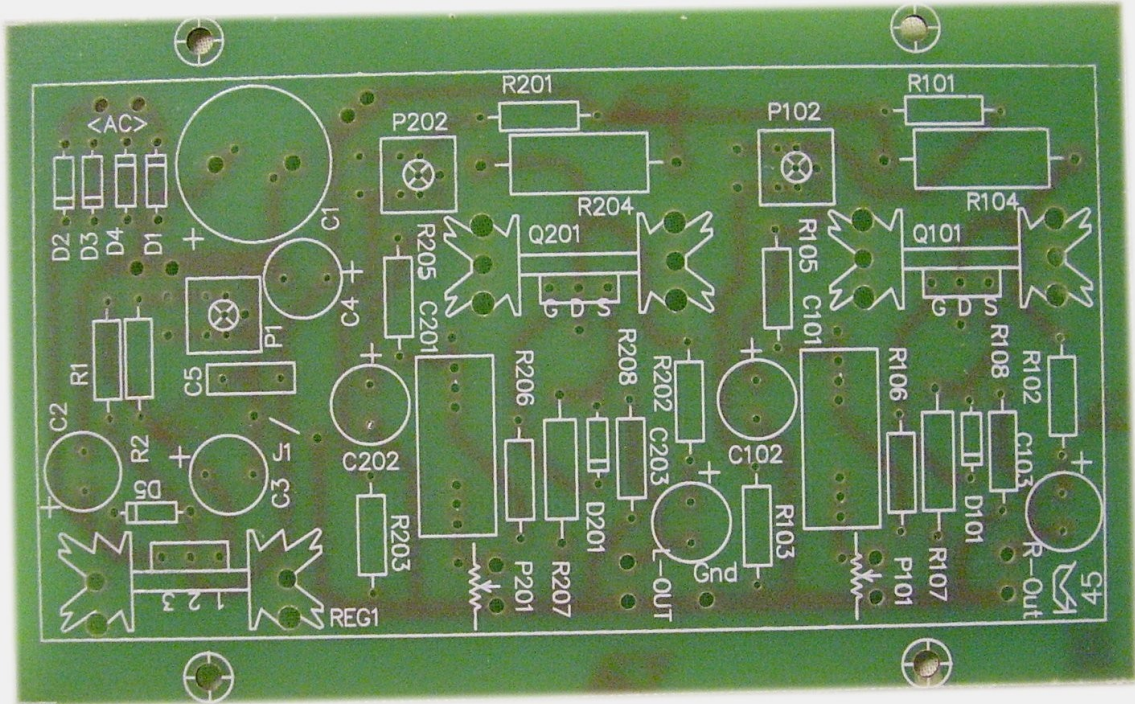


# MooseFET

Single MOSFET Line Stage Printed Circuit Board

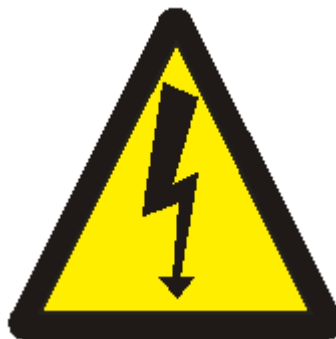


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Classic Valve Design assumes no responsibility for circuit or user damage from the use or misuse of these boards or any other product. We simply provide these on an AS-IS basis with workmanship quality as the only thing guaranteed at this time.

This product may be designed for and use around **LETHAL VOLTAGES**. We assume the user has a reasonably competent grasp of line operated electronics at the time of sale.

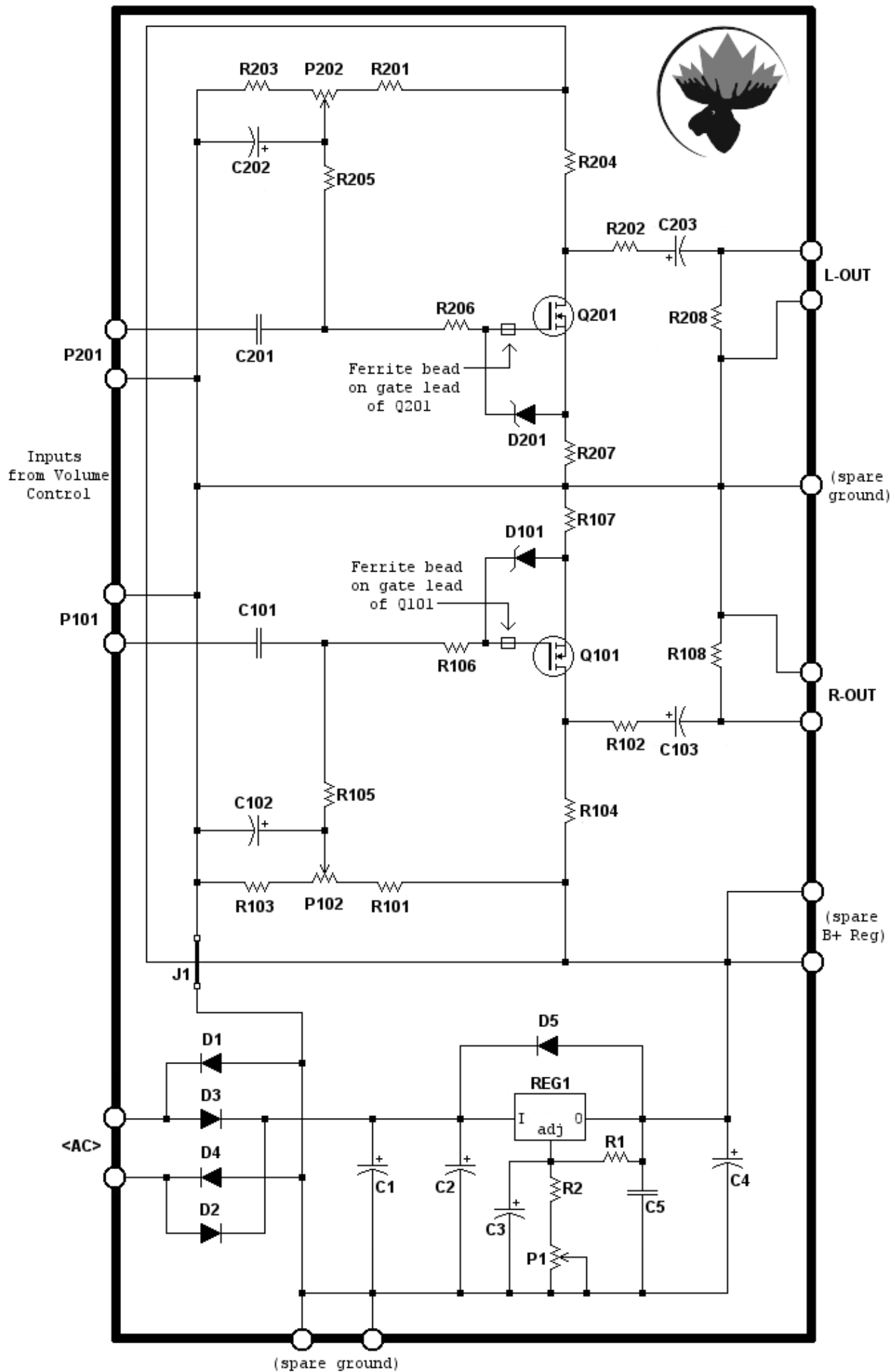


The MooseFET™ line stage is designed as a low gain, line level pre-amplifier for audio equipment. It was specifically designed for the following purposes:

- For where most pre-amplifiers have too much gain, but a passive pre isn't enough. MooseFET has a maximum gain of 5.4.
- The convenience of Solid State, without the sterility. Components have been chosen to give this MOSFET line-stage a very triode-like frequency spectra.
- Circuit simplicity and reliability. No weird or exotic components are needed.
- Forgiving circuit - sonically relatively insensitive to component quality variations.
- Tolerates highly capacitive patch cables without parasitic oscillations typical of one-single-ended-MOSFET designs.
- The PCB will drop into "PC-6" slot of the Dynaco® PAS preamplifier, replacing the 12AX7 gain board (tone controls not available). It is the mainboard companion to our **MOSeiden** "PC-5" phono replacement.
- MooseFET has a built-in power supply capable of also supplying the **MOSeiden** phono board from a Hammond 166FB24 power transformer (which fits in the PA-211 position).

Any part numbers listed in the parts list is for reference only we DO NOT condone one supplier over another.

**Safety Note:** When MooseFET™ is powered up, the output capacitors charge from zero to the drain bias voltage. Make sure this preamp is the *first thing powered and the last unit turned off*, or speaker/power amplifier damage may result from the turn on/off 'thump'.



## Parts List

### Capacitors:

**C1:** 3300 $\mu$ F, 35V Electrolytic (tested with as low as 1000 $\mu$ F as OK. Use no less than 2200 $\mu$ F if powering our *MOSeiden* board as well)

**C2:** 47 $\mu$ F, 50V Electrolytic

**C3, C4, C102, C202:** 10 $\mu$ F, 50V Electrolytic

**C5:** 100nF film

**C101, C201:** 220nF, MKP film

**C103, C203:** 47 $\mu$ F, 25V Audio Electrolytic (Muse or Silmic-II for example)

### Resistors:

**R1:** 220 ohms,  $\frac{1}{2}$ W, 5%

**R2:** 3.9K,  $\frac{1}{2}$ W, 5%

**R101, R201:** 82K,  $\frac{1}{2}$ W, 5%

**R102, R202:** 470 ohms, 2W, 5%, Metal Oxide

**R103, R203 (for using an IRF510):** 20K,  $\frac{1}{2}$ W, 5%

**R103, R203 (for using an IRF610/IRF710):** 22K,  $\frac{1}{2}$ W, 5%

**R104, R204:** 120 ohms, 2W, 5%

**R105, R205:** 220K,  $\frac{1}{2}$ W, 5% Metal Oxide

**R106, R206:** 150 ohms,  $\frac{1}{2}$ W, 5% (must be carbon film or carbon composition)

**R107, R207:** 18 ohms, 1W, 5% Metal Oxide

**R108, R208:** 100K,  $\frac{1}{2}$ W, 5%

**P1:** 200 ohms, linear trimmer

**P101, P201:** 50K or 100K audio Log (volume control)

**P102, P202:** 5K, linear trimmer

### Semiconductors:

**D1, D2, D3, D4, D5:** 1N4007

**D101, D201:** 1N4739A, 9.1V, 1W Zener

**Q101, Q201:** IRF510, IRF610 or IRF710

**REG1:** LM317T

### Miscellaneous:

**Ferrite Bead:** JW Miller FB43-110-RC

**J1:** Clipped lead from another component

**Heatsink:** PCB mount Aavid Thermalloy 513102B02500G or bolt on type 504222B00000G

**Power Transformer:** 24VAC or 25VAC @ 500mA

**Mounting Hardware**

## Circuit Notes

As mentioned earlier, the circuit is fairly forgiving. For the electrolytic capacitors (except C103 and C203), I tried on my prototype typical junk box salvages to the lowest impedance United Chemi-Con LXZ types with negligible difference sonically or on the computer Fast Fourier Transform (FFT).

I have used both the Nichicon Muse and Elna Silmic-II for C103 and C203 and the difference will be up to your ears as to which is best. You may even wish to drop in a PTFE or polypropylene cap there if you wish.

The Input capacitors I like to stick to MKP (various manufacturers), but my business partner recently got me addicted to the surplus Russian Teflon capacitors out there.

The resistors I used Yageo  $\frac{1}{2}W$  carbon film types. For R106 and R206, you must keep to a carbon film or composition here, because metal film/oxide anything will encourage VHF or UHF radio parasitic oscillations (those resistors can be quite inductive at 500MHz). If you wish to use metal film types in other areas of the circuit, go nuts! Other than the power resistor types specified, you may even use  $\frac{1}{4}W$  types if that's what you have (as mainly a tube designer, I have nothing less than  $\frac{1}{2}W$  in stock, other than values used for cathode or screen 'fusing')

I have specified some metal oxide types on the drain and source of the MOSFET and output snubber. Metal film or power carbon film/composition can be used for R104, R204, R107 and R207 with no issues, but wire-wounds will exaggerate top end performance. R102 and R202 provide a needed immunity from funky load capacitances and inductances and in tests, the metal oxide did best (carbon composition was not tested though). These are specified as 2W simply judged by sound.

The ferrite beads on the gates are critical. They prevent the IRF\*10 transistors from becoming V/UHF radio transmitters. If you can't find them from your local supplier, sometimes they can be scavenged from CATV boxes. If you do use scavenged beads, use two in series on the gates as they are usually lower in permeability than the ones specified in the parts list.

I have tested this with the International Rectifier IRF510, IRF610 and the Vishay/Siliconix IRF710. There are minor bias voltage requirements due to the internal structure differences, hence different values for R103 and R203. Future tests with other MOSFETS will be reported on in updates to this document.

The power transformer can be a modern 24VAC unit (like the Hammond 166FB24), a 24VAC doorbell transformer or even a wall-wart. A 48VCT unit can be used if you **OMIT** D1 and D4 and tie the centre tap to one of the spare grounds.

Spare ground and B+ pads are included on the PCB for indicator LED's, muting relays, etc.

## **Circuit Adjustment**

Before powering up MooseFET for the first time, turn P102 and P202 to centre position and P1 full counter-clockwise.

Upon powering the unit, adjust P1 for 24.00V on the B+ rail (the power side leads of R104 or R204 make a good test point for this). This will drift as the unit warms up and readjusting to 24.00V after a 30-minute warm-up is recommended.

If the B+ can't be adjusted, make sure the unregulated side of REG1 is at least 4V higher (28V or more). If it isn't, your chosen power transformer may not have the current rating and is 'sagging' too much. If the B+ is too high, power down immediately and check for errors in the power supply section.

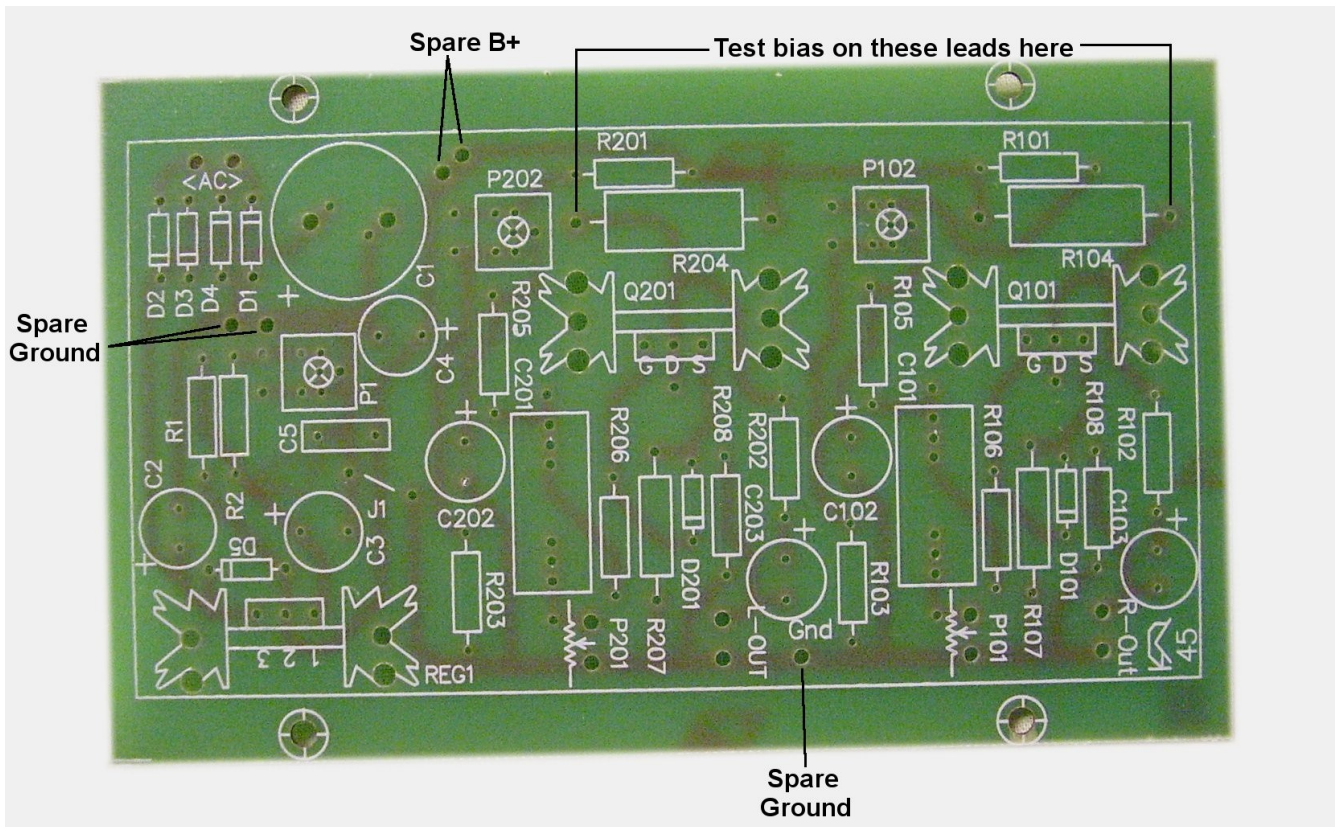
Once the B+ is confirmed, with an accurate voltmeter, check the drain voltage (the drain side leads of R104 or R204 make a good test point for this. See image below). While checking the drain voltage on Q101, adjust P102 for 14.8V if you are using an IRF510 or, 14.9V for IRF610 and 14.95V if you are using an IRF710. Repeat for Q201 with P202. Readjust after a 30-minute warm-up. Done!

If you are using a MOSFET not specified here, the best way to check is with a function generator and an oscilloscope. Using a triangle waveform input signal, bring the input up just until compression on the output and adjust the bias for symmetrical compression on the peaks. This will guarantee a FFT that gives a decaying harmonic spectra like a single-ended triode preamp.

## Changing the PAS to Full Solid State

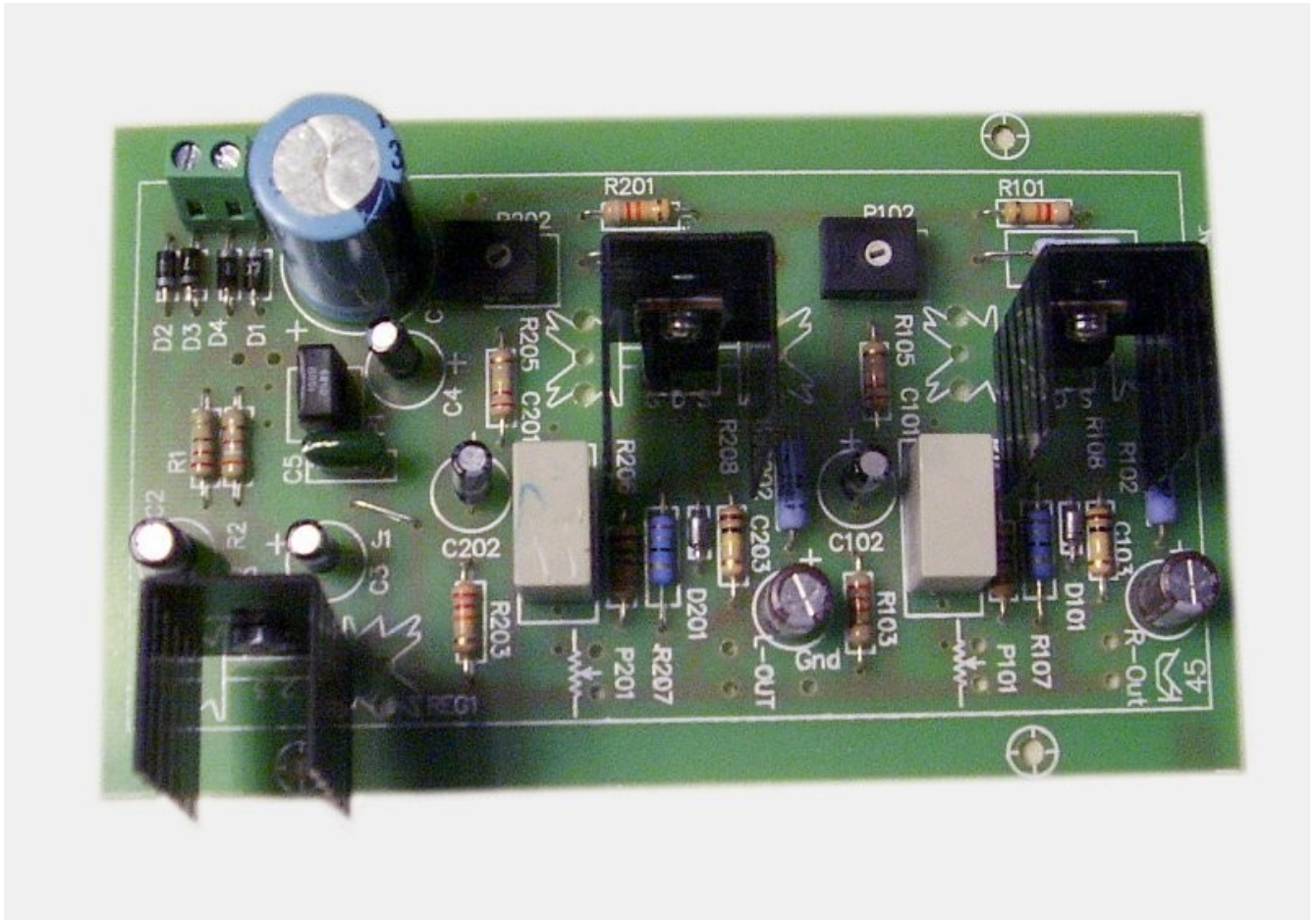
As mentioned, the Hammond 166FB24 will fit in the same mounting spot as the PA-211 power transformer. For changing the PAS over, you need to:

- Remove the PA-211 and associated power supply components, including the 12X4 rectifier, as it will not be needed.
- The 12X4 socket and can cap can stay for aesthetic reasons, but are not used.
- Wire the secondary leads of the transformer into the <AC> position of MooseFET.
- Run a wire from the "Spare B+" (shown below) to the "V+" of the MOSeiden.
- Run the centre tap and one side (doesn't matter which) of the 166FB24 to our LED indicator replacement board (order CK-57) wired for 12V operation.
- If you are using another LED replacement board as available on the internet, it does NOT have an isolated mounting and the mounting screw forms part of the circuit. In this case, use the other "Spare B+" connection and rewire your LED board for 24V operation.
- Use of the incandescent bulb with this modification is NOT recommended (draws more current)



Spare Power and Test Points





**Authors Assembled Preamp**

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