LADDER TO THE MOON

Build Document last updated april 2024
Version 1.0 2024

The Ladder to the Moon is a massive sounding monophonic CMOS based guitar synthesizer with two oscillators - A saw / square oscillator fixed at one octave down with two types of phaser modulation (smooth or stepped). The other oscillator is a tunable and tracking oscillator that can be tuned from about one octave down to one octave up and anywhere in between. It has a vibrato with a fixed rate.

This pedal works best with high output pickups. It is gated by nature of the CMOS logic. If you are using single coils and need more sustain, try a boost or compressor in front. To improve tracking, use the neck pickup on your guitar and play single notes closer to the 12th fret.

Have fun building and playing the Ladder to the Moon!

Prototype build

Named after the use of resistor ladders in the circuit,
but also after the art by Georgia O'Keeffe

Power

Input voltage - 9V DC
Current draw - 34mA

Controls

Potentiometers

- Level – overall volume
- Rate – controls the rate of the phaser (oscillator 1)
- Blend – blends between the two oscillators
- Tune – tunes oscillator 2

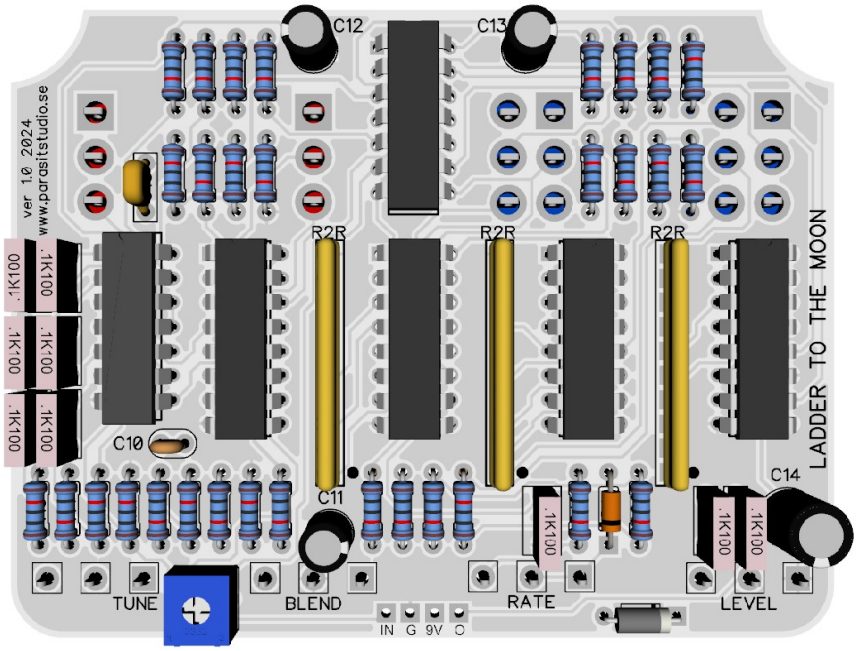
Switches

- Shape – changes the waveshape of oscillator 1 (saw or square)
- Phaser – turns the two phaser modes on/off (oscillator 1)
- Vibe – turns the vibrato on/off (oscillator 2)
- Octave – changes the range of oscillator 2 by one octave

Depth (pcb trimpot) – adjusts the depth of the vibrato
Can be modded to be an external potentiometer instead. See the mods section about this.

The populated PCB

Here's a 3D render approximation of what the fully populated board should look like (except that the IC's should be in sockets). There is a render of a unpopulated PCB on the mods page.

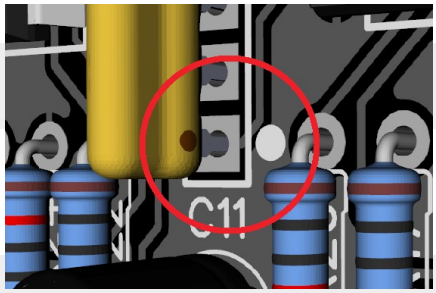


The PCB measures 86mm wide x 66mm tall

General building tips

- Just follow the Bill of Materials and solder the low profile components first.

  Recommended order: resistors and diodes, chip sockets, resistor ladders, trim pot, multilayer and ceramic capacitors, film box capacitors, electrolytic capacitors, pots and switches, offboard wiring (jacks and the 3PDT switch). Bend the legs of the components alittle bit to prevent them from falling out, or use tape to hold them in place while soldering.



- The resistor ladder orientation is important! Indicated by the dots.
- Also pay special attention to the orientation of the LED's, diodes and the electrolytic capacitors.
- Always use sockets for IC chips to avoid heating them directly. It also makes it much easier to swap them out if needed.
- CMOS chips are very sensitive to static charges and can be easily damaged. It's a good idea to wear a anti-static wristband. Or at least don't wear a woolen jumper and pat your dog while building, and keep the circuit away from rugs... Put the chips in last, after everything else is soldered in place.
- Break off the small tap on the potentiometers, so they can sit flush against the top cover.
- Make sure that the backside of your pots are covered so they don't short anything on the PCB. If you not have pot covers I recommend pvc electrical tape.
- When it's time to solder the potentiometers, switches and buttons I recommend having the enclosure/lid prepared to make sure that they line up with the holes.

  I recommend that you solder only the middle pin of each potentiometer to the PCB (so that the placement matches the silkscreen on the PCB and the pot stays in place when you turn the PCB around but still has some wiggle room). Screw in the toggle switches in the enclosure and then put the PCB with the pots into the enclosure so that everything fits and finally solder the rest of the pot pins and the switches from the component side of the PCB.

Ladder to the Moon BOM (Bill of Materials)

Resistors

R1	1M
R2	1M
R3	1M
R4	1M
R5	1M
R6	10K
R7	10K
R8	10K
R9	10K
R10	10K
R11	10K
R12	10K
R13	10K
R14	10K
R15	4.7K
R16	4.7K
R17	100K
R18	100K
R19	1K
R20	1K
R21	1K
R22	22K
R23	33K
R24	47K
R25	47K
R26	47K
R27	47K
R28	47K
R29	220K
R30	18K
R31	470K
CLR	4.7K

Capacitors

C1	100nF
C2	100nF
C3	100nF
C4	100nF
C5	220nF
C6	2.2nF
C7	4.7nF
C8	10nF
C9	22nF
C10	100pF
C11	2.2uF
C12	4.7uF
C13	22uF
C14	100uF
C15 *	100nF

Diodes

D1	1N4148
D2	1N4001
1x LED	(bypass)

IC's

U1	CD4069(UBE)
U2	CD4046(BE)
U3	CD4040(BE)
U4	CD4040(BE)
U5	CD4040(BE)
U6	LM339N (or AN)

Potentiometers

LEVEL	A100K
RATE	C1M
BLEND	B50K
TUNE	B50K
DEPTH (trimpot)	1M

Switches

SHAPE	DPDT on/on
PHASER	DPDT on/off/on
VIBE	SPDT on/on
OCT	SPDT on/on

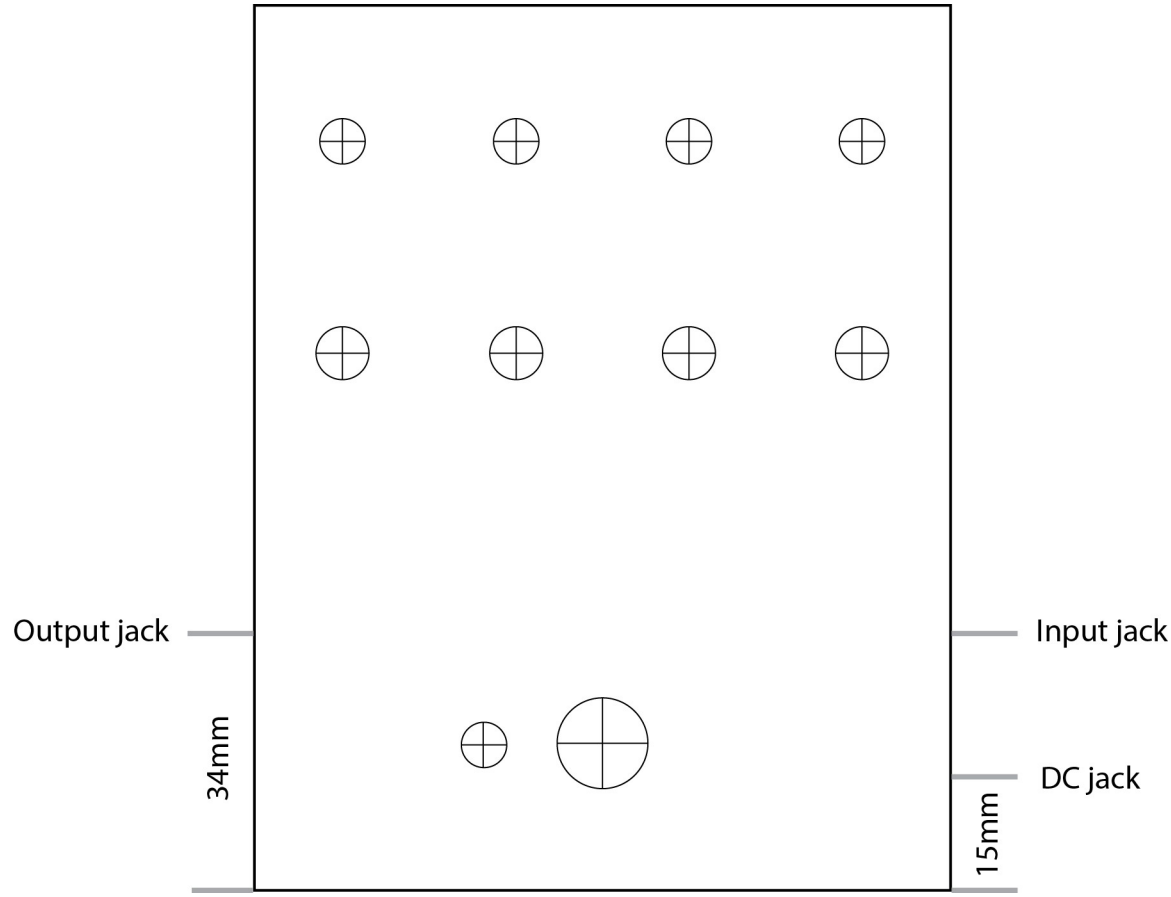
Resistor Ladders

3x 4610X-R2R-103LF

BOM Notes

- * = should be a multilayer ceramic capacitor (yellow capacitor)
- CLR is the current limiting resistor for the bypass LED (mounted on the 3PDT daughterboard or off board if you don't have the daughterboard).
- Things that are not included in the BOM list: enclosure, input and output jacks, DC jack, 3PDT stomp switch, led bezel and knobs.

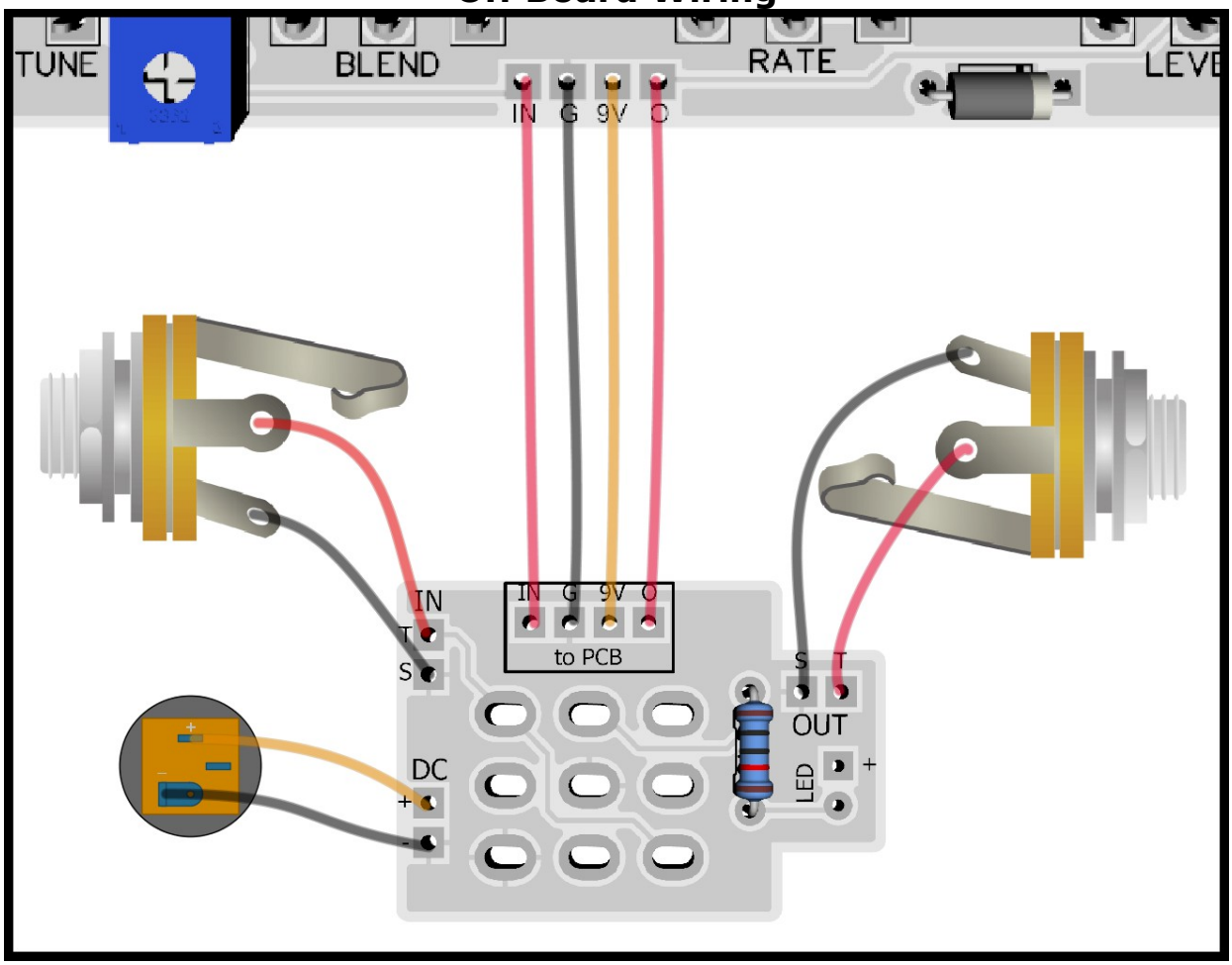
Drill Template (1590BB)



- Use at your own risk! This template is approximate.
- Make sure your printer isn't doing any scaling (100% print size).
- Jacks are measured from the edge at the front/top of the enclosure (as they were drilled on the prototype), but you can drill the positions for the footswitch, DC jack and input/output jacks to your own preference.
- The distance between the center of the 3PDT switch and the center of the LED is 15mm
- Typical drill sizes are:
  - switches / LED bezel (for a 3mm LED) - 6mm
  - potentiometers - 7mm
  - DC jack / 3PDT footswitch – 12mm
    (8mm for lumberg style DC jacks)
  - input/output jacks (Neutrik style) – 9,5mm
    (9mm for Lumberg style jacks)

Measure and confirm before drilling!

Off Board Wiring



The top row of connections on the 3DPT daughterboard connects directly across to the main PCB as shown.

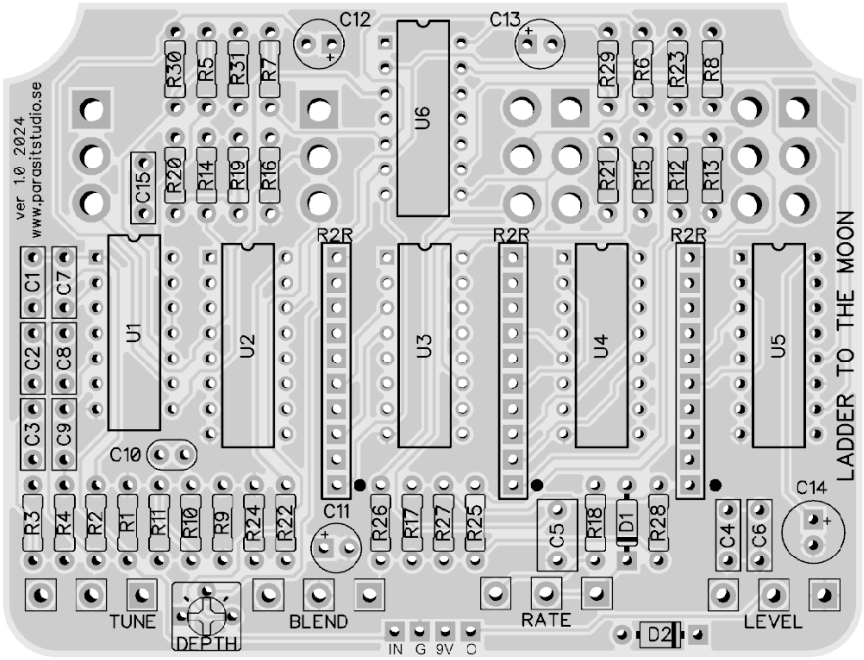
Input jack sleeve → ”S” IN pad
the lug that connects with the inner ring of the jack
Input jack tip → ”T” IN pad
the lug that connects to the bracket on the jack

Output jack sleeve → ”S” OUT pad
the lug that connects with the inner ring of the jack
Output jack tip →”T” OUT pad
the lug that connects to the bracket on the jack

DC jack negative → ”–” DC pad
the widest lug, or the short lug if using a Lumberg style jack
DC jack positive → ”+” DC pad
the outer lug if it's a 3 pin DC connector, or the long lug if using a Lumberg style jack

If you are not using the 3PDt daughterboard PCB, have a look at the offboard wiring diagram here (fig1/3): wiringrev3.pdf (parasitstudio.se)

Mods



Suggested mods:

- Make the vibrato depth trimpot external

Insted of the trimpot you could use an external B1M potentiometer. Wire the middle trimpot solderpad to pin 2 on the pot and wire the right trimpot solderpad to pin 3 of the pot. Leave pin 1 unconnected. Just be aware the a deep vibrato setting will negate the tuning of the oscillator.

- Add an external vibrato rate control

If you want to be able to adjust the vibrato rate, you can add a C100K potentiometer in series with R30. Just lift one of the legs of R30 (which one doesn't matter) from the PCB and wire the unconnected end of the resistor to pin 2 of the pot. Wire pin 3 of the pot to where the resistor end used to go. Leave pin 1 unconnected.

The resistor R30 sets the maximum rate, so lower the value of R30 for a faster max rate. For even slower minimum rates use a larger value pot like a C250K.

- Adjust how gated the output is

If you find that the output is too gated for your guitar, you can lower the value of R23 (33K) to something like 10K-22K to make it less gated, or replace the resistor with a 50K trimpot. Just be aware the some LFO ticking can easier be bleeding through to the output if this value is lowered. You can also socket and play around with the values of C7, C8 and C9 (the input filter capacitors) if you want to change the tracking response. Lower values will track better on high notes (and make it less gated) but it will make the tracking worse on low notes and vice versa.

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.

If you are still having trouble, please visit the madbean forum Parasit Studio subforum section and ask for help there.

http://www.madbeanpedals.com/forum/index.php?board=84.0

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

https://www.musikding.de/kontakt.php?lang=eng

www.parasitstudio.se
parasitstudio@gmail.com