*"Heavens Light is Our Guide"*

# Rajshahi University of Engineering and Technology


Course code: 1202

Course title: Circuits & Systems – II Sessional

Report Number: 02

Experiment Name: **Study of the relation between phase current and line current in a delta connected 3 – ϕ balanced system.**

Date of Submission: 10 September 2024

**By**

Md Ahnaf Abid Fahim

Roll: 2210022

Registration No: 1076 / 2022 – 2023

Department of **Electrical & Computer Engineering**, RUET

**Submitted to**

Oishi Jyoti

Assistant Professor

Department of ECE, RUET

# Experiment 2

**2.1 Name of the Experiment:** Study of the relation between phase current and line current in a delta connected 3 – ϕ balanced system.

**2.2 Theory:** In a balanced 3 – ϕ Y - Δ system, phase currents are:

$$I_{ab} = \frac{V_{ab}}{Z_\Delta}, I_{bc} = \frac{V_{bc}}{Z_\Delta} \text{ and } I_{ca} = \frac{V_{ca}}{Z_\Delta}$$

The line currents can be obtained from applying KCL. So, the line currents will be:

$$I_A = I_{ab} - I_{ca}, I_B = I_{bc} - I_{ab} \text{ and } I_C = I_{ca} - I_{bc}$$

Since $I_{CA} = I_{AB}\angle -240^\circ$,

$$I_A = I_{ab} - I_{ca} = I_{ab}\,(1 - 1\angle -240^\circ) = I_{ab}\,(1 + 0.5 - j0.866) = I_{ab}\sqrt{3}\angle 30^\circ$$

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

$$I_P = \frac{I_L}{\sqrt{3}} \ldots\ldots\ldots (1)$$

**2.3 Required Apparatus:**

1. Source
2. VARIAC
3. Voltmeter
4. Ammeter
5. Resistor
6. Multimeter
7. Connecting wires

## 2.4 Circuit Diagram:

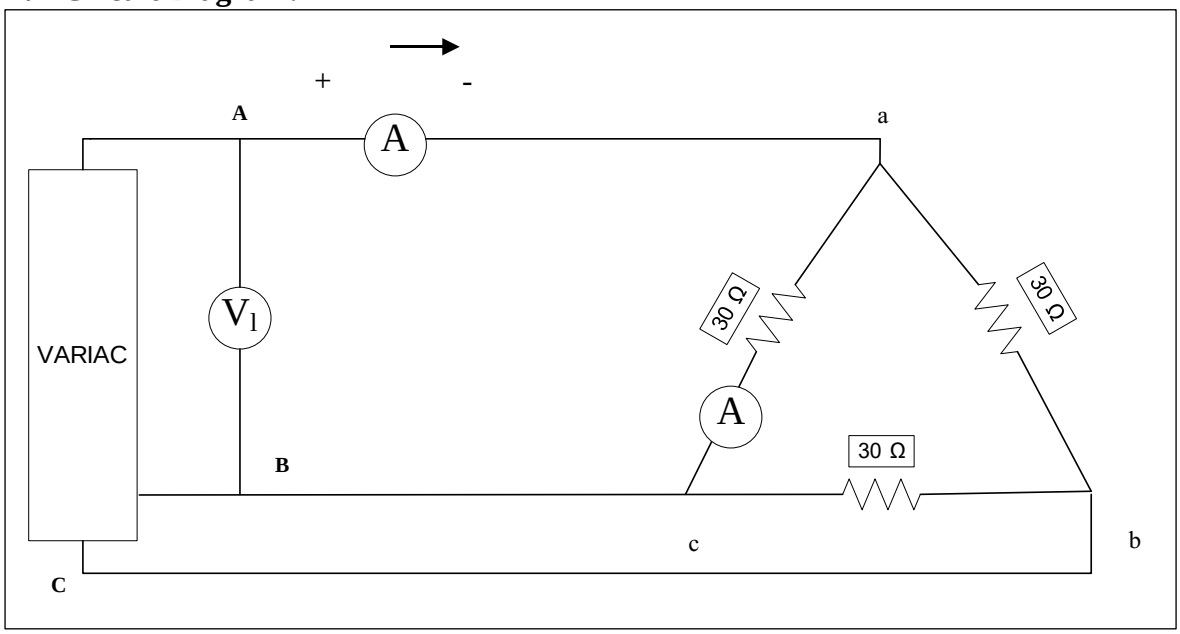


Fig: A balanced 3 – ϕ Y - Δ system

## 2.5 Calculation:

1. **Reading 1:**

   Line current, $I_L$ = 2.25 A

   Measured phase current, $I_{P(m)}$ = 1.26 A

   Calculated phase current, $I_{P(calc)}$ = 1.29 A

   Error = $\frac{|I_P(calc) - I_P(m)|}{I_P(calc)}$ X 100% = $\frac{|1.29 - 1.26|}{1.29}$ X 100% = 2.32%

2. **Reading 2:**

   Line current, $I_L$ = 0.72 A

   Measured phase current, $I_{P(m)}$ = 0.39 A

   Calculated phase current, $I_{P(calc)}$ = 0.41 A

   Error = $\frac{|I_P(calc) - I_P(m)|}{I_P(calc)}$ X 100% = $\frac{|0.41 - 0.39|}{0.41}$ X 100% = 4.87%

3. **Reading 3:**

   Line current, $I_L$ = 1.28 A

   Measured phase current, $I_{P(m)}$ = 0.7 A

   Calculated phase current, $I_{P(calc)}$ = 0.74 A

   Error = $\frac{|I_P(calc) - I_P(m)|}{I_P(calc)}$ X 100% = $\frac{|0.74 - 0.7|}{0.74}$ X 100% = 5.4%

4. **Reading 4:**

   Line current, $I_L$ = 1.87 A

   Measured phase current, $I_{P(m)}$ = 1.04 A

   Calculated phase current, $I_{P(calc)}$ = 1.08 A

   Error = $\frac{|I_P(calc) - I_P(m)|}{I_P(calc)}$ X 100% = $\frac{|1.08 - 1.04|}{1.08}$ X 100% = 3.7%

5. **Reading 5:**

   Line current, $I_L$ = 2.79 A

   Measured phase current, $I_{P(m)}$ = 1.59 A

   Calculated phase current, $I_{P(calc)}$ = 1.61 A

   Error = $\frac{|I_P(calc) - I_P(m)|}{I_P(calc)}$ X 100% = $\frac{|1.61 - 1.59|}{1.61}$ X 100% = 1.24%

∴ Average error = $\frac{2.32+4.87+5.4+3.7+1.24}{5}$ = 3.506%

## 2.6 Table for Studying Relation Between Line and Phase Voltage:

| Serial No | Line Current, $I_L$ (A) | Measured Phase Current, $I_{P(m)}$ (A) | Calculated Phase Current, $I_{P(calc)}$ (A) | Percentage of Error (%) | Line Voltage, $V_L$ (V) | Phase Voltage, $V_P$ (V) |
|---|---|---|---|---|---|---|
| 1 | 41.47 | 23.5 | 24.07 | 2.32 | 39.0 | 38.3 |
| 2 | 34.1 | 19 | 19.69 | 4.87 | 12.84 | 12.83 |
| 3 | 55.5 | 31.4 | 32.04 | 5.4 | 22.15 | 21.83 |
| 4 | 63.6 | 35.6 | 36.72 | 3.7 | 32.17 | 31.6 |
| 5 | 71.7 | 40.5 | 41.4 | 1.24 | 47.3 | 47.1 |

## 2.7 Result:

Average percentage of error: 3.506%

## 2.8 Discussion:

Performing the experiment above, we could prove the relation between phase and line current in a 3 – ϕ balanced Y - Δ system. After all the calculations, we figured our error margin was 3.506% which is negligible. This little error margin certifies that, the line current is √3 times that of phase current.

## 2.9 References:

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