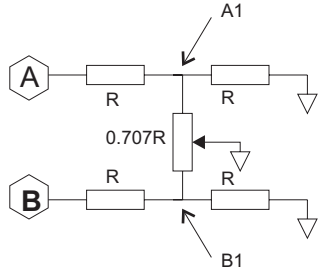


# PANNING FOR FUN



When pot is all the way toward B, then voltage at A1 is

$$A1 = A \times \frac{(0.707R \parallel R)}{R + (0.707R \parallel R)} = A \times \frac{\frac{(0.707R \times R)}{R + (0.707R)}}{R + \frac{(0.707R \times R)}{R + (0.707R)}} = A \times \frac{\frac{(0.707)}{1 + (0.707)}}{1 + \frac{(0.707)}{1 + (0.707)}} = A \times 0.29289$$

B1 is of course zero - it's shorted to ground

When pot is all the way toward A, then voltage at A1 is likewise B x 0.29289

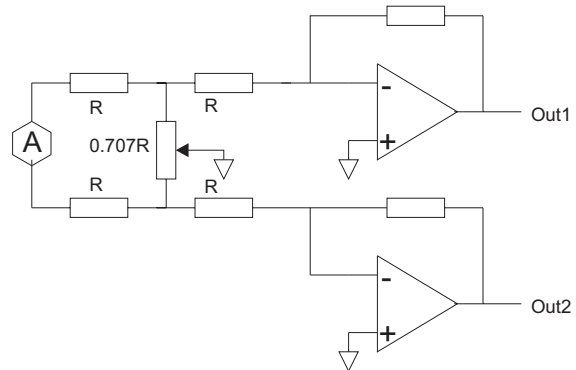
When pot is in the middle, then voltage at A1 is

$$A1 = A \times \frac{(0.35355R \parallel R)}{R + (0.35355R \parallel R)} = A \times \frac{\frac{(0.35355R \times R)}{R + (0.35355R)}}{R + \frac{(0.35355R \times R)}{R + (0.35355R)}} = A \times \frac{\frac{(0.35355)}{1 + (0.35355)}}{1 + \frac{(0.35355)}{1 + (0.35355)}} = A \times 0.2071$$

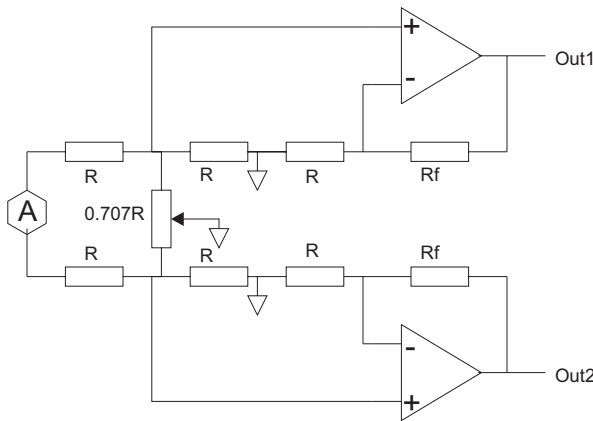
And the voltage at B1 is B x 0.2071 as well.

Since the middle of the pot is grounded, A and A1 do not interact with B and B1.

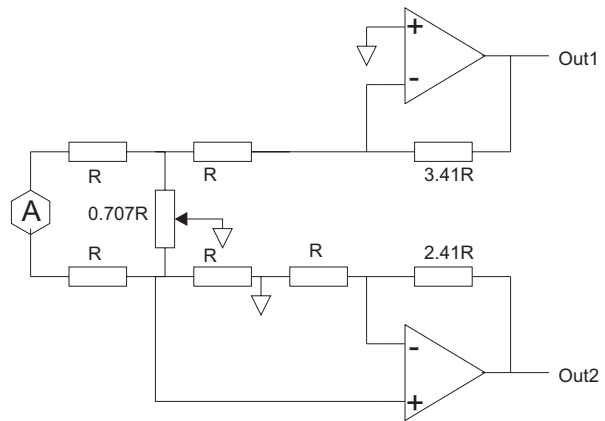
If we take note that the inverting input of an opamp is at a virtual ground, we can connect both of the output R's that were grounded and get the same result, but the opamp mixes the signals, and at the same time, can supply some gain. If we make the gain setting resistor in the feedback loop be just enough to make either A or B have no loss when the pot is turned all the way to one side, then we have a constant power cross fader. The value of resistor to do this is one divided by the loss or 3.41 times R. Convenient values of resistors are R=15K, 0.707R = 10K, and the feedback resistor is 51K.



If we want to pan one signal to two different places, we can do it by using two opamps, each with a gain of 3.41, but connect them to the two different sides. Now A is panned from one output to the other, in a constant power manner.

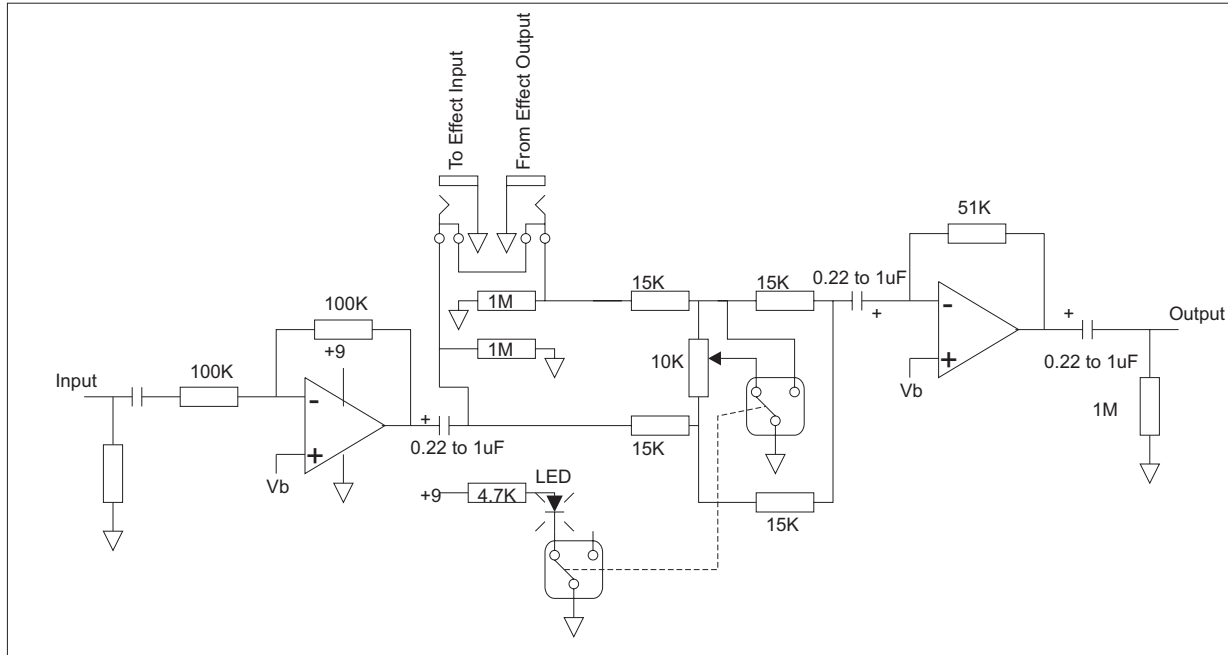


We can do the same thing without inverting the signal if we take the signal at A1 and B1 to two separate opamps, and correct the gain of the opamp. Now we need another resistor from the inverting input to ground, and Rf needs to be 2.41R. If R=15K, 0.707R=10K and 2.41R = 36K.



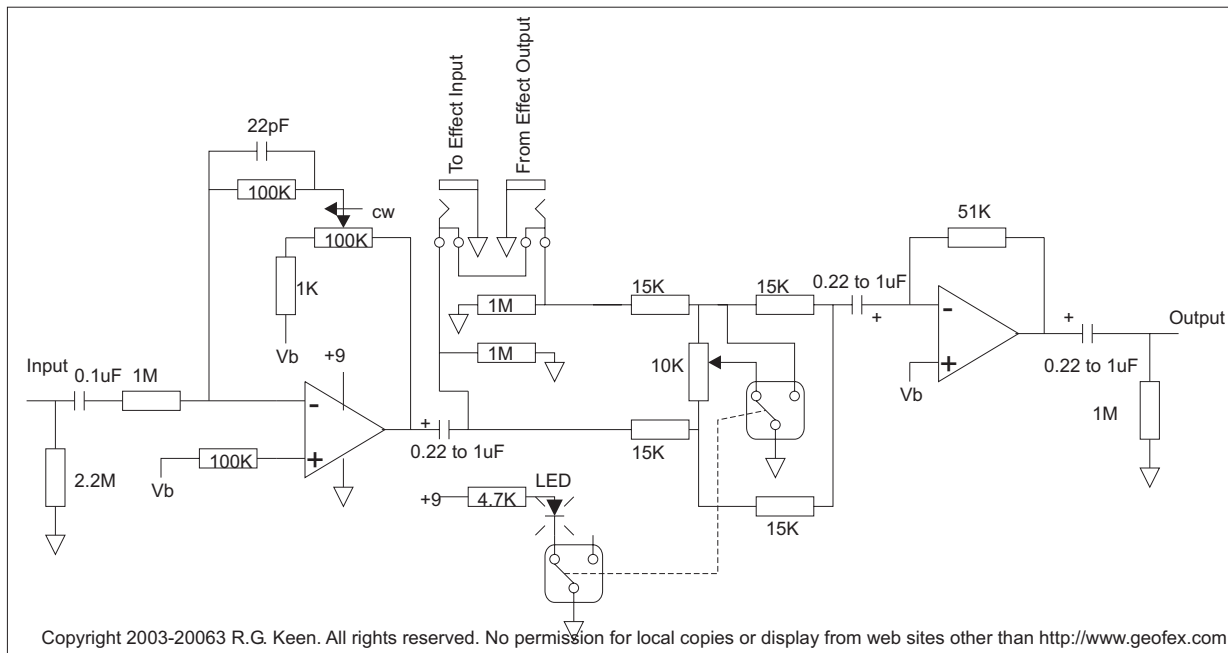
We can even get one output inverted, the other not - just use the right opamp circuit on the side you want true/inverted. Notice that we could use two signal sources, too. It doesn't matter what the signal is. The circuit pans the input(s) with constant power.

# PAN IN AND PAN OUT

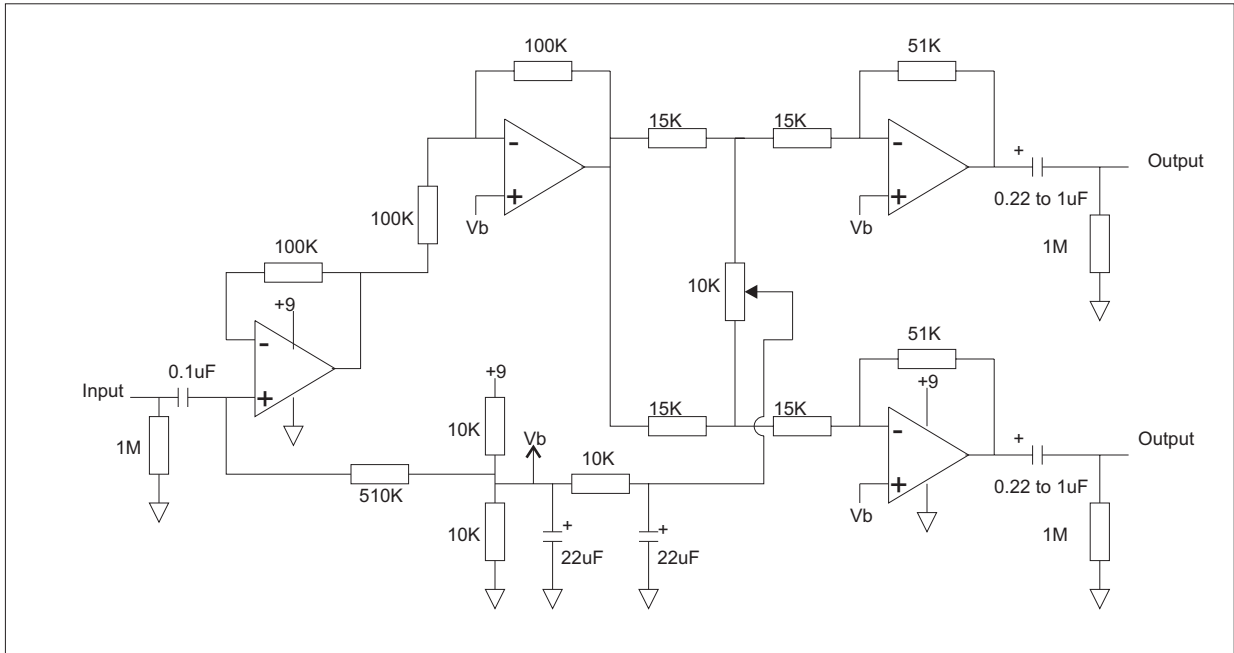


Here's a panning application - an effect blender. The input signal is inverted by the first opamp and drives the panner circuit but also goes out to an effect-loop out jack. The return from the effect loop goes into the other side of the panner circuit. The "bypass" switch does not bypass. What it does is in one position, it grounds the effect side of the panner circuit, and opens the wiper lug to ground. This is the same as forcing the pot to be rotated all that way to the effect return side, so the effect-only side of the panner has signal through it as though the pot were turned to full signal. In the blend position, the switch grounds the lug of the panner pot and the other section of the switch turns on an indicator LED.

The input impedance is not particularly high, only 100K. This is because the input opamp inverts the signal to keep the final output in true phase with the input. If this is not a high enough impedance, an emitter follower input buffer can be added.  
 -- or you could use the high impedance version shown below. The input stage has been reworked to have an input impedance of about 1M, ignoring the 2.2M at the input cap. This version will give no treble loss with a raw guitar input.



# PAN BETWEEN OUTPUTS



Another panning application - panning one source to two outputs. You might use this to pan one guitar between two effects chains. You may be able to pan between two amps; but remember, that application is fraught with hum problems, and this circuit will not make the hum issues better or worse.

I have only shown generic opamp pinouts. You will have to match the pins on your actual opamps with the functions shown, like the non-inverting input (+), the inverting input (-) and outputs. You will also have to select opamps. I would use two dual opamps like the TL072 or LM833. But a single quad opamp like the TL074 will work too.

See the trick with the bias voltage? I did a normal bias voltage for the opamp inputs, but separated the "ground" connection of the panning pot. This ensures that the signal from the panning pot does not pollute the bias voltage and cause oscillation problems.