

Lab Exercise 1 Report

by Nathan Davies

FILE	6774_NATHAN_DAVIES_LAB_EXERCISE_1_REPORT_151599_101737405 2.DOCX		
TIME SUBMITTED	11-DEC-2018 09:04 AM (UTC+0000)	WORD COUNT	1154
SUBMISSION ID	96857939	CHARACTER COUNT	5500

Lab Exercise 1 Report

Power Electronics and Drives

Nathan Davies

1706135

DR STEVE MOSEY

Introduction

The premise for this report is to conduct an experiment on a three-phase synchronous motor. This experiment will look at the aspects of the motor e.g the amount of current going through the motor during different shunt capacitors and the power output of the motor. This report will be laid out with the question asked then a brief description on how the answer is calculated with the answer proceeding these calculation, this answer will also be underlined so it is easily distinguishable.

Brief background research

The motor that will be used throughout this lab experiment will be a three-phase motor. These are motors that are designed to run off three phase alternating currents, these currents are mainly found within industry. The way three phase current works is as follows three conductors carrying an alternating current at the same frequency, **but each conductor is at a 120° phase shift apart from each other**, with one common line of reference which is tied to ground[2]. As with any motor there are two different parts the rotor and the stator, the rotor as the name suggests is the part of the motor that **turns** while the stator is the casing around the rotor that keeps it in place, this normally connects to the rotor via the brushes, the stator is the part of the motor which contains the rings which are used to make the rotor spin[1].

The three phase motor spins as followed, each ring within the stator is connected to a different phase from the power supply[1]. **This creates a magnetic field which makes the rotor spin in a direction depending on which order the magnetic rings are energised. This is because as the rings are at different phases the current introduces lag, because of this lag the rotor keeps trying to keep up with the rings, therefore the rotor spins[1].**

Exercise 1

1A

Correction capacitor	None	C2 – 10 μ F	C3 + C2 – 20 μ F	C2 + C4 – 15 μ F
Phase angle (lag/lead)	12°	2°	9°	2°
Current amplitude	520mA p-p	420 mA p-p	480 mA p-p	520 mA p-p

The phase angle for the table above was found by looking at the onscreen oscilloscope and measuring the distance between the voltage waveform and the waveform created by the shunt capacitors listed above. The peak to peak current was calculated by first finding the peak to peak voltage for each capacitor and then using the following equation to calculate it:

$$\frac{2 \times \text{peak voltage} \times 1000}{10}$$

1B – Enter the value of shunt capacitor which gives the nearest complete correction of phase angle.

10 μ F – This value was chosen as the phase angle of this capacitor is the lowest. 15 μ F also has a phase angle of 2 this would also be a suitable shunt capacitor for this circuit.

1C – With the best value of power factor correction capacitor in circuit the,

phase angle is a minimum and the current a minimum. This is because the phase angle needs to be as close to 0° so that it is in phase with the original voltage wave form, the table above shows that when the 10F which is the lowest phase angle the current is the lowest of the 4 results, this shows that when the phase angle is low the current is also low.

1D – Calculate and enter the power factor ($\cos \varphi$) with no correction capacitor in circuit

$$\begin{aligned} \cos \varphi \\ &= \cos 12 \\ &= 0.98 \end{aligned}$$

1E – calculate and enter the power factor ($\cos \varphi$) with the best correction capacitor

$$\begin{aligned} \cos \varphi \\ &= \cos 2 \\ &= 0.994 \end{aligned}$$

1F – Calculate and enter the power supplied in watts $V I \cos \varphi$ with no correction capacitor in circuit.

$$\frac{2 \times 520 \times 10^{-3}}{8} \times \cos 12 = \underline{127.16mW}$$

1G – calculate and enter the power supplied from VI with the best correction capacitor in circuit.

$$\frac{2.1 \times 420 \times 10^{-3}}{8} \times \cos 2 = \underline{110mW}$$

Comparison of two power results

9 The resulting power supplied to the circuit with no shunt capacitor is 127.16mW and the resulted power result for the 10μF is 110mW. As can be seen these values are fairly similar with only a 17mW difference between them this is to be suspected as the latter result has a capacitor to charge.

Exercise 2

2A

Correction capacitor	None	C2 – 10μF	C3 + C2 – 20μF	C2 + C4 – 15μF
Phase angle (lag/lead)	6°	1°	5°	2°
Current amplitude	502.8 mA p-p	404 mA p-p	468.6 mA p-p	520 mA p-p

10

Again, as with the last set of questions these results were recorded in a similar manner where the phase angle was measured by comparing the voltage waveform to the resulted waveform when the varies capacitors were added. The peak to peak current was also measured the same way as the previous table where the peak to peak voltage was found from the oscilloscope then inputted into the following equation to calculate the result:

$$\frac{2 \times \text{peak voltage} \times 1000}{10}$$

2B

Table comparisons

Correction capacitor	None	C2 – 10μF	C3 + C2 – 20μF	C2 + C4 – 15μF
Phase angle (lag/lead)	12°	2°	9°	2°
Current amplitude	520mA p-p	420 mA p-p	480 mA p-p	520 mA p-p

11

Above is a copy of the table found in exercise one of this report. As can be seen comparing the two tables the results for the phase angle found in table 2 are half the results for table 1 except for the phase angle for the 20μF capacitor. The peak to peak current found in table 2 is lower than the current found in table one this could be down to the fault that was introduced at the start of this

12

exercise. An investigation into what component is at fault will be conducted in the next question found below on the next page.

2C – Deduce which component is faulty.

The component that was found to be faulty was C2. This was because it was found that capacitor 2 had increased in capacitance for some reason. This can be seen in the tables where the results that contain C2 e.g the current are vastly different in table 2 compared to table 1. This was also deduced as when each capacitor was tested individually C2 was the only capacitor that had skewed results while the others had normal results.

This fault would possible have happened due to someone placing the wrong value capacitor into the circuit other than this reason there isn't any possible reason why a capacitor should increase in capacitance whilst being active or once left the factor, the capacitance could decrease due to temperature for example but there is very little reason why the capacitor would increase in capacitance.

Fault finding results

Correction capacitor	None	C2 – 10 μ F	C3 + C2 – 20 μ F	C2 + C4 – 15 μ F
Phase angle (lag/lead)	6°	1°	5°	2°
Current amplitude	490 mA p-p	457.2 mA p-p	582.8 mA p-p	554.2 mA p-p

References

- [1] I. David, "How a Three-Phase Motor Works," Sciencing, 24 April 2017. [Online]. Available: <https://sciencing.com/threephase-motor-works-5191973.html>.
- [2] "Three Phase Electric Power," Wikipedia, 14 September 2018. [Online]. Available: https://en.wikipedia.org/wiki/Three-phase_electric_power.



Lab Exercise 1 Report

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

65/100

PAGE 1

PAGE 2



Comment 1

The current through each conductor is at a 120 degrees phase difference from the current through the other conductors.



Comment 2

parts



Comment 3

turns



Comment 4

I assume you are referring to a rotating magnetic field.

PAGE 3



Comment 5

Are these phase angles lead or lag?



Comment 6

various?



Comment 7

units



Comment 8

10uF

PAGE 4



Comment 9

motor with a 10uF capacitor connected



Comment 10

Are these phase angles lead or lag?



Comment 11

Are these phase angles lead or lag?



Comment 12

This statement is not very definite and needs to be more firm

PAGE 5



Comment 13

Are these phase angles lead or lag?



Comment 14

It would have been nice to see the results for C3 on its own and C4 on its own to be able to see how you reached your conclusions.

PAGE 6



Comment 15

Your reference sources are not reputable. You could have referenced the Art of Electronics for power factor correction, or a multitude of other books - some of which are available as e-books from the university library

GRADING FORM: SMU GENERIC_SMOSEY

NATHAN DAVIES

64.75

ENGAGEMENT WITH LITERATURE

including reading, referencing, academic conventions and academic honesty



Although the report is only a short one, more, high quality, reference sources should have been used. You also seem to cite [2] before [1] which seems really odd.

2.25

KNOWLEDGE & UNDERSTANDING

Knowledge of the basic underlying concepts and principles of a subject.



Knowledge is good but it would have been nice to see more of an explanation of some of your points to allow you to demonstrate your knowledge and understanding more.

19.5

COGNITIVE & INTELLECTUAL

Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.



You have correctly analysed the results of the experiment and reached the correct conclusions. A

21

more thorough analysis would have gained you more marks here - you did not state if the current phase was leading or lagging the voltage once.

PRACTICAL APPLICATION SKILLS

Different approaches to solving problems in particular contexts.



A very good application of a range of methods, materials, tools and/or techniques. Very good consideration of the context of the application.

19.5

TRANSFERABLE SKILLS

Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.



Can communicate effectively in a suitable format, but has minor errors. Mostly coherent work and is in a suitable structure.

2.5