

# Solid State Circuit Protection for Distributed Power Grids

## Abstract:

The adoption of distributed energy resources such as renewable generation and battery storage mandates the use of power electronic interfacing circuits. Unlike traditional transformers or machines, semiconductor-based power electronic converters have a much lower fault ride-through capability both in terms of overcurrent ( $<3X$  nominal) and time ( $<100\mu\text{s}$ ). Solid state circuit protection offers a viable solution in many AC and DC distributed power systems. This tutorial will provide a review and performance comparison on the state of the art solid state and hybrid circuit protection solutions. It will cover a few case studies, including a 380VDC SSCB for DC data center applications, a 6kV MVDC HCB based on a transient commutation current injection concept, a SiC-based AC solid-state circuit breaker, and a protective Smart Plug 2.0 for homes and offices. The talk will also highlight the fundamental challenges faced by these technologies and shed some light on future research directions.

## Instructor Bio:



Dr. John Shen is Grainger Chair Professor of Electrical and Power Engineering at Illinois Institute of Technology. He has more than 30 years of industrial, academic, and entrepreneurial experience in power electronics and power semiconductor devices with over 300 publications and 18 issued U.S. patents in these areas. He has been involved in circuit breaker research since 2013, and is an inventor of several patents and an author of 25 publications on the subject. He serves as PI of an ARPA-E CIRCUITS project on low-voltage solid-state circuit breakers and co-PI on an ARPA-E BREAKERS project on MVDC hybrid circuit breakers. He is a recipient of the 2012 IEEE Region 3 Outstanding Engineer Award, the 2012 E. T. Walton Fellowship from Science Foundation of Ireland, and the 2020 Illinois Institute of Technology Senior Faculty Sigma Xi Research Award. He has served the IEEE Power Electronics Society (PELS) in various capacities including Vice President of Products, AdCom member, Chair of Distinguished Lecturers Program, Deputy Editor-in-Chief of IEEE Power Electronics Magazine, Guest Editor-in-Chief of the IEEE Transaction on Power Electronics and the IEEE Journal of Emerging and Selected Topics in Power Electronics. He has been on the organizing or technical program committee of over 30 international conferences in the field, and served as the General Chair of the 2016 Energy Conversion Congress and Exposition (ECCE2016) and the 2018 International Symposium on Power Semiconductor Devices & IC's (ISPSD2018). He is a Fellow of IEEE and the U.S. National Academy of Inventors.