

Name: _____

Roll Number: _____

Laboratory 1 – Basic Electronics

Introduction:

This assignment introduces you to the basic tools and devices that you will use throughout the rest of the semester:

1. Power Sources: DC electrical power supply and Function Generator
2. Measurement devices: Digital multimeter (DMM) and Digital Storage Oscilloscope (DSO)
3. How to build and test circuits on breadboards.

It is assumed that you know what is a resistor – if you don't please ask. You don't need to calculate the resistor values based on color bands imprinted on them. All components are kept in the lab cabinets in neatly labeled boxes. However, when taking a 1.1 k Ω resistor from a box marked 1.1 k Ω it's a good idea to quickly check its value with a DMM.

Procedure:

1. Please write your name and roll number on each page of this assignment sheet – you will submit the entire sheet at the end of the lab session.
2. All your answers must be filled out in the spaces provided.
3. Marks for all the questions and activities will be allotted during the lab session: please make sure you demonstrate each part of the experiment to a TA and get your marks allotted as you complete each section.
4. Feel free to ask questions to the TA if you are stuck or have a doubt about something – there is no penalty for asking questions. Discussion among your group members to clarify concepts is also encouraged – copying is frowned upon.

Introduction

There are two quantities that are important in electronic circuits: voltage and current. A circuit element that provides voltage is called a voltage source, One that provides current is a current source.

It is important to know the difference between the two sources of power. In the *ideal* case -

- **Voltage Source:** A two terminal 'black box' that maintains a fixed potential difference V across its terminals, regardless of the current required. This means that it must supply *any* current $I=V/R$ when *any resistance* R is connected across it's terminals
- **Current source:** A two terminal 'black box' that maintains a constant current through the external circuit connected to it, regardless of the load Voltage required.

In practice,

- A real-world voltage source can only supply a finite maximum current. To limit I in $I=V/R$, it behaves in practice like an ideal voltage source with a small internal resistance in series with the load
- Similarly, a real-world current source has a limit to the maximum voltage it can work at. It behaves in practice like an ideal current source with a large internal resistance in parallel with the load.

On your lab desktop, you have two sources of power: an adjustable DC power supply; and a variable amplitude function generator. The purpose of this exercise is to determine which of these two devices is a voltage source and which a current source.

Note on building circuits: You must use the 'nearest equivalent' standard value of the component. For example when a 500 Ω resistor is specified, select 470 Ω or 510 Ω from the labelled parts cabinet.

/2	/3
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Q A.1

Q A.2

/2	/3
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Q B.1

Q B.2

/10

Total

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Part A: Resistor divider

Connect the circuit shown in Fig A.1 on a breadboard - two resistors R_1 & R_2 in series providing a total load resistance $R_L = R_1 + R_2$ to the source.

Supply 5V power to the circuit using your benchtop DC power supply.

Measure the current through the lower R_2 by connecting the digital multi-meter (DMM) in series with it – make sure to set the DMM in DC current measuring mode.

Question 1a: Measured value current through $R_2 =$ _____

Question 1b: Measure the voltage across R_1 , R_2 and $R_1 + R_2$: _____

Question 1c: Change R_2 to a few different values in the range $\sim 500\Omega$ to $\sim 10k\Omega$ and repeat your measurements of **1a** and **1b** Record your observations here:

$R_1 =$ _____ $R_2 =$ _____: $I_{R2} =$ _____ $V_{R1} =$ _____ $V_{R2} =$ _____ $V_{(R1+R2)} =$ _____

$R_1 =$ _____ $R_2 =$ _____: $I_{R2} =$ _____ $V_{R1} =$ _____ $V_{R2} =$ _____ $V_{(R1+R2)} =$ _____

$R_1 =$ _____ $R_2 =$ _____: $I_{R2} =$ _____ $V_{R1} =$ _____ $V_{R2} =$ _____ $V_{(R1+R2)} =$ _____

Convince yourself that your measurements obey Kirchhoff's voltage laws for a resistor divider.

Based on your measurements of Questions 1c, and the definitions of voltage & current sources:

Question 2: Is the Benchtop power supply a: voltage source? or current source? (tick one)

Part B: Function Generator: Voltage or Current Source?

Now disconnect the 5V source and instead build the circuit shown in Fig B. The composite device in the dashed box of Fig B, consisting of the basic function generator and the two $100k\Omega$ resistors is our Device Under Test (DUT) for Part B. Put the function generator in sine-wave output mode, with frequency set at 100 Hz. (Note that to measure current for this exercise, you will have to switch the DMM to AC current mode. The AC voltage measured by the DMM will be the RMS value)

Question 1: Set the amplitude of voltage produced by the function generator to 10V pk-pk. Change the load resistance R_L and measure the AC current and voltage supplied by the DUT for each case.

$R_L = 0\Omega$: $I_{RL} =$ _____ $V_{RL(RMS)} =$ _____

$R_L = 1k\Omega$: $I_{RL} =$ _____ $V_{RL(RMS)} =$ _____

$R_L = 2k\Omega$: $I_{RL} =$ _____ $V_{RL(RMS)} =$ _____

Based on the above measurements

Question 2: Is the DUT in the dashed box of Fig B a: voltage source? or current source? (tick one)

