Dhaka International University

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DEPARTMENT OF CSE

LAB REPORT

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REPORT NO : 03

REPORT ON : Varification of Kirchhoff's Current Law (KCL) and Current Divider Rule (CDR)

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DATE OF SUBMISSION :

Lab Report: Varification of Kirchhoff's Current Law (KCL) and Current Divider Rule (CDR).

Objective:

- To learn analysis of DC parallel circuit.
- To verify Kirchhoff's Current Law (KCL)
- To verify Current Divider Rule (CDR)

Theory:

... Parallel Circuit:

A parallel circuit is defined by the fact that all components share two common nodes. The voltage is the same across each components and will equal to the applied source voltage. The total supplied current may be found by dividing the voltage source by the equivalent parallel resistance. It may also be found by summing the currents in all the brances. The current through any resistor branch maybe found by dividing the source voltage by the resistor value. Consbequently, the currents in a parallel circuit are inversely propotional to the associated resistances. An alternate technique to find a particular current is the Current Divider rule. Parallel circuit have following rules:

01. Voltage is the same across each branch of a parallel circuit.

02. The sum of the individual branch currents equals the total current in the circuit

03. The reciprocal of the total resistance equals the sum of the reciprocals of the individuals branch resistances.

The total or equivalent resistance (R_T) is given by

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \ldots\ldots + \frac{1}{R_n}$$

If there are only two resistors in parallel, it is more convenient to use,

$$R_T = \frac{R_1 R_2}{R_1 + R_2}$$

... Kirchhoff's Current Law (KCL):

Kirchhoff's current law is based upon the fact that at any connecting point in a network the sum of the currents flowing toward the point is equal to the sum of the currents flowing away from the point. The Law is illustrated in the examples in figure 01, where the arrows shows the directions in which it is given that the currents are flowing. (The number alongside each arrow is the amount of current associated with the arrow.)

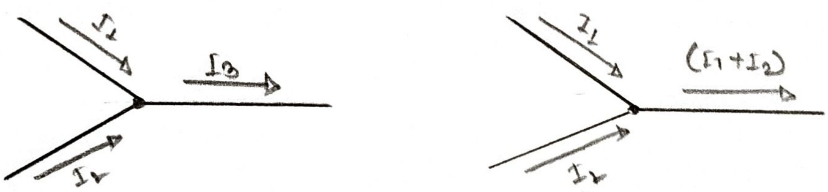

Figure: 01

However, by Kirchhoff's current Law, $I_3 = I_1 + I_2$ and thus, as shown in fig 01, we need to use only two current designations. In other words, if we know any two of three currents, we can find the third current. In the same way. If there are say four branch currents entering and leaving a node point, and if we know any three of the currents, we can then find the fourth current and so on.

$$I_1 + I_2 = I_3$$

$$I_1 + I_2 - I_3 = 0$$

- The Kirchhoff's current Law can be state in the form:
- The algebric sum of the currents at a node (junction) is equals to zero.

∴ Current Divider Rule:

Applying current divider rule (CDR) for a circuit of only two resistors in parallel as shown in figure 02.

$$I_1 = \frac{R_2}{R_1 + R_2} \cdot I_T$$

And $$I_2 = \frac{R_1}{R_1 + R_2} I_T$$

For a parallel combination of N resistors, the current I_1 through R_1 is

$$I_1 = \frac{\frac{1}{R_1}}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots\ldots + \frac{1}{R_N}} \cdot I_T$$

Equipment:

- Variable DC Power supply
- Digital Multimeter
- Resistances - 3 pieces
- Trainer Board
- Connecting wires

Circuit Diagram:

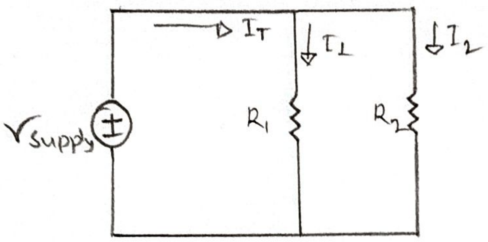

Fig: 2

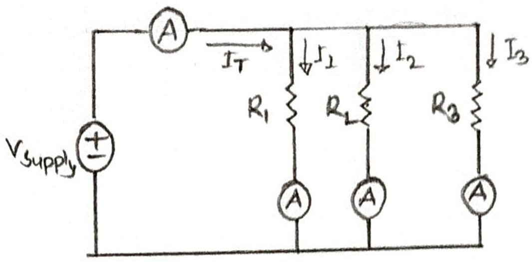

Fig: 3

Procedure:

01. Measures the resistance by using ohmmeter and record the values in table 1.

02. construct the circuit as shown in Figure 3.

03. The measure input resistance or equivalent resistance R_T using ohmmeter and record that value in table 01.

04. Turn on the DC power supply and set the DC power supply to

05. Measure the currents I_T, I_1, I_2 and I_3 by using Ammeter and record it in the table 01.

06. Calculate I_1, I_2 and I_3 using current Divider Rule (CDR).

Experimental Data:

— Table 01

Resistance	Equivalent Resistance, R_T		Entering current, I_E	Current Flow		
	Masured by Multimeter	calculated		Measured by Multimeter	Using CDR	Error %
$R_1 = 1.2 k\Omega$	0.62 kΩ	0.62 kΩ	24.01 mA	$I_1 = 12.54 mA$	12.405 mA	1.0882
$R_2 = 3.178 k\Omega$				$I_2 = 4.73 mA$	4.684 mA	0.982
$R_3 = 2.15 k\Omega$				$I_3 = 7 mA$	6.924 mA	1.0976

Calculation:

Entering current, $I_E = 24.01 \text{ mA}$

Leaving current, $I_L = I_1 + I_2 + I_3$

$= 12.54 + 4.73 + 7 = 24.27 \text{ mA}$

$\therefore$ Error in $I_L \% = \dfrac{24.27 - 24.01}{24.01} \times 100\%$

$= 1.0828\%$

Using CDR,

$$I_1 = \frac{R_T}{R_1} . I_E = \frac{0.62}{1.2} \times 24.01 = 12.405 \text{ mA}$$

$$I_2 = \frac{R_T}{R_2} . I_E = \frac{0.62}{3.178} \times 24.01 = 4.684 \text{ mA}$$

$$I_3 = \frac{R_T}{R_3} . I_E = \frac{0.62}{2.15} \times 24.01 = 6.9238 \text{ mA}$$

$$\therefore \text{Error in } I_1\% = \frac{I_1(\text{measured}) - I_1(\text{calculated})}{I_1(\text{calculated})} \times 100\%$$

$$= \frac{12.54 - 12.405}{12.405} \times 100\%$$

$$= 1.0882\%$$

$$\therefore \text{Error in } I_2\,\% = \frac{I_2\,(\text{measured}) - I_2\,(\text{calculated})}{I_2(\text{calculated})} \times 100\,\%$$

$$= \frac{4.73 - 4.684}{4.684} \times 100\%$$

$$= 0.982\,\%$$

$$\therefore \text{Error in } I_3\,\% = \frac{I_3(\text{measured}) - I_3(\text{calculated})}{I_3(\text{calculated})} \times 100\%$$

$$= \frac{7 - 6.924}{6.924} \times 100\%$$

$$= 1.0976\,\%$$

Conclusion:

From the above experiment it we have studied and verified that the observation value is approximately same to the conclusion value in parallel circuit. The result verify the Kirchhoff's Current Law and Current Divider Rule.

Precautions:

01. Ensure all connections are correct and secure.
02. Use a reliable multimeter for current measurements.
03. Turn off the power supply while modifying the circuit
04. Avoid exceeding the current rating of components.
05. Handle resistors and wires carefully to prevent damage.
06. Ensure proper grounding to avoid errors in current distribution.