



CAPT

Center for Advanced Power Technologies
National Tsing Hua University, TAIWAN

國立清華大學 電機系
先進電源科技中心

2019 功率半導體元件短期課程

Taiwan Power Semiconductor Workshop (TPS) 2019

Dr. Leo Lorenz
President, ECPE
IEEE Fellow

Prof. T. Paul Chow
Professor, Rensselaer Polytechnic Institute
IEEE Fellow

時間：2019年7月31日 13：30 - 16：30
2019年8月7-8日 13：30 - 16：30

地點：新竹 國立清華大學 台達館R217

主辦單位：IEEE EDS Student Branch Chapter at NTHU、國立清華大學
先進電源科技中心、國立清華大學電機系/電子所

協辦單位：IEEE Taipei Section、IEEE EDS/PELS/IAS Taipei Chapter、
科技部半導體射月計畫推動辦公室



July 31

**New Generation of Power Devices
- Impact on Packaging Technology and System Design -**



LEO LORENZ received the M.Eng. degree from Univ. of Berlin Germany in 1976 and the PhD. degree (first class Hons.) from University of Munich in 1984 (Germany).

He is currently Technology Advisor for several Research Institutions , Board Member of key Power Electronics Conferences and President of ECPE. From 1988 to 1998 he was Senior Director at Siemens responsible for Power Semiconductor Devices in Automotive & Industrial Application. From 1998 to 2012 he served as Senior Principle in Application and Concept Engineering for all power semiconductor Technologies in Munich/Singapore/Shanghai. In this field he has published more than 400 Journal/conference papers with a high citation rate and is the owner of many basic patents. He gave more than 90 key note presentations at high level Summits and Conferences.

Beside his work in Industry he is a Honorable/Adjunct Professor at several Universities in Germany and Worldwide . In this function he provides courses on power semiconductor technologies and supervised more than 20 PhD Students.

Dr. Lorenz is one of the Key Founder of ECPE (European Center of Power Electronics) and since the foundation in 2003 President of this organization. He is Founder/Co-founder of several conferences such as CIPS (Conference on Integrated Power Systems), PCIM Asia, EPE, etc. He served as General Chair of several Conferences e.g. CIPS since 2005, EPE 2005, ISPSD 1997, PCIM since 2001 and is in the Advisory Board of all of these Conferences. Dr. Lorenz received several times the best paper Award at IEEE Conferences. In 1996, 98 and 99 he received the Siemens Innovation Award and from the German Industry Society the Innovation Award in 2002.

Beside these he received several high level IEEE Awards e.g. IEEE-ISPSD Outstanding Contributory Award in 2010 (Japan), the IEEE- Gerald Kliman Innovator Award in 2011 (USA) and the IEEE- William E. Newell Power Electronics Award in 2012 (USA), Ernst Blicke Award in 2015 (Germany), Sun Yun-Suan Honorary Professorship from Nat. Tsing Hua University TW in 2016 and a Dr. Honoris Causa nomination in 2017.

He is a distinguished lecturer at several Universities since 2003. He owns an IEEE- Fellowship since 2006 and is a Member of German Academy of Science since 2005. Dr. Lorenz is in the Advisory Board of several Research Institutions e.g. Fraunhofer Institute, Robert Bosch Center, CORPE Denmark etc. and a Technology Advisor/Reviewer of Governmental Organizations and Funding Programs.



Outline

- Introduction (New Energy Efficiency Program, Research Program, etc)
- Power Electronics Development Overview (in ECPE; WBG Roadmap, etc)
- Overview Development (MOSFET; Super Junction Device, IGBT, SiC, GaN)
- Challenges in Application of Fast Switching Devices (impact of parasitics like di/dt ; dv/dt on chip level, on package level in system applications, thermal considerations, etc)
- Development Trend of Power Devices (e.g. Si, WBG)
- Summary

Contents of Seminar:

Introduction

Power Electronics is responsible to control the flow of electrical energy from the source up to the load very precisely by using power converters with high efficiency ratings, high power density design and outstanding reliability along with cost optimized technologies. The driving technology to achieve this goal are digital controlled SMART circuit technologies together with the new generation of power semiconductor devices. The consequent introduction of all new technologies available today is having a big impact on energy saving and the reduction of CO₂ emission. A special expert team - called PECTA - has been installed by several governmental organizations worldwide to work out fundamental data for further sustainable environmental protection. Power Electronics plays a key role in reducing the CO₂ emission.

This presentation will discuss:

- The main directions in the development of power devices based on silicon and WB materials. Both technologies are still having a huge development potential. In particular it will be shown how the fast and ultrafast switching devices will contribute to the future challenges in terms of efficiency, power density, reliability and cost for many future fields of applications.
- There is always a big discussion what might be the lead application of WBG devices. An evaluation of the benefits by using WBG in given and emerging fields of system application will provide ideas for the decision making process.
- The impact on packaging technologies, thermal management, reliability issues and system designs will be demonstrated and
- How ECPE is contributing to the development of Power Electronics in EUROPE



□ August 7-8

Fundamentals of Power Semiconductor Devices



T. PAUL CHOW was born in China in 1953. He received the B.A. degree in mathematics and physics (summa cum laude) from Augustana College, Sioux Falls, SD in 1975, the M.S. in materials science from Columbia University, New York, NY in 1977 and the Ph.D. degree in electrical engineering from RPI in 1982.

From 1977 to 1989, Dr. Chow was with GE Corporate Research and Development (now GE Global Research Center) in Niskayuna, NY. He first worked on the chemical vapor deposition of antimony doped tin oxide films for transparent electrode applications. Then, he studied thin film processes of refractory metal silicides and their applications as gates and interconnects for VLSI silicon MOS integrated circuits. In 1982, he started his research work on high voltage power semiconductor devices and ICs, exploring and optimizing several power devices (such as planar or trench IGBT and MCT) and developing a high-voltage control IC.

Since 1989, he has been with the Electrical, Computer and Systems Engineering Department of RPI, where he holds the rank of Professor. His present research interests are in developing new device concepts, integrated processes and circuit models for smart power devices and integrated circuits of silicon and wide bandgap semiconductors. Since the formation of CPES, he has been the thrust leader in power devices and Campus Director at RPI. He has demonstrated numerous novel power device structures in silicon, SiC and GaN. Also, he has developed models of silicon IGBT and low-voltage lateral trench MOSFET, SiC Schottky rectifiers, BJT, JFET and MOSFET for power circuit simulations.

Dr. Chow has published over 125 papers in refereed scientific journals, presented over 200 conference talks, contributed eight chapters in technical reference books and has 15 patents issued. He offered several distance-learning power semiconductor device courses to industry and organized several short courses in ISPSD conferences.

Dr. Chow is a Fellow of the IEEE. He has won the Young Author Award of the Electrochemical Society in 1982. He has won the Dushman Award and two management awards for his technical contributions while he was at GE. He received the Horizon Award from Augustana College in 1986. Two of his doctoral students have won the Best Student Paper Awards in international technical conferences (ISPSD in 1995 and EMC in 2000). He has also won the Research Award from the School of Engineering at RPI in 2003 and awarded Sun Yun-Suan Honorary Professorship from Nat. Tsing Hua University in 2018.



Outlines

Day 1

1. IGBT
2. MOS-gated Thyristors
3. SiC and GaN Vertical Devices

Day 2

4. Lateral and quasi-vertical Devices,
5. RESURF and Superjunction Devices
6. GaN and SiC Lateral Devices
7. Power ICs.

Introduction

In this short course, we will go through fundamental and important physics of bipolar semiconductor power devices in silicon as well as other vertical power devices in new semiconductors such as silicon carbide (SiC) and gallium nitride (GaN) on the first day. On the second day, Lateral device and power ICs in Si, SiC, GaN will be covered and new device concepts such as reduced surface field effect (RESURF) and superjunction will be introduced. Critical design issues of these devices will be discussed. This short course is suitable for device designers, researchers, and students to quickly gain knowledge about theoretical and practical design aspects of modern power semiconductor devices.



授課教授: Dr. Leo Lorenz (ECPE president, IEEE Fellow)
Prof. T. Paul Chow (RPI professor, IEEE Fellow).

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課程網頁

<https://sites.google.com/view/2019-tpsworkshop>

報名網頁

詳見 [2019 功率半導體元件短期課程](#)

2019 年 7 月 31 日

學生(IEEE 會員)	每人 1,000 元
學生(非 IEEE 會員)	每人 1,500 元
一般人士 (IEEE 會員)	每人 2,000 元
一般人士 (非 IEEE 會員)	每人 2,500 元

2019 年 8 月 7-8 日

學生(IEEE 會員)	每人 2,000 元
學生(非 IEEE 會員)	每人 3,000 元
一般人士 (IEEE 會員)	每人 4,000 元
一般人士 (非 IEEE 會員)	每人 5,000 元

2019 年 7 月 31 日暨 8 月 7-8 日 兩堂課程報名優惠價

學生(IEEE 會員)	每人 2,500 元
學生(非 IEEE 會員)	每人 3,800 元
一般人士 (IEEE 會員)	每人 5,100 元
一般人士 (非 IEEE 會員)	每人 6,300 元

現在加入 IEEE 學生會員只要 USD 13.5 (半年)，一般會員 USD 78(半年)。詳見

<https://www.ieee.org/membership/join/dues.html>



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匯款帳號資訊

完成報名後付款訊息將以 E-mail 通知

敬請留意 E-mail 信箱

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