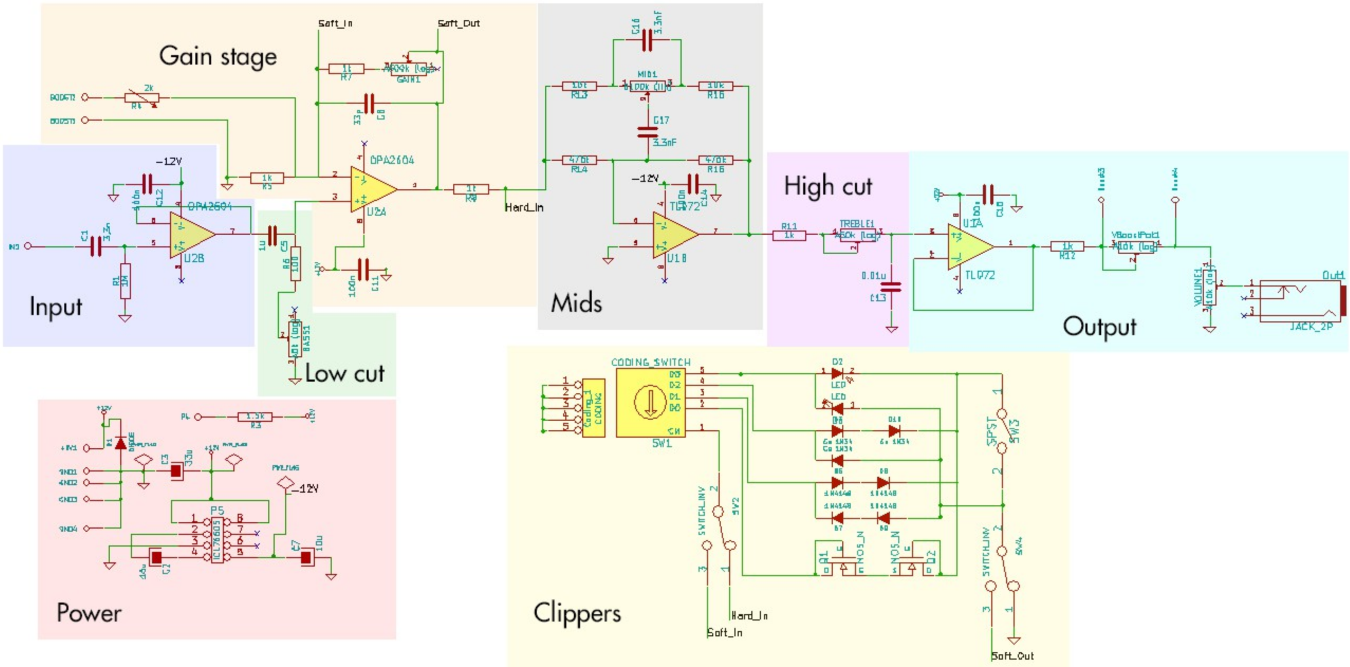
ZORGVERDRIVE DELUXE

TECHNICAL DATA

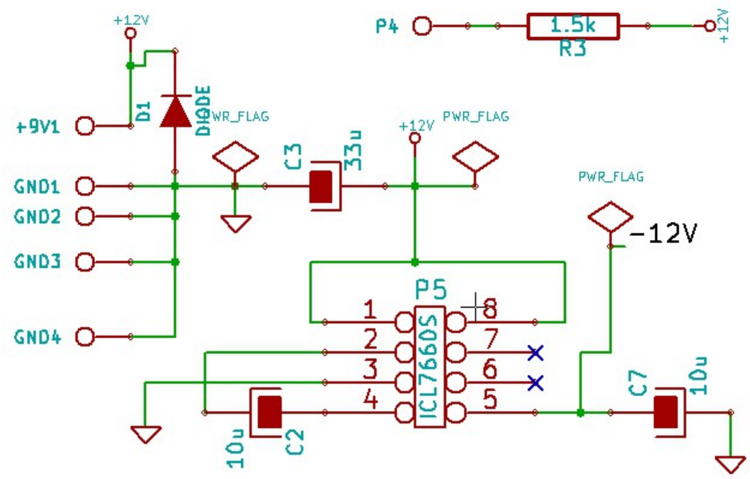
Power:
Input voltage: 9v or 12v - center negative.
(The analysis below is made with 9v input)
Current consumption: 40mA max.

Dimensions:
H/W/L: 39mm/95mm/120mm
Weight: 400g

Schematic analysis:
The schematic can be divided in 8 parts:
1- Power block
2- Input buffer
3- Low cut filter
4- Gain stage
5- Clippers
6- Mid Eq
7- High cut
8- Output


Gain stage
Input
Low cut
Mids
High cut
Output
Power
Clippers

Alim block:

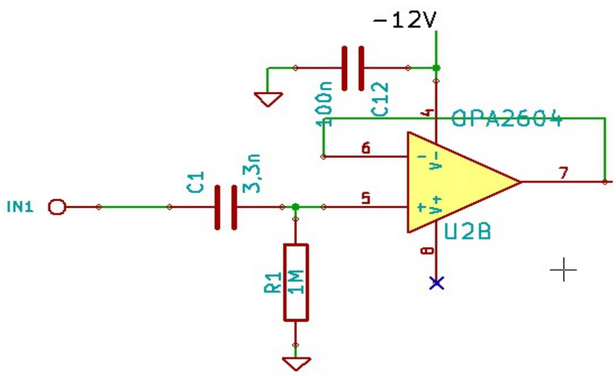


The 1N4001 D1 diode is here to prevent reverse voltage accidents.
The 1.5k resistance R3 is used to give adequate power to the bypass led.
Condenser C3 is filtering the input.
P5, C2 and C7 is a charge pump montage based on an ICL7660S. It is used to create the negative voltage from the positive voltage. For more information check the ICL7660S datasheet.
Using a charge pump to create negative voltage has two advantages:

- A bit less than 2x more headroom.
- Virtual ground is avoided.

The drawback being it cannot supply a lot of op amps. The negative voltage drops as more and more current is asked from the negative side.

Input buffer:



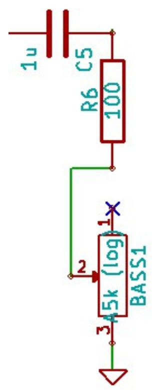
C12 is a decoupling cap.

This input stage acts as a high pass filter cutting at 1/(2xPIxR1xC1) = 48,22Hz.

It also acts to fix input impedance really high around R1 value: 1Mohms.

Then one part of the opamp is wired as a simple buffer.

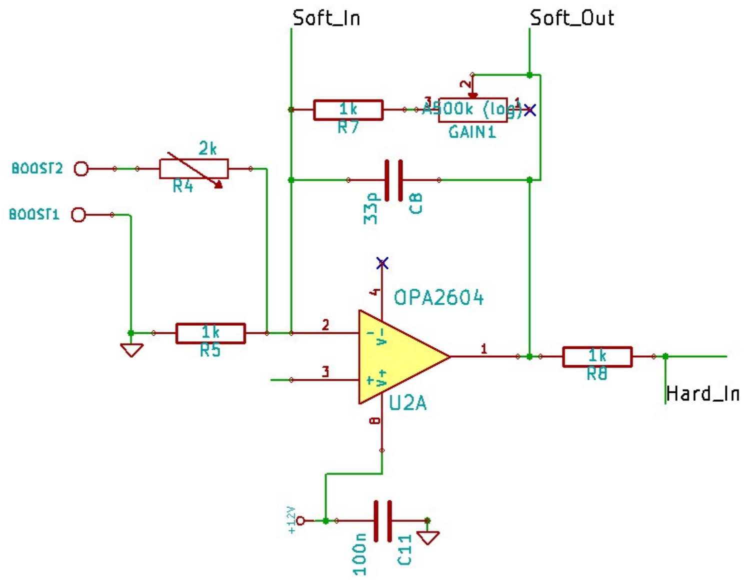
Low cut filter:



This is a simple passive RC high pass filter. Frequency cut ranges from 1/(2xPIx(R6+BASS1)xC5) = 1591,55Hz to 31,2Hz.

When clipped the bass frequency creates more harsh fuzzy sounding harmonics. Placing this high pass filter helps to remove some of them before the gain stage. You should know that common overdrives for guitars cuts around 300-400Hz.

Gain stage:



C11 is a decoupling cap.

This kind of gain/clipping gain stage is very common, it is used in the tube screamer pedal.

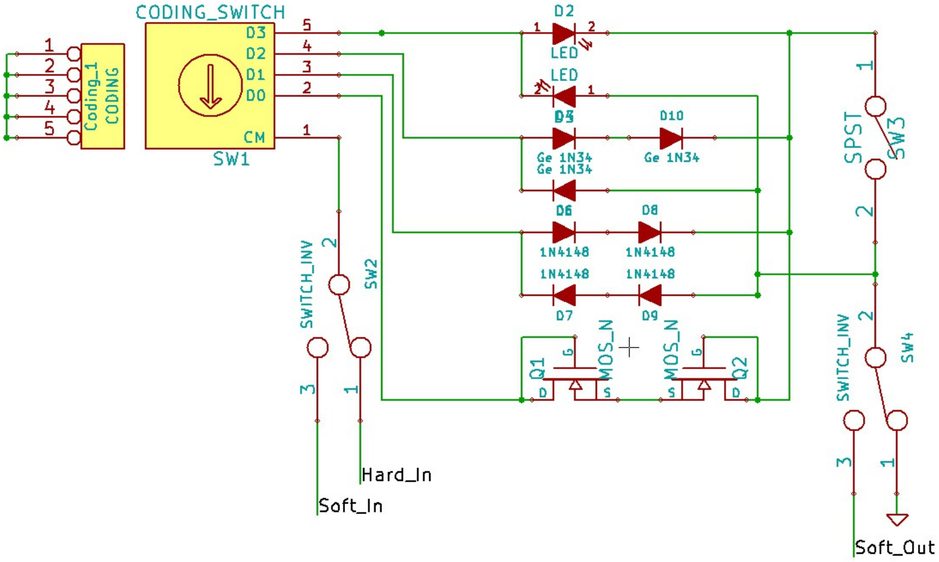
First, resistances R5, R7 and pot TGAIN1 set the gain of the stage: Gain=(1+TGAIN1+R7/R5). TGAIN1 being 500koHms, the gain can thus go from x2 to x501.

The C8 capacitor forms a low pass filter with TGAIN1 pot and R7 at cut off frequency F=1/(2*pi*C8*(TGAIN1+R7)). This is used to prevent high frequency feedback when the gain is setup very high. When Tgain1 is at the maximum the cut off frequency is 9626Hz.

R4 is a 2k trimpot who can provide and alternative gain for the whole stage: boost1 and boost2 are connected to an external footswitch which will connect or disconnect the trimpot in parallel with R5. Thus changing the equivalent resistance value according to R5 position: (R4*R5)/(R4+R5). So the equivalent resistance could be trimmed from 0 if R5=0 oHms. Down to 666 oHms.
I personally set it up around 1k to get a 2x gain when engaging R5.

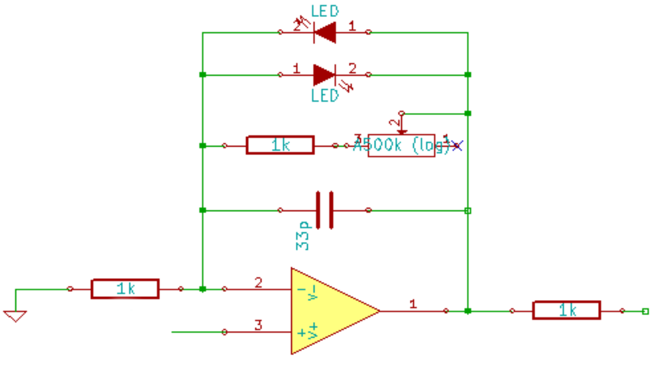
But this gain stage works together with the clipping stage. R8 limits the output current when the clipping mode is set to hard.

Clippers stage:



The clipping stage provides the choice between 4 different clippers. For each clippers there's the possibility to use symmetrical or asymmetrical clipping and hard or soft clipping. So there are 2*2*4 = 16 combinations available.

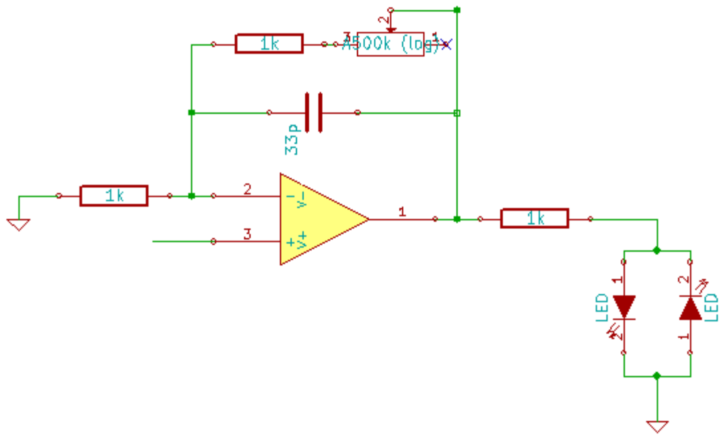
Switches SW2 and SW4 are actually the same DPDT on/on switch.
They either connect the clippers in the feedback loop of the op-amp either at the output.
When connecting to the feedback loop, we have the following schematic:



Leds will provides smooth clipping distortion. Being green leds, if the output of the opamp rise higher than their threshold (+/-2V), they will short circuit the GAIN pot and 1k resistance, but as soon as the gain pot is short circuited the gain of the

opamp would fall to 1 (buffer), and thus tension would certainly fall under their threshold (+/-2V) bringing back the GAIN pot in action. So to simplify, what will dynamically happen is that the signal will never raise above 2V or fell under -2V. That's smooth clipping.
Note that if one of them leds is suppressed the output will be able to rise until it reaches the opamp voltage rail value (if there's enough gain). This will provide asymmetrical clipping, as one side of the signal will stop at 2V and the other at -9V.

When connecting the clippers at the output, we have the following schematic:



This one as a much simplifier explanation: the opamp will amplify the signal up to it's voltage rail value +/-9v. Then the leds will shortcut the signal to ground when the signal is higher than their threshold of +/-2V.
In this clipping schematic, the signal is clipped twice: first with opamp and then with the leds. This provides a much more aggressive and modern harmonic content and thus is called hard mode.

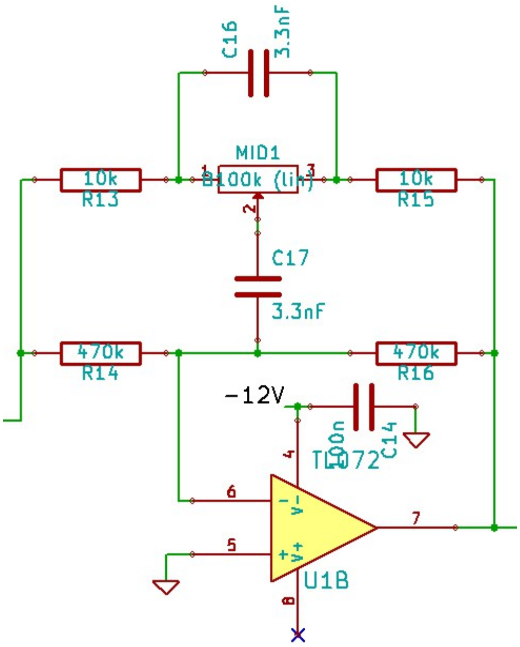
Switch SW3 selects symmetrical and asymmetrical mode. Note that in case the mosfets transistors are used, SW3 will just remove any clipper from the gain stage, making it a booster stage.

Clippers choices are made according to switch SW1:
- Mosfet clipping, with 2x 2N7000. Threshold is around 1,8v
- 4 x 1N4148 clipping. Threshold is around 1,4v.
- 2 x Green leds clipping. Threshold is around 2v.
- 3 x 1N34 germanium diode clipping. With 1v and 2v thresholds.

All these clippers have different properties and frequencies responses which will provide different overdrives tones. For some reason, Germanium diode clipping in the feedback loop don't work very well...

One last thing: if a TL072 is used for opamp, it's gain/bandwidth value 3MHz. So with x500 gain it would cut at 6kHz. This would be added to the filtering done by C8. Some would think it's ok. I don't. I prefer to use OPA2604 with 20MHz gain/bandwidth which will cut at 40kHz. It gives a more bite, more aggressive harmonic content when overdriven hard and better attack.

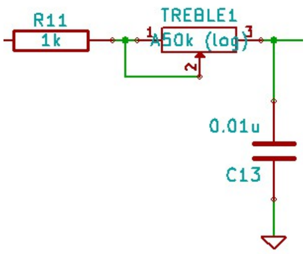
Mid stage:



This is a mid frequency cut/boost filter.
C14 is a decoupling cap.
The formula to get the cut off frequency is:
Assuming R13 = R15 and R14=R16
F=(1 / 2 x pi) x Sqrt((2 x R13 + MID1)/(R13 x MID1 x C16 x C17 x (R13 + R14)))
Giving us F=760Hz for the filter center frequency.

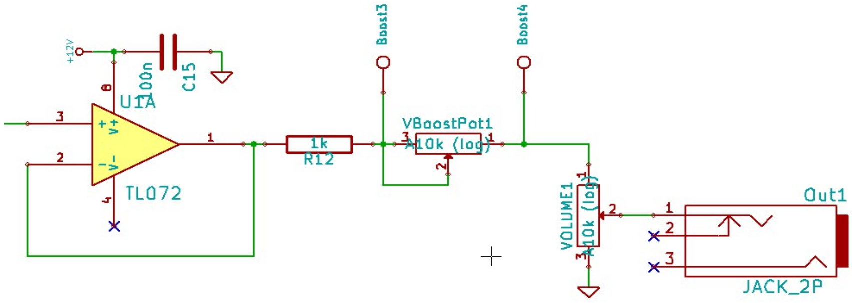
The max attenuation/boost at 760Hz is given by:
Gboost= ((R14 x (R13 + Mid1))/(R14 + R13+ Mid1))/((R14 x R13)/(R14 + R13))
Gcut= 1/Gboost
Giving us:
Gboost=9,1 or 19,2dB
Gcut=0,1099 or -19,2dB

Low cut stage:



This a simple RC low pass filter to smooth the distortion.
Frequency cut ranges from 1/(2xPIx(R11+TREBLE1)xC13) =312Hz to 15915kHz.

Output stage:



The output stage is a simple opamp buffer and a volume knob.
C15 is a decoupling cap.
VboostPot1 is a trimpot who can be bypassed or opened by an external footswitch. This allows to change the output value.