Flow Motion FM Synthesizer

User Guide

Contents

Introduction

Frequency modulation synthesis has been a popular tool among sound designers and musicians for decades. Although still widely used, frequency modulation (FM) synthesizers are most closely associated with music of the 1980s. The introduction of off-the-shelf synthesizers–most notably the Yamaha DX7–paved the way for many artists, such as Stevie Wonder, Michael Jackson, and Phil Collins, to create the signature sound of the time.

FM synthesis combines at least two oscillators: a carrier and a modulator. The carrier frequency forms the foundation of the sound, and it's usually controlled by MIDI. The modulator alters the characteristics of the carrier by manipulating its phase and pitch.

Despite their success in forging a new sound, FM synthesizer-based instruments were considered to be complicated and unwieldy. Waves now offers Flow Motion as an alternative approach to the traditional process of FM synthesis. It brings FM synthesis to a level far above the classic instruments of the 1980s, with a workflow that is logical and easy to understand.

What is Flow Motion?

Flow Motion is an advanced FM-based synthesizer. Its unique matrix design, coupled with a built-in snapshot sequencer, makes Flow Motion one of the most powerful and flexible digital instruments today. Among its features:

- An extended four-oscillator matrix with controllable interconnections.
- Four independent LFO/Envelope modulators. Each can be patched to inserts throughout the signal flow.
- Dedicated sections for filters, EQ, amplitude, FX and delay, voices, and pitch.

All Flow Motion controls are structured within a snapshot system. This allows you to store up to 16 different patches, in sequencer steps that vary in musical intervals.

Even with this power and flexibility, Flow Motion is easy to learn, thanks to its intuitive design.

Flow Motion can be used as a plugin or as a standalone instrument.

Quick Start

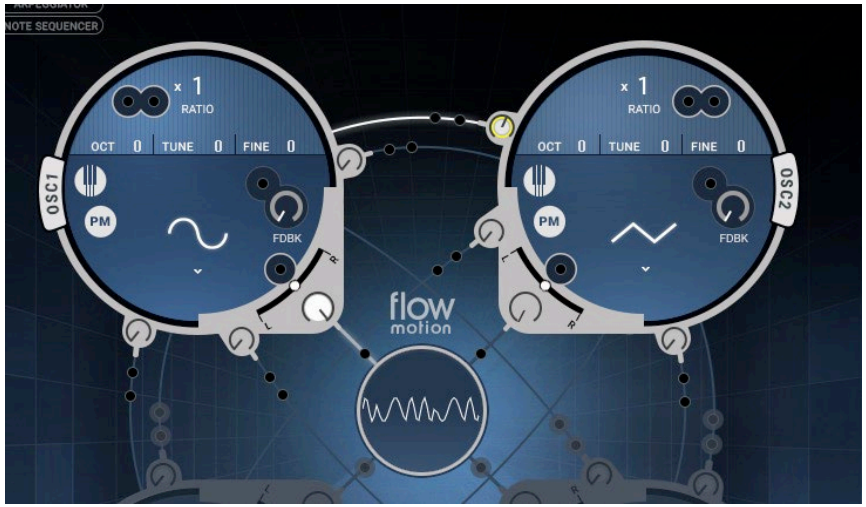
Flow Motion is flexible and modular. There are different types of synthesis that you can work with, and there are many different ways to go about getting what you want. This Quick Start presents three different ways to use Flow Motion. This ought to be enough to get you going. The rest is up to you.

FM Synthesis

FM synthesis, at its simplest, is modulating two or more oscillators—one modulating the others. At least one oscillator must be in an audible range, otherwise there's no point doing it. An oscillator can modulate the others through phase or frequency. Traditionally, this is done via an integrated Attack-Decay-Sustain-Release (ADSR) envelope that controls the level of the modulation over time. In Flow Motion, the envelopes can be set to either a traditional ADSR envelope or an LFO. These modulators are "floating" and can be assigned to any of the oscillators or to other parameter controls.

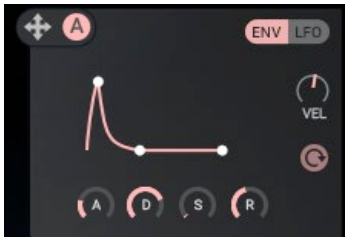
This Quick Start takes you through the steps of setting up basic frequency modulation.

1. Insert Flow Motion on an instrument track of your host application or launch the standalone application.
2. Activate Oscillator (OSC 1). Set all Pitch controls and Ratio to their default positions. The easiest way to do this is to go to the load menu in the WaveSystem toolbar and select "Flow Motion Full Reset." Increase the oscillator gain until you see activity on the oscilloscope.
3. Select a waveform type.



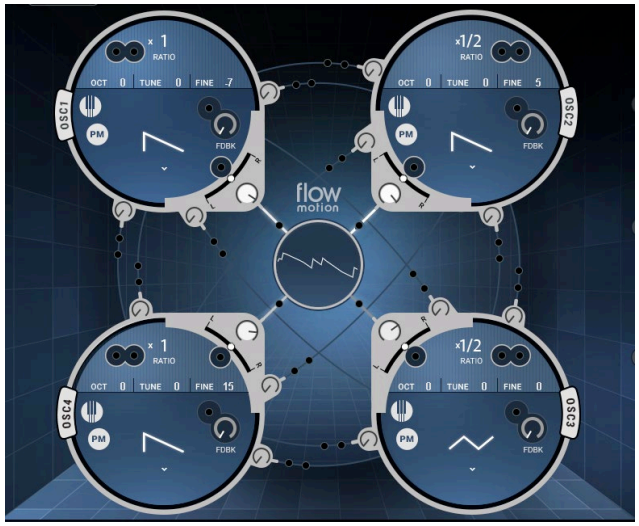
4. Activate Oscillator (OSC) 2. Set it so a different waveform type. Slowly bring up the modulation path level on OSC and listen to the results. Note that the waveform on the oscilloscope is being distorted.
5. This is an effective way to create complex and harmonically rich waveforms. This modulation is, however, static over time. Let's make it more dynamic.
6. Bring the modulation knob back to zero and assign a floating modulation (Mod A) to one of the two modulation slots on the path between OSC1 and OSC2.

7. Assign the modulator by dragging it onto the desired modulation slot.
8. Drag over the modulation slot to adjust modulation depth.



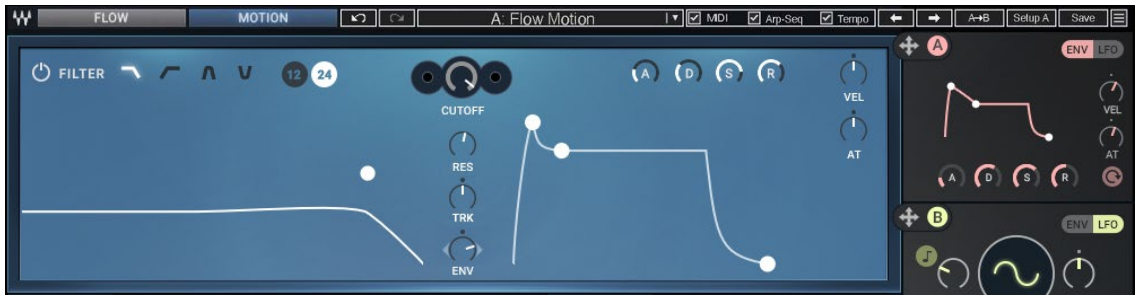
9. Set Mod A as an ADSR envelope. For this example, lets increase only the Decay value. Now the modulation happens only when playing a new note and it fades out based on the ADSR Decay time that we have just set.
10. Experiment with different Envelope values: switch the Envelope to an LFO, patch additional modulations and connections between the oscillators. But be careful, it's very easy to reach unpleasant sounds when overdoing FM modulation. Back off until the effect is what you are seeking.

Analog Oscillators

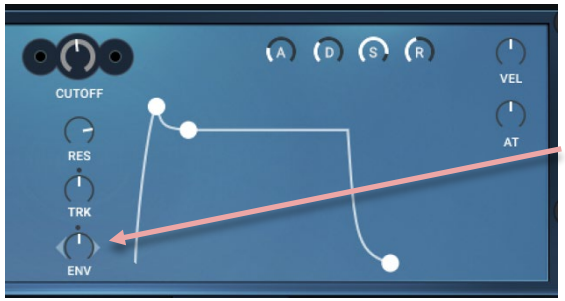


The four Flow oscillators can also be used in a more traditional, subtractive, “analog” manner. They can be summed together to create harmonically rich, stereophonic waveforms. When this signal is passed through a resonant filter, you can create particularly rich, fat sounds.

1. Begin by turning on all four oscillators. Adjust their pitch, panning and gain controls to create the initial sound that you’re looking for.
2. Use the floating modulators to enhance the movement and dynamics of the sound. Modulator slots are spread throughout the interface. Click on a slot and select a modulator from the drop-down menu or drag a modulator handle directly onto a slot
3. Once you’re happy with the oscillator sound, move to the “Motion” screen. Here, the filter is a main player.



4. Adjust the filter’s Cutoff frequency to determine the color and timbre of your sound.



5. Use the integrated ADSR envelope to create dynamic filter movements per note.
6. Change the value of the ENV control to engage these ADSR envelope settings. Increase the ENV level and the filter cutoff frequency will increase based on the envelope. Lower the ENV value and the filter cutoff frequency will decrease. Raise the value and it will be lower.

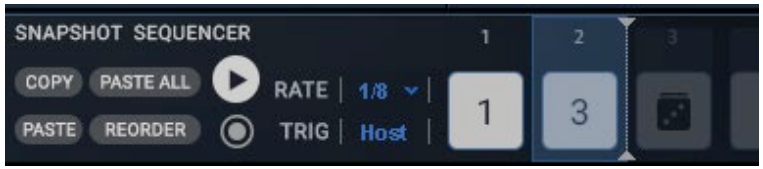
Snapshot Sequencer

The Snapshot Sequencer is one of Flow Motion's most powerful features. It enables you to capture different states of the synth and switch between them in musical rates, in real-time. There are 16 steps, each of which can accommodate one snapshot. To get familiar with the Snapshot sequencer let's begin by switching between four snapshots.

Creating the Snapshots

1. Create a sound that you're happy with. By default, this will be written to snapshot number one. Select the next step and set up Flow Motion as you like. These parameters will be copied to that snapshot. Continue until you have four snapshots in the sequence.
2. Drag the vertical cursor left or right to limit the number of steps that will be played in the sequence.
3. Click and drag vertically on frames to change the sequence in which snapshots are triggered. A snapshot can be repeated or skipped altogether.
4. Select the "dice" icon. This will randomly play one of the 16 snapshots when that frame is triggered.
5. Click once on a snapshot to load it into the synth.

Play the Sequence



There are three ways to trigger the sequencer and to set its rate.

1. In “Host” mode, the sequencer is locked to your DAW. Flow Motion and the host move in tandem.
2. In “BPM” mode, the sequencer runs freely regardless of whether the host plays or not.
3. In the “Key” mode, the sequencer is retriggered whenever a new note is played.

Note: The sequencer Play button must be engaged to enable transport activity. Once the Snapshot Sequencer is in Play mode, it will wait for a trigger from the Host transport or a Key. It will play immediately when set to BPM.

Interface

Flow Screen

The four oscillators are controlled in the Flow Screen. Paths between the oscillators vary in brightness based on signal level. Envelope and LFO modulators (right) can be inserted in a number of places in the signal flow.

Arpeggiator / Note Sequencer

Oscillator section

Interface

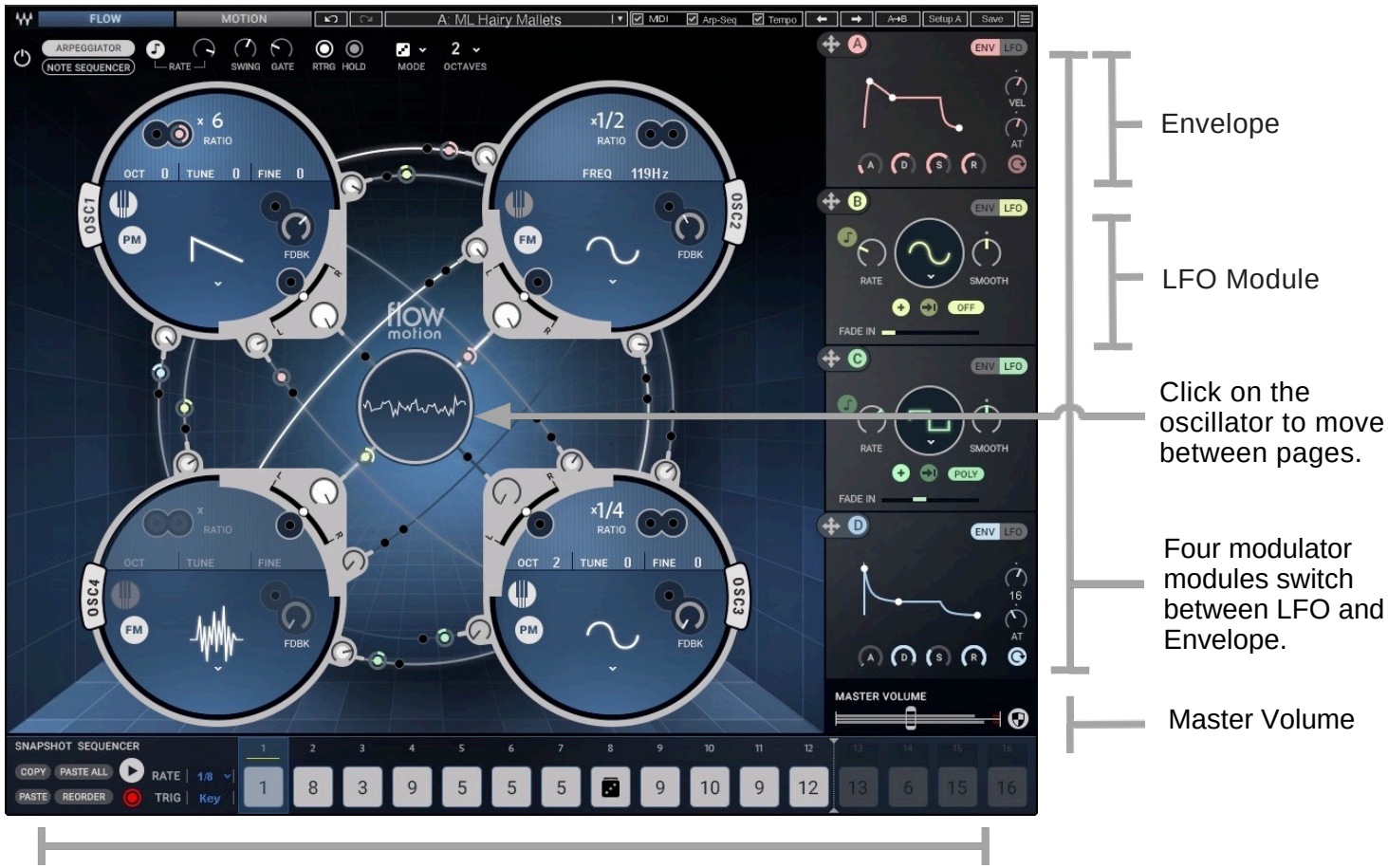
Motion Screen

The Motion screen features additional sound design sections that enable further tweaking and adjustments to compliment the patch. It consists of five main sections: Filter, EQ, Amplitude, FX and Global.

Interface

General Controls

Certain sections are visible from both screens.

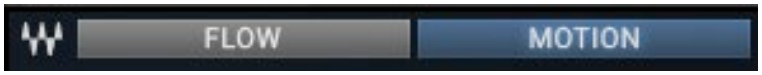


Managing Presets

The toolbar at the top of the plugin is used to save and load presets, compare settings, undo and redo steps, and resize the plugin. To learn more, click the icon at the upper-right corner of the window and open the WaveSystem Guide.

The Flow Motion toolbar also includes a few unique controls:

Flow/Motion Select



Click these toolbar buttons to move between the Flow and Motion screens. You can also click the oscilloscope to change screens.

Midi, ArSEQ, and Tempo Checkboxes

MIDI –You've assigned a MIDI controller knob to a Flow Motion oscillator's Feedback control. Loading the next preset will reset this parameter; you will then have to redo the MIDI Learn routine in order to attach the knob to the control. However, if you uncheck the MIDI checkbox, the next preset will be loaded while the current MIDI assignment will remain in place.

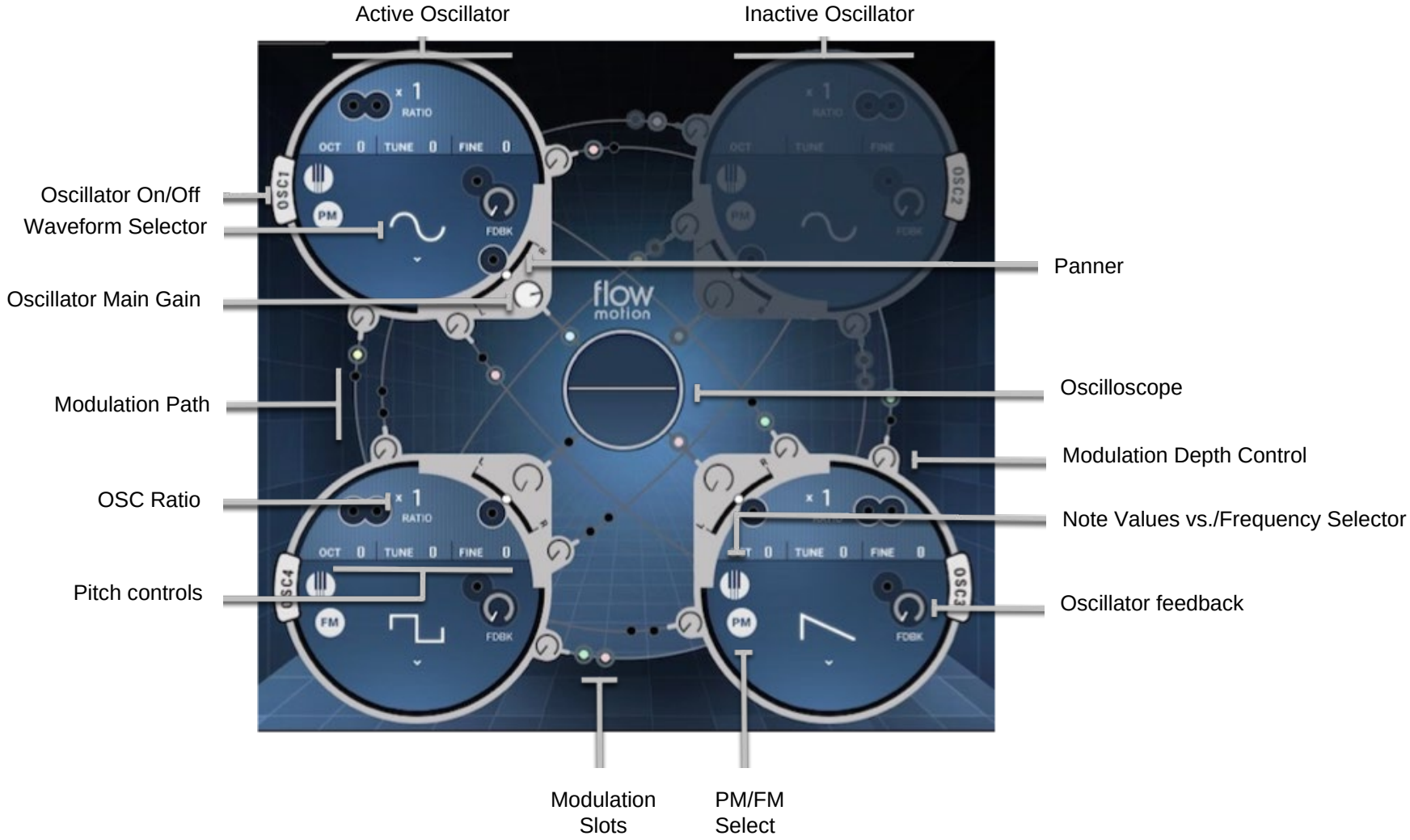
Arp/Seq – You've created an arpeggio effect that you like, and you want to test the pattern using a different sound. Uncheck the Arp/Seq checkbox and the preset will be loaded without any associated Arp/Seq settings, leaving the pattern as is.

Tempo – You're working on an arpeggio with an internal tempo of 140 BPS. Loading presets may set the tempo to a different value or to the value determined by your host computer. To ignore tempo settings saved with other presets, uncheck the Tempo box; your current tempo setting will remain in place when other presets are loaded.

Controls

Flow Screen

Flow Motion consists of four oscillators connected to each other by the interconnected FM matrix. In this section you can control the tonality of your sound by modifying the pitch and amplitude behavior of the oscillators.



Oscillator Controls

Oscillator On/Off

Activates or deactivates the oscillator. When an oscillator is turned off, audio does not pass through it. Modulation path connections leading to and from the oscillator are disabled.
Range: on or off

Ratio

Determines the pitch coefficient of the oscillator. The pitch value is multiplied by this setting. Ratio is a mathematical calculation, not a musical one. As such, it is less likely to create dissonant harmonics.
Range: multiplier = x0.25 to x36

Pitch Controls

The three pitch controls adjust the oscillator's pitch value. There are three resolutions:

Octave Controls the pitch offset of the oscillator in units of octaves. Range -4 octaves to +4 octaves.
Tune Controls the pitch offset of the oscillator in units of semitones. Range: -12 semitones to +12 semitones
Fine Controls the pitch offset of the oscillator in units of cents. Range: -100 cents to +100 cents

Feedback

Controls the modulation depth of an oscillator signal back to itself. Range: 0–100

Waveform Selector

Sets the waveform type. Click the small arrow on the waveform display to select a waveform type from a drop-down menu or click on the waveform itself to toggle through the options.
Range: sine, triangle, sawtooth, square, and noise.

Keyboard Tracking

Switches the oscillator's pitch to respond to note values, or to be set a fixed frequency. When the keyboard icon is selected, the pitch oscillator follows the MIDI keyboard and the pitch is adjusted with the pitch controls. When off, only the selected frequency will play, regardless of which note is played on the MIDI controller.

PM/FM Select

Determines how an input signal will modulate the oscillator: phase modulation or frequency modulation. In phase modulation, the phase of the carrier is shifted rapidly by the modulator's frequency. This is the more common technique used in traditional FM synths. Default is phase modulation.

Oscillator Gain Out

Controls the gain level sent to main out. Range: 0–100

Modulation Depth Controls

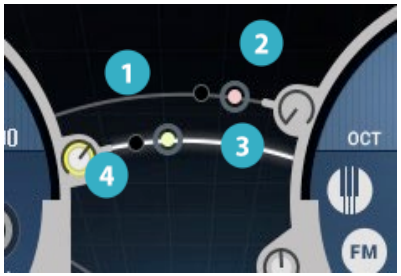
Sets the modulation depth onto the other oscillators. Range: 0%–100%

Pan

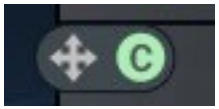
Controls the balance of the main output of the oscillator. Range: -50 (left) to +50 (right)

Modulation Paths

An oscillator can send a signal to and from any other active oscillator. This enables oscillators to modulate one another. To make setup simple and easy to visualize, lines connecting the four oscillators illustrate these connection paths.



1. A modulation path stretches between oscillators.
2. Path gain is set on the output of an oscillator.
3. As the signal in a modulation path increases with respect to the signal input, it becomes brighter.
4. Each path between oscillators has two modulation slots, where a modulator can be inserted at that point in the in the signal flow. There are also modulation slots on the oscillators themselves. To insert a modulator, click on a modulation slot and select from the four modulators in the drop-down menu.



Alternatively, grab and move a modulator's handle directly onto a modulation slot.
Click and drag vertically on a slot to adjust its modulation depth.
Depth Range: -100 to +100
Refer to the Modulators section of this user guide to learn more.

Oscilloscope

The oscilloscope displays the summed waveforms of the four oscillators. The visual feedback helps in understanding the current modulations and summing.
Click the oscilloscope to move between the Flow and Motion pages.

Arpeggiator/Note Sequencer

The Arpeggiator/Sequencer section functions as both a traditional arpeggiator and a 16-step sequencer. Each sequencer step has an in/out toggle as well as a pitch control that can be set +/-24 semitones from the currently held note.

Click on the Arpeggiator or Note Sequencer button to select a mode.

On/Off button

Turns the unit on or off.

Arpeggiator / Note Sequencer Controls

Rate

Sets the rate of the sequencer. There are two modes for calculating sync.
Sync sets the sequencer rate based on music note duration values as it relates to the host's BPM.
Range: 1/32T, 1/32, 1/32D, 1/16T, 1/16, 1/16D, 1/8T, 1/8, 1/8D, 1/4T, 1/4, 1/4D, 1/2T, 1/2, 1,/2D
Free sets the sequencer rate independent of the host BPM.
Range: 1% –100%

Swing

Adds shuffle to the groove by applying an offset to even-numbered notes.
Range: 0%–100%

Gate

Controls the length of the generated notes by truncating their ends. When Gate is set to 100%, a note will be held as long as possible until the next note is played.
Range: 0%–100%

RTRG

Determines whether the note sequence resets to the first step with every new note played. When RTRG is activated and a new note is played, the sequencer will start from the beginning of the sequence. When the function is off and a new note is played, the sequence will continue from the current note.
Range: on or off

Hold

On: When enabled, a played note will continue to play until released.

Controls Unique to the Arpeggiator

Mode

Sets the arpeggiator playing order.
Range: Up, down, up/down, random sequence

Octaves

Determines the range of the arpeggiator.
Range 1, 2, 3, or 4 octaves

Controls unique to the Note Sequencer

Notes Enable

Sets the steps that will be played by the sequencer.

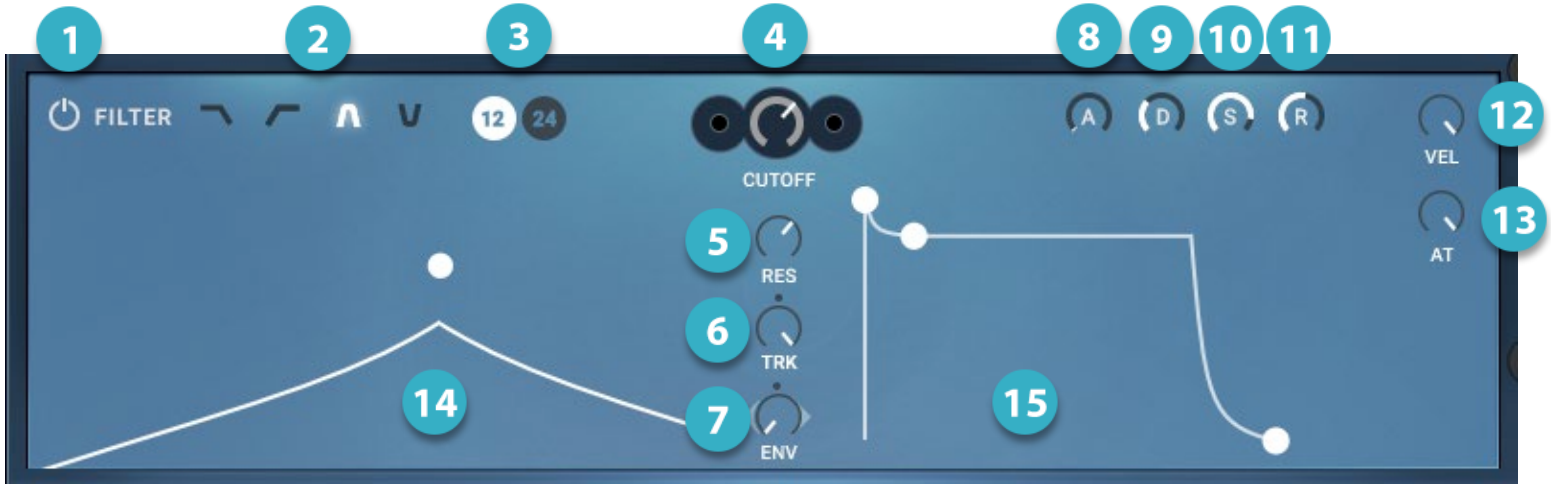
1. Use the slider to select a range of notes.
2. Click on individual notes to select or deselect them.
3. Steps Pitch: determines the pitch of the step. Click and drag on a note to set value or double-click and type in a value.

   Range: -24 semitones to +24 semitones

Motion Screen

The Motion Screen provides control over the Filter, Amplitude, EQ and the additional effects sections. The high-quality filter and its dedicated envelope allow Flow Motion to serve as a powerful traditional “subtractive” synth. This screen provides further control over the timbre and the character of your sound. The Global Section, sets the voice-handling states of the synth and general tune control.

Filter Section



3 Filter Section on/off

2 Filter Type

Sets the filter type.
Range: LP, HP, BP, BR

3 Filer Slope

Sets the order of the filter.
Range: 12 dB or 24 dB

4 Cutoff

Modifies the cutoff frequency of the filter.
Range: 0–100
Note that on either side of the Cutoff control are modulation slots.

5 Resonance

Controls the amount of filter resonance.
Range: 0–100

6 Tracking (TRK)

Controls how much the cutoff frequency is influenced by keyboard notes. At very low settings, the effect of the cutoff frequency is largely unchanged, so frequencies outside the cutoff are attenuated or changed. At very high settings, the cutoff frequency tracks the incoming notes, leaving the notes unchanged.
Range: -100 to +100

7 Envelope Depth

Sets the depth of the filter envelope's modulation.
Range: -100 to +100

8 Attack (A)

Sets the attack time of the filter's envelope.
Range: 0–100

9 Decay (D)

Sets the decay time of the filter's envelope.
Range: 0–100

10 Sustain (S)

Sets the sustain time of the filter's envelope.
Range: 0–100

11 Release (R)

Sets the release time of the filter's envelope
Range: 0–100

12 13 Velocity and Aftertouch

These controls allow you to adjust the amount of modulation applied to the filter envelope in response to MIDI keyboard input.

12 Velocity (VEL)

Sets the point at which the modulator begins to open, based on the velocity of the MIDI keys.
Range: -100 to 100

13 Aftertouch (AT)

Sets modulator response to secondary key pressure on the MIDI keyboard.
Range: -100 to +100

Graphic Displays

14 Filter Graph

Displays and controls the filter cutoff frequency and resonance.
Filter Cutoff X axis, horizontal movement
Resonance Y axis, vertical movement

15 Envelope Graph

Grab and slide a marker to adjsut the corresponding envelope ADSR parameter. Grab a line between markers to modify the slope of the line between markers.

EQ Section

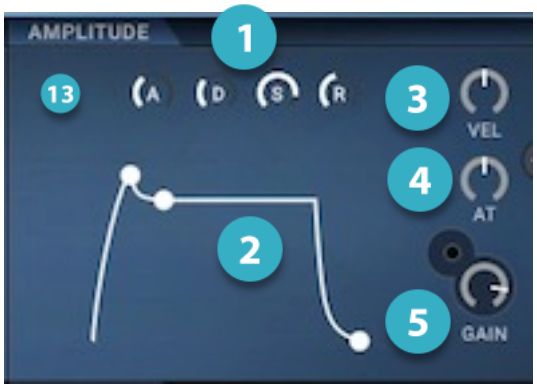
The EQ section consists of a four-band paragraphic EQ, plus LP and HP filters.

1 Band 1 low
Band 2 low mid
Band 3 high mid
Band 4 high

2 LP filter

3 HP filter

Amplitude Section



The Amplitude section consists of a single dedicated envelope that modulates the output volume of the synth.

1. The ADSR knobs control the attack, decay, sustain, and release times of the amplitude envelope.
2. A single ADSR graph represents the amplitude envelope. The Amplitude Envelope is described in the Common Modules section of this user guide.
   Drag a graph marker to change the parameter value. Drag between markers to change the shape of the amplitude graph curve.

3. Amplitude Velocity
   Sets the depth of the envelope modulation to amplitude.
   Range: -100 to +100
4. Aftertouch (AT)
   Sets modulator response to secondary key pressure on the MIDI keyboard.
   Range: -100 to +100
5. Gain
   The overall level of the Amplitude envelope. Note the modulation slot next to the Gain control. This provides yet another point in the signal flow to insert one of the four modulators.
   Range: 0–100

FX Section

The FX section consists of eight studio quality effects available for further tweaking of your sound or any other creative usage. Note that the amount of each effect can be modulated.

FX Controls

There are six effects controls:

- Drive
- Distortion
- Crusher
- Phaser
- Flanger
- Chorus

FX: Delay+Reverb Control

Delay Mix
Controls the balance between the dry and wet signals of the Delay section output.
Delay Feedback (FB)
Controls the amount of delay feedback.
Delay Left
Controls the left-channel delay time value.

Delay Right
Controls the right-channel delay time value.
Reverb Mix
Controls the balance between the dry and wet signals of the Reverb section.
Reverb Damp
Controls the reverb's damping amount.
Reverb Predelay
Controls the reverb's pre-delay value.
FX Reverb Time
Sets the decay time of the FX section reverb.

Global Section

The Global section controls relate to voice-handling and affect the behavior of the synth. Settings in this panel influence CPU usage. Playing notes in unison can result in high CPU drain, so monitor your CPU while getting to know Flow Motion.

Unison Controls
Voices
Sets the maximum number of voices
Range: 1 to 8 voices
Detune
Controls the amount of detune between voices.
Spread
Sets the width of the stereo image of the voices (in unison).

Polyphony Controls

Voices

Sets the number of “notes” that can be played together.

Mono

Forces one voice.
Range: on or off

Legato

Determines whether to reset or continue the envelopes when playing "legato notes." Available in mono mode only.
Range: on or off

BPM

Sets the tempo source
Host: The host application or other external source provides tempo.
Internal: Flow Motion sets BPM.
Range (Internal mode only): 1 BPM–300 BPM

Pitch Controls

Bend

Determines the range of pitch bending (in semitones) controlled by the MIDI keyboard pitch wheel.

Portamento

Sets the time value for pitch gliding.

Tune

Adds pitch offset to the entire synth.

Fine

Allows fine control over the pitch offset in cents.

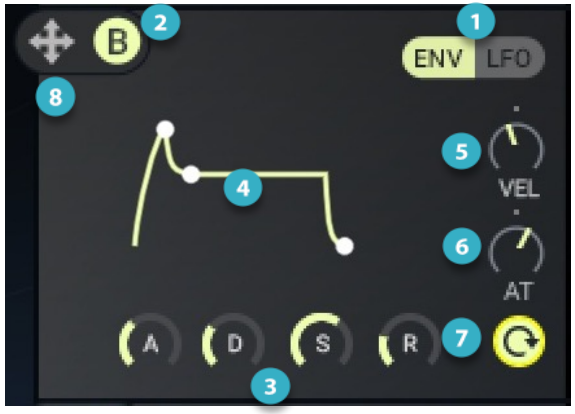
Controls Common to Both Screens

1. Modulators Section: Four identical LFO or envelope modulators
   - 1a LFO Mode
   - 1b Envelope Mode
2. Snapshot Sequencer
3. Master Output Volume
4. WaveSystem Toolbar

Modulators

There are four identical smart modulators (A, B, C, and D), any of which can operate as an envelope editor or as an LFO. These generators are used to modulate other controls in the synthesizer.

13 Envelope Editors



1 **Modulator Type Selector**
Range: Envelope or LFO

2 **Module Name**
This name appears in the modulation slot drop-down menu when a processor is inserted into a signal path.

3 **Envelope ADSR Controls**
Settings are reflected in the graph above**.**
Range or all controls: 0–100

4 **Envelope ADSR Graph**
Grab and slide a marker to adjust the corresponding envelope ADSR parameter. Grab a line between markers to modify the slope of the line between markers.

5 **Velocity**
Controls how the depth of each MIDI note velocity affects the overall level of the envelope. It can be set to a negative or a positive value–0 means no effect.

6 Aftertouch (AT)

Sets modulator response to secondary key pressure on the MIDI keyboard.

Range: -100 to +100

7 **Envelope Loop**

Sets the envelope to loop infinitely. This mode disregards the envelope's sustain value setting.

Range: -100 to +100

8 **Modulator Drag Handle**
Grab/drag this handle onto any modulation slot to insert the modulator in the desired place within the signal flow.

LFO Modulators

is

1. **Modulator Type Selector**
   Range: Envelope or LFO
2. **Module Name** (letter)
   This name appears in the modulation slot drop-down menu when a processor is inserted into a signal path.
3. **Free/Sync**
   Toggles the Rate knob values between Free and Sync modes. In Sync mode, the rate of the LFO is calculated by BPM. In Free mode, Free Motion controls the rate of the LFO.
4. **Rate**
   Sets the rate of the LFO. Display units dependent on the Free/Sync setting.
5. Smooth
   Controls the shape of note starts by smoothing wave transitions. Higher settings yield notes with a more appreciable impact at their onset. Lower settings are smoother.
6. Fade In
   Determines how long a note will be held before LFO modulation fades in. Fade-in duration is content dependent.
7. Polarity Type
   Sets the polarity of the LFO.
   + Unipolar: wave never goes below the LFO zero-crossing point.
   ± Bipolar: wave is centered above and below the zero-crossing point.

8 One Shot

Sets whether LFO stops after one cycle or starts continuously

9 Retrigger (RTRG)

Sets the trigger behavior of the LFO. It has three states:

Poly Each note retriggers an LFO per Voice.

Mono New notes retrigger the same LFO.

Off (free-running) The LFO will not be triggered by notes. This “one-shot” mode forces the LFO to be polyphonic and bipolar.

Master Volume

The Master Volume fader controls the relative output level of the plugin. Level is indicated on the meter. The shield on the right engages a limiter set to -0.1 dBFS. Fader Range: 0 to 100

Snapshot Sequencer

The Snapshot sequencer is a tool that plays a series of up to sixteen snapshots. A snapshot is a frozen description of the entire plugin condition; change a setting and the active snapshot will be updated. Snapshots can be played back in any order. A Flow Motion preset is made up of a maximum of 16 snapshots.

Snapshot Sequencer Components

1 Snapshot Management Section

Used to re-sequence snapshots within a preset and to copy snapshots to other presets or sessions.

Copy Copies the settings of the active step to clipboard.

Paste Pastes the clipboard into the active step.

Paste All Pastes the copied step to all steps. Every step will be the same.

Reorder Resets the step order to its default sequence.

2 Transport/Trigger Section Controls transport and sets triggering rules:

Transport Play/Stop Stops/Starts sequencer play. Transport start depends on trigger mode setting.

Record Works much like touch automation: it records control actions when there is a value change. This overwrites all existing steps. Control changes made when not in record are not saved.

Trigger Sets what will trigger Snapshot Sequencer play.

Host: Snapshot Sequencer transport follows host transport.

Key: Sequence will be triggered by any MIDI note. Tempo is set by the host.

BPM : Snapshot Sequencer transport is not synced to the host transport. Rate is set in the BPM section of the Motion Screen.

Rate

Sets the interval between the sequencer steps

Range: 4 Bars, 3 Bars, 2 Bars, 1 Bar, 1/2D, 1/2, 1/4D, 1/2T, 1/4, 1/8D, 1/4T, 1/8, 1/16D, 1/8T, 1/16, 1/32D, 1/16T, 1/32

3

Sequence Panel

Each snapshot is represented by a frame. Snapshots always play from left-to-right; the playback sequence can be changed by clicking on a snapshot and dragging up or down to select a new sequence number. When the transport is in play or record, the sequence is locked and frames cannot be moved.

4 Active Snapshot

5 This snapshot reflects the current condition of the plugin. All parameter changes in the plugin will overwrite this snapshot.

Random Snapshot

6 Select this symbol and a random snapshot will play at this position.

Selection Boundary

Slide this marker left and right to set the number of snapshots that are repeated in the sequence.

MIDI Learn

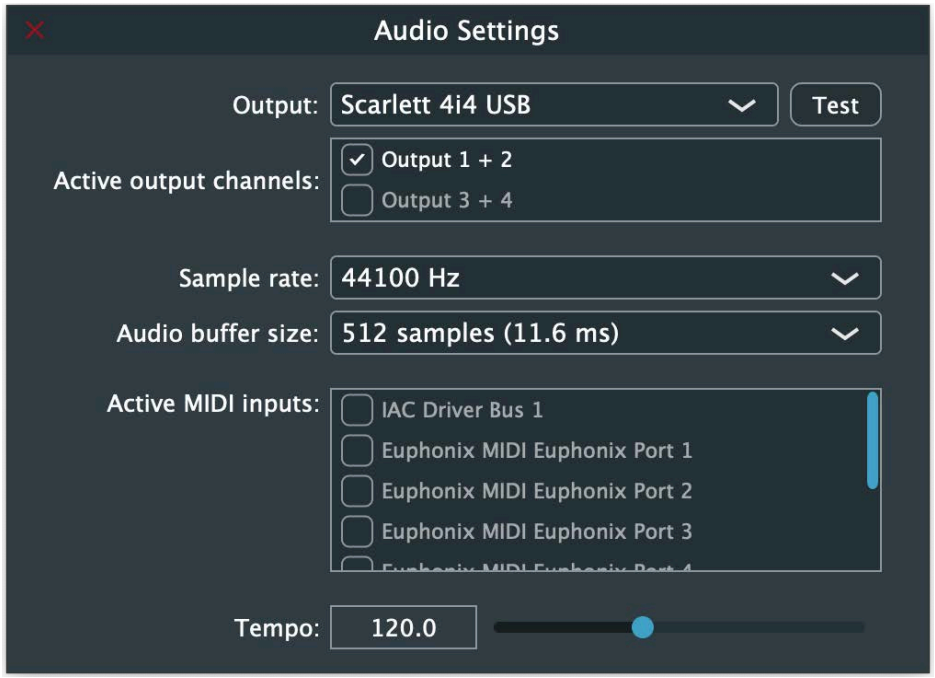
Almost every Flow Motion control can be assigned to a MIDI control through MIDI learn. Right click on a control and select “Learn” from the menu. The name and description of the control appears at the top of the menu. MIDI control includes most variable and discrete controls. It does not include menu items or navigation buttons, such as “Flow/Motion” or “ENV/LFO.”

FlowMotion Standalone Application

The FlowMotion application can be used as a standalone instrument. It requires ASIO drivers for Windows or Core Audio for macOS. FlowMotion.exe (Win) or FlowMotion.app (Mac) loads the FlowMotion instrument and configuration preferences dialogs. Set up the standalone application from its File menu:

- All Notes Off — Sends an All-Notes-Off MIDI command to the FlowMotion synthesizer. This is useful in cases of “stuck” sustaining notes.
- Preferences — Displays the Preferences dialog for the Audio, MIDI, and User Choices configurations.

PREFERENCES



Output displays the audio devices available on the system. **Test** plays a sound if the outputs are configured correctly.

Active Output Channels allows selection of audio outputs from the selected device.

Sample Rate displays and sets the sample rate.*

Audio Buffer Size displays and sets the buffer size, which influences latency.*

*In Windows, sample rate and buffer size cannot be changed from this panel. To modify these settings: close the application, adjust sample rate and buffer size with your driver's control panel (link shown below), and then relaunch.

(Windows Only)

Active MIDI Inputs is a list of available MIDI input devices on the current system. Select the MIDI device for receiving MIDI data.

Tempo: Sets the tempo for all relevant plugins. By default, tempo-based Waves plugins are in a “tempo listen” state and will fix to this value.