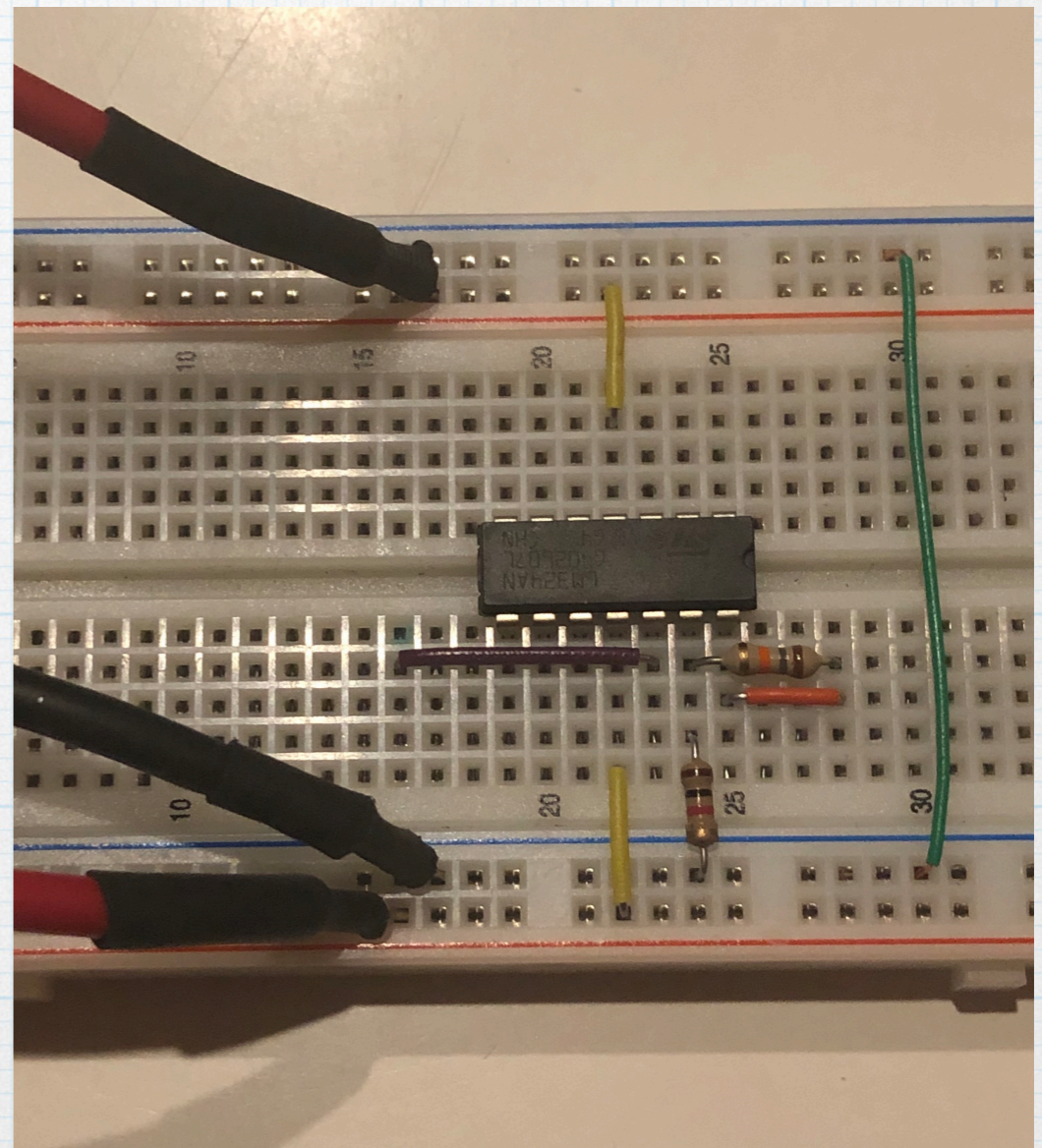


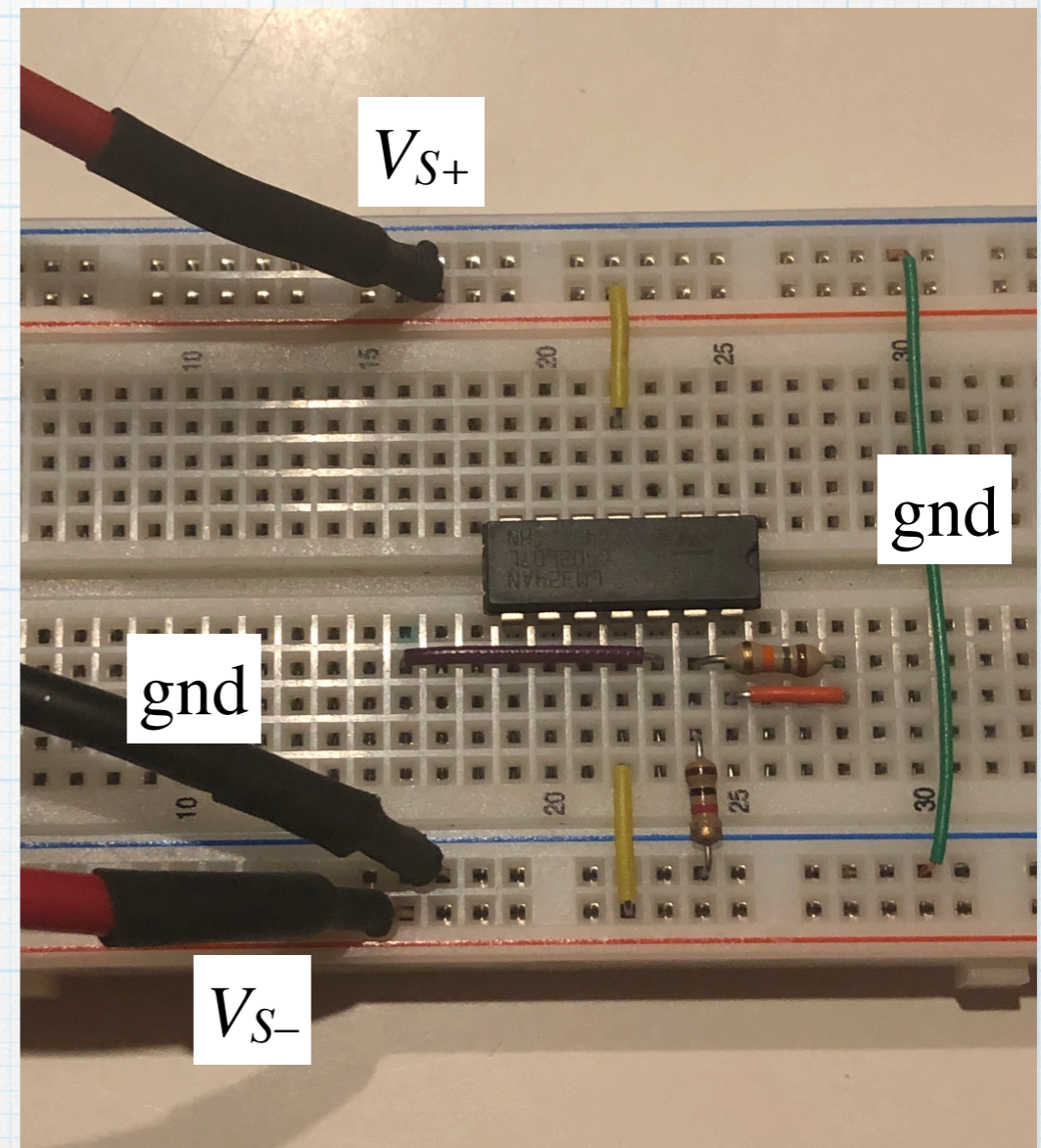
Power supplies

Op amps always need power supplies, at least one and sometimes two. In lab 4, we use two supplies for each circuit — one at $V_{S+} = +10\text{ V}$ and the other at $V_{S-} = -10\text{ V}$. The $+/-$ pair of supplies are on the triple output supply are ideally suited for powering op amps.

The breadboard is well-suited for using DIP (dual in-line) chip packages. Insert the op amp chip so that it straddles the “trench”. I like to have the positive supply pin (4) “up” and the negative supply pin (11) “down”, so I’ve located the notch to the right. Pins 1-7 are on top, with pin 1 in the upper right and pins 8-14 on the bottom. But the orientation of the chip is a matter of choice.



Use the upper long rail that is marked + for the positive supply. Use a jumper between pin 4 and the positive rail. Use the lower long rail that is marked + for the negative supply. (OK, that is a little confusing, but there are only two symbols for three supply leads. You can use a sharpie to change the name of the negative supply rail if you want.) Use a jumper between pin 11 and the negative supply rail.

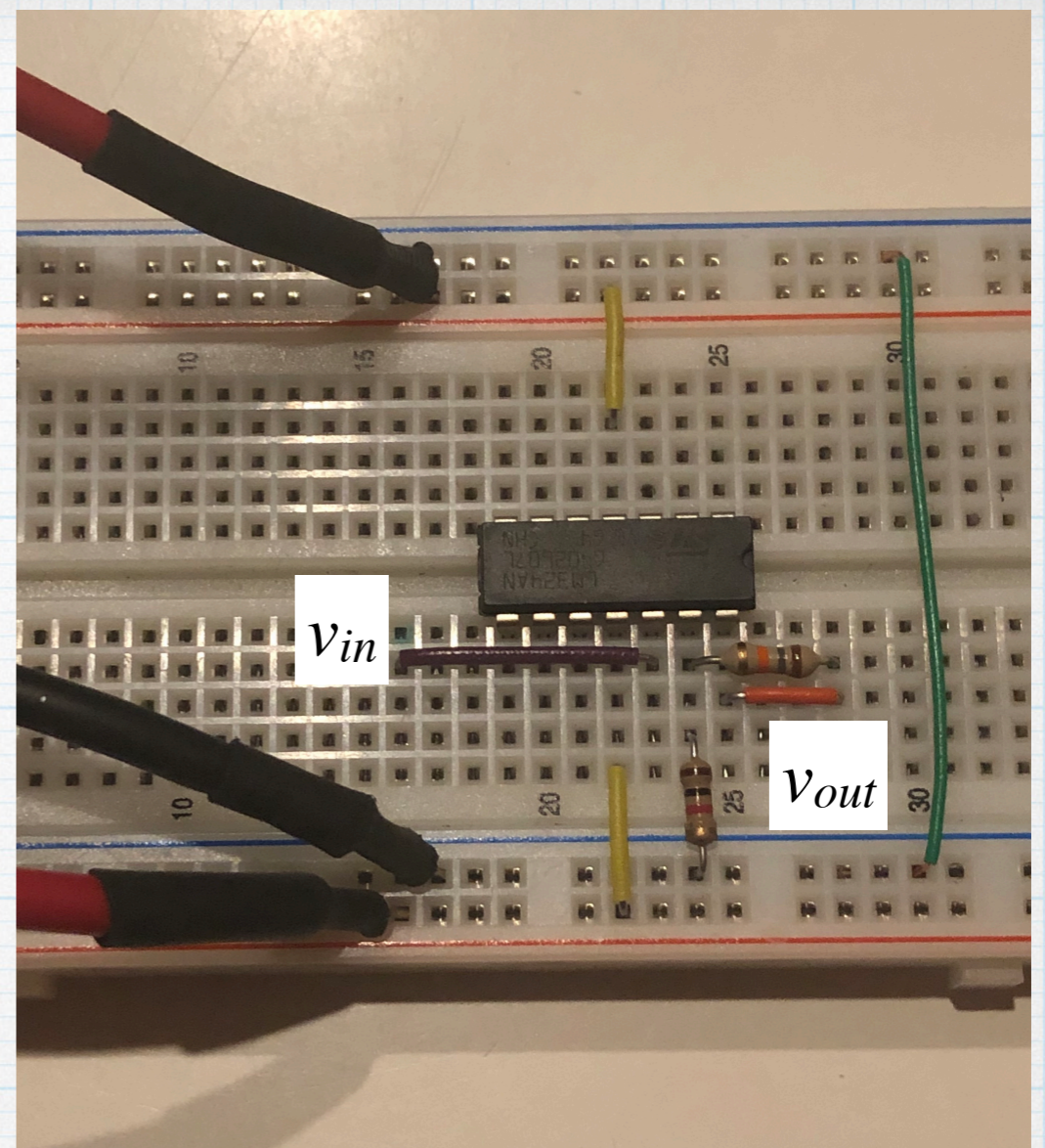


Use a jumper to connect the upper and lower long rails marked -. These two rails will be ground connections. Sometimes with electronics, you need lots of ground connections. (We won't need so many for this lab, but we might as well start developing good habits.)

Connect the leads from the power supplies to the rails, and power up.

The LM324 has 4 op amps in the package. They are all the same — you can use any of them. Here we are using the amp connected to pins 12, 13, and 14 (v_+ , v_- , and v_o respectively) to make a simple non-inverting amp. To keep it clean we use short resistors and jumpers.

For the other circuits in the Lab 4, reconfigure as needed.



EE 201 students seem to have a lot of trouble getting op-amp circuits to work initially. Often blame is placed on “a bad op amp”. More likely, the cause is user error.

Op amps can be killed, but the death is never by suicide. (Chipicide?) The most common cause of op-amp mortality is when a n00b connects the power supplies backwards. (N00bicide.) So one of the best ways to achieve happiness in an op-amp lab is to *check the power supply connections before turning on the power.*

Trouble-shooting

One of the most common problems encountered with op-amp circuits is when the output seems to be “stuck” at a large-ish DC voltage — slightly less than V_{S+} or slightly higher than V_{S-} . In that case, the output is said to be saturated. There are a number of things to check.

1. First, check the connections — make sure the circuit is wired correctly. In particular, the output will saturate if there is not a proper feedback loop.
2. Use the voltmeter to check the power supply voltages right at the pins. Are they on? (You would be surprised how often this is the problem.) Are they backwards? (If so, your amp might be dead.)
3. Check the output current readings on the power supply. They should be only a few milliamps for most simple op amp circuits. If there is a large current — upwards of an amp — then probably something is shorted to ground. Check the wiring again.
4. An amp circuit with a properly functioning feedback network should force the inputs to have the same voltage. Use the voltmeter to measure v_- and v_+ . They should be the same. (In the inverting configuration, you can check to see if v_- is at virtual ground.) If everything is powered and connected correctly and the inputs do not have the same voltage, then you may have a dead op amp. You should probably go to ETG and get a new one.