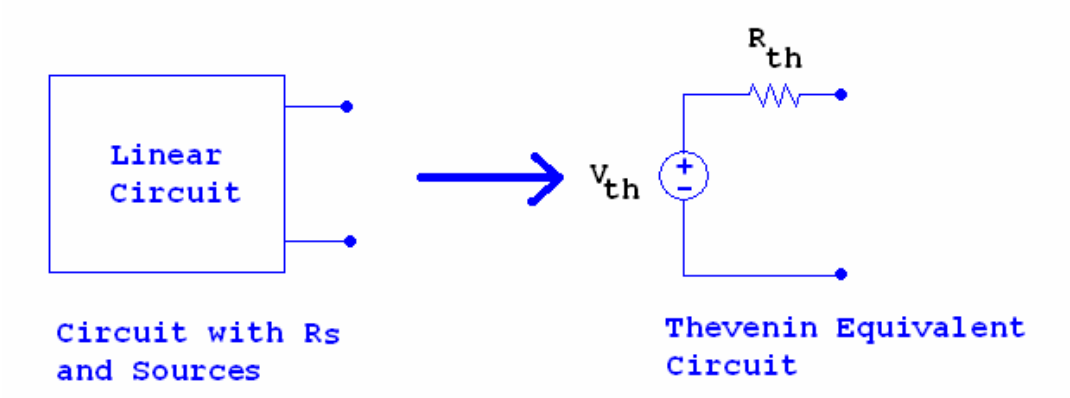
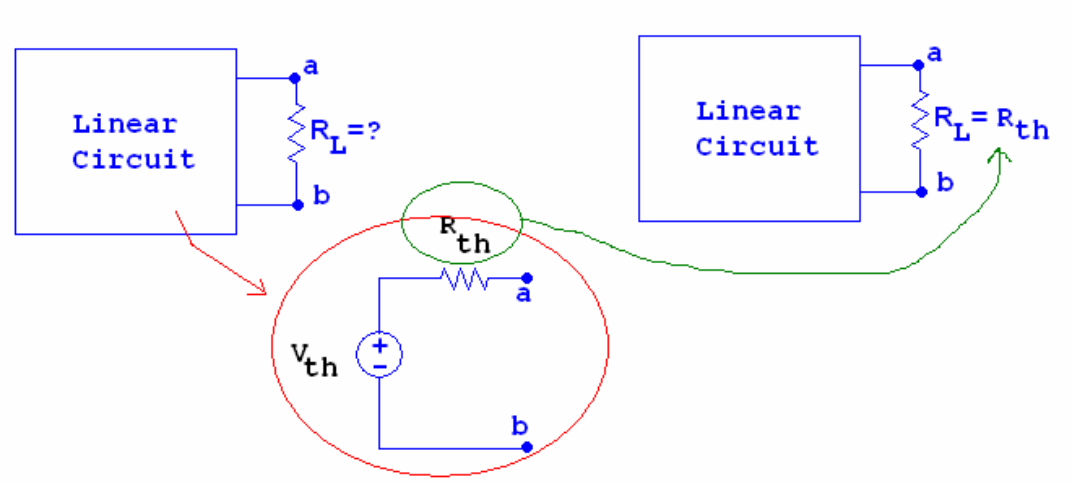
NET1LAB Hybrid Class (202&208) Dr. Charles Kim

Mobile Studio (MS)-06 - Thevenin Theorem and Maximum Power Transfer

1. Thévenin's theorem: Thévenin's theorem says that any two-terminal circuit with linear e lements can be represented with an equivalent circuit containing a single voltage source ("Thevenin Voltage", V_{th}) in series with a single resistor ("Thevenin Resistor", R_{th}) as illustrated below.



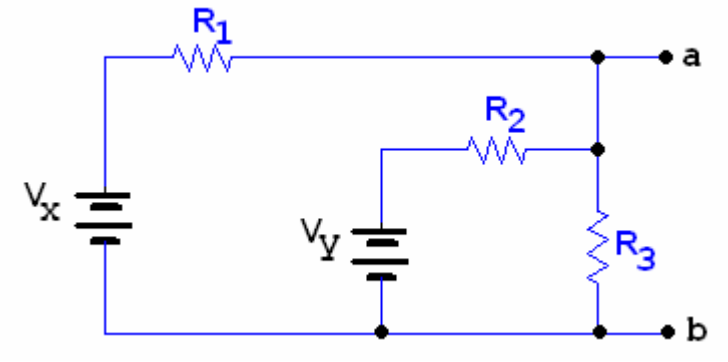
2. Maximum Power Transfer: What it says is that the value of the load resistance that absorbs the maximum power from a two-terminal circuit is equal to the Thévenin resistance. In other words, to deliver the maximum power from a circuit (like an audio amplifier) to a load (like a speaker), the load resistance (i.e., the speaker resistance) must be the same as the circuit's resistance (i.e., the Thevenin resistance of the circuit.), as illustrated below.



When the maximum transfer condition is met (i.e. $R_L = R_{th}$), the total resistance of the circuit is $2R_{th}$. Since the current through the load is $I_L = \frac{V_{th}}{2R_{th}}$, the power delivered to the load will be: $P_L = I_L^{\,2} \cdot R_{th} = \frac{V_{th}^{\,2}}{4R_{th}}$.

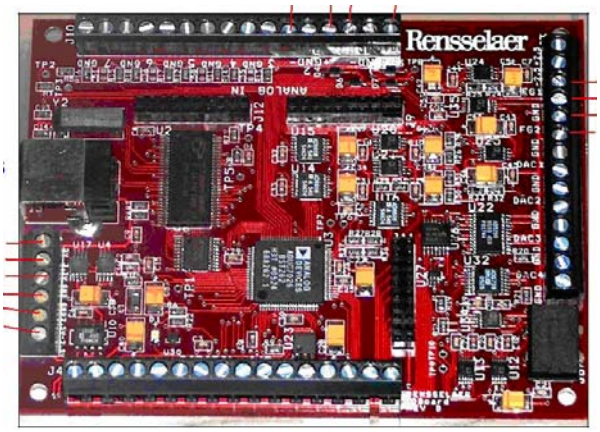
PRE-LAB -6: **Name:** _____

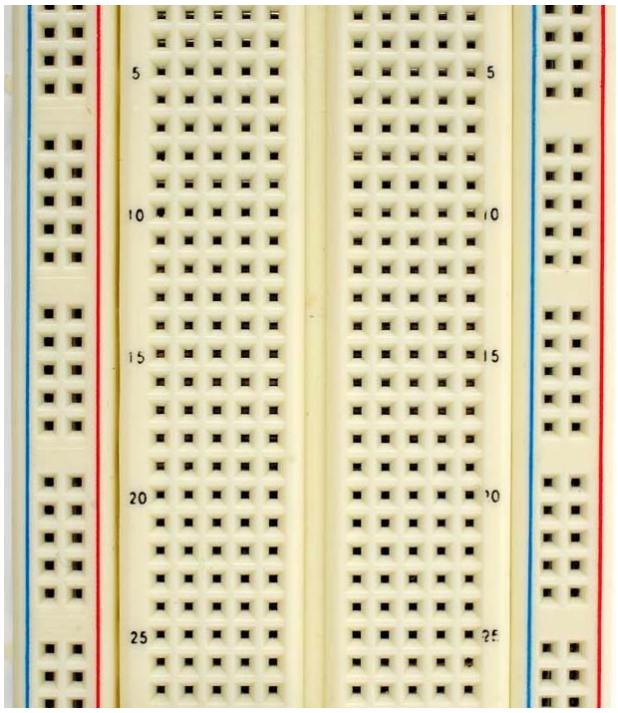
1. Find the general Thevenin voltage and resistance equations using R1, R2, R2, Vx, and Vy at the terminals **a** and **b** for the network shown below. ***Note that your generation equation must also be written into the first box of the MS-06 Procedure page.***



2. If R1=R2=R3=1KΩ, (a) what value of load resistance connected between **a** and **b** would get the maximum power from the circuit? and (b)what would be the value of the power if Vx=5[V] and Vy=2.5[V]?

3. Implement the circuit of using the Instrumentation board and the breadboard.

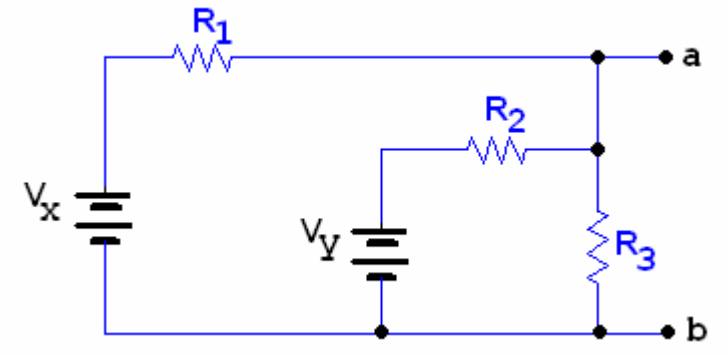




MS-05 Procedure

1. Write your general Thevenin voltage equation and Thevenin Resitance equation below:

2. Construct the circuit on the breadboard as shown below. Randomly select three different resistors (for R1, R2, and R3) in the range of [100Ω - 1000Ω]. (*Note: Choose different values of resistance for R1, R2, and R3.) Apply V_x and V_y with sources of 5 [V] and 2.5 [V] from the instrumentation board, respectively.



3. Now, with the values chosen in the step 2 above, find the numeral values of Thevenin voltage and Thevenin resistance (using the equations in the box of the step 1 above.)

V_{th}: _____

R_{th}: _____

4. In rudimentary way, we will verify the result with measurement:
   (a) Measure the open-circuit voltage between **a** and **b** of the circuit:_____
   (b) Do the measured and calculated values match? _____
   (c) Now we are going to connect a resistor between **a** and **b**, and measure the voltage across. Our target here is, by applying the maximum power transfer condition of the resistor (which must be the same as the Thevenin resistance), to find the power consumed by the inserted

resistor, and we keep selecting, inserting, and measuring the voltage across, until we are sure we get the maximum power delivered to the inserted resistor. Here, you are not totally blind. Since you have your calculation result above. So, now select at least 10 resistors from the supply box, and insert it between **a** and **b**, and measure the voltage, one at a time. Record your results below:

No	Resistor Value (R)	Measured Voltage between **a** and **b** (V)	Calculated Power (P) by V^2/R
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

(d) Plot P vs R using the table obtained in (c) above.

(e) Now, do you find the Thevenin resistance of the circuit from the above plot?

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REPORT

Name:_____ ID#:_____ Group#:_____

1. What would be easier and simpler way to find the Thevenin Circuit (instead of following all the processes in the MS lab procedure)? Explain why? And show the method and find the Thevenin equivalent circuit of the problem.

2. Discussions and Comments

3. Logistics (MS-06 Thevenin Theorem and Maximum Power Transfer)
(* This section is not graded, but your honest answers would be appreciated.)

(a) What was most frustrating in the class?

(b) What was most interesting in the class?

(c) How much do you understand the subject?

(d) How confident are you in implementing circuits on the breadboard?

(e) How much are you comfortable with measuring voltage using the instrumentation board and tablet PC?

(f) Was mobile studio a helper (with your understanding and practice of the subject) or a distracter/nuisance ?

(g) Did you get your needed help from the discussion with your team member?

(h) Did you get your needed help from the instructor/TA? Satisfied?