

# Internship Report

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*Submitted by*

**Rahul Yadav**

**B20059**

**Hardware Design Intern in Power Electronics**

**Statcon Electronics India Limited**

*4th Jan 2023 to 30th Jun 2023 (6 Months)*



*Under the supervision of*

**Sarv Parteek Singh , JoysinghaPal**

**Bachelors of Technology in Electrical Engineering**

*2020 to 2024*

**IIT Mandi**



## Objective :

The objective of the internship was to gain practical experience in thermal management, power electronics design, and control systems relating to solar photovoltaic applications.

## Project Details :

### Thermal Management of IGBTs used in H-bridge and MPPT

In this Project the thermal resistance for heat sinks used for H-Bridge's IGBT and Buck Converter-based MPPT's IGBTs including their free wheeling diode was calculated for different power conditioning units (PCUs). Various key parameters were taken into account such as airflow speed with a fan and the expected junction temperature of the IGBT for a specific heat sinks. I analyzed the power losses and thermal behavior of the IGBT modules. Through accurate calculations and effective thermal modeling techniques, I optimized the size and number of fins in the heat sinks to ensure efficient cooling and enhanced performance of the PCUs.

Also, for automation, a Python script was written that takes PCU ratings as input and returns the favourable model number and thermal resistance of heat sinks.

### Enhanced Inductor Design and MPPT Operation to Prevent Core Saturation in Buck Converters

In buck converter-based Maximum Power Point Tracking (MPPT) systems for battery charging, I have proposed the key factors to prevent the core saturation problem. To avoid this issue, various important factors were considered. Like, Selecting the right core material that can handle high magnetic flux and has low energy losses. Second, the core's shape, size, and air gap (for EE-type cores) must ensure efficient energy transfer. Lastly, using an effective switching frequency such that IGBT switching losses won't raise the junction temperature and simultaneously prevent core saturation,

A python script for MPPT was also written that returns crucial parameters of inductor like input current, Ripple and Number of turns of the inductor based on the rating of the PCUs.

### Verified the Existing Circuits Using LTspice and addressed the dissimilarities.

In this project, I have used LTspice to verify and resolve mismatches in existing circuits and tested them practically after implementing them. An example of such a mismatch involved the fan fail signal derived from an NTC (Negative Temperature Coefficient) component. By simulating the circuit in LTspice, we were able to identify discrepancies between the expected and practical results. Subsequently, improvements were implemented to rectify the mismatch, ensure accurate fan fail detection, and practically tested it to ensure accurate functioning.

### Studied and Implemented Different MPPT algorithms in Matlab:

Implemented Perturb and Observe (P&O) and Fuzzy Logic Control (FLC) techniques for Maximum Power Point Tracking (MPPT) with a Buck Converter in Matlab and addressed the limitations of P&O method by incorporating Fuzzy Logic Control to adapt to varying environmental conditions.

## Conclusion :

This internship provided invaluable practical experience in the design, simulation, and optimization of power electronic systems for solar photovoltaic applications. Through hands-on projects, key skills were developed in areas such as thermal management, inductor design, maximum power point tracking algorithms, and circuit verification.

Furthermore, Python scripts were developed to automate the process of heat sink selection and MPPT inductor design, improving efficiency and reducing human error.

# Internship Certificate



## Statcon Electronics India Limited

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### TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. Rahul Yadav, a 3<sup>rd</sup> year student of Bachelor of Technology in Electrical Engineering at Indian Institute of Technology Mandi, interned at Statcon Electronics India Limited. He worked on a variety of projects focused on electrical circuit design and simulation for improving the efficiency of our power systems, particularly the ones deployed for solar applications. He used LT Spice, Simulink, and Python for simulations, and used lab hardware tools like oscilloscopes, multimeters and the like for hardware tasks.

Rahul worked with us from Jan 4, 2023 to June 30, 2023, in a full-time capacity. He was methodical, diligent, innovative, and dedicated in his approach towards all the problems assigned to him. He got along well with all his colleagues and our staff was impressed by the contributions he made to the company.

We wish him tremendous success in his future endeavors and hope to work with him again in the near future.

Sincerely,

(For & On behalf of Statcon Electronics India Limited)



Manoj Kumar

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