Introduction

Lab Goals

1. Learning how to build simple parallel/series circuits
2. Understand how diodes differ from resistors
3. Clearly establish the concept of constant voltage in parallel circuits
4. Clearly establish the concept of constant current in series circuits
5. Learn how to use DMM's such as the ammeter and the voltmeter in a circuit
6. Understand the relationship between current and voltage in series and parallel circuits

For this lab we aimed to establish a basic understanding of the lab goals and become more proficient in the tools available such as the ammeter and the voltmeter.

Lab Procedure

Part I. The Characteristics of Linear and Non-Linear Devices

1. Construct a test circuit with a variable DC-supply-voltage-source in series with a current limiting resistor value of 2.7 kΩ and a **Device Under Test** [**DUI**]. The DUI in the experiment was a 4.7 kΩ resistor. Then using two digital multimeters, for a voltmeter and an ammeter, to measure the voltage drop across the DUI or the current in series with the circuit respectively.

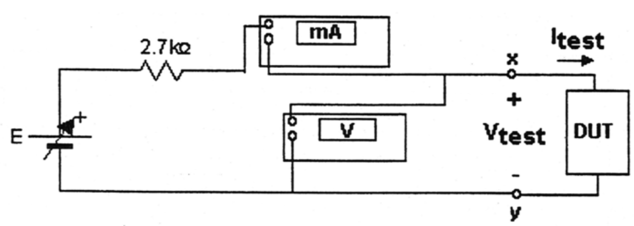


Fig. 1: DUT circuit

2. Adjust the dc-supply voltage to set $\mathbf{V_{test}}$ at each of the given values in the graph below and record the values. Reverse the terminals and observe what happens.

3A. Reverse the terminals of the resistor and observe what happens. Graph the i-v data gathered.

4. Replace the unknown resistor with a forward-bias diode as the DUT. Repeat all the previous steps, and tabulate the results.

3B. Reverse the terminals of the diode and observe what happens. Graph the i-v data gathered.

Part II. Simple Series Circuit

5. Set the value of the DC-supply-voltage-source **"E" @ 20V**. Create a series circuit with the DC-supply, a 3.3 kΩ resistor, and a 10 kΩ in series. Then use the DMM to measure the voltage across and the current through each device of the circuit listed in the table below. Calculate the power absorbed by each device.

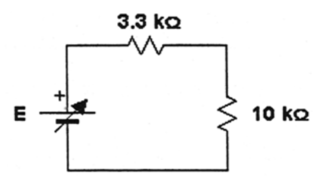


Fig. 2: Simple Series Circuit

6. Create a simple parallel circuit with a DC-supply **"E" @ 20V**, and two resistors of values 3.3 kΩ and 10 kΩ connected in parallel to each other. Then repeat in step 5.

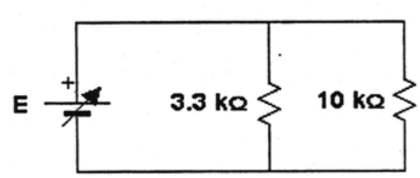


Fig. 3: Simple Parallel Circuit

Results

Table 1: Test Resistor DUI circuit

$\mathbf{V_{test}(V)}$	**0.5**	**1**	**5**	**10**
$\mathbf{I_{test}(mA)}$	0.071	0.140	0.692	1.384

Table 2: Test Forward Biased Diode DUI circuit

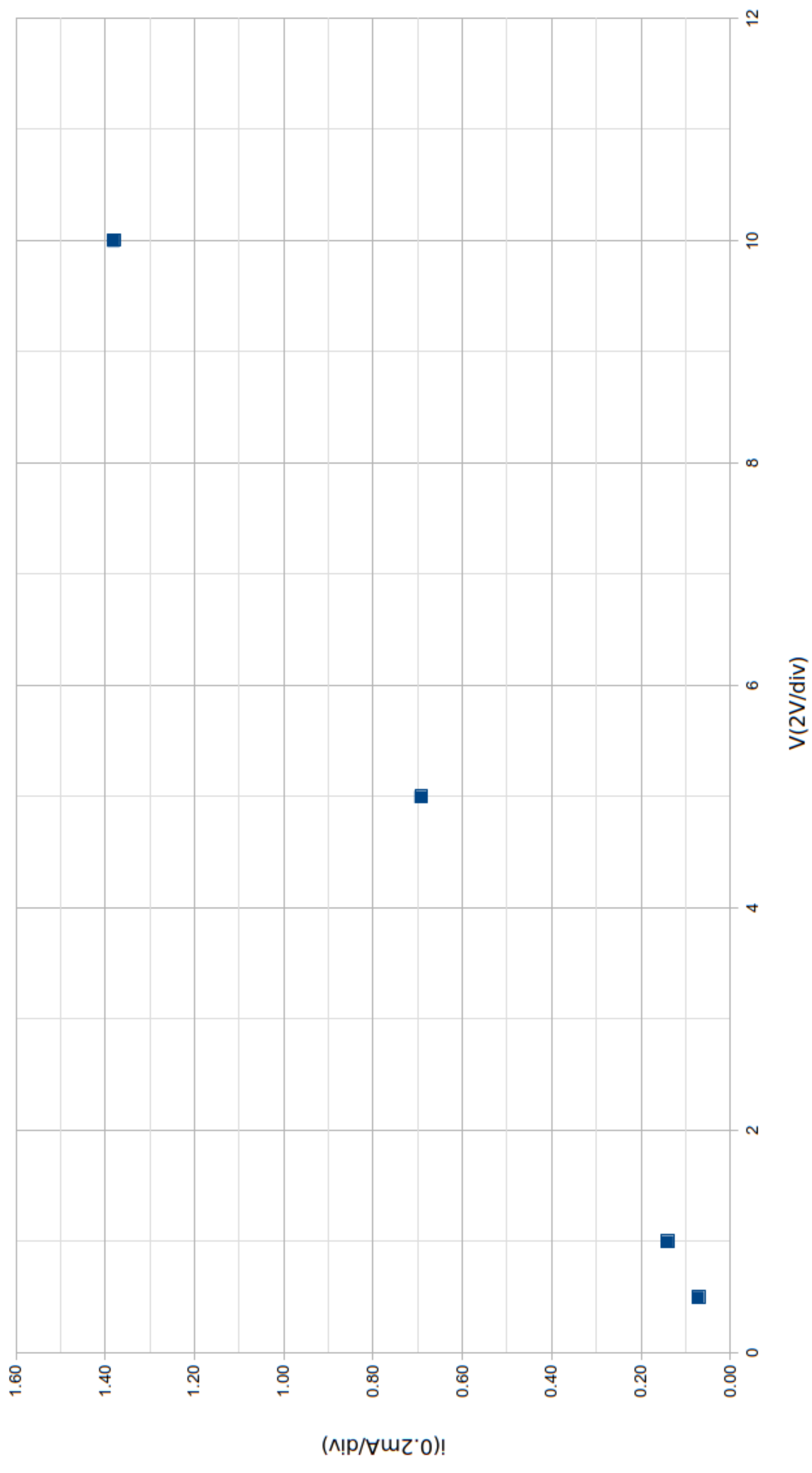
$\mathbf{V_{test}(V)}$	**0.2**	**0.5**	**0.6**	**0.7**
$\mathbf{I_{test}(mA)}$	0.001	0.036	0.0.065	0.097

Table 3: Simple Series Circuit

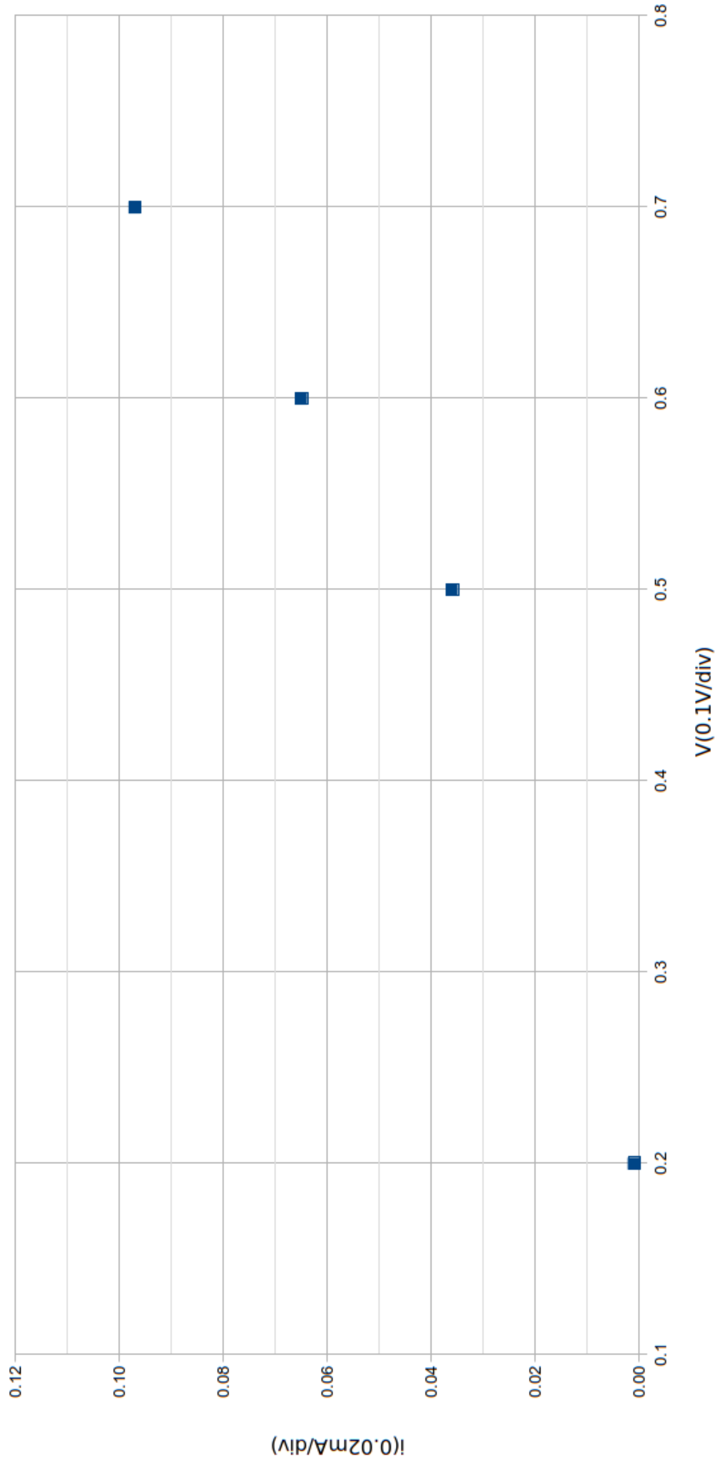
Device	**Voltage Across (V)**	**Current Through (mA)**	**Absorbed Power (mW)**
Source	20	1.541	30.82
10 kΩ	15.303	1.541	23.58
3.3 kΩ	4.995	1.541	7.697

Table 4: Simple Parallel Circuit

Device	**Voltage Across (V)**	**Current Through (mA)**	**Absorbed Power (mW)**
Source	20	8.302	166.04
10 kΩ	20.243	2.047	41.437
3.3 kΩ	20.243	6.273	126.98



Graph 1: i-v graph for resistor DUT



Graph 2: i-v graph for forward biased diode DUT

Procedure Questions

3A If you reverse the terminals, nothing happens, the current stays the same as measured in the table above and Graph 1.

3B If you reverse the for the forward bias diode terminals, the current drops to zero for all values of $\mathbf{V_{test}}$ in the table above and would be a constant line with a zero slope, with a value of zero for all voltages

Conclusion Questions

1. Use the plot of the i-v characteristics of the unknown resistor to formulate an expression for the current through "i" as a function of voltage across "v" of the resistor.

$$m = \frac{1}{R} = \frac{1.384\text{mA} - 0.071\text{mA}}{10\text{V} - 0.5\text{V}} = \frac{1}{7.235}$$
$$v = iR$$
$$i(v) = \frac{v}{R} = \frac{v}{7.237}$$

2. How does the i-v characteristic of a diode differ from that of a resistor? Use two test points on Graph 2 to show if the diode satisfies the properties of superposition and homogeneity.

$$v_1 = 0.5\text{V}; i_1 = 0.036\text{mA}$$
$$v_2 = 0.7\text{V}; i_2 = 0.097\text{mA}$$
$$R_1 = \frac{v_1}{i_1} = 13.89\text{k}\Omega$$
$$R_2 = \frac{v_2}{i_2} = 7.216\text{k}\Omega$$
$$\frac{v_2}{v_1} = 1.4; \frac{R_2}{R_1} = 0.52$$
$$\frac{v_2}{v_1} \neq \frac{R_2}{R_1}$$

Therefore, diode differs from the resistor as it does not show a linear relationship. Due to this lack of relationship it proves that the diode does not satisfy the property of superposition and homogeneity.

3. Use Table 3 to determine basic properties of simple series circuits

(a) Current is always constant
(b) Each resistor has a specific voltage drop
(c) Individual resistors can be added to give a total voltage
(d) The sum of voltage sources equals the sum of voltage drop
(e) Sum of power supplied equals the sum of power lost

4. Specify at least one practical application for connecting devices in a simple series form.

   One practical application is Christmas lights. In order to make sure a tree is well lit, you would require long strings full of led lights without power sources and wires everywhere. So it would be more practical to wire them in a series configuration.

5. Use Table 4 to determine basic properties of simple parallel circuits

   (a) The voltage drop is the same across all components
   (b) All currents can be added to find the total current
   (c) Total resistance is the inverse sum of all resistances in the circuit
   (d) Each branch has its own current path
   (e) Sum of power supplied equals the sum of power lost

6. Specify at least one practical application for connecting the devices in a simple parallel form

   Circuit Breakers, each room can have its own fuse/switch. When one part of the house or device draws too much current, it stops the current flow helping prevent fires etc, while allowing other devices which are functional normally to continue operating.

Conclusion

Overall, when conducting the labs we were able to meet all the lab goals which were outlined in the introduction.