

## **Arthur W. Kelley, Ph.D.**

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Power electronics professional with over thirty-five years experience covering an exceptionally wide range of applications and technologies in academic, industry and intellectual property settings.

### **Expertise**

Power supplies, power electronics, magnetics, power quality and power management integrated circuits. Dc-to-dc converter topologies including forward, flyback, full-bridge, push-pull, buck, boost, buck/boost and SEPIC; synchronous rectifiers.

Application of discrete power semiconductor devices including gate drives.

Design for production of high-performance power management integrated circuits.

Magnetics (60-Hz and high-frequency switching) including magnetic materials and saturable magnetic devices (mag amps and ferroresonant transformers).

Experience in terrestrial, marine and aircraft power systems.

Recent power supply application areas include: Ac power supplies for consumer electronics, LED lighting, medical implants, line-interfaced photovoltaics, hybrid power air vehicle, connectorless or non-contact power and transmission level power flow control.

### **Laboratory test facilities**

Agilent 4395A Network/Impedance/Spectrum Analyzer (10 Hz to 500 MHz)

Tektronix TDS 3034C Digital Oscilloscope (300 MHz, 2.5 GS/s)

Chroma 61502 Programmable Ac Power Source (up to 250 Vrms, 15 Hz to 1kHz, 1 kVA)

AE Techron 7224 Single-Channel Industrial Amplifier (dc to 300 kHz, 1 kW)

Agilent/HP 34401A Digital Multimeter (3)

Transistor Devices 50-60-1000A Electronic Load

Tektronix P5205A 100 MHz High Voltage Differential Probe

Tektronix TCP202 Current Probe

ESD Laboratory Bench and associated ESD control

Microscope, current sensors, thermocouple, etc.

### **Status**

U.S. Citizen, previous security clearance Top Secret

### **Experience (reverse chronological order)**

#### **Current, Independent Consultant**

Consulting research, design and analysis services for

Smart Wires, Inc., Union City, CA (headquarters San Francisco, CA). Transformer based power electronic product for improved utilization of electric power system transmission grid.

Expert witness for Power Integrations, Inc. (PI) represented by Fish & Richardson, Redwood City, CA in Petition for possible *Inter Partes Review* of U.S. Patent No. 6,107,851 vs. On Semiconductor (acquired Fairchild Semiconductor).

### **September 2007 to recent past, Independent Consultant**

- Expert witness for Power Integrations, Inc. (PI) represented by Fish & Richardson, Redwood City, CA in Petition for *Inter Partes* Review of U.S. Patent No. 6,212,079 vs. Silver Star Capital, LLC.
- Expert witness for Power Integrations, Inc. (PI) represented by Fish & Richardson, Redwood City, CA in Civil Action No: C 09-5235 MMC, Power Integrations, Inc. vs. Fairchild Semiconductor International, Inc., Fairchild Semiconductor Corporation and System General Corporation. Trial took place in December 2015. Work included preparation of declaration, supplemental declaration, deposition and trial testimony.
- U.S. patent to PI 6,212,079 Method and Apparatus for Improving Efficiency in a Switching Regulator at Light Loads  
U.S. patent to PI 6,538,908 Method and Apparatus for Providing a Multi-function Terminal for a Power Supply Controller
- Expert witness for Power Integrations, Inc. (PI) represented by Fish & Richardson, Redwood City, CA in Civil Action No: C 12-540-LPS Fairchild Semiconductor International, Inc., Fairchild Semiconductor Corporation and System General Corporation (FCS) vs. Power Integrations, Inc. Trial took place in May/June 2014. Work included preparation of declaration, supplemental declaration, deposition and trial testimony.
- U.S. patent to PI 7,952,895 Method and Apparatus for Implementing Dormant Mode in a Power Converter  
U.S. patent to PI 7,995,359 Method and Apparatus for Implementing an Unregulated Dormant Mode with an Event Counter in a Power Converter  
U.S. patent to PI 8,115,457 Method and Apparatus for Implementing a Power Converter Input Terminal Voltage Discharge Circuit  
U.S. patent to PI 6,229,366 Off-Line Converter with Integrated Softstart and Frequency Jitter  
U.S. patent to FCS 7,259,972 Primary-Side-Control Power Converter Having a Switching Controller Using Frequency Hopping and Voltage and Current Control Loops
- Expert witness for Terumo Cardiovascular Systems Corporation represented by Fish & Richardson, Minneapolis, MN in Civil Action No: 4:13-CV-03281 and in *Inter Partes* Review IPR2015-00263, Terumo Cardiovascular Systems Corporation, Inc. vs. Sheilah D. King and Allen Paige King including preparation of declaration. Case settled before reaching depositions.
- U.S. patent to King 6,423,268 Blood Heating System with Mutually Exclusive Relay-Controlled Heat Exchangers
- Consulting research, design and analysis services for Logos Technologies, Alexandria, VA. Supporting Raleigh NC site. Architect hybrid electric propulsion system for a powered parafoil.
- Adjunct Associate Professor, North Carolina State University – in conjunction with the Future Renewable Electric Energy Delivery Management (FREEDM) Systems Center, A National Science Foundation Engineering Research Center. Taught classes in power electronics.
- Consulting research, design and analysis services for Rambus, Inc., Chapel Hill, NC. Supporting LED Lighting Division, Brecksville, OH. Technology research, trade study and down selection of power supply architecture for LED lighting.
- Expert witness for Power Integrations, Inc. represented by Fish & Richardson in Civil Action No: 08-309-JJF-LPS, Power Integrations, Inc. (PI) vs. Fairchild Semiconductor International, Inc., Fairchild Semiconductor Corporation and System General Corporation (FCS), Trial took place in April 2012. Work included preparation of declaration, supplemental declaration, deposition and trial testimony.
- U.S. Patent to PI 6,107,851 Offline Converter with Integrated Softstart and Frequency Jitter  
U.S. Patent to PI 6,249,876 Frequency Jittering Control for Varying the Switching Frequency of a Power Supply  
U.S. Patent to PI 7,110,270 Method and Apparatus for Maintaining a Constant Load Current with Line Voltage in a Switch Mode Power Supply  
U.S. Patent to PI 7,834,605 Method and Apparatus for Maintaining a Constant load Current with Line Voltage in a Switch Mode Power Supply  
U.S. Patent to FCS 7,259,972 Primary-Side-Control Power Converter Having a Switching Controller Using Frequency Hopping and Voltage and Current Control Loops  
U.S. Patent to FCS 7,352,595 Primary-Side Controlled Switching Regulator
- Expert witness for Ericsson, Inc. represented by McKool Smith, Washington, DC and Austin, TX in Civil Action No. 2:11-CV-054-TJW-CE, SynQor, Inc. v. Ericsson, Inc. including preparation of declaration, supplemental declaration and deposition in response to Motion for Preliminary Injunction. Parties settled in advance of ruling.
- U.S. Patent to SynQor 7,072,190 High Efficiency Power Converter  
U.S. Patent to SynQor 7,272,021 Power converter with isolated and regulated stages  
U.S. Patent to SynQor 7,558,083 High Efficiency Power Converter  
U.S. Patent to SynQor 7,564,702 High Efficiency Power Converter  
U.S. Patent to SynQor 7,269,034 High Efficiency Power Converter
- Consulting research, design and analysis services for Innerpulse, Inc., Research Triangle Park, NC. Power supply for intravascular implantable defibrillator.

SolarBridge Technologies, Austin, TX. Transformer and power electronics design for grid-connected photovoltaics (formerly SmartSpark Energy Systems, Champaign, IL, now part of Sunpower, San Jose, CA)

Oriel Therapeutics, Durham, NC. Power supply for vibrating inhaler for administration of asthma medication.

Access Business Group, Ada, MI. Magnetically coupled connectorless power and communications for portable devices. One U.S. Patent issued.

#### **November 2000 to September 2007, Senior Design Engineer**

Linear Technology Corporation, Raleigh Design Center, Cary, NC (Headquarters Milpitas, CA)

Principal responsibility is design of high-performance analog integrated circuits for power management. At

Linear "Senior Design Engineer" is essentially a Product Technical Lead whose responsibilities, in addition to design, include aspects of product definition, layout, manufacture, debug, ESD, functional test, life test, characterization, correlation, applications and datasheet. I designed the LTC3705/25 half of the LTC3705/25/06/26 innovative chipset in the then newest BiCMOS process. Design was completely from scratch (rare). Subsequently designed LTC3805 and LTC3805-5 flyback controller in CMOS.

One U.S. Patent issued.

#### **July 1993 to June 2001, Associate Professor (with tenure)**

#### **July 1987 to June 1993, Assistant Professor (tenure track)**

North Carolina State University

Department of Electrical and Computer Engineering, Raleigh, NC

Developed funded research program including power electronics, power semiconductor devices, magnetics, power quality, power systems, motor drives and motors.

Funding from US Navy ONR Power Electronic Building Block (PEBB) program, electric utilities, power equipment manufacturers, and semiconductor manufacturers.

Of special note: developed several instruments including a calorimeter for measuring magnetic core loss, an impedance analyzer for energized power lines and instruments for semiconductor characterization.

Supervised numerous Graduate Research Assistants to the completion of their degrees.

Developed and taught undergraduate and graduate classes in power electronics.

Six U.S. Patents issued.

#### **Consulting (while at NCSU)**

Expert witness for insurance companies in two electronic product-failure litigations  
(one a boat fire and the other gasoline spill)

Technical consultant to Diamond Microelectronics Corporation  
(innovative diamond-based power-electronic devices).

Numerous other short-term technical consulting activities.

#### **January 1985 to July 1987, Senior Engineer**

Sundstrand Corporation (subsequently Hamilton-Sundstrand, now UTC Aerospace Systems), Rockford, IL  
Aerospace applications of power electronics including commercial aircraft, military aircraft and spacecraft.

(Top Secret security clearance)

One U.S. Patent issued.

#### **Education**

B.S., Electrical Engineering, Duke University 1979, *summa cum laude*, Phi Beta Kappa.

M.S. and Ph.D., Electrical Engineering Duke University 1981 and 1984, respectively.

James B. Duke Fellow

#### **Service to the Profession**

Editor in Chief, Newsletter, IEEE Power Electronics Society 2009 to 2012

Editor in Chief, IEEE Transactions on Power Electronics 2000-2001-2002  
(the premier journal in my field)  
Program Chair, Power Electronics Specialists Conference 1997  
Recipient of 2003 IEEE Power Electronics Society Service Award  
Numerous other volunteer positions with the IEEE Power Electronics Society

## Publications

- Kelley, A., Cavaroc, J., Ledford, J., Vassalli, L., Voltage Regulator For Contactor Ridethrough, IEEE Transactions on Industry Applications, Volume 36, Issue 2, March-April 2000, pp. 697 – 704.
- Kelley, A.W., Edwards, S.W., Rhode, J.P., Baran, M.E., Transformer Derating For Harmonic Currents: A Wide-Band Measurement Approach For Energized Transformers, IEEE Transactions on Industry Applications, Volume 35, Issue 6, Nov.-Dec. 1999, pp. 1450 – 1457.
- Baran, M.E., Maclaga, J., Kelley, A.W., Craven, K., Effects Of Power Disturbances On Computer Systems, IEEE Transactions on Power Delivery, Volume 13, Issue 4, Oct. 1998, pp. 1309 – 1315.
- Baran, M.E., Jinxiang Zhu, Kelley, A.W., Meter Placement For Real-Time Monitoring Of Distribution Feeders, IEEE Transactions on Power Systems, Volume 11, Issue 1, Feb. 1996 pp. 332 – 337.
- Baran, M.E., Kelley, A.W., A Branch-Current-Based State Estimation Method For Distribution Systems, IEEE Transactions on Power Systems, Volume 10, Issue 1, Feb. 1995, pp. 483 – 491.
- Jungreis, A.M., Kelley, A.W., Adjustable Speed Drive For Residential Applications, IEEE Transactions on Industry Applications, Volume 31, Issue 6, Nov.-Dec. 1995, pp. 1315 – 1322.
- Baran, M.E., Kelley, A.W., State Estimation For Real-Time Monitoring Of Distribution Systems, IEEE Transactions on Power Systems, Volume 9, Issue 3, Aug. 1994, pp. 1601 – 1609.
- Kelley, A.W., Wilson, T.G., Owen, H.A., Jr., Analysis Of The Ferroresonant Transformer With A Rectified Output In The Low-Line-Voltage Minimum-Line-Frequency Full-Load Condition, IEEE Transactions on Power Electronics, Volume 9, Issue 3, May 1994, pp. 318 – 327.
- Kelley, A.W., Yadusky, W.F., Rectifier For Minimum Line-Current Harmonics And Maximum Power Factor, IEEE Transactions on Power Electronics, Volume 7, Issue 2, April 1992, pp. 332 – 341.
- Kelley, A.W., Measurement Of Spacecraft Power Transformer Acoustic Noise, IEEE Transactions on Magnetism, Volume 26, Issue 1, Jan 1990, pp. 281 – 289.
- Kelley, A.W., Owens, W.R., Connectorless Power Supply For An Aircraft-Passenger Entertainment System, IEEE Transactions on Power Electronics, Volume 4, Issue 3, July 1989, pp. 348 – 354.
- Baran, M., Mahajan, N.R., Kelley, A.W., Grainger, J.J., A Distribution System Simulator For Protection And Control, 2001 IEEE/PES Transmission and Distribution Conference and Exposition, Volume 1, 28 Oct.-2 Nov. 2001 pp. 307 – 310, vol.1.
- Linkous, R., Kelley, A.W., Armstrong, K.C., An Improved Calorimeter For Measuring The Core Loss Of Magnetic Materials, 2000 IEEE Applied Power Electronics Conference and Exposition, Volume 2, 6-10 Feb. 2000, pp. 633 – 639.
- Jones, M., Kelley, A.W., Wideband Circuit Model For Busbar Impedance, 2000 IEEE Applied Power Electronics Conference and Exposition, Volume 2, 6-10 Feb. 2000 Page(s):839 – 845.
- Baran, M.E., Tocharoenchai, W., Craven, K., Kelley, A.W., Effects Of Power Supply Surges On Personal Computers, 2000 IEEE Industrial and Commercial Power Systems Technical Conference, 7-11 May 2000, pp. 141 – 146.
- Kelley, A., Cavaroc, J., Ledford, J., Vassalli, L., Voltage Regulator For Contactor Ridethrough, 1999 IEEE Industrial and Commercial Power Systems Technical Conference, 2-6 May 1999.
- Kelley, A., Harris, M., Cavaroc, J., Jones, M., Linkous, R., Hartzell, D., Darch, D., Bus Connector For Coordinated Interconnect: Laboratory Measurement And Finite Element Simulation, 1999 IEEE Applied Power Electronics Conference and Exposition, 14-18 March 1999, pp. 325 – 331.
- Kelley, A., Harris, M., Hartzell, D., Darcy, D., Coordinated Interconnect: A Philosophical Change In The Design And Construction Of Power Electronic Converters, The 1998 IEEE Industry Applications Conference, 12-15 Oct. 1998, pp. 1105 – 1110.
- Rhode, J.P., Kelley, A.W., Baran, M.E., Complete Characterization Of Utilization-Voltage Power System Impedance Using Wideband Measurement, 1996 IEEE Industrial and Commercial Power Systems Technical Conference, 6-9 May 1996, pp. 123 – 130.
- Jungreis, A.M., Kelley, A.W., The Axial Air Gap Wobble Motor-An Appropriate Topology For Magnetic Micromotors, 1995 IEEE Industry Applications Conference, 8-12 Oct. 1995, pp. 781 – 788.
- Rhode, J.P., Kelley, A.W., Baran, M.E., Line Impedance Measurement: A Nondisruptive Wideband Technique, 1995 IEEE Industry Applications Conference, 8-12 Oct. 1995, pp. 2233 – 2240.
- Kelley, A.W., Wilson, J.M., Rhode, J.P., Baran, M., On-Line Wideband Measurement Of Induction Motor Impedance, 1995 IEEE Industry Applications Conference, 8-12 Oct. 1995, pp. 647 – 654.

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