Rajshahi University of Engineering and Technology

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Experiment Name: Study the relationship between phase and line voltages of wye connected three phase balanced system.

Objectives: To measure the phase voltage and line voltage of a wye-wye connection system and compare the relationship between them.

Theory: A balanced wye-wye system is a three-phase system with a balanced wye connected source and a balanced wye connected load. It is also called there-phase four wire system. Because it has neutral wire as well as regular wire. It has three sources, and these sources have the same starting point. They have phase difference 120 degree from each other. In a balanced wye-wye connection, all loads are the same and the magnitude of each source are the same as well. The sum of all voltages is zero for a balanced connection. The line voltage (V_L) is voltage between two lines. Where the phase voltage (V_P) is the voltage between the line and the neutral line.

The relationship between line voltage and phase voltage in wye-wye connection is given by,
$V_L = \sqrt{3}\, V_P$

And the line current (I_L) is equal to the phase current (I_P) in a balanced Wye connection:
$I_L = I_P$

Required Apparatus:

- Three-phase AC power supply
- Resistive load
- Ammeter
- Connecting wires
- Multimeter

Circuit Diagram:

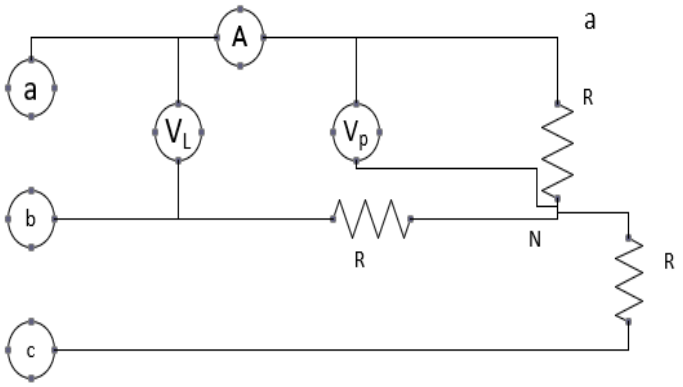
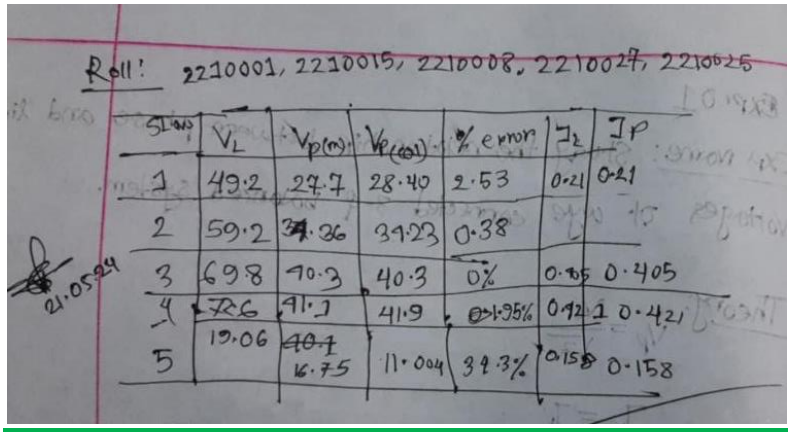


Fig. Three phase Y-Y connect balanced system.

Data Table:

Sl No.	V_L	V_p (m)	V_p (Cal)	%Error	I_L	I_P
1	49.2	27.7	28.40	2.53	0.21	0.21
2	69.8	40.3	40.3	0%	0.405	0.405
3	72.6	41.1	41.9	1.95%	0.421	0.421
4	19.06	16.75	11.004	34.3%	0.158	0.158

Data Table from lab:



Calculation:

For 1st calculation,

V_L=49.2 V, V_P(Cal) = $\frac{VL}{\sqrt{3}}$ =28.40 V, V_P(m) =27.7 V, Error=$\left|\frac{\text{Vp (m)} - V_{P(cal)}}{\text{Vp (m)}}\right|$=2.53%

For 2nd calculation,

V_L=69.8 V, V_P(Cal) = $\frac{VL}{\sqrt{3}}$ =40.3 V, V_P(m) =40.3 V, Error=$\frac{\text{Vp (m)} - V_{P(cal)}}{\text{Vp (m)}}$=0%

For 3rd calculation,

V_L=72.6 V, V_P(Cal) = $\frac{VL}{\sqrt{3}}$ =41.9 V, V_P(m) =41.1 V, Error=$\left|\frac{\text{Vp (m)} - V_{P(cal)}}{\text{Vp (m)}}\right|$=1.95%

For 4tht calculation,

V_L=19.06 V, V_P(Cal) = $\frac{VL}{\sqrt{3}}$ =11.004 V, V_P(m) =16.75 V, Error=$\left|\frac{\text{Vp (m)} - V_{P(cal)}}{\text{Vp (m)}}\right|$=34.3%

Discussion: In this experiment, we have measured the line voltages and phase voltages. Then we calculated the phase voltages by using the formula of ($V_L = \sqrt{3}\ V_P$). The phase voltages from calculated and measured are almost the same. But this result has some errors. This error is caused for not using multimeter properly. If we neglect the error, this result confirms that the relation between phase voltage and line voltage is ($V_L = \sqrt{3}\ V_P$). We have also measured the line current and the phase current. In theoretically, we know that the line and phase current are same in a balanced wye-wye connection. The result also proved that.

References

Christopher, K., & Sadike, M. N. (n.d.). *Fundamentals of Electric Circuits.* New York: McGRAW-HILL Education International.

Star Connection in a 3 Phase System. (n.d.). Retrieved from Circuit Globe : https://circuitglobe.com/star-connection-in-3-phase-system.html