

R A Q ' s

Rarely Asked Questions

Strange but true stories from the call logs of Analog Devices

Check the Bias Current (Or How to Ensure that a Blessing is Heard)

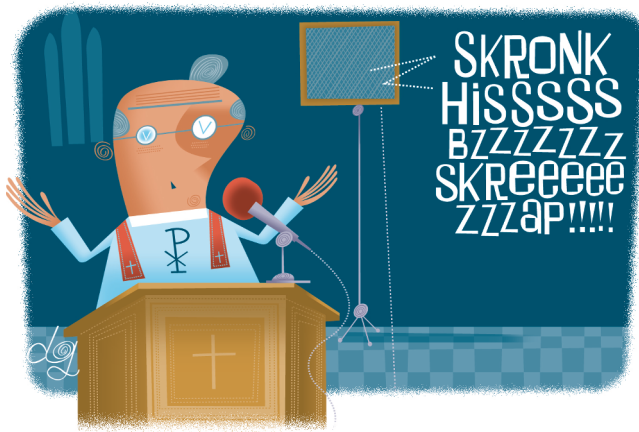
Q. *The bias current in modern amplifiers is very small. Do I need to bother about it?*

A. At Mass in Limerick, Ireland (the location of one of Analog Devices' manufacturing facilities) one Sunday, the priest was rather softly spoken. Almost whispering into the microphone he said, "The Lord be with you."

Nothing at all came out of the PA system and only the front row could possibly have heard him. Picking up the microphone he murmured to himself, "There's something wrong with the microphone." This was amplified to fill the church and the congregation responded to a man, "And also with you!" I restrained my mirth with difficulty and afterwards offered to fix the problem.

It was a moving coil microphone with a differential output to an SSM2019 preamplifier. The microphone was in perfect condition and delivering a signal to the amplifier inputs, but the connection from the cable screen to the metal microphone body was broken. A broken ground might cause hum (this barely happened), but why should it disable the amplifier?

When I examined the preamplifier circuit it became clear—the microphone's center-tap, which was grounded to the case of the microphone, carried the bias currents of the two SSM2019 inputs. With the ground open-circuited, there was nowhere for bias currents to flow and the amplifier stopped working. When Father Aidan touched the microphone, his body provided a current path to ground and everything worked again, albeit with a little hum.



All amplifying devices—bipolar transistors, JFETs, MOSFETs, and even tubes—have dc currents, known as bias currents, in their inputs. For some JFETs and MOSFETs these are as small as 20 fA (2E-14 amps)—

about one electron every eight microseconds—but the inputs of op-amps and in-amps typically have bias currents in the range of pA to μ A. A circuit design that does not accommodate these bias currents will not work properly, and may not work at all. But because they are so small, unintended leakage paths (the one through Father Aidan's body is an example) may often allow a badly designed circuit to work despite itself—but it probably won't work well. Good analog designs do not leave bias current effects to chance and good luck, but allow for them and ensure that they affect neither performance nor functionality.

Not only did I repair the broken connection, I also added two equal grounded resistors to the amplifier inputs ensuring that future microphone ground faults might cause hum but would not silence Father Aidan.

To learn more about how bias current affects op amps,

Go to:

<http://rbi.ims.ca/5696-104>



Contributing Writer
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Have a question involving a perplexing or unusual analog problem? Submit your question to:

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