myDAQ exercise: Dynamic resistance of a diode

Your task is to study the dynamic resistance of a diode. For that you use the impedance measurement from where the dynamic resistance rd is found indirectly. Due to the need to bias the diode a dc voltage source is needed. A DC block must be connected so as to isolate myDAQ from that dc bias. The circuit schematic used in this task is shown in Figure 1.

The schematic includes C1 which is the DC block. Resistor R1 and potentiometer R2 are used control the DC current that flows through the diode. Let us call as R3 the series combination of R1 and R2. The overall value for R3 cannot be measured directly but it is obtained as follows:

i. First one finds the voltage over R1 which gives current I1 through R1.
ii. Then one measures voltage V3 over both the R1 and R2, with I1 and V3 one can find value of R3.

From the ac impedance measurement (see Fig. 1) we obtain an impedance value that corresponds to the total parallel resistance of rd and R3. Once R3 is known, one can solve for rd.

In the measurement we vary the DC current I_{DQ} through the diode. As one can deduce, I_{DQ} equals I3. With these measurements we can also check how rd varies as a function of I_{DQ}.

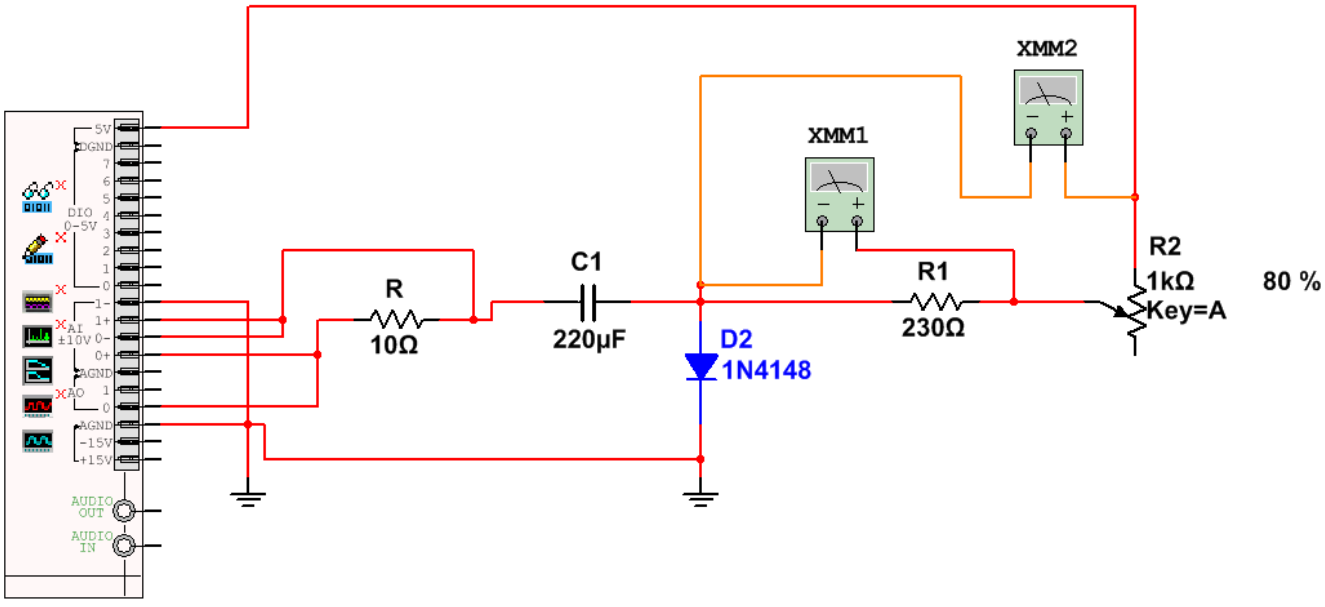

Figure 1. Measurement setup for dynamic resistance of a diode.

1. Get familiar with the potentiometer, it is used as a variable resistor in the measurement. Notice that both in simulations and measurements, one leg of the potentiometer is floating, i.e., not connected.

2. Measure the value of R and R1. Use the measured resistance values in the simulations.

   R = 10Ohm **R1 =** 240Ohm

3. Draw the schematic and simulate the case. You can use the table below to store the results. Recall to pay attention to units.

   Set 'Start Frequency' to 100 Hz, 'Stop Frequency' to 20 kHz, and 'Peak Amplitude' to 0,09. Determine the impedance at 10 kHz. Figures 2 and 3 detail the simulation and measurement settings.

   NOTE: Pay attention to the value of 'Peak Amplitude' as it may get changed when working with the 'Bode Analyzer'. Adjust

R2, slider%	V1	I1 = I_{DQ}	V3	R3	|Z| @10 kHz	/ Z @10 kHz	rd
800	-2.39	-9.95m	-4.382	1040	10.4	-0.41	10.5050
600	-1.676	-6.98m	-4.47	840	11.6	-0.37	11.762
400	-1.293	-5.38m	-4.526	640	12.8	-0.34	13.06
200	-1.054	-4.391m	-4.566	440	14.0	-0.31	14,46
0	-889.4m	-3.705m	-4.596	240	15.2	-0.29	16.227

4. Construct the circuit, vary the potentiometer setting to alter the current I_{DQ}. Use the myDAQ multimeter to find the voltages V1 and V3.

V1	I1 = I_{DQ}	V3	R3	|Z| @10 kHz	/ Z @10 kHz	rd
-0.93		-1.62	1.01k	15.1	-0.79	15.329

5. Find the dynamic resistance also at low I_{DQ} for that use simulations and the setup that is shown in Figure 4. Adjust the source voltage of the voltage source such values that the diode is just ON. Consider also the case when the diode is OFF.

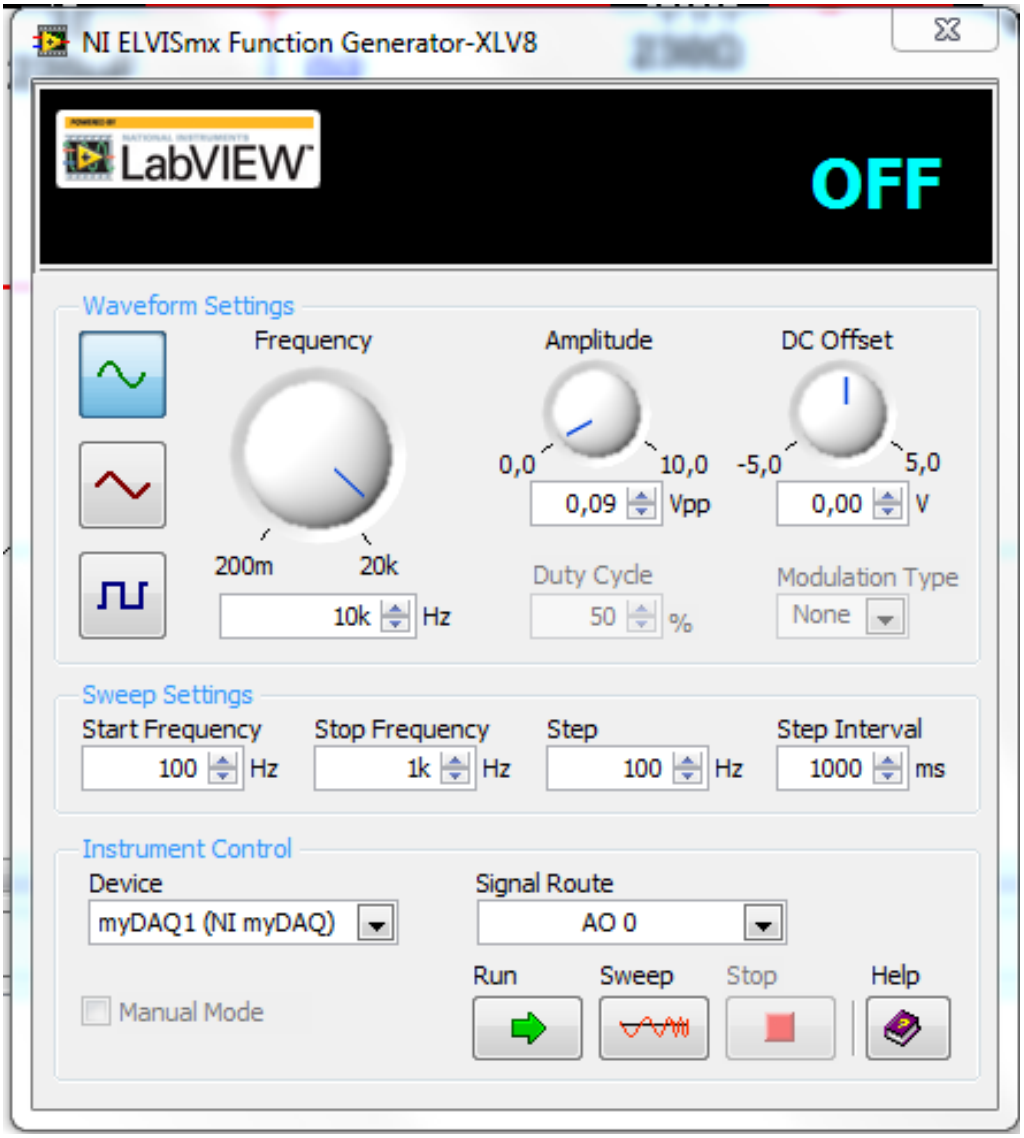

Figure 2 Settings of the function generator.

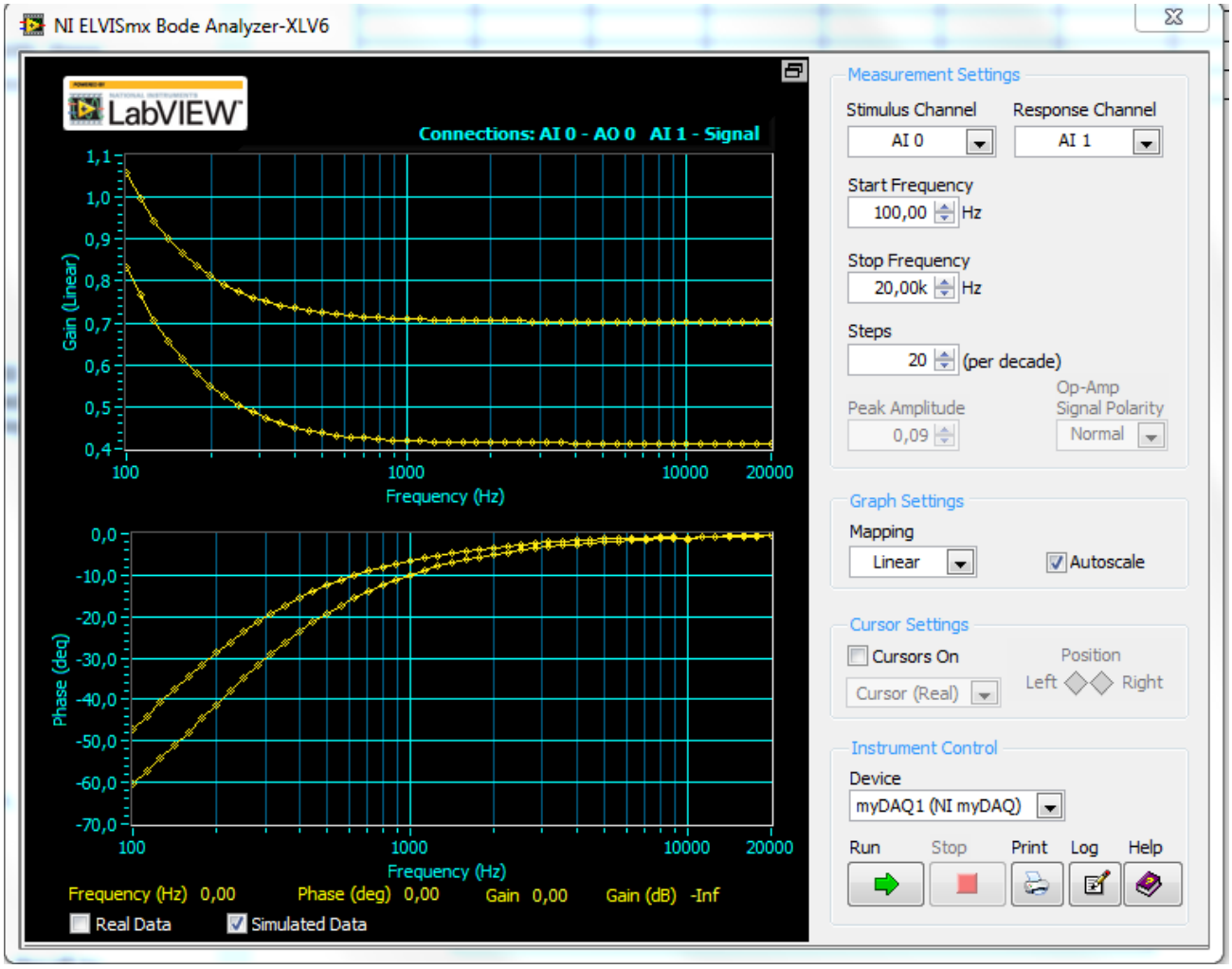

Figure 3 Settings of the Bode Analyzer.

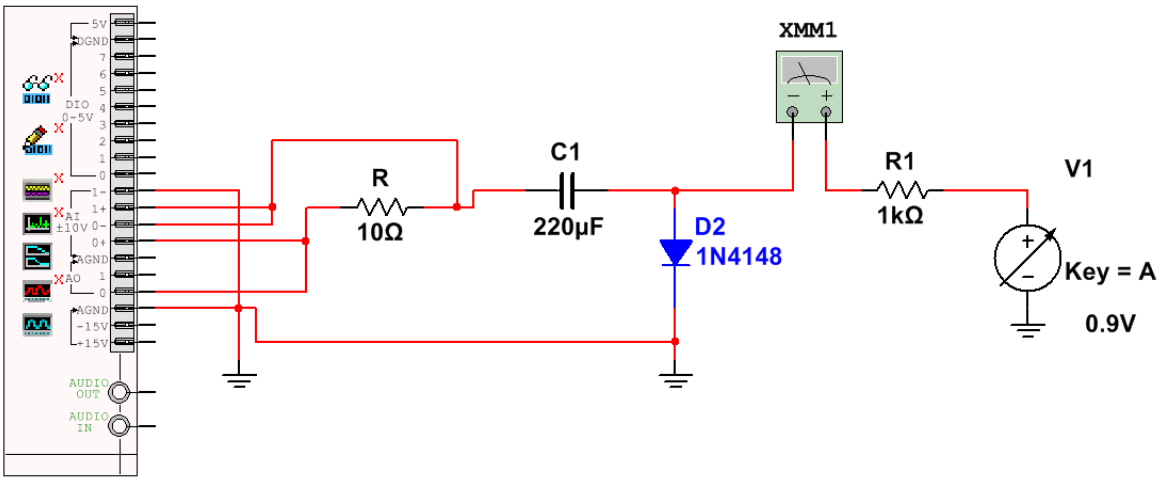

Figure 4 Modified schematic for finding the dynamic resistance at low I_{DQ} values.