Introduction

During this exercise we will investigate the concept of a balanced three phase (3Φ) systems, specifically looking at the relationship between the phase and line voltages of a wye-connected (Y-connected) source, along with the currents flowing in a 3Φ balanced load and 3Φ complex power.

Procedure

1. Locate the constant 3Φ voltage source on your lab bench. Turn on the supply and take measurements to determine the magnitude and phase angle of the source's ***phase and line voltages*** while using the phase angle of $\widetilde{V}_a$ as the zero-degree reference angle. Record your results in Table **10**.1:

	Magnitude	**Phase Angle**
$\widetilde{V}_a$ **(volts)**		
$\widetilde{V}_b$ **(volts)**		
$\widetilde{V}_c$ **(volts)**		
$\widetilde{V}_{ab}$ **(volts)**		
$\widetilde{V}_{bc}$ **(volts)**		
$\widetilde{V}_{ca}$ **(volts)**		

Table 10.1 – Balanced 3Φ Y-connected Source Voltages

2. Connect a balanced 3Φ, Y-connected load, consisting of three 240Ω resistors, to the source and take measurements to determine the three ***line currents*** supplying the load while using the phase angle of $\widetilde{V}_a$ as the zero-degree reference angle. Record your results in Table **10**.2:

R Load	**Magnitude**	**Phase Angle**
$\widetilde{I}_a$ (amps)		
$\widetilde{I}_b$ (amps)		
$\widetilde{I}_c$ (amps)		

Table 10.2 – Line Currents into a 3Φ Y-connected Resistive Load

3. Use the Lab-Volt Data Acquisition System to determine the ***real power***, the ***reactive power***, and the ***apparent power*** supplied to each phase of the 3Φ resistive load and record your results in Table **10**.3:

R Load	**Phase A**	**Phase B**	**Phase C**
Real Power **P** (W)			
Reactive Power **Q** (Var)			
Apparent Power **|S|** (VA)			

Table 10.3 – Power Measurements into the 3Φ Resistive Load

4. Add a 240Ω capacitive reactance in parallel with each of the 240Ω resistors in the Y-connected load and repeat the ***current*** measurements.

RC Load	Magnitude	Phase Angle
$\widetilde{I}_a$ (amps)		
$\widetilde{I}_b$ (amps)		
$\widetilde{I}_c$ (amps)		

Table 10.4 – Line Currents into a 3Φ Y-connected R-C Load

5. Use the Lab-Volt Data Acquisition System to determine the ***real power***, the ***reactive power***, and the ***apparent power*** supplied to each phase of the 3Φ R-C load and record your results in Table **10**.5:

RC Load	Phase A	Phase B	Phase C
Real Power **P** (W)			
Reactive Power **Q** (Var)			
Apparent Power |**S**| (VA)			

Table 10.5 – Power Measurements into the 3Φ R-C Load

6. Remove the 240Ω resistors from the Y-connected load such that the load only consists of the 240Ω capacitive reactances and repeat the ***current*** measurements.

C Load	Magnitude	Phase Angle
$\widetilde{I}_a$ (amps)		
$\widetilde{I}_b$ (amps)		
$\widetilde{I}_c$ (amps)		

Table 10.6 – Line Currents into a 3Φ Y-connected Capacitive Load

7. Use the Lab-Volt Data Acquisition System to determine the ***real power***, the ***reactive power***, and the ***apparent power*** supplied to each phase of the 3Φ R-C load and record your results in Table **10**.7:

C Load	Phase A	Phase B	Phase C
Real Power **P** (W)			
Reactive Power **Q** (Var)			
Apparent Power |**S**| (VA)			

Table 10.7 – Power Measurements into the 3Φ Capacitive Load

Report Guide

1. Given a balanced, 3Φ, Y-connected source with phase voltage $\tilde{V}_a = 120\angle 0°$ volts, calculate all of the phase and line voltages for that source and express the results by their phasor values. Compare the calculated voltages (both magnitude and phase angle) to the measured voltages recorded in Table **10**.1.

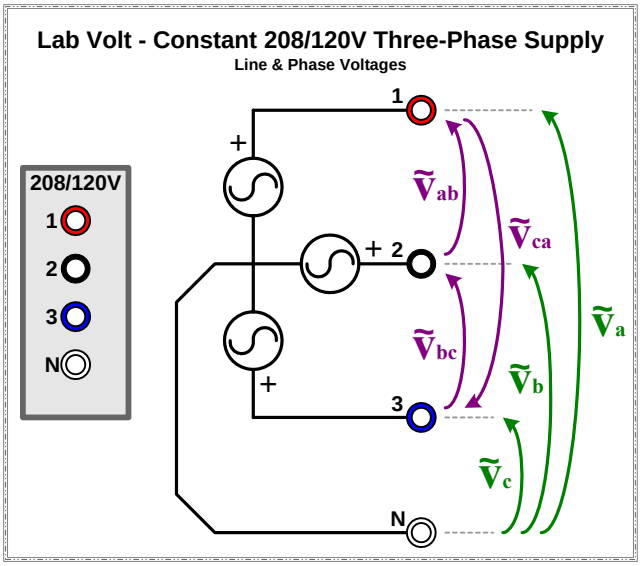
2. Given a balanced, 3Φ, Y-connected source with phase voltage $\tilde{V}_a = 120\angle 0°$ volts that is supplying a Y-connected load, each phase consisting of a 240Ω resistor; calculate the line currents supplying the load and the total (3Φ) real, reactive, and apparent powers supplied by the source to the load. Compare your calculated values to the measured results recorded in Tables **10**.2 and **10**.3.

3. Given a balanced, 3Φ, Y-connected source with phase voltage $\tilde{V}_a = 120\angle 0°$ volts that is supplying a Y-connected load, each phase consisting of a 240Ω resistor in parallel with a 240Ω capacitive reactance; calculate the line currents supplying the load and the total (3Φ) real, reactive, and apparent powers supplied by the source to the load. Compare your calculated values to the measured results recorded in Tables **10**.4 and **10**.5.

4. Given a balanced, 3Φ, Y-connected source with phase voltage $\tilde{V}_a = 120\angle 0°$ volts that is supplying a Y-connected load, each phase consisting of a 240Ω capacitive reactance; calculate the line currents supplying the load and the total (3Φ) real, reactive, and apparent powers supplied by the source to the load. Compare your calculated values to the measured results recorded in Tables **10**.6 and **10**.7.

Notes: **Your calculations must be completed neatly on blank paper, and you must show all of the work required to obtain the final results.**

Utilize the "ECET2111 Lab 10 Results" pages provided at the end of this booklet to submit your results.



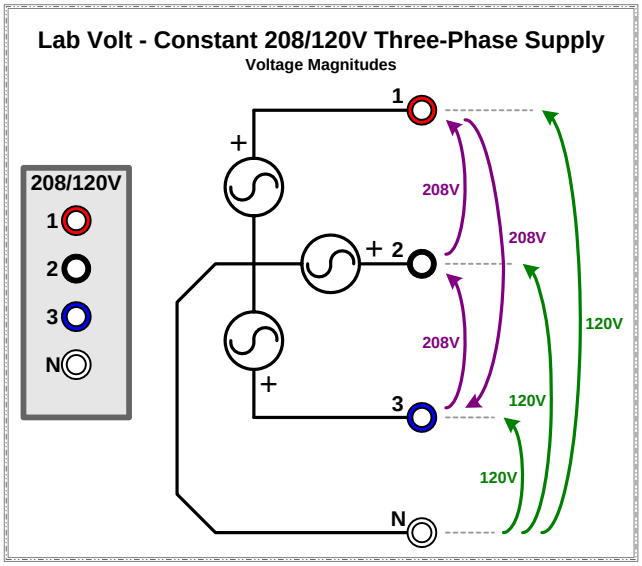


Figure 10.1 – Lab-Volt 3Φ Supply Voltages

ECET 3000 Lab 10 Results Name:_____

Instructions: Copy both your measured values and calculated values into the tables shown below.

<u>Staple</u> your calculations to the back of the "ECET2111 Lab 10 Results" pages.

Part 1 – 3Φ Supply Phase and Line Voltages:

	Measured		Calculated	
	Magnitude	**Phase Angle**	**Magnitude**	**Phase Angle**
$\widetilde{V}_a$ **(volts)**				
$\widetilde{V}_b$ **(volts)**				
$\widetilde{V}_c$ **(volts)**				
$\widetilde{V}_{ab}$ **(volts)**				
$\widetilde{V}_{bc}$ **(volts)**				
$\widetilde{V}_{ca}$ **(volts)**				

Table 10.1a – Balanced 3Φ Y-connected Source Voltages

Part 2 – 3Φ Y-connected Resistive Loads – Line Currents and Powers:

	Measured		Calculated	
	Magnitude	**Phase Angle**	**Magnitude**	**Phase Angle**
$\widetilde{I}_a$ (amps)				
$\widetilde{I}_b$ (amps)				
$\widetilde{I}_c$ (amps)				

Table 10.2a – Line Currents into a 3Φ Y-connected Resistive Load

	Measured			Calculated		
	Phase A	**Phase B**	**Phase C**	**Phase A**	**Phase B**	**Phase C**
P (W)						
Q (Var)						

|S| (VA)						

Table 10.3a – Power Measurements into the 3Φ Resistive Load

ECET 3000 Lab 10 Results (continued)

Part 3 – 3Φ Y-connected Resistive/Capacitive Loads – Line Currents and Powers:

	Measured		**Calculated**	
	Magnitude	**Phase Angle**	**Magnitude**	**Phase Angle**
$\widetilde{I}_a$ (amps)				
$\widetilde{I}_b$ (amps)				
$\widetilde{I}_c$ (amps)				

Table 10.4a – Line Currents into a 3Φ Y-connected R-C Load

	Measured			**Calculated**		
	Phase A	**Phase B**	**Phase C**	**Phase A**	**Phase B**	**Phase C**
P (W)						
Q (Var)						
|S| (VA)						

Table 10.5a – Power Measurements into the 3Φ R-C Load

Part 4 – 3Φ Y-connected Capacitive Loads – Line Currents and Powers:

	Measured		**Calculated**	
	Magnitude	**Phase Angle**	**Magnitude**	**Phase Angle**
$\widetilde{I}_a$ (amps)				
$\widetilde{I}_b$ (amps)				
$\widetilde{I}_c$ (amps)				

Table 10.6a – Line Currents into a 3Φ Y-connected Capacitive Load

	Measured			**Calculated**		
	Phase A	**Phase B**	**Phase C**	**Phase A**	**Phase B**	**Phase C**
P (W)						

Q (Var)						
|S| (VA)						

Table 10.7a – Power Measurements into the 3Φ Capacitive Load