Ryerson University

Department of Electrical, Computer, & Biomedical Engineering
Faculty of Engineering & Architectural Science

ELE 202
Electric Circuit Analysis
LAB COVER PAGE for Part II submission.

Lab #:	4	Lab Title:	circuit theorems and the super position principle

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Student #*:	501112545
***Signature*:**	Hamza

(* Note: remove the first 4 digits from your student ID)

Section #:	22
Submission date and time:	Friday march 11 3pm
Due date and time:	Friday march 11 4pm

Document submission for Part II:

- A completed and signed "COVER PAGE – **Part II**" has to be included with your submission, a copy of which is available on D2L. The report will not be graded if the signed cover page is not included.
- Scan your completed pages of **Section 5.0** and **Section 6.0** (via a scanner or phone images), together with any required In-Lab Oscilloscope screen-shot images.
- Collate and create a .pdf or .docx file of the above, and upload it via D2L **by 11.59 p.m. on the same day** your lab is scheduled. ***Late submissions will not be graded.***

**By signing above, you attest that you have contributed to this submission and confirm that all work you have contributed to this submission is your own work. Any suspicion of copying or plagiarism in this work <u>will result in an investigation of Academic Misconduct and may result in a "0" on the work,</u> an "F" in the course, or possibly more severe penalties, as well as a Disciplinary Notice on your academic record under the Student Code of Academic Conduct, which can be found online at: <u>www.ryerson.ca/senate/current/pol60.pdf</u>.*

5.0 IN-LAB Experiment: IMPEMENTATION & MEASUREMENTS

(a) *Thevenin Equivalent Circuit*

Implement the respective circuits in **Figure 2.0b** on your breadboard using the resistor values as shown. Set the input D.C. source voltage, **E** to **10V**. Turn OFF the power supply.

1. Turn ON the power supply.
2. For the circuit at the top in **Figure 2.0b**, use the DMM Voltmeter to measure the open-circuit voltage, V_{OC} between the open-circuit terminals "x" and "y". Record your result in **Table 5.0** below.
3. For the circuit at the bottom in **Figure 2.0b**, use the DMM Ammeter to measure the short-circuit current, I_{SC} through the short-circuit wire between terminals "x" and "y". Record your result in **Table 5.0** below.
4. Turn OFF the power supply.

	V_{OC}	I_{SC}	$V_{Th} = V_{OC}$	$R_{Th} = V_{OC}/I_{SC}$
E	Measured Result **(volts)**	Measured Value **(mA)**	**(volts)**	**(kΩ)**
10 (volts)	8.364	2.070	8.364	4.136

Table 5.0: Experimental results of the Figure 2.0b circuits

(b) *Maximum Power Transfer*

Implement the circuit of **Figure 2.0a** in MultiSIM; set the input D.C. source voltage, **E** to **10V**, and use a potentiometer as the variable load resistance, R_L.

1. Turn OFF the power supply.
2. Locate a **5kΩ potentiometer** (R_P) in your Kit and connect it as illustrated in **Figure 2.0d** and keep track of the potentiometer terminals as wired to the circuit.
3. Turn ON the power supply.
4. Monitor the load voltage, V_L across the variable load, R_P using the DMM Voltmeter.
5. Adjust the potentiometer until the output voltage, V_L is equal to $V_{Th}/2$. Refer to your Pre-Lab analysis for the V_{Th} value to use. Record the value of the output voltage, V_L in **Table 6.0** below.
6. Turn OFF the power supply.
7. Remove the potentiometer off the breadboard, and use the DMM to measure the resultant resistance value between potentiometer terminal "1" and "2" (per **Figure 2.0d**). Record this resistance value as R_L in **Table 6.0** below.
8. Turn OFF the power supply.

Input Source, E	Thevenin voltage, V_{TH} (volts)	Measured load voltage, V_L (volts)	Load resistance R_L per resultant potentiometer, R_P reading. (kΩ)
	From Pre-Lab	Measured Result	Measured Result
10 (volts)	8.361	4.176	4.134

Table 6.0: Experimental results at the Maximum Power Transfer point for the Figure 2.0 circuit.

(c) *Superposition Principle*

Implement the circuit in **Figure 3.0** on your breadboard using the resistor values as shown. Set the input D.C. voltage sources, E_1 **= 10V** and E_2 **= 4V** on each respective power-supply. Turn OFF both power supplies. (**Note:** the positive terminal of the power supply E_2 is connected to your *common ground* reference point on your breadboard to which the negative terminal of power supply E_1 is also connected).
Setup and connect the DMM **Voltmeter** to monitor the voltage across resistor, R_3; and the DMM **Ammeter** to monitor the current through resistor, R_3.

1. Investigates direct contributions of E_1 and E_2 to V_X and I_X

1. Turn ON both power supplies.
2. Record the readings of the voltage, V_X across resistor, R_3 and the current, I_X through resistor, R_3 in **Table 7.0** below.
3. Turn OFF both power supplies.

2. Investigates contribution of only E_1 to V_X and I_X

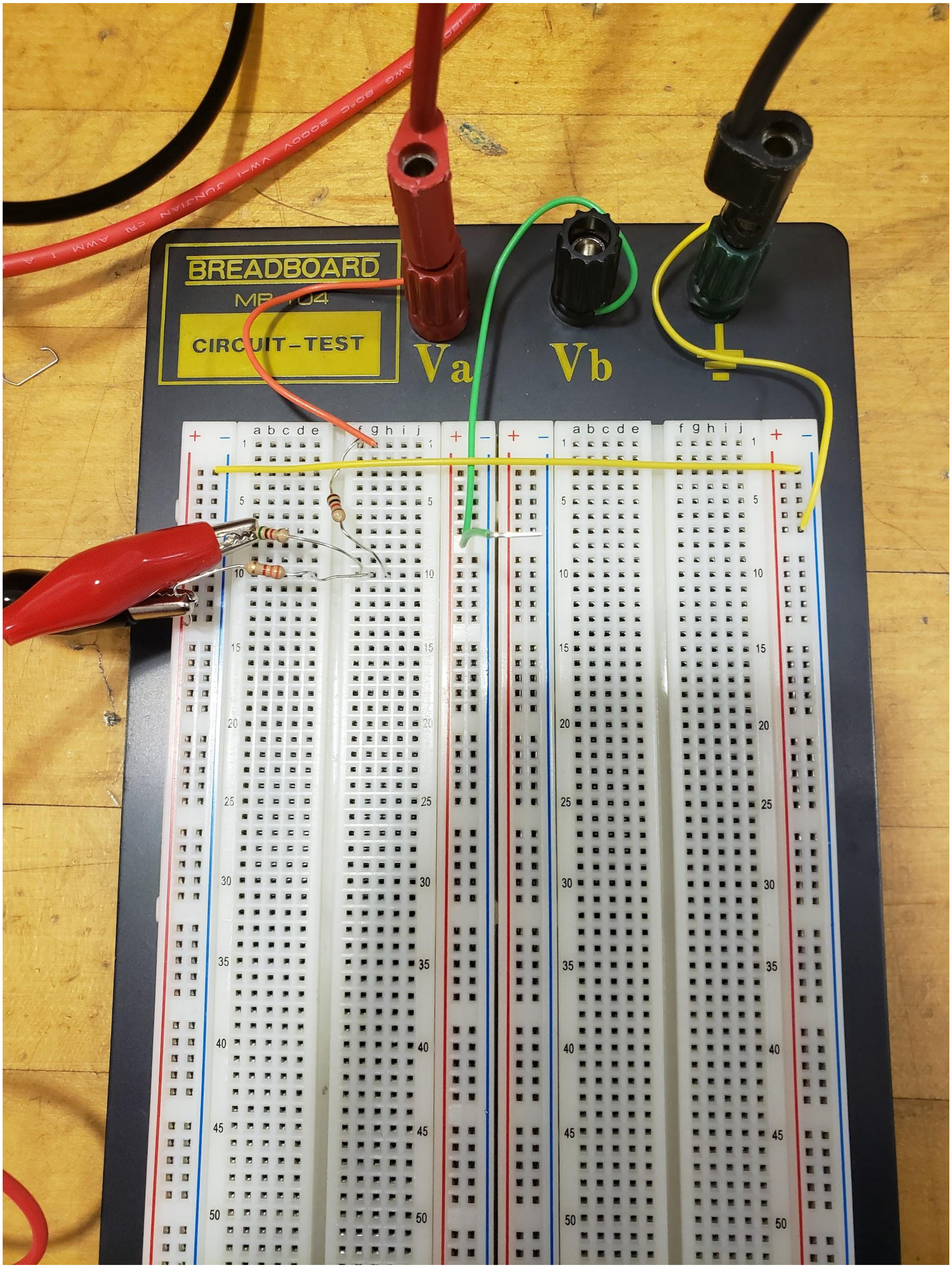
1. Remove voltage source, E_2 connections from your breadboard circuit, and replace it with a wire between "**c**" and "**d**" to create a short-circuit.
2. Turn ON the E_1 power supply.
3. Record the readings of the voltage, V_{X1} across resistor, R_3 and the current, I_{X1} through resistor, R_3 in **Table 7.0** below.
4. Turn OFF the E_1 power supply.

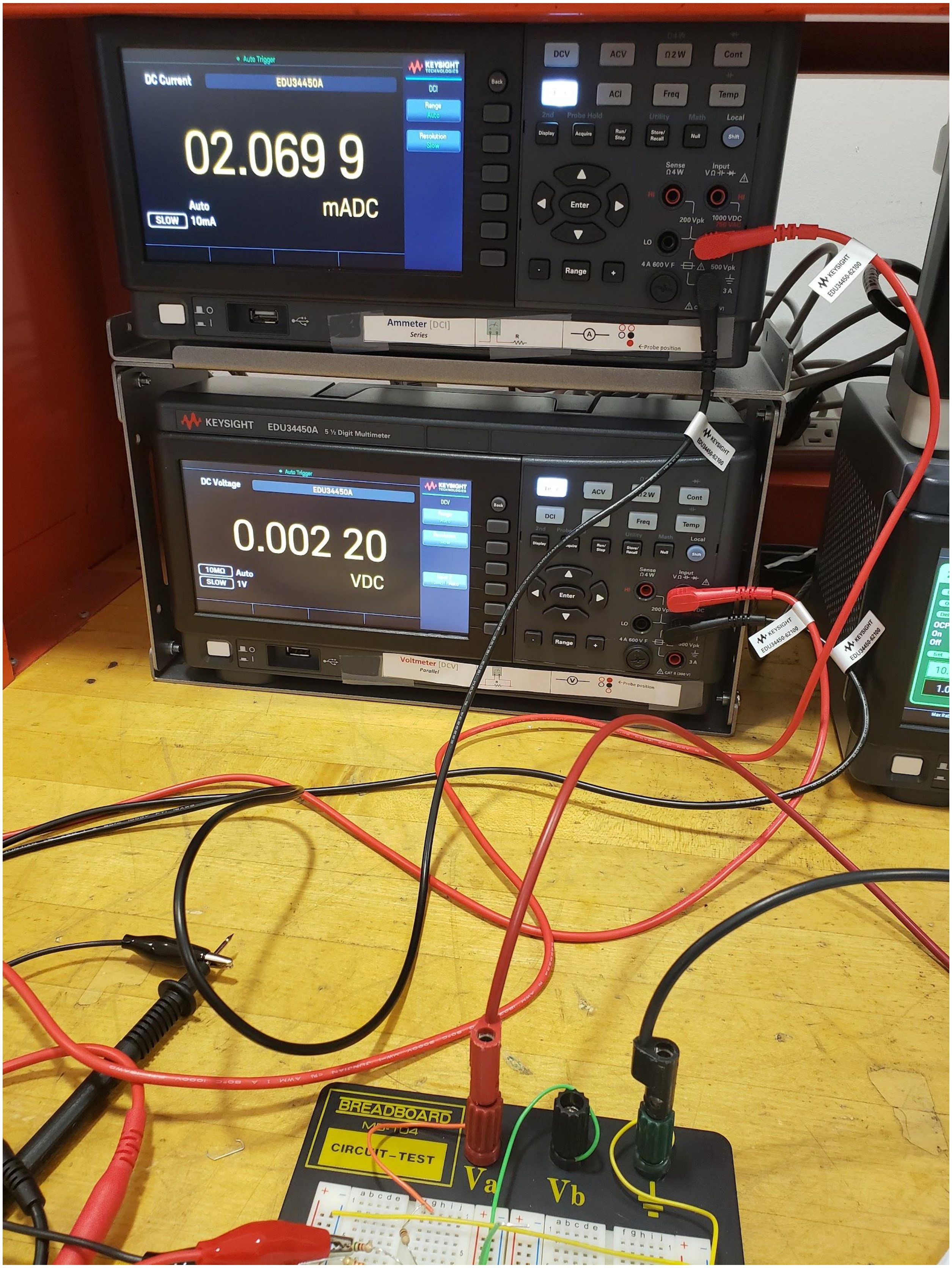
3. Investigates contribution of only E_2 to V_X and I_X

1. Remove voltage source, E_1 connections from your breadboard circuit, and replace it with a wire between "**a**" and "**b**" to create a short-circuit.
2. Reconnect input source, E_2 back to its original place between "c" and "d", and make sure the positive terminal of E_2 power supply is connected to your *common ground* reference point on the breadboard.
3. Turn ON the E_2 power supply, and verify the voltage is still at the original setting of **4V**.
4. Record the readings of the voltage, V_{X2} across resistor, R_3 and the current, I_{X2} through resistor, R_3 in **Table 7.0** below.
5. Turn OFF the E_2 power supply.

V_X (volts)	I_X (mA)	V_{X1} (volts)	I_{X1} (mA)	V_{X2} (volts)	I_{X2} (mA)	$V_X = V_{X1} + V_{X2}$	$I_X = I_{X1} + I_{X2}$
Measured Result	Measured Result	Measured Result	Measured Result	Measured Result	Measured Result	From measured results	From measured results
2.645	1.322	3.61	1.804	-0.962	-0.981	2.652	1.322

Table 7.0: Experimental results from the Figure 3.0 related circuit.


BREADBOARD
CIRCUIT-TEST
Va
Vb



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EDU34450A
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Parallel
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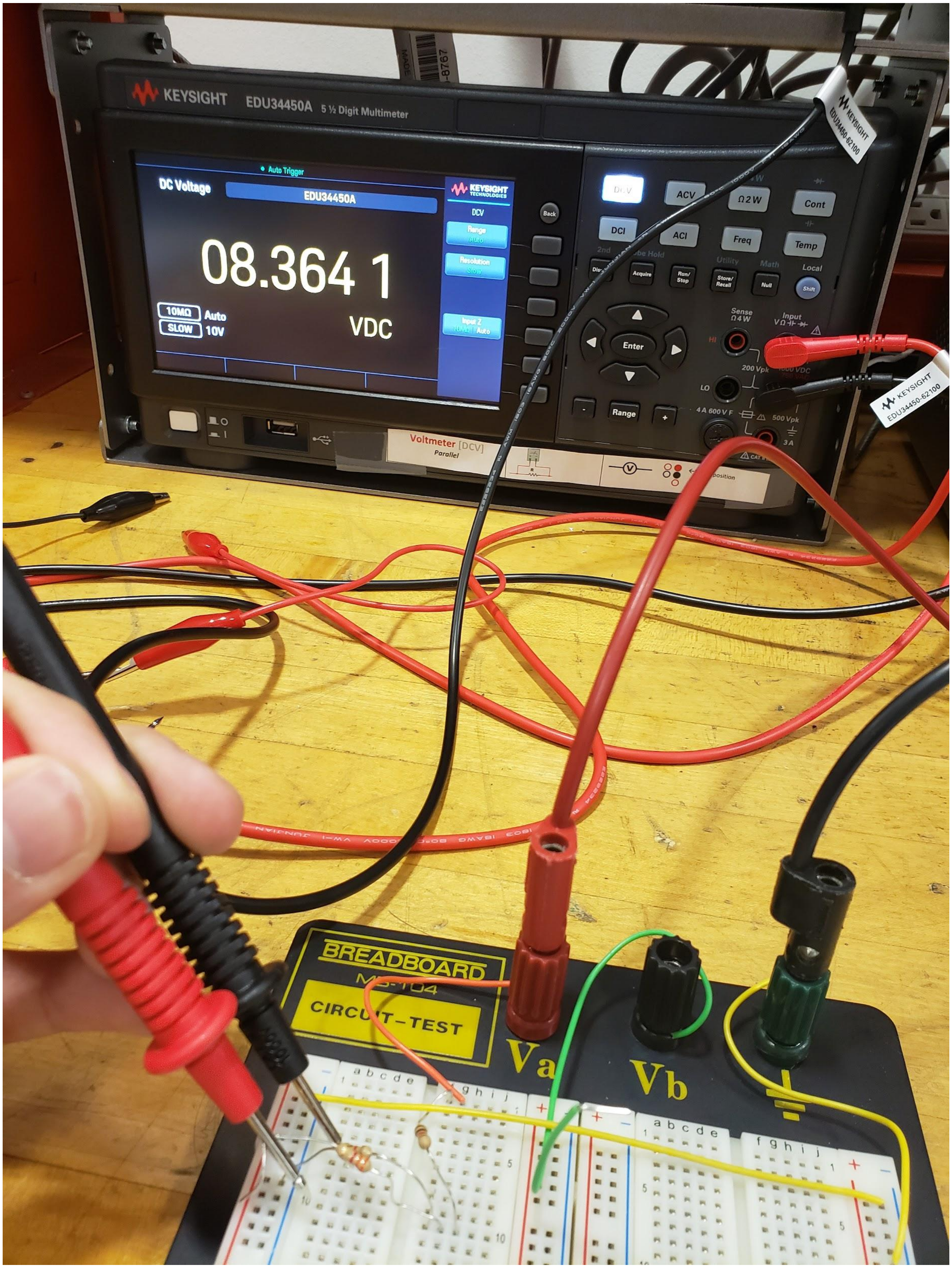
CIRCUIT-TEST
Va
Vb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Range
Resolution
Input Z
Back
DCV
ACV
Ω2W
Cont
DCI
ACI
Freq
Temp
Acquire
Run/Stop
Store/Recall
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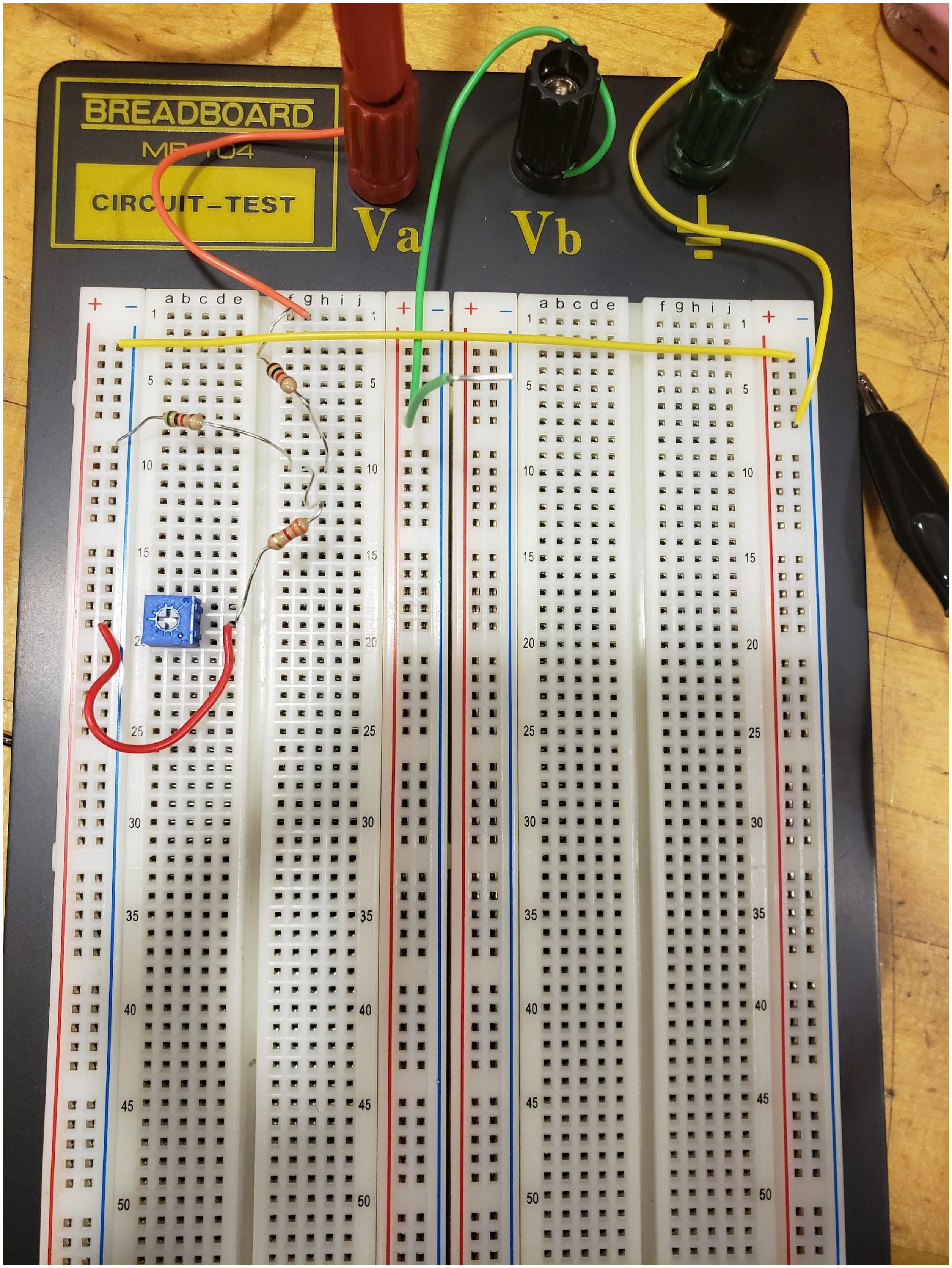
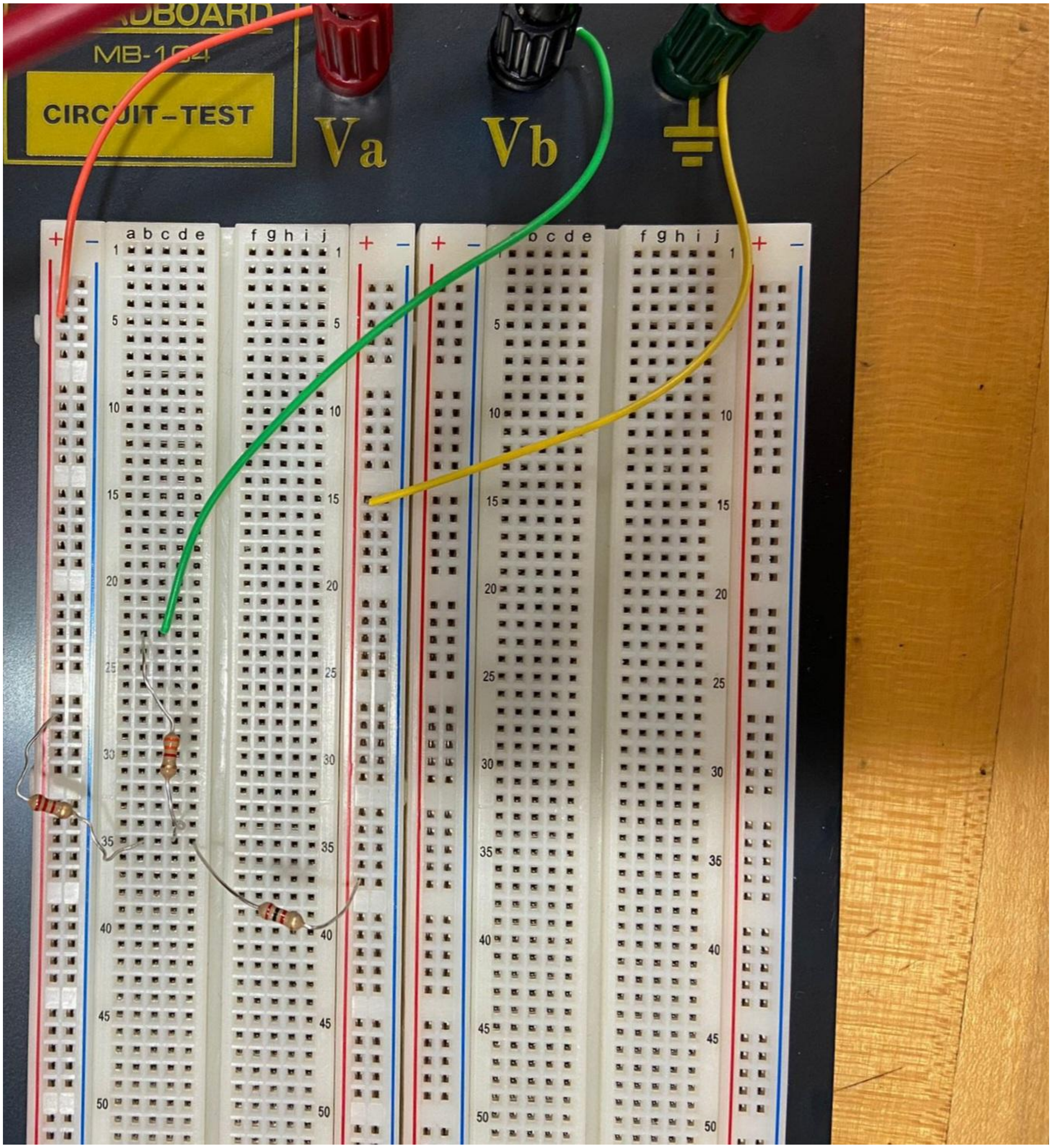


BREADBOARD
CIRCUIT–TEST
Va
Vb



MB-104
CIRCUIT–TEST
Va
Vb
a b c d e
f g h i j

6.0 POST-LAB: OBSERVATIONS AND ANALYSIS OF RESULTS

(a) *Thevenin Equivalent Circuit*

Workspace

- From your observations of the results in **Table 5.0**, compare these results to their corresponding values in **Table 2.0** obtained from the Pre-Lab exercise? Explain possible causes of any discrepancies.

from the observations of the results in table 5.0 and table 2.0 their corresponding values were the same with minor discrepancies based on the quality of the equipment, and other sorts of human error.

- Was the concept of Thevenin's equivalent circuit verified? Explain.

yes the thevenin's equivalent circuit was verified to simplify any linear circuit ~~to~~ no matter how complex to just a basic simple basic series connected circuit.

(b) *Maximum Power Transfer*

Workspace

- Explain how your experiment results of V_L and R_L in **Table 6.0** compare to the corresponding values in **Table 3.0**? Comment on any discrepancies.

For the results of VL and RL in Table 6.0 and comparing to the corresponding values in table 3.0 both were the same with minor discrepancies which were caused due to human error, etc.

- Did the experiment results verify the maximum power transfer theorem? Explain.

yes the maximum power theorem was verified as when the circuits were made VL = Vth/2 meaning VL was Vth which is RL meaning same as Rth and therefore verifies the results.

(c) ***Superposition Principle***

Workspace

- From your observation of the experiment results in **Table 7.0**, were $V_X = V_{X1} + V_{X2}$ and $I_X = I_{X1} + I_{X2}$ relationships satisfied per the Superposition Principle? Explain.

Yes $Vx = Vx1 + Vx2$ and $Ix = Ix1 + Ix2$ relationship satisfied as per the Superposition Principle because Vx1 and Ix1 Values form one half the circuit while Vx2 and Ix2 form the other half and when everything was put together gave us very similar values of the measured Vx and Ix.

- How do the results in **Table 7.0** compare to those in **Table 4.0**? Comment on any discrepancies.

The results in Table 7.0 compare to those in Table 4.0 were very close with just some minor differences which could be due to discrepancies such as the quality of the equipment, and or other forms of human error.

- What have you discovered about the Superposition Principle?

What I have discovered from the superposition principle was it made the process of analyzing and simplifying circuits much more simplier ~~as~~ using just one source of power.