EV Charging Technology Laboratory

The EV Charging Technology Laboratory is a specialized facility that offers comprehensive hands-on and simulation-based training in power electronics systems, essential for the development and optimization of electric vehicle (EV) charging technology. The lab bridges theoretical knowledge with practical application, equipping students and professionals with the skills to design, analyze, and optimize various EV charging systems.

Leveraging advanced simulation tools such as PSIM and Altair Flux, the lab focuses on key components of EV charging systems, including diode bridge rectifiers, boost power factor correction (PFC) circuits, and off-board charger topologies like isolated DC-DC converters. Through detailed experiments, students gain in-depth knowledge of power electronics and how to design energy-efficient, reliable, and compliant EV charging systems.

The laboratory offers a dynamic learning environment where participants can experiment with real-world applications, making it an ideal space for anyone interested in advancing their understanding of EV charging infrastructure.

Key Areas of Focus in the EV Charging Technology Lab

1. Design and Study of Single-Phase / Three-Phase Diode Bridge Rectifiers

The **diode bridge rectifier** is a crucial component in converting alternating current (AC) from the grid into direct current (DC) for use in EV charging. This experiment provides a detailed exploration of the principles of rectification and power conversion.

Key learning objectives include:

- Understanding the operation of single-phase and three-phase diode bridge rectifiers.
- Analyzing the conversion of AC to DC voltage, which is essential for powering EV batteries.
- Studying the effects of various filters (capacitive, inductive, and resistive) on the output voltage and improving power quality.
- Exploring input current variations, power factor, and total harmonic distortion (THD) with different filter configurations.
- Understanding the grid-side requirements in terms of THD and power factor and the importance of power factor correction (PFC) for regulatory compliance.

The lab encourages participants to use simulation tools like PSIM to optimize the design of these rectifiers, ensuring high efficiency and minimal loss during power conversion.

2. Design and Study of Single-Phase / Three-Phase Boost Power Factor Correction (PFC) Circuits

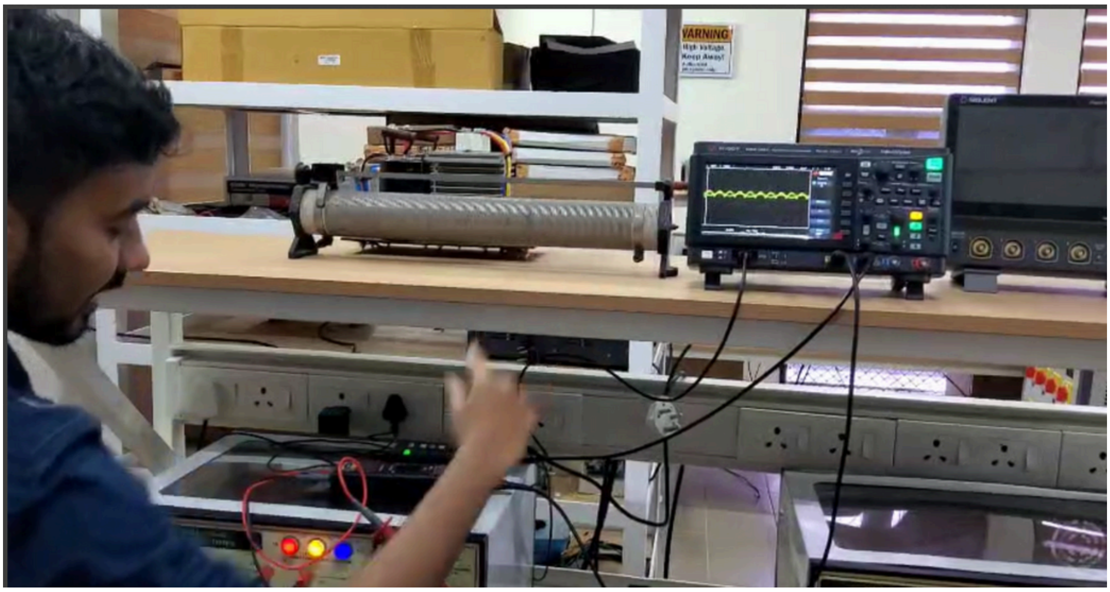
Power Factor Correction (PFC) is a critical technology for improving the efficiency of electric power systems, especially for EV charging. By aligning the input current with the voltage waveform, PFC circuits help reduce energy losses, improve system efficiency, and minimize the impact on the power grid.

In this experiment, participants gain hands-on experience with both single-phase and three-phase Boost PFC circuits, key components in high power applications, including energy storage systems and EV charging infrastructure.

Learning objectives include:

- Understanding the working principles of single-phase Boost PFC and three-phase PFC circuits.
- Exploring the impact of different control techniques for regulating input current and achieving optimal power factor.
- Implementing closed-loop control strategies to achieve unity power factor, thus improving the efficiency of the power supply system.
- Learning the process of passive component selection and sizing to meet performance requirements.

The lab provides an opportunity to simulate the PFC circuit designs and study their performance under various operating conditions, thereby optimizing for real-world power quality and energy efficiency.



3. Design and Study of Off-Board Chargers for EVs

Off-board chargers are external charging units that convert AC power from the grid into DC power to charge EV batteries efficiently. These chargers are typically used in public charging stations or home charging setups. This experiment focuses on the design, operation, and optimization of off-board chargers, which are essential components of the EV charging infrastructure.

Learning objectives include:

- Understanding the principle of operation of off-board chargers, which play a key role in the charging process of electric vehicles.
- Studying both the grid-side and battery-side requirements for efficient charging and ensuring compatibility between the charger, grid, and battery systems.
- Analyzing the selection and sizing of passive components, such as inductors, capacitors, and transformers, to ensure that the charger delivers a stable and regulated output voltage.
- Implementing closed-loop control systems to regulate the charging process, ensuring the safe and efficient transfer of energy to the EV battery.

Participants will also use simulation tools like PSIM and Altair Flux to model and optimize the chargers, gaining practical insights into how to design and build efficient, scalable EV chargers.

The EV Charging Technology Laboratory provides a cutting-edge environment for learning and developing EV charging systems. The lab is designed for students, engineers, and researchers who want to enhance their understanding of power electronics and EV charging infrastructure. By working with real-world components and using industry-leading simulation tools, participants gain a comprehensive understanding of EV charging technologies and the skills required to contribute to the rapidly growing field of electric mobility.

Whether you're designing high-efficiency rectifiers, optimizing power factor correction circuits, or developing advanced off-board chargers, the lab offers the resources and expertise necessary to drive innovation in the electric vehicle industry. Participants will not only build their technical knowledge but also become proficient in creating reliable, compliant, and future-ready charging systems for electric vehicles.

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