

MARK J. KEITH, BSEE, MSECE, PE, CFEI, CPQ
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Credentials

Professional Engineer

- North Carolina License PE # 021552
- South Carolina License PE # 30445
- Virginia License PE # 0402-051757
- Georgia PE # 038712
- Tennessee PE # 117314
- West Virginia PE # 20720
- Pennsylvania PE #PE084878

CFEI – Certified Fire and Explosion Investigator (# 10672-10121)

CPQ – Certified Power Quality Professional



Education

Master of Science in Electrical and Computer Engineering

North Carolina State University, 1993

Bachelor of Science in Electrical Engineering

Pennsylvania State University, 1980

Professional Summary

Mr. Keith has over thirty years of engineering experience. His areas of expertise and services include electrical/electronic engineering investigations, including all aspects of the design, fabrication, production, and operation, patent infringement analysis, reverse engineering, product teardowns and failure analysis of electrical and electronic devices and products as well as computer systems, hardware and software. Other areas of expertise include fire origin and cause (O&C) investigations, lightning investigations, telecommunication/data network engineering, industrial automation and control products/applications and electrical product testing and compliance (UL, CE and FCC) in the design phase, and in post-design product failure analysis, including power and signal line surge analysis. He has also served as an expert witness and forensic engineer on many cases involving a wide variety of electrical and electronic devices and applications. Some projects have focused on fire hazards, and others dealt with shock and operator safety. He has also analyzed designs in reference to user abuse and unintended operation, which is often an overlooked aspect in most product safety reviews.

Expertise and Services

Energy Audits
Failure Analysis & Reverse Engineering
Fire Origin and Cause
Forensic & Investigative Electrical Electronic Engineering
Industrial Automation & Controls
Lightning Investigations
Patent Infringement Analysis
Power Line and Signal Surge Analysis
Power Quality
Safety & EMC Compliance
Telecommunication and Data Network Engineering

Principal Industries Served

Forensic Electrical, Patent Infringement, Computer, Power Electronics, Electrical/Electronic Design Services, Industrial Automation & Controls, Medical, Mobile Communications, Telecom, Data Communications, Legal & Insurance Industries.

Areas of Concentration

Agency standards - UL, CE, CSA, FCC & IEC	Grounding
Contamination of Electronic Assemblies	HALT/HASS Testing
Computer engineering & applications	High-speed data and telecom networks
Electrical & electronic devices/equipment	Industrial automation & controls
Electrical & electronic engineering	Lightning/surge protection and analysis
Electrical systems	National Electrical Code
Electrical safety	Patent Infringement
Electronic failure analysis	Power quality
Electronic manufacturing	Product safety and liability
EMC design & compliance testing	Product testing and safety evaluation
Energy audits	Residential and Commercial Wiring
Environmental testing	Semiconductors
ESD - Electrostatic Discharge	Telecommunications
Fire origin & cause	Thermal analysis, evaluation & testing
FMEA - Failure Mode & Effect Analysis	Quality and Reliability

INVESTIGATIVE & INDUSTRY ENGINEERING EXPERIENCE:

Consulting and forensic engineering services for industry, attorneys and insurance companies regarding product liability, fire (O&C) investigations and electrical/electronic failure analysis investigations. Issues addressed, but not limited to, include all aspects of the design, fabrication, production and operation, liability, patent infringement analysis, reverse engineering, product teardowns and failure analysis of electrical and electronic devices and products as well as computer systems, hardware and software.

EFI Global, Charlotte, NC – Forensic Electrical Engineering Consultant 2013 - Present

- Additional information regarding cases and job responsibilities is company confidential.

Forensic Consultants of North America, NJ– Forensic Electrical Engineering Consultant 2012 - Present

- Additional information regarding cases and job responsibilities is company confidential.

Envista Forensics, Morrisville, NC – Forensic Electrical Engineering Consultant 2013 - Present

- Additional information regarding cases and job responsibilities is company confidential.

IEC & Associates, Raleigh NC – Founder & Principal Investigative Engineer

- Investigated multiple fire and product liability cases 2014 - Present
- Investigated a personal injury case involving a seat heater. 2013
- Investigated a lemon law motor vehicle case. 2013
- Investigated a fire origin and cause case involving a washing machine 2013
- Investigated multiple electrical wiring related fire origin and cause cases 2013
- Investigated multiple lightning strike incidents 2013
- Investigated fire origin and cause case involving a toaster. 2013
- Investigated fire origin and cause case involving a battery charger 2013
- Investigated fire origin and cause case involving telephone equipment 2012
- Investigated fire origin and cause case involving electrical failures in a portable space heater 2012
- Investigated electronic failures in Industrial Automation Equipment. 2012
- Investigated electrical failures and safety issues in a heating pad. 2012
- Investigated electronic failures in computers. 2012
- Investigated electrical & electronic safety issues in a forklift. 2012
- Investigated a fluorescent lighting fixture fire. 2012
- Investigated a utility surge and loss incident at a local golf course. 2012
- Investigating a suspected Laptop Computer overheating incident which resulted in severe burns to the client. 2010 – 2012
- Investigated an electrical shock incident related to an extension cord. 2011
- Investigated electronic reliability issues in a computer monitor. 2011
- Investigated a lightning strike incident at an asphalt plant and an airport 2011
- Investigated a power utility surge event and fire damage to a home. 2011

- Investigated a fire origin and cause case at a convenience store. 2010
- Investigation of electronic failures and a fire in an electrical power conditioning device that resided in a medical facility. 2008

National Forensic Consultants, Norristown PA - Investigative Engineer

- Investigated multiple fire and product liability cases, lightning and Surge Analysis for multiple clients. Responsibilities included evidence review, electronic equipment failure analysis and final report preparation/presentation to the clients. 2007 – 2016
- Electrical Engineering consultant for a fire origin and cause investigation involving residential wiring. Responsibilities included evidence review and final report preparation/presentation to the client. 2006
- Electrical Engineering consultant for a fire origin and cause investigation involving a cash register. Responsibilities included evidence review and research. 2006
- Electrical Engineering consultant for a fire origin and cause investigation involving a large manufacturing facility. Responsibilities included evidence review and research. 2006
- Expert witness in a legal case involving a defective electrical home appliance. Responsibilities included investigation, evidence review, electronic failure analysis, destructive testing and final report preparation/presentation to the client. 2004

Forensic Analysis Corporation, Raleigh NC - Investigative Engineer

- Investigated water contamination loss in electronics at a data server center 2013
- Investigated suspected electronic failures on a Motorcycle accident case. 2008 – 2010
- Investigated a residential fire incident and suspected damage to high end video and audio home theater electronics. Responsibilities included fire investigation, research, and evidence review. 2009
- Expert witness in a case regarding a malfunctioning medical implantable device. Responsibilities included investigation, research and evidence review. 2009
- Investigation of suspected electronic failures in a residential HVAC system. 2008
- Expert witness in lemon law motor vehicle case. Responsibilities included investigation, research, evidence review and deposition 2008
- Investigated a heavy equipment excavator fire. Responsibilities included fire investigation, research, and evidence review. 2007
- Investigated a Power Utility Surge event involving a multi-million dollar residential structure. Responsibilities included electronic equipment failure analysis, Insurance fraud investigation. Responsibilities included evidence review and final report preparation/presentation to the client. 2005 – 2006
- Investigated and provided Lightning/Surge Analysis for multiple clients. Responsibilities included electronic equipment failure analysis, Insurance fraud investigation and final report to the client. 2002 – 2005

Intota (Infogroup/ORC) – Investigative Engineer

- Investigation of suspected electronic failures in a Microwave fire. Fire origin and cause case. 2010
- Investigation of suspected electronic failures in a residential HVAC system. Fire origin and cause case. 2010
- Expert witness regarding failure analysis in laundry appliance electronics. 2007
- Electrical Engineering consultant regarding failure analysis of video electronics. 2007

Marshall Miller Associates, Raleigh NC - Investigative Engineer

- Co-investigator on an origin and cause investigation involving a Veterinary CBC machine. 2010
- Co-investigator on an origin and cause investigation involving an apartment fire. Responsibilities included evidence review and final report presentation to the client. 2005
- Conducted a fire origin and cause investigation involving a television set. Responsibilities included evidence review, electronic failure analysis, TV and electrical appliance fire research and final report preparation/presentation to the client. 2003

Tasa Group, Blue Bell PA - Investigative Engineer

- Conducted an investigation of suspected electronic failures in a emergency backup electrical power system. Working as an expert witness in the legal case with respect to the electrical/electronic hardware design and failure analysis. 2008 – 2010

- Consolidated Consultants, Chula Vista, CA - Investigative Engineer** 2008
- Investigation of a Power Utility Surge event involving a residential structure and suspect electrical and electronic failures.
- Institute for Products, Engineering & Construction, Scottsdale AZ. – Investigative Engineer**
- Investigation of suspected electronic failures in a mobile phone 2008
 - Investigation of suspected electronic failures in a laptop computer 2008
 - Expert witness involving a laptop computer fire. Responsibilities included fire investigation research and evidence review. 2007
 - Expert witness involving computer software/systems, financial records and information. 2004 – 2005
 - Electrical Engineering consultant for an electronic design dispute between a major appliance manufacturer and a sub-contract manufacturer. Responsibilities included evidence review, product design research, and final report preparation/presentation to the client. 2005
 - Conducted a origin and cause investigation of a cook top fire involving a solid surface range appliance. Responsibilities included evidence review, electronic failure analysis, electrical appliance fire research and final report preparation/presentation to the client. 2005
- Technical Assistance Bureau, Inc, St Louis, MO - Investigative Engineer**
- Electrical Engineering consultant for a fire origin and cause investigation involving a floor model water cooler. Responsibilities included evidence review and final report preparation/presentation to the client 2006
- Moore Forensic Engineering, Apex, NC - Investigative Engineer**
- Electrical Engineering consultant for a fire origin and cause investigation involving a rear projection TV. Responsibilities included evidence review and final report preparation/presentation to the client. 2006
- Forensic Fire Consultants, Raleigh NC - Investigative Engineer**
- Electrical Engineering consultant for a fire origin and cause investigation involving a manufactured home. Responsibilities included evidence review and final report preparation/presentation to the client 2005
 - Conducted two fire origin and cause investigations involving television sets. Responsibilities included evidence review, electronic failure analysis, TV and electrical appliance fire research and final report preparation/presentation. 2004
- Kevin Kennedy & Associates INC, Indianapolis IN - Investigative Engineer**
- Conducted a fire origin and cause investigation involving emergency backup electrical power equipment. Worked as an expert witness in the legal case with respect to the electrical/electronic hardware design and failure analysis. 2003 – 2004
- Kemper Auto & Home, Charlotte NC - Investigative Engineer**
- Conducted a power surge investigation on an industrial electrical generator. Responsibilities included evidence review, electronic failure analysis, and final report preparation/presentation to the client. 2004

INDUSTRY EXPERIENCE:

- Ametek ESP SurgeX, Knightdale, NC – Compliance Safety/Test Engineering Consultant** 4/2013 - Present
- Project engineer for safety and agency compliance. Responsible for compliance and safety testing on all new and existing products, EMC/EMI/RFI requirements and standards, and design reviews.
 - Currently preparing our in-house testing lab for self-certification via Intertek's SATELLITE Laboratory Scheme Data Acceptance Program.
 - Also responsible for surge testing and analysis (UL 1449), failure analysis and internal forensic investigations. Currently working with the following compliance agencies: Intertek located in Cortland, NY, TUV Rheinland of North America located in Boxborough, MA and Youngsville, NC,

TUV SUD located in Shenzhen City, 518052, P.R. China and Underwriters Laboratory located in RTP NC.

- Bolam Corporation, Fort Mill, SC – Hardware Design Consultant** 9/2014 - Present
- Hardware Design Engineer for next generation 3G wireless data acquisition products for automotive, industrial and commercial applications. Responsibilities include Hardware Design, PCB debug, PCB test procedures and environmental testing.
- Overture Networks, Morrisville, NC – Senior Hardware Design Engineer** 1/2008 – 10/2012
- Project engineer for UL and NEBS compliance. Also responsible for EMC/EMI/RFI design reviews, safety standards, compliance and testing on all new and existing products.
 - Design Engineer for next generation Gigabit Ethernet and OC3/DS3 data aggregation products. Responsibilities include high-speed signal integrity analysis, Hardware Design, JTAG test generation and implementation, PCB debug, PCB test procedures and environmental testing. Corelis JTAG software tools were used in the projects.
 - Environmental analysis and test verification of new and existing products
 - Interim hardware manager for 4 months (2010) while manager was on sick leave. Responsible for 5 engineers and new product introduction.
 - Manufacturing and Test Engineering liaison for new product introduction.
- Senior Hardware Engineer - Safenet Inc, Morrisville, NC** 3/2005 – 12/2007
- Design Engineer for data encryption hardware projects for Safenet's next generation OC192, SONET and Gigabit Ethernet Encryption products. Responsibilities included Hardware Design, High Speed Signal Integrity Analysis, ROHS Compliance, JTAG test generation and implementation, PCB debug and PCB Test Procedures.
 - Agency Compliance and Environmental testing and contract manufacturing liaison.
 - Mentor Graphics and JTAG Technology JTAG software tools were used in these projects.
Note: Additional information describing the job responsibilities is classified.
- Senior Hardware Design Engineer- CipherOptics, Raleigh, NC** 12/2002 – 1/2005
- Co-Project/Design Engineer for three projects for CipherOptics next generation Internet security product offering.
 - Responsibilities include hardware design/debug, printed circuit board signal integrity analysis, and product verification and test. Cadence Concept 15.2 CAD or OrCad 10.0i was used for the designs.
 - Additional responsibilities included
 - JTAG test development and generation of manufacturing test sets using Corelis JTAG software tools.
 - Thermal analysis and test verification.
- Principal Engineer, Inovia Telecom - Centennial Campus, Raleigh, NC** 1998 – 5/2002
- Provided technical hardware solutions for Video over VDSL technology for new product line offering.
 - Design and implemented universal high speed Gigabit ATM switch fabrics for Inovia's DSLAM product line. Responsibilities included hardware design/debug, printed circuit board design, and product verification.
 - Motorola MPC8260 and MPC860 microprocessors were used in all hardware designs.
 - Designed and implemented ATM test and interface boards for hardware verification.
 - Lead hardware engineering interface for sister design team in Israel.
 - Product support for current DSL access products in the field.
 - Responsible for IEC 61000-4/IEC 801 EMC/EMI/RFI standards, compliance, and testing.
 - Technical advisor/mentor to NC State Electrical Engineering Intern students.
- Staff Engineer - IBM Corporation, RTP, NC** 1997
- Design Engineer for a PCMCIA 25 Mbit ATM adapter card. Responsibilities included hardware design of a XILINX FPGA PCMCIA/ISA arbitration controller. The design was VHDL based.
 - Responsible for IEC 61000-4/IEC 801 EMC/EMI/RFI standards, compliance, and testing.
- Senior Design/Development Engineer - Connectware Inc., Morrisville, NC** 1995 – 1997
- Project/Design Engineer for an ATM-LAN (OC3, Ethernet and Token Ring) Bridge/Router device. The product was an Intel I960 33MHz microprocessor-based design. Responsibilities included hardware design/debug, PCB design, and product verification.
 - Lead hardware engineering interface for a remote design team India.
 - **Responsible** for IEC 61000-4/IEC 801 EMC/EMI/RFI standards, compliance, and testing.

- Senior Design/Development Engineer- Square D Company, Knightdale, NC** 1989 – 1995
Industrial Computer-Programmable Logic Controllers Division, 1992 – 1995
- Designed and implemented a XILINX EPLD chip for a Programmable Logic Controller. Design provided backplane bus arbitration between an Intel 80C186 and a Motorola 68000 microprocessor, additional control functions and various I/O interfaces.
 - Designed an AC/DC (120 VAC/24V DC) 10 Watt switch mode (Buck converter) power supply.
 - Responsible for hardware design of an Intel 80C152 microprocessor based remote Programmable Logic Controller. Responsibilities included all phases of hardware design, test, and PCB design. This product received **Control Engineering** magazine's 1993 Editor's Choice Award for best distributed I/O product.
 - Responsible for IEC 1000-4/IEC 801 EMC/EMI/RFI standards, compliance, and testing on newly developed Industrial Programmable Logic Controller Products.
 - Team member of the Square D EMC/EMI/RFI Standards Committee.
 - Team member of the Square D Component/Supplier Qualification Committee.
- Photoelectric Sensors Division,** 1989 - 1991
- Project/Design Engineer for analog/digital ASIC design and implementation for Industrial photoelectric proximity sensors. Designed and developed three high performance photoelectric ASICs. Responsibilities included all phases of design, test and final product manufacturing.
 - Team member of the Square D Corporate ASIC Strategic Implementation Group.
- Senior Microelectronic Design Engineer - Avnet International Corporation, Smithfield, NC** 1988 – 1989
- Project/Design Engineer for digital system design for commercial satellite television receivers. Responsibilities included ASIC chip set re-design and verification.
- Senior Product/Quality Engineer - Exide Electronics Corporation, Raleigh, NC** 1987 – 1988
- Provided Product/Quality Engineering for Uninterruptable Power Source Systems (UPS), Emergency Lighting Systems, and Motive Power Battery Charger Products.
 - Responsibilities included system design modifications, PCB redesign and resolution of field failures and reliability issues.
- Senior Integrated Circuit Design Engineer- GE Corporation, Research Triangle Park, NC** 1980 – 1986
- Team member of the Microprocessor and ASIC Design and Development Group. Designed various Integrated circuits including an Arithmetic Logic Unit, Dual Port RAM ASIC, Medical Data Processing ASIC and a Control ASIC for a 120 Volt experimental light bulb. Responsibilities included all phases of Integrated Circuit design and fabrication.
 - Provided technical support and design assistance for strategic customer accounts (domestic and foreign) and internal tactical application engineers.

INTELLECTUAL PROPERTY AND PATENT INFRINGEMENT ANALYSIS:

- Aphileon, Raleigh NC – Co-Founder/Owner** 2013 – Present
- Currently working with several major IP licensing and litigation law firms. Responsibilities included technical evaluation and claim chart generation, product teardowns, prior art and documentation research, product testing, final report and presentation to the client.
- IEC & Associates, Raleigh NC – Principal Investigative Engineer** 2010 – Present
- Currently working with an IP portfolio attorney on mobile phone and tablet computer patent portfolios. Responsibilities include technical evaluation and claim chart generation, product teardowns, prior art and documentation research, product testing and final report.
 - Patent and prior art search regarding microprocessor control and application in industrial motorized vehicles. 2011 -2012
- Otto Technologies, Raleigh NC - Investigative Engineer** 2010
- Patent infringement and review regarding multiple cases involving distributed computing systems for mobile devices. Responsibilities included prior art investigation, final report and presentation to the client.
- Forensic Analysis Corporation, Raleigh NC - Investigative Engineer** 2009
- Patent infringement and review regarding an electronic pest and rodent pest control

repeller. Responsibilities included claim review, prior art investigation, final report and presentation to the client.

Professional Organizations:

Association of Energy Engineers
ASTM International
Institute of Electrical and Electronic Engineers (IEEE)
National Association of Fire Investigators (NAFI)
North Carolina Adjusters Association
Product Safety Engineering Society (IEEE PSES)

Continuing Education:

Currently preparing for the Professional Energy Manager (PEM) certification from the North Carolina State University and Schneider Electric SA's Energy University.
Currently preparing for the Certified Energy Auditor (CEA™) certification from the Association of Energy Engineers
Power Quality Professional (CPQ) Certification – September 2013
National Electric Code Training - 2013 (Three day course), Keith Educational Seminars, Wilmington NC
NAFI CFEI (Certified Fire and Explosion Investigator) - 2013
Electromagnetic Compatibility Engineering – 2012 (Three day course), Henry Ott Consultants
NEBS Conference -2010, Verizon and UL (Compliance for Wireless and Broadband Networks)
North Carolina State University – Post Master's Degree

- ASIC Design (ECE520), 2008
- National Electrical Code Seminar, Oct. 2002
- High Speed Networks (ECE570), 1997
- Computer Communications (ECE571), 1996
- Electromagnetic Fields and Systems (ECE540), 1995

Fire Detection and Investigation – 2005, Durham Tech, Course # FIP 128, Durham NC.
Product Liability: Understanding the design Process – 2004, The Warren Group
Residential Home Inspector - April 2004 Wake Tech Community College, NC
National Electrical Code Seminar- October 2002, North Carolina State University
C Programming for Engineers -1994, University of Massachusetts
Electromagnetic Interference and Compliance Seminar - 1993, Interference Control Technology Inc.
Industrial Computers and Programmable Logic Controllers -1993, Square D Company
Quality Engineering Theory, Practices and Principles - 1988, Stat-A-Matrix Institute