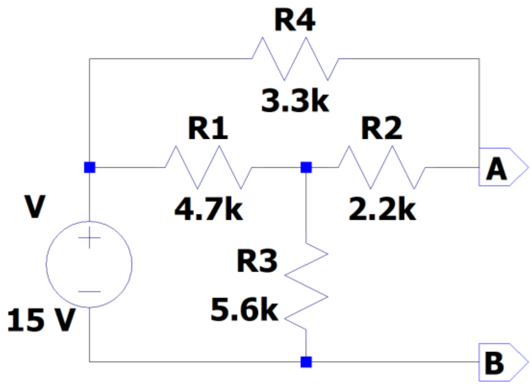
Ex.No.2	VERIFICATION OF THEVENIN'S AND MAXIMUM POWER TRANSFER THEOREM
Date:	

AIM:

(a) To obtain the Thevenin's equivalent circuit across the terminals A and B for the given circuit and to calculate the load current for 1kΩ load resistance.



(b) To verify the maximum power transfer theorem for the same circuit.

APPARATUS REQUIRED:

S.No	Name of the apparatus	Range	Quantity
1	RPS	(0-30)V	1
2	Resistor	2.2kΩ,3.3kΩ,4.7kΩ, 5.6kΩ	1
3	Multimeter		1
4	Decade Resistance box		1
5	Ammeter	(0-30)mA	1
6	Voltmeter	(0-15)V	1
7	Bread board	------	1
8	Connecting wires	------	As required

THEORY:

(a) Thevenin's Theorem:

This theorem states that a network composed of lumped, linear circuit elements may , for the purposes of analysis of external circuit or terminal behaviour, be replaced by a voltage source V(s) in series with a single impedance.

Thevenin's theorem simplifies the method of finding current through any specified branch. For this purpose we have to find two things:

1. Thevenin's Resistance Rth

2. Thevenin’s Voltage Vth

To find Vth

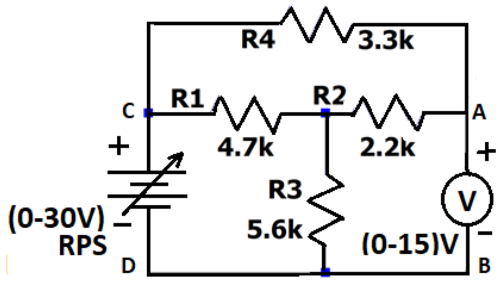


Figure 1.

To find Rth

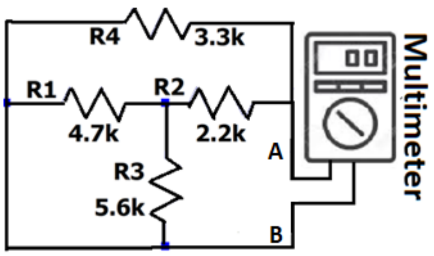


Figure 2.

Procedure to find Rth

1. Remove the voltage source and short the terminals (named C and D in the circuit diagram).

2. Resistance measured between A and B terminals is the Thevenin’s resistance.

Procedure to find Vth

1. Remove the load resistance if any.
2. Measure the voltage across the open circuited terminals (here across A B).
3. Thevenin’s equivalent circuit is obtained by connecting Vth and Rth in series.
1. Connect the resistance 1K in series with Thevenin’s equivalent circuit and measure current across the load
2. Verify the current measured in Thevenin’s equivalent circuit and original circuit.

Thevenin’s equivalent circuit

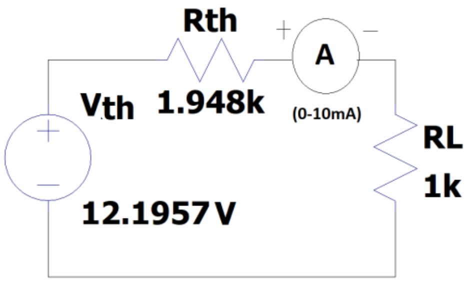


Figure 3.

(b) Maximum power transfer theorem

The maximum power transfer theorem states that maximum power is delivered from a source to the load resistance when the load resistance is equal to source resistance. (RL = Rth is the condition required for maximum power transfer).

Procedure

1. Connect the circuit as shown in figure 3.
2. Vary the load resistance in steps and note down voltage across the load and current flowing through the circuit.
3. Calculate power delivered to the load by using formula P=V*I.
4. Draw the graph between resistance and power (resistance on X- axis and power on Y-axis).
5. Verify the maximum power is delivered to the load when RL = Rth for DC.

Maximum power transfer calculations:

Load current= I= Vth/ (Rth + RL)

P= Power delivered to load = $(Vth / (Rth + RL))^{2}$ RL

Maximum power transferred = $Vth^2/4RL$

Tabular column

S. No.	RL (Ω)	RTH (Ω)	IL(mA)	PL(mW)
1	1000	1948		
2	1950	1948		
3	2200	1948		
4	3300	1948		

Model graph

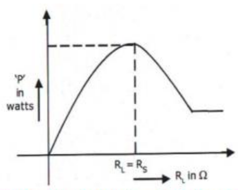
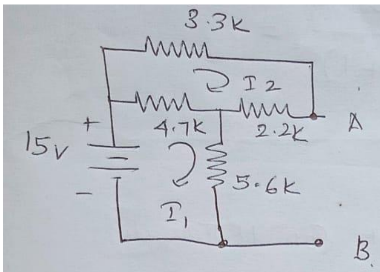


Fig – 7.2 Output Graph of Maximum Power Transfer Theorem

Theoretical calculations:

To find Vth – Mesh analysis – (Vth = sum of voltage drop across 2.2k and 5.6k ohm resistors)



Apply KVL around mesh ①.

$$\cancel{47}\ 4700(I_1 - I_2) + 5600(I_1) = 15.$$

$$10{,}300 I_1 - 4700 I_2 = 15 \quad -①.$$

Apply KVL around Mesh ②.

$$3300 I_2 + 2200 I_2 + 4700(I_2 - I_1) = 0$$

$$-4700 I_1 + 10{,}200 I_2 = 0. \quad -②$$

Solving equation 1 and 2.

$$I_1 = 1.844 mA.$$

$$I_2 = 8.497 \times 10^{-4} A.$$

$$= 2200(8.497 \times 10^{-4}) + (5600 \times 1.844 \times 10^{-3})$$

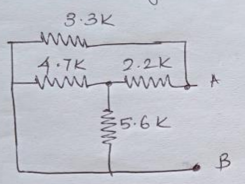
$$= 1.86934 + 10.3264$$

$$V_{th} = 12.19574V$$

Rth is calculated by removing all the sources present in the network

(Current sources are open circuited and voltage sources are short circuited)

Calculation of Rth.



$$\Leftarrow ((5.6 \parallel 4.7) + 2.2) \parallel 3.3k$$

$$\Downarrow$$

$$= (2.553 + 2.2) \parallel 3.3$$

$$\Downarrow$$

$$4.753 \parallel 3.3$$

$$\Downarrow$$

$$1.948$$

Maximum power transfer theorem

Calculation of load current for 1KΩ resistor

$$I = \frac{V_{Th}}{R_{Th} + R_L} = \frac{12.1957}{(1.948 + 1)} = 4.1369\,mA$$

$$P = I_L^2 R_L$$

$$= (4.1369 \times 10^{-3})^2 \times 1000$$

$$= 17.1142\,mW$$

Maximum power transferred

Condition for maximum power $R_{Th} = R_L$

$$= \frac{V_{Th}^2}{4 R_L}$$

$$= \frac{(12.1957)^2}{4 \times 1948}$$

$$= 19.088\,mW$$