

**EET / CPE 1140**

**Circuits / DC Circuit Fundamentals Lab**

**Fall 2021**

Laboratory Report

Lab # 6

Lab:

Thevenin Equivalent Circuit Analysis

and Maximum Power Transfer Theorem

Submitted by: Bruce Liu

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# Prelab:

R Thevenin:

Diagram

Description automatically generated

R1 || R3 = 2000\*2000/4000 = 1000Ω

R1 || 3 + R5 = 1000 + 1000 = 2000Ω

R (((1 || 3) + 5) || R4­ = 2000\*2000/4000 = 1000Ω

R (((1 || 3) + 5) || 4) + R2 + R6 = 1000 + 470 + 100 = 1570Ω

V Thevenin:

Calendar

Description automatically generated

R5 +R4 = 1000+2000 = 3000Ω

R 5 + 4 || R3 = 3000\*2000/5000 = 1200Ω

V target = R target / ∑ R \* V source = 1200/3200 \* 10 = 3.75V

V target = R target / ∑ R \* V source = 2000/3000 \* 3.75 V = 2.5V

Thevenin Circuit:

Diagram

Description automatically generated

Rth =1.57kΩ

Eth =2.5V

Thevenin with load:

A picture containing diagram

Description automatically generated

V= I \* R

V Th / (R Th + R load) = I Th

P = I \* V

P = I2 \* R

|  |  |
| --- | --- |
| Expected measured current | Expected power transfer |
| IL (470) = 1.225 mA | P (470) = 0.705 mW |
| IL (1k) = 0.972 mA | P (1k) = 0.944 mW |
| IL (Rth) = 0.796 mA | P (Rth) = 0.994 mW |
| IL (2.7k) = 0.585 mA | P (2.7k) = 0.924 mW |

Lab data:

Initial value measurements:

|  |  |  |  |
| --- | --- | --- | --- |
| Resistor label | Resistor value Ω | Resistors measured Ω | Resistor ranges Ω |
| R1 | 2000 | 1944.96 | 1900.000-2100.000 |
| R2 | 470 | 465.67 | 446.500-493.500 |
| R3 | 2000 | 1982.71 | 1900.000-2100.000 |
| R4 | 2000 | 1969.88 | 1900.000-2100.000 |
| R5 | 1000 | 989.33 | 950.000-1050.000 |
| R 6 | 100 | 98.211 | 95.000-105.000 |
| R L1 | 470 | 463.61 | 446.500-493.500 |
| R L 2 | 1000 | 984.45 | 950.000-1050.000 |
| R L th | 1570 | 1547.84 | 1491.500 – 1648.500 |
| R L 4 | 2700 | 2657.3 | 2565.000-2835.000 |
| R 100 | 100 | 98.834 | 95.000-105.000 |

|  |  |
| --- | --- |
| Full circuit values | Thevenin equivalent circuit |
| Rth=1550.96Ω | R th = 1555.33Ω |
| ES=10.0015V | Null |
| Eth = 2.5221V | V th =2.4999 V |

|  |  |
| --- | --- |
| Full circuit values | Thevenin equivalent circuit |
| IL (470) = 1.251 mA | IL (470) = 1.2367 mA |
| IL (1k) = 0.994 mA | IL (1k) = 0.983 mA |
| IL (Rth) = 0.81372 mA | IL (Rth) = 0.80496 mA |
| IL (2.7k) = 0.59903 mA | IL (2.7k) = 0.5931 mA |

|  |  |
| --- | --- |
| Calculated power transfer NW) | Measured power transfer |
| P (470) = 0.705 mW | P (470) = 0.718 mW |
| P (1k) = 0.944 mW | P (1k) = 0.966 mW |
| P (Rth) = 0.994 mW | P (Rth) = 1.007 mW |
| P (2.7k) = 0.924 mW | P (2.7k) = 0.949 mW |

All lab results are within expected values since the resistors are slightly lower than expected values higher current and power transfer is reasonable. I did try to measure the resistance of the power supply. Acted like a current source of with a Thevenin resistance of 49.990 MΩ.

Multisim simulation:

A picture containing scatter chart

Description automatically generated

Diagram

Description automatically generated

I am fairly certain that this is likely what the intention is. The instructions are misleading.

Conclusion:

I have learned that the value of the perceived voltage and resistance when connecting to an existing circuit can be modeled by Thevenin equivalent. When using voltage divider, I would have to include the Thevenin resistance. Also, the Thevenin voltage will be lesser than the source voltage. The current is found by the Thevenin voltage in series with the Thevenin resistance and the load. Using ohms law.

Since all my resistors were lower than spec but still in range my measured R Thevenin and R Thevenin equivalent circuit was lower than expected. Which also effected the voltage drop. So, the V Thevenin was higher than expected. The load currents were lower than that of the full circuit since the resistance is slightly higher than the full circuit.

The highest power transfer was when the R Thevenin and load resistance was the same. The Thevenin equivalent was measured and confirmed. The reduced circuit did everything the large circuit could.