# North South University

Department of Electrical & Computer Engineering

# LAB REPORT

Course Code:EEE362 L

Course Title: Power system

Course Instructor: Mohammed Shafayet Hossain

Experiment Number:05

Experiment Name:

Phase Angle and voltage Drop between Sender and Receiver

Date of Experiment:07/09/2020

Date of Submission: 21/09/2020

Section:02

Group Number:

Submitted By : Mohammad Mahmudur Rahman

Score

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## Objective:

i) To regulate the receiver end voltage.

ii) To observe the phase angle between the voltages at the sending and the receiving end of the transmission line.

iii) To observe the line voltage drop when the sending and receiving end voltages have same magnitude

## Theory:

If there is a voltage drop at the end of a transmission line, this would be harmful in practical conditions. As, motors, relays & lot other ~~equp~~ equipments work properly under a suitable voltage, thus, to keep the receiving end voltage at a constant value we need ~~the~~ to regulate the voltage at receiving end.

Voltage regulation in regulated power supplies refers to maintain voltage at a desired level. Voltage Regulation can be defined as following equation:

$$\text{percentage VR} = \frac{|V_{nl}| - |V_{fl}|}{|V_{fl}|} \times 100\%$$

## Required Equipments:

(i) Resistive load (model 8311)

(ii) Three phase transmission line (model 8329)

(iii) Capacitive load (model 8331)

(iv) AC Voltmeter (model 8426)

(v) Three phase Wattmeter/Varmeter (model 8446)

(vi) Phase meter (model 8451)

(vii) Power Supply (model 8821)

(viii) Connection leads (model 9128)

## Circuit Diagram:

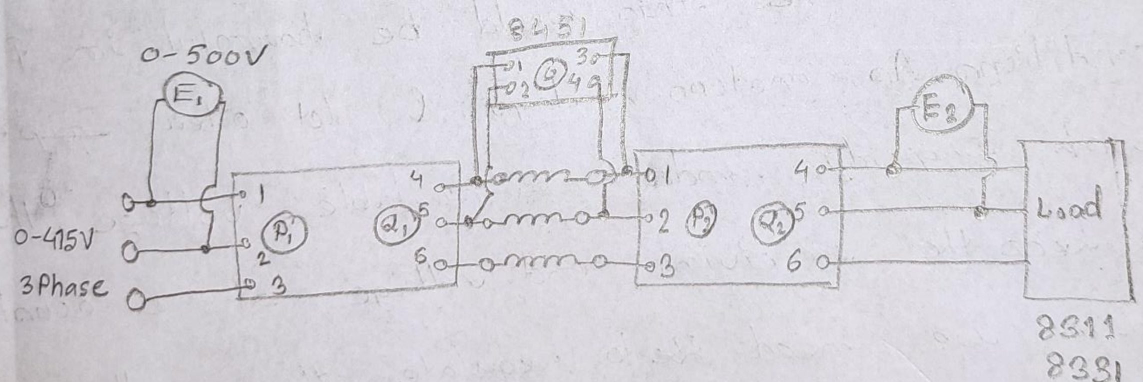



Figure: Circuit Diagram

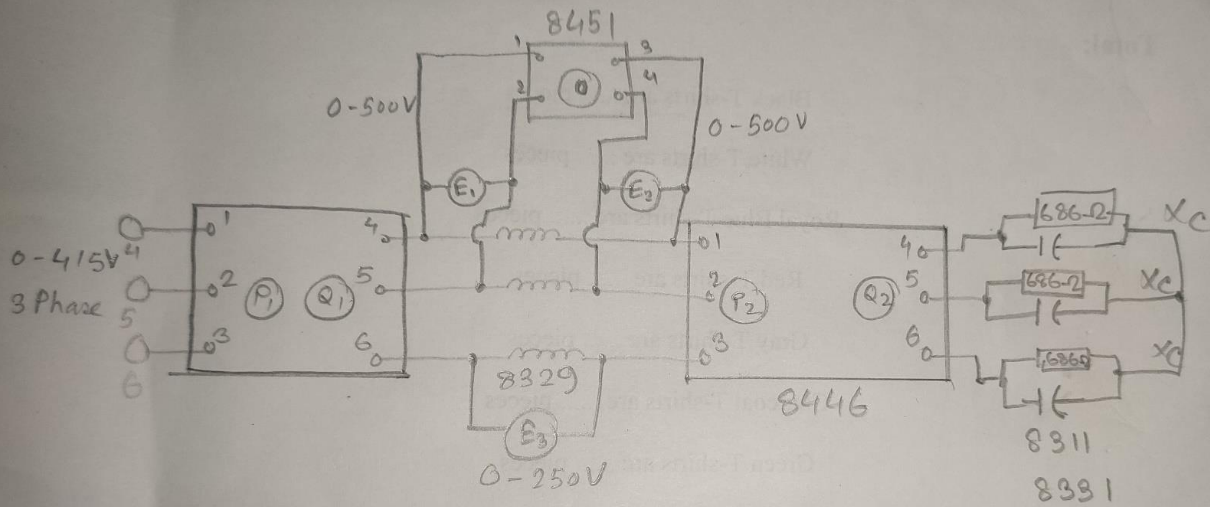



Figure: Circuit Diagram.

## Data table :

| Voltage Regulation with Resistive load. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R | $\cancel{X_C}$ | $E_1$ | $P_1$ | $Q_1$ | $E_2$ | $P_2$ | $Q_2$ | Angle |
| Ω | $\cancel{\Omega}$ | V | W | Var | V | W | var | ° |
| ∞ | | 350 | 0 | 0 | 350 | 0 | 0 | 0 |
| 4800 | | 350 | 12 | 0 | 330 | 0 | 0 | 0 |
| 2400 | | 350 | 25 | 0 | 305 | 20 | 0 | 0 |
| 1600 | | 350 | 30 | 0 | 300 | 25 | 0 | 0 |
| 1200 | | 350 | 80 | 10 | 300 | 75 | 0 | 15 |
| 960 | | 350 | 90 | 20 | 305 | 80 | 0 | 15 |
| 800 | | 350 | 98 | 30 | 290 | 95 | 0 | 16 |
| 686 | | 350 | 100 | 30 | 280 | 92 | 0 | 16 |

| Voltage Regulation with Resistive load. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R | $X_C$ | $E_1$ | $P_1$ | $Q_1$ | $E_2$ | $P_2$ | $Q_2$ | Angle |
| Ω | Ω | V | W | Var | V | W | Var | ° |
| ∞ | 0 | 350 | | | | | | |
| 4800 | 0 | 350 | 28 | 0 | 320 | | 0 | |
| 2400 | 685.71 | 350 | 28 | 0 | 310 | 20 | 0 | 36° |
| 1600 | 685.71 | 350 | 100 | -100 | 350 | 80 | -255 | 24° |
| 1200 | 342.9 | 350 | 180 | -150 | 350 | 180 | -190 | 33° |
| 960 | 1200 | 350 | 110 | 0 | 340 | 100 | -50 | 20° |
| 800 | 1200 | 350 | 130 | 10 | 340 | 110 | -60 | 20° |
| 686 | 600 | 350 | 150 | 0 | 345 | 135 | -75 | 18° |

Calculations:

(a) Reactive Power,

$$Q_C = \frac{E_1 E_2 \cos\delta}{x} - \frac{E_2^2}{x}$$

Now,

$$P = \frac{E_1 E_2 \sin\delta}{x}$$

So, $50 \times 10^6 = \frac{100 \times 100 \times 10^6}{100} \sin\delta$

So, $\delta = 30°$.

$\therefore \cos 30 = 0.867$.

$$\therefore Q_C = \frac{100 \times 100 \times 0.87 \times 10^6}{100} - \frac{100^2 \times 10^6}{100}$$

$= -13.4 \times 10^6 = -13.4$ MW.

(b)

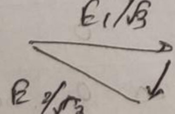
Again,

Reactive Power at sender end,

$$\frac{E_1^2}{x} - \frac{E_1 E_2 \cos\delta}{x_1}$$

$= 13.4$ MW.

(c)




$E_3$ = voltage drop per phase $= \frac{2}{\sqrt{3}} E_1 \sin\frac{\delta}{2}$

$= 29.89$ KV drop

(d) Phase angle between sender & receiver voltage,

$\delta = 30°$.

(e) Apparent Power supply by sender.

$$S_1 = \sqrt{P_1^2 + Q_1^2}$$

$$= \sqrt{(50)^2 + (13.4)^2 + 10^6} = 51.8 \text{ MVA}$$

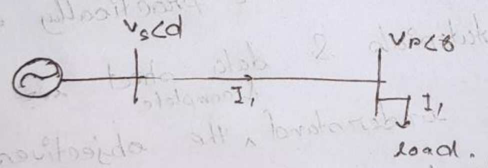
Answer to question NO: 3

Yes, it is possible to raise the receiver end voltage by using static capacitors.

As the transmission line is purely resistive, Thus, Reactive power absorbed by transmission line is zero.

$\Rightarrow Q_{abs} = 0$.

If a static capacitor is added at the receiving end of the transmission line, this capacitor supplies reactive power to the transmission line.




Receiving end voltage $= V_{r_1}$.

$$|V_{r_1}| = |V_s| - \frac{|X|}{|V_s|} Q. \quad \left[\begin{array}{l} X = \text{reactance} \\ V_s = \text{sendin end voltage} \end{array}\right]$$

$$\Rightarrow |V_{r_1}| = |V_s| - \frac{|X|}{|V_s|}(Q_{abs} - Q_{Gen} - Q_{sh.cap})$$

$$\Rightarrow V_{r_1} = |V_s| - \frac{|X|}{|V_s|}(-Q_{Gen} - Q_{sh.cap}) \quad [Q_{abs} = 0]$$

$$\Rightarrow |V_{r_1}| = |V_s| + \frac{|X|}{|V_s|}(Q_{Gen} + Q_{sh.cap}).$$

$Q_{Gen} \rightarrow$ Reactive power supplied by generator

Discussion:

The experiment was based on practically observing the regulation of receiver end voltage, & observing the phase angle between the voltages of the sending and the receiving end. Due to pandemic situation, we could not observe practically but, from ~~as~~ ~~pere~~ video lesson, tutorials & data sheet ~~we~~ we can say we have understand & complete the objectives. We have successfully able to calculate the values of sender and receiving end voltages & also calculated the phase angle between them.