2014 IEEE Energy Conversion Congress and Expo

Tutorial Proposal Form

1. **Title of Tutorial**

   GaN Transistors for Efficient Power Conversion

2. **Abstract (500 word limit, If the tutorial is accepted, this abstract will be published in the conference web page, program, and proceedings)**

   Gallium Nitride (GaN) is now accepted in many power conversion and RF applications. The technology is rapidly developing and product experience in the field is expanding. This tutorial will begin with a discussion of the state-of-the art in GaN technology, including an overview of GaN technology, GaN transistor structures and the latest electrical performance.

   The tutorial will continue with application examples including new developments in high efficiency DC-DC conversion and emerging applications enabled by GaN transistors, such as high frequency Envelope Tracking (ET), and Wireless Power Transfer (WiPo). Following these examples, drivers, layout, paralleling, dead-time management, and thermal considerations will be examined.

   The tutorial concludes with a look into future of this relatively young technology and its potential to improve performance in existing applications and enable new applications not possible with aging silicon MOSFETs. Beyond the discrete transistor, the extension of GaN technology to fully integrated circuits will be discussed, furthering the potential of GaN to raise the bar in power conversion performance.

3. **Outline of Tutorial (Outline would only define the topics and the subtopics that would be covered. No detail descriptions should be included in the proposal)**

   I. Introduction (5 min): Alex Lidow

   II. Where is the state-of-the-art today? (45 min): Alex Lidow
   - Introduction to wide band gap materials, introduction to the structure of GaN devices including discussion of depletion-mode and enhancement-mode transistors
   - Performance in terms of high frequency performance, figures of merit, BV, $R_{DS(ON)}$, power conversion efficiency, and IC developments

   III. Design Examples Using GaN FETs (60 min): David Reusch
   - Buck Converters
   - Isolated Converters – eighth brick, resonant bus converter
   - Envelope Tracking
   - Wireless power
   - Class-D Audio

   IV. Break and Discussion (15 min)

   V. Design Basics (60 min): David Reusch
   - Gate Drive requirements and considerations

- Layout techniques for high frequency, multi-megahertz switching
- Paralleling GaN transistors
- Dead-time requirements
- Thermal Management
- High Speed Measurement Techniques

VI. A Look into the Future (20 min): Alex Lidow

VII. Questions and Answers (10 min): Alex Lidow/David Reusch

4. Lead Instructor (Name / Affiliation & contact information)

Alex Lidow, Ph.D.
CEO
Efficient Power Conversion Corporation (EPC)
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5. Other Instructor (Name / Affiliation & contact information)

David Reusch, Ph.D.
Director, Applications Engineering
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6. Instructor Bios: ~150 words each (Please provide a brief biography of each instructor, describing the qualifications for presenting the proposed tutorial, including the work and publications that are most relevant to the proposal)

Alex Lidow is CEO of Efficient Power Conversion Corporation (EPC). Prior to founding EPC, Dr. Lidow was CEO of International Rectifier Corporation. A co-inventor of the HEXFET power MOSFET, Dr. Lidow holds many patents in power semiconductor technology and has authored numerous publications on related subjects, including the first textbook on GaN power transistors – *GaN Transistors for Efficient Power Conversion*. Lidow earned his Bachelor of Science degree from Caltech in 1975 and his Ph.D. from Stanford in 1977.

David Reusch is Director, Applications at EPC Corporation. Dr. Reusch earned a doctorate in electrical engineering from Virginia Tech, where he also earned his bachelor's and master's degrees. While working on his Ph.D. he was a Bradley Fellow at the Center for Power Electronics Systems (CPES). Dr. Reusch has first-hand experience designing with GaN transistors to meet the demands for lower loss and higher power density in power converters. He is active in IEEE organizations and during the last several years has published papers at APEC and ECCE conferences.