ShockWave Synthesizer User Manual

v1.0

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Introduction

ShockWave by **Numerical Audio** is a monophonic Phase Destructor Synthesizer that brings modular-style workflow to the world of audio plugins. Built around the concept of Phase Distortion (PD) Synthesis, ShockWave delivers a unique and powerful sound design experience. This manual provides a detailed guide to ShockWave's features and operation.

Installation & Setup (macOS)

Installation

ShockWave is distributed by **Numerical Audio** directly and can be used as a standalone app or loaded as an **Audio Unit Extension (AUv3)** in compatible DAWs.

Supported Formats & Connectivity

- **AUv3 (Audio Unit)**
- **Standalone App**
- **MIDI support**: Works with wired, network, and Bluetooth MIDI controllers
- **AudioBus & IAA support (iOS only)**

Installing the AUv3 plugin

- No additional installation is required. The AUv3 plugin is automatically registered with the system upon launching the standalone version for the first time.

Registration & Activation (macOS)

ShockWave is free to download and try out, it is designed to be registered and activated for continued use.

Unless unlocked with a license key, ShockWave will run in demo mode where noise will be overlaid after 15 minutes if use.

Activation

1. Purchase a license key from the Numerical Audio Store
2. Download the app and install it on your Mac
3. Open the app and click the **Register** button in the top left corner of the screen
4. Enter license name and key to activate the plugin

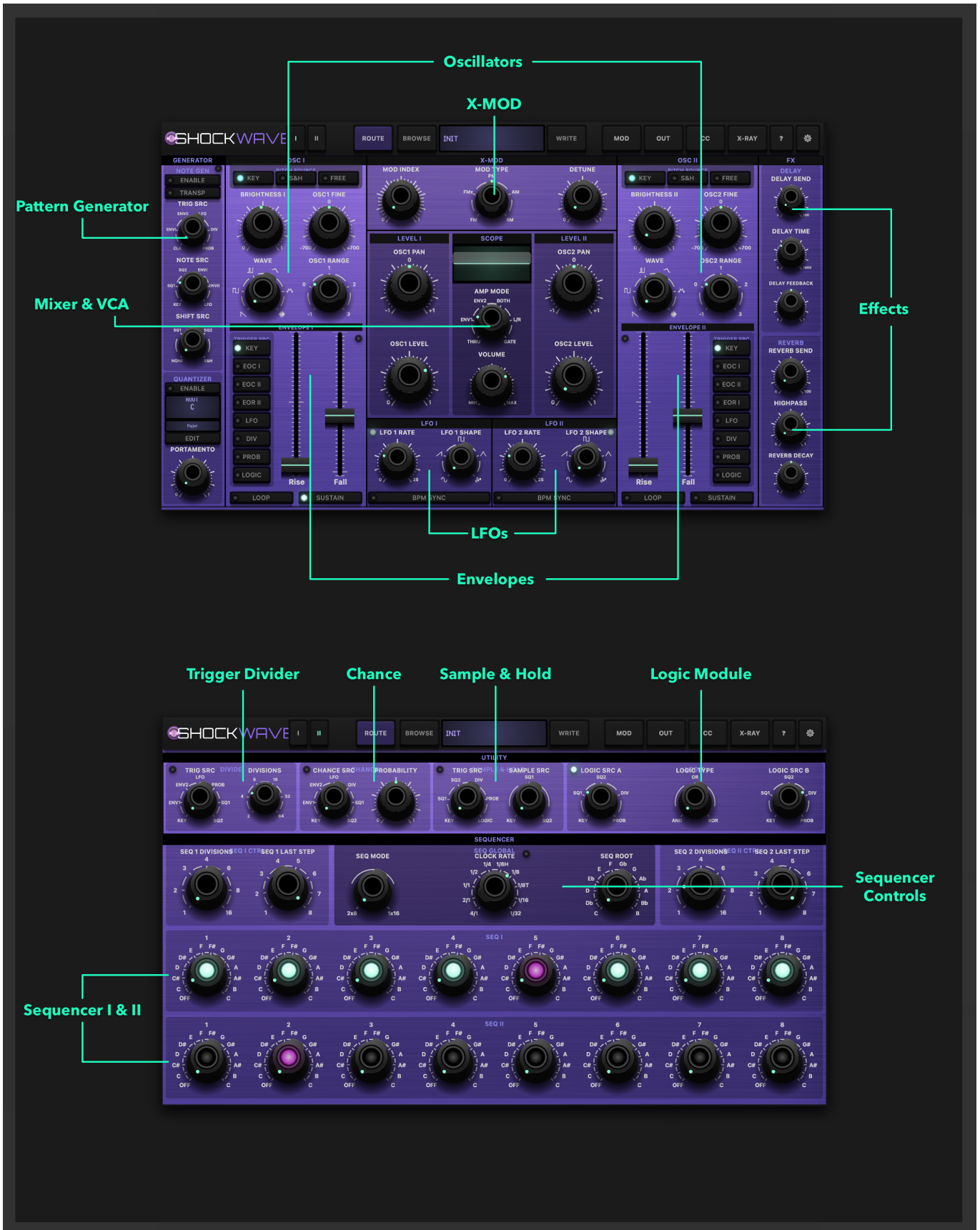# User Interface Overview

ShockWave's interface is divided into two sections:

- **Main Synth Voice, Effects & Pattern Generator (I)**
- **Sequencer & Utilities (II)**

These sections can be accessed via on-screen switches or by sliding between them.

> *Hint:* You can also scroll between the sections to quickly access the **Main Synth Voice** and
> **Sequencer & Utilities** sections.

Sound Engine

The ShockWave Synthesizer voice architecture is built around Phase Distortion (PD) Synthesis, offering a unique approach to sound generation. The core components - dual PD oscillators, cross-modulation capabilities, and extensive modulation sources - are organized in a semi-modular architecture that provides both immediate access to essential parameters and deep sound design possibilities.

Phase Distortion Oscillators

Phase Distortion Synthesis is a unique method of sound generation that was first introduced by Casio in the 1980s. Unlike traditional subtractive synthesis, which shapes sound by filtering harmonically rich waveforms, phase distortion synthesis manipulates the phase of a waveform to create complex harmonic structures. By dynamically altering the phase angle of a sine wave, it is possible to generate a wide variety of waveforms and timbres, ranging from smooth and mellow to harsh and aggressive. This technique allows for a high degree of flexibility and expressiveness in sound design, making it a powerful tool for synthesists.

ShockWave features two Phase Distortion Oscillators, each capable of creating a wide range of waveforms:

- **Waveform Types**:
    - Smooth Sawtooth
    - Smooth Square
    - Pulse Width Modulation
   - Resonance Sweep
    - Sync Sweep
    - Filtered Noise
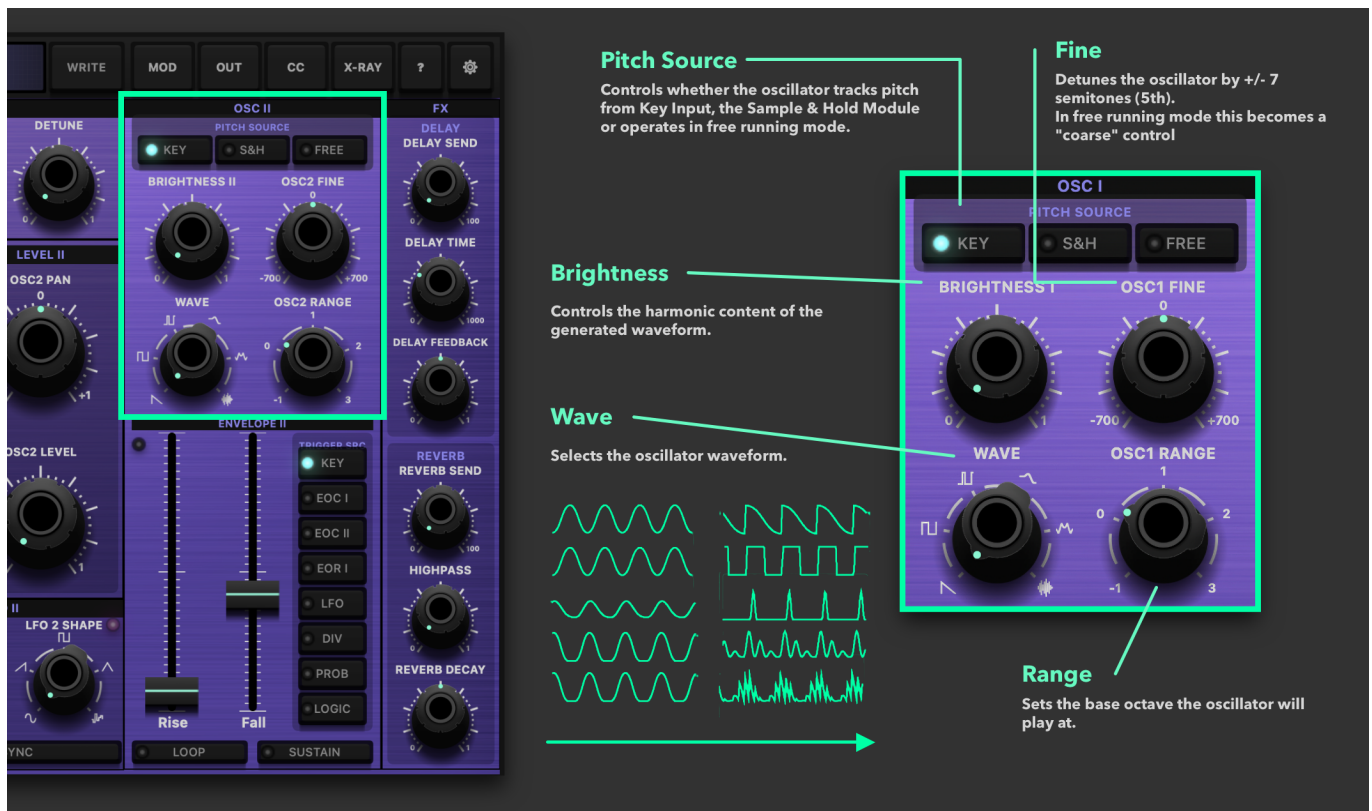
Brightness Control

In traditional subtractive synthesis, oscillators are mixed together and sent through a filter to shape the harmonic content of the sound. However, in ShockWave, each oscillator features its own brightness control, allowing for direct adjustment of the harmonic content of the waveform. This approach provides a more

intuitive and immediate way to sculpt the sound, as users can independently control the brightness of each oscillator without relying on a shared filter.

The brightness control works by dynamically altering the harmonic content of the waveform, enabling a wide range of timbral variations. This allows for precise shaping of the sound, from smooth and mellow tones to bright and aggressive textures. By giving each oscillator its own brightness control, ShockWave offers greater flexibility and creative potential in sound design, making it easier to achieve the desired sonic character.
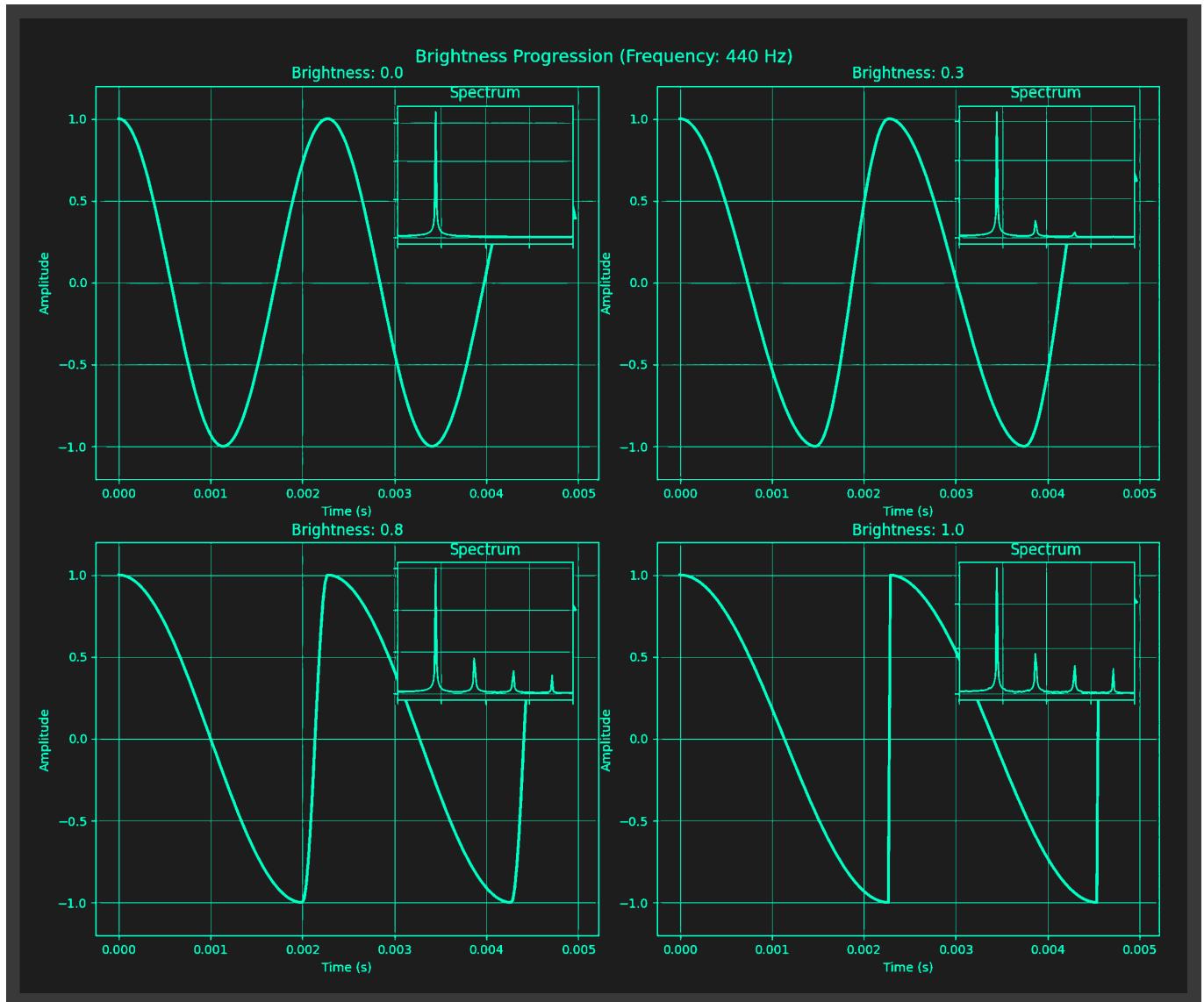
This unique feature enhances the overall expressiveness of the synthesizer, allowing users to create complex and evolving sounds with ease. Whether you're looking to craft subtle nuances or bold, striking tones, the individual brightness controls provide the tools needed to bring your sonic vision to life.

Cross-Modulation

Cross modulation is a powerful synthesis technique where two or more oscillators interact with each other to create complex and evolving sounds. By modulating the frequency, amplitude, or phase of one oscillator with the output of another, a wide range of timbres and textures can be achieved. This interaction can produce rich harmonic content and dynamic movement within the sound, making it a valuable tool for sound designers looking to add depth and interest to their patches. In ShockWave, cross modulation allows for

intricate sonic possibilities, enabling users to explore new realms of sound creation.

Mod Type Control

The two oscillators can interact through various modulation types (Mod Type Control):

- **DX-Style Phase Modulation (PM)**: This type of modulation can produce bright, metallic, and bell-like tones, often associated with classic FM synthesis.
- **Linear Frequency Modulation (FM)**: This type of modulation can produce a wide range of harmonic and inharmonic sounds, often resulting in complex and evolving timbres that are rich in texture.
- **Exponential Frequency Modulation (FMx)**: This modulation type can create sounds with a more pronounced and dramatic change in pitch, leading to unique and expressive tonal variations that can add intensity and character to the sound.
- **Amplitude Modulation (AM)**: This modulation can result in sounds with a characteristic tremolo effect at low frequencies, or complex sidebands and new frequencies at higher modulation rates, adding richness and depth to the sound.
- **Ring Modulation (RM)**: This modulation type can produce complex and metallic sounds by combining the frequencies of the two oscillators, often resulting in bell-like or dissonant tones.

Comparison of Different Modulation Types
Carrier: 440Hz, Modulator: 110Hz, Mod Index: 1.0
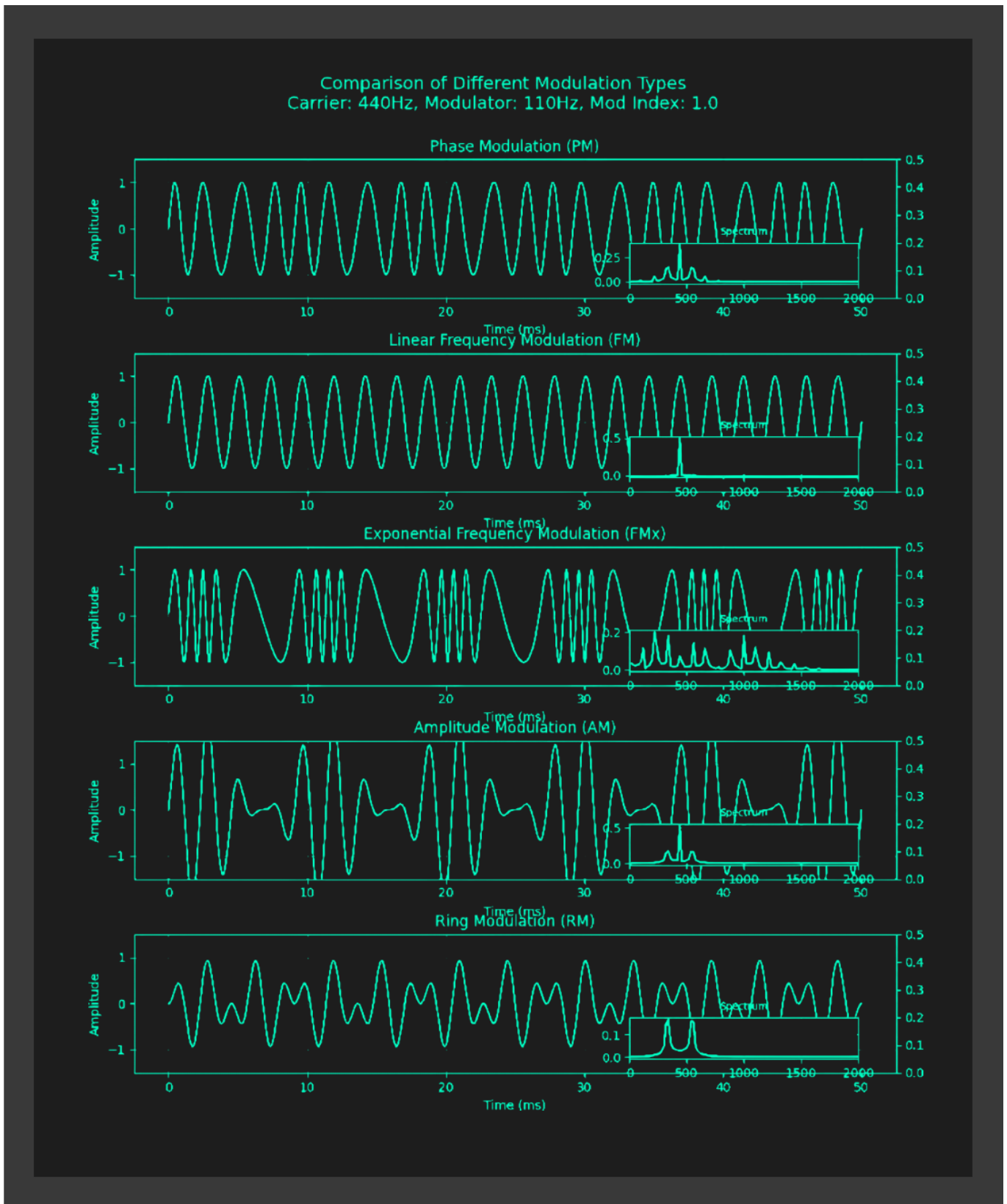
Mod Index Control

The Mod Index control in ShockWave is a crucial parameter that adjusts the amount of cross modulation between the oscillators. By increasing the Mod Index, you can intensify the interaction between the oscillators, resulting in more complex and harmonically rich sounds. Conversely, lowering the Mod Index will reduce the modulation effect, yielding a more subtle and straightforward tone.

To make the best use of the Mod Index control, consider the following tips:

1. **Start with Low Values**: Begin with a low Mod Index setting to understand the basic interaction between the oscillators. Gradually increase the value to explore the range of timbres and textures that can be achieved.

2. **Experiment with Different Modulation Types**: The effect of the Mod Index will vary depending on the type of cross modulation being used (e.g., PM, FM, FMx, AM, RM). Try different modulation types to discover unique sonic characteristics and find the best combination for your sound design goals.

3. **Combine with Other Parameters**: Use the Mod Index in conjunction with other parameters such as oscillator pitch, waveform type, and brightness control. This will allow you to create intricate and evolving sounds with greater depth and complexity.

4. **Dynamic Modulation**: Assign an LFO or envelope generator to the Mod Index control to create dynamic changes over time. This can add movement and expressiveness to your patches, making them more engaging and lively.

5. **Subtle Adjustments**: Sometimes, small adjustments to the Mod Index can have a significant impact on the overall sound. Use fine-tuning to achieve the desired level of modulation without overwhelming the original character of the oscillators.

By mastering the Mod Index control, you can unlock a wide range of sonic possibilities and enhance the versatility of your ShockWave synthesizer. Whether you're aiming for subtle modulation effects or bold, dramatic tones, the Mod Index provides the flexibility needed to achieve your creative vision.

Detune Control

The Detune control allows you to slightly offset the pitch of the two oscillators against each other. This can be used to create a richer, more complex sound by introducing a subtle phase difference between the oscillators. Detuning is often used to add warmth and depth to the sound, making it feel fuller and more vibrant. It can also be used to create classic synth effects such as chorusing and thickening, which are essential for achieving lush pads, leads, and basses. By carefully adjusting the Detune control, you can enhance the harmonic content and overall character of your patches.

Modulation Sources

Modulation is a fundamental concept in sound synthesis that involves varying a parameter of the sound over time to create movement and interest. In ShockWave, almost any parameter can be modulated using one or more of the included modulation sources, such as LFOs, envelope generators, and sequencers. This allows users to dynamically alter aspects like brightness, cross modulation, panning, volume and more, resulting in evolving and expressive sounds. By assigning modulation sources to different parameters, users can craft intricate and unique sonic textures that respond to their performance and programming.

ShockWave includes a comprehensive set of modulation sources:

Envelope Generators

The envelope generators in ShockWave draw significant inspiration from the world of modular synthesizers, offering a high degree of flexibility and control. Unlike traditional synthesizers where envelopes are typically triggered by keyboard input alone, ShockWave's envelope generators can be triggered by a variety of sources. This includes not only the keyboard but also internal sources such as the utility modules, other envelopes, and even themselves.

This modular-inspired approach allows for complex and dynamic sound shaping possibilities. For instance, you can set up one envelope to trigger another, creating cascading effects that evolve over time. Additionally, the envelopes can be triggered by the internal trigger divider, logic module, and chance module, providing a wide range of rhythmic and probabilistic modulation options.
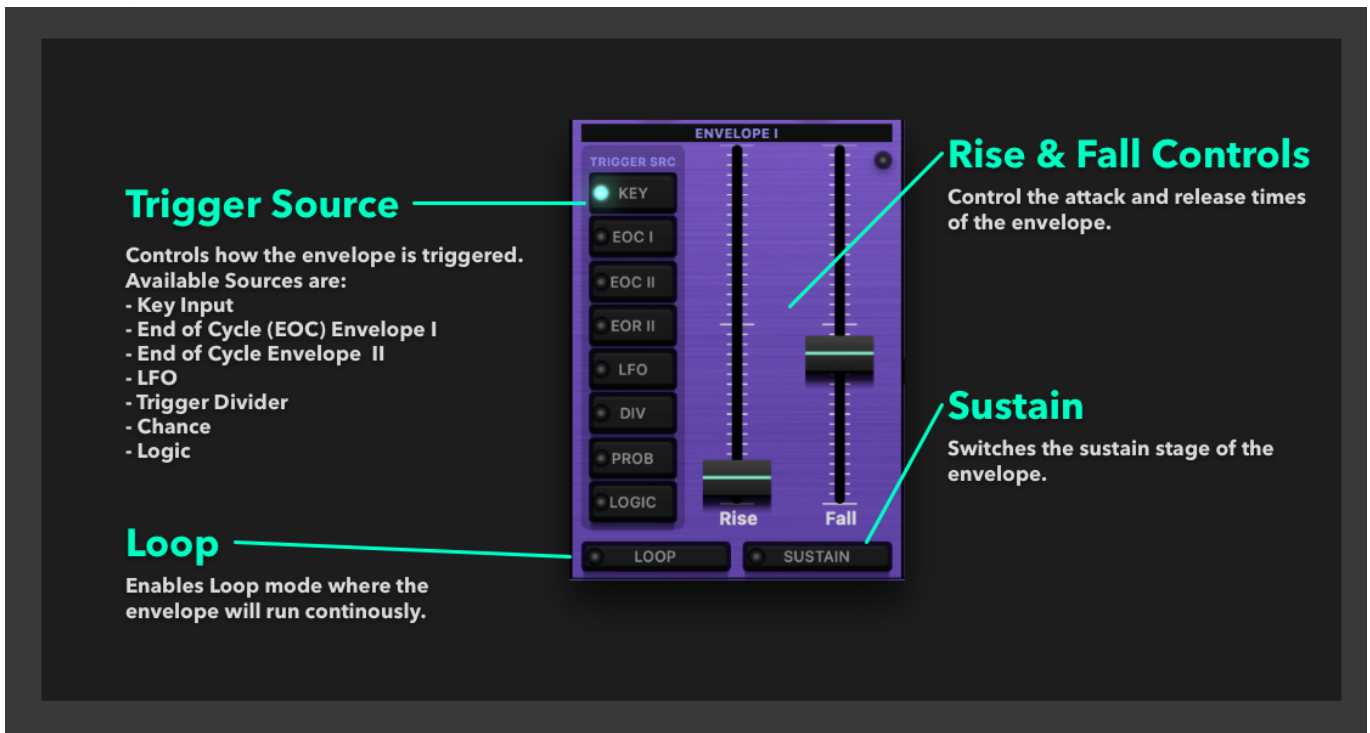
By leveraging these diverse trigger sources, users can create intricate and evolving soundscapes that respond to both performance and programmed events. This level of control and interactivity is a hallmark of modular synthesis, and it empowers users to explore new realms of sound design within the ShockWave synthesizer.

> **Reminder:** Rise and fall times can be modulated as well. This allows you to use different modulation sources to dynamically alter the attack and decay phases of your envelopes, creating more intricate and evolving soundscapes.

- Two Attack/Sustain/Release (ASR) Envelopes
- Variable trigger sources including:
    - Internal trigger divider
    - Logic module
    - Chance module
    - Cross-triggering between envelopes
- Loop Mode
- Switchable Sustain stage

Low Frequency Oscillators (LFOs)

Low Frequency Oscillators (LFOs) are used in sound synthesis to modulate parameters like pitch and amplitude, creating effects such as vibrato and tremolo. Typically operating below 20 Hz, they add movement and complexity to sounds, enhancing expressiveness.

ShockWave features 2 distinct LFOs with idendentical features.
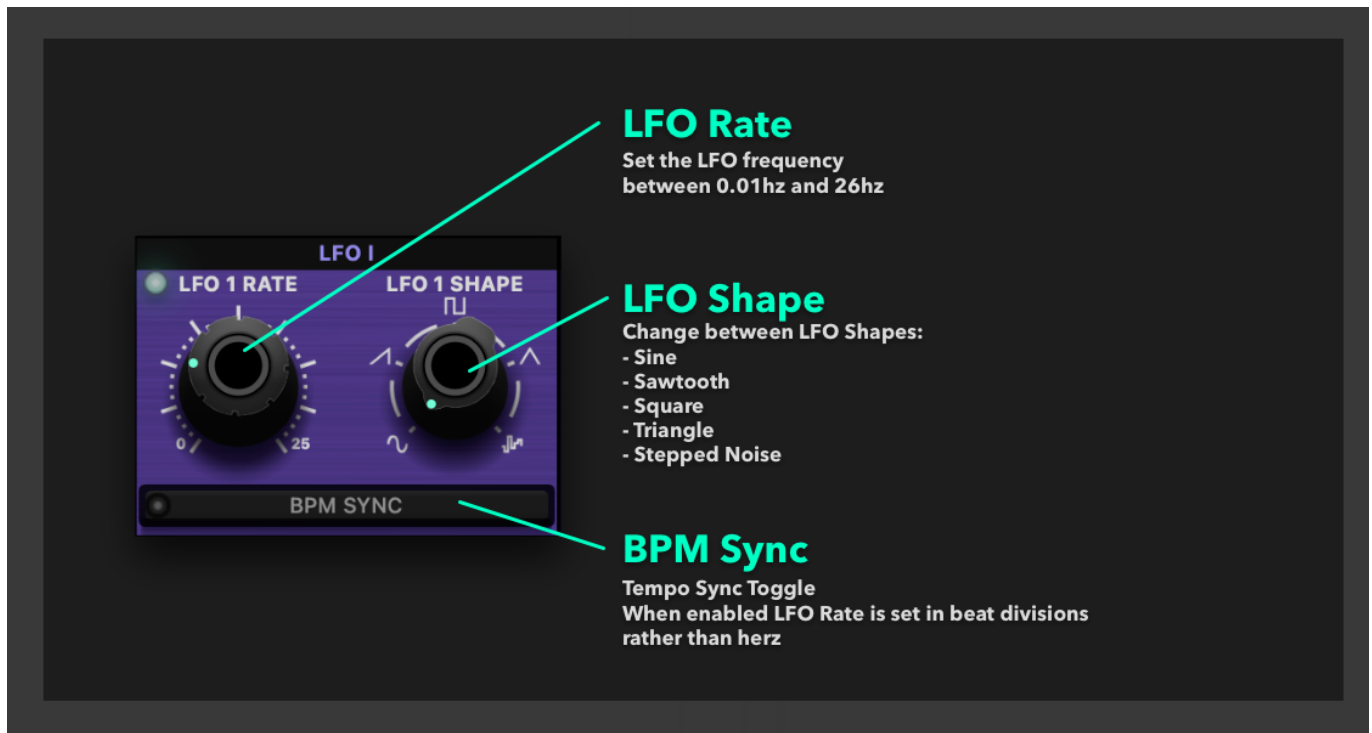
Output VCA

Main Output VCA

The main output Voltage Controlled Amplifier (VCA) in ShockWave provides a range of flexible control options to suit various sound design needs. The VCA is responsible for controlling the amplitude of the audio signal, and its behavior can be modified using different modulation sources. Here are the available control options for the main output VCA:

1. **Envelope Control**: The VCA can be controlled by either of the two ASR (Attack/Sustain/Release) envelopes. This allows you to shape the amplitude of the sound over time, creating dynamic changes in volume that follow the envelope's contour. You can choose to use either Envelope I or Envelope II to modulate the VCA.

2. **Dual Envelope Control**: For more complex amplitude modulation, you can use both envelopes simultaneously to control the VCA. This setup allows for intricate and layered volume changes, providing a richer and more dynamic sound.

3. **No Envelope Control**: In this mode, the VCA operates without any envelope modulation. This is particularly useful for creating drone sounds, where a constant and unchanging amplitude is desired. It allows the sound to sustain indefinitely without any modulation.

4. **Stereo Split Mode**: The VCA can be configured to operate in stereo split mode, where the left and right channels are processed independently. This mode is ideal for creating wide and spatially rich sounds, as it allows for different amplitude modulation on each channel, enhancing the stereo image.

5. **Simple MIDI Gate Mode**: In this mode, the VCA is controlled by MIDI gate signals. When a MIDI note is played, the gate signal opens the VCA, allowing the sound to pass through. This mode is straightforward and effective for triggering sounds in a rhythmic and precise manner, making it suitable for percussive and rhythmic patches.

By understanding and utilizing these VCA control options, you can achieve a wide range of amplitude modulation effects, from subtle volume changes to complex and evolving dynamics. Experiment with different configurations to discover the full potential of the main output VCA in your sound design process.

Control Section

ShockWave includes a dedicated control section with various utility modules:

Pattern Generator

Like many integral parts of ShockWave, the Pattern Generator also draws inspiration from the modular synthesizer world, offering a flexible and intuitive workflow for creating complex and evolving sequences. It allows users to generate musical patterns from various internal sources, such as key input, sequencers, envelopes, and LFOs. With features like a built-in quantizer, key transpose, and multiple trigger options, the Pattern Generator captures the essence of modular synthesis by providing extensive control over the rhythmic and melodic content of your patches. Whether you're looking to create simple arpeggios or intricate, evolving sequences, the Pattern Generator provides the flexibility and power needed to bring your musical ideas to life, all while embracing the modular-style approach to sound design.

- Generates sequences from various internal sources
- Quantizer with 19 scales plus user scales
- Key transpose the playing sequence
- Generate Notes from: Key input, Sequencer I & II, Envelope I & II or LFO
- Trigger from various sources including: Clock, Envelope I & II, LFO, Trigger Divider & Probability Gate
- Shift the playing sequence within the active scale using output from: Sequencer I & II or Sample & Hold
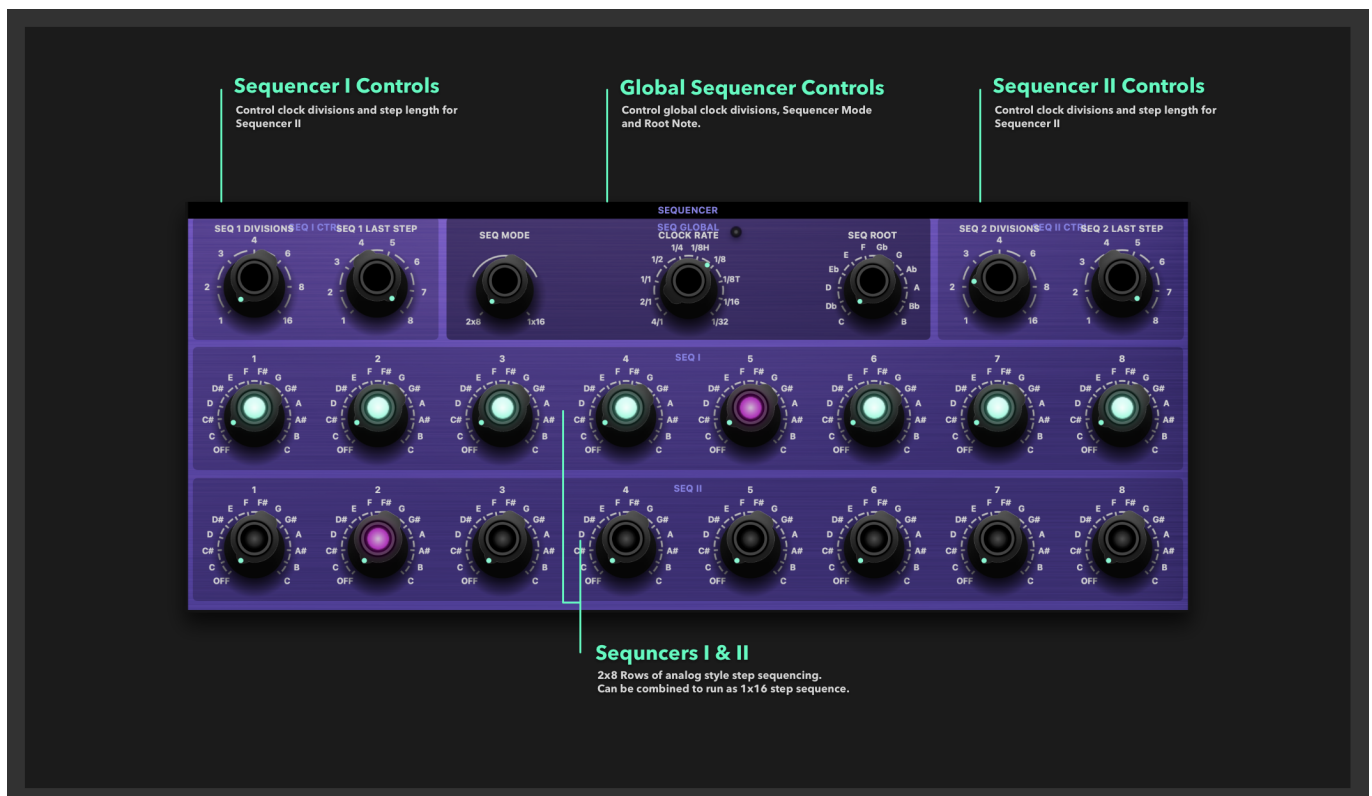
Using the Pattern Generator

General Usage

1. Enable the Pattern Generator
2. Choose from one of the available trigger sources
3. Choose a note source
4. Setup the Quantizer if desired
5. Enjoy

> **Example (Basic): Generating Patterns from the Sequencers**
>
> 1. Enable the Pattern Generator
> 2. Select "CLK" as Trigger Source
> 3. Select "SQ1" as Note Source
> 4. Pattern Generator will play the squence configured in Sequencer I

Sequencers

Inspired by modular synthesizers, ShockWave's sequencers offer a modern take on classic step sequencing. They provide intuitive control for crafting rhythmic and melodic patterns, with features like independent rate and length control, and flexible routing. This allows for both simple loops and complex sequences, enhancing your sound design capabilities.

- Two 8-step sequencers
- Can combine into one 16-step sequence
- Independent rate and length control for each section
- Flexible routing options

**Note on Using Sequencers with the Pattern Generator**

To effectively use the sequencers with the Pattern Generator, follow these steps:

1. Enable the Pattern Generator.
2. Select "CLK" as the Trigger Source to ensure the Pattern Generator is synchronized with the clock.
3. Choose either "SQ1" or "SQ2" as the Note Source to play the sequence configured in Sequencer I or Sequencer II, respectively.
4. Configure the desired sequence in the selected sequencer (SQ1 or SQ2).
5. The Pattern Generator will now play the sequence from the chosen sequencer, allowing you to create rhythmic and melodic patterns.

By combining the sequencers with the Pattern Generator, you can achieve complex and evolving sequences that enhance your sound design capabilities.

Trigger Divider

The Trigger Divider module in ShockWave is a powerful tool for creating rhythmic variations and complex timing structures. By dividing incoming trigger signals, it allows you to generate polyrhythms and intricate patterns that can add depth and interest to your sequences. With adjustable division factors and the ability to sync to both internal and external clock sources, the Trigger Divider offers versatile and precise control over your rhythmic elements, making it an essential component for advanced sound design and performance.
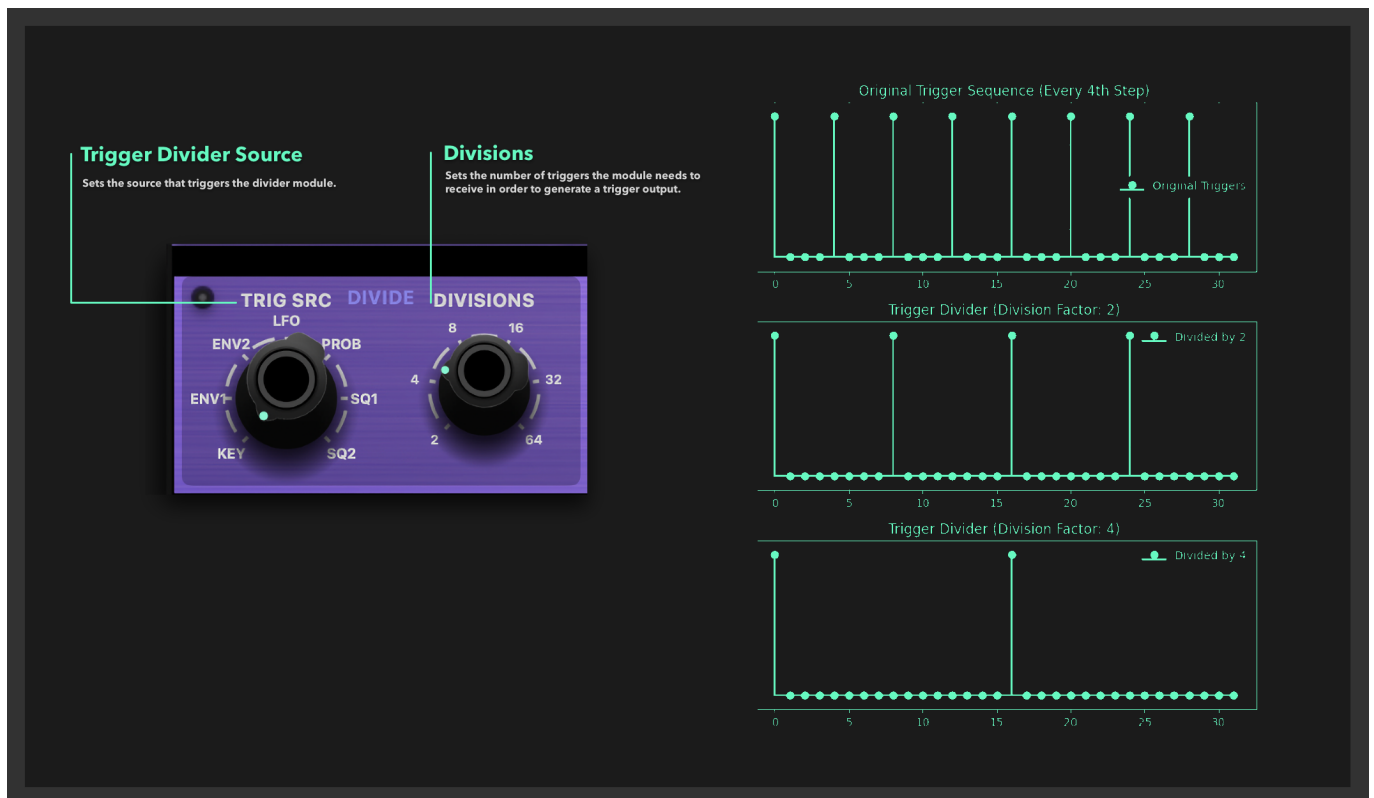
- Divides incoming triggers to create rhythmic variations
- Adjustable division factor
- Can be used to create polyrhythms and complex timing structures
- Syncs to internal or external clock sources

**Example: Using the Trigger Divider**

By using the Trigger Divider, you can add intricate timing structures and polyrhythms to your sequences, enhancing the complexity and interest of your sound design.

> - Example Setup:
> - Sequencer I -> Trigger Divider (Division Factor: 2) -> Envelope Generator II -> OSC Brightness
> - This setup will trigger the envelope every 2nd step of the sequence essentially following a half-speed rhythm compared to the original sequence.

Experiment with different division factors and routing options to discover new and exciting rhythmic possibilities with the Trigger Divider.

Chance

The Chance module in ShockWave introduces an element of controlled randomness to your sequences. By allowing you to set the probability of trigger events, it can create evolving and unpredictable patterns that add a dynamic and organic feel to your music. This module is particularly useful for generating variations and keeping your sequences interesting over time. Whether you're looking to add subtle variations or completely randomize certain aspects of your sound, the Chance module provides the tools to achieve it.
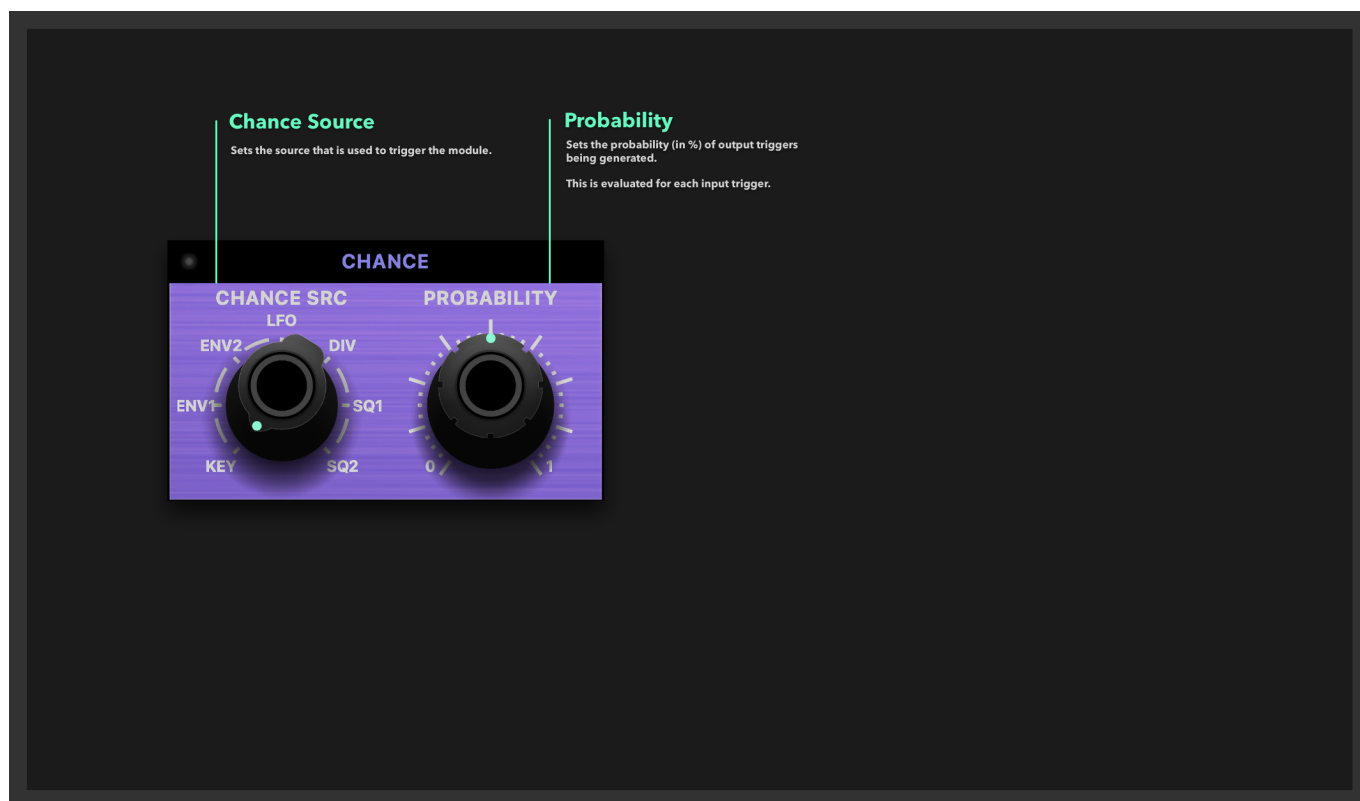
- Probability-based trigger module
- Receives triggers from various sources including: Key Input, Envelope I & II, LFO I, Trigger Divider, Sequencer I & II
- Outputs triggers based on user defined probability ("chance control")
- Can introduce controlled randomness to sequences
- Useful for creating evolving and unpredictable patterns

Example: Using the Chance Module

The Chance module can be used to introduce controlled randomness into your sequences, adding an element of unpredictability and variation to your sound design.

> Example Setup:
>
> - Sequencer I -> Chance Module (Chance Control: 50%) -> Envelope Generator I -> Oscillator Brightness
> - This setup will trigger the envelope with a 50% probability on each step of the sequence, creating a dynamic and evolving brightness modulation.

Experiment with different probability settings and routing options to discover new and exciting ways to use the Chance module in your patches.

Sample and Hold

The Sample and Hold module in ShockWave captures and holds values from an input signal, creating stepped modulation effects. It can be triggered by various sources, adding rhythmic and textural variations to your patches. This module is ideal for introducing complexity and dynamism to your sound design.
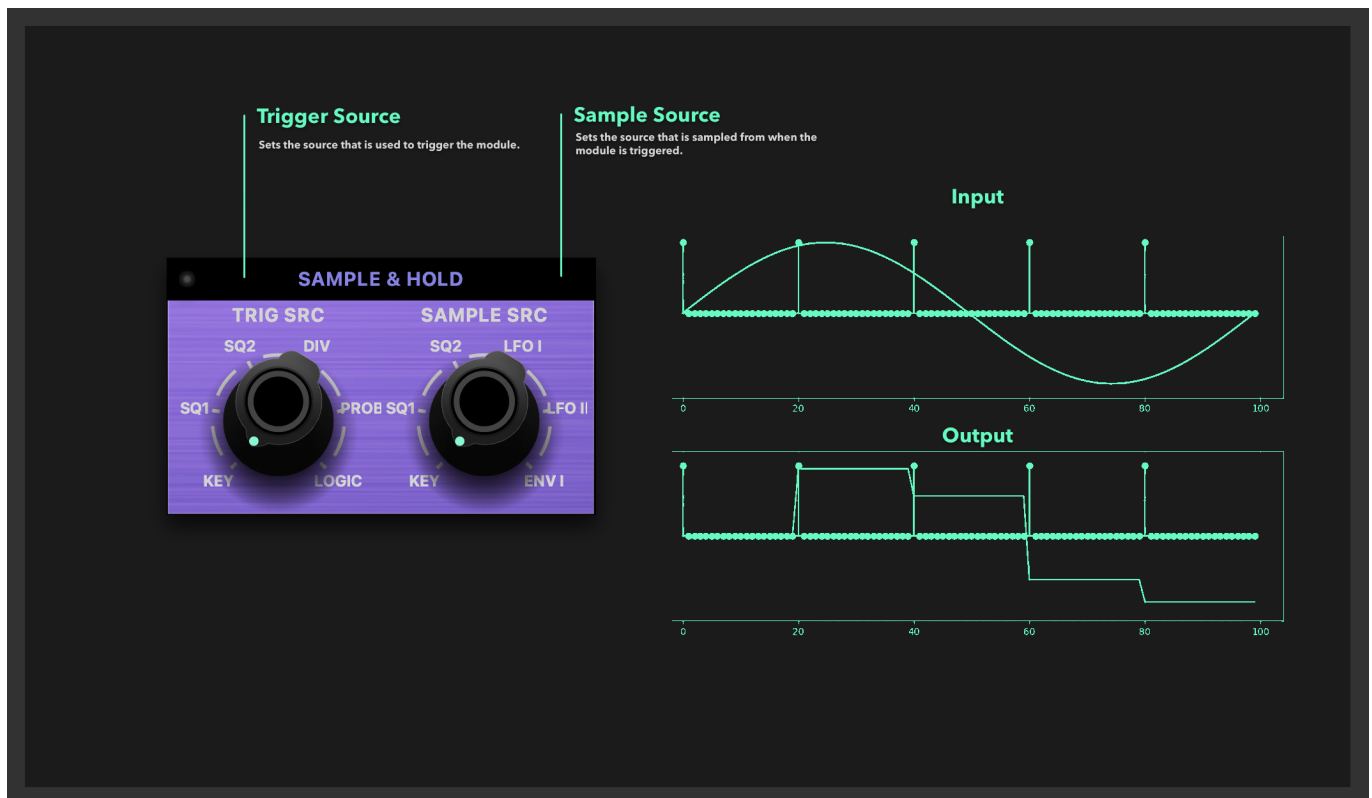
- Captures and holds a value from an input signal
- Can be triggered by various sources including: Key Input, Sequencer I & II, Trigger Diver, Chance & Logic Module
- Useful for creating stepped modulation effects
- Can sample from various modulation sources

**Example: Using the Sample and Hold Module**

> Example Setup:
>
> - LFO I (Sine Wave) -> Sample and Hold (Trigger: Sequencer I) -> Oscillator Pitch

- This setup will sample the LFO's sine wave at each step of the sequencer, creating a stepped pitch modulation effect.

Experiment with different input signals and trigger sources to discover new and exciting ways to use the Sample and Hold module in your patches.

Logic

The Logic module in ShockWave allows you to combine multiple trigger and gate signals using various logic operations. This module is essential for creating complex rhythmic patterns and interactions between different parts of your patch. By using logic operations such as AND, OR, XOR, and NOT, you can achieve advanced modulation routing and trigger generation, adding a new layer of depth and complexity to your sound design.
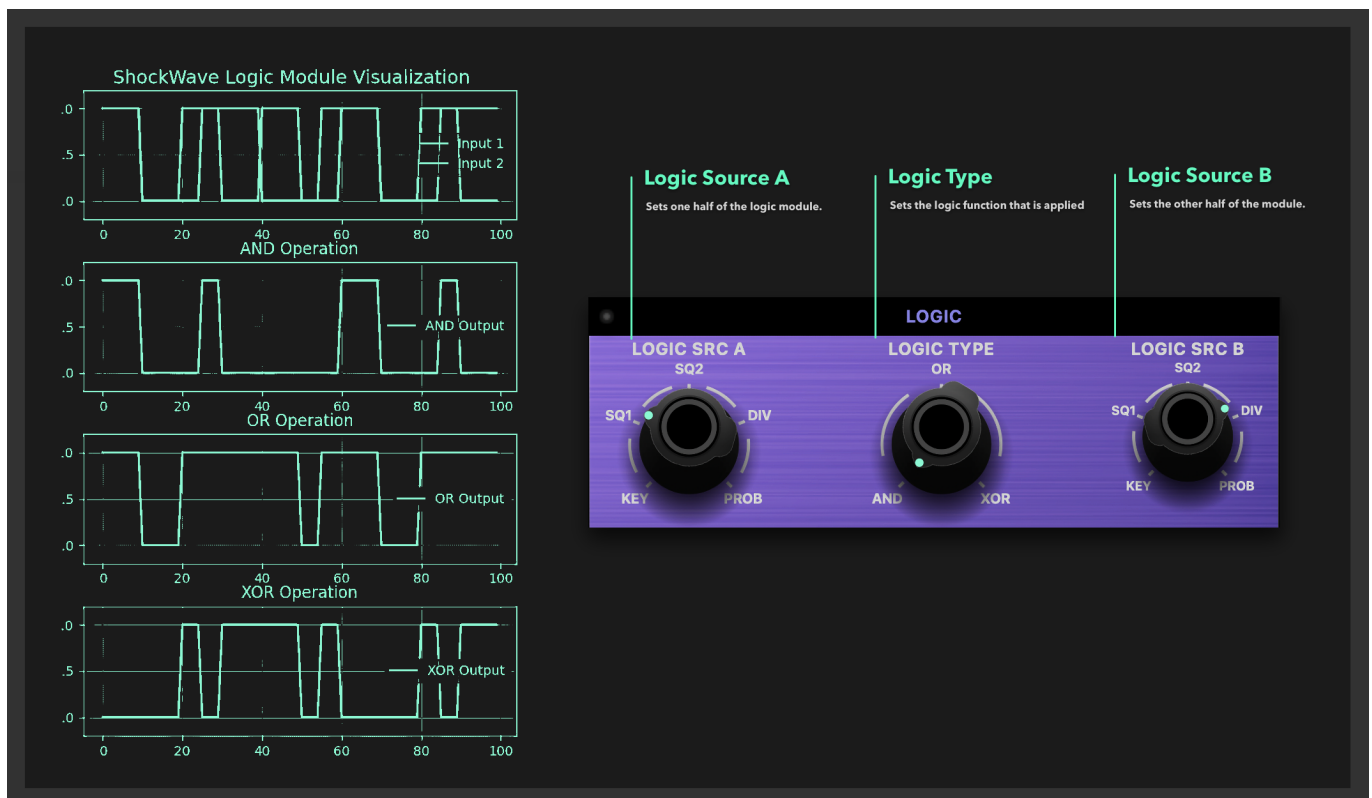
- Combines multiple trigger/gate signals using logic operations
- AND, OR, XOR, and NOT operations available
- Can create complex rhythmic patterns and interactions
- Useful for advanced modulation routing and trigger generation

Example: Using the Logic Module

The Logic module can be used to create complex rhythmic patterns by combining multiple trigger signals. Here are a couple of examples to illustrate its use:

Example Setup 1:

- Sequencer I (Trigger) AND LFO I (Square Wave) -> Envelope Generator I -> X-Mod
- This setup will trigger the envelope only when both the sequencer and the LFO are active, creating a rhythmic modulation that follows the combined pattern of the sequencer and the

> LFO.

Experiment with different logic operations and trigger sources to discover new and exciting ways to use the Logic module in your patches.

Modulation & Routing

Introduction to Modulation

The modulation section of ShockWave is designed to provide extensive control over your sound design. With up to 11 simultaneous modulation sources and 40 modulation destinations, you can create intricate and dynamic patches. The X-Ray mode offers real-time visualization of your modulations, making it easier to understand and fine-tune your settings. Additionally, a dedicated modulation page provides an overview and allows for easy adjustment of all your modulation routings.

Setting Up Modulations

ShockWave features an intuitive and powerful modulation system that allows you to create complex sound designs without the need for virtual patch cables. The modulation system is accessible directly from the main interface, making it easy to set up and visualize your modulation routings.

1. **Enter Modulation Mode**:

   - Press and hold (or right click) any control you want to modulate
   - The available modulation sources will appear in a list

2. **Select Modulation Source**:

   - Choose from 11 available modulation sources:

- LFO 1 & 2
- Envelope 1 & 2
- Sequencers
- OSC 2
- Mod Wheel
- Slide
- Pressure
- Velocity

3. **Adjust Modulation Amount**:

- Use the slider to set the modulation depth
- Positive values modulate in one direction
- Negative values invert the modulation
- The X-Ray mode shows the current modulation amount

Modulation Matrix Page

The dedicated Modulation Matrix page provides an overview of all active routings:

- List of all modulation sources and their destinations
- Quick access to adjust modulation amounts
- Ability to remove or modify existing routings
- Visual representation of modulation paths
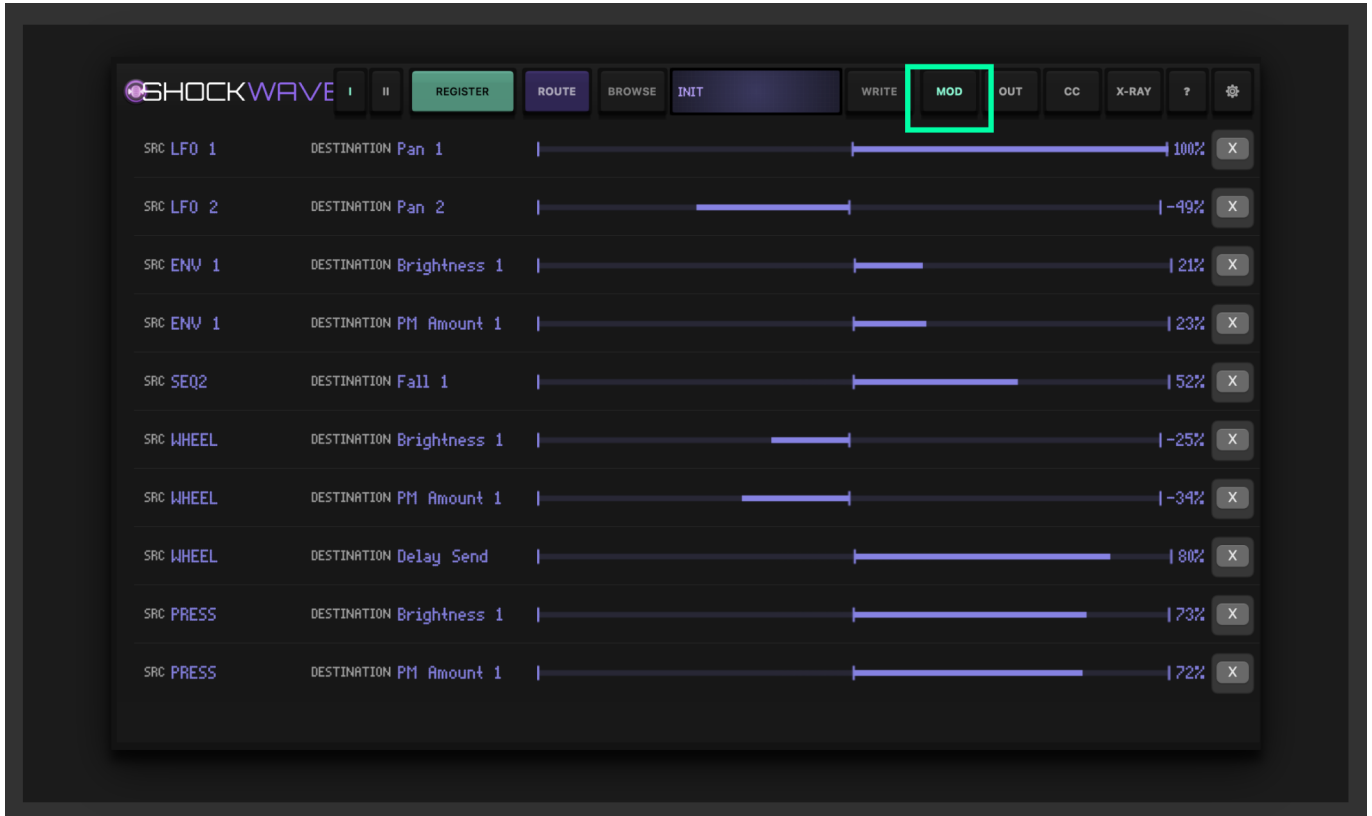
X-Ray Mode

The X-Ray mode provides a real-time visualization of all active modulations:

- Orange indicators show the current modulation amount
- The brightness of the indicator reflects the modulation depth
- Multiple modulations to the same parameter are shown with different colors
- Quickly identify which parameters are being modulated

Tips for Modulation

- Start with subtle amounts and increase gradually
- Use negative modulation amounts for inverse relationships
- Combine multiple sources for complex modulation patterns
- Use the X-Ray mode to understand your patch structure
- Save modulation-heavy patches as templates

Effects & Processing

ShockWave includes built-in Delay and Reverb sections placed on send busses, with all controls including send levels available as modulation destinations.

Delay

The Delay effect is a digital delay placed on a send bus, providing every day echo capabilities:

- **Send Level**: Adjustable per-module send amount
- **Delay Time**: Delay Time in milliseconds
- **Feedback**: Control the number of echo repetitions

Reverb

The Reverb effect is based on a lush vintage digital reverb, utilizing internal modulation to add spatial depth and richness to your sound:

- **Send Level**: Adjustable per-module send amount
- **Highpass**: Adjusts the built int highpass filter
- **Decay**: Control the reverb tail length

> **Note:** All effect parameters are available as modulation destinations, allowing for dynamic control and evolving soundscapes.

MIDI Integration

ShockWave features comprehensive MIDI support for both input and output, making it a powerful tool for both standalone use and integration with external gear.

Input Features

- **MPE Support**: Single Channel MPE implementation
- **Aftertouch**: Channel and Polyphonic aftertouch support
- **Standard MIDI Controls**:
  - ModWheel
  - Pitchbend
  - Tempo Sync
  - Custom CC Control mapping

Output Features

ShockWave can generate MIDI output from various internal sources:

- **Note Output**: Generated from sequencers and other internal sources
- **Control Change Output**: From envelopes, LFOs, and other modulation sources
- **External Control**: Can control external MIDI gear or chain multiple plugin instances

MIDI Implementation

- **Connectivity Options**:
  - USB MIDI
  - Network MIDI
  - Bluetooth MIDI
- **Tempo Sync**: Internal clock can be synchronized with host DAW
- **Custom CC Mapping**: Flexible assignment of MIDI controls to parameters

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MPE Integration & Usage

MPE (MIDI Polyphonic Expression) allows each note played on a compatible controller to have its own individual pitch bend, timbre, and volume expression. ShockWave is fully MPE-compatible and provides deep integration for expressive performance.

> **Note:** ShockWave, being a monophonic synthesizer, only supports single channel expression. This means that while it can respond to MPE data, it will interpret all notes and expressions on a single channel, rather than providing per-note expression across multiple channels.

Enabling MPE in ShockWave

1. **Open the MIDI Settings** in ShockWave.
2. Ensure your **MPE-compatible controller** is connected via USB, Bluetooth, or network MIDI.
3. Enable **MPE Mode** in the MIDI settings.
4. Adjust **pressure and slide settings** in the **Performance section** to map MPE controls to different parameters.
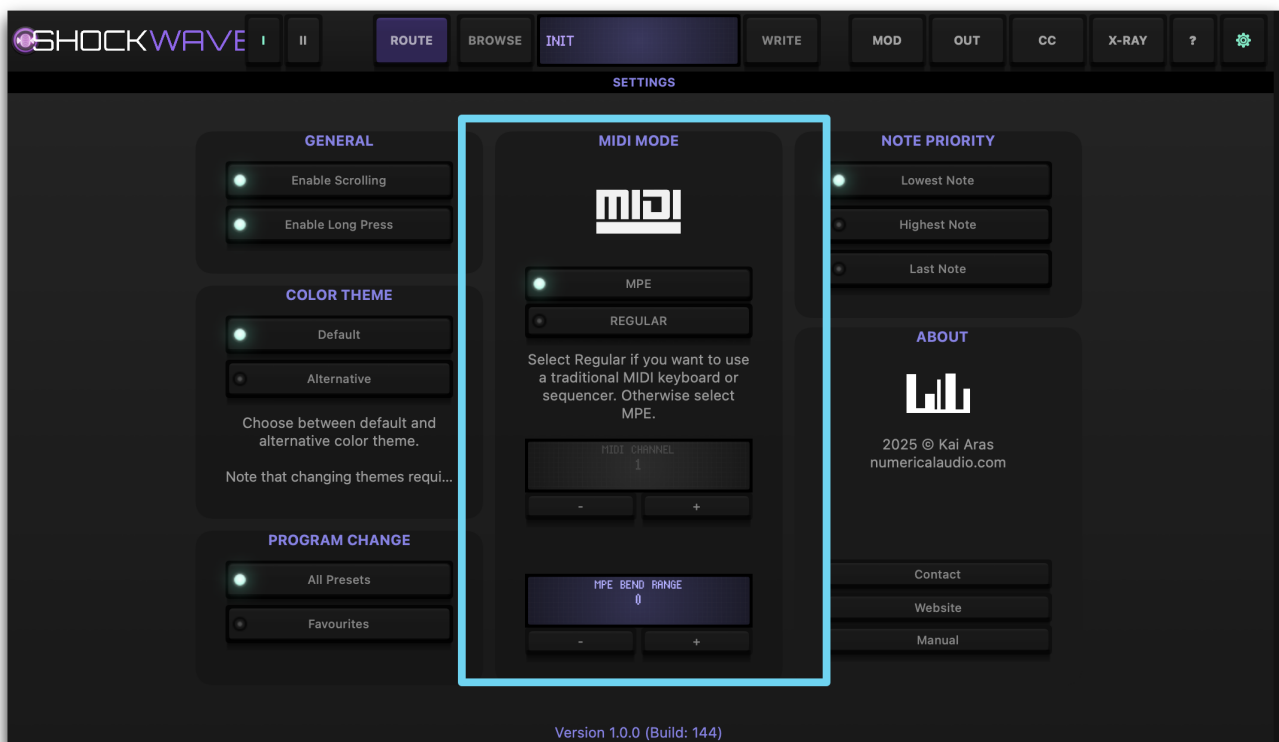
Using MPE with External Controllers

- **Pitch Glide (Per Note Bending)**: Controlled by individual note movement on an MPE controller.
- **Slide (Y-Axis Movement)**: Can be assigned to **filter cutoff, modulation depth, or other parameters**.
- **Pressure Sensitivity (Z-Axis Control)**: Assignable to volume, vibrato, or other modulations.
- Works with controllers like **ROLI Seaboard, Linnstrument, and Sensel Morph**.

Using MPE with ShockWave's Built-in Keyboard (Standalone only)

- ShockWave's **2D touch keyboard** allows expressive control **without an external controller**.
- Enable **slide control** to use on-screen vertical movements for modulation.
- Adjust **pressure settings** for simulated aftertouch response.


Preset Management

Saving Presets

1. Click the **Save** button in the top right corner of the screen
2. Select **Save Preset** in order to save changes to the current patch
3. Select **Save as New Preset** in order to save a new patch
4. Select a **Category** for the preset
5. Enter a **Name** for the preset
6. Click **Save** to save the preset

Loading Presets

1. Open the **Preset Browser** by clicking the **Browse** button in the center of the menubar
2. Select a **Preset** to load
3. Click **Load** to load the preset
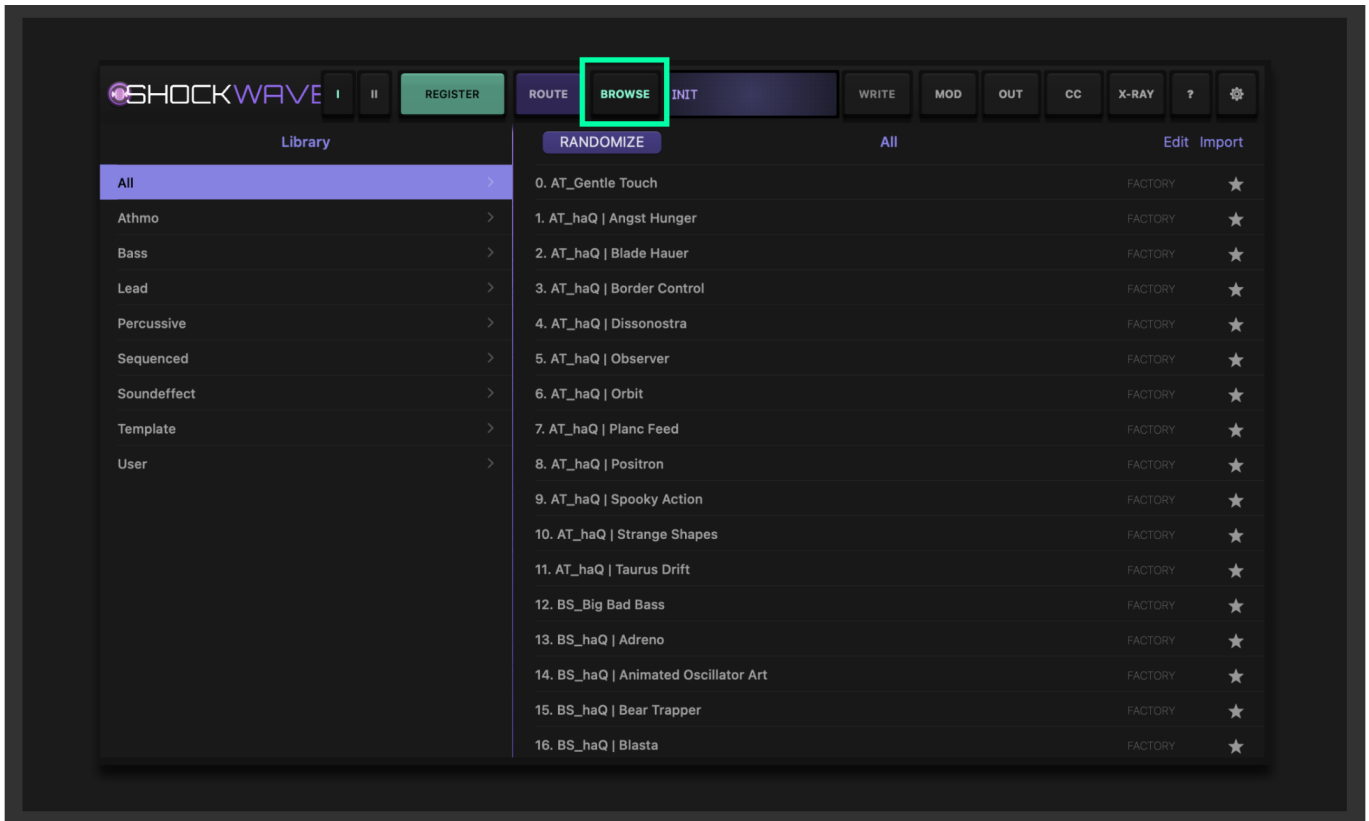
Tips & Tricks

- Use **Phase Distortion** to create analog-like filter sweeps without actual filters
- Experiment with **Cross-Modulation** between oscillators for complex timbres
- Combine the two 8-step sequencers into a 16-step sequence for longer patterns
- Use the **Pattern Generator** with probability gates for evolving sequences
- Take advantage of the **X-Ray mode** to visualize active modulations
- Create self-generating patches using MIDI output to control external gear
- Use the **Logic Module** to create complex trigger patterns
- Explore the **Sample & Hold** module for random variations in your sequences
- Try using both envelopes on the VCA for complex amplitude shaping
- Use the **Quantizer** to force sequences into specific musical scales

Conclusion

ShockWave is a powerful and unique Phase Destructor Synthesizer that brings modular-style workflow to the world of audio plugins. With its dual Phase Distortion oscillators, extensive modulation capabilities, and comprehensive control section, ShockWave offers both immediate access to essential parameters and deep sound design possibilities. Whether you're creating evolving sequences, complex modulation patterns, or exploring the unique timbres of Phase Distortion synthesis, ShockWave provides a versatile and powerful toolset for sound design and music production.

For further updates and support, visit Numerical Audio's official website or check the Product page for the latest version.