"Heavens Light is Our Guide"

Rajshahi University of Engineering and Technology

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Course title: Circuits & Systems - II

Report Number: 01

Experiment Name: **Study of the relation between phase voltage and line voltage in a wye connected 3 – ф balanced system.**

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Experiment 1

1.1 Name of the Experiment: Study of the relation between phase voltage and line voltage in a wye connected 3 – ϕ balanced system.

1.2 Theory: In a balanced 3 – ϕ Y – Y system, if phase voltage of a phase is considered as ,

$$V_{an} = V_p \angle 0° \text{ and } V_{bn} = V_p \angle -120°$$

Then, line – to – line voltage between phase "a" and "b" is,

$$V_{ab} = V_{an} + V_{nb} = V_{an} - V_{bn}; \text{ which is:}$$

$$V_{ab} = \sqrt{3}\, V_p \angle -30°$$

Now, if we consider the magnitude only, we get the relation between phase and line voltage as,

$$V_L = \sqrt{3} V_P \ldots \ldots \ldots (1)$$

1.3 Required Apparatus:

1. AC voltage source
2. Ammeter
3. Multimeter
4. Connecting wire
5. Clamp meter

1.4 Circuit Diagram:

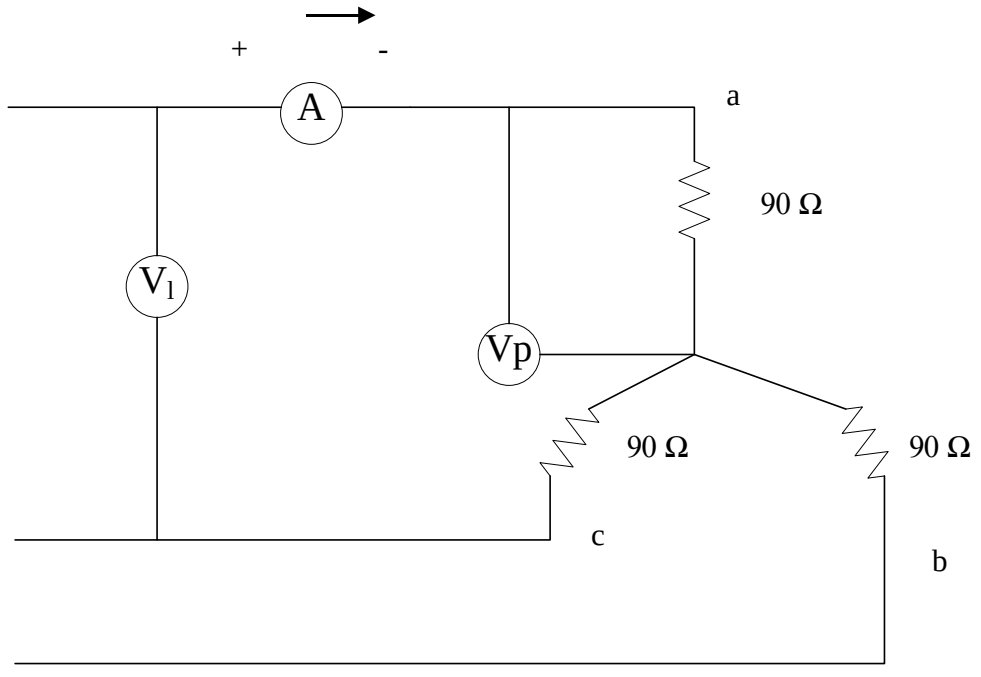

Fig: Balanced 3 – ϕ Y – Y system.

1.5 Calculation:

1. **Reading 1:**

   Line voltage, V_L = 41.7 V

   Measured phase voltage, $V_{P(m)}$ = 23.5 V

   Calculated phase voltage, $V_{P(calc)}$ = 24.07 V

   Error = $\frac{|VP(calc) - VP(m)|}{VP(calc)}$ X 100% = $\frac{|24.07 - 23.5|}{24.07}$ X 100% = 2.43%

2. **Reading 2:**

   Line voltage, V_L =34.1 V

   Measured phase voltage, $V_{P(m)}$ = 19 V

   Calculated phase voltage, $V_{P(calc)}$ = 19.69 V

   Error = $\frac{|VP(calc) - VP(m)|}{VP(calc)}$ X 100% = $\frac{|19.69 - 19|}{19.69}$ X 100% = 3.63%

3. **Reading 3:**

   Line voltage, V_L = 55.5 V

   Measured phase voltage, $V_{P(m)}$ = 31.4 V

   Calculated phase voltage, $V_{P(calc)}$ = 32.04 V

   Error = $\frac{|VP(calc) - VP(m)|}{VP(calc)}$ X 100% = $\frac{|32.04 - 31.4|}{32.04}$ X 100% = 2.05%

4. **Reading 4:**

   Line voltage, V_L = 63.6 V

   Measured phase voltage, $V_{P(m)}$ = 35.6 V

   Calculated phase voltage, $V_{P(calc)}$ = 36.72 V

   Error = $\frac{|VP(calc) - VP(m)|}{VP(calc)}$ X 100% = $\frac{|36.72 - 35.6|}{36.72}$ X 100% = 3.41%

5. **Reading 5:**

   Line voltage, V_L = 71.7 V

   Measured phase voltage, $V_{P(m)}$ = 40.5 V

   Calculated phase voltage, $V_{P(calc)}$ = 41.4 V

   Error = $\frac{|VP(calc) - VP(m)|}{VP(calc)}$ X 100% = $\frac{|41.4 - 40.5|}{41.4}$ X 100% = 2.21%

∴ Average error = $\frac{2.43+3.63+2.05+3.41+2.21}{5}$ = 2.746%

1.6 Table for Studying Relation Between Line and Phase Voltage:

Serial No	Line Voltage, V_L (V)	Measured Phase Voltage, $V_{P(m)}$ (V)	Calculated Phase Voltage, $V_{P(calc)}$ (V)	Percentage of Error (%)	Line Current, I_L (A)	Phase Current, I_P (A)
1	41.47	23.5	24.07	2.43	0.24	0.24
2	34.1	19	19.69	3.63	0.21	0.21
3	55.5	31.4	32.04	2.05	0.358	0.35
4	63.6	35.6	36.72	3.14	0.407	0.4
5	71.7	40.5	41.4	2.21	0.462	0.46

1.7 Result:

Average percentage of error: 2.746%

1.8 Discussion:

Performing the experiment above, we could prove the relation between phase and line voltage in a $3 - \phi$ balanced Y – Y system. After all the calculations, we figured our error margin was 2.746% which is negligible. This little error margin certifies that, the line voltage is $\sqrt{3}$ times that of phase voltage.

1.9 References:

1. Fundamentals of Electric Circuits by Charles K. Alexander and Mathew N. O. Sadiku.