

Senior Design Project Description

Company Name	Atom Power	Date Submitted	May 18, 2017
Project Title	Atom Switch using GaN Power Semiconductor Devices (ATOM_SEMIC)	Planned Semester	Fall 2017

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project. 250 hours are expected per person.

Complete the following table if this information is known, otherwise the Senior Design Committee will develop based on the project scope:

Discipline	Number	Discipline	Number
Mechanical	1	Electrical	3
Computer	1	Systems	
Other ()			

Project Overview:

One of the key devices seen in every building, data center, and even growing electric vehicle charging station is a disconnect switch or circuit breaker. These circuit breakers are meant to bring protection and safety, yet there are around 30,000 arc flash incidents every year in the US only. This is due to the fact that conventional mechanical circuit breakers are too slow or may not be selected properly for continuously dynamic load conditions. Solid-State Circuit Breakers (SSCB), in contrast to mechanical circuit breakers, bring programmability, metering capability and more importantly increased safety. Nonetheless, SSCB was not a realistic option five years ago because of inherent limitations of Silicon power devices. With advent of post-silicon semiconductor devices known as Wide Band-Gap (WBG) semiconductor such as SiC and GaN, today, we can have access to fast, efficient and compact solid-state circuit breakers. Atom Power, a Charlotte-based start-up is the pioneer in developing WBG-based SSCBs. So far, they have commercialized the world's fastest SiC-based circuit breakers used in several buildings and industrial plants.

This project in collaboration with Atom Power is to design, implement and test a GaN-based 100A/480V solid-state circuit breaker. The project includes:

- Detailed search and comparison of the state-of-art commercially-available GaN devices to meet the efficiency targets of greater than 99.5%.
- Design and implementation of hardware including the power stage, sensing and conditioning circuitry considering reliability, protection, noise, cross-talk, EMI, etc.
- Design and implementation of necessary firmware (microcontroller) for basic operation and



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testing.

- Design and implementation of the system in a package considering thermal management

Initial Project Requirements:

Ideal team includes students from three engineering disciplines, electrical, computer and mechanical engineering. The team should be familiar with basic power electronics circuit design tools such as PSPICE, Cadence printed circuit board layout tools or similar, C/C++ for microcontroller programming, Comsol multi-physics simulation tool or similar. This is an exciting but demanding project for which the students will interact with the company's employees and senior personnel. It is expected that students are eager to learn and do not have more than 16-18 credit hours while doing this project.

Expected Deliverables/Results:

Fully packaged working prototype of 100A/480V GaN solid-state circuit breaker.

- A complete report comparing this solution with the existing SiC version of the Atom Switch.
- It is expected that the team will gain a very unique experience in which different aspects of engineering will come together for a very practical and transformative solution.

Disposition of Deliverables at the End of the Project:

Deliver to the Technical Supporter after the conclusion of the Expo

List here any specific skills, requirements, knowledge needed or suggested (If none please state none):

- PSPICE, Cadence or similar
- C/C++
- Comsol