X060994

UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE

Department of Electrical Engineering

Experiment No._____**DC Voltage and Current Sources**

INTRODUCTION

CONSTANT VOLTAGE SOURCE: A constant voltage source is a device that will maintain a constant voltage across its output terminals,regardless of the magnitude of current it supplies (within limits,of course). Stated another way, it is a voltage source that has zero, or nearly zero, internal resistance. Obviously, a nonconstant voltage source is one that has an appreciable internal resistance and will not maintain a constant terminal voltage as the load (current) varies. An example of a nonconstant voltage source would be a car battery or a flashlight battery. There are regulated voltage supplies on the market today that have less than 0.05 percent variation (expressed as percent regulation) in their terminal voltage from a no-load to rated load condition.

$$\textbf{Percentage Regulation} = \frac{V_{no\text{-}load} - V_{full\text{-}load}}{V_{full\text{-}load}} \times 100$$

CONSTANT CURRENT SOURCE: A constant current source is a device that will maintain a constant current output regardless of the magnitude of the voltage across its output terminals (within limits, of course). Stated another way, it is a current source that has infinite, or nearly infinite, internal resistance. A non-constant current source then could be defined as a current source that has a finite internal resistance. Regulated current sources are available on the market today that have less than 0.1 percent variation (again expressed as percent regulation) in current from no-load to rated conditions.

Generally, the higher the rated current or rated voltage of a power source and the better the percent regulation it has, the more expensive it is.

DC supplies which operate from AC sources must convert AC to DC. How well they do this is expressed in terms of "ripple factor". Ripple factor is defined as follows:

Ripple Factor = $\frac{\text{VAC at its terminals}}{\text{VDC at its terminals}} \times 100$ or $\frac{\text{IAC}}{\text{IDC}} \times 100$

where AC and DC terminal voltages or currents are measured under rated conditions. Generally, the smaller the ripple factor (a purer DC), the more expensive the power supply.

The purpose of this experiment is to obtain the V-I output characteristics of a constant DC voltage source, constant DC current source, an unregulated DC voltage source, and a small battery. Regulation and ripple factor, where appropriate, will be determined for each device.

PRELIMINARY

P-1. A DC voltage supply in the main photon torpedo battery of a planet-class light cruiser, the Arcturus, is rated at 2.18 megavolts at 0.18 amperes with a ripple factor of 0.1% and regulation of 0.05%. Assuming any ripple is due solely to a 400 Hertz sinusoid, calculate:

a. the maximum RMS value of the ripple voltage, VAC.

$V_{rated} = 2.18 \times 10^6$ V

$\%\ \text{ripple} = \frac{\text{VAC}}{\text{VDC}} \times 100$

$\text{VAC} = 0.1/100 \times (2.18 \times 10^6) = 2180$ V

$\text{maximum RMS value} = \text{VAC} / \sqrt{2} = 1541$ V

b. the no-load voltage of the power supply.

FullLoad = 2.18 V

$\frac{\text{Vno-load} - 2.18 \times 10^6}{2.18 \times 10^6} = 0.005$

Vno-load = 2.19 MV

P-2. Circle the correct answer to the questions below.

1.To measure the no-load voltage of a DC voltage supply, the load resistor should be:

a. Infinite (open-circuit) (ans)
b. Zero (short-circuit)
c. Equal to the internal resistance of the power supply.

2.To measure the no-load current of a DC current supply, the load resistor should be:

a. Zero (short-circuit) (ans)
b. Infinite (open-circuit)
c. Equal to the internal resistance of the power supply.

3. To measure the output characteristics of a DC voltage supply that DOES NOT have a current-limit adjustment, the load resistance should be varied:

a. from zero to infinite value.
b. from infinite to zero value.
c. from infinite to a value that gives rated conditions. (ans)

P-3. For the following voltages and currents, determine the resistance and wattage of the load resistor

Voltage (VDC)	Current (mADC)	Resistance (ohms)	Wattage (watts)
20	80	.250	1.6
20	150	133	3
100	1	100k	0.1
200	1	200k	0.2
100	100	1k	10
200	100	2k	20

(INSTRUCTOR'S SIGNATURE_____DATE_____)

PROCEDURE

CAUTION: While performing the following laboratory procedures, make sure that the power rating of the load resistor is not exceeded. Refer to the Preliminary Procedure P-3 above.

L-1. Determine the V-I characteristics of a regulated DC Voltage supply with its output voltage set at 20 volts (no-load) and its short-circuit current limit set at 80 mA (see Figure l). Remember to take more data points whenever the variable being plotted varies rapidly. Also measure VAC at the terminals of the power supply at a load current which is 70 percent of the current limit.

L-2. Repeat Procedure L-1 above for the voltage set at 20 volts and a current limit of 150 mA.

L-3. Determine the V-I characteristics of a small battery charger.Assume a rated current of 140 mA with a "never-exceed" current of 200 mA. DO NOT FORGET TO MEASURE THE OPEN-CIRCUIT VOLTAGE!Also measure VAC across the terminals of the battery charger at 140 mA.

L-4. Measure the open-circuit voltage of a small battery. Obtain the V-I characteristics of the battery, loading it until the terminal voltage drops to 90 percent of its open-circuit voltage. DO NOT OVER-LOAD THE BATTERY!!

CAUTION: In the following two parts, DO NOT MAKE OR BREAK A ANY CONNECTION UNLESS THE OUTPUT OF THE CURRENT SUPPLY IS OFF!!

L-5. Determine the I-V characteristics of a regulated DC Current supply with its output current set at 100 milliamperes (noload)and its open-circuit voltage limit set at 100 volts. Again remember to take more data points when the variable being plotted varies rapidly. Also measure IAC from the terminals of the power supply at a load voltage which is 70 percent of the voltage limit.

L-6. Repeat Procedure L-5 above for the current set at 100 mA and a voltage limit of 200 volts.

L-7. Repeat Procedure L-5 above for the current set at 1 mA and a voltage limit of 100 volts.

L-8. Repeat Procedure L-5 above for the current set at 1 mA and a voltage limit of 200 volts.

REPORT (should include at least the following)

R-1. Plot the V-I characteristics of the regulated DC Voltage supply for both current limits on the same graph.

R-2. Plot the V-I characteristics of the small battery charger on a graph.

R-3. Plot the V-I characteristics of the small battery on a graph.

R-4. The regulation for the small battery was specified to be 10 percent (rated load voltage at 90 percent of open-circuit voltage). What is the current at this specified load condition?

R-5. Plot the I-V characteristics of the regulated DC Current supply at 100 mA for both voltage limits on the same graph.

R-6. Plot the I-V characteristics of the regulated DC Current supply at 1 mA for both voltage limits on the same graph.

R-7. Determine the internal resistance of all the power supplies over their normal operating range (the slope of the V-I characteristic curves).

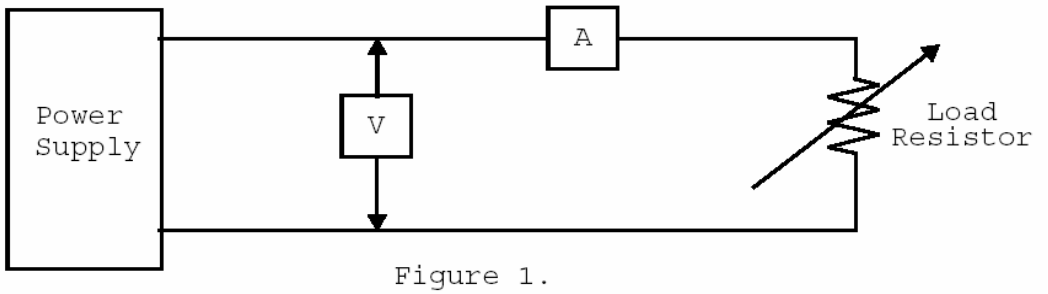

Figure 1.