

## MSc Project Plan: (By the end of July)

### 1, Finish all circuit test and design. Including KiCad design & Result collection:

- A, Electronic Load – one stage and four stages switch
- B, Short circuit relay – high current follow – separate path control
- C, Involved Arduino control – ADS1115 measurement – LCD display – Temp monitor – Fan control
- D, Power MOSFET heat sink and fan location
- E, Measurement socket – (Vout+ & Vout-); Test jumper – Arduino PWM pin for Vref – Rsense voltage – Gate voltage
- F, SP3T switches control test + Digital potentiometer control test + CapSelect&SyncBack switch by using relay or dual MOSFET check

### 2, Dissertation Plan:

#### Chapter 1 Introduction, Aims and Overview

- 1.1 Introduction (introduction to the MSc project)
- 1.2 Background on Remote Lab (Educational Lab – history and other examples)
- 1.3 Motivation (Motivation of turning in-person lab experiment into remote operation experiment)
- 1.4 Scope (Only designed for the MSc course in power engineering of University of Edinburgh)
- 1.5 Aims and Objectives (check mission statement)
- 1.6 Thesis Organization and Outline (wait for last minutes to complete)

#### Chapter 2 Introduction to the Buck Converter Laboratory Course

- 2.1 Introduction to Switch Mode Power Supply
- 2.2 Curriculum and Educational Purpose (Curriculum, Target, Education Purpose, Outcomes)
- 2.2 Laboratory Setting (Buck converter board, Adjustable components, Designed parameters – Vout, Iout etc)
- 2.3 Buck Converter Board Design (Main Components, Working principle, Operation modes, Circuitry for adjustable components, etc)
- 2.4 Main Observation Results on the Buck Converter Laboratory Course (Questions and results from the lab course)

Each section should include methods evaluation, device selection, Arduino control, simulation or experimental results

#### Chapter 3 Digital Switches Design (Setpoint, Flyback, CapSelect, Switch bottom)

- 3.1 Switch between Two Setpoints for Output Voltage
- 3.2 Switch between Synchronous and Non-synchronous (Rectifying Type) Buck Converter
- 3.3 Selection on Output Capacitance of the Buck Converter
- 3.4 Selection on Operation Mode for Switching Regulator Controller (LTC7800)

#### Chapter 4 Digital Potentiometers Design (Setpoint, Frequency, Feedback)

- 4.1 Adjust the Regulated Output Voltage
- 4.2 Adjust Switching Frequency
- 4.3 Adjust Feedback Gain in PID Control

#### Chapter 5 Methods of Building A Controllable Dummy Load

- 5.1 Function Requirements (Minimum–0.25Ω, Maximum–33Ω, Short circuit)
- 5.2 Methods Explanation and Evaluation
  - 5.2.1 Potentiometer with Motor
  - 5.2.2 Electronic Load
  - 5.2.3 Relay
  - 5.2.4 Methods Evaluation (the last two methods remains)

#### Chapter 6 Electronic Load Design

- 6.1 Introduction to Electronic Load (CC, CV, CR – basic operation mode for commercial device)
  - 6.1.1 Basic Operation Mode and Principle
  - 6.1.2 Modern Electronic Load Devices (Commercial devices and data sheet explanation or even patents)
  - 6.1.3 Electronic Load Circuit Design
- 6.2 Circuit Design and Evaluation (CC&CR&Voltage divider&Arduino control)
- 6.3 Constant Current Mode – Electronic Load Design, Development and Test
- 6.4 Constant Resistance Mode – Electronic Load Design, Development and Test

#### Chapter 7 Relay Design

- 7.1 Introduction to Relay

## 7.2 Short Circuit Design, Development and Test

Chapter 8 Measurement and Display (Power supply, Oscilloscope)

Chapter 9 Complete Working Prototype of Remote Laboratory