



EPE'22 ECCE Europe – Tutorial Announcement

## **Power factor correction: theory and practice.**

### **Name(s) and Affiliation(s) of the Lecturer(s):**

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### **Scope and Benefits:**

The tutorial has the dual objective of providing the theoretical bases of power factor correctors (PFC) and introducing the audience to the design challenges of boost PFC pre-regulators, certainly the most common power factor correction solution, with a mixture of theoretical knowledge and practical wisdom.

### **Contents:**

In the first part of the tutorial, after exposing the basics of ac power line rectification and the technical issues that lead to the need of high-quality rectification, the regulatory and practical aspects of PFC usage are considered. Then, many of the solutions used in industry will be reviewed, with a special focus on the boost PFC pre-regulator, its control methodologies and design challenges.

The second part of the tutorial focuses on the DCM/CCM boundary boost PFC pre-regulator with peak current mode control. After a design-oriented simplified analysis, a paper design of a pre-regulator for a street lighting LED lamp will be tackled. A step-by-step procedure will be provided that, starting from the electrical specification, addresses the design of both the power stage and the control part. Finally, the experimental data of a prototype designed with that procedure will be given.

### **Part I - Introduction to power factor correction:**

- Power Factor Correction (PFC) and regulatory aspects
- Passive and active methods of power factor correction
- PFC Pre-regulators
- Topologies and their variants
- Analog and digital control methodologies
- Design considerations and issues
- Single-stage PFC



## Part II - Analysis and design of a boost PFC pre-regulator

- Simplified analysis of DCM/CCM boundary Boost PFC pre-regulator
- Paper design of a DCM/CCM boundary Boost PFC pre-regulator for an LED driver in a streetlighting LED lamp
  - Overall LED driver architecture
  - A typical analog PFC controller
  - Electrical schematic of the pre-regulator
  - Electrical design specification
  - Step-by-step design procedure
  - Maximum device stress assessment
  - Power stage design: sense resistor, inductor, MOSFET, diode, output capacitor
  - Signal part: zero-current detection, analog multiplier, line voltage feedforward, output voltage control loop.
  - Experimental data, wrap-up, and conclusions

### **Schedule:**

Schedule is as follows:

#### **Monday, 5 September 2022 - 1<sup>st</sup> Tutorial Day - Morning**

09:30 - 11:00 : Introduction to power factor correction

11:00 - 11:30 : Coffee Break

11:30 - 13:00 : Analysis and design of a boost PFC pre-regulator

### **Who should attend:**

The tutorial is especially recommended to power engineers, graduate, and PhD students who are starting their learning curve in power factor correction. They will find the theoretical foundations and several useful practical tips to enrich their knowledge and get familiar with the challenges and the practical aspects of the design of PFC systems.

It is not excluded that also expert designers may find some lesser-known peculiarity or an interesting idea to explore.

### **Technical Level:**

Beginners and advanced; sound knowledge of fundamentals of power electronics required.



### About the Lecturers:



**Claudio ADRAGNA** joined STMicroelectronics in 1994, after two years at Co.Ri.M.Me, a microelectronics Research Consortium. He is a Company Fellow of STMicroelectronics' Technical Staff, the scientific community of the Company. He is responsible for ensuring the continuous development of his organization's technological competence in power conversion, as well as the preservation of its leadership position in the marketplace. Expert of ac-dc and dc-dc power conversion, in his thirty-year career he has defined or supervised the definition of over a hundred products, contributing also to their market introduction. Among them are the PFC controllers in STMicroelectronics' portfolio. He is the author or co-author of over eighty publications and his contributions to innovation in power conversion technology have yielded more than two hundred international patents.



**Francesco GENNARO**, graduated in Electrical Engineering in 1996 and pursued the Ph.D. in Electrical Engineering in 2000 both at University of Catania. After a period as Associate Researcher at University of Catania and a period at University of Wisconsin, Madison (WI), USA, he joined STMicroelectronics. Since 2015 he is a Principal Member of ST Technical Staff with expertise on SMPS and PV converters. He is author of more than 40 papers on IEEE Journal, Conferences and other magazines and holds 6 patents on power converters and related solutions. Currently, he is involved in the development of new and innovative solutions in the field of high efficiency converters, i.e. Data Center applications, and High Power/High Frequency converters using Wide Band Gap (WBG) devices and digital controllers.