



Input and Mixing

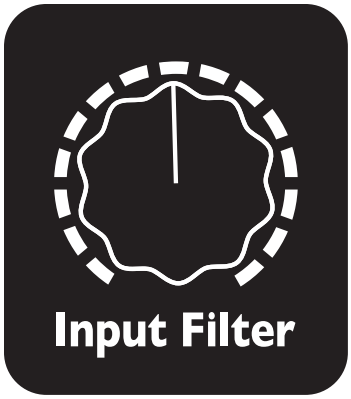


Input Level sets the gain of the signal entering **Mesa** before any reverb processing occurs. The knob ranges from fully silent (-∞dB) to a moderate gain of 1.3x (+2.5dB).

The **Clip** light flashes red when the incoming signal exceeds the safe input ceiling. If the **Clip** light is lit consistently, reduce the **Input Level** knob to avoid clipping. Occasional brief flashes on transient peaks are not necessarily a problem, but if the **Decay** parameter is high, clipping could be induced in the reverb tank.

Dry/Wet crossfades between the original unprocessed signal and the reverberated signal. When turned all the way counterclockwise, only the dry signal passes through. At the fully clockwise position, only the wet reverb signal is heard. The center position gives an even blend of both.

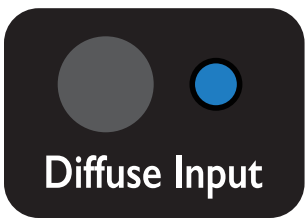
The **Clip** light near the **Dry/Wet** knob flashes when the output signal is close to clipping. The **Dry/Wet** output runs through a soft drive compressor (tanh curve) that kicks in at 75% of the maximum level. When the output of the compressor exceeds 95% of the maximum level, this Clip light turns on. To reduce overdrive distortion, turn the **Input Level**, **Decay**, and/or **Dry/Wet** controls down.



The **Input Filter** knob shapes the tone of the signal before it enters the reverb tank. The knob simultaneously controls a low-cut filter and a high-cut filter on the input, sweeping from a brighter, fuller input when turned up to a darker, narrower input when turned down. Center position lets the full input signal pass with no filtering.

Using the **Input Filter** to roll off high frequencies creates warmer, darker reverbs. Rolling off low frequencies creates reverbs with less muddiness and more sense of space and air.
The **Input Filter** is always active, even when the reverb tank is frozen.

Pre-Delay adds a delay between the input signal and the reverb tank.
When not reversing (that is, when the **Rev/Clear** light is off or dim — see *Rev/Clear* section), this simulates the time it takes for sound to reach the walls of a room by adding a short delay up to one second. Even a few milliseconds can dramatically increase the perceived clarity and separation between the dry signal and the reverb tail, keeping the direct sound present and punchy while still building a lush reverb.
When reversing (that is, when the **Rev/Clear** light is on), the **Pre-Delay** knob and CV control the size of the reverse window. See *Rev/Clear* for details.



The **Diffuse Input** button enables or disables the input diffuser stage. When enabled, the input signal passes through a series of all-pass filters that smear

and spread the signal in time before it enters the reverberator. This creates a smoother, more blended reverb onset. When disabled, the input signal enters the reverb algorithm directly, which results in a sharper, more defined attack and more audible early reflections in the reverb tail.

Disabling **Diffuse Input** is useful when you want the source material to retain its transient character within the reverb, or for creating more distinct echos or unusual, metallic reverb textures.

Reverb Tank Parameters

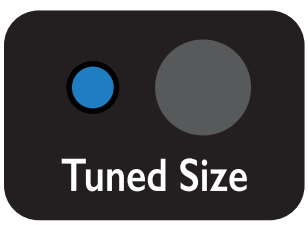
Size sets the overall delay time of the reverb tank, which translates to the apparent physical size of the space being simulated. At minimum, the reverb is very tight and short, like a small room or chamber. At maximum, the reverb becomes extraordinarily long and expansive, suggesting a vast cavern or a space far larger than anything found in nature. The **Tuned Size** button changes how this knob and CV work, see *Tuned Size* for details.

The **Decay** knob controls how quickly the reverb tail fades to silence after the input signal stops. At minimum, the reverb decays quickly and the tail is short. At maximum, the reverb decays extremely slowly, sustaining for a very long time and evolving into a slowly dying cloud of sound. When **Freeze** is activated, this knob and CV are disabled, and the

reverb will sustain indefinitely.

Diffusion controls how smeared and blended the reverb reflections become. At zero diffusion, individual echoes from the reverb algorithm become audible as discrete repeats, similar to a multi-tap delay. As diffusion is increased, those echoes blend together into a smooth, continuous wash of reverberation. Full diffusion results in a dense, smooth reverb tail with no discernible individual echoes. Reducing diffusion can be used creatively to produce unusual metallic or slapback-like textures, distinct echos.

The **Reverb Filter** knob and CV shape the tone of the signal inside the reverberation tank itself. It simultaneously controls the low-cut and high-cut filters that act on the signal as it circulates through the algorithm. When turned up, the higher frequencies build up in the reverb cause a brighter sound. Turning it down rolls off high frequencies, creating a warmer, muffled reverb character reminiscent of old plate reverbs. At the center position, no filtering is done in the reverb tank. When **Freeze** is active, this control is disabled.



The **Tuned Size** button reconfigures the **Size** knob and CV to make it easier to play pitches with the reverb. In Tuned Mode, the delay times in the algorithm are shortened so that feedback resonates in the audio range. The polarity of the CV jack is reversed and the response of the knob and CV together is changed

from linear to exponential. This means that a pitch CV applied to the **Size CV** jack will transpose the reverb in a musical way, allowing it to be "played" like an instrument. Since the delay buffers are intentionally not tuned to each other, the result is not a perfect 1V/octave tracking, but rather the reverb takes on a resonant, almost synth-like quality with distinct musical pitches audible in the decay.

When **Tuned Size** is off, the reverb behaves as a standard plate reverb with no pitch tracking.

Rev/Clear Button

The **Rev/Clear** button has two uses:
- Toggling Reverse mode
- Clearing the reverb tank

Toggling Reverse Mode

By default, tapping the **Rev/Clear** button or sending a trigger into the jack toggles Reverse mode on and off. When the light is dim, Reverse is off and audio is fed into the reverb tank normally through the **Pre-Delay** buffer. Tapping the button turns Reverse mode on. In Reverse mode the light turns on brightly, and audio is reversed before being sent to the reverb tank. The **Pre-Delay** knob and CV control how much audio is recorded before being played in reverse into the reverb tank. Essentially, **Pre-Delay** always controls the amount of delay between the input signal and the reverb tank: in Reverse mode the audio is backwards and in normal mode the audio is forwards. In Reverse mode, the minimum perceived latency between an input signal and the

output, is about 250ms. This is the minimum size of the reversing buffer.

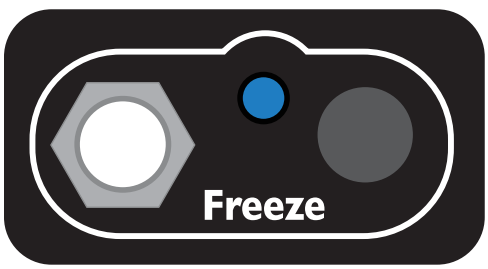
Clearing the Reverb Tank

Holding down the **Rev/Clear** button for 2 seconds will change its function. The light will turn off (not dim or bright) to indicate Clear mode. When you press the button or fire a trigger into the jack, the reverb tank's buffers will be cleared. This creates a sudden silence where the reverb tail was, followed by the reverb responding fresh to incoming signal.

This is extremely useful for creating gated reverb effects: build up a dense reverb, then clear it at rhythmic points to create dramatic space. It is also useful for escaping runaway feedback or chaos in experimental patches. The light will briefly flash to indicate the buffers were cleared whenever you press the button or fire a gate.

Holding the **Rev/Clear** button down again for 2 seconds will change its function back to toggling Reverse mode on/off (the light will be dim or bright).

Freeze Button



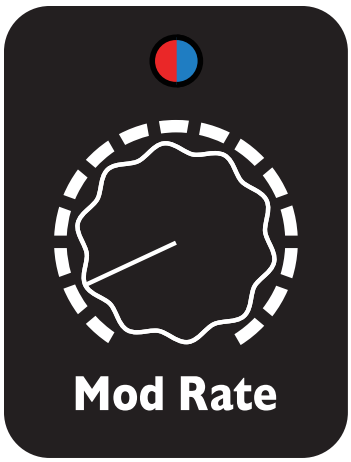
The **Freeze** button freezes the reverb buffer, setting the decay to infinite so the reverb tail sustains indefinitely. While frozen, the reverb tank circulates the audio to create an evolving, self-sustaining pad. The **Freeze** light is lit when the module is in frozen state. The **Reverb Filter** is disabled when frozen, but new incoming audio is shaped by the **Input Filter** before it combines with the feedback.

The **Freeze** jack on the panel also toggles this function. A gate signal activates **Freeze** for as long the signal is above 2V, and releases **Freeze** when it goes below that threshold.This allows the F**reeze** to be triggered rhythmically from a sequencer or clock.

Freeze Latch vs. Momentary

By default **Freeze** is active only while you're pressing the button or holding a gate high. However, you can make **Freeze** latch on/off by pressing both **Freeze** and **Diffuse Input** at the same time. This will change the behavior from momentary to latching for both the button and the jack. To go back to momentary mode, press **Freeze** and **Diffuse Input** at the same time again.

Modulation



Mod Rate knob and CV set the speed of the internal low-frequency oscillators (LFOs) that modulate the delay times in the reverb tank. These LFOs serve two purposes: they prevent unpleasant resonant ringing from building up over time, and they cause the reverb tail to slowly evolve and shift in a natural, organic way.

At low **Mod Rate** settings, the modulation is very slow and subtle. As **Mod Rate** increases, the modulation speed increases, which can introduce pitch shifting and shimmering chorusing effects within the reverb tail.

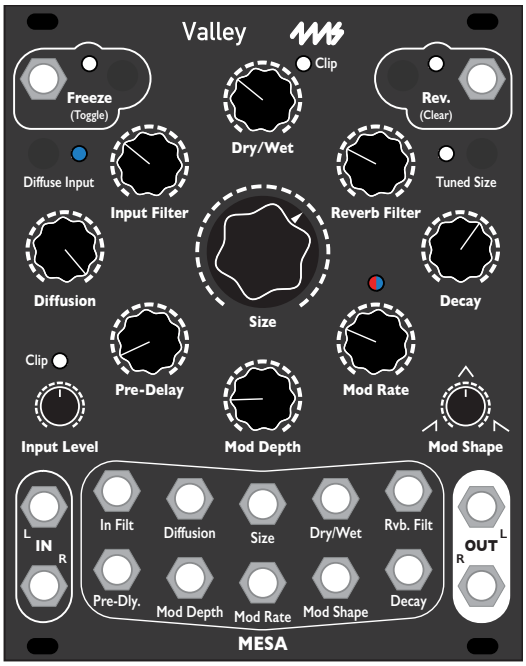
A blue and red light flashes to display the average frequency of the LFOs.

Mod Depth knob and CV control how much the LFOs modulate the delay times. At zero depth, there is no modulation and the reverb has a static, purer character. Turning **Mod Depth** up just a small amount creates an almost intangible amount of modulation that brings a full, richer reverb while suppressing unwanted ringing. As **Mod Depth** increases, a chorusing effect within the reverb tail becomes more pronounced. At high **Mod Depth** settings intense vibrato and a shimmering, detuned quality emerges.
It's recommended to start with **Mod Depth** at about 5%, just enough to prevent ringing feedback but not enough to color the sound.

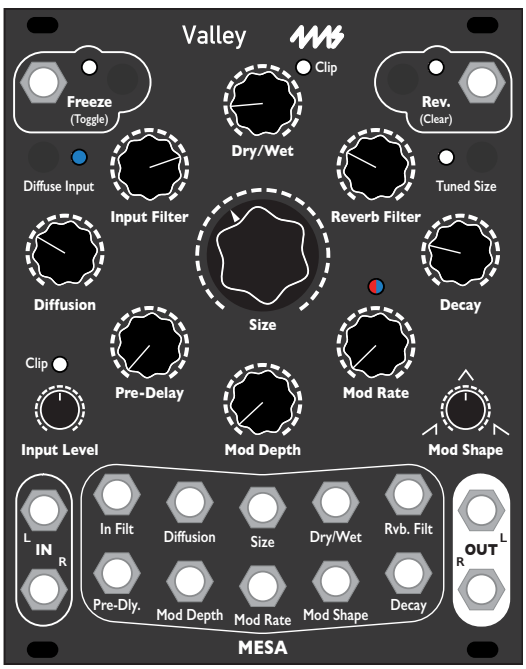
Mod Shape knob and CV set the waveform shape of the modulation LFOs. At one extreme, the LFOs use a rising ramp and at the other they use a falling ramp. In the middle is a balanced triangle wave. At higher **Mod Depth** settings, the choice of **Mod Shape** can have a dramatic effect, on the movement and shimmer in the reverb tail.

Tips and Tricks

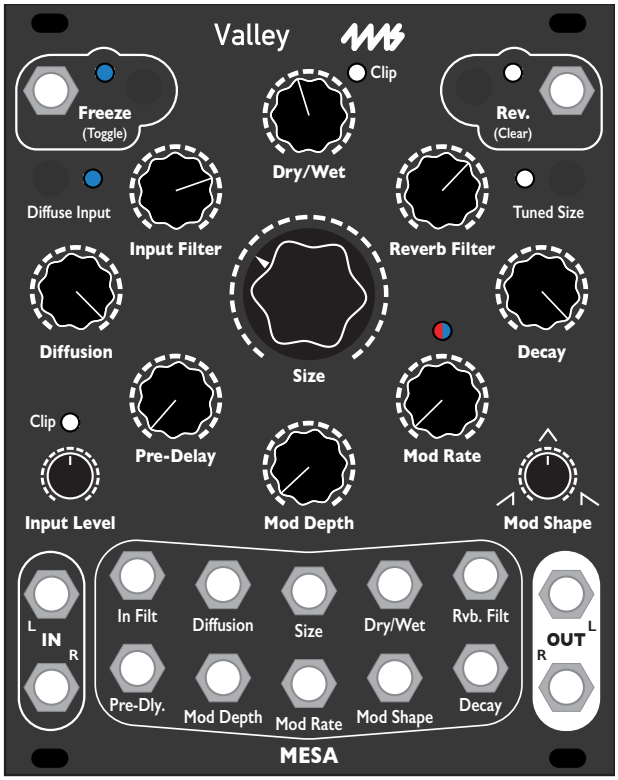
Reverb Tips



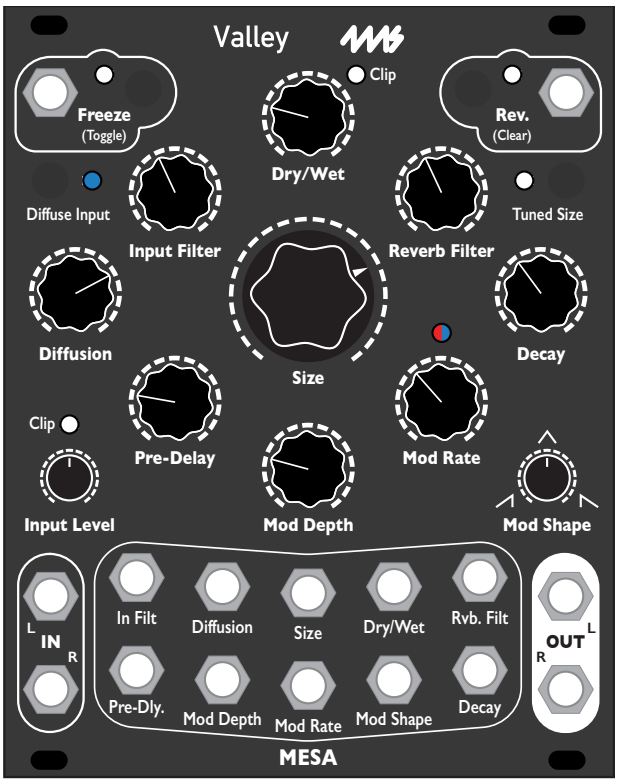
Classic lush plate: The result is a smooth, dense plate reverb suitable for pads, strings, and melodic material.



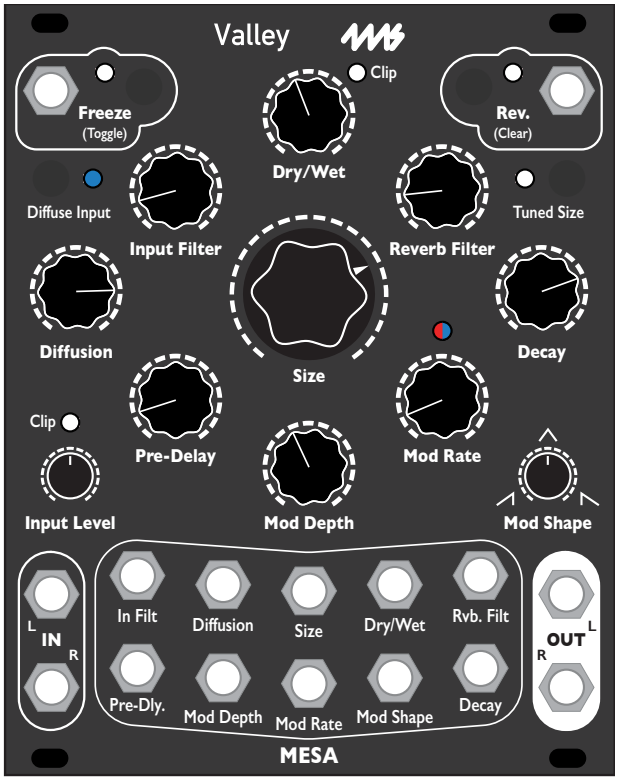
Short, tight room: This creates a believable small room or chamber ambience, useful for adding a sense of space without dominating the mix.



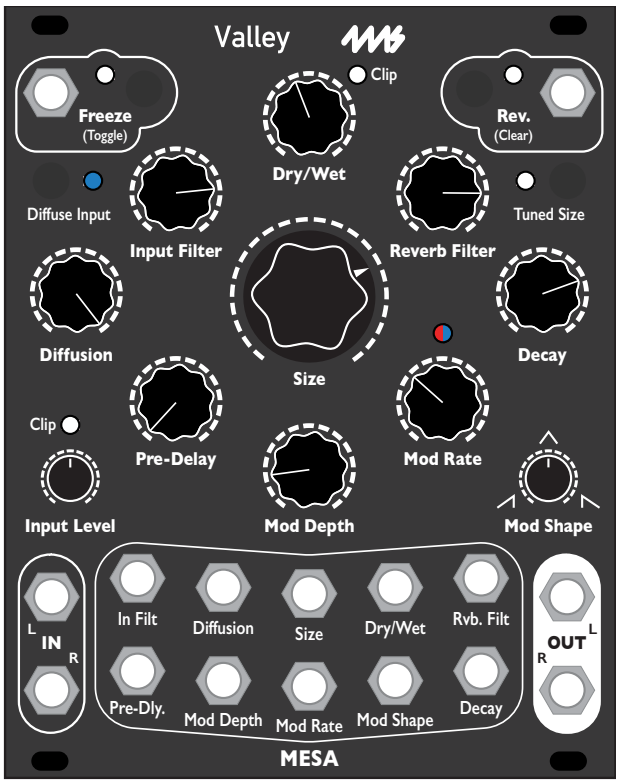
Infinite sustain pad: Feed a chord into **Mesa** and fire a gate into **Freeze** shortly after the chord. The chord will sustain indefinitely as an evolving pad.



Pre-Delay for clarity: When using reverb on a percussive or melodic source, the dry signal and the reverb onset can blur together. Adding a short **Pre-Delay** pushes the reverb tail back in time, allowing the dry transient to pop through clearly before the reverb begins. This is one of the most effective mixing techniques for creating the perception of space without muddiness.

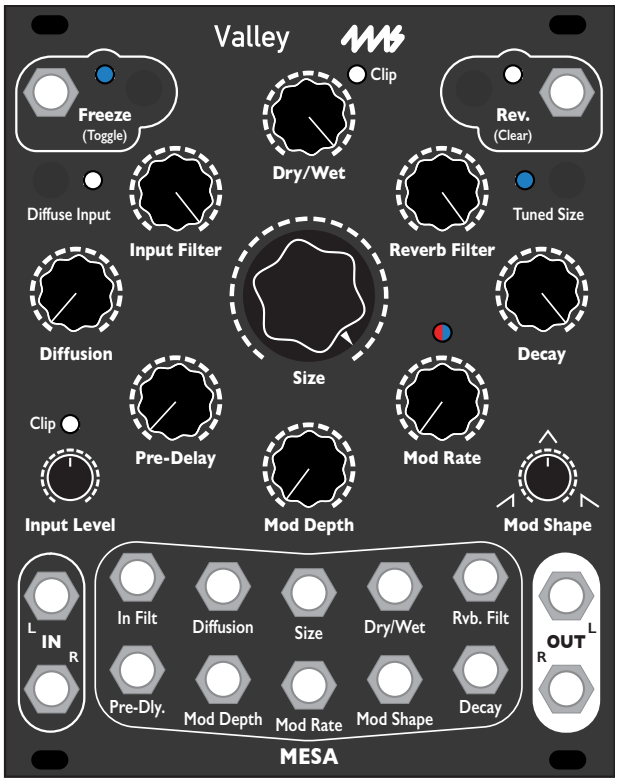


Dark, vintage character: Turn the **Reverb Filter** knob towards the darker side to roll off high frequencies from the tank. This creates a warm, muted reverb tail reminiscent of old tape-based reverb units. Adding a small amount of **Input Filter** darkening as well further enhances this vintage character

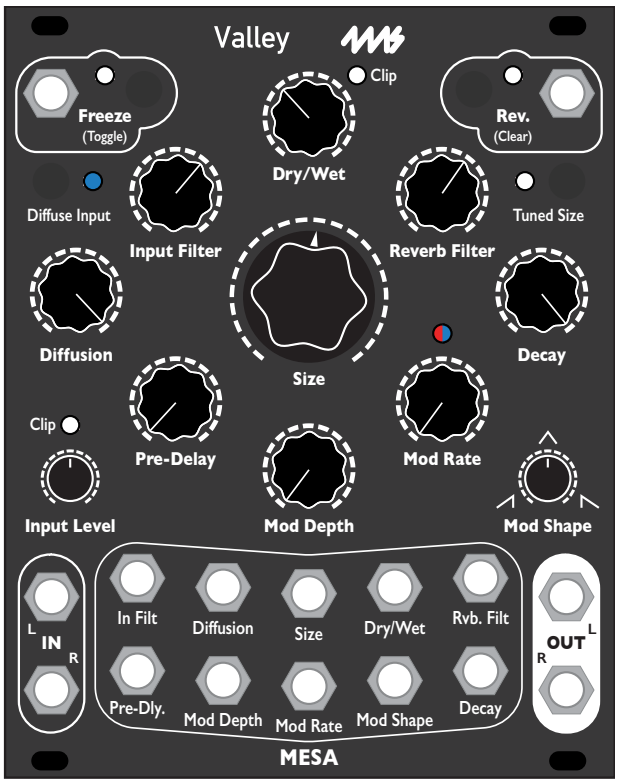


Crisp, airy reverb: Turn the **Reverb Filte**r towards the brighter end to let the full high-frequency spectrum build up in the tank. This is excellent for creating a sense of air and space around high-frequency content like cymbals, high strings, or vocal sibilance. Use the **Input Filter** to roll off any unwanted low frequencies before they muddy the reverb.

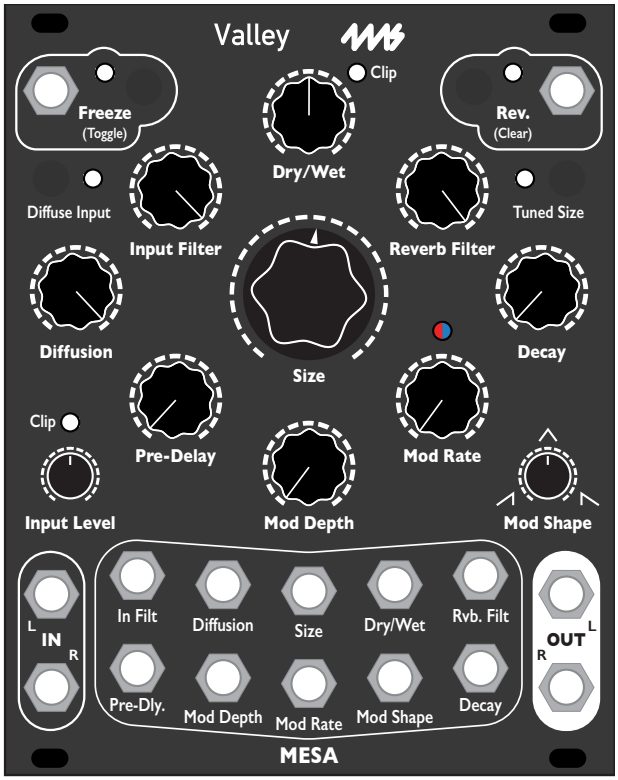
Creative Uses



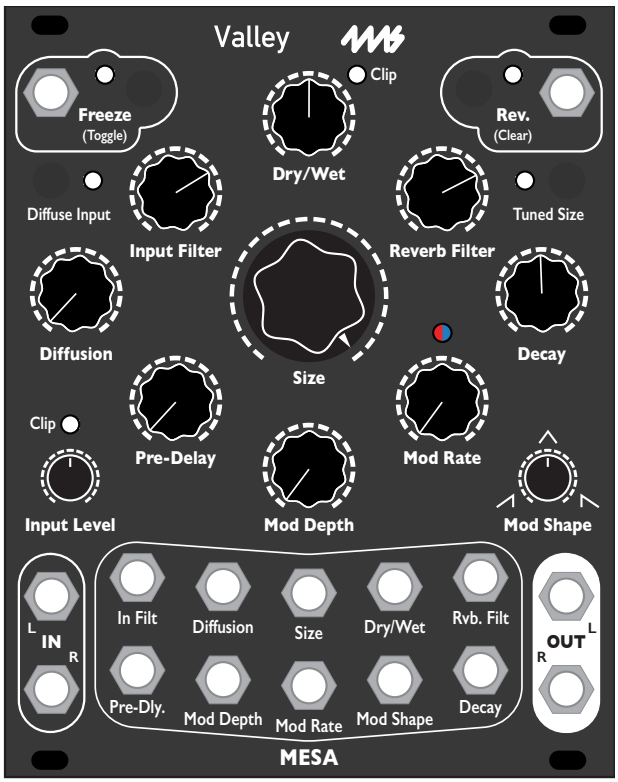
Tuned reverb as a pitched drone: Enable **Tuned Mode** and patch a slow-moving pitch CV (from a sequencer or manually controlled source) into the **Size CV** input. The reverb now has a pitched quality that can be transposed. Set **Decay** high and **Freeze** the reverb. Turn down **Input Level**. The result is a pitched drone whose fundamental can be changed with CV, and which sustains and evolves on its own.



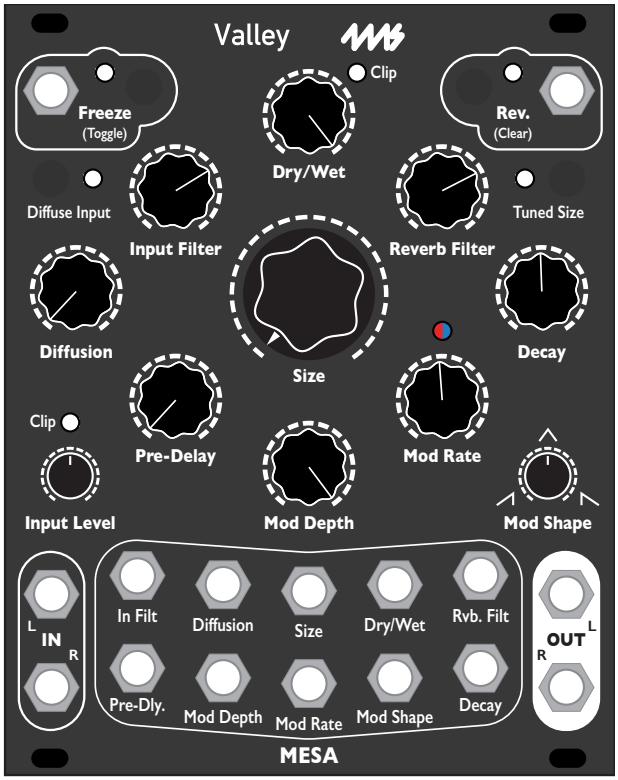
Gated reverb: Set **Decay** high and **Diffusion** full. Then patch a rhythmic clock or gate signal into the **Clear** jack with **Rev/Clear** set to clear mode. Every time the gate fires, the reverb is instantly purged. This produces a rhythmic "chop" in the reverb tail, creating a gated reverb effect similar to the iconic '80s drum sound, and fully controllable by the gate timing.



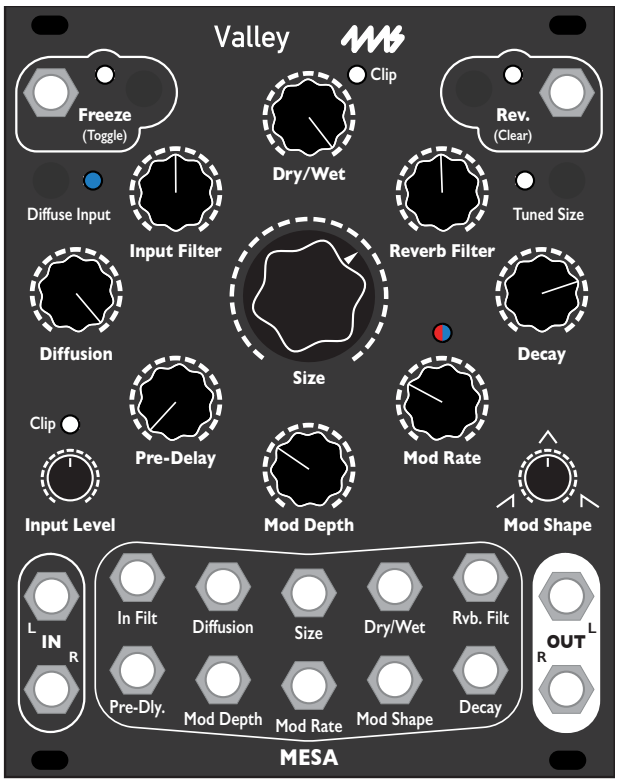
Reverb freeze as a sampler: Use **Mesa** to capture and freeze a single moment of your patch as an infinite pad. Route a complex, evolving patch into **Mesa**, then press **Freeze** to capture the sound as a sustained reverb cloud. The frozen buffer continues to evolve slowly due to the internal modulation.



Reducing diffusion for metallic textures: With no diffusion, the reverb algorithm produces distinct, repeating echoes rather than a smooth wash. These echoes have a metallic, resonant quality that works well for industrial sound design or unusual percussion processing. Adjust **Size** to tune the spacing of the echoes.



Modulation as a chorus: Turn **Dry/Wet** fully up, **Decay** to minimum, and **Size** to minimum. Increase **Mod Depth** and **Mod Rate** to moderate values. The result is not a reverb but a chorus/flanger effect, as the modulated delay lines create pitch shifting and comb filtering without significant decay.



CV-modulated filter sweeps: Patch a slow LFO into the **Reverb Filter CV** input. As the LFO rises and falls, the reverb tail shifts between bright and dark, creating a filter-swept reverb texture. This works especially well on sustained, droning input material where the slowly evolving tone color of the reverb becomes the main feature.

System

Upgrading Firmware

1. Firmware update files are posted at https://4mscompany.com/mesa. Download the latest version and save it to your computer or phone.
2. To enter bootloader mode on the **Mesa**, hold down the **Rev/Clear** and **Tuned Size** buttons while powering up. Release them when you see the lights flash.
3. If either red clip light is flashing, tap the **Rev/Clear** button again to reset the bootloader.
4. Plug your computer/phone into the **Left In** jack using a mono TS cable (not stereo TRS). Remove any phone case and turn off notifications that might interrupt the audio. Set the computer/phone's volume to 50%-75% before playing the file.
5. Start playing the firmware audio file using basic playback software. The Mod Rate light should be purple. Automatic gain compensation is applied, so do not adjust the computer/phone level during playback. You can monitor the audio by listening to the **Out Left** jack.
6. While the file is playing, you should see the blue lights flash.
7. If there’s an error (volume changed too much during playback, playback was interrupted, or loose/bad cable), the audio will stop and the red clip light will flash. Press the **Rev/Clear** button and try playing the file again from the start.

8. If the file loads successfully, there will be a 1-2 second pause and then you'll see the lights turn on one at time in a circular pattern. Power cycle the module or press the low shelf button to continue.

When powering on, the lights flash rapidly to show the version:

v1.0: Freeze

v1.1 (not released yet): Diffuse Input

Listen IO Connections

The **Mesa** has a 3-pin header on the back that can be used to connect to a 4ms Leveling EQ Amplifier, Listen Four, Listen Four Quarters, Listen IO, or WAV Recorder module. A standard 1x3 Audio Jumper cable, or a set of DuPont style square-pin jumper wires, can be used for the connection.

The header marked **OUT** (underneath the **Out** jacks) can be connected to the **IN** headers of a Listen or WAV Recorder module, and the **Mesa's** output signal will appear in the other module's mix without needing to patch additional cables. This is useful in a system where the **Mesa** is always at the end of the chain, right before the output mixer or recorder. Patching cables to the **Mesa's Out** jacks will not disrupt the connection, so you can still use the **Mesa** normally.

Note that there is an additional 3-pin header marked **IN**, which should be left unconnected.

Electrical and Mechanical Specifications

Mechanical

- 20HP Eurorack format module
- 0.98” (25mm) maximum depth (including power cable)

Power Consumption

- +12V: 205mA max
- -12V: 36mA max,
- +5V: not used

Audio

- Freq. response (dry): 20Hz-13kHz ±0.1dB, 16kHz -1.1dB, 20kHz -3.0dB
- Latency (input to dry output): 0.72ms
- Maximum amplitude: 19.2Vpp

CV Input

- Voltage range -5V to +5V
- Gate inputs threshold: 2V

DSP

- 96kHz sample rate, 64-bit double-precision float processing, and 24-bit output
- 1GHz Cortex-A7 processor

Acknowledgements

Conception, core code: Dale Johnson
Firmware, panel, hardware design: Dan Green
PCB layout: Zach D'Agostino

The reverb algorithm is based on the original Plateau VCV Rack plugin by Dale Johnson (Valley Audio). The Plateau algorithm and all DSP code are used with permission.

The underlying reverb design is based on the digital plate reverb algorithm described by:

Dattorro, J. (1997). Effect design part 1: Reverberator and other filters. J. Audio Eng. Soc, 45(9), 660-684.

Special thanks to Dale Johnson for creating and open-sourcing the original Plateau plugin.

Thanks also to everyone else on the 4ms team who made this module possible: Thomas Fang, Kira Sassano, Cantrell Hepner, Payne Gibson, Ross Fish, and Jeannot Quenson.