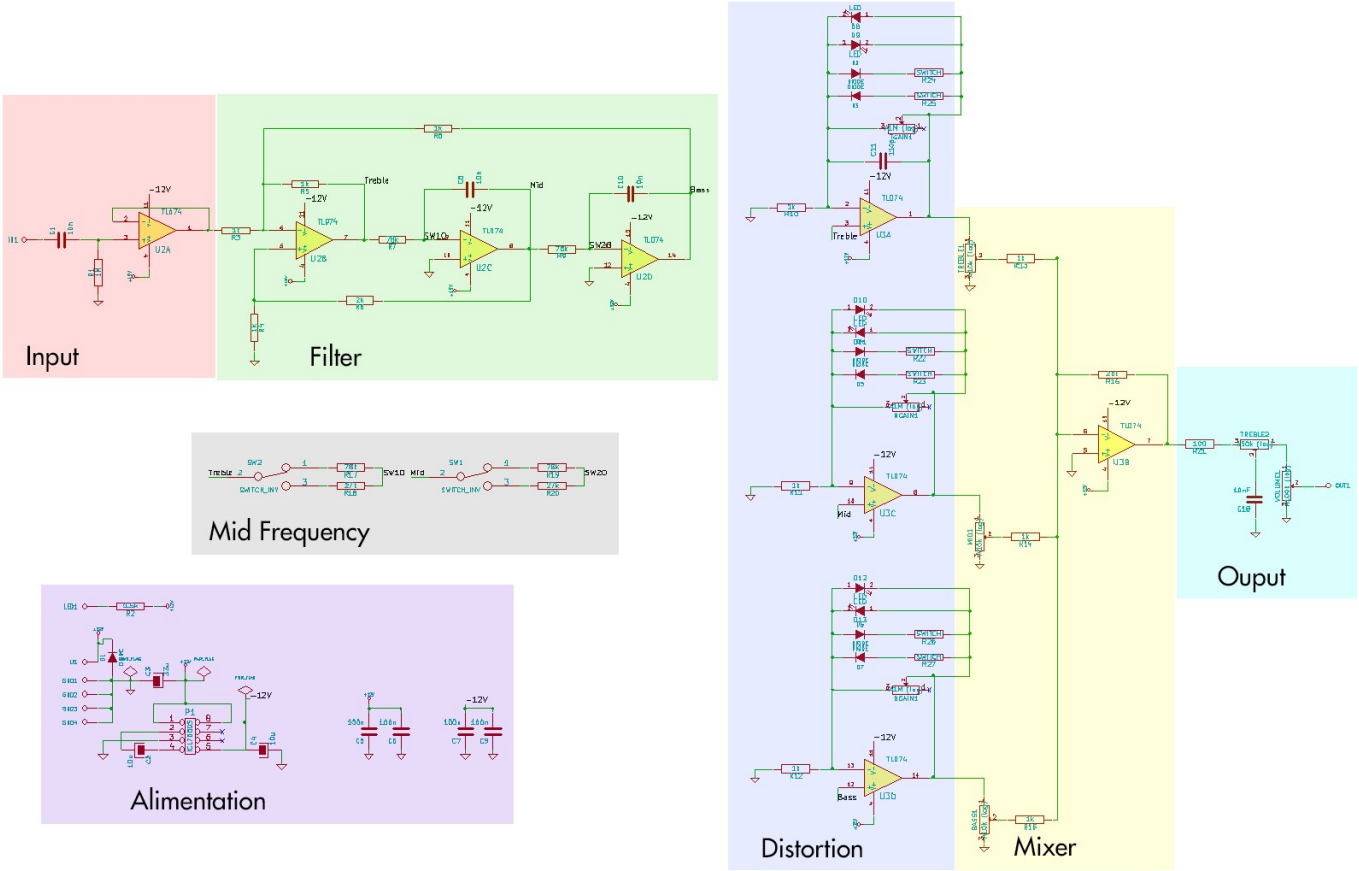
Glorious Basstar
Technical data

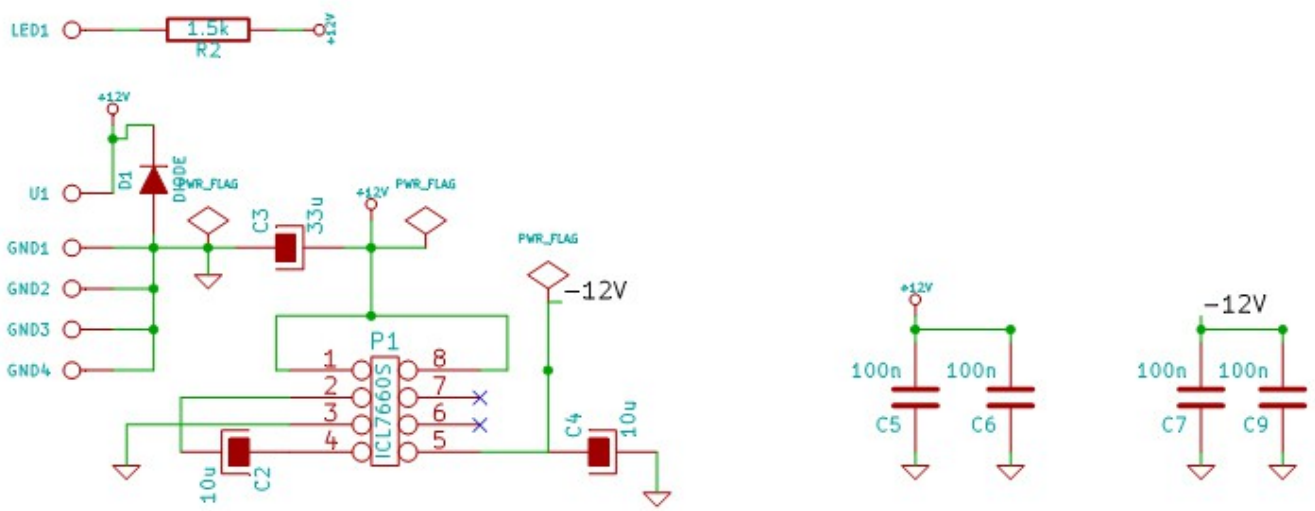
Power:
Input voltage: 9v or 12v - center negative.
(The analysis below is made with 9v input)
Curent consomption: 40mA maximum.

Dimensions:
H/W/L: 39mm/95mm/120mm
Weight: 350g

Schematic analysis:
The schematic can be divided in 6 parts:
1- Alimentation block
2- Input buffer
3- 3 Band filter
4- 3x Distortions stages
5- Mixing stage
6- Output stage



Alim block:

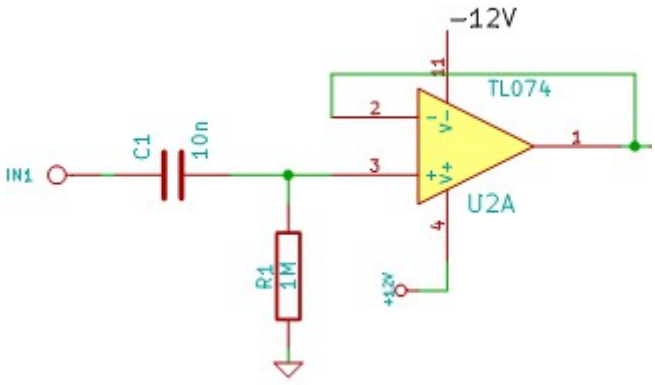


The 1N4001 D1 diode is here to prevent reverse voltage accidents.
The 1.5k resistance R2 is used to give adequate power to the bypass led.
Condensers C5, C6, C7 and C9 are decoupling caps for the two op amps used in this schematic. C5 and C6 are for the positive alimentation, C7 and C9 for the negative alimentation.
Condenser C3 is filtering the input.
P1, C2 and C4 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:

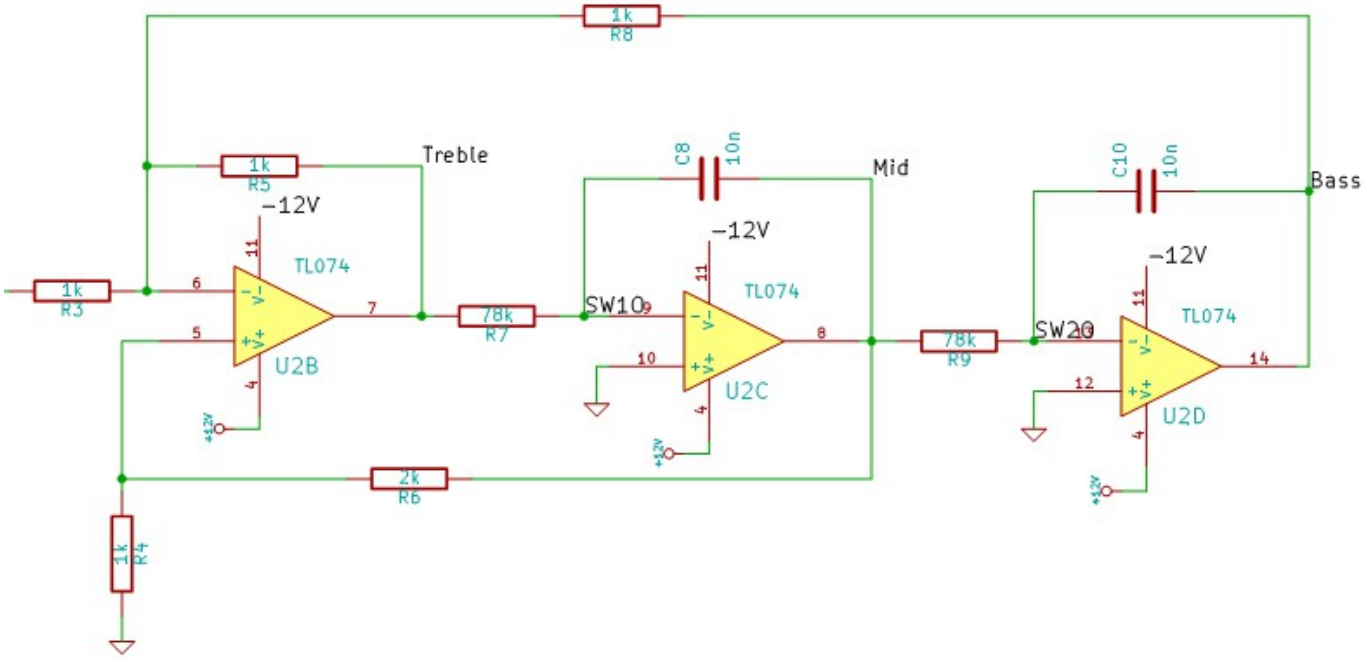


This input stage acts as a high pass filter cutting at 1/(2xPIxR1xC1) = 15,91Hz.

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.

3 Band filter:



This one is tricky, this is an active filter providing:

- a low pass filter with -12db/octave slope at "Bass" point (output of U2D),
- a mid band filter with -6db/octave slope at "Mid" point (output of U2C),
- a high pass filter with -12db/octave slope at "Treble" point (output of U2B).

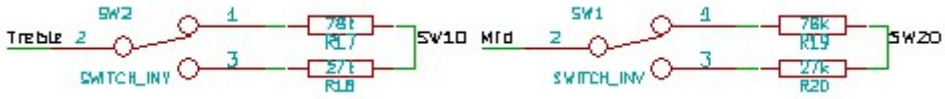
This filter topology is also used in the love Philter pedal and as well as the Qtron.

The cut off frequency is the same for all 3 filters and is given by R7 and C8: F=1/(2xPixR7xC8)=204Hz.
If values of R7, R9, and C8, C10 are not equal, the filter will not work properly.

The quality factor is fixed by R6/R4. Increasing R6 will provide higher Q values, hence providing resonance at the cut off frequency.

As you can see, the filtering is achieved with 3 stages: a summing/subtracting stage (U2B) and two integrators (U2C and U2D). Each integrator is feeding back to the input summing/subtracting opamp.

Also there's the mid frequency switch which add some resistances in parallel of R7 and R9, thus changing the cut off frequency:



Using a 3 position on-off-on switch you can get:

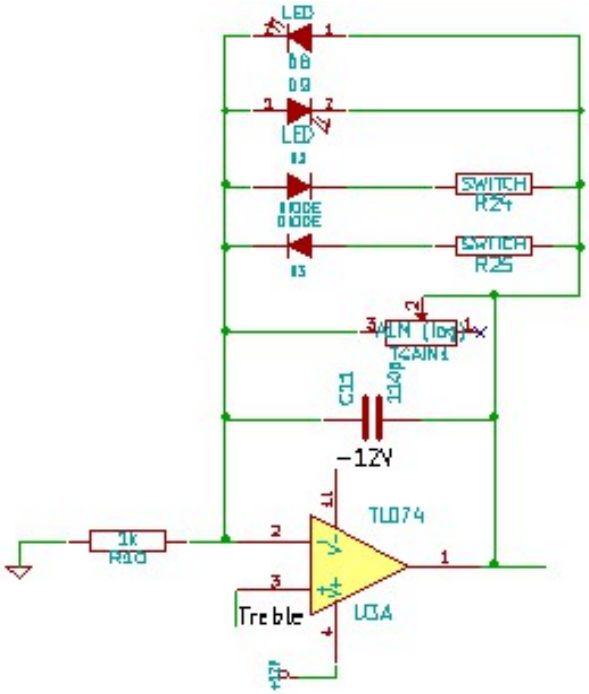
- R7 and R9 alone and a cut off around 200Hz.
- R7 // R17 and R9//R19 which change the resistance to half of 78k and thus

shifts cut off frequency to 400Hz.

- R7 // R18 and R9//R20 which change the resistance to around 20k and thus shifts cut off frequency to somewhere near 800Hz.

3x Distortions stages:

From the filter above, the three bands are fed into 3 almost identical distortions stages. Both mid and bass stages just don't have the low pass filtering capacitor as the high stage has, which is C11:



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

First resistances R10 and pot TGAIN1 set the gain of the stage: Gain=(1+TGAIN1/R10). TGAIN1 being 1MoHm, the gain can thus go from x1 to x1001.

The C11 capacitors forms a low pass filter with TGAIN1 pot at cut off frequency F=1/(2*pi*C11*TGAIN1). 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 482Hz. If the gain is set to be x100 (which is already very high) the cutoff frequency will be 4822Hz.

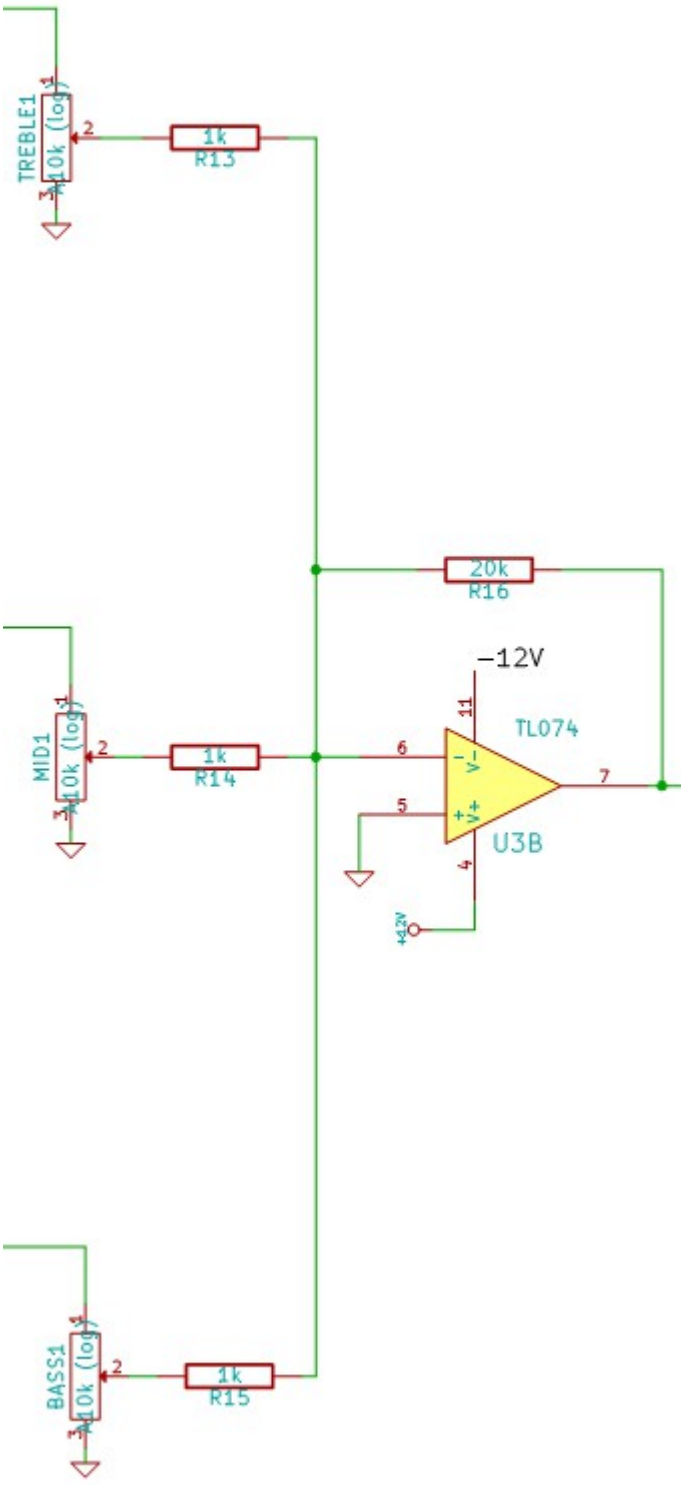
Diodes D2 and D3 provides smooth clipping distortion. Being 1N4148 diodes, if the output of the opamp rise higher than their threshold (+/-1V), they will short circuit the GAIN pot, but as soon as the gain pot is short circuited the gain of the opamp would fall to 1 (buffer), and thus tension would certainly fall under their threshold (+/-1V) bringing back the GAIN pot in action. So to simplify, what will dynamically happen is that the signal will never raise above 1V or fell under -1V. That's clipping.

Leds D8 and D9 do the same job as the diodes, except their threshold (I used green leds) are around +/-2V so there's more headroom and less gain. Also their response is a bit different in clipping, producing a different distortion.

R24 and R25 are in fact a dip switch allowing to add or remove the diodes. When opened, only led will work. When closed diodes are in action, and has they've a smaller threshold than the led, it's making the led useless.

One last thing: if a TL074 is used for opamp, it's gain/bandwidth value 3MHz. So with x1000 gain it would cut at 3kHz. This would be added to the filtering done by C11. Some would think it's ok. I don't. I prefer to use TLE2074 with 8MHz gain/bandwidth who will cut at 9kHz. It gives a little more bite, more aggressive harmonic content when overdriven hard and better attack to the high pass filtering gain stage.

Mixing stage:

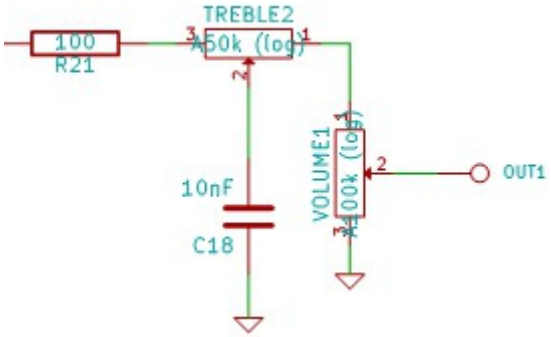


This stage is used to mix in all three distortion stages. The three pots are used to set the amount of input signals: from 0 to 100% for each input.

Then it is a classic summing opamp: Out = -R16x(TREBLE/R13 + MID/R14 + BASS/R15). As we have R13=R14=R15, it's just summing equally the tree signals and with a gain of x20. That x20 gain is useful to use the glorious basstar as a

frequency booster, or for settings where a little more output is needed. But as we will see, part of that x20 gain is also lost with output stage.

Output stage:



The output stage is a low pass filter and a volume knob.

The low pass filter cuts at F=(1/2xPix(R21+TREBLE)xC18).
So at minimum, the cut off frequency will be 159154Hz. At maximum it will cut at 317Hz.
The volume is set by a tension divider done by VOLUME1 pot. But TREBLE2 pot and R21 are also dividing the maximum volume available from what's entering R21 (Vin) at: Vmax=Vin x VOLUME1/(R21+TREBLE+VOLUME1)= Vin x 66%.
So the maximum volume available would be 66% of the volume available at the output of the mixer. Giving the pedal an overall gain of x13.33 (+22.5dB) if all three gains pots are setup at minimum and volumes at maximum.

