

Exp no: E1 (Study of ohm's law)

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Theory :

Ohm's law: Ohm's law deals with the relationship between voltage and current in a conductor.

This law states that at fixed temperature the current passing through a conductor between two points is proportional to the voltage (or potential difference) across the two points and inversely proportional to the resistance between them. In mathematical terms it is written as $V = IR$, where

V is the potential difference in Volts, I is the current in Amperes and R is a constant. The constant R is called the resistance and is measured in Ohms (Ω). The potential difference is also known as voltage drop and is denoted by both E and V .

Current: The electric current through a conductor is defined as the amount of electric charge flowing through the conductor in unit time. This is expressed as $I = \frac{Q}{t}$ /

, where Q is the charge in

Coulombs (C), t is in seconds and unit of I

is Ampere.

Voltage: To move an electron in a conductor in any direction requires some work or energy transfer. This is performed by an external force created by chemical sources (batteries), generators or power supplies.

Voltmeter: A voltmeter is an instrument used for measuring electrical potential difference between two points in an electric circuit. Analog voltmeters move a pointer across a scale in proportion to the voltage of the circuit; digital voltmeters give a numerical display of voltage by

use of an analog to digital converter.

Voltmeters are made in a wide range of styles. Instruments permanently mounted in a panel are used to monitor generators or other fixed apparatus. Portable instruments, usually equipped to also measure current and resistance in the form of a multimeter, are standard test instruments

6

used in electrical and electronics work. Any measurement that can be converted to a voltage can be displayed on a meter that is suitably calibrated; for example, pressure, temperature, flow or level in a chemical process plant. Voltmeter is a measuring instrument containing an indicating needle over a dial showing Volts. The voltage is measured by placing two probes on two points across an element. Digital voltmeters show the numerical values on a LCD screen.

General purpose analog voltmeters may have an accuracy of a few percent of full scale, and are used with voltages from a fraction of a volt to several thousand volts. Digital meters can be made with high accuracy, typically better than 1%. Specially calibrated test instruments have higher accuracies, with laboratory instruments capable of measuring to accuracies of a few parts per million. Meters using amplifiers can measure tiny voltages of microvolts or less.

Ammeter: An ammeter is a measuring instrument used to measure the electric current in a circuit. Electric currents are measured in amperes (A), hence the name. Instruments used to measure smaller currents, in the milli ampere, microampere range, are designated as milli ammeters, micro ammeters or. Early ammeters were laboratory instruments which relied on the Earth's magnetic field for operation. By the late 19th century, improved instruments were designed which could be mounted in any position and allowed accurate measurements in electric power systems.

Ammeter is a measuring instrument containing an indicating needle over a dial showing current in Amperes. The current passing through an element is measured by placing the two probes in series through the element. Digital ammeters show the numerical values on a LCD screen.

Wattmeter: A typical wattmeter in educational labs has two voltage coils (pressure coils) and a current coil. We can connect the two pressure coils in series or parallel to each other to change the ranges of the wattmeter. Another feature is that the pressure coil can also be tapped to change

the meter's range. If the pressure coil has range of 300 volts, the half of it can be used so that the range becomes 150 Volts.

The traditional analog wattmeter is an electrodynamic instrument. The device consists of a pair of fixed coils, known as current coils, and a movable coil known as the potential coil. The current coils connected in series with the circuit, while the potential coil is connected in parallel. Also, on analog wattmeter, the potential coil carries a needle that moves over a scale to indicate the measurement. The strength of this field is proportional to the line current and in phase with it. The potential coil has, as a general rule, a high-value resistor connected in series with it to reduce the current that flows through it. The result of this arrangement is that on a dc circuit, the deflection of the needle is proportional to both the current and the voltage, thus conforming to the equation $W=VA$ or $P=VI$.

Multimeter: A multimeter or a multi tester, also known as a VOM (Volt-Ohm meter), is an electronic measuring that combines several measurement functions in one unit. A typical

7

multimeter would include basic features such as the ability to measure voltage, current, and resistance. Analog multimeter use a micro ammeter whose pointer moves over a scale calibrated for all the different measurements that can be made. Digital multimeter (DMM, DVOM) display the measured value in numerals, and may also display a bar of a length proportional to the quantity being measured. Digital multimeter are now far more common than analog ones, but analog multimeter are still preferable in some cases, for example when monitoring a rapidly varying value.

A Multimeter is a measuring instrument that combines several functions in one unit. Most instruments include an ammeter, voltmeter and an ohmmeter. Nowadays, both analog and digital meters are available. Modern multimeters can measure other parameters also.

Resistors: A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. The ratio of the voltage applied across a resistor's terminals to the intensity of current in the circuit is called its resistance, and this can be assumed to be a constant (independent of the voltage) for ordinary resistors working within their ratings. The current through a resistor is in direct proportion to the voltage across the resistor's terminals. This

relationship is represented by Ohm's law: $V = IR$, where I is the current through the conductor in units of amperes, V is the potential difference measured across the conductor in units of volts, and R is the resistance of the conductor in units of ohms.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel-chrome). Resistors are

8

also implemented within integrated circuits, particularly analog devices, and can also be integrated into hybrid and printed circuits.

The electrical functionality of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. When specifying that resistance in an electronic design, the required precision of the resistance may require attention to the manufacturing tolerance of the chosen resistor, according to its specific application. The temperature coefficient of the resistance may also be of concern in some precision applications. Practical resistors are also specified as having a maximum power rating which must exceed the anticipated power dissipation of that resistor in a particular circuit: this is mainly of concern in power electronics applications. Resistors with higher power ratings are physically larger and may require heat sinks. In a high-voltage circuit, attention must sometimes be paid to the rated maximum working voltage of the resistor.

Resistor Color Coding: A 2260 ohm, 1% precision resistor with 5 color bands (E96 series), from top 2-2-6-1-1; the last two brown bands indicate the multiplier ($\times 10$), and the 1% tolerance. The larger gap before the tolerance band is somewhat difficult to distinguish. To distinguish left from right there is a gap between the C and D bands.

- band A is first significant figure of component value (left side)
- band B is the second significant figure (Some precision resistors have a third significant figure, and thus five bands.)
- band C is the decimal multiplier

- band D if present, indicates tolerance of value in percent (no band means 20%)

For example, a resistor with bands of yellow, violet, red, and gold will have first digit 4 (yellow in table below), second digit 7 (violet), followed by 2 (red) zeros: 4,700 ohms. Gold signifies that the tolerance is $\pm 5\%$, so the real resistance could lie anywhere between 4,465 and 4,935 ohms. Resistors manufactured for military use may also include a fifth band which indicates component failure rate (reliability); refer to MIL-HDBK-199 for further details. Tight tolerance resistors may have three bands for significant figures rather than two, or an additional band indicating temperature coefficient, in units of ppm/K. All coded components will have at least two value bands and a multiplier; other bands are optional.

The standard color code per EN 60062: 2005 is as follows:

Color Significant
figures

Multiplier Tolerance Temp. Coefficient
(ppm/K)

Black 0 $\times 10^0$ – 250 U Brown 1 $\times 10^1$ $\pm 1\%$ F 100 S Red 2 $\times 10^2$ $\pm 2\%$ G 50 R
Orange 3 $\times 10^3$ – 15 P Yellow 4 $\times 10^4$

($\pm 5\%$) – 25 Q Green 5 $\times 10^5$ $\pm 0.5\%$ D 20 Z

Blue 6 $\times 10^6$ $\pm 0.25\%$ C 10 Z Violet 7 $\times 10^7$ $\pm 0.1\%$ B 5 M Gray 8 $\times 10^8$
 $\pm 0.05\%$

($\pm 10\%$) A 1 K

White 9 $\times 10^9$ – – Gold – $\times 10^{-1}$ $\pm 5\%$ J –
Silver – $\times 10^{-2}$ $\pm 10\%$ K –

10

Breadboard: A breadboard (or proto board) is usually a construction base for prototyping of electronics. The term "breadboard" is commonly used to refer to a solder less breadboard (plug board). A breadboard originally was a flat wooden cutting board used to support a loaf of bread (or other foods) while it was being sliced; this original meaning is still in use, but has a new additional meaning as "a base for prototyping". The concept of "bread boarding" as prototyping is not confined to electronic design; "mechanical breadboards" have been and continue to be used by mechanical engineers.

Because the solderless breadboard for electronics does not require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design.

Older breadboard types did not have this property. A strip board (vero-board) and similar prototyping printed circuit boards, which are used to build semi-permanent soldered prototypes or one-offs, cannot easily be reused. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs).

Power Supplies: A power supply is a device that supplies electric power to an electrical load.

The term is most commonly applied to electric power converters that convert one form of electrical energy to another, though it may also refer to devices that convert another form of energy (mechanical, chemical, solar) to electrical energy. A regulated power supply is one that controls the output voltage or current to a specific value; the controlled value is held nearly constant despite variations in either load current or the voltage supplied by the power supply's energy source.

11

Every power supply must obtain the energy it supplies to its load, as well as any energy it consumes while performing that task, from an energy source. Depending on its design, a power supply may obtain energy from:

- Electrical energy transmission systems. Common examples of this include power supplies

that convert AC line voltage to DC voltage.

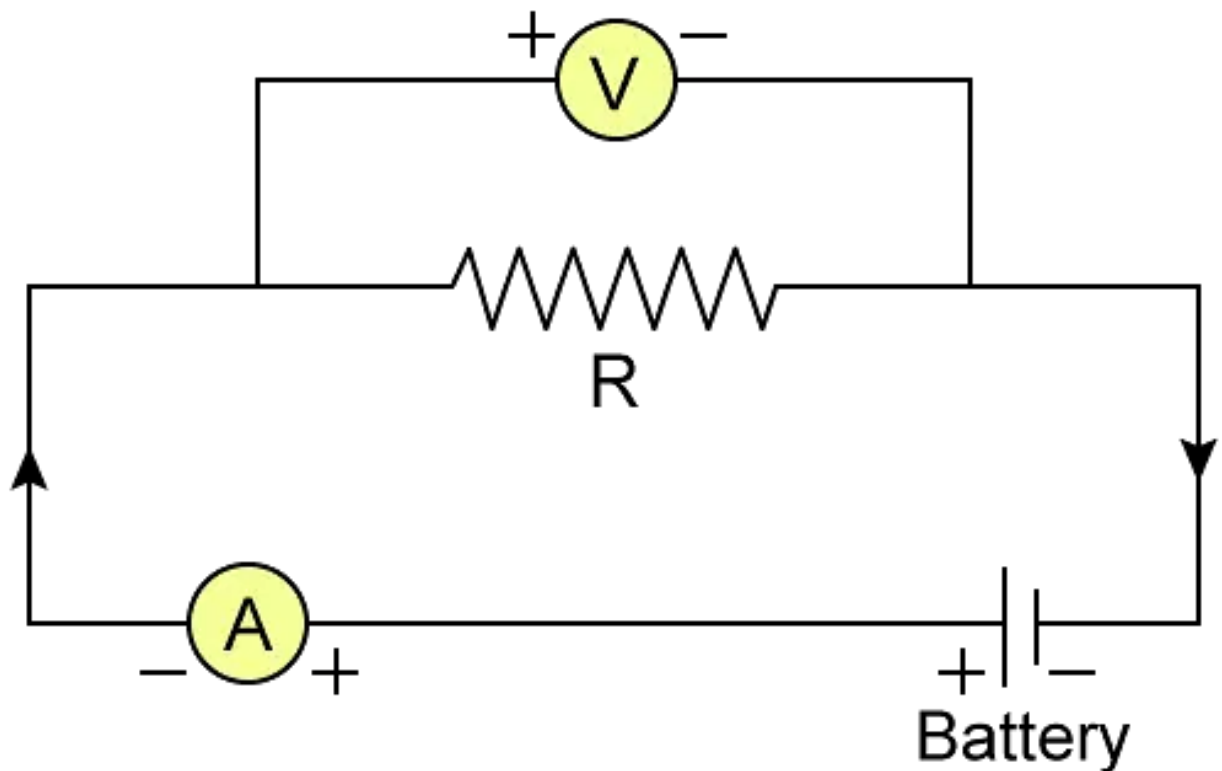
- Energy storage devices such as batteries and fuel cells.
- Electromechanical systems such as generators and alternators.
- Solar power.

A power supply may be implemented as a discrete, stand-alone device or as an integral device that is hardwired to its load. Examples of the latter case include the low voltage DC power supplies that are part of desktop computers and consumer electronics devices.

Commonly specified power supply attributes include:

- The amount of voltage and current it can supply to its load.
- How stable its output voltage or current is under varying line and load conditions.
- How long it can supply energy without refueling or recharging (applies to power supplies that employ portable energy sources).

Circuit diagram :



Supply Voltage (V)	V	I
1	1000 mv	500 mA
2	2 v	1000 mA
3	3 v	1.50 A
4	4 v	2.00 A
5	5 v	2.50 A
6	6 v	3 A
7	7 v	3.50 A
8	8 v	4 A

Supply Voltage (V)	V	I
9	9 v	4.50 A
10	10 v	5 A

[DATA TABLE]

Graph :

x-axis labeled "Voltage (V)" and a vertical y-axis labeled "Current (A)". the voltage values 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 on the x-axis and the corresponding current values from the table on the y-axis.

Plotting the data points on the graph using dots or small circles. Also Plotting this point on the graph by placing a dot at the intersection of the x-value **voltage (v)** and the y-value **Ampere(I)**

Calculation :

X axis – 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

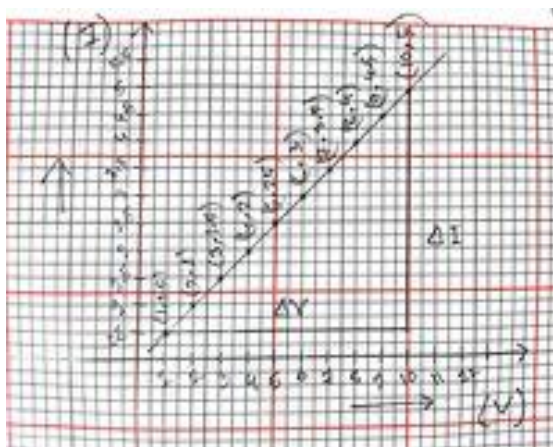
Y axis - 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5.

the slope (m) of a line given two points (x1, y1) and (x2, y2):

$$m = (y_2 - y_1) / (x_2 - x_1)$$

$$= (5 - 0.5) / (10 - 9)$$

$$= 4.5$$



Discussion :

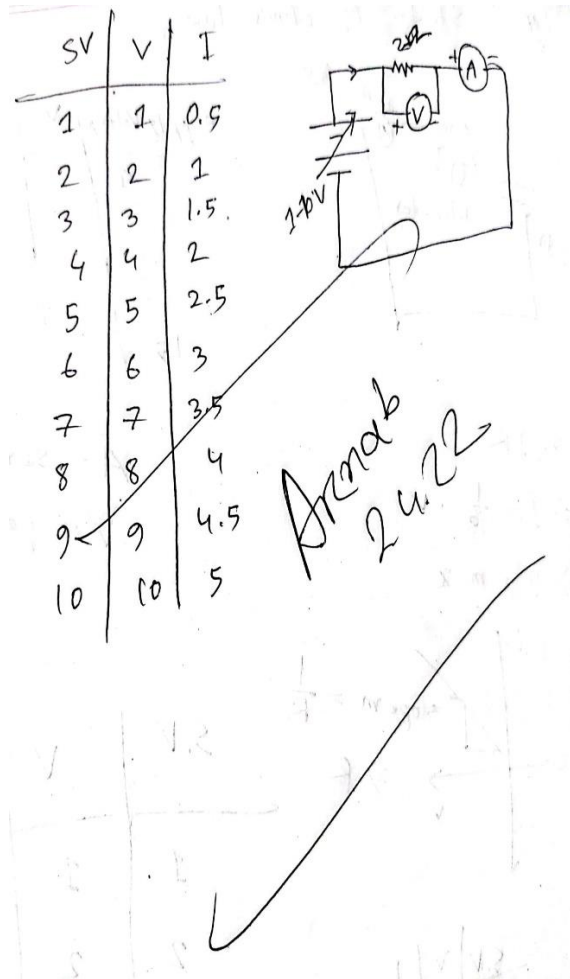
Ohm's law is a fundamental principle in electrical engineering and physics that describes the relationship between voltage, current, and resistance in an electrical circuit.

According to Ohm's law, the current flowing through a conductor between two points is directly proportional to the voltage across the two points and inversely proportional to the resistance between them. This means that if the voltage across a circuit is increased, the current through the circuit will also increase, assuming the resistance remains constant. Similarly, if the resistance of the circuit is increased, the current through the circuit will decrease, assuming the voltage remains constant.

The mathematical formula for Ohm's law is $I = V/R$, where I is the current in amperes, V is the voltage in volts, and R is the resistance in ohms.

In conclusion, Ohm's law is a fundamental principle in electrical engineering that describes the relationship between voltage, current, and resistance in an electrical circuit. It is a powerful tool for designing and analyzing circuits.

Signed Data Sheet :



Screenshot of Tinkercard :

