EE3C11 Exercises Electronics Part 3 (V1)

March 4, 2020

You can work on these exercises during the entire teaching period. Please take sufficient time to work on an exercise and completely understand the way to come to a solution[1].

Exercise 1

1. Motivate the use of feedback in amplifier design.
2. What is the function of the nullor in a feedback amplifier?
3. Which of the following statements is correct?
   (a) The input impedance of a nullor is infinite
   (b) The noise of a nullor must be modeled with two noise sources
   (c) A nullor and an 'ideal' operational amplifier are actually the same
   (d) Swapping the input terminals OR the output terminals of the controller in a feedback amplifier changes the sign of the transfer of this amplifier
   (e) In single-loop passive negative feedback amplifiers in which the source and the load share one terminal ('common-ground') the sign of the transfer cannot be designed independently from the type of transfer
   (f) In single-loop negative feedback amplifiers, output voltage sensing ideally results in zero output impedance
   (g) Fixing the transmission-1 matrix parameter C requires input voltage comparison
   (h) Fixing the transmission-1 matrix parameter C requires output voltage sensing
   (i) In single-loop negative feedback amplifiers, input current comparison ideally results in zero input impedance
   (j) Negative feedback can be used to reduce (cancel) noise in an amplifier

[1] You can always contact one the teaching staff for assistance if you need help solving the exercises during or outside lecturing hours or the lecturing period.

Exercise 2:
Figure 1 shows an active-feedback inverting voltage amplifier.

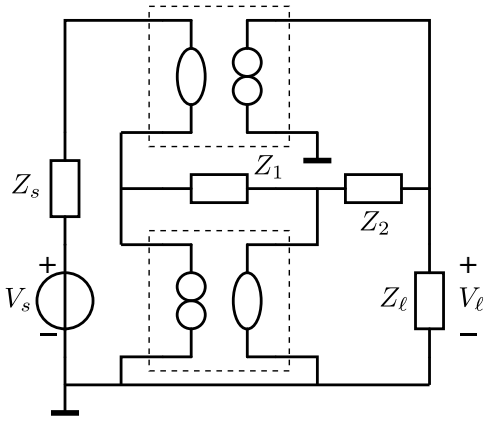

Figure 1: Active-feedback inverting voltage amplifier.

1. Why is this amplifier called an 'active feedback' amplifier?
2. Evaluate the ideal gain of the circuit[2] from figure 1.

Theoretically, there exists no transfer from a nullator to a norator: a nullator sets a network condition by adding an equation and a norator adds the required extra dependent variable such that the condition can be satisfied. After different pairings of the nullators and norators, a new circuit is found as the cascade connection of two single loop feedback amplifiers. This configuration is shown in figure 2.

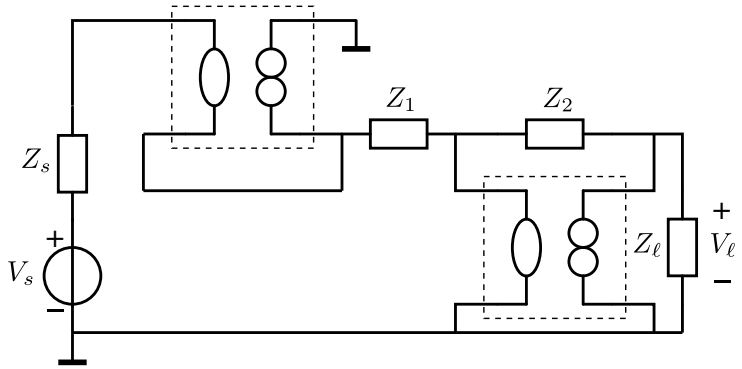

Figure 2: Alternative solution for the active-feedback inverting voltage amplifier from figure 1

3. Evaluate the ideal gain of the circuit[3] from figure 2.
4. Is there a difference in noise performance between the two amplifiers in figure 1 and figure 2?

[2]This is also in figure 7.35 in the book (book edition 1.1: page 257, edition 1.2: page 259)
[3]This is also in figure 7.36 in the book (book edition 1.1: page 257, edition 1.2: page 259)

Exercise 3:
Figure 3 shows a negative feedback current amplifier.

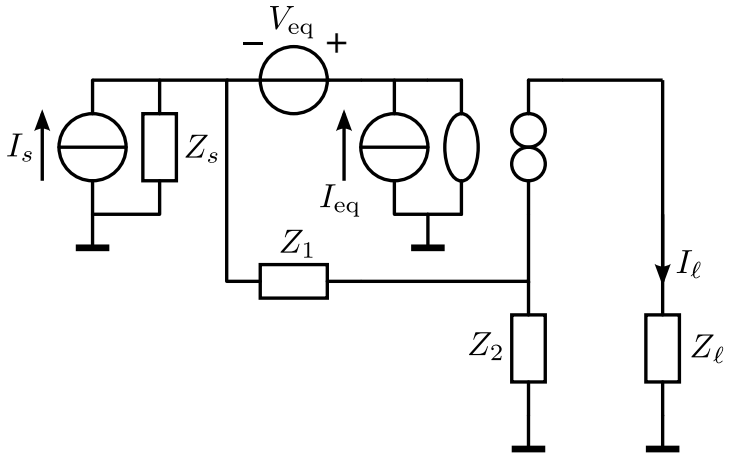

Figure 3: A negative feedback current amplifier.

1. From what information in figure 3 can you conclude that the amplifier is a current amplifier.

2. Explain why this is a correct feedback topolopy for a current amplifier.

Figure 4 shows a model that can be used to calculate the equivalent noise source of a negative feedback current amplifier.

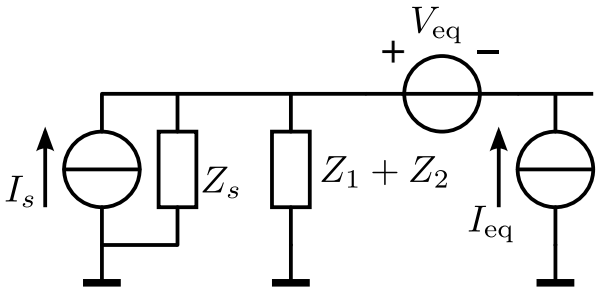

Figure 4: A model that can be used for noise calculations.

3. Prove the correctness of the model in figure 4 by calculating the equivalent noise source for the current amplifier in fig.3.