Short Course 2 – Solid-State Switching: Applications and Device Trends
8:00 am – 3:00 pm (6 hour course with 1 hour lunch break)
$300

Power modulators for industrial, scientific, and defense use are characterized by low duty factor, repetitive operation. The controllability, reliability, and cost of solid-state (semiconductor) switches are unmatched, and they are often enabling technology for high pulse repetition frequency (PRF) modulators. But the vast bulk of semiconductor devices available in the market place are products designed for relatively high duty factor, low peak power applications in conventional power electronics. Nevertheless, many application examples have been built using solid-state switching.

The design engineer may consider solid state switching for replacement of non-solid-state switched legacy systems or to address demanding new applications, especially where the need for high average power or high PRF exists. The continuing improvement in semiconductor device performance deserves regular consideration (or reconsideration) of the feasibility of using solid-state switching.

This course is intended to address key questions that a practicing engineer or scientist faces when considering solid-state switching in power modulator design. How best to use solid-state switching in the design of typical systems and subsystems used in power modulators? What is the state of the art in semiconductor switch technology? What are the physical limits and design rules that apply when adapting commercially available semiconductor devices for use in power modulators?

This short course addresses these questions by bringing together experts in applications and semiconductor devices. Bill Reass of Los Alamos National Laboratory covers solid-state modulator design; Jerry Hudgins of University of Nebraska covers power silicon technology; and Mike Mazzola of Mississippi State University covers emerging wide-bandgap semiconductor technology. The short course will be divided evenly between system level applications design with examples and overviews and trends in semiconductor device technology with recommended best practice. Since commercial availability of wide bandgap devices is presently limited to lower current discrete components or some custom products, the bulk of the wide bandgap program will be to inform participants of the progress being made in the development of primarily silicon carbide devices intended for pulsed power application, and those more mature wide bandgap devices intended for the conventional power electronics market, but usable with advantage by designers of power modulators.

William Reass received his BSEE from the University of Texas in 1975. He has lead engineering teams for over 30 years in the development and implementation of pulsed power, RF, and high average power systems within the parameter space of meg-amperes, megavolts, megawatts, and terajoules. The multi-megawatt class electronic systems have included: 1) polyphase resonant converters, 2) gridded tube modulators, 3) klystron RF amplifier systems, 4) pulsed oscillators, 5) fast (feedback controlled) plasma equilibrium systems, and 6) high current superconducting magnet power systems. The pulsed-power systems that have been developed, designed, and implemented are: 1) multi-megampere marks banks, 2) giga-volt-ampere inductive energy storage and transfer systems, 3) capacitor discharge banks, and 4) battery bank systems that are used for controlled-fusion, railgun, and stockpile stewardship experimentation. He has developed many types of fiber optic systems and specialized high speed electronic systems for diagnostic and feedback control purposes. William is an R&D 100 (team) recipient and has one patent.

Jerry Hudgins is a native of West Texas. He attended Texas Tech University, in Lubbock, Texas, where he received a Ph.D. degree in electrical engineering in 1985. Dr. Hudgins served as Associate and Interim Department Chair of Electrical and Computer Engineering at the University of South Carolina prior to joining the University of Nebraska as Chair. He continues to serve as an electrical engineering program evaluator for ABET since 2000. Dr. Hudgins' research involves power electronic device characterization and modeling. This includes devices made from silicon and wide bandgap materials such as silicon carbide and gallium nitride. Dr. Hudgins served as the President of the IEEE Power Electronics Society (PELS) for the years of 1997 and 1998, and as President of the IEEE Industry Applications Society (IAS) in 2003. He has also served in many international technical conference committee roles through the IAS and PELS, including General Conference Chair of the 1999 IEEE Power Electronics Specialists Conference, Technical Program Chair for the 2001 IEEE Industry Applications Society Annual Meeting, and General Conference Chair of the 2002 IEEE Industry Applications Society Annual Meeting. Dr. Hudgins has published over 60 technical papers and book chapters concerning power semiconductors and engineering education, and has worked with numerous industries including Ford Motor Co., Northrup-Grumann, International Rectifier, Powerex, and Harris Electronics.

Michael S. Mazzola received his PhD from Old Dominion University in 1990, and from 1990 to 1993 worked at the Naval Surface Warfare Center in Pulsed Power Research and Technology. In 1993 he joined the faculty of Mississippi State University where he is currently a tenured professor within the Department of Electrical and Computer Engineering. He is also a co-founder of SemiSouth Laboratories, Inc, a start up company that manufactures silicon carbide power transistors for high-temperature and high-efficiency applications. From 2005 through August of 2007 he served as Vice President for Technology while on a two year leave of absence from Mississippi State University. Dr. Mazzola has a technical background in semiconductor devices and applications in power electronics, and their application in automobiles gained while leading research in the MSU Center for Advanced Vehicular Systems (CAVS). He has led research in the areas of silicon carbide device prototyping and semiconductor materials growth and characterization for the last 13 years. Dr. Mazzola, who has published more than 100 papers and has been awarded 7 patents, is a registered professional engineer.