MULTIWAVE MEGA
user manual

v1.0

The Multiwave Mega guitar synthesizer

Supply: 9V DC, negative center
Current draw: 56mA

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1.

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2.

Intro

The Multiwave Mega is a monophonic wavetable-based guitar synthesizer with an analog resonant lowpass filter

KEY FEATURES

* Two oscillators with several waveshapes
* One oscillator that can be detuned
* Resonant lowpass filter with envelopes
* Sustain mode (aka “drone mode”)
* LFO’s for both the oscillators and filter
* OLED oscilloscope*

* only avaliable on the fully assembled version

The two oscillators will be reffered to here as the primary and the secondary oscillator. When first powering up you will only hear the primary oscillator by default.

The secondary oscillator needs to be activated using the Blend function - see page 6

3.

Buttons

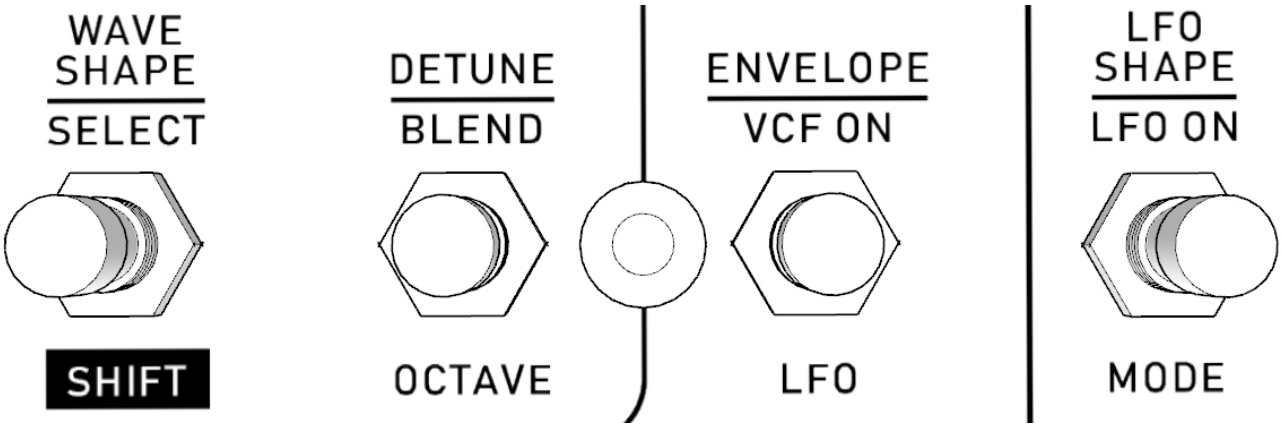
OVERVIEW

The Mega has four push buttons. In this manual we will refer to them as button 1 through 4 (from left to right).

Each push button has three different functions
* **Normal press** - *short press*
* **Long press** - *press and hold for at least 500ms*
* **Shift press** - *press and hold button 1 (marked "Shift"), then press one of the other buttons*

The LED will blink two times to indicate a long press, and it will blink 3 times fast when doing a shift press. This gives a nice visual indication of the button response.

The top row describe the normal press functions. the second row describe the long press functions.



The row under the button describe the Shift press functions.

4.

Button 1

1/2

WAVESHAPE

normal press

This will cycle through all the waveshapes
for the primary oscillator.

1. Sawtooth
2. Square
3. Pulse
4. Narrow pulse
5. Bell *
6. Sine
7. Noise **

** The "Bell" waveshape is an FM inspired shape that blends sinewaves at different frequencies, to produce a bell-like sound.*
*** The noise is technically still a sinewave, but it starts from a random postition within the wavetable to produce noise.*

Button 1

2/2

SELECT

long press

This will save the current waveshape as the waveshape for the secondary oscillator.

See the Blend details on button 2 (page 6)

SHIFT

Press and hold this button, then press one of the other buttons to activate their respective shift functions.

Shift functions are described under the buttons on the same row as the "Shift" marking

6.

Button 2

1/2

DETUNE

normal press

This will detune the primary oscillator to a higher pitch. It will toggle through 6 different steps. The first step is just slightly detuned, followed by 5 other musical intervals.

Note that only the primary oscillator will detune, so when the blend is activated this will create a layered sounds between the two oscillators, almost like playing chords. The first detune setting is just slightly out of tune so it will create a cool phasey modulating sound.

Button 2

BLEND

long press

This will activate the secondary oscillator blended together with the primary oscillator.

The waveshape of the secondary oscillator can be selected by doing a long press of button 1. This way you can blend any* of the waveshapes together using button 1 (toggle & select).

** except the noise (waveshape 7) that can only be used with the primary oscillator.*

OCTAVE

shift press

This will transpose the secondary oscillator down one octave, so it can basically become a "sub oscillator" to fatten up the tone.

8.

Button 3

1/4

ENVELOPE

normal press

When the VCF is activated (by doing a long press), this will toggle through three different envelope shapes used to sweep the filter cutoff.

1. fast attack/slow release

2. slow attack/slow release

3. slow attack/fast release

If the VCF isn't activated, normal presses to this button does nothing.

9.

Button 3

2/4

VCF ON

long press

This will activate the VCF = **V**oltage **C**ontrolled **F**ilter.

The filter cutoff is normally controlled by the "cutoff/rate" knob. But with the VCF activated, the filter is insted controlled by an envelope that will sweep the filter cutoff automatically, just like having an invisible robot turn the filter cutoff knob for you, when hitting a note. :)

This envelope is triggered by the guitar input *(by default)*.

For this to work, the threshold needs to be adjusted to suit the guitar signal-strenght. - See page 15 on the threshold control.

Button 3

3/4

VCF ON *(cont.)*

In VCF mode, the filter is normally "closed", just like turning the cutoff pot fully clockwise (full treble attenuation).

When you hit a note and the threshold LED comes on, it will go through the attack portion of the envelope - the filter will open up and hold it open until the signal has dropped below the threshold (and the LED turns off again) - then it will go through the release portion of the envelope.

In VCF mode, the filter cutoff knob now acts as a rate knob insted. It now controls how fast it goes through the envelope. From slow sweeps to fast wah'ish sounds.

11.

Button 3

4/4

LFO (filter)

shift press

This enables automatic repeats of the filter envelope, insted of being triggered by the guitar signal, basically turning it into an LFO = **L**ow **F**requency **O**scillator.

The rate is controlled by the cutoff/rate knob, and the same selection of envelope shapes can still be toggled through with normal button presses.

The filter envelope LFO and the main LFO are totally independent, so both can be running simulaniously with different rates and shapes.

12.

Button 4

1/3

LFO SHAPE

normal press

When the LFO is on (by doing a long press), normal presses will toggle through 4 different waveshapes for the LFO.

1. Sinewave
2. Sawtooth
3. Ramp (inverted saw)
4. Pseudo random

When the LFO is off, normal presses to this button does nothing.

Note that the random shape sounds alot faster than the other LFO shapes, so turn down the rate when using it (or max the rate to use it as a noise creator...)

13.

Button 4

2/3

LFO ON

long press

This will turn on the LFO.

This function is pretty quirky and wierd, but too fun to not include and can create some unexpected sounds... :)

The LFO has two modes. In both modes it will respond very differently depending on the oscillator waveshape.

For example; for square waves it will do a clean amplitude (volume) modulation, like a tremolo. But if the oscillator is running a sawtooth, it will modulate the amplitude, but also the waveshape and frequency as the amplitude goes up and down *(this is most noticable at low LFO rates)*.

14.

Button 4

3/3

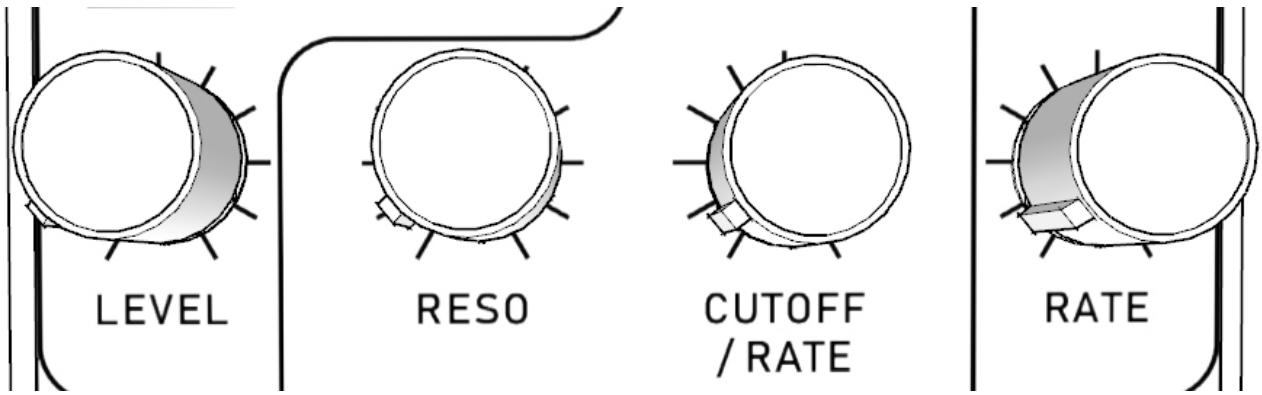
MODE

shift press

This will change the mode of the LFO to an alternative mode that does a more intense and harsher sounding frequency modulation with less amplitude modulation.

One of my favourite settings is using this LFO mode together with the random wavshape, which will create what sounds like a random note sequencer. :)

15.
Knobs
1/2



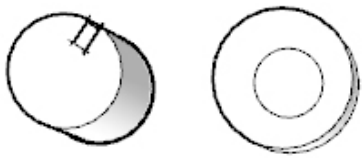
LEVEL - controls the overall output volume
RESO - control the amout of filter resonance
CUTOFF - controls the filter cutoff frequency
RATE - controls the speed of the LFO

In VCF mode the cutoff knob insted becomes a rate control for the envelope & filter LFO.

16.

Knobs

2/2



THRESHOLD

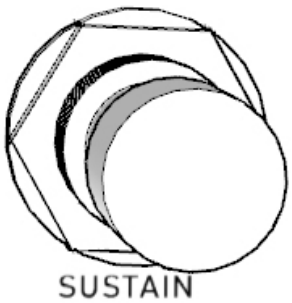
The threshold control sets the guitar signal trigger point. This is used for both the filter envelope and the sustain mode (see pages 10 and 17).

It needs to be adjusted so that the threshold LED (next to the threshold pot) only lights up when you hit a note, and turn off as soon as the note starts to decay.

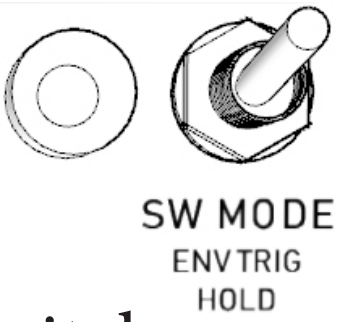
Tip: Turn the pot fully clockwise (the LED will turn on) and then turn it slowly counter-clockwise until the LED goes off. Just around this point there's a small sweetspot that will trigger the envelope/sustain mode) just the right way. Note that the guitar output may be very low when playing on the highest notes thus not triggering the threshold at all. This is normal. Just find a good compromise between sustain and tracking.

The Sustain footswitch

The Multiwave Mega has a sample and hold feature that will sustain a note forever (aka “drone Mode”). This is enabled with the Sustain footswitch.



When the sustain mode is enabled the LED (next to the toggle switch) will turn on.



The SW MODE switch

There are two different sustain modes, depending on the position of this toggle switch.

Down position - In this mode the footswitch will hold the note forever (basically bypassing the guitar input), until pressed again.

Up position - In this mode the footswitch will enable guitar signal triggered sustain. When the threshold LED turns off, as the signal falls below the threshold, it will hold the current note.

For the guitar triggered sustain mode to work the Threshold needs to be set up correctly- see page 15.

19.

Tips

Tracking

To get the best sounds out of the Mega, keep in mind that it is a monophonic device. Strummig chords will not work. Play single notes and keep it clean. I recommend using the neck pickup on your guitar with the tone/treble rolled all the way down. This will improve tracking greatly.

You can also try palm muting notes, especially when playing low notes, to improve the tracking.

Sustain mode

Adjusting the playstyle is even more important when using the guitar triggered sustain mode. I find that I get the best results when letting notes sustain as much as possible, insted of playing "choppy", since it will sample and hold no matter what when the threshold is crossed.

20.

Quirks & bugs

* After doing certain shift presses, the rate pots for the VCF and LFO will sometimes become unresponsive and you will have a very slow rate. This is a known bug, but easily fixed by simply pressing any button once to regain rate control.

* When pressing Button 3, the filter will temporarily open. This is normal behaviour.

* When the noise is selected it demands alot of processing power from the microcontroller so it's best used without the blend activated.

* Just note that the filter has a bit of stepping to it, especially at the bottom of the range which gets pronounced with the resonance turned up.

* The Sample & Hold is analog, so after a while it will start to drift alittle out of tune. It uses a capacitor to store the VCO voltage, and unfortunately no capacitor is perfect and will leak the charge eventually.

21.

Data

TECHNOBABBLE

*The Multiwave Mega is a analog / digital hybrid.
On the analog side with got the preamp, sample and hold and the resonant lowpass filter. On the digital side we have a microcontroller that handles the oscillators, filter control, the LFOs and the buttons.*

It uses a CMOS based preamp stage that converts the guitar signal into a square wave and then multiplies the frequency by 64 using a Phase Locked Loop together with a binary counter. This is needed so that the microcontroller doesn't have to do anything too demanding using timers. It simply uses an external interrupt to cycle through the waveshape arrays.

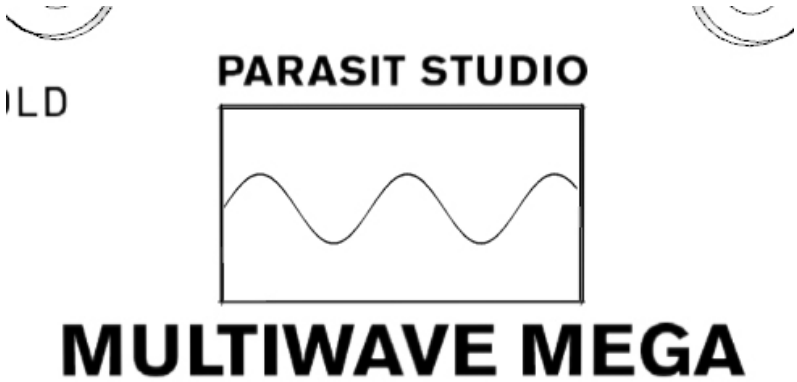
The oscillators are wavetable based, which means that every waveshape is stored as an array of numbers that represents pwm duty cycle (voltage levels) for a single waveshape cycle. It has a 6-bit resolution (64 steps) for the oscillators and the LFO, and a 7-bits resolution (128 steps) for the envelopes.

It has a total of 35 wavetables stored on the microcontroller for the different waveshapes (and one for each detune setting) with a few unique wavetables for the envelopes and the LFO.

22.

OLED

THE TINY OSCILLOSCOPE



The Fully assembled version of the Mega features a small 64x128 pixel monochrome oscilloscope that gives a nice visual feedback.

The OLED and the related circuitry is not included or supported with the PCB/DIY kit, since it would make it harder to for people to build (having to make a square hole) and add an extra cost. The scope is nice to have but not necessary. All the other features are the same.

23.

Credits

The Mega was created by me, Fredrik Lyxzén, during a period of 8 months, from around january to september 2019. I spent hundreds of hours of breadboarding and late night programming. Over the course of these months, the project has gone through several major changes and been redesigned from scratch twice. I wanted to raise the bar this time and make something special.

It's been both fun and frustrating. It's been a great learning experience, especially since programming is not my strong suite, so I had to learn alot as I went along. When the third prototype PCB arrived (after a long wait) and had several issues I was almost ready to give up and scrap the whole project... But I kept going at it (patience young padawan) and finally had a working final version worthy of a release. In the end I think that it turned out great! It's not perfect due to the limitations of the microcontroller, but it's damn cool just as is.

I'm very proud over this pedal and I hope that you have as much fun using it as I had developing it.

/ Fredrik

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