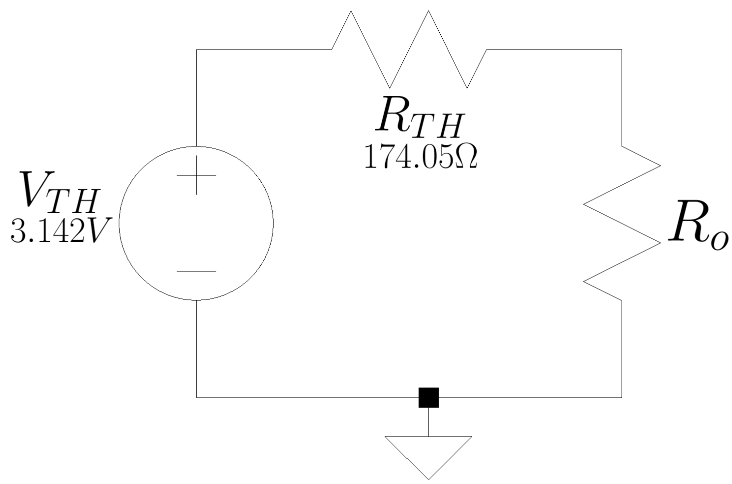
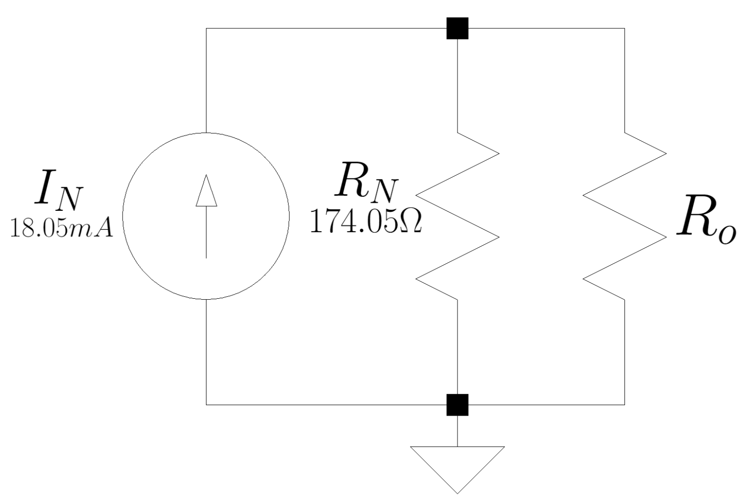
ELECENG 2CI5 Lab 6 Prelab

Raeed Hassan
hassam41

i.
The measured value of the Thevenin voltage, V_{TH}, is equal the voltage measured across V_o after creating an open circuit, and is measured to be $3.142V$. The Thevenin resistance, R_{TH}, is calculated from creating a short circuit across the voltage source and then finding the equivalent resistance across the circuit (excluding R_o). $R_{TH} = (R1||R2||R4||R5) = 174.05\Omega$.



ii.
The value of I_N is equal to the value of the I_{SC} when the Thevenin equivalent circuit is short circuited at the load, therefore $I_N = I_{SC} = \frac{V_{TH}}{R_{TH}} = \frac{3.142V}{174.05\Omega} = 18.05mA$. The Norton resistance, R_N, is equal to the Thevenin resistance of the Thevenin equivalent circuit, therefore $R_N = R_{TH} = 174.05\Omega$.



iii.
The value of R_o that would allow for the maximum power transfer in this circuit is 174.05Ω. This is because the derivative of the power in a Thevenin/Norton circuit is equal to zero when the load resistance is equal to the Thevenin/Norton resistance.

iv.

$$P_{max} = I^2 R_o = (\frac{V}{R_o + R_{TH}})^2 R_o = (\frac{3.142}{174.05 + 174.05})^2 174.05 = 14.18mW$$

The maximum power transfer in the circuit is $14.18mW$.

v.
The theoretical value for R_{TH} can be calculated by creating a short circuit around the voltage source and then finding the equivalent resistance of the circuit (excluding the load resistor, R_o). $R_{TH} = (R1 \,||\, R2 \,||\, R4 \,||\, R5) = (220 \,||\, 1k \,||\, 10k \,||\, 10k) = 174.05\Omega$. The theoretical value for V_{TH} can be found by creating an open circuit around V_o and calculating the open circuit voltage. We can use nodal analysis, there is a single node with voltage at that node equal to the open circuit voltage, V_{oc}.

$$\left[\frac{1}{220} + \frac{1}{1k} + \frac{1}{10k} + \frac{1}{10k}\right] \left[V_1\right] = \left[\frac{4V}{220}\right]$$

$$\left[V_1\right] = \left[\frac{1}{220} + \frac{1}{1k} + \frac{1}{10k} + \frac{1}{10k}\right]^{-1} \left[\frac{4V}{220}\right]$$

$$\left[V_1\right] = \left[3.1642V\right]$$

After performing nodal analysis, we can see that $V_{TH} = V_1 = 3.1642V$. The measured value of V_{TH}, $3.142V$, is very similar to the calculated value of V_{TH}, $3.1642V$.

vi.
The resistor used had a resistance of 220Ω. The voltage for the Thevenin circuit using a similar resistance to the Thevenin resistance is similar to the voltage of the original circuit.