

Pre-Lab

Objective: The following task will acquaints us with the characteristics of a non-linear devise - the diode. Measurements of temperature and voltage will be done using a thermocouple and an A/D converter respectively. For the analysis of the accumulated data we shall use a spreadsheet program - LibreOffice Calc.

Task 1: Analyze the diode's characteristics using PSpice, Run the examples in the PSpice folder: (Files are available in **Supplemental**).

Task 2: Use the Characteristics results to find the temperature coefficients of Si and Ge.

Task 3: Use the Temperature Sweep results to find the temperature coefficients of Si and Ge.

Experimental

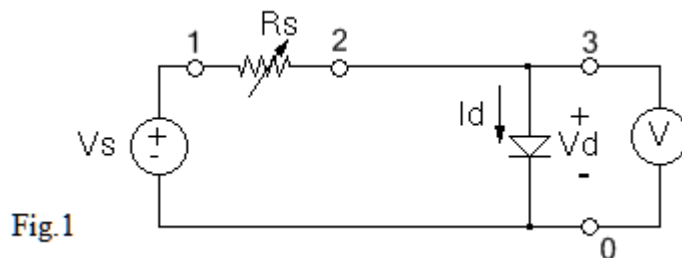
Notice: in the following experiments all team members work together, not individually.

Task 4: Measuring the I_d vs. V_d characteristics of the Silicon diode 1N916.

Set-up the thermocouple software (TempView):

Setup the circuit of Fig.1 on your main breadboard with the diode on the small breadboard placed in inside the oven. Make sure that the thermocouple is in the vicinity of the diode.

Connect nodes 1 and 2 respectively to the Hi and Low of channel 0 of the A/D unit and nodes 3 and 0 respectively to H and L of channel 1.



Set the power supply to independent mode, voltage measurement.

Connect the leads from the power supply to your breadboard. Turn the voltage knob all the way counter clockwise and the current knob all the way clockwise.

Open and setup TracerDAQ > open Strip Chart > click on the **Start** button (black arrowhead at the top left) and as quickly as possible Click on **Start** in the TempView window

Once the temperature is stabilized start to slowly increase the voltage. when you reached or went over 6.7 V start lowering the voltage back . Save TracerDAQ measurements as name.csv.

Exit both TempView and TracerDAQ.

Task 5: Analyzing the experimental data using 'Calc' (a free Excel equivalent)

Open **Tracer files**, open your saved name.csv file, the window 'Text Import' opens. Make sure that 'Separated by' and the sub-items 'Comma' and 'Space' are checked, click OK. 'LibreOffice Calc' window opens, highlight the values of V_d and V_{RS} which you want to analyze.

'Insert' > 'Chart' a graph window and the 'Chart Wizard' window open. In the last window click the XY (Scatter) item, when the Scatter graph appears in the graph window click 'Finish'.

Right-click on any data point of the graph and click 'Insert Trend line...' , the trend Line window opens, click 'Exponential' and 'Show Equation' > 'OK'. The Trend Line and its Experimental Equation of V_{RS} as a function of V_d appear in the graph window.

Task 6: Determination of I_d vs. V_d Characteristics of the Silicon diode 1N916 at about 3 degrees above room temperature.

Increase the oven's temperature by 3 °C, switch the oven off and wait until stabilization then repeat the measurement of **Task 4**.

Task 7: Use your experimental information to find the Temperature Coefficients of the silicon and germanium diodes you used in the former tasks for a diode current of 1 mA.

The Temperature coefficient of a diode is given by $\frac{dV_d}{dT}$ (in $\frac{mV}{K}$)

Issues to be discussed in your report:

- 1) Use Calc and the output file of Pspice. to get the equation of the graphs of $V_1(d1)$ vs. temperature.
- 2) For an extra credit of up to 20% design an experiment using the available equipment to directly measure the temperature coefficient. Submit a detailed discussion of your design.