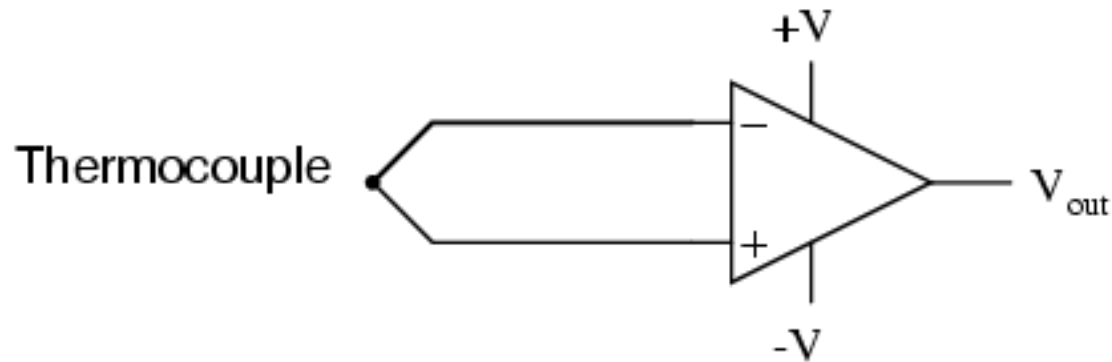


Examples Lecture 5

Example 1

- This example is related to Bias Current
- Op-amps, especially those op-amps with bipolar transistor inputs, must have some amount of current through their input connections for their internal circuits to be properly biased.
- Under certain conditions, op-amp bias currents may be problematic.

Problem with Thermocouple

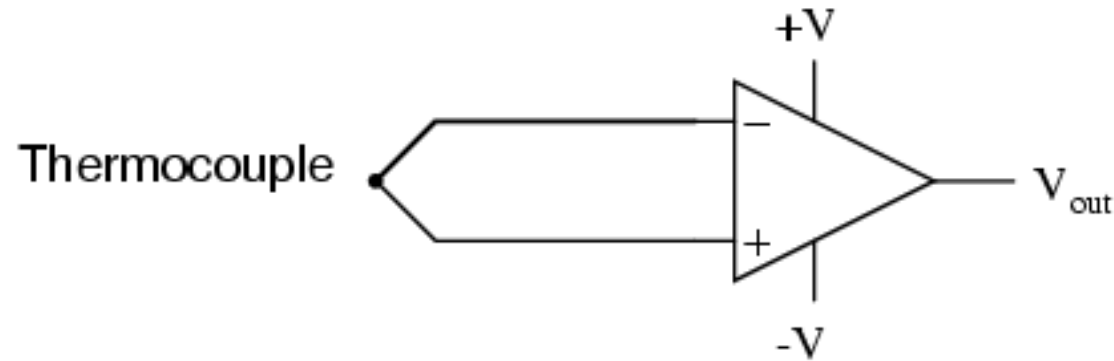


- A thermocouple generates a small voltage proportional to temperature.
- More accurately a voltage proportional to the *difference* in temperature between the measurement junction and the "reference" junction formed when the alloy thermocouple wires connect with the copper wires leading to the op-amp
- This drives the op-amp either positive or negative.
- This is a kind of comparator circuit, comparing the temperature between the end thermocouple junction and the reference junction which is near the op-amp.

Problem with Thermocouple

The problem is this:

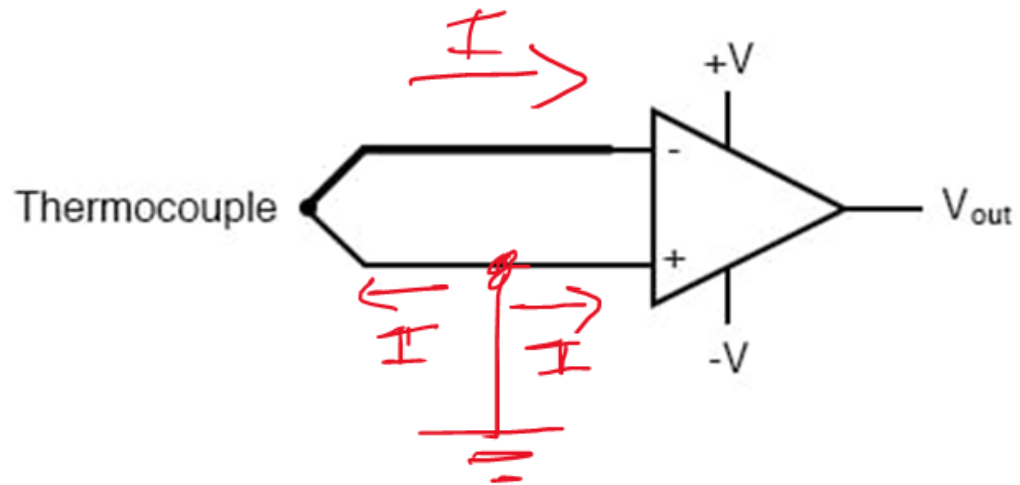
- the wire loop formed by the thermocouple does not provide a path for both input bias currents as both bias currents are trying to go the same way (either into the op-amp or out of it).



How would you solve this?

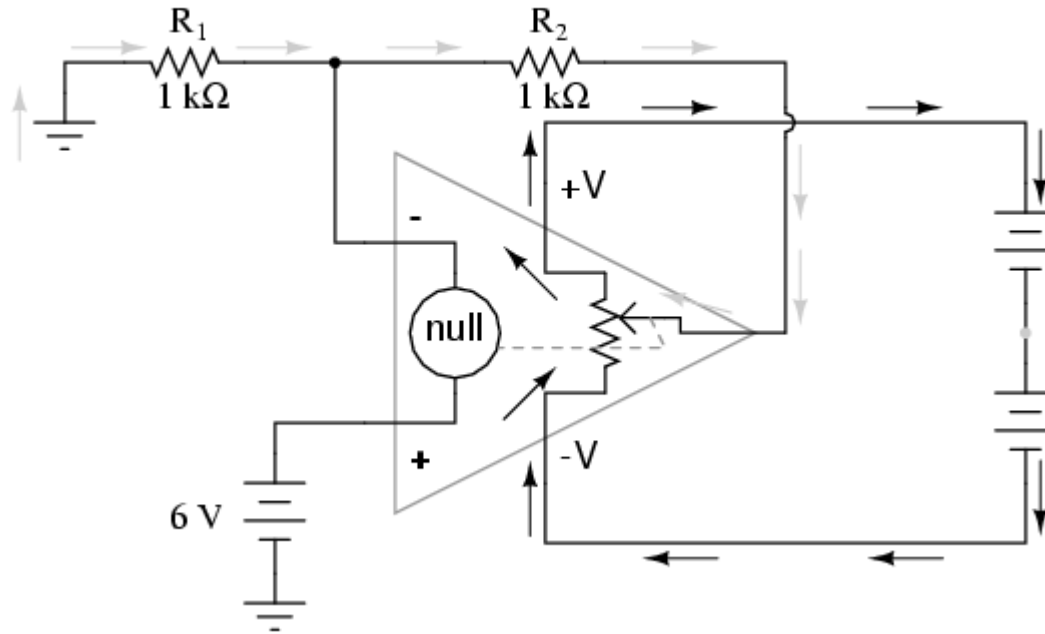
- Work in pairs for 5 minutes and discuss the problem.
- Draw a diagram of the solution.

Solution



You need to add a ground to provide a path for both bias currents.

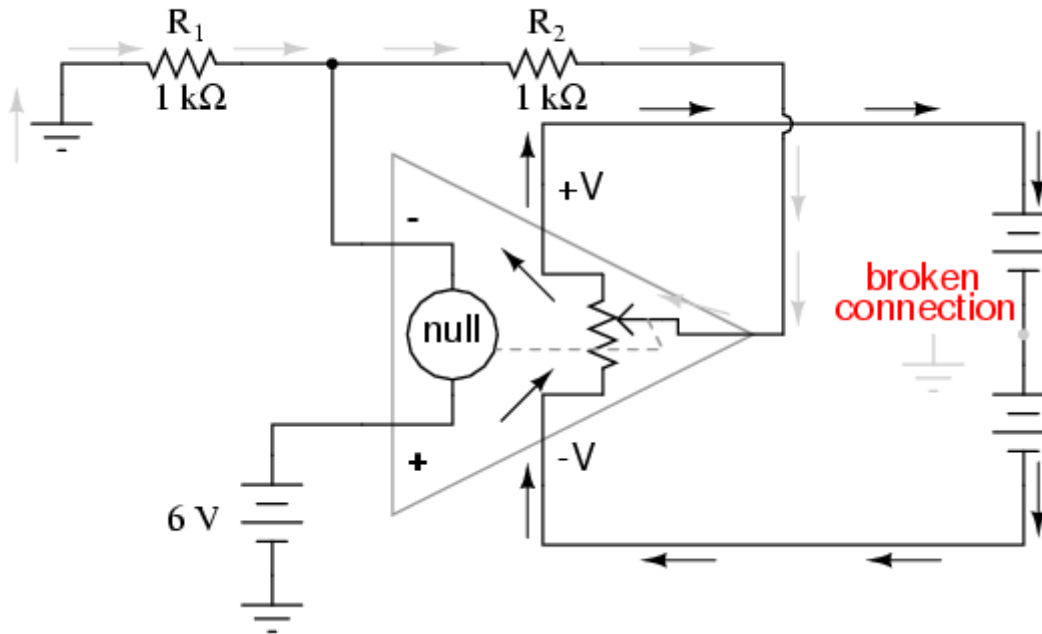
Problem 2. More Bias Current Blues



What is wrong here?

Current paths !

A power supply ground is essential to circuit operation!



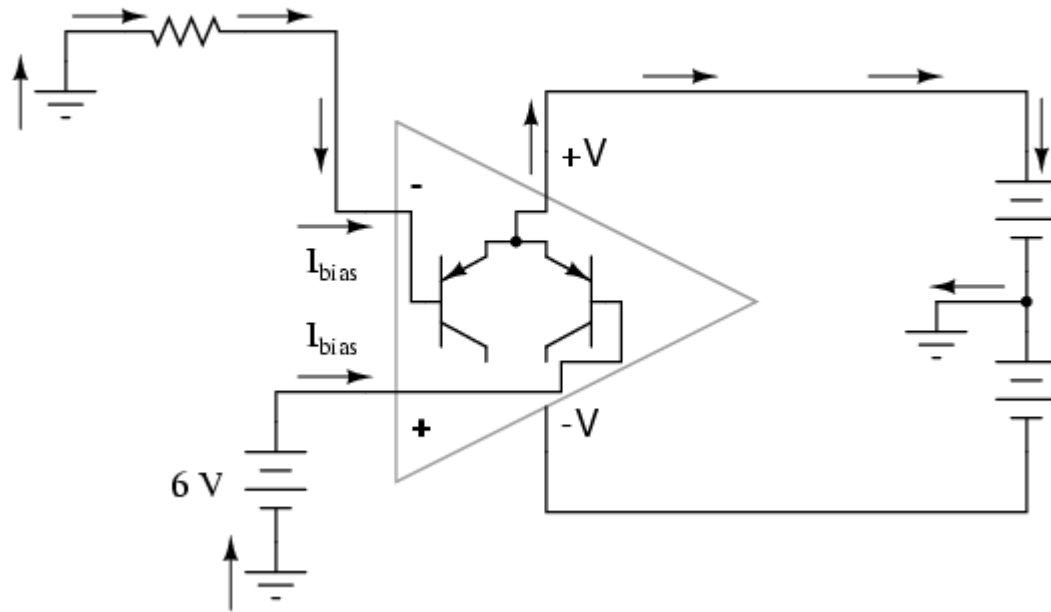
No electrons may flow in or out of the op-amp's output terminal, because the pathway to the power supply is a "dead end."

Thus, no electrons flow through the ground connection to the left of R₁ or through the feedback loop.

The can neither sustain current through the feedback loop, nor through a grounded load, since there is no connection from any point of the power supply to ground.

Bias Currents

Bias current paths shown, through power supply



The bias currents rely on a path to the power supply and back to the input source through ground.

Review

- Op-amp inputs usually conduct very small currents, called bias currents, needed to properly bias the first transistor amplifier stage internal to the op-amps' circuitry.
 - Remember bias currents are small (in the microamp range or less), but large enough to cause problems in some applications.
- Bias currents in both inputs must have paths to flow to either one of the power supply "rails" or to ground. It is not enough to just have a conductive path from one input to the other.
- To cancel any offset voltages caused by bias current flowing through resistances, just add an equivalent resistance in series with the other op-amp input (called a compensating resistor). This corrective measure is **based on the assumption** that the two input bias currents will be equal.
- Any inequality between bias currents in an op-amp constitutes what is called an input offset current.
- It is essential for proper op-amp operation that there be a ground reference on some terminal of the power supply, to form complete paths for bias currents, feedback current(s), and load current.