

„The Professor“

– an old school amp project from back in the day

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1. Some personal history (just skip it if you want to get to the circuits right away)

I was just going through some old papers and I stumbled across two hand-drawn circuits from some DIY-projects I tackled in the early 1980's. In view of all the discussions I experienced about guitar circuits over the years, I felt I should take advantage of the "Member Projects" page on the GITEC website and post these old hardware approaches. Since the circuits were used to do some recordings I can even present some audio examples.

This amp project originated sometime in the late 1970's when even in provincial Southern Germany word got around amongst the guitar playing folk that there was a new wonder weapon from California: the BOOGIE amp. I somehow even got hold of a sales brochure and left that lying around in my parents' house some day. My dad (who as a professor held the chair of the Institute of Electroacoustics at the Technical University in Munich) saw it and he took note. Not of the amps as such (for him all the tube technology was a bit boring because he could honestly say: "been there – done that") but of the beautiful amp-cabinets shown in the color pictures. In his free time, (among other things like gardening or hiking in Bavarian mountains) my dad loved to work with wood and built lots a furniture for the house, and he loved the look of those Boogie amps. It did not take long for him to suggest that he could build me a mahogany cabinet for an amp if I wanted to do a DIY project. Of course I jumped at the chance - and so it began.

By early 1981, I had seen a drawing of the circuit of a Boogie Mk. 1 and was shocked to find next to no difference to the souped-up fender Twin Reverb I had been playing for a while. I also started to be frustrated with certain aspects of tube amps, and had read the books by Helmuth Lemme on guitars and amps – which pointed to the possibility of using solid-state technology despite the bad rap it had in guitarist circles. In addition, some very usable devices such as the Ibanez Tubescreamer and the Boss OD-1 had come out and indicated that solid-state was not necessarily bad at all.

With this as a background, and given that I was just getting my own place to live, I decided that the amp I was going to build with my dad should be living-room-compatible (i.e. good looking and small), and include only solid state technology (that tied in with the size aspect). I have had a love affair with JBL speakers all my live (well, since I could afford them – my Twin didn't have any ☺) and had good experiences with a K110. Such a speaker was thus going to be the basis for the amp, and the cabinet was going to be so small that it could just accommodate the 10"-speaker. The overall design was going to be that of early Fender or Vox amps with the controls accessible from the top of the amp. My dad found some nice mahogany and went to work, even carving the dove-tail joints all by hand. He finished the cabinet quite quickly (and nicely!) so I had to follow up with the electronics.



2. Amp Electronics (with a little history thrown in ...) – see the Figures

The electronics of the amp come together in a number of stages.

- **Power amp and power supply (not shown):** it was clear from the beginning that the project was going to be a solid-state one since the amp was going to have a very compact format but also decent power output. Only a transistor power amp could offer this combination. Also, with my knowledge and experience at the time, it was clear that as a consequence any distortion had to be generated in the preamp and not in the power amp.

I later learned that there were other approaches possible but at that time, the experiments I had done with various equipment I had owned, built and used over the 10 years or so since I had started playing the electric guitar pointed that way.

The power amp I chose was a kit available from a Munich company called RIM, capable of delivering 160 W into a 4 Ω load. The K110 speaker used in the amp was rated at 16 Ω impedance and 75 W power handling capacity so it was reasonably safe given that the power amp could deliver (nominally) approx. 50 W into that load. However, I could connect further speakers to take advantage of the massive power capacity. The big heat sink of the power amp made a substantial part of the real surface of the amp. The power amp required merely a very simple power supply with 1 rectifier and 4 capacitors – this could be fitted to the bottom of the amp cabinet while the pretty big (and HEAVY) mains transformer was bolted to the speaker baffle next to the K110. (This particular power amp died 20 years later due to negligence on my part when servicing the amp. Since experience had shown that massive power was never required from the amp, the power amp was replaced by a 40 W Power Module which made the amp considerable lighter ☺)

- **Linear preamp (Fig. 1):** in a first construction stage, I did not fit any distortion circuit to the amp since I did not really have a grip on what to do there at the time.

The preamp includes a first stage (IC1), a very much Fender- and MusicMan-inspired tone stack with treble and bass controls plus bright and deep switches, a send/return stage and a (master) volume control. The bright switch controls a simple RC-filter in the feedback loop of IC1 which produced a boost of 6 dB above about 2,5 kHz. The deep switch is in fact a “normal or less bass” circuit cutting frequencies below 230 Hz with a shallow 6db/Oct slope. The preamp has a trimmer to adjust the sensitivity – in fact I never touched that again after setting it once so as not to distort with Gibson Dirty Fingers pickups.

The preamp also includes a pre-wired optional additional treble boost (dashed in the figure) which was never connected because the circuit generates a lot of treble as is.

Two voltage regulators fed from the power amp supply deliver the +/-12V for the OP-amps.

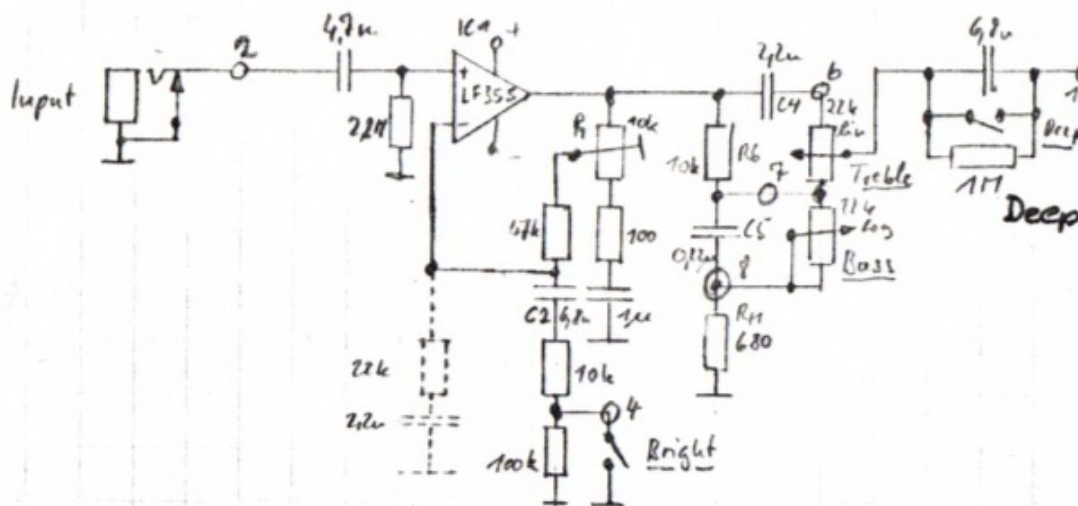


Fig. 1: Preamplifier (linear part) with “Treble” & “Bass” controls, and “Bright”- and “Deep”-switches

At this point, the amp became operational, and I used a Boss “Heavy Metal” stomp box connected to the Send/Return-stage for sound shaping.

- **Distortion circuitry** (introduced a year later): investigating circuits used in the distortion generating stomp boxes mentioned above (which I generally liked but found a bit unnatural sounding), and also based on what I had read in the Lemme-books, it was clear that OP-amps plus (as non-linear devices) diodes in the feedback path would give a decent sound.

Experimenting with a Boss OD-2, I found that I could never get enough distortion from it because of the way the non-inverting-OP-Amp design works (a characteristic of many of the simpler distortion boxes including the Tubescreamer TS-808). This led me to think that I would require two such circuits (IC2, IC3) in series to obtain the degree of distortion I wanted. An additional diode clipper between the two stages was going to round out the circuit. This clipper was switchable as a kind of boost.

Originally, I used SI-diodes in the OP-amp feedback circuits and GE-diodes for the clipper in between the two stages. Later, I replaced the SI-diodes in the first distortion stage with (green) LED's to obtain a higher output level of that stage.

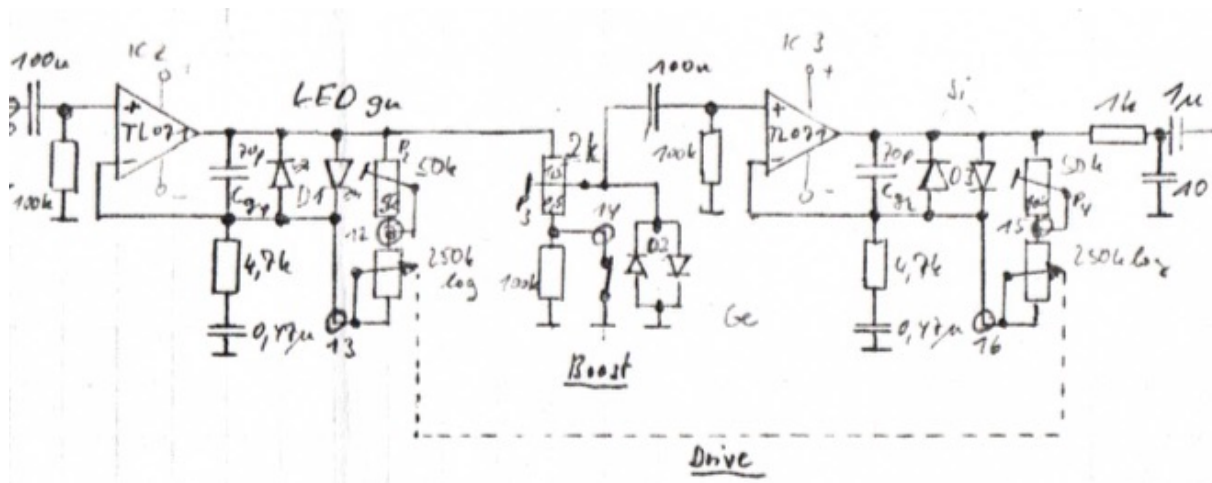


Fig. 2: Overdrive/distortion circuitry with “Drive”-control and “Boost”-switch

- **Send/Return and recovery stage:** prior to the S/R there is a simple 16 kHz low-pass which has no effect on the sound, and after the S/R there is a simple recovery OP-amp to match the output of the preamp (and of the effects devices) to the power amp

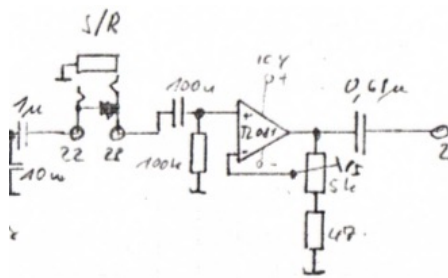


Fig. 3.: Send/return-circuitry and gain recovery stage.

- Description of **overall circuit (see last page)**: IC1 is merely a preamplifier with a very high input impedance to accommodate the guitar output characteristics, increase signal levels, and drive the tone stack. My investigations with other devices had shown that, for a natural amp sound I preferred, the position of the tone stack ahead of the distortion stage was best (again in line with the scenario in the classic amps). The distortion stage consisting of two OP-amps (IC2, IC3) with diode clippers (D1, D3) in the feedback circuits, and a further diode clipper (D2) between them was fitted between the tone stack and the S/R-stage so that any effects could be routed between distortion and power amp. No post-distortion filtering was introduced since the loudspeaker would take care of this – just as it does in any classic amp.

The “Deep”-switch cuts the low-frequency content of the signal ahead of the distortion circuit. This position helps to avoid the “muddy” sound sometimes associated with pre-distortion-tone-stack amps such as the Boogie Mk. I.

No frequency response shaping is done anywhere in the distortion stages – this is very much like the situation in most classic tube amps. My feeling is that this results in a rather natural sound - but not necessarily in a very modern and aggressive one.

Both active distortion stages are controlled simultaneously by a stereo “Drive” potentiometer. They also both include a trimmer setting the minimal gain when the “Drive” pot is at minimum i.e. when adjusted for a clean sound. For my taste, a great “clean” tone may well include a bit of distortion that is not noticeable as such but provides more of a “coloring”. This can be adjusted via these trimmers – I set them (again using a high-output guitar) so that both stages do provide gain but no actual immediately audible distortion. This seems to nicely “warm up” the sound.

The “Boost” switch circuit includes also a trimmer that adjusts how much the signal is attenuated before hitting the GE-diodes. Since all three distortion stages operate somewhat differently (1st with LED’s, 2nd with GE-diodes, 3rd with SI-diodes), this trimmer can adjust to some degree the contribution of the various stages to the overall distortion although I think that issue does not make much of a difference.

3. That's (almost) all, folks!

So, that's it: a very simple, straightforward preamp which has accompanied me for more than 30 years, and it still sounds good to me in conjunction with a linear power amp and the JBL K110. The date on the figure (1984) is the date when the final changes were made in the form of introducing the LED's to the first distortion stage.

In retrospect, I could have gone a different way in the distortion stage by introducing a inverted-amplifier approach which would have given me all the distortion I could have wanted in one single stage (many distortion devices later than the TS-808 and the Boss OD's use that successfully, including the Rockman). I cannot say how much the multi-stage distortion sounds differently. I suspect not much.

There are some audio samples posted on the GITEC website which present this preamp run through a simple DYI-direct box with an even simpler speaker simulator (discussed in my "other" member-projects posting). Check them out – the guitars are easily discerned: a Strat, a Tele, a ES-335, and an el-cheapo Guyatone lap-steel – all played through The Professor and recorded straight into the board via my direct box. No EQ from the board.

Ah ... yes, the name: I named the amp "The Professor" because my dad (the professor) had such a large part in it!¹

Thanks for your interest & take care,

Tilman , in Oct. 2017

¹ I should mention that years before this project, when I was just starting out playing the guitar, I inquired with my dad how that guitar sound on Santana's Abraxas album might be generated. He – i.e. somebody who had no connection to musical instrument electronics and certainly none to desired „distortion“, but who had a lifetime in audio electronics and acoustics under his belt – just like that took a pencil and made a little drawing showing two anti-parallel diodes and a simple low-pass HE WAS SO RIGHT ON THE MARK!

