EE320 - project 1 - op-amps

Objective

To design a system using op-amps.

You are working for the Big Sound Company, on a new line of mixer products. These will be marketed toward bands, DJ's, and radio stations.

Requirements

You need to design the mixer system.It is really a 4 channel board, but for now you can design one channel. They are all the same.

There may be as many as 16 inputs, which may be any combination of these types:

1. Microphone, -40 dBV nominal level, balanced,
   2k input impedance, low noise.
2. Balanced Line, -10 dBV nominal level, balanced,
   10k input impedance.
3. Unbalanced Line, -10 dBV nominal level, unbalanced,
   10k input impedance.

Each of these will have a "preamp" with a nominal output level of 0 dBV.

This feeds a "fader", which is a 10k slide potentiometer, with audio taper. The gain is specified for a 12 dB "setting loss" in the fader. They are calibrated for a 22k load.

Each feeds one input of the summing amplifier. The input impedance is 22k on each input. The summing amplifier should have unity gain.

This feeds a "master gain" fader, another 10k slide potentiometer with audio taper, like the other faders. Again, figure a 12 dB setting loss and a 22k load.

This feeds a "line amplifier", which drives a line. The nominal level is 0 dBV, into a 600 ohm load. It should have a nominal output impedance of 50 ohms. Use a series resistor to accomplish this. 47 ohms is close enough.

We will use type 5532 and 5534 op-amps, with a power supply of +/- 18 volts. You need to figure out how much current is needed. In project 2, you will design the power supply for it.

You must use capacitors to block any DC from the potentiometers. Figure the value of the capacitor to give you a .1 second time constant. You must also use capacitors to make the DC gain of each amplifier as low as possible, yet still meet the AC gain requirement. Again, choose the capacitors for a .1 second time constant. It is permissible for the time constants to be longer than .1 second to allow the use of standard component values.

The Report.

1. The cover:

On the cover, show a complete schematic of a 3 input mixer, with one input of each type. Also, give the power requirement, assuming 16 inputs of the kind resulting in the highest power consumption.

2. Calculations:

Provide a complete design for the system, one stage at a time, and show how they connect together. You also need to calculate power requirements.

3. Simulation:

Use simulation to verify that it works as expected, using 1 kHz as the reference frequency. Also, sweep the frequency to find the low frequency at which the overall gain is 3 dB below the gain at 1 kHz.

Extra Credit:

There are two opportunities for extra credit.

1. Provide additional analysis as follows ..
   a. Determine the error in gain that results from 5% tolerance resistors.
   b. Determine how many inputs can be summed by the summing amplifier, and still have a response within 1 dB at 20 kHz.
   c. Determine the common mode rejection for the balanced inputs, assuming 1% resistors where it matters.

2. Build the circuit, and verify that it works as expected. Supply a list of measured results.

Grade:

Your grade is based on a 5 point scale, with one point each for presentation, functionality, design basics, design completeness, and verification. You get the point if the part is there and of expected quality. You might get a half point if it is incomplete.

If you do extra credit, you get one extra point for the analysis, one point for actually building it, and one more for doing both, for a possible 3 extra points. The extra credit only applies if the basic requirements are met.

Due date:

It is due Monday of 4th week.

If it is late, extra credit does not apply and there will be a penalty as follows: 1 point if I get it before I hand them back, 2 points later. Late reports will be graded to the higher standards that are applied later in the course when I actually receive it.