**Diode I-V Curve**

***This lab activity was created and graciously provided by Dr. Karl Stephan***

Simulate the following Fig. 1 circuit in Multisim or an equivalent circuit-simulation software package:

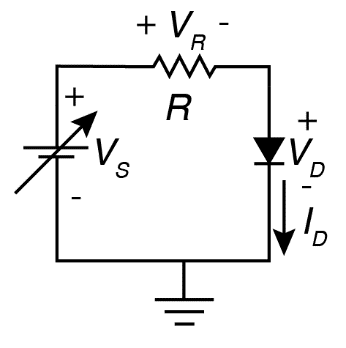


Fig. 1. Diode I-V test circuit. *R*  = 10 kW, diode is 1N4001 (a silicon rectifier diode).

Prepare a report of less than two pages which includes the following data and records:

* An explanation of what you will learn from this lab.

We will investigate the forward I–V behavior of a silicon diode (1N4001) in series with a 10 kΩ resistor using a DC source VS. Verify KVL/Ohm’s law, compare to Shockley’s model, and extract VT and IS from two operating points.

* An explanation of how *VS*, *VD*, *VR*, and *ID* are related.

VS = VD + VR

ID = VR / R = (VS – VD) / 10 kΩ

* Using the simulation software, fill out *VD* and *VR* forTable 1 for the simulation circuit you built.
* Calculate *ID* = *VR*/*R*, and complete the *ID* column with your calculated values.
* For *VS1* = 1 V and *VS2* = 2 V, use the values of *VD1*, *VD2*, *ID1*, and *ID2* to find values for the scale current *IS* and the thermal voltage *VT* in the following approximate ideal diode equation:



Vt = 47.4 mV

Is = 1.22 \* 10^-8 A

Table 1: Simulated Values

|  |  |  |  |
| --- | --- | --- | --- |
| *VS* (V) | *VD* (V) | *VR* (V) | *ID* (*m*A) |
| 0 | 0 | 0 | 0 |
| 0.5 | 340.25mV | 159.75 mV | 15.95 |
| 0.75 | 380.05mV | 369.94mV | 36.99 |
| 1 | 402.768mV | 597.23mV | 59.72 |
| 1.1 | 409.64mV | 690.26mV | 69.03 |
| 1.2 | 415.69mV | 784.31mV | 78.43 |
| 1.3 | 421.09mV | 878.91mV | 87.89 |
| 1.4 | 425.96mV | 979.04mV | 97.90 |
| 1.5 | 430.40mV | 1.07V | 107.00 |
| 1.6 | 434.47mV | 1.166V | 116.60 |
| 1.7 | 438.24mV | 1.262V | 126.20 |
| 1.8 | 441.72mV | 1.358V | 135.80 |
| 1.9 | 444.997mV | 1.455V | 145.50 |
| 2 | 448.06mV | 1.552V | 155.20 |
| 2.25 | 454.96mV | 1.795V | 179.50 |
| 2.5 | 461.00mV | 2.039V | 203.90 |
| 2.75 | 466.38mV | 2.284V | 228.40 |
| 3 | 471.21mV | 2.529V | 252.90 |
| 3.25 | 474.61mV | 2.774V | 277.40 |
| 3.5 | 479.641mV | 3.02V | 302.00 |
| 3.75 | 483.36mV | 3,267V | 326.70 |
| 4 | 486.81mV | 3.513V | 351.30 |
| 4.25 | 490.032mV | 3.76V | 376.00 |
| 4.5 | 493.05mV | 4.007V | 400.70 |
| 4.75 | 495.89mV | 4.254V | 425.40 |
| 5 | 498.571mV | 4.501V | 450.10 |

Show your report to the TA or instructor at the beginning of the lab, and you will receive a prelab grade for that report.

**2. In the lab on the assigned day:**

* Build the circuit shown in Fig. 1, using a bench power supply as *VS*.
* Fill out Table 2 with your experimental lab-measured data, calculating the values of *ID* as before. Also calculate experimental values for *IS* (experiment) and *VT* (experiment), using *VS1* = 1 V and *VS2* = 2 V, but experimental values for *ID* and *VD*.
* Using Excel or other means, plot both your simulation data and your experimental data.
* You must finish the lab during your assigned lab period. No lab makeups are allowed without an excused absence or other documented reason.
* ***Include at least 2 pictures with your lab report, one of the setup and at least one of instrument readout. In addition, selfies are encouraged!***

|  |  |  |  |
| --- | --- | --- | --- |
| *VS* (V) | *VD* (V) | *VR* (V) | *ID* (*m*A) |
| 0 | 1.3 mV | 1.2 mV | 0 |
| 0.5 | 0.39V | 0.11 V | 11.13 muA |
| 0.75 | 0.43 V | 0.317 V | 32.7 muA |
| 1 | 0.45 V | 0.54 V | 54.4 muA |
| 1.1 | 0.46V | 0.638 V | 63.5 muA |
| 1.2 | 0.466 V | 0.732 V | 72.9 muA |
| 1.3 | 0.472 V | 0.827 V | 82.3 muA |
| 1.4 | 0.477 V | 0.922 V | 91.8 muA |
| 1.5 | 0.48 V | 1.018 V | 101.3 muA |
| 1.6 | 0.485 V | 1.115 V | 110.9 muA |
| 1,7 | 0.489 V | 1.21 V | 0.12 mA |
| 1.8 | 0.492 V | 1.3 V | 0.129 mA |
| 1.9 | 0.496 V | 1.4 V | 0.139 mA |
| 2 | 0.498 V | 1.5 V | 0.149 mA |
| 2.25 | 0.505 V | 1.74 V | 0.173 mA |
| 2.5 | 0.512 V | 1.987 V | 0.197 mA |
| 2.75 | 0.517 V | 2.23 V | 0.221 mA |
| 3 | 0.522 V | 2.476 V | 0.246 mA |
| 3.25 | 0.527 V | 2.72 V | 0.270 mA |
| 3.5 | 0.531 V | 2.967 V | 0.295 mA |
| 3.75 | 0.534 V | 3.214 V | 0.319 mA |
| 4 | 0.538 V | 3.459 V | 0.343 mA |
| 4.25 | 0.542 V | 3.7 V | 0.368 mA |
| 4.5 | 0.545 V | 3.95 V | 0.392 mA |
| 4.75 | 0.547 V | 4.2 V | 0.417 mA |
| 5 | 0.55 V | 4.44 V | 0.442 mA |

Table 2: Experimental Values

Vt = 47.6 mV

Is = 4.30 nA

A circuit board with wires and cables on a desk

AI-generated content may be incorrect.