EEEE2046 22/23: Energy Project: First Week Objectives

1.0 Introduction

This short document recommends an approach to completing objective 2 of the Energy project tasks whilst ensuring that the required data and information for the group report (due 22nd February 2023) is collected.

2.0 Objective 1: Subtasks

2.1 PLECS Download and Install

PLECS is available on the PCs in the lab. If you decide to download it for your personal computer/laptop use the following link.

https://www.plexim.com/download/standalone

There is some guidance on Moodle that will help with the installation and licensing.

2.2 Familiarity with PLECS

It is very unlikely that you have used PLECS for simulating switching converters- you will not get any strict guidance documentation for this but there will be some advice in the lab if you are completely stuck. The recommendation is that to become familiar with the approach to using PLECS for simulating power electronics and general good practice you should read the "PLECS minicourse" PDF document on Moodle

2.3 New design

The specification for the converter that you will design is as follows:

Power rating (P_{max})	50W
Input Voltage for basic testing	35Vdc
Input voltage AC (Step Down XFMR)	230Vac @ 50Hz- (30Vac isolated)
Output voltage	8Vdc
Output voltage ripple (peak to peak)	<0.1V
Load resistance at discontinuous output current threshold	R=Resistance for 15% P_{max}
Switching Frequency	75 – 105kHz

Using the methodology given during your EEEE2045 lectures, determine the values for the converter- duty cycle, transformer turns ratio, switching frequency, output filter inductor, output filter capacitor.

2.4 Including "real" Components

In a copy of your simulation from 2.3, consider the impact of "real" components. Real diodes and transistors have an on state voltage and resistance (you may need to research this). Real wound components have a resistance because of the wire used to form their windings. Real Electrolytic

capacitors have an Equivalent Series Resistance [ESR] (note: do not confuse this with capacitive impedance- they are not the same!). Investigate this using a combination of the internet and the data sheets on the Moodle page. Look at the effects that these components have on the converter output voltage in your simulation.

2.5 AC input supply

In a real converter, the dc input voltage would be obtained from an AC source which is rectified (using a "Bridge" or "Full Wave" Rectifier) and filtered using an output "smoothing" capacitor (**use 2mF).** Add this to a copy of the simulation from 2.4- you may need to research how this works- there is a lot of info online but ask if you don't understand it. Especially important, is the series inductance and resistance of the transformer (Leakage inductance and winding resistance- see your first year notes on transformers) which produces the 30V AC input- this also has an effect on the output voltage of the converter over the full load range. Look at the data sheets on Moodle for support in this task.

2.6 Gate Drive and PWM Circuit

This task is described thoroughly in the handout "EEEE2046 Energy-PWM gate Drive 22-23". See Moodle.

3.0 Coursework 2: Converter Design Group Report

This report, due on the 22nd February 2023 at 3pm (submit through Moodle), should not become a significant piece of work as long as you have completed objective 1 in the lab.

Think of this "industry" situation: Your boss has been away for a week and wants a short, concise update of what you have been doing. Your boss does not need a 50 page detailed book, just the important parts, well presented.

The length of the report, not including a title page, **should not exceed 10 pages**. The report should have the following sections. I have been deliberately vague- think about what results it will be useful to show and remember the page limit:

- Short Introduction
- Calculations for the Forward converter
- Simulation Results under ideal conditions, comments
- Simulation results with non-ideal components, comments
- Simulation Results with AC derived input, comments
- A picture of the gate drive circuit schematic in PLECS and explanation of how it works.
- Short Summary

Please do not ask us about details of what we want in the report. Follow the instructions carefully- there is more than enough information here.

You are now second years, you should know how to present a good report, especially after my feedback for EEEE2045 (Control). There will be deducted marks for a poor presentation of the report. Make sure you include figure captions, axis labels, no tiny figures, numbered section headings etc.

Al Watson, January 2023