

Lab Report 2

by Nathan Davies

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Lab Exercise 2 Report

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Introduction

The premise of this report is to conduct a series of experiments on a three-phase inverter. This report will look at various aspects of this circuit e.g. the way the circuit functions, observing the input and output pulses, the current flowing throughout the circuit and understanding how PWM is created. The way this report is set out will be similar to the last report where the question asked will be stated with the answer following after, then accompanied by a brief explanation on why that answer was chosen.

Brief Background Research

A power inverter is a circuit/device which can convert electrical energy from DC into AC [1]. These devices come in a variety of forms from low power ones such as powering a car radio to devices that back up data for a building in case of power outages [1]. One of the main reasons of DC/AC power inverters is to take a low voltage from a battery such as 12V and transform it into a larger AC power source that operates at 60Hz [1]. The way these devices work is by using a modified sine wave. This sine wave is similar to a square wave but instead has a more stepping look to it that emulates a sine wave [1]. This method in creating a step like wave to control the output is called PWM (Pulse width modulation).

PWM is a term used for describing a type of digital signal [2]. PWM is used for many real-world applications including sophisticated control circuitry and motor speed control [2]. PWM is a technique to provide logic 0 and logic 1 for a controlled period of time [3]. It's a modulation type that involves modulating its duty cycle to control the amount of power sent to the load [3]. The time period for the square wave is kept constant and the time for which the signal remains high is varied [3]. The PWM pulses on the output is in such a way that the average value of Highs and Lows is proportional to the PWM input [3]. A PWM signal is a constant period square wave with a varying duty cycle [3].

To produce the input data to generate a PWM a comparator is used [3]. The comparator output is set to 1 when both values are equal, this comparator output is also used to set an RS latch [3]. This output of the RS latch gives the desired PWM output [3]. The main use of PWM used within this report will be to control the speed of a three-phase motor.

Another circuit type that is used within this report is Over-current protection. Overload/overcurrent protection is self-defining, any current in excess of rated load current is, in effect, an overload [4]. This overload occurs when an electrical circuit, is required to convey load current in excess of the rated-load ampacity of the circuit conductors [4]. Overload conditions can occur at the service, feeder or branch circuit level of electrical-power distribution systems [4].

Exercise 1

1a. At the positive peak of the sine wave, the microcontroller pulses become

A – Broader, this was observed from the onscreen oscilloscope, the screen showed a PWM pulse over a sine wave, when the sine wave rises to the peak the PWM pulses became broader.

1b. The number of microcontroller positive pulses in on half-cycle is approximately

B – 40, This was the number of pulses counted in a half cycle when the onscreen oscilloscope was observed.

1c. Is any ripple visible

B – No, no visible ripples were observed from the oscilloscope.

Exercise 2

Load current = 26.4mA, this is the initial current flowing through the circuit load after the over current protection had been added.

2a. Enter the measured value of current in mA

45.1mA, Current flowing through the circuit.

2b. The short circuit across the load immediately causes the supply voltage to

B – reduce to 0, after a short circuit was added between connections 2.2 and 2.3 the observation that was made was that the supply voltage reduces to 0V.

2c. As the short circuit across the load is allowed to remain it causes the load current to

C – increase to, and stay at, a maximum, this answer was deduced by observing the onscreen oscilloscope.

2d. When the short circuit is removed the voltage and current

B – do not return to normal, this answer was observed from the connected oscillator, this result is a result of the voltage and current not having a way to properly return to the normal results, turning the circuit off and back on will fix this problem.

Current = 7.1mA

Voltage = 9.143V

2e. Is the power supply immediately allowed to return to normal? – power supply switched off then on.

A – yes, this answer was observed using an oscilloscope.

2f. Has the power supply recovered to normal? – power supply turned off for 5 minutes.

A – Yes, this was proven by overserving the oscilloscope after having turned the circuit back in after the allotted amount of time.

During the lab exercise one of the questions in-between exercises was to introduce a random fault and determine what and where the fault is within the circuit. The fault deduced to be the problem was a short circuit between 4.12 and 4.2 this means I3 isn't in circuit.

Exercise 3

3a. the method used by the microcontroller to generate three phase sine waves is based on

A – PWM.

3b, an inverter is a device for

A – converting AC into DC.



3c. the frequency of the supplies produced by the three-phase generator can be varied by changing the

D – Width of the microcontroller pulse.



3d. in the generation system of the three phase supplies, a broader pulse from the microcontroller will give

D - a lower frequency of output.



3e. The program for generating sine waves by the inverter is stored in

A – RAM.



3f. The purpose of the over-current protection circuit in a power supply is to prevent

B – Damaging the power supply.

References

- [1] D. E. J. S. Jim Doucet, "DC/AC Pure Sine Wave," Worcester polytechnic institute, Worcester, 2006-2007.
- [2] Sparkfun, "Pulse Width Modulation," Sparkfun, [Online]. Available: <https://learn.sparkfun.com/tutorials/pulse-width-modulation/all>.
- [3] Electronics Projects Focus, "Generating PWM Signals With Variable Duty Cycle using FPGA," Electronics Projects Focus, [Online]. Available: <https://www.elprocus.com/generating-pwm-signals-variable-duty-cycle-fpga/>.
- [4] A. Faizen, "Overcurrent Protection in AC Power Systems," All About Circuits, 27 October 2017. [Online]. Available: <https://www.allaboutcircuits.com/technical-articles/ocpd-overcurrent-protection-device-power-system/>.

Lab Report 2

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

57 / 100

Instructor

PAGE 1

PAGE 2



Comment 1

50Hz for UK and Europe. 60Hz for America



Comment 2

This is a quote. you should either write it as a quote, or better paraphrase it and reference it.



Comment 3

to control



Comment 4

Another direct quote. You should be paraphrasing.

PAGE 3



Comment 5

I was hoping that you would have expanded on your answers. Without extended answers it is difficult to assess your understanding.

PAGE 4



Comment 6

Converting DC into AC. Wrong way around.



Comment 7

Clocking rate of the microprocessor



Comment 8

A more positive output voltage



Comment 9

EPROM

PAGE 5

GRADING FORM: SMU GENERIC_SMOSEY

NATHAN DAVIES

56.65

ENGAGEMENT WITH LITERATURE

including reading, referencing, academic conventions and academic honesty



You have referenced a limited range of relevant sources. A couple more sources would have been nice. When using material from sources, you should paraphrase the information you take, not copy and paste it. Even though you are citing the source, you should paraphrase to show understanding.

2.5

KNOWLEDGE & UNDERSTANDING

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



You have shown a basic knowledge and understanding of the subject, but your brief answers and quoted material have not allowed me to fully assess your understanding.

17.1

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.



Evidence of some logical, analytical thinking and some attempts to synthesise, albeit with some weaknesses.

14.4

PRACTICAL APPLICATION SKILLS

Different approaches to solving problems in particular contexts.



A very good application of a range of methods, tools and techniques.

18.9

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 professionally and, confidently in a suitable format. Work is coherent, very fluent and is presented professionally.

3.75