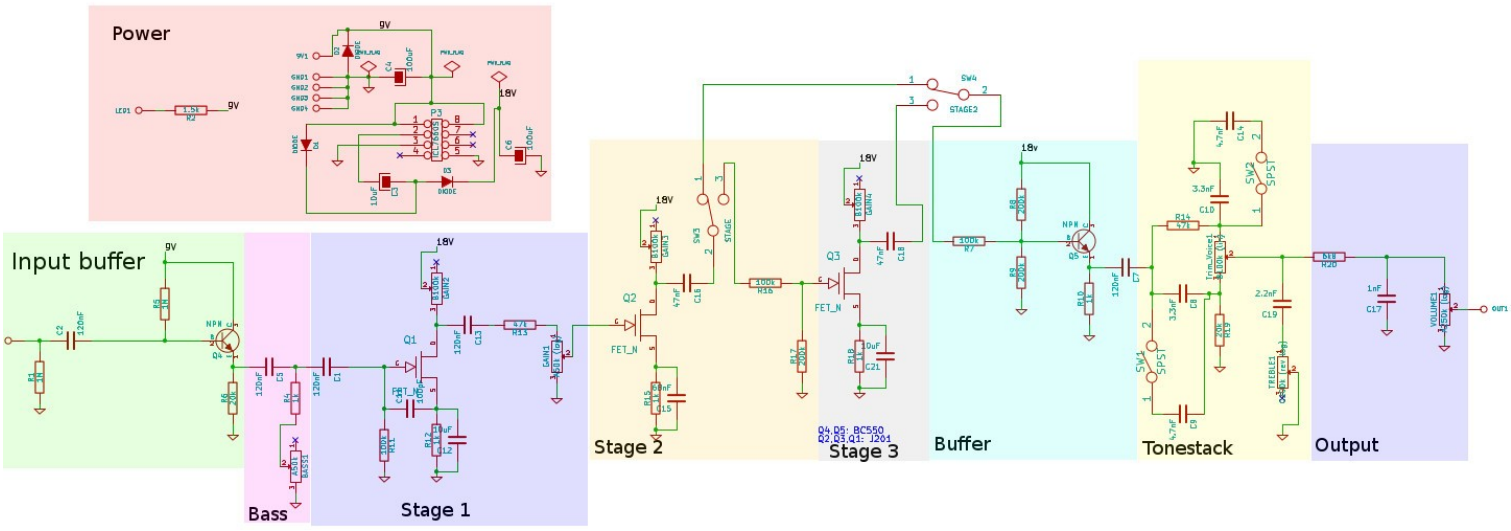
Jour de FET
Technical data

Power:
Input voltage: 9v or 12v - center negative.
(The analysis below is made with 9v)
Power consumption : 20mA maximum.

Dimensions:
H/W/L: 50mm/70mm/110mm
Weight:350g

Analysis:
This paper is intended to focus more on the filtering made in the pedal, which explains the overall tone of the pedal, rather than the amplifications aspect.

In short, appart from the power part, we can divide the Jour de FET schematic in 8 parts:
- Input buffer
- Bass filter.
- Gain stage 1
- Gain stage 2
- Gain stage 3
- Buffer
- Tonestack
- Output



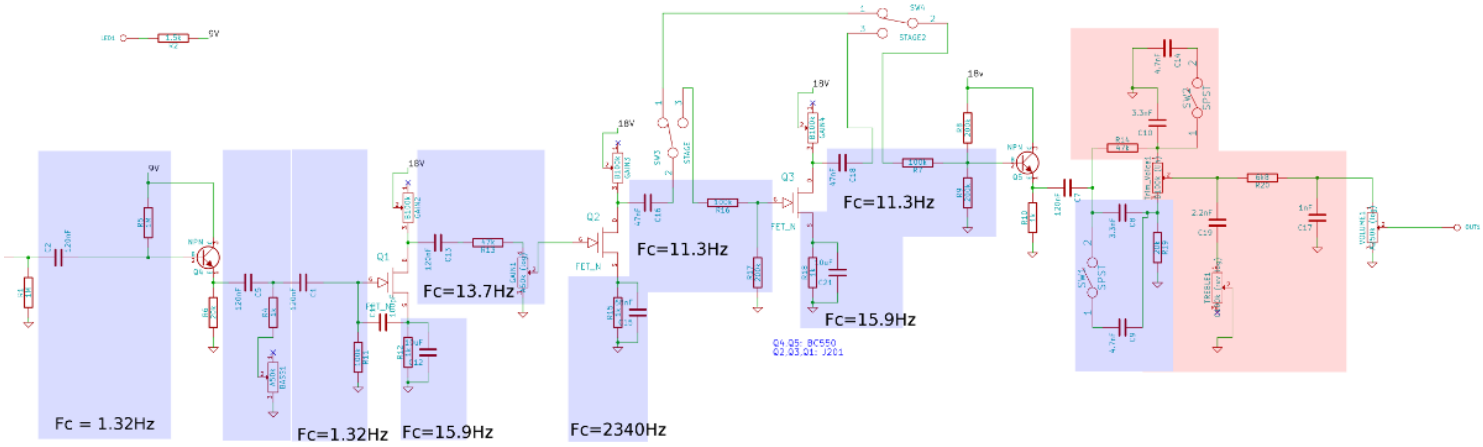
The power part consist of a 1N4001 diode which protects the circuit in case of wrong and inverse polarity on the input jack. C4 is a filtering cap. The ICL7660S part is used to create 17v from the 9v input (2x9v minus the D3 diode voltage drop)

The buffers are classic bipolar transistors with common emitter use.
The input buffer is to avoid attacking directly the bass filtering by the guitar and to keep a high input impedance.
The output buffer is used to adapt the impedance for the tonestack. The tonestack has a too small overall impedance to be driven directly by the JFET from stage 3.

The gain stages used to produce distortion are classic JFETs autobias. Each stage has a gain of around 15. The maximum gain is given from these 3 gains and the 3 tension dividers of R13 and Gain1, R16 and R17 and R7 and R9. That gives us with GAIN1 at maximum: G = (15x0,5)x(15x0,66)x(15x0,66) = 750.

From a filtering point of view then, the different caps mounted on the gain stages, plus the treble, bass, and tonestack stages will change the tone or grain of the distortion.

The jour de FET has 13 filters shown below. In blue the high pass filters, in pink the low pass filters. The cut off frequencies are shown on those that are fixed.



As you can see: The low pass filters from decoupling caps C1, C2, C12, C13, C16, C18, C21, C7 cut low enough (less than 20Hz) to be considered as having no effect on the overall sound.

The bass filter:

The bass filter stage from C5 cap and the potentiometer allows to change the cutoff frequency between: Fc=1/2xPix(R4+BASS1)xC5. Thus from 26Hz to 1362Hz, which is a very large span.

Filtering in gain stage 2

The pair R15/C15, cuts a bit high : 2340Hz. But in fact this filter don't cut the signal drasticaly. Instead C5 cap changes the gain of the stage 2 from this frequency. Below 2340Hz, the gain is around 12, upper than the frequency, the gain is about 15. It helps to remove a bit of low frequencies in the next gain stages.
Too much bass in the gain stage changes the distortion grain, it gives a less aggressive, sweeter distortion.
Also it avoid a muddy playing when playing low chords, the attack is not covered by the bass of the sound.
Also the bass cut done here will be balanced back with the tonestack.

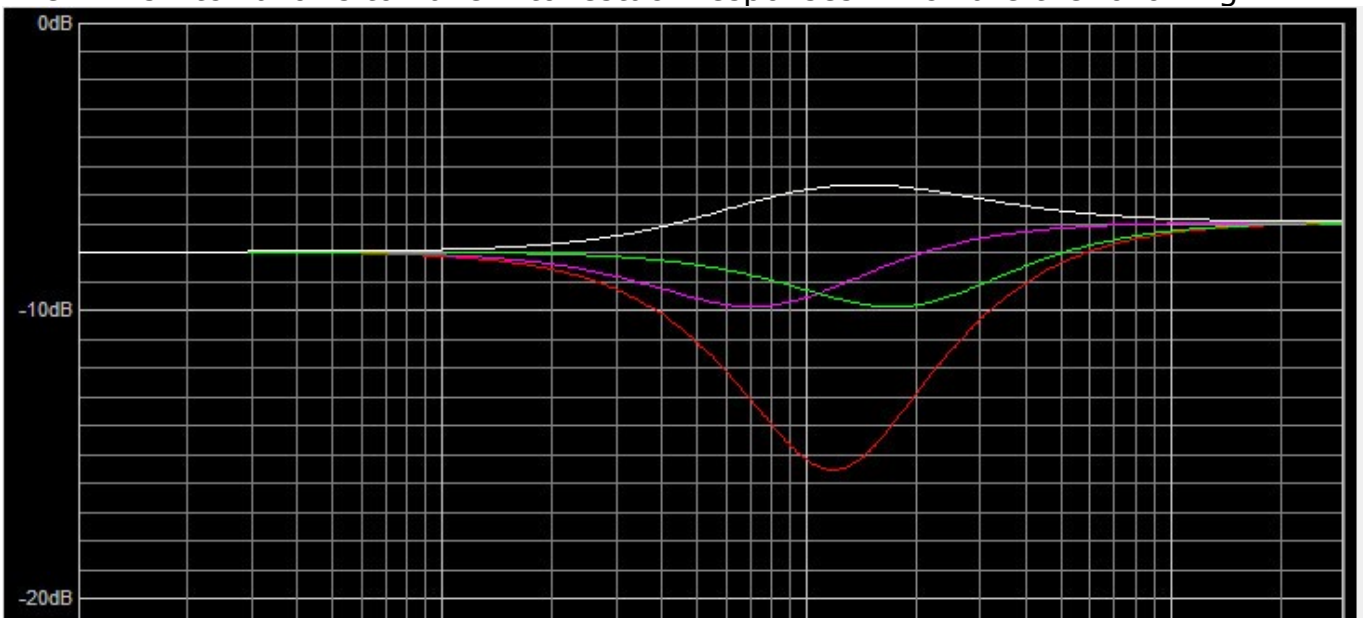
Tonestack analysis:

To understand how the tonstack works, just think that it's just two RC filters in parrallel, one low pass, the other high pass, of which the output is blended with the trim_voice1 pot.

One can thus easily calculate the values of R and C to get all sorts of band pass or notch filters.

The idea on the jour de FET was to smooth a bit of the high medium brightness produced by the distortion, and re-equilibrate the bass loss from stage 2.

The DIP switch allows to have 4 tonestack responses which are the following:



More precisely on the high pass filter we have two possibilities:
1- Fc= 1/(2xPixC9xR19)=2411Hz
2- Fc= 1/(2xPix(C9+C8)xR19)=994Hz

and on the low pass filter:
3- Fc= 1/(2xPixC10xR14)=1026Hz
4- Fc= 1/(2xPix(C10+C14)xR14)=423Hz

With these four values we can create:
- A notch of -2dB at 700Hz, removes a bit of bright mids but keeps a bright attack. (Combination of cut off 2 and 4)
- A notch of -2dB at 1718Hz, removes a lot of brightness.(Combination of cut off 1 and 3)
- A notch of -7,5dB at 1400Hz, A very scooped doom sound. (Combination of cut off 1 and 4)
- A peak of +3dB at 1100Hz, Very sweet with crunch sounds a bit on the vintage side. (Combination of cut off 2 and 3)

The the pot Trim_Voice1 allows to balance the bass and trebles around the 4 frequencies given upper.

Output stage:

Trim_Voice1, VOLUME1, R20 ad C17 form a low pass filter which cuts the very aggressive high frequencies created by the distortion and sweetens the output.

The response of this filter being a function of trim_voice 1, it's also variablebut to simplify:
- Volume 1 is big enough to be neglected. Not that is has not action, but his action is above 20kHz and thus out of the audible domain.
- Trim_Voice1 is used to set a balance between bass/treble and small vairations are sufficient to balance the tone (At least with closed cabs). We can make the hypothesis that a 30/70 ratio is already extreme, in one way or another. Most of the time 50/50 will fit.

In this conditions if Trim_Voice1 is divided in resistances Ra and Rb, uone approximation of the cut off frequency is:
Fc = 1 / (2 x Pi x ((Ra//Rb) + R20) x C17)
With Ra//Rb = (Ra x Rb)/(Ra+Rb).

That gives us 5004Hz if Ra=Rb=50kOhms
Or 5724Hz if Ra=30kOhms and Rb=70kOhms, or Ra=70kOhms and Rb=30kOhms.

Then the attenuation of this filter is added to the one from TREBLE1/C19.

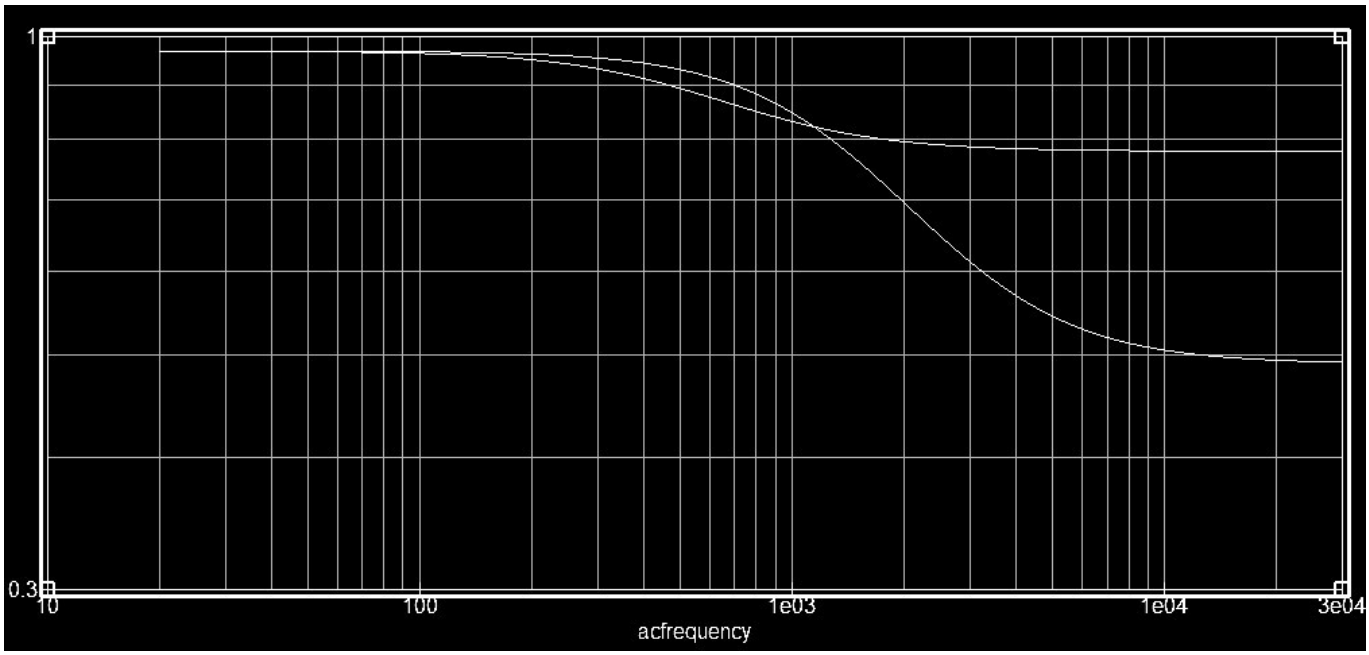
Low pass filter:

This low pass filter is made by cap C19 and pot TREBLE1. It works like R20/C17: its cut off frequency is influenced by the position of Trim_Voice1. We'll consider here that it's in central position it has thus an equivalent resistance of 25kOhms (Ra//Rb with Ra and Rb=50 kOhms)

If TREBLE1 is 0Ohm, an approximation of the cut off frequency is given by:
Fc = 1 / (2 x Pi x ((Ra//Rb)) x C19) = 2893Hz

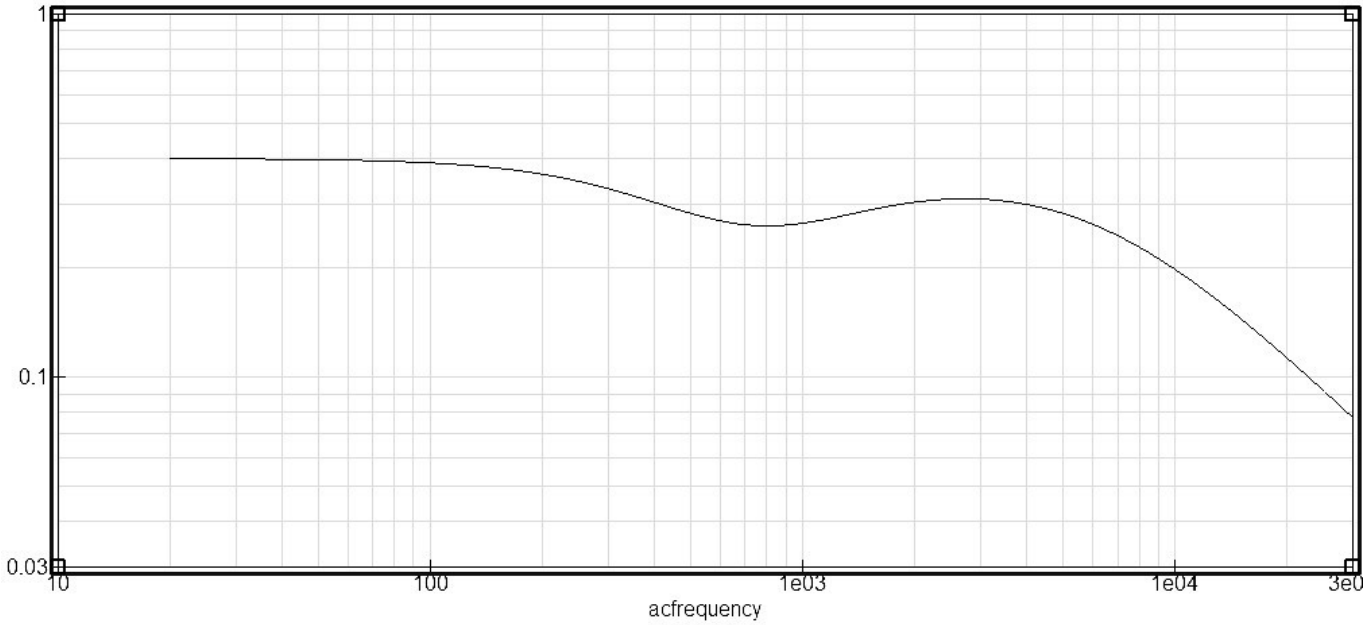
If TREBLE1 is more than 0, it's different.
One has to consider that above the cut off frequency, C19 caps is in shortcut and the signal flow to the TREBLE1 pot. So at these frequencies Trim_Voice1 and TREBLE1 forms a tension divider.
So in the cut off band, the attenuation will be:
TREBLE1 / (TREBLE1 + (Ra//Rb))
Thus given the values of TREBLE1:
If TREBLE1 = 100kOhms : 100/(100 + 25) = 4/5 of the input.
If TREBLE1 = 25kOhms : 25/(25 + 25) = 1/2 of the input.

Here are the response curves with TREBLE1 = 100kOhms and TREBLE1= 25kOhms :



So the rotation of TREBLE1 mostly changes the attenuation of the cut frequencies.

And in conclusion here’s the overall curve for the tonestack and output stage with the values: notch of -2dB at 700Hz, Trim_Voice1 centered, Treble at 100kOhms:



And that’s all that makes the Jour de FET sound so sweet!

