Bruce Trump *Jul 17, 2012*

Other Parts Discussed in Post: OPA211, OPA320

In helping to select op amps and instrumentation amps I frequently hear the comment, "I need really high input impedance." Oh really?… are you sure?

It's rare that input impedance, or more specifically, ***input resistance*** is an important issue. (Input capacitance, the reactive part of input impedance, is another matter so save that one for another day.) What's most often needed is ***low input bias current, I_B***. Yes, they're related but different. Let's sort it out:

A simple model of a single input is a parallel combination of a current source (the input bias current) and an input resistor, figure 1. The resistor causes the input current to vary with input voltage. The input bias current is the input current at a specific input voltage, usually at mid-supply.

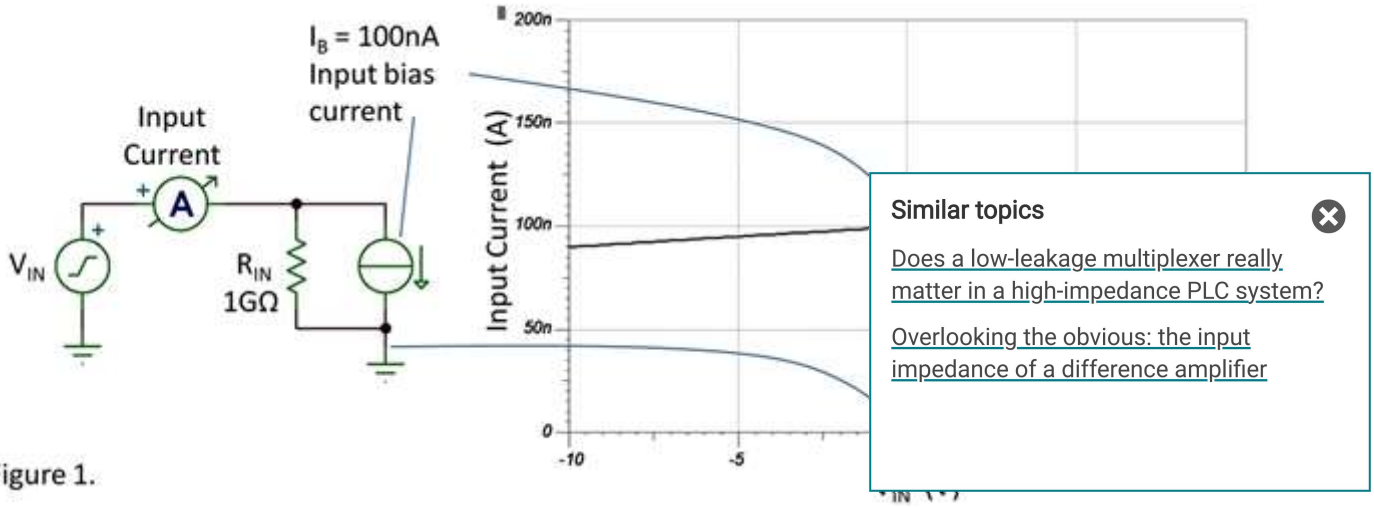

Figure 1.

- The input resistance is a measure of the *change input current with a change in input voltage*. It's possible to have an ampere of input bias current and still have an extremely high input resistance.

We often provide a typical graph showing input bias current vs. common-mode voltage. A couple of examples are shown below and you can see that it's not a perfectly straight line. Note that the OPA211 is a BJT-input op amp with input bias current cancellation that greatly reduces input bias current but it's still pretty high. The OPA211's input bias current and high noise current (yet another topic for later) make it an unlikely choice with a source resistance greater than 10kΩ, so its input resistance of 1.3GΩ is seldom an issue.

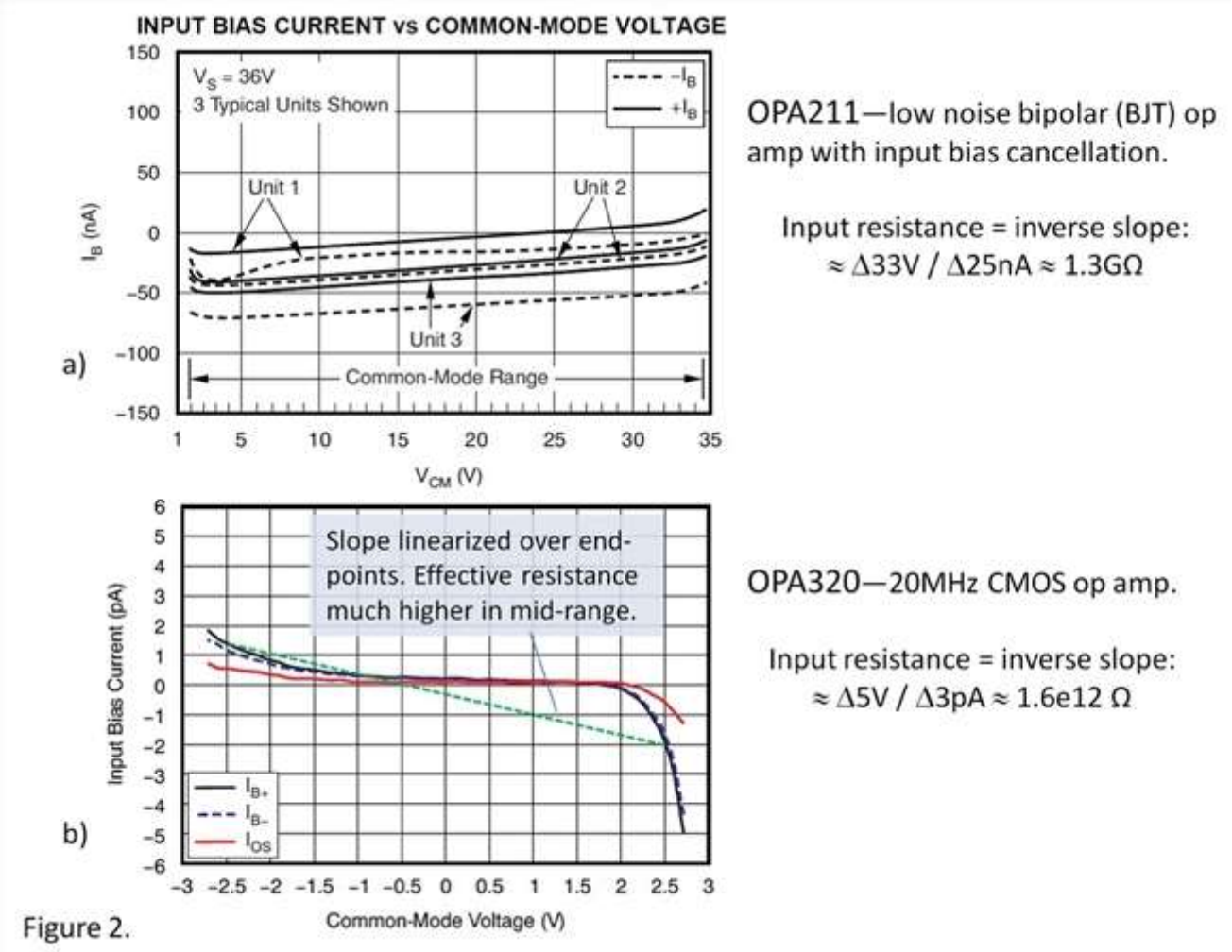

Figure 2.

The OPA320 CMOS op amp has a tiny input bias current, primarily coming from leakage of its input ESD protection circuitry. These leakage currents reach a maximum near input amplifiers are generally the best choice when very low input b resistance is high, too, but not generally the important factor in amp

There are several ways that input bias current can be detrimental in through a source resistance or feedback network resistance, it can Flowing in certain sensors and chemical cells such as pH probes, it can polarize the electrodes, creating

- error and even causing permanent damage. Input bias current will charge the capacitor of an integrator circuit, creating a ramping output with zero input.

Depending on the sensitivity of your circuit to input bias current, it can be the deciding factor in amplifier selection. Check out typical performance graphs showing variation of I_B with input voltage with an eye to the particular voltage range of interest. Over- temperature behavior may be particularly important with CMOS and JFET amplifiers as their I_B generally rises dramatically with increasing temperature.

Thanks for reading. Comments seen by all are welcome below. Other thoughts, suggestions and crabbing can be e-mailed to thesignal@list.ti.com.

Bruce

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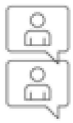

Alex Scott *over 3 years ago*

I agree that flowing in certain sensors and chemical cells such as pH probes, it can polarize the electrodes, creating drywall repair error and even causing permanent damage. Input bias current will charge the capacitor of an integrator circuit, creating a ramping output with zero input.