

M0SS-309 User Manual

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1. Introduction

The M0SS-309 is the third in the line of M0SS synthesizers. It is a dual-oscillator 9 voice subtractive polyphonic synth, taking inspiration from designs like the Prophet-5 and the Juno-6.

Polyphonic synths are typically designed to be excellent performance instruments, ideal for use with a keyboard, or keyboard-like controller. With this in mind, we designed the synthesis engine in the M0SS-309 to balance the ability to produce lush and accessible sounds easily, with the ability to experiment and create unique timbres as well.

A dual-oscillator topology offers some expanded possibilities compared to a single oscillator design, for example audio rate modulations, detune, and oscillator sync. To maximize the users access to these features, we included a modulation matrix. While many polyphonic synths offer some subset of possible modulation paths, the M0SS-309 allows any modulation source to connect to any destination.

To complete the design, we added some master FX, which we think really makes this a complete and independent instrument. On-board Chorus, Delay and Reverb means that this synth will be at home in the studio, on stage or in any production environment.

We are so excited to hear all the things you are able to create with this unique little polysynth.

Andrew March and Lucas Henry

1.1. Connections

The M0SS-309 is powered by a standard DC barrel jack, often used for guitar pedals. It takes 9V center negative power, provided at the port at the top. It draws ~200 mA, plus whatever power is drawn by a connected USB MIDI controller.

Audio out is standard stereo unbalanced line level 1/4".

There are two options for MIDI in: TRS type A located on the left side of the case, or USB host at the rear. The M0SS-309 will power an external controller through its USB MIDI host.

The M0SS-309 also includes MIDI TRS type A through on the right side of the case.

1.2. Extra Resources

Ultra Palace YouTube Channel: <https://www.youtube.com/@ultrapalace>

M0SS Discord Server: <https://discord.gg/SX8BX6Hhq4>

Ultrapalace Website: <https://www.ultrapalace.com>

2. Getting Started

Using a standard guitar pedal power supply, plug in your M0SS-309. It will boot immediately (there is no power on/off switch for the device). Connect a MIDI controller either through TRS or USB, and connect the audio out.

By default, the device is set to respond to all MIDI channels (Omni), so simply press a key on your controller and hear the response.

2.1. How to Use the Interface

The M0SS family of products has a unique way of interacting with its parameters, which is what allows us to make the devices so small. Each button on the interface corresponds to a parameter, labelled above or beside the button. To select the parameter, simply press the button. There are also shift parameters, secondary functions for many buttons indicated by labels in smaller text. To access these, hold the **ALT** button before pressing the button you want to select.

Parameters come in three types: Selectors, Faders, and Switches. Modifying these parameters works differently.

2.1.1. Editing Selectors

Selectors are indicated by a row of LEDs below the button, each with a label corresponding to the option. Repeated presses of this button will cycle through the available options for this parameter, indicated by the LEDs changing.

2.1.2. Editing Faders

Fader parameters are the equivalent of knobs on most synthesizers, they can take on a range of values. Once a fader parameter is selected, the bottom row of LEDs on the unit will light, indicating the corresponding value. LEDs will light from the left. While a slider is selected, simply rotate the single encoder to change its value.

2.1.3. Editing Switches

Editing switches works in mostly the same way as Selectors, but these parameters only have one corresponding panel LED. Repeated presses of the button will toggle its value.

2.1.4. MIDI Learn

All of the M0SS synthesizers are fully MIDI compatible, and designed to be used with external controllers. To map an external controller's CC knobs to a parameter in your M0SS unit, follow the steps below.

1. Activate MIDI learn mode by pressing the **LEARN** button (**ALT + OS2**). Once in MIDI learn mode, all LEDs will light orange.
2. Select any parameter by pressing the button (shift parameters are also selectable). The LEDs will light yellow.
3. On your controller, send a MIDI CC (by turning the knob/slider you want to assign). The LEDs will light green.
4. Press **ALT** to exit.

To map aftertouch, hold a note on the keyboard, perform steps 1 and 2, then modulate the aftertouch (change the pressure with which you hold down the note).

To map velocity, perform steps 1 and 2 then press any key on the keyboard.

The learned CC mapping is saved **per-preset**, so remember to save your preset to save the learned CC map.

2.1.5. Preset Save/Load

The MOSS-309 is able to store 198 presets. These are stored in 18 banks of 11 presets each. Preset **Banks** are managed using the 18 LEDs in the modulation matrix. Preset **Slots** are managed using the 11 LEDs at the bottom.

To save a preset, follow the steps below.

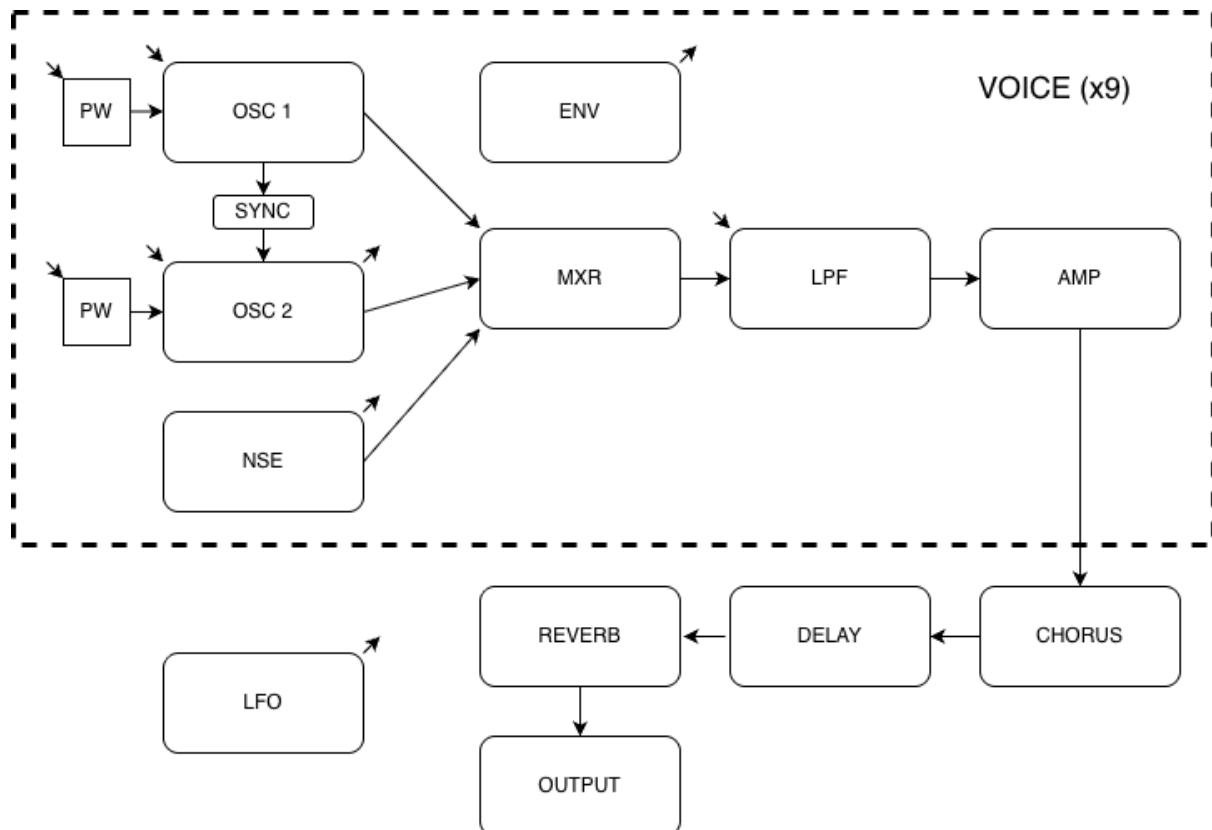
1. Activate save mode (**ALT + CTF**). Save slots that are available will glow green, while occupied ones will glow orange. The currently selected preset will glow blue. The save cursor will blink rapidly, allowing you to navigate to the slot you wish to save on using the encoder. To navigate through Banks, hold **ALT** and turn the encoder.
2. Press the encoder button to save the preset to the slot indicated by the save cursor. This can overwrite a slot.

To load a preset, follow the steps below.

1. Activate load mode (**ALT + RES**). The current slot will glow blue, while occupied slots will glow orange. The load cursor will blink rapidly, allowing you to navigate to the slot you wish to load from using the encoder. To navigate through the Banks, hold **ALT** and turn the encoder.
2. Press the encoder buttons to load the preset indicated by the load cursor. Current settings will be lost if not saved.

3. General Description

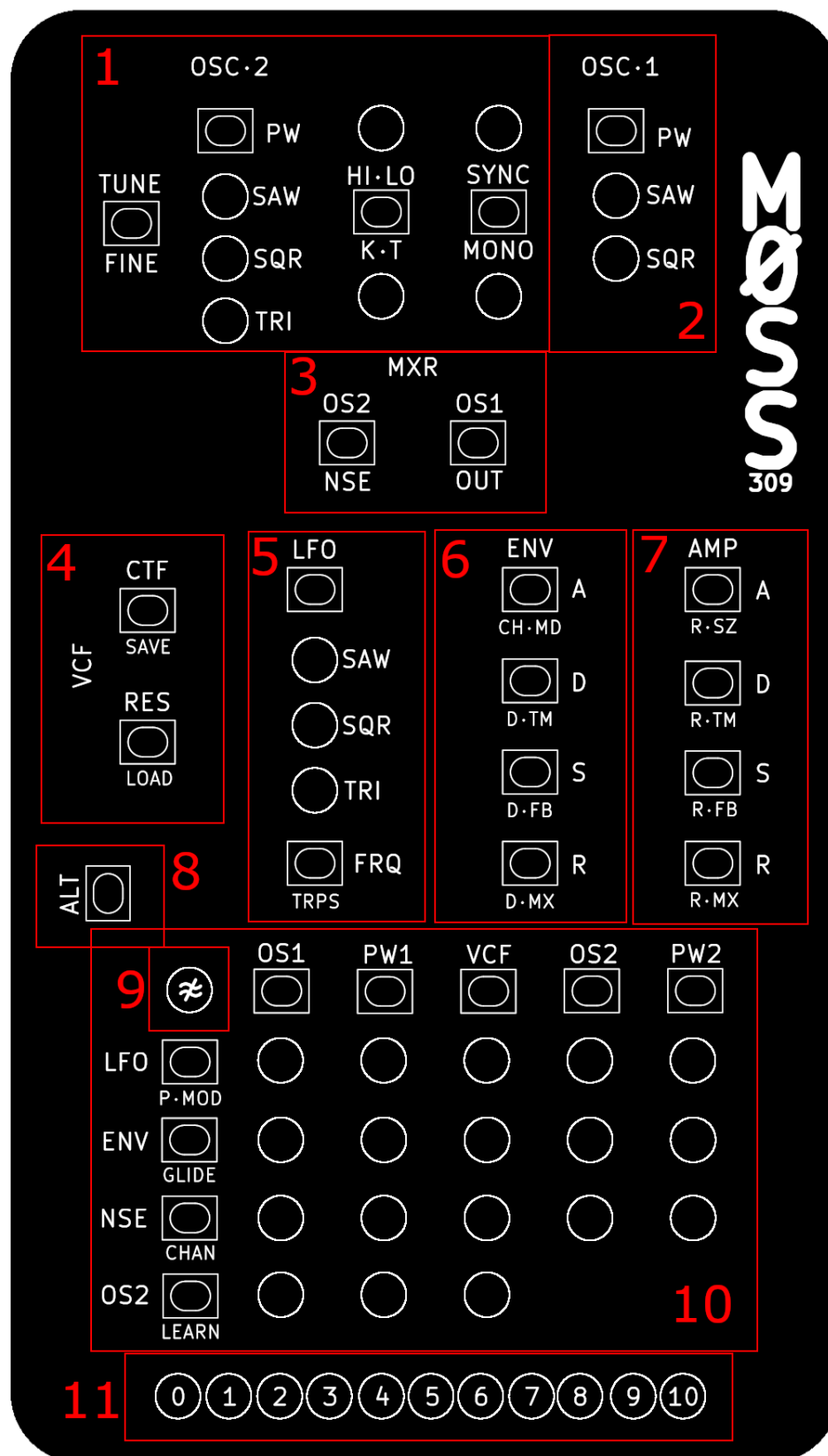
OSC-1 is the primary oscillator on the M0SS-309. OSC-2 can function as a secondary oscillator, in this mode it can be sync'd and can modulate the pitch of OSC 1, or alternatively it can function as a second LFO. The 2 oscillators are mixed with the noise source, then passed to the filter, then the amp, then to the master FX, and then to the output.



Modules inside the region outlined by a dotted line are part of a voice, and the M0SS-309 has 9 of them. These 9 voices are mixed together on their way to the master FX.

The M0SS-309 also features a modulation matrix. Anywhere a small diagonal arrow points **out of** a box, that is a **modulation source**. Anywhere a small diagonal arrow points **into** a box, that component is a **modulation destination**.

3.1. Front Panel Overview



1. Oscillator 2, with pulse width, waveform, hard sync, fine/coarse tuning, key tracking toggle, and hi/lo frequency controls, plus MONO button.
2. Oscillator 1, with pulse width and waveform controls.
3. The Mixer, with inputs from Oscillator 1 and 2 plus a white noise generator, and the master output volume.
4. The Low Pass Filter, with resonance and cutoff. Alternate functions are **SAVE** and **LOAD**.
5. The LFO, with waveform and frequency controls, alternate function is Transpose (**TRPS**).
6. The Modulation Envelope, which can be assigned using the modulation matrix. Alternate functions are **CH-MD** (Chorus Mode), **D-TM** (Delay Time), **D-FB** (Delay Feedback) and **D-MX** (Delay Mix).
7. The Amp Envelope, which always controls the amplifier. Alternate controls are for **R-SZ** (Reverb Size), **R-TM** (Reverb Time), **R-FB** (Reverb Feedback) and **R-MX** (Reverb Mix).
8. The ALT button. Use to access parameters written in smaller font next to or below buttons.
9. The PolyMod indicator.
10. The Modulation Matrix source (row) and destination (column) buttons and indicator LEDs.
11. Parameter value indicator LEDs.

3.2. Dual Oscillators

The MOSS-309 provides a flexible dual oscillator architecture. In the default mode, both oscillators function normally, blending in the mixer. Oscillator 2 has a number of additional features, including drone-mode (with key tracking disabled), hard sync and fine/coarse (de)tune. Using the modulation matrix, it is possible to do cross-modulation from oscillator 2 to oscillator 1.

The oscillators also respect MIDI Pitch Bend commands. The range of the pitch bend can be set using these unmarked parameters:

- **ALT + Mod Matrix OS2** - Pitch Bend range up
- **ALT + Mod Matrix PW2** - Pitch Bend range down

3.2.1. Oscillator 1

Oscillator 1 can output a Sawtooth or Square waveform. These are selected by pressing the **OSC-1** button, which cycles through the waveforms. The pulse width control applies only to the Square waveform.

Oscillator 1 can receive pitch information from several sources:

1. MIDI note in
2. MIDI pitch bend
3. The Envelope through the modulation matrix
4. The LFO through the modulation matrix
5. FM from Oscillator 2 through the modulation matrix
6. White Noise Generator through the modulation matrix

3.2.2 Oscillator 2

Oscillator 2 has three settings that allow it to operate in different modes.

The first setting is **HI-LO**, which changes the frequency range of the oscillator. When this switch is set to high, the oscillator is audio rate. When set to low, the oscillator acts as an LFO, useful for control signals.

The second setting is **K-T** (the shift function for the **HI-LO** button), which toggles key-tracking. When on, the oscillator will stay in tune with incoming MIDI pitch, but will run free when off. This can be useful for creating a drone oscillator when at audio rate, or a simple LFO at control rate.

The third setting is **SYNC** which causes its phase to “sync” with the phase of oscillator 1, triggering the phase to reset whenever the phase of oscillator 1 resets.

The frequency of the oscillator 2 can be modified using its tuning parameters. **TUNE** applies coarse tuning in semitones up to 2 octaves, while **FINE** offers smaller amounts in cents. When keytracking is enabled, these 2 settings constitute an amount of detune from the pitch of oscillator 1. When keytracking is disabled, these settings control the amount of detune from **Middle C** (C4 or 261.63 Hz).

Oscillator 2 has three available waveforms: sawtooth, square and triangle. These are selected by pressing the **OSC2** button, which cycles through the waveforms.

3.2.3 Mixer

The Mixer has 3 inputs, each of which can be assigned a volume. The 3 input sources are Oscillator 1, Oscillator 2, and a White Noise Generator. These sources are only connected to the mixer, and so turning one or more of these inputs to zero means that the sound created by that source will not be heard. The mixer also has an Output setting **OUT** which sets the master output volume of the device.

3.3 Low Pass Filter

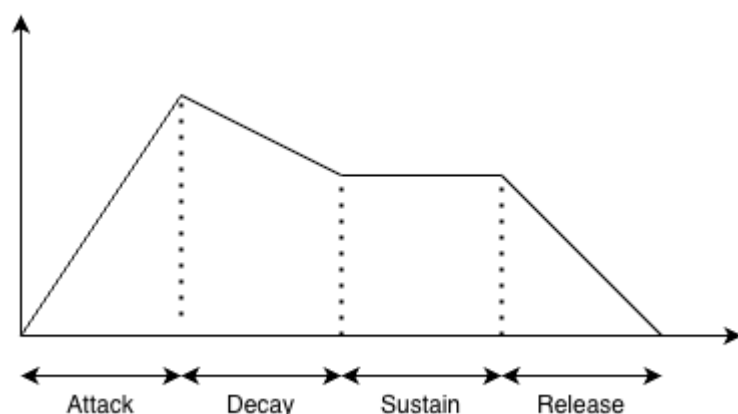
The M0SS-309 has a Low Pass filter that is modelled after the Low Pass filter from the Korg MS-20. There are 2 controls for the filter, cutoff (controlling the frequency that the filter starts to apply its cut), and resonance (controlling the amount of resonance created by the filter at the cutoff frequency).

The cutoff is a modulation destination, so it can be modulated by the LFO, the Modulation Envelope, the White Noise Generator, or by Oscillator 2.

Since Oscillator 2 can be in the audio spectrum, the filter is capable of producing FM tones, when the resonance is high.

3.4 Dual Envelopes

The M0SS-309 has 2 independent envelope generators per voice, each with controls for Attack (**A**), Decay (**D**), Sustain (**S**) and Release (**R**). Both envelopes are gated by MIDI note-on and note-off events. The Attack controls the amount of time it takes for the envelope to go from fully closed to fully open. Decay controls the amount of time it takes for the envelope to close to the level determined by the Sustain setting. If Sustain is at 100% (the default) then nothing will happen during the Decay phase. The envelope stays at the Sustain level until a MIDI note-off event occurs, and from there, the Release control determines how long it will take for the envelope to fully close. If a note-on event occurs before the Sustain phase is complete, then the envelope begins to open again, at the rate determined by the Attack control, until it is fully open, and then proceeds as usual to the Decay phase.



Fast attack and Decay settings, with a low Sustain will create a 'plucked' sound. Slow Attack and Release with high Sustain will produce a gentle pad.

3.4.1 Amplifier envelope (**AMP**)

This envelope exclusively controls the volume of the voice.

3.4.2 Modulation envelope (**ENV**)

Using the modulation matrix, this envelope can be applied to any of the modulation destinations, including the frequency or pulse width of Oscillator 1 or 2, of the filter cutoff frequency. Until it is connected to one or more destinations, this envelope will not have an audible effect on the sound.

3.5 LFO

The LFO on the M0SS-309 has 3 waveforms, Sawtooth (**SAW**), Square (**SQR**) and Triangle (**TRI**). Use the button labelled **LFO** to toggle between these. The frequency of the LFO is set using the **FRQ** button, and can additionally be modulated via the modulation matrix.

The LFO output signal can be connected to any of the modulation destinations using the Modulation Matrix. Sending it to Oscillator 1 or 2 will create a vibrato effect, sending it to the Filter will give the sound some nice harmonic movement.

3.6 Modulation Matrix

The modulation matrix is a core component of the M0SS-309, and takes up a significant amount of space on the panel. It allows virtual patch connections to be made throughout the synthesizer, from any of four sources (**LFO**, **ENV**, **NSE** and **OSC**) to any of the five destinations (**OS1**, **PW1**, **VCF**, **OS2** and **PW2**).

These connections are bipolar, modeling the attenuverters popular in modular synthesis, so they can provide positive or negative modulation.

To use the mod matrix, select a source by pressing the corresponding button, and that row will light. Now press a destination, and that column will light. The selected parameter is now at the cross-hairs of the lighted row and column. Like any other parameter, simply turn the encoder to increase the modulation depth from that source to that destination. Turning the encoder to the left from zero will provide negative modulation, and the corresponding LED will glow Red, while turning it to the right from zero will provide positive modulation, and the corresponding LED will glow Green. The LEDs glow on the matrix with a strength proportional to the modulation depth.

You can then press any other row button, or column button to change to a new parameter in the matrix. The cross-hairs will move to show what is selected.

To reset any parameter in the Modulation Matrix back to exactly zero, hold **ALT** and click the encoder.

3.6.1 PolyMod Matrix

The M0SS-309 has a second Modulation Matrix called the PolyMod Matrix which allows a single CC to control multiple modulation connections. This is modeled after the Mod Wheel functionality on some classic polyphonic synths.

To use the PolyMod matrix:

1. Assign a CC to the PolyMod parameter (**ALT + LFO**) using MIDI learn.
2. Send a high value on this CC to turn it up.
3. Press the PolyMod button (**ALT + LFO**) to toggle into PolyMod display mode. The # symbol now indicates that the PolyMod Matrix is selected.
4. Apply some modulation connections just like with the normal Mod Matrix.
5. Modulate the PolyMod CC that you assigned earlier up and down, and the effects of this PolyMod matrix will morph in and out.

3.7 Master FX

The M0SS-309 places the master FX last in the chain. The FX are Chorus, Delay and Reverb. All 3 FX are stereo, and applied in the order listed above. By default all 3 are disabled, Chorus is set to the **OFF** mode, and the mix for delay and reverb are both set to 0.

3.7.1 Chorus

The Stereo Chorus has 4 modes:

1. Off
2. Chorus I
3. Chorus II
4. Chorus I+II

Pressing **CH-MD** will toggle through the chorus modes.

Chorus I is mellow and slow. Chorus II is faster and more aggressive. Chorus I+II applies both Chorus I and Chorus II together in series.

3.7.2 Delay

The delay is a simple digital delay, with 3 settings

1. **D-TM**: Delay Time - the time between the incoming audio and the delayed sound. Very short times can sound almost like a chorus, while longer ones are perceived as an echo.
2. **D-FB**: Delay Feedback - how much of the delayed signal is mixed back in. This can allow for multiple repeats of a signal signal, each decaying in amplitude slightly. Set to 0, there is only one echo audible. At very high amounts, the signal can repeat almost indefinitely.

3. **D-MX:** Delay Mix - how much of the delayed signal is added into the final output. With the control set to 0, the delay is inaudible. When set to maximum, the main signal is not heard at all, only the delayed repeats.

3.7.3 Reverb

The Reverb is an algorithmic reverb inspired by the famous Eventide Black Hole. It has 2 controls

1. **R-SZ:** Reverb Size - the length of the reverb tail.
2. **R-TM:** Reverb Time - the delay time of the reverb early reflections.
3. **R-FB:** Reverb Feedback - the number of reverb early reflections.
4. **R-MX:** Reverb Mix - how much of the reverb signal is added into the final output. With the control set to 0, the reverb is inaudible. When set to maximum, the main signal is not heard at all, only the reverb tail.

3.8 Polyphony

The M0SS-309 has 9 voices of polyphony, meaning it can generate 9 notes at once, each on its own voice. Each voice includes 2 oscillators and white noise, mixer, filter, 2 envelopes, and amp. The LFO is common to all the voices, and the voices mix together before the master FX are applied.

There is a voice stealing algorithm which determines what happens when more than 9 notes are playing at once. When the 10th note is started, the oldest note (the first one to have been pushed) will be stopped, the envelope will be reset, and the new note will start on that voice. This means that the stolen note will not execute (or complete) its release phase.

If a new note is played, and less than 9 notes are currently held, the algorithm will try to find a note that is not in its release phase, to minimize interruptions. This means that with a slow release, when playing rapid staccato notes, all the voices may be utilized, and the voice stealing algorithm may still be called on to steal the oldest note still in its release phase.

3.8.1 MONO mode

In MONO mode, all 9 voices will play the same note. In this mode the M0SS-309 also applies an analog modelling algorithm to simulate the drift in analog oscillators. This produces a very rich tone.

To toggle MONO mode on and off, use the **MONO** button (**ALT + SYNC**).

Note that in MONO mode, the Glide functionality works very well.

4. Other Capabilities

M0SS-309 has some additional capabilities controlled by special files on the SD Card, allowing you to control CC mappings, Pitch Bend range, share preset files, etc..

4.1 m0ss-config.txt

This file controls the state of the M0SS-309 at boot. It allows some settings and parameters to persist after a reset of the device, including:

- The MIDI channel.
- The Pitch Bend range

4.2 preset files

The /presets directory stores all the saved presets. These can be copied off the SD card and shared with friends, or copied onto the SD card if a friend shares with you. These files are loaded into the preset banks based on the name. A file called bank-00-slot-00.json means the first preset in the first bank. M0SS-309 will load this file at boot, in that slot and bank. The preset files also contain the CC mapping for that preset.

4.3 kernel8.img

This is the M0SS-309 firmware file. As updated and alternative firmwares become available, this is the file that will be updated on the SD Card. It must always be called exactly kernel8.img, so you will need to keep these files organized in some way, since the files' names will not differentiate between them.