# Report for E-design 344

by

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*E-Design report # 1*

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# Declaration

By submitting this report electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualifcation.


Signature: .....

E. Stewdent

Date: .....

# Contents

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# Nomenclature

**Constants**

$g = \quad 9.81\,\mathrm{m/s^2}$

**Variables**

| | | |
|---|---|---|
| $P$ | Power | [W] |

# Chapter 1

# Power supply system design

## 1.1 System overview

Here you insert a block diagram of your power regulation system. There is no need to specify the capacitor and resistor values here, but you want to capture the higher-level functional arrangement you have opted for. The diagram ties together the other chapters in this report and helps the reader understand how you have connected the transformer, rectifer, and regulation types into a solution to provide 5 VDC and −5 VDC. This diagram can also indicate the ground configuration. See Fig. 1.1 as an example which is one level too high.

## 1.2 Rationale

Here you describe your rationale for using the setup you have chosen. The detail design of each subsystem (e.g. linear regulation) does not go here, but goes in the appropriate chapter. You can point forward to the sections, for example, the rectification detail design is described in Section 2.2.

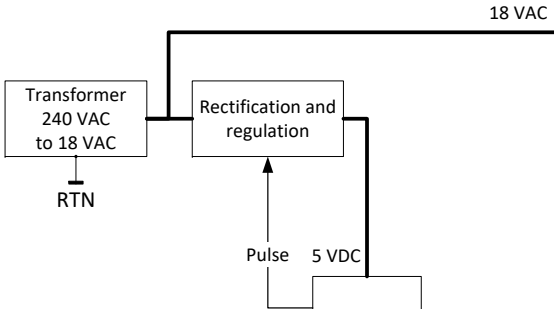



Figure 1.1: System diagram

# Chapter 2

# Rectifier

## 2.1 Theory and releated work

In this section, you put a very short summary of infrormation you gatherered from literature (papers, web sites, datasheets) that you used to do the design. Be sure to include the references, which you can add in the `References.tex` file.

Some examples of how to cite (all in `References.bib`): It was stated by [? ] that ... . Subsequently, he changed his mind and said in [? ] that ... . While [? ] claims it to be ... .

## 2.2 Design

In this section, you need to capture your design, which should include the following:

- Design rationale, i.e. what your thinking was behind the design
- Design calculations, for example to determine resistor values and capacitor values, or to check for allowed voltage and current ranges and levels.
- Circuit diagram like the one in Figure 2.1. I used "print to PDF" from LT-Spice, but feel free to use a cropped screengrab if you are PDF-challenged and do not have a PDF printer (there are some free PDF creators online).

For your benefit, here is how to write values with units: 150 m$\Omega$, and this is how we write ranges: 2 to 5 kV.

Here is a numbered equation in Eq. 2.1.

$$a = \frac{55}{45+3}. \tag{2.1}$$

.

Here is an inline equation $\frac{55}{45+3}$.

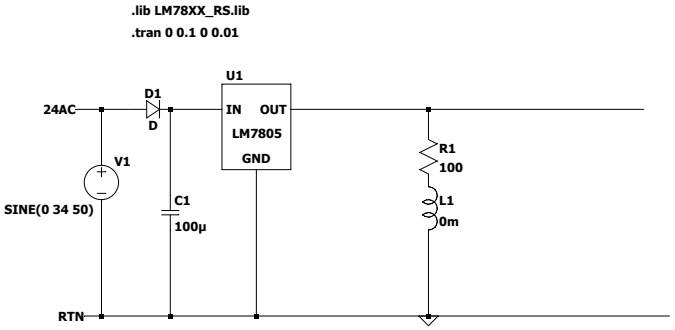



Figure 2.1: A circuit driagram of sorts

Table 2.1: Example of a table.

| | 2017 | 2018 | $\Delta_{Abs}$ | $\Delta_{DiD}$ |
|---|---|---|---|---|
| A | 9,868 | 10,399 | +5 | -11 |
| B | 10,191 | 10,590 | +4 | -12 |

Table 2.2: Example of another table.

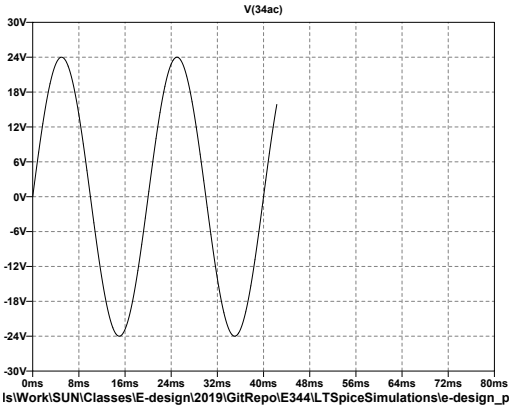
| Schools | Total energy used | | Change | |
|---|---|---|---|---|
| | 2017 [kWh] | 2018 [kWh] | $\Delta_{Abs}$ [%] | $\Delta_{DiD}$ [%] |
| A | 9,868 | 10,399 | +5 | -11 |
| B | 10,191 | 10,590 | +4 | -12 |

## 2.3 Simulation

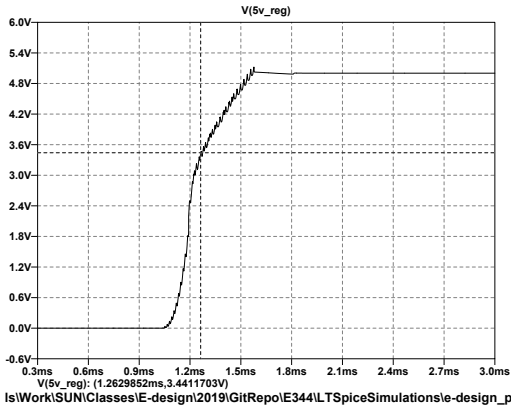
In this section, you want to demonstrate, by means of simulation results, using the designed circuit, what your circuit is expected to behave. An example is the figure shown in Figure 2.2 or Subfigure 2.2a. Be absolutely sure that the text and information in your report are readable.

## 2.4 Measurements

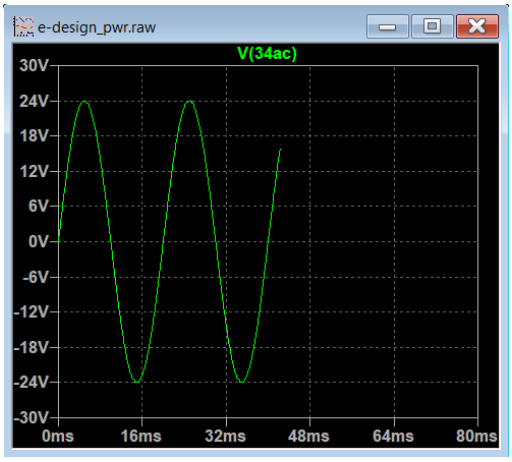
In this secion, you must present your measured results. You can use screengrabs or photos of the oscilloscope, or download the CSVs and plot them as PDFs using Matlab, Excel or similar. You can also use tables, example of which are presented in Tables 2.1 and 2.2.



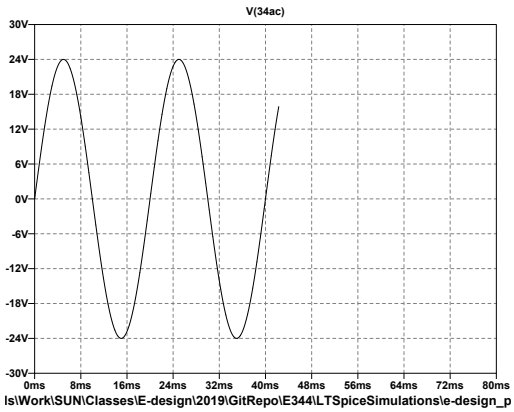

(a) 24 VAC supply voltage.




(b) Positive 5 V rise time.




(c) It is OK to use a screengrab if you are technologically challenged, my mum is too.




(d) Say something, I'm giving up on you.

Figure 2.2: Energy and temperature results of the different control strategies represented as distributions for all water heaters. (a) depicts electrical energy used per EWH per day, (b) depicts thermal energy drawn per EWH per day, (c) depicts outlet temperatures during usage events, (d) depicts thermal losses per EWH per day.

# Chapter 3

# Switchmode regulation

## 3.1 Theory and releated work

## 3.2 Design

## 3.3 Simulation

## 3.4 Measurements

# Chapter 4

# Linear regulation

## 4.1 Theory and releated work

## 4.2 Design

## 4.3 Simulation

## 4.4 Measurements

# Chapter 5

# Charge pump regulation

## 5.1 Theory and releated work

## 5.2 Design

## 5.3 Simulation

## 5.4 Measurements

# Chapter 6

# System test results

# Appendix A: Social contract

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E-design 344 Social Contract

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The purpose of this document is to establish commitment between the student and the organisers of E344. Beyond the commitment made here, it is not binding.

In the months preceeding the term, the lecturer (Thinus Booysen) and the Teaching Assistant (Stefan Gerber) spent countless hours to prepare for E344 to ensure that you get your money's worth and that you are enabled to learn from the module and demonstrate and be assessed on your skills. We commit to prepare the demis for the lab sessions, to set the tests and assessments fairly, to be reasonably available, and to provide feedback and support as best and fast we can. We will work hard to give you the best opportunity to learn from and pass analogue electronic design E344[1].

Signature: ..... Date: .....

.....

I, ..... have registered for E344 of my own volition with the intention to learn of and be assessed on the principals of analogue electronic design. Despite the potential publication of supplementary videos on specific topics, I acknowledge that I am expected to attend the lectures and lab sessions to make the most of these appointments and learning opportunities. Moreover, I realise I am expected to spend the additional requisite number of hours on E344 as specified in the yearbook.

I acknowledge that E344 is an important part of my journey to becoming a professional engineer, and that my conduct should be reflective thereof. This includes doing and submitting my own work, working hard, starting on time, and assimilating as much information as possible. It also includes showing respect towards the University's equipment, staff, and their time.

Signature: ..... Date: .....

[1] Find Stefan, Thinus, or one of the demis to sign this section

1

# Appendix B: Wiring safety check

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E-design 344 Plug to fuse safety check

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Wire up the power plug to the high-voltage side of the transformer, the connectors and cable on the low-voltage side of the transformer, and the fuse. Get a demi sign off on the check list below. Include a scanned copy of the signed form as an appendix to your report.

- ☐ Live and Neutral wires the right way around.
- ☐ Wires tightenend properly.
- ☐ Plug cover attached properly with screw.
- ☐ No loose strands inside plug.
- ☐ Cut 24V wire terminated safely.
- ☐ Clear physical separation between the wires in the low-voltage side connectors
- ☐ Fuseblock connected in in series immediately downstream from connector.

Signature ..... Date: .....

Name and surname .....

1

# Appendix C: Screengrab of GitHub repo