Multiwave Mega

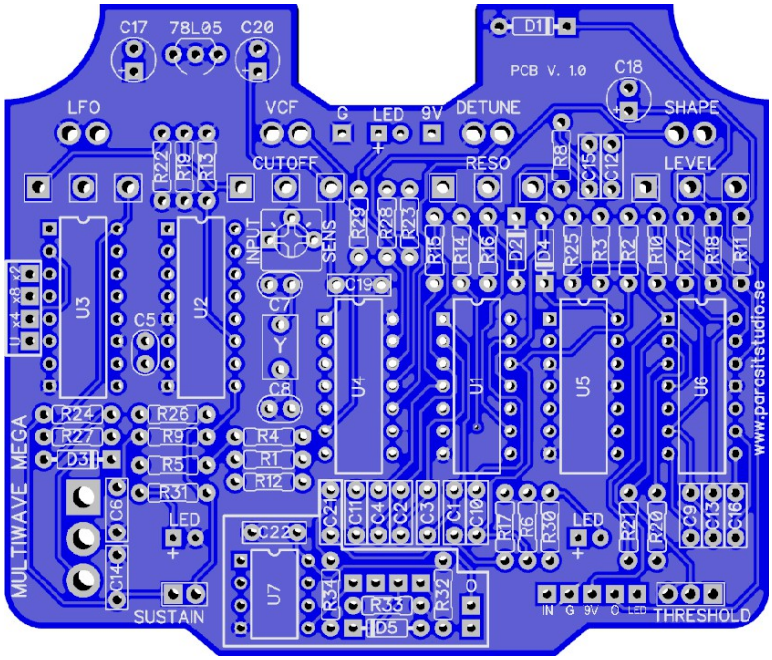
Guitar Synthesizer

Build Document last updated october 2019
Version 1.0 2019

The Multiwave Mega is a monophonic wavetable-based guitar synth with an analog resonant lowpass filter. It has two oscillators with several waveshapes that can be blended together and detuned, guitar triggered filter envelopes, a sustain mode (aka ”drone mode”) and an LFO with several waveshapes for modulating both amplitude and frequency.

Happy building and playing!

Note: When first powering up the pedal, the sustain function may be active, so to first get any sound through the pedal, make sure that the sustain is off (by pressing the sustain footswitch).



Controls

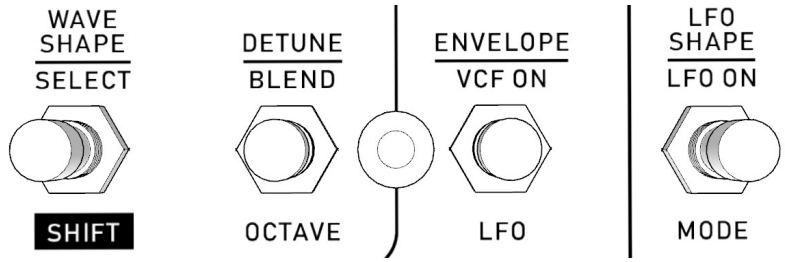
For more details on the Mega features, please download the **user manual** from: www.parasitstudio.se/mega

BUTTON FUNTIONS

The four push buttons has three different functions each:

- Normal press
- Long press (press and hold for at least 500ms)
- SHIFT press

The top row describes the normal push functions.
The second row describes the long press functions.



The bottom row (below the buttons) describe the shift press functions.

When doing a long press, the LED will blink twice and when doing a shift press it will blink three times fast, to give a visual indication of the button response.

BUTTON 1

WAVESHAPE - toggles through the waveshapes for the primary oscillator.
SELECT - selects the current waveshape for the secondary oscillator.
SHIFT - Press and hold, then push one of the other buttons to activate their respective shift functions.

BUTTON 2

DETUNE - toggles through 6 different detune setting for the primary oscillator.
BLEND - activates the secondary oscillator, blended with the primary oscillator.
OCTAVE - makes the secondary oscillator go one octave down.

BUTTON 3

ENVELOPE - toggles through 3 different envelope shapes (when the VCF is on).
VCF - turns the VCF on/off - the guitar triggered filter cutoff envelope. *
LFO - makes the filter envelope an LFO insted of being triggered by the guitar.

* *Note that the threshold control needs to be set for the envelope to trigger*

BUTTON 4

LFO SHAPE – toggles through the LFO waveshape (when the LFO is on).
LFO on/off – turns the LFO on/off.
MODE – switches to a different LFO mode for a different kind of modulation.

THE SUSTAIN FOOTSWITCH

The sustain footswitch will activate the sustain mode. It has two different sustain modes, either 1. - a manually enabled hold, or 2. - a guitar triggered hold, depending on the SW MODE switch position.

The SW MODE switch

Down position - Manual hold mode. Press the sustain footswitch to hold the note. Press it again to go back to normal operation.
Up position - Guitar triggered sustain*. Press the sustain footswitch to enable this mode. Press it again to go back to normal operation.

* *Note that the threshold control needs to be set for the sustain to trigger.*

POTENTIOMETERS

LEVEL – controls the overall output volume.
RESO – controls the amount of filter resonance.
CUTOFF / RATE - controls the filter cutoff.*
RATE – controls the speed of the LFO.
THRESHOLD – sets the trigger point for the sustain and envelope. For the best trigg result, you may also try adjusting the input sens trimmer on the PCB.

** in VCF mode, this pot will control the rate of the filter envelope and filter LFO.*

General builds tips

- Solder the low profile components first, from short to tall height. Recommended order: resistors, diodes, IC socket, film-caps, electrolytics, pots and switches.
- CMOS chips are very sensitive to static charges and can be easily damaged. It's a good idea to wear a anti-static wristband.
- Always use sockets for IC chips and transistors to avoid heating them directly. It also makes it much easier to swap them out if needed.
- Pay special attention to the orientation of the diodes, electrolytic capacitors, LED's and the voltage regulator.
- This PCB's is designed for 16mm Alpha PCB mounted angeled pots, except for the threshold pot which needs to be a 9mm PCB mounted type.
- Cut off the outside mounting pins on the 9mm threshold pot, so that it fits against the PCB (do not cut the 3 middle pins!)
- Mount the pots and the switches to the back side (solder side) of the PCB and solder them from the front side (component side).
- Cover the back of the pots (with pot covers or tape or a piece of carbon) so that they don't create a short on the PCB.
- Cut off the small tap on the potentiometers, so they can sit flush against the PCB.
- When mounting the PCB in the enclosure, I recommend that you take the following steps:

  1. Place the SPDT switch and buttons inside the enclosure.
  2. Place the potentiometers on your PCB.
  3. Solder only the middle pin of each pot to keep them attached but allowing some movement.
  4. Place the LED's in the PCB holes without soldering.
  5. Carefully place the PCB inside the enclosure, make sure everything lines up.
  6. Solder everything in place.

  If you are having trouble getting everything lined up, try mounting and soldering one type of component at the time. For example, start with the pots and place them on the PCB, carefully place the PCB inside the enclosure, then solder. Then remove the PCB from the enclosure do the same method for the switches/buttons, then do the LED's ect. Takes alittle bit of extra time having to add and remove the PCB from the enclosure a few times, but makes it much easier to get everything lined up.

tech notes

Current draw: 45mA
(measured without the OLED/Attiny85)

This pedal draws alot of current, so keep this in mind when powering the pedal, especially if you are using a pedalboard with many pedals. I don't recommend using a battery with this build since it will drain pretty quickly.

Multiwave Mega Bill Of Materials (BOM)

Resistors	
R1	10K
R2	47K
R3	470R
R4	22K
R5	22K
R6	22K
R7	10K
R8	100K
R9	22K
R10	15K
R11	10K
R12	330K
R13	10K
R14	1M
R15	1M
R16	1M
R17	1M
R18	10K
R19	15K
R20	39K
R21	470K
R22	15K
R23	10K
R24	1M
R25	10K
R26	4.7K
R27	4.7K
R28	10K
R29	CLR**
R30	CLR**
R31	CLR**
R32	100K
R33	100K
R34	10K

Capacitors	
C1	100nF
C2	100nF
C3	1nF
C4	4.7nF
C5	100pF
C6	220nF*
C7	22pF
C8	22pF
C9	150nF
C10	1.5nF
C11	4.7nF
C12	100nF
C13	1nF
C14	100nF
C15	1uF*
C16	4.7nF
C17	10uF
C18	10uF
C19	100nF*
C20	10uF
C21	1uF*
C22	100nF*

Diodes	
D1	1N4001
D2	1N4148
D3	1N4148
D4	1N5817
D5	1N5817

IC's	
U1	CD4069UBE
U2	CD4046BE
U3	CD4040BE
U4	ATTINY84(*)
U5	CD4066BE
U6	TL974***
U7	ATTINY85(*)

(*) pre-programmed

Potentiometers	
LEVEL	B100K
RESO	A10K
CUTOFF	C10K
RATE	C10K
THRESHOLD(*)	B100K

(*) 9mm pot

Buttons & switches
4x momentary push buttons
1x SPDT on/on (SW MODE)
1x momentary SPST footswitch (sustain)
1x 3PDT footswitch (bypass)

misc parts
1x 20mhz crystal (Y)
1x 78L05 voltage regulator
1x 200K trimpot (input sens)
3x LED's
1x 128x64 4-pin SPI OLED

- The PCB from Parasit Studio and the DIY kit from Musikding comes with a pre-programmed Attiny84 chip.

- The push buttons are momentary normally open (SPST-no).
  I use these: https://www.taydaelectronics.com/electromechanical/switches-key-pad/push-button/white-knob-push-button-panel-mount-spst-no-pb-11d02-th1-00.html

- * Use multilayer ceramic capacitors for these values – important!

- ** Current Limiting Resistors for the LEDs'. Use the appropriate value for your LED type. I recommend using 4.7K resistors for diffused LED's or 15K resistors if using clear superbright LED's.

  Note that these LED's are powered from the 5 volt rail, so the resistor value can be a bit smaller than what you usually use with a 9 volt supply, but avoid using anything less than 4.7K to limit the current draw from the voltage regulator.

- The top LED is used as the bypass indicator (aswell as a push button indicator) so you don't need an extra LED for the 3PDT.

- *** You can also use a common TL074 if you don't have a TL974, but I really recommend using a TL974 since it will be much less noisy with a higher headroom for the filter (it can distort, and not in the good way, when having the resonance maxed).

- The PCB is designed for angeled PCB mounted 16mm Alpha pots, except the threshold control which needs a 9mm PCB mounted pot.

  Cut off the outside mounting pins on the 9mm threshold pot, so that it fits against the PCB (don't cut the 3 middle pins!).

- The 200K trimpot sets the input sensitivity.

  Adjust the sens trimpot from very noisy when barely touching the strings to very gated. Find a good balance without making it too gated (it will cause the trigg/threshold much harder to adjust).

- The components that are greyed out (inside the outlined area on the PCB) are only used for the OLED oscilloscope circuitry. It is are not included or supported by the PCB or DIY kit, and only used for the fully assembled Parasit Studio build (which shares the same PCB layout for my own convenience). Sorry to disappoint anyone!

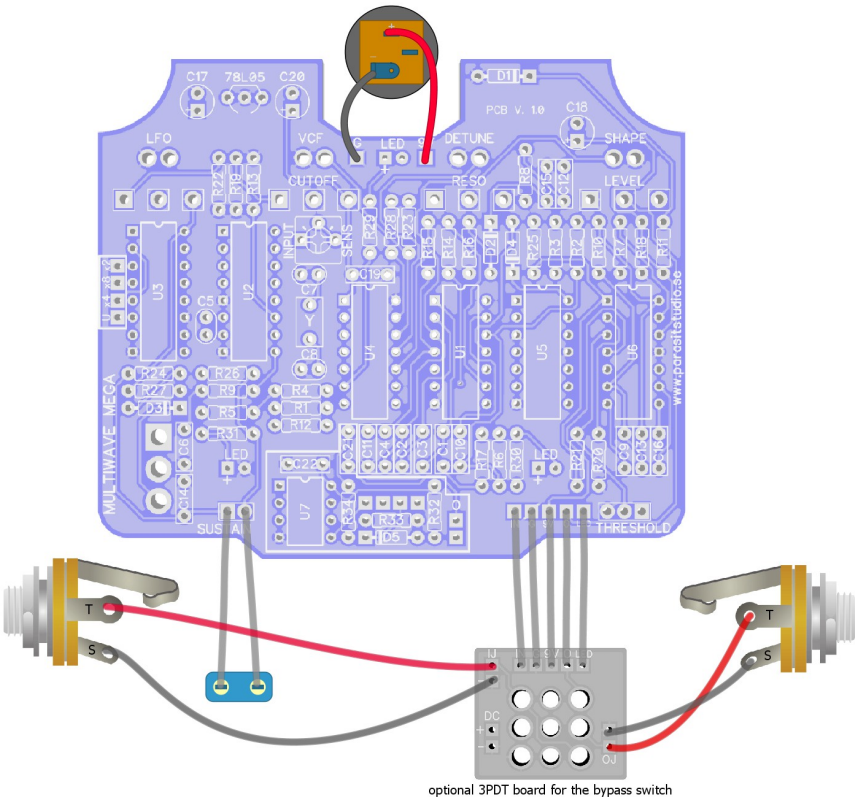
The reason that it's not included is because it would make the build much more difficult. Alot of people does not have the tools needed to make a square hole in the enclosure. It also adds a big extra cost. The oscilloscope is a fun novelty feature but not really necessary. :)

That said... if you really want to add it, you can find the HEX code for the Attiny85 (that is driving the oled screen) in the blog, but you have to program the chip yourself. Parasit Studio is not selling preprogrammed Attiny85 chips for this use, with no exceptions.

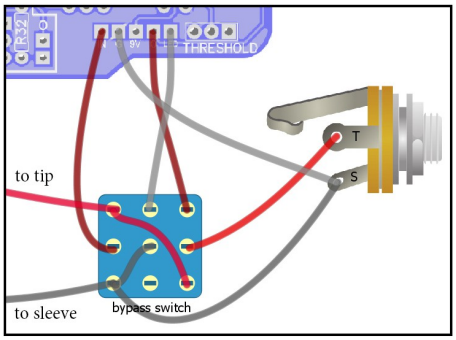
Other things needed that is not included in the BOM:

- enclosure - 1590BB (or bigger)
- input & output jacks
- DC jack
- led bezels
- knobs

Offboard wiring



without a 3PDT board

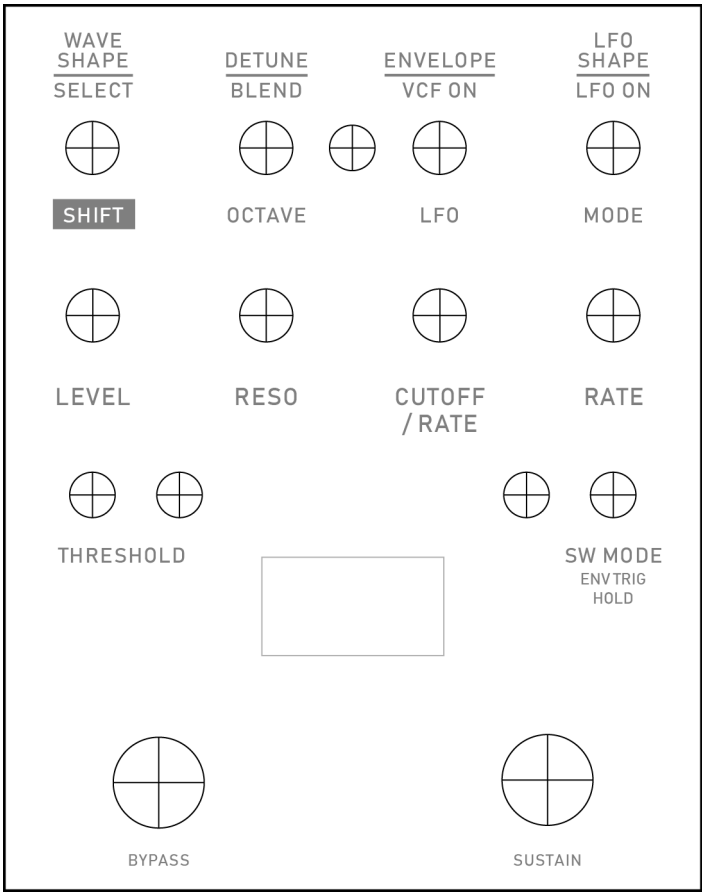


- Note that the DC jack only needs to be connected to the pads at the top of the PCB.
- It's not necessary to connect the 9v pads between the PCB and 3PDT board.

  The picture shows this connected, but it's not really needed. I personally use ribbon cable between the boards and then it's easier (and looks more tidy) to just include the 9v connection aswell.

- You can ignore the four pads on the left side of the PCB next to U3 (marked x2, x8, x4, U). These are not used.
- *I don't recommend using a battery with this build, because of the high current draw (45mA). The battery would drain pretty quickly.*

Drilling template (1590BB)



- This template is approximate. Use at your own risk!
- Make sure your printer isn't doing any scaling / is set to 100% print size.
- The PCB have a top cutout for the DC jack, to have the DC jack mounted in the middle of the top side of the enclosure.
- Drill the input/output jacks to your own preference between the PCB and the footswitches. **I recommend using Lumberg type jacks, which are smaller than normal open jacks and will allow for more drilling errors, since this is a tight fit...**

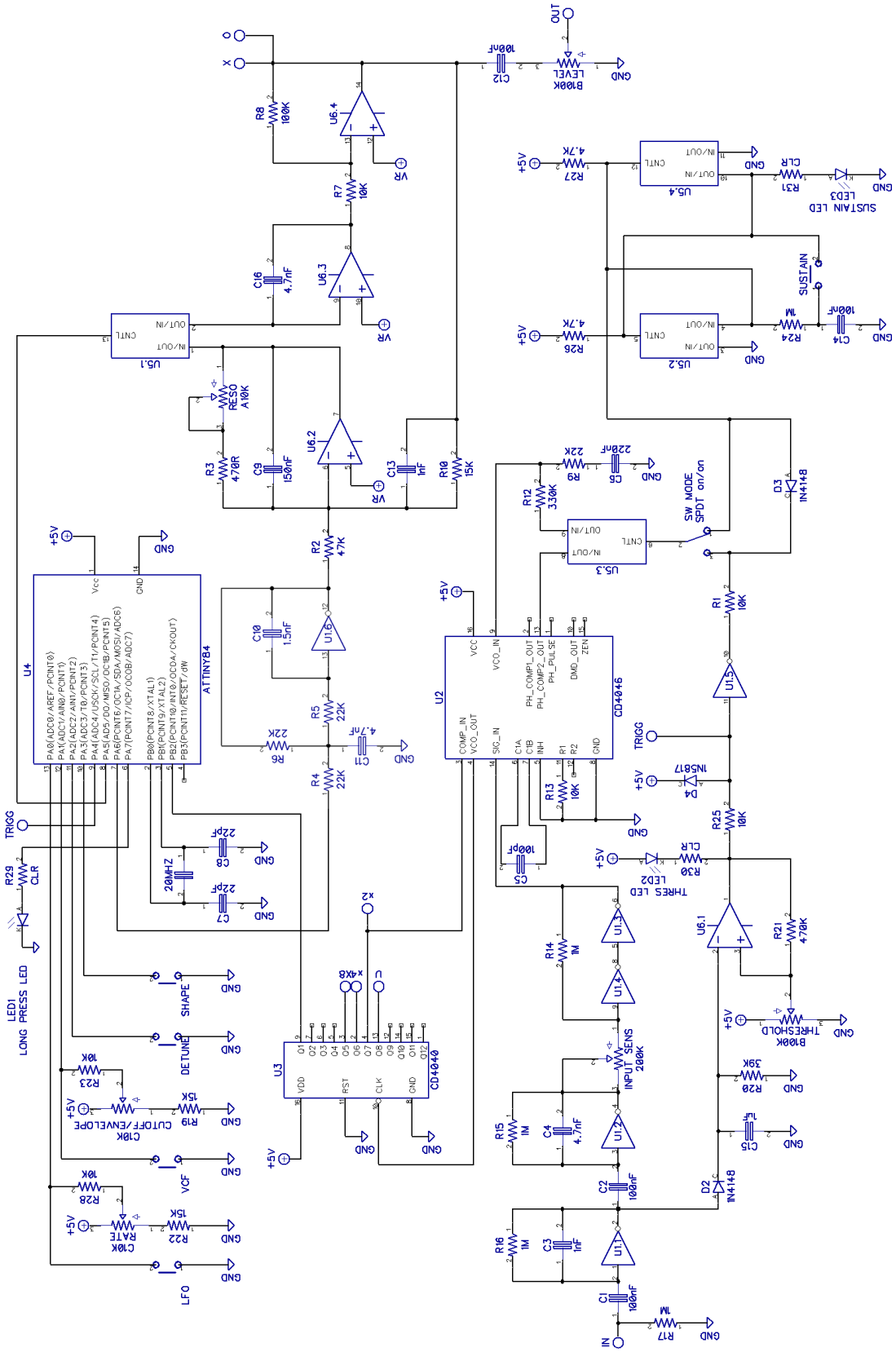
Measure and confirm before drilling!

Hole sizes

◦ Potentiometers and push buttons	7mm (0.2756 inch)
◦ LED's (for 3mm LED's with LED bezels)	6mm (0.3462 inch)
◦ SPDT switch	6mm (0.3462 inch)
◦ 3PDT (bypass) and sustain footswitch	12mm (0.4724 inch)

(DC jack, input and output jacks holes can vary depending on type)

Schematic



Please note that DC filtering, polarity protection, voltage regulation, Vref and the OLED display associated circuit is not shown in this schematic

Troubleshooting

There's always a chance of running into trouble. To minimize error, follow the BOM and general building tips carefully. Take your time and don't rush. Take a break now and then. Use good solder, and it helps to have a decent soldering station insted of a cheap iron.

Musikding DIY kit

If you have bought the Musikding DIY kit and have recieved a faulty faulty, incorrect or missing component, please contact musikding.

Contact us

Smallbear Electronics / Synthcube DIY kit

If you have bought the Smallbear Electronics DIY kit and got a faulty, incorrect or missing component, please contact Smallbear Electronics.

smallbearelec@synthcube.com

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PCB's and circuit designs from Parasit Studio are intended for personal use only. No commersial use. It's not ok to build and sell these pedals without permission. However, it's totally ok to build a few pedals and give to your friends and bandmates. After all, that's what this hobby is about. :)

www.parasitstudio.se
parasitstudio@gmail.com