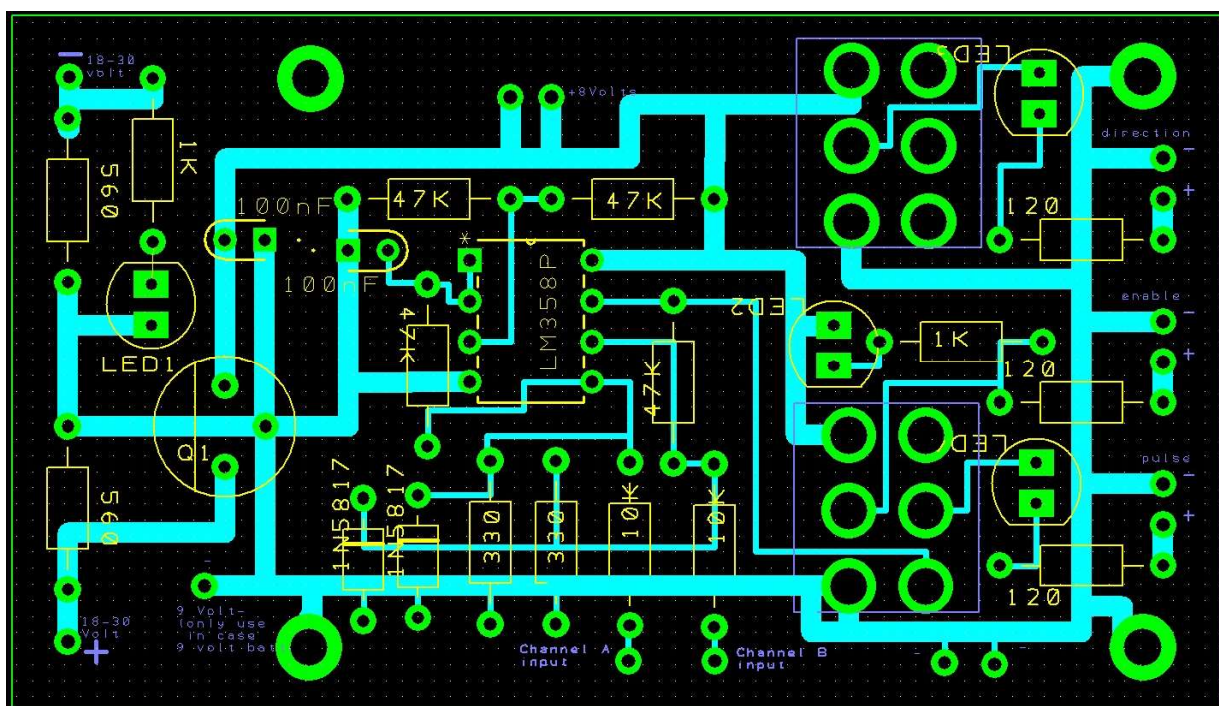




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## Jointmaster Amplifier technical manual



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## Introduction

This document contains building instructions to create the line amplifier that can be used together with the Jointmaster software to create finger/ box joints.

We made effort to design the line amplifier so that it can be created using through hole components. Thus there is no real need for a Printed Circuit Board. Buying the PCB at [www.jointmaster.eu](http://www.jointmaster.eu) can be a time-saver because:

- Less chance there is an error in the wiring.
- Less soldering of wires between components.
- You get an order-list to buy the components at RS-Online. Thus you will have the correct components.
- You get 2 free Jointmaster Windows software licenses.



## Functional operation

The Line amplifier amplifies the signal from your mobile phone stereo jack or the signal from your soundcard speaker output stereo jack to so-called TTL level 5 Volt. At the same time it delivers sufficient current to switch opto-coupler LEDS on and off.

These opto-coupler LEDS can be found in all step motor drivers. All step motor drivers have enable, direction and pulse signals driven by the opto-coupler LEDS. For this reason the Line Amplifier main function is to: **“Control a step motor driver”**

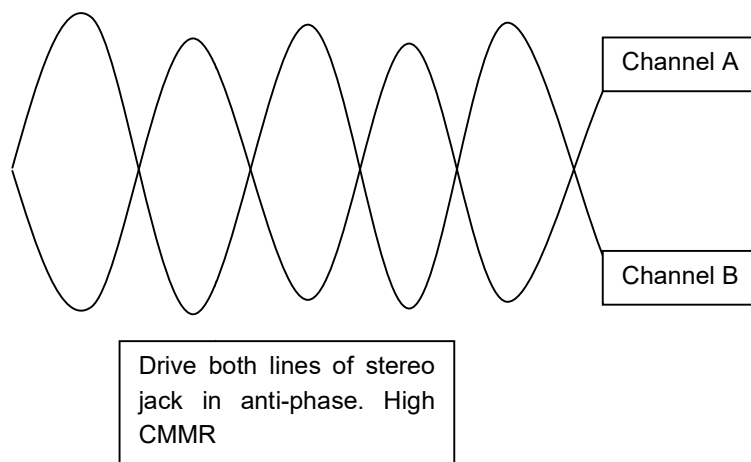
**Important Note:** the line amplifier is not meant to be connected to your sound card “Line Level output” because the line amplifier input impedance is rather low (around 300 Ohm). It will probably not fry the Line Level output but is not beneficial either.

## Interfaces

**Channel A input:** Channel one of stereo input. Coax around channel A connected to minus and PCB housing (if made from metal).

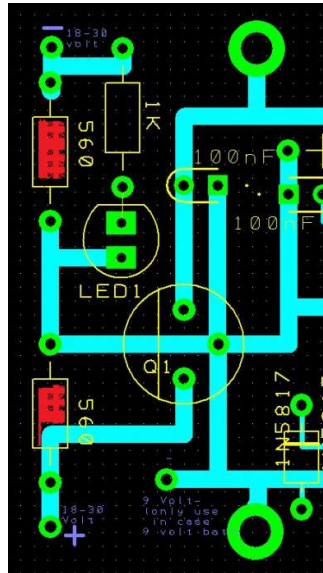
**Channel B input:** Channel two of stereo input. Coax around channel B connected to minus and PCB housing (if made from metal)

To create sufficient voltage difference on the amplifier input and have high common mode rejection ratio (to remove 50 Hz grid signals for example) Channel A and B have to be opposite phase as shown in the picture below. The Jointmaster software delivers this signal:

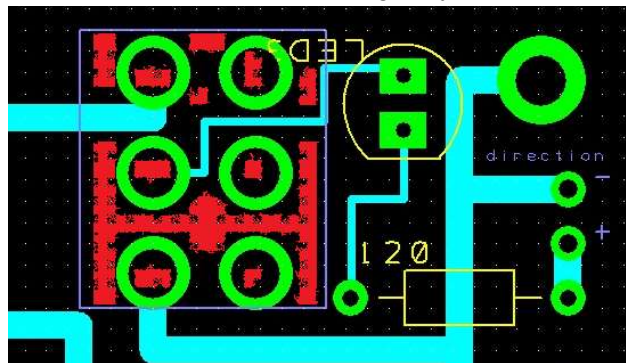




**36 Volts input:** The step motor power supply is used to power the line amplifier. By means of a voltage divider the voltage is reduced to 18 Volt. The 8 Volts voltage regulator (Q1 in PCB print) creates 8 Volt from the 18 Volt. The 560 Ohm resistors shown red below should be 1 Watt version. Alternatively, the amplifier can be powered from a 9 Volts battery. In that case leave out the 560 Ohm resistors and connect 9 Volts plus to the +. LED 1 shows if there is power when powered from 36 Volts.

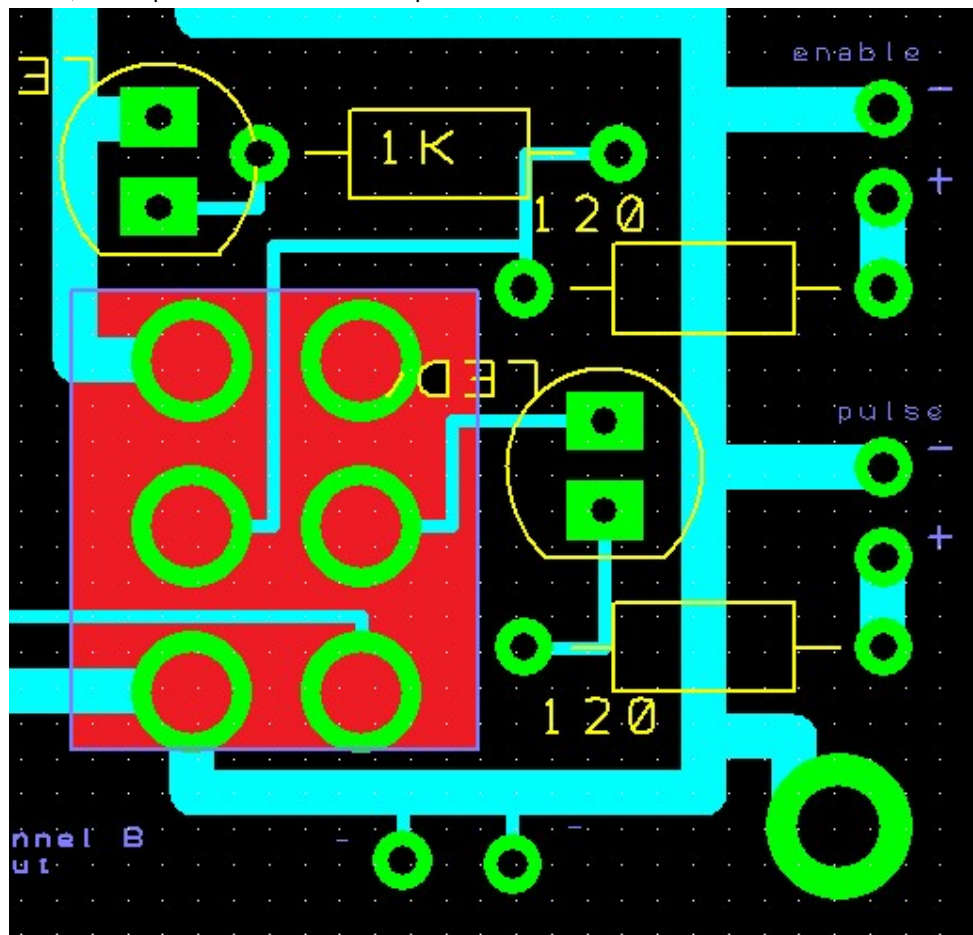


**Direction output:** The direction output drives the step motor driver direction signal. LED 3 shows direction. Direction is changed by means of a rocker switch shown below:





**Enable output:** The enable output drives the step motor driver enable signal. LED 2 burns when the step motor is enabled. Enable is changed by means of a rocker switch shown below: When the stepper motor is disabled, the pulse signal that forces the step motor driver to make a step is also disabled. Note that this rocker switch can also be implemented as emergency stop switch. If you put your fingers by accident between parts moved by the step motor, then operate this switch to stop all motion.

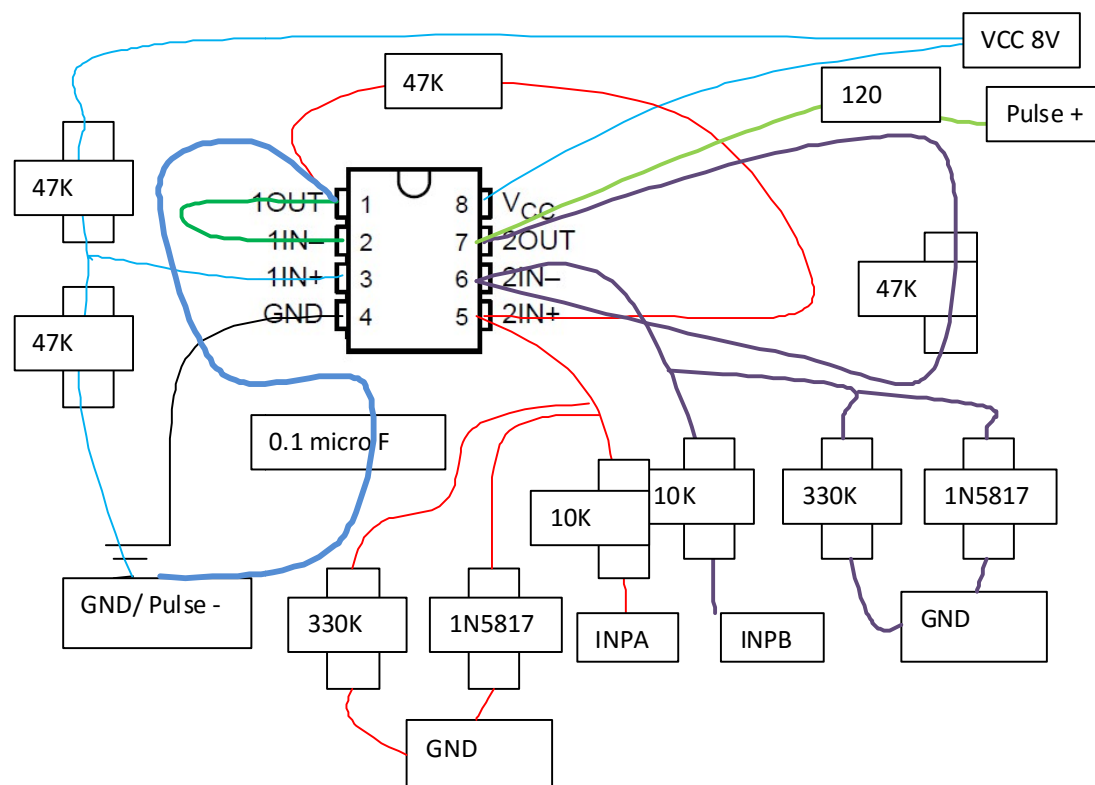


**Pulse output:** : The pulse output drives the step motor driver pulse signal. LED 4 burns when the step motor pulse signal is high. The pulse output is the amplified difference between channel A and B.



## Amplifier part Schematic

This schematic can be used to measure resistance and diodes using your volts meter in case the amplifier does not work.





## Grounding/ EMC

The PCB print housing should be connected to minus. Note that the PCB housing is grounded via the stereo jack interface when using a PC soundcard. Using a PC sound-card gives rise to so-called ground loop because a PC sound card coax is connected to earth ground (and is connected to line amplifier PCB minus). The green lines (in the picture on the next page) denote the PCB minus that is connected to the PCB housing.

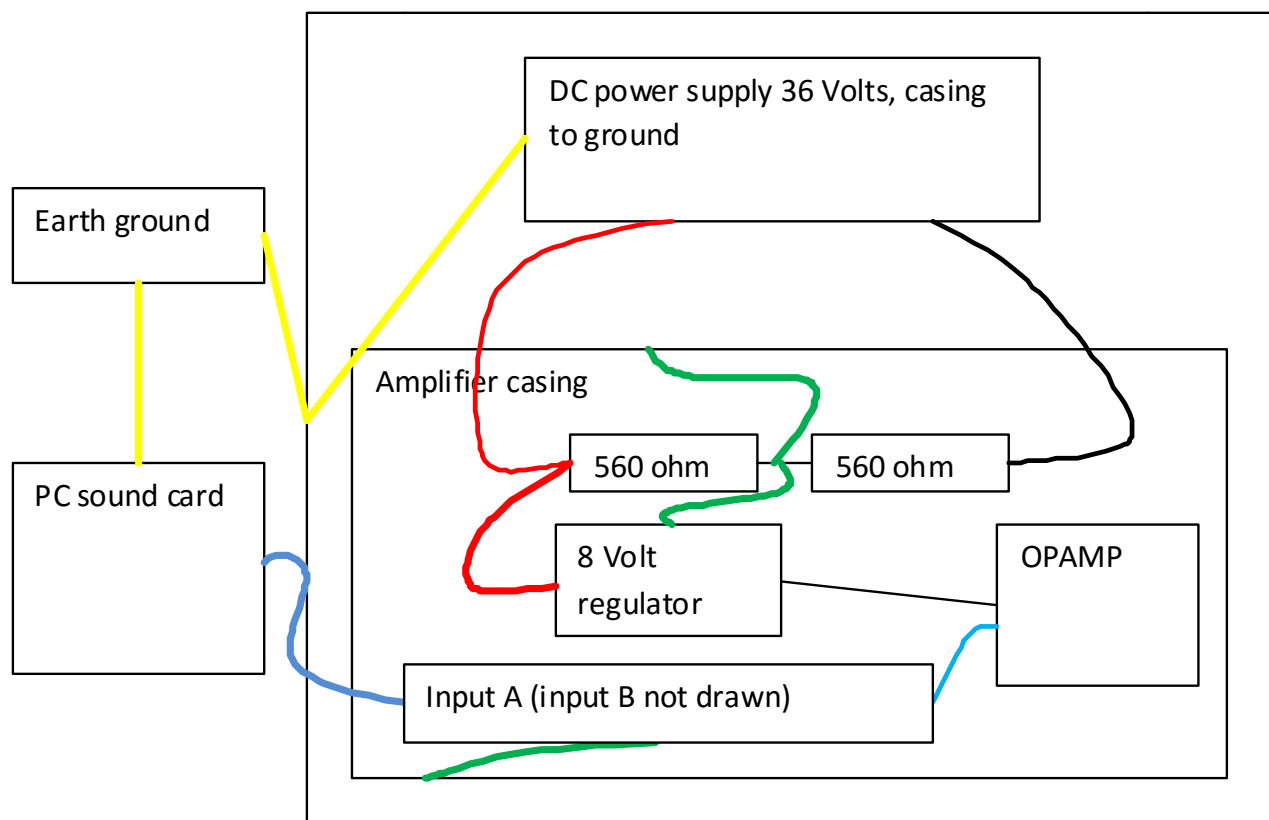
When powering step motor power supply and PC from the grid, use the same power connection point to prevent ground loop problems. So far we did not encounter problems.

Note that there is also a defined ground path to the step motor power supply via the 560 Ohm resistors. The PCB housing should not be connected to earth ground as shown on the next page when the housing is build into a bigger casing to prevent ground-loop.

**Of course, the power supply housing should be grounded (connected to earth ground)**



**Grounding concept (Note, there is a ground path via the 560 Ohm and via PC sound card). When build into a bigger unit, the amplifier does not have to be grounded. More ground loop chance.)**







## Addendum: Simulations

This chapter is probably only interesting for technicians/ those who want to use the amplifier in different projects. We also created a LTSPICE model of this balanced amplifier. If you buy something in the shop, this LTSPICE model is also in the downloadable .zip.

Simulations are shown on the next pages. The Schottky diodes 1N5817 protect the LM 358 against too low voltage on the inputs. The LM358 amplifier houses two OPAMPS. One OPAMP is used to provide a so-called virtual ground. This virtual ground also provides a DC input voltage to your stereo jack. For this reason the 330 Ohm resistor to ground is added. 330 Ohm is a reasonable value for the expected impedance (as seen by mobile phone when earbuds are connected)

