

R A Q ' s

Rarely Asked Questions

Strange but true stories from the call logs of Analog Devices

Amplifier plumbing 101: Are leaky amps sinking your design?

Q. My amplifier "leaks" a low level signal at the output with the power supplies off. What gives...is my circuit sunk?

A. Ah yes, I've come across this "plumbing" problem once or twice before, it truly is one of those "rarely asked questions." Upon further discussion with the customer, I found out the amplifier is connected as a voltage follower, the power supplies are off and there is a 2-V p-p signal at the amplifier input... a key piece to the puzzle. The problem appears to be output related, but the source of the leak can be traced back to the input. More specifically, the input protection circuitry for the differential input stage.

Processes used to fabricate high-speed (>50 MHz) amplifiers utilize transistors with very high f_t . While these devices operate at very high frequencies, their breakdown voltages can be quite low, hence the need for protection. Input protection can be as simple as a few series diodes connected in anti-parallel between the non-inverting and inverting input of an amplifier. The diodes limit the amount of voltage applied across the base-emitter junctions of the input differential pair and prevent reverse breakdown. The number of series diodes determines the differential input voltage rating. Voltage ratings can range anywhere from ± 0.8 V to $\pm V_s$. The value is easily determined by checking the Max Ratings Table in the data-sheet, under Differential Input Voltage.

This particular customer was using an amplifier with a ± 0.8 -V differential input



rating. What happened was the protection diodes became forward biased when the 2-V p-p signal was applied to the input. The input signal then "leaked" through the protection diodes to the output via the feedback resistor. Fortunately, you don't need to call a plumber to fix this type of leak. Instead, reduce the input signal level to below ± 0.8 V p-p, or simply use an amplifier with a higher max differential input voltage rating.

So, next time you come across a "leaky" amplifier, check your differential input voltage rating. And, remember, if you can't lower the input voltage to solve the problem, then, just like a plumber who needs to replace a washer to stop a leak you might have to replace the amplifier.

**To learn more about
high-speed amplifiers,
Go to: <http://rbi.ims.ca/5696-123>**



Contributing Writer
John Ardizzoni is an Application Engineer at Analog Devices in the High Speed Amplifier Group. John has been with Analog Devices for 4 years, he received his BSEE from Merrimack College in 1988 and has over 27 years experience in the electronics industry.

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