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FOR HARP AND GUITAR

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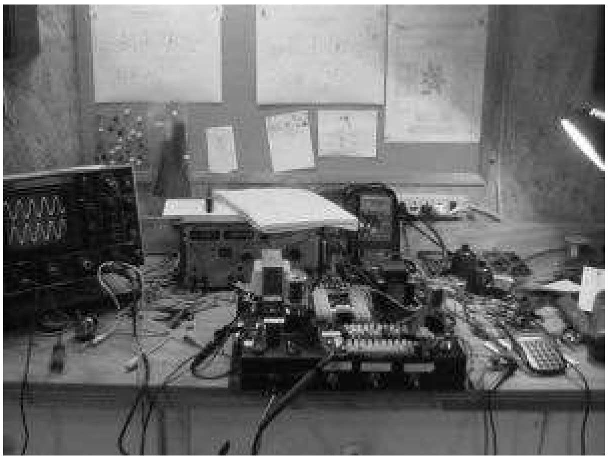
THE LONE WOLF 6L6SE
STEP-BY-STEP FREE HARP AMP PROJECT

CIRCUITRY



HEAR IT FIRST
Helmut Wiegand sent a mp3 of his 6L6SE; he used a Hammond 125DSE OT on his build. We also recorded some sound samples at SPAH from the monitor port so no speaker breakup is heard, and we also had to keep the volume down due to a seminar in the adjacent room. The second is **Riccardo Grosso** from Conegliano, Italy playing a C harp, and the third is **Gino** from San Hosa, CA playing a B Flat. They were playing around getting a feel for the amp, and no effects were used.
Helmut Wiegand - **Sample 1** Riccardo Grosso - **Sample 2** Gino - **Sample 3**

INTRODUCTION
In an effort to give a little back to the Internet harp and tube amp communities, I have decided to offer this free project. The project details the build of a single-ended 6L6 harp amp. From schematic to ordering parts to cab design, it is all here and explained in detail. This project is intended to be built as designed and not piece milled with other designs; the reason for this is that my design is a holistic design, meaning it is designed to all work together from the power supply to the speaker. Changes made in gain, tubes, capacitance, etc., will affect other stages in ways that may not be positive. I will offer alternatives along the way that will not affect the end result negatively, but I suggest

you give it a try as shown because the end result will be a known good product.

In designing the schematic, I put a lot of effort in R&D, tried many different scenarios, and tested many popular myths before I came up with the schematic I will present here. My design goals included building an amp with a simple design, minimum parts, a fat tone, a good bass frequency response, early breakup, and feedback resistance. Below, I will explain the role of the different circuits and what I took into consideration when designing them.

Now here is the catch; we want YOUR input. The site forum will be utilized to communicate ideas, successful builds, and to help troubleshoot problems. Changes will be made to the project as we work together to make improvements, as long as it is a general consensus that it is a notable improvement that can be heard in the amp's performance and all possible effects of the change have been addressed. This project will be expanded in the future to include build options, such as different tone controls and final tubes.

THE POWER SUPPLY

The power supply's job is to produce a ripple-free DC voltage to power your amp along with a heater voltage to supply the tube's heaters. The rectifier is the component that converts AC to DC current, and we have two choices here: tube or solid state. Tube is the traditional choice, but solid state is the logical choice; why? Because heat is the enemy of electronic components, and tube rectifiers generate a lot of heat; they are also inefficient, producing lower voltages and putting extra load on the power transformer. An issue that often comes up with tube rectifiers is sag: distortion created by tube rectifiers, i.e. compression when there is a sudden heavy current draw. In this case, we are building a single-ended amp. In a single-ended amp, there is maximum current draw at idle when you are not playing hard; the current draw actually decreases when you begin playing, just the opposite condition that is needed to produce sag, which simply does not exist in a single-ended amp period. In the event we were building a push-pull amp, it would be different, and we would have to decide if we want sag or not. But we are building a single-ended amp, so it is not an issue. A solid state rectifier is efficient, does not produce excessive heat, is much cheaper, and most importantly it will not take away from the tone of the amp. So, solid state is the rectifier that we will use.

There is absolutely nothing to gain from a poorly filtered power supply (except noise), and there is nothing to gain from an excessive amount of filtering. The chosen amount that you will see on the schematic will produce a good clean DC voltage that will allow us to go big in value on our coupling caps, and this will allow us to have a good bass response. Too little filtering with large coupling caps will cause a popping noise in your amp often described as motorboating, so take filtering into consideration when modding an amp with large coupling caps.

The heater voltage will be at a DC potential, which will do plenty to reduce hum. The ON/OFF switch will have a standby that will preheat the heaters of the tubes before applying plate voltage; this is an important feature to have on a solid state amp.

THE PREAMP

The preamp is the heart of an amp; this is where it all begins and where tone is shaped and molded, added to and from which it is taken. It is second only to the speaker in its effect on the final product. Plenty of effort, experimenting, and testing was put into the preamp: the number of stages and the gain of each has to be right for a microphone, headroom has to be right for the distortion, the monster that is feedback lies in the preamp and must be chained down, plus there is the tone control circuitry. Here you will see a very unique design in that both the tone control and the volume control is placed after the second stage. The reason for this is to have a fixed drive to the second stage. The fixed drive to the second stage will allow us to set up the exact amount of preamp overdrive that we want, which will be just a small amount. Too much preamp overdrive and you muddy-up your tone and too little is thin. The setup you see will produce a fat tone at any volume setting. The distortion that a preamp produces is even harmonic distortion, which all agree is a pleasant sound when used in moderation; remember a little is good, but a lot is bad.

The amount of gain and the bias voltage required, which determines headroom, dictates the tube to be used; for the effect we want, it is the 12AX7. In most if not all guitar amps, the 12AX7 produces too much gain for the harp player. But ultimately it is the circuitry around the tube that determines gain. By eliminating cathode bypass capacitors, lowering the plate voltages, and with the bias voltage used, I was able to achieve the overall effect that was desired.

The plate voltage chosen is 120V but anything in the 115 to 160V range is good. A voltage lower than 100V puts the operation of the tube in a nonlinear range, causing uneven amplification of the upper and lower half of your signal and a tone that is muddied. The cathode resistor needs to be chosen to produce the correct bias voltage in relation to the plate voltage used; this is important and should not be overlooked in preamp design because if the bias voltage is not correct once again, you will end up in a nonlinear situation. When choosing the bias voltage, always refer to the tube data sheet for the correct voltage.

The first stage is easy because it takes a relatively low signal (around 0.4vac p-p when playing softly) and really cannot be overdriven by a mic. The gain should be enough to drive the second stage and make up for losses in the tone control circuitry. In the case of this project, I am placing the tone control and volume control after the second stage, so all we have to do here is consider the gain needed to drive the second stage. To achieve the fat, even, harmonic-laden tone that we seek, we want to drive the second stage at about a 2 to one signal to bias ratio, placing the volume control after the second stage is key to maintaining this ratio. In order to aid in controlling the gain there will be a high and low input jack with a voltage divider. The voltages and gains are shown on the schematic, so check it out. All of the numbers given can fluctuate a little; they do not have to be exact.

The second stage needs only to provide enough gain to drive the 6L6; I usually set up my amp for a gain of 3 to 1 signal to bias ratio. This 3 to 1 ratio is an approximation that will assure that feedback is controlled, but there is still enough gain to provide the overdrive that we want. Check out the schematic to see how it was achieved. Close attention to the gain of each stage is a big help in controlling feedback. The coupling caps most commonly used in harp amps is 0.1uF and was also used in the Fender Bassman; 0.22uF is used here. The tone control is a simple treble cut that you will find to be common in vintage amps; I feel that it is efficient and allows for superior bass response.

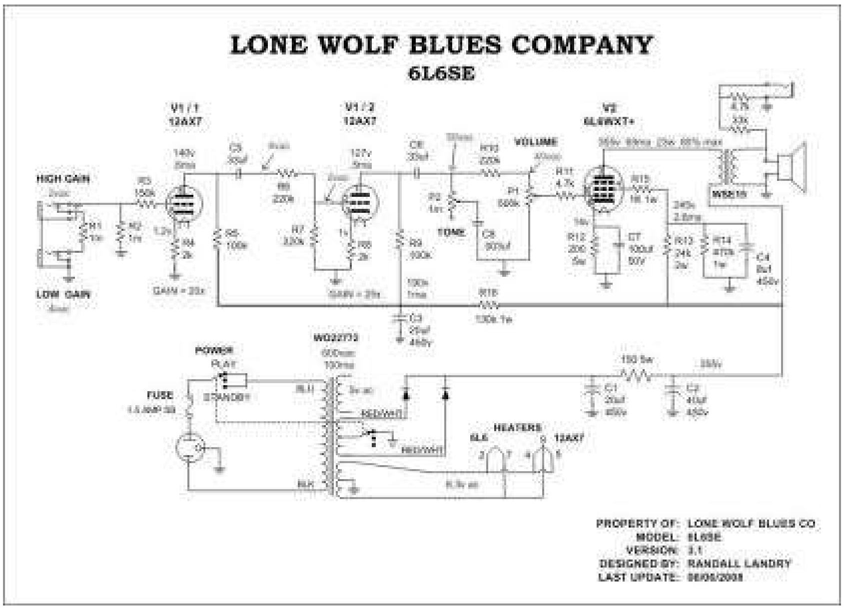
I anticipate that there will be some skepticism due to the placement of the tone and volume controls, but in actuality, the design produces very similar results as the vintage Harmony amps. In effect the 2 preamp stages are treated as one, and this enables the builder to control the tonal characteristics as well as the overall gain of the preamp by changing the value of one resistor. Plus, the preamp will produce the same harmonic signature no matter what the volume setting is, giving the amp a more consistent tonal response at all volume settings, so don't be afraid to give it a try.

THE POWER STAGE

Single-ended amps produce a tone that is extremely popular with harp players, so much so, that many choose to mic their lower-powered single-ended amps through a PA when performing, rather than use an amp with a push-pull configured final that produces more power. Once again, detailed testing and measuring went into the choice of tubes. The two candidates were the 6V6 and the 6L6. When these two tubes are compared, it is often said that the 6L6 is darker sounding. The comparison is usually in the same amp, and if a single-ended amp is biased optimum for the 6V6, a 6L6 put in its place will always run cold; why? Because the value of the cathode resistor will not be optimum for the 6L6 and neither will be the load of the output transformer; this may be the reason that it is described as "darker." In single-ended testing with equal drive and equal bias points (as a percentage of maximum bias), the 6L6 was every bit as lively as the 6V6 but louder, and the harmonics generated by the two tubes were within test tolerances of each other; to sum it up, a 6L6 is a 6V6 with balls. The biasing of the tube is set to about 70% of max power with a plate voltage that is closer to what the vintage amps had than what is often used today. The bias voltage is set low to allow for early breakup, and the screen voltage is filtered for added noise reduction.

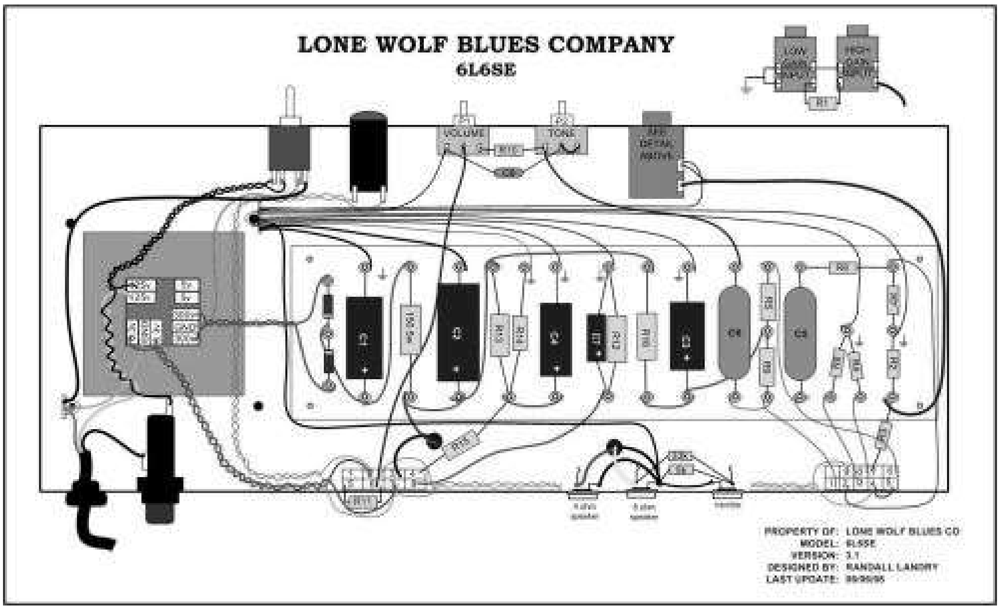
THE OT AND THE SPEAKER

The output transformers are chosen based on the output power, current draw, load, and tonal quality. An overdriven output transformer can induce a great amount of distortion into the signal, higher order harmonics that sound harsh. There are some who like a smaller transformer; indeed many of the vintage amps had the smallest OT that the builder could get away with. The larger transformer improves the bass response and is favored by many today, but if the OT is too large, the amp will sound sterile. Because the circuitry in this amp has such great low end performance, I did not need to go with an oversized OT but was able to chose one that is the correct size according to the current draw and output power of the amp. The recommended speaker was chosen based on vintage qualities: early breakup, crunchy/compressed tone, and response. The Weber signature series speaker with an "H" dustcap is my choice.



There may be minor changes to the schematic as the build progresses, so this is just a primer.
Check the "Last Update" date on the schematic to be sure you are using the most current copy.

THE LAYOUT
This layout is designed to fit easily into a Hammond 13x5" enclosure although changes can be made for it to fit into a 9x5". I chose the larger because my cab will be large enough to fit a 10 to 12" speaker, and I will have enough room to fit the larger chassis. Features include: star grounding, shielded audio input, 4 and 8 ohm speaker jacks, a monitor jack, and a turret board to mount the components. The turret board method is chosen because of the ease of changing components for those who cannot resist experimenting with mods. The turrets are hollow, and the components' leads are inserted into the center of the turret and soldered, and then the wires are wrapped around the post of the turret. Methods other than the turret mounts can be used such as eyelets, terminal strips, or point-to-point wiring. The designed layout as shown is proven to be noise-free with minimum to no 60Hz hum.



THE PARTS' LIST
Here is the **Parts' List**; this PDF also contains the schematic and turret board drawings. I recommend getting a few varieties of R16 and R13, meaning different values for adjusting your voltages, especially if you get a different power transformer. Vendors change suppliers sometimes, so your selection of parts may vary slightly as well as pricing. I do not recommend building anything until all parts are in and the size of parts, like the transformers, is verified.

For discussion, visit the LONE WOLF BLUES CO FORUM

CIRCUITRY CHASSIS WIRING AND PARTS BUILDERS' COMMENTS

For questions or comments, email us at customerservice@lonewolfblues.com