In this lab you will finalize the design of your operational amplifier and explore the stability of the amplifier.

The learning goals are listed below:

- See how many analog subcircuits can come together into a more complex analog system.
- Appreciate the power of op-amp compensation.

1 Build Your Op-Amp

1. Design a common emitter gain stage for your operational amplifier. It must operate on the same 12V voltage rail as your differential amplifier and it must operate when DC coupled to the output of the differential stage. A PNP device may be easier to DC couple to your NPN differential stage. Bias the amplifier output so that it can be DC coupled to the class AB output stage on your board. The amplifier should have a gain of at least 80, higher is fine.
2. Test your gain stage on its own, be sure it is working with a DC coupled input voltage.
3. Connect a single-ended output from your differential amplifier to the input of your gain stage, and connect the output to the class AB output stage. Add a 10nF compensation capacitor to the gain stage.

2 Assess Your Stability

1. Is the amplifier open-loop stable? If not, improve your bypassing, biasing and compensation. Is it stable without the compensation capacitor?
2. Measure a Bode plot of your open loop gain. You may need to attenuate (and/or capacitively couple) your test input to do so.
3. Configure your op-amp for unity gain feedback. Is it stable? Does this match your Bode plot. If it is not unity gain stable, then configure it for non-inverting gain and increase the attenuation of the feedback factor until it become stable.
4. Find the maximum capacitive load of your op-amp. Does your maximum capacitive load make sense when you compare it to your Bode plot and to the design of your output stage?