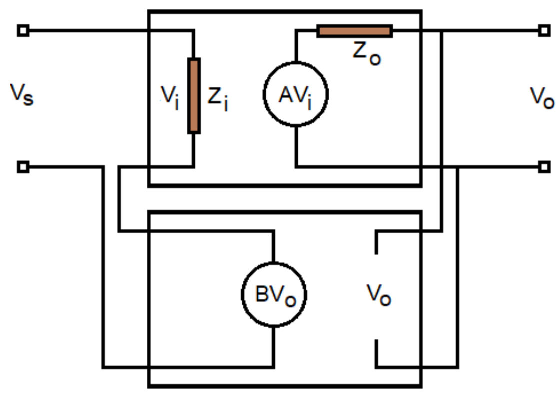
Electronics

Amplifier with feedback

Problem 1.- An amplifier without load has a voltage gain A = 200, input impedance 1kohm and output impedance also 1kohm.
You have a signal from a source that has 100kohm output impedance that needs to be connected to an instrument with input impedance 10ohm.
Design a feedback scheme with the amplifier, such that you sacrifice gain for impedance matching.
Draw the quadrupole diagram and indicate what will be the new gain.

Solution: Since we want to increase the input impedance and lower the output one, we should use a voltage feedback scheme in series whose diagram is shown below.



The input impedance with feedback is $Z_{if} = Z_i(1+AB)$

And the output impedance is $Z_{of} = Z_o/(1+AB)$

To equalize the impedances, the factor (1+AB) should be 100 so that 1kohm/100 give us the 10ohm that we want at the output and 1kohm×100 give the 100kohm we want at the input.

Since $100 = (1+AB) \rightarrow B = 0.495$

The new gain will be $A_f = A/(1+AB) = 2$

Problem 2.- A Geiger counter has an analog output proportional to the radiation, measured as rate of events (clicks). This signal has an output impedance of 10kohm. We want to connect it to a meter whose input impedance is 200ohm.

You have an amplifier that in open circuit has a voltage gain A = 100, input impedance of 1kohm and output impedance of 1kohm as well.

Design a scheme that uses the amplifier with feedback to match the impedances. Indicate the new gain.

Solution: The solution can be done using feedback similar to the previous problem. However, for the input impedance we would want a factor of 10, to match 1kohm with 10kohm, and for the output a factor of 5, to match 200ohm with 1kohm. We could use either of these factors or better yet an intermediate value like 7, which gives us:

$$1 + AB = 7 \rightarrow B = \frac{7-1}{A} = 0.06$$

And with this value of B, the new gain will be

$$A_f = \frac{A}{1+AB} = \frac{100}{7} = 14$$