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StudentZone—Activity: Zero-Gain Amplifier (MOS)

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Objective

As a continuation of the November StudentZone, this activity introduces a current mirror, which has an output that has been desensitized to variations in input current. Therefore, it is helpful to examine the behavior of a zero-gain amplifier from another perspective, using MOS transistors.

Materials

- ADALM2000 Active Learning Module
- Solderless breadboard
- One 2.2 kΩ resistor (or any similar value)
- One 168 Ω resistor (use a 100 Ω in series with a 68 Ω)
- One small signal NMOS transistor (enhancement mode CD4007 or ZVN2110A)

Directions

The schematic of an NMOS zero-gain amplifier is presented in Figure 1.

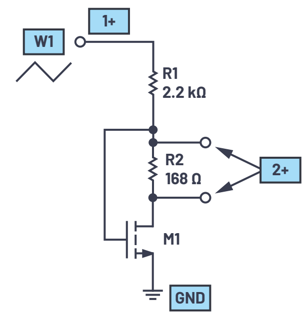


Figure 1. NMOS zero-gain amplifier.

Hardware Setup

The breadboard connections are as shown in Figure 2. The arbitrary waveform generator 1 output drives one end of resistor R1. Resistor R2 is connected between the gate and drain of transistor M1 with the other end of resistor R1 connected to the gate as well. The source of M1 is grounded; thus, M1 is in a common source configuration.

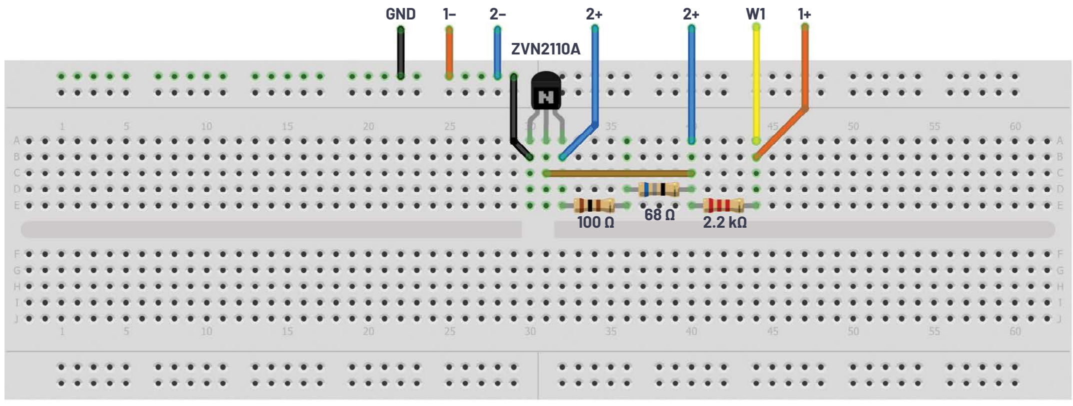


Figure 2. NMOS zero-gain amplifier breadboard circuit.

Procedure

The waveform generator 1 should be configured for a 1 kHz triangle wave with 4 V amplitude peak-to-peak and 2 V offset. Connect Scope Channel 1 to display output W1 of the AWG. The single-ended input of Scope Channel 2 (2+) is used to measure alternately the gate and drain voltage of M1.

Configure the oscilloscope instrument to capture several periods of the two signals measured. Make sure to enable the XY feature.

Plot examples using the oscilloscope are provided in Figure 3 through Figure 5.

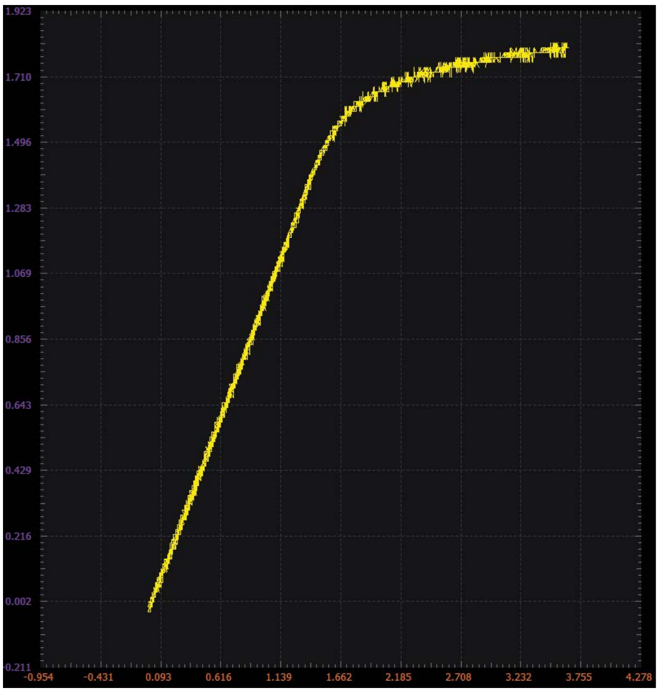


Figure 3. Scopy V_{GATE} plot.

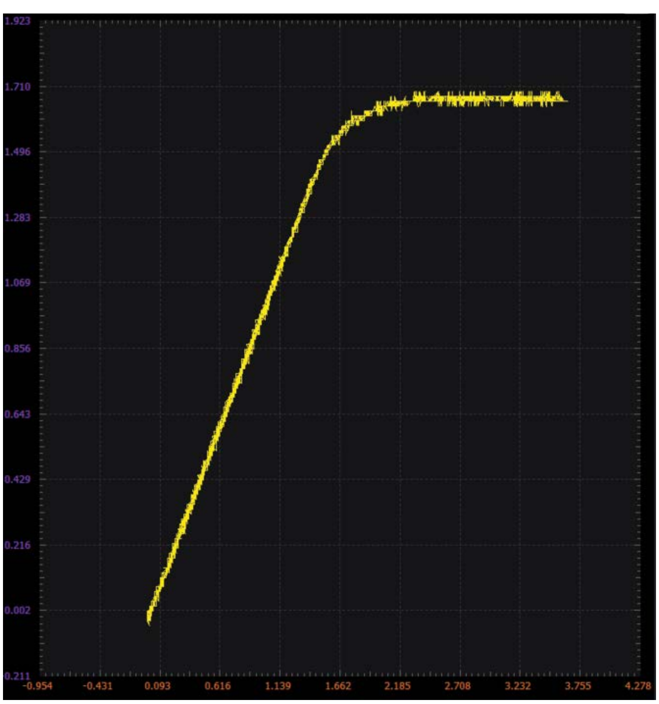


Figure 4. Scopy V_{DRAIN} plot.

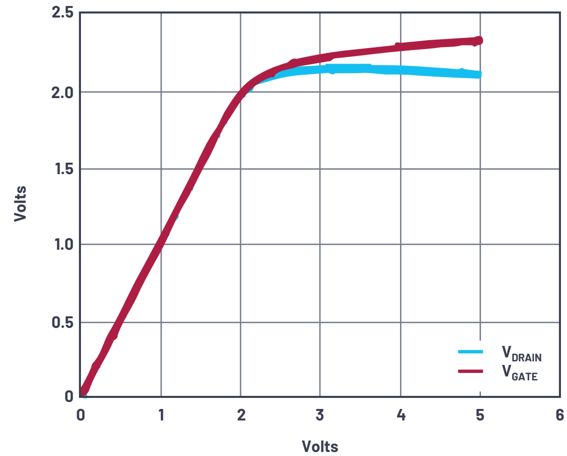
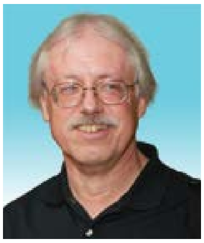


Figure 5. An example comparing V_{GATE} and V_{DRAIN}.

Question:

- What would be the main purpose of introducing a zero-gain amplifier in your circuit designs?

You can find the answer at the StudentZone blog.



About the Author

Doug Mercer received his B.S.E.E. degree from Rensselaer Polytechnic Institute (RPI) in 1977. Since joining Analog Devices in 1977, he has contributed directly or indirectly to more than 30 data converter products and he holds 13 patents. He was appointed to the position of ADI Fellow in 1995. In 2009, he transitioned from full-time work and has continued consulting at ADI as a Fellow Emeritus contributing to the Active Learning Program. In 2016 he was named Engineer in Residence within the ECSE department at RPI. He can be reached at doug.mercer@analog.com.

About the Author

Antoniu Miclaus is a system applications engineer at Analog Devices, where he works on ADI academic programs, as well as embedded software for Circuits from the Lab®, QA automation, and process management. He started working at Analog Devices in February 2017 in Cluj-Napoca, Romania. He is currently an M.Sc. student in the software engineering master's program at Babes-Bolyai University and he has a B.Eng. in electronics and telecommunications from Technical University of Cluj-Napoca. He can be reached at antoniu.miclaus@analog.com.