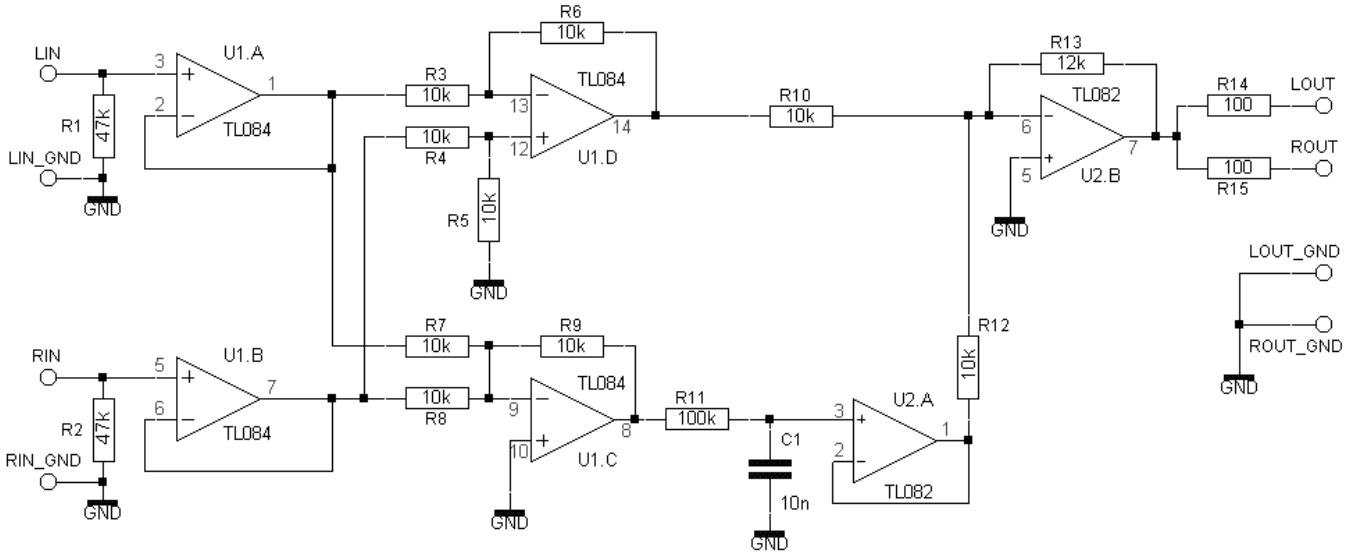
Vocal Eliminator

A vocal eliminator is a device that removes the vocals from a song. These devices are primarily used by professional singers. Amateurs want to have one, but these eliminators are quite expensive. So the poor amateurs always had to perform their soundmix show by simply singing louder than the artists on CD.
Well... not anymore! Simply build this vocal eliminator and amaze your friends!

Schematic

Vocal eliminators use the fact that only the music is recored in stereo; the vocals (of the lead singer) are recorded in mono. This means that we only have to subtract the left channel signal from the right channel signal. Unfortunately, this also eliminates nearly all low frequence signals (bass); these have to be added afterwards. The schematic below does exactly that:

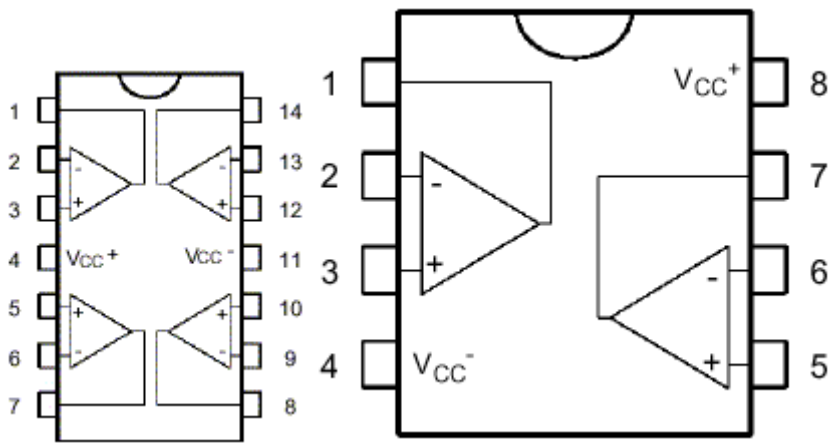


Opamps U1.A and U1.B buffer the input signals.
Opamp U1.D is used as a differential amplifier. It's a combination of an inverting and a non-inverting amplifier. Since R3 = R4 = R5 = R6, U1.D's output is RIN - LIN.
The inverting amplifier around opamp U1.C adds RIN and LIN. Its output is fed to a low pass filter (R11, C1, U2.A). The result is a signal that only contains the low frequency part of both the left and the right channel.
This signal is added to RIN - LIN by opamp U2.B. Output resistors R14 and R15 make sure U2.B survives an accidental short to ground of the output terminals.

Choosing components

Opamps:

You can just take any opamp you like. I used a TL084 for U1.A...U1.D and a TL082 for U2.A and U2.B. A single TL084 contains 4 opamps; a TL082 contains 2 opamps:



Resistors
All resistors except R3...R6 are generic 1/4W resistors. R3...R6 should be 1% precision resistors to make sure that U3's output is exactly RIN - LIN.
If you want to control the amount of bass signal, you may replace R12 with a variable resistor.

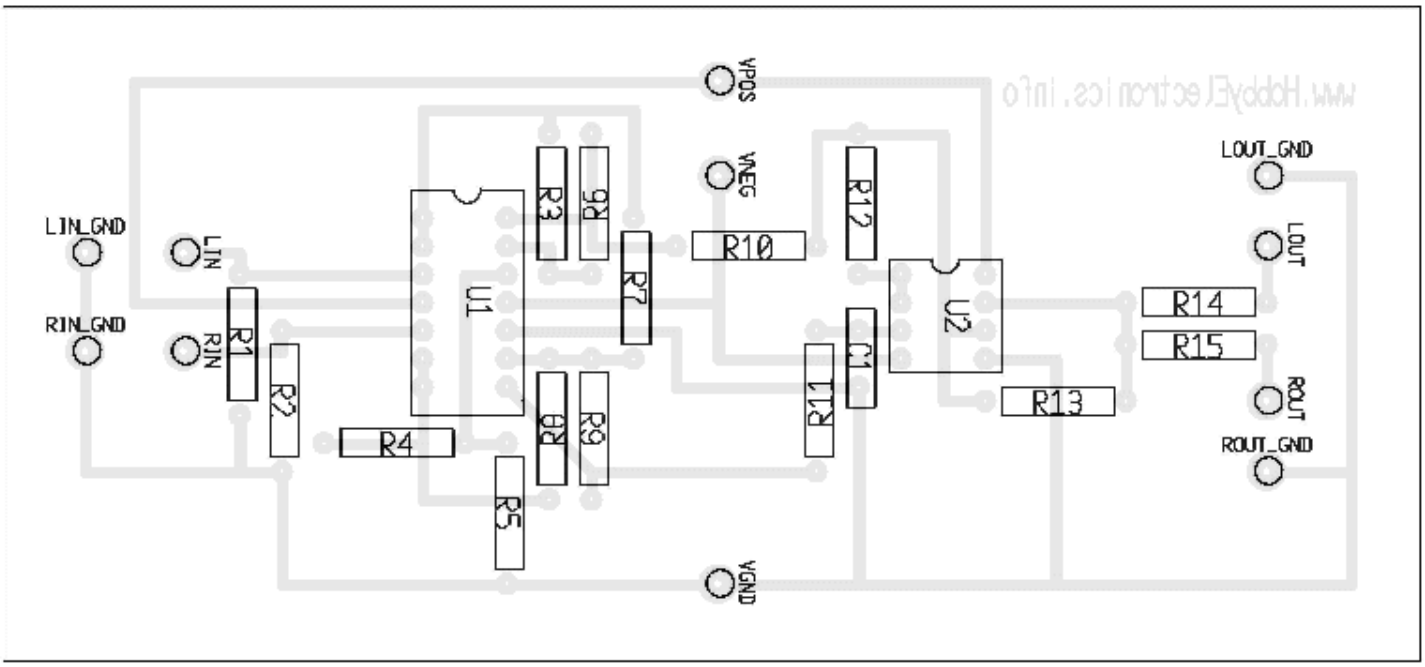
Power supply
The power supply has not been drawn in the schematic. It can be just a simple small symmetric power supply as described in section 16.1. A +/- 6V supply is sufficient for the vocal eliminator, so TR1 can be a 15V transformer and U1 a 78(L)12 voltage regulator.

Testing

Connect RIN and LIN to the line out terminals of a CD player, cassette deck or whatever you use as the music source. Connect ROUT and LOUT to the line in terminals of an amplifier. If you have a mono amplifier, just connect either ROUT or LOUT. Note however that the music source *must* be stereo.
If you play a mono CD track or tape, RIN and LIN are the same, so RIN - LIN = 0. You can test this by temporarily removing R12. You should hear no sound. If you disconnect LIN or RIN, you should hear the music.
Having R12 still removed, play a stereo song. You should now hear the music, but no vocals. Otherwise, the vocals are recorded in stereo as well; try another song (preferably from another CD or tape).
If you hear that the vocals are gone, you can put R12 back in place. If you hear the vocals again, the low pass filter may not have been properly dimensioned. Experiment a little with R11 and C1. If you can't get it right, you may need to add a second filter (just between R11/C1 and the + pin of U2.A), making the attenuation 40dB per decade.

Assembly

You can download the PCB (printed circuit board) of the vocal eliminator in several formats here: JPEG, EPS and HPGL. There are many ways to create a PCB from a layout, but that's beyond the scope of this course.
The component layout looks like this:



The power supply has its own PCB.

You can mount both boards in one cabinet, or in separate cabinets. If you give the power supply its own case, you can use it for other projects as well.