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Objective: Engineering assignments that will take advantage of my extensive experience in electronic design, project management, engineering management and manufacturing, most especially in the areas of RF design, antenna design and engineering, analog design, system engineering, team building and leadership and EMC engineering as outlined below.

- Development of complex products that involved RF, analog and digital circuit design and complex firmware and software and system development. Some particular areas of endeavor have been in very complex marine radio transceivers, electric utility wireless meter reading (AMI/AMR), load-management, feeder automation and Home Area Networks, wireless gas metering, wireless water metering. Other past areas of particular accomplishment have been in the area of unmanned spacecraft electronics and charged-particle detection apparatus. Particular strengths in embedded antenna implementation for metering.
- Design verification and product qualification. Design reviews.
- Interface with customers in their application and operation of various electronic equipments, primarily in the wireless data acquisition and control areas. I have significant experience and accomplishments in these areas, and my customers have appreciated my efforts and accomplishments on their behalf.
- FCC, Industry Canada and other compliance design and certification
- Electromagnetic compatibility design and testing. This includes both regulatory compliance and manufacturing and engineering EMC compatibility for engineering product development and manufacturing test activities.
- Trouble-shooting, problem solving and emissions and environmental compliance design and assistance.
- Manufacturing support

Highlights of Qualifications:

Over 40 years of electronic design and product development experience, especially in RF design for consumer electronics, land-mobile and marine radio, and utility and industrial wireless data communications and control applications. These have included voice and data AM, FM, FSK and AFSK receivers and transmitters and controllers, in the frequency range 25 MHz to 2.4 GHz.

Extensive experience in research and development, project management, engineering management, manufacturing and quality control. Experience in component procurement and qualification, and vendor interfaces.. Experience in personnel selection and engineering management.

Areas of particular interest, strength and expertise are in the areas of receiver and transmitter design, antenna design and integration, printed circuit design for VHF, UHF radio and high-speed digital circuits to frequencies ranging into the 2.4 GHz region, and integration of wireless, analog and digital circuits into complex products such as meters, load-management devices and feeder automation devices, management of firmware and software development and design for manufacturability.

Extensive experience in high-volume manufacturing and low-cost electronic design.

Extensive experience and knowledge in FCC, Industry Canada and other regulatory compliance design and certification activities.

Experience in design of wide-input range (57-530 VAC) off-line switching power supplies for electricity meters and other electric utility equipment.

Customer support. Design, installation and support of customer-specific data and control interfaces for wireless data and control applications are some of my particular areas of accomplishment and strength. I am at home in the customer environment as well as the design lab and manufacturing environments. Wide circle of customers and clients in the electric utility industry in US and Canada.

Experience in radio-frequency communications equipment design, nuclear instrumentation, digital and analog, monolithic and hybrid IC design, microprocessor development, spacecraft instrumentation (particle detection, scintillation counters, solid-state particle detectors, pulse, analog and digital circuits), and technical writing. Experience in PLL synthesizer designs and the design of receivers and transmitters (HF, VHF and UHF).

Experience in modem design, data communications and technical writing.

Additional experience as a teacher of solid-state circuit design to newly-hired technical staff at Johns Hopkins University Applied Physics Lab.

Employment and Relevant Skills:

**Self-Employed as an Independent Contractor/Consultant
November 2002 to Present – Cunningham Technologies, Inc.**

Clients:

**CDI Aerospace – Contract Senior RF Engineer for GE Energy – Atlanta
(October 2010 – March 2011)**

- Redesign of Zigbee 2.4 GHz Home Area Network (HAN) module for GE electricity meters.. Schematic Revisions, BOM production component selection and design reviews. Conference calls and consultation with GE sites in US, UK, Australia and India

Nanovision Melbourne, Florida (October 2010)

- Antenna and PCB design for Bluetooth and Wi-Fi antennas and antenna matching networks for automotive applications. Redesign of PCB to improve stray capacitance and improve antenna performance.

Elliott Tech, LLC Holly Springs, NC (March 2010 – October 2010)

Transmitter, receiver, PCB and embedded antenna design (902 MHz and 1.4 GHz GPS) for personal security device for high volume production for Elliott Tech, LLC in the Raleigh, NC area. Trained Elliott Tech personnel in RF design, RF measurement techniques using vector network analyzer, spectrum analyzer and EMC antennas. Taught antenna tuning and impedance matching using Smith Chart and network analyzer

Elster Electricity (October 2002 –December 2008)

Elster Integrated Solutions (July 2005 – December 2008) (Separate contract with an Elster “sister company”)

Notable activities and accomplishments were the design of receivers and transmitters for electric-utility meter-reading and for water and gas meter reading in the 902-928 MHz ISM band and design of complete equipments incorporating those RF designs, for Elster Electricity, and Elster Integrated Solutions.

Design of 2.4 GHz Zigbee HAN modules and antenna design and matching for 2.4 GHz.

Other significant activities included FCC and Industry Canada compliance and equipment certification. CTIA cellular compliance testing – TIS and TRP.850 and 1800/1900 MHz. Also PTCRB compliance These compliance activities were conducted for Elster Electricity in Raleigh, NC and for SmartSynch/Itron Cellular in Jackson, Mississippi.

Recent projects included development of 902-928 MHz transmitters for Elster Electricity, LLC, with embedded antennas, microprocessor and register interfaces for water and gas meters. The initial designs operated properly and met all specifications, in the initial implementation. These have been deployed in test systems and operated virtually 100 percent. This is, I believe, a significant testament to my skill as an RF designer and to my skill in implementing RF designs on printed-circuit circuit assemblies.

I also designed a new wireless electricity meter radio and a novel printed circuit notch antenna for this device. Antenna patent – US Patent 7696941. Issued April 13, 2010.

I designed, constructed and calibrated a test system to enable the characterization and measurement of quartz crystals to permit one of my clients, Elster Electricity, to measure the essential electrical characteristics of quartz crystals used in their products and to evaluate spurious modes in those crystals in order to resolve crystal vendor and manufacturing problems.

Cannon Technologies Minneapolis- St. Paul, MN and Carrington, ND

2001 Designed UHF, 930 MHz Frequency-Synthesized, Paging Band Load Management Receiver for Cannon Technologies (now part of Cooper Power Systems.)

2003 Wireless performance improvements for Progress Energy's capacitor bank control system that incorporated my 930 MHz receiver designs. Performance improvement was primarily in the areas of antenna improvements at remote sites and improved large-signal interference rejection. Involved extensive travel over central and eastern/coastal North Carolina with mobile spectrum analyzer and service monitor to visit capacitor bank controller sites.

2004 FCC and Industry Canada Certification for 930 MHz Paging Band Smart Thermostat f for Cannon Technologies

2004 Designed Frequency-Synthesized VHF (148-174 MHz) load management receiver for Cannon Technologies, with NO TUNING Adjustments - LCR-4500

2005 Designed 85-530 volt off-line switching power supply to enable electricity meters for be equipped with 9 KHz and 12 KHz distribution-line carrier transponders for Cannon Technologies

2006 Provided upgrade and modification to one of Electricities of NC VHF load management systems at Red Springs, NC, that also included an earlier VHF receiver design of mine, as well as custom transmitter interface equipment that I developed while an employee of ABB.

2007 Re-designed the LCR -4500 VHF Load management receiver to new LCR -4700 product in a much smaller package with a much smaller antenna. The small antenna was a real challenge in the 148-174 MHz band. The LCR-4700 had no tuning adjustments.

(2000 – 2007) Worked with the TUV compliance lab in our area to obtain several FCC and Industry Canada emissions compliance approvals This work involved test-plan development and equipment modification for compliance testing.

Ballard Spahr Law Firm, Atlanta, Georgia (August, 2011- November, 2011)

- **Non-testifying Expert Witness (August, 2011-November, 2011) for Ballard Spahr Law firm in Atlanta (and several other law firms across the United States) for a very large case in federal court involving antenna patent infringement claims, resulting from Transdate filing suit against most of the meter manufacturers and suppliers and a significant number of utilities in the United States, based on a patent, that, in my professional opinion, is invalid and has no merit.** My first involvement in this matter was in 2001/2002 on behalf of ABB and Elster Electricity. I worked with the Woodcock-Washburn law firm in Philadelphia and we successfully defended against the Transdata claims against ABB and Elster.

ADDITIONAL CONTRACT EXPERIENCE:

1968 Wrote course material to be used in two **Capitol Radio Engineering Institute** courses in Audio Amplification and Feedback while I was with the Johns Hopkins University Applied Physics Laboratory

1977 As a contract designer, I developed a 16-channel digitally tuned (PLL) VHF telemetry receiver for heavy machine tool application (dull tool detection), for **Houdaille Industries**, Buffalo, NY.. Was responsible for all phases of design through final documentation and FCC certification.

1989 As a contract designer/developer, designed and developed ultrasonic distance measurement equipment for **Technology Transfer Institute**, Raleigh, NC..

Additional full-time (W2) Employment

ABB Power T&D Company (Formerly Westinghouse Electric) Raleigh, NC (1989 -2002)

Performed complete design and development of low-cost, high-performance VHF, UHF and FM broadcast sub-carrier receivers for electric utility load control and automation functions. Provided RF design assistance to vendors to ABB and to other departments within ABB

Developed system requirements and performed complete design and development of customer-specific systems and interface equipment for integration of ABB load-management, feeder-automation and home automation equipment into ABB customers' communications infrastructures. These systems included, VHF, UHF radio systems, FM broadcast radio systems, microwave radio systems and telephone trunks and subscriber loops.

Participated in proposal development, sales calls and presentations in support of ABB marketing and sales organizations. Wrote and published application notes for ABB wireless load-management, feeder-automation products and radio-frequency data communication systems.

Provided RFI/EMI compliance design assistance to ensure compliance of ABB products with requirements of the FCC, Canadian DOC and other regulatory agencies.

Westinghouse Electric, Meter Division Senior Design Engineer (December, 1979 - 1993)

Designed VHF and FM broadcast radio-frequency receivers, transmitter interface equipment, test equipment and provided manufacturing support for a new family of VHF radio residential load management equipment, which employs FM Broadcast, VHF Radio, telephone network and residential power line carrier technology. My primary design responsibilities included VHF receiver design, EMI compliance design and certification, modem design and FCC Parts 15 and 68 certification. Had complete project responsibility for an electric utility load control system that employed FM broadcast sub-carrier (SCA) channels. Responsibilities included receivers, central station computer interfaces and telecommunications equipment design as well as broadcast station sub-carrier control equipment.

Provided RFI/EMI measurement and design assistance to ensure compliance with FCC and DOC regulations.

Designed Bell 103, 202 and CCITT V.21 and V.23 data sets for use in electric power demand recorders and in electric utility distribution automation equipment. These included environmental and robust lightning surge protection suitable for operation in utility substations.

Designed remote data collection telecommunications system that employed HP-1000 minicomputers to gather billing and load-profile data from electric power demand recorders. Design responsibilities included communication system architecture and protocol designs, operator interfaces and error control and recovery procedures. For this achievement I received a *Westinghouse Outstanding Engineering Achievement Award*.

Assisted in design of family of electric power demand recorders that employed magnetic bubble memory for non-volatile data storage. My primary responsibilities were the design of the bubble memory controller and interfaces and design of modems and communication interfaces. Collaborated with Fujitsu, Ltd. in design of custom bubble memory controller and cassette system. My concept for extending the operating temperature range of their bubble memory cassette by using one of the drive coils to preheat the device was subsequently incorporated by Fujitsu into a custom design for Westinghouse and later as an option in their standard product line.

As part of the strategic and product planning for a new generation of load profile recorders, I was assigned responsibility for surveying and evaluating available and emerging memory and data storage technologies and suppliers and presenting my findings, recommendations and risk assignments to the Strategic Planning Board.

Aerotron, Inc Raleigh, NC

Engineering Manager: Under-Dash Radio Products. (August, 1978 - December, 1979) (Reported to Vice President of Engineering)

Responsible for development of a new family of lower cost under-dash mounted land-mobile FM two-way radios (25-512 MHz).

Implemented component selection and standardization programs that were expected to effect savings of at least \$250K per year on purchased parts.

Additional duties included selection and training of engineering personnel.

Regency Electronics

7707 Records Street
Indianapolis, Indiana 46226

Engineering Manager: (July, 1972 - July, 1978) (Reported to Executive Vice President)

Projects included 40-channel CB transceivers, scanning and special-purpose VHF and UHF receivers and a new family of VHF marine transceivers that included Automatic Direction Finders, Frequency Synthesizers and microprocessor control. The Marine Radio programs required heavy involvement in the marketing, product planning and industrial design areas. Additional projects included the design of crystal-controlled TV sound channel receiver used for CATV control signal reception and the design of production test equipment for Heath Dynamics crystal plant. Other products for which I had project responsibility and supervised design efforts included VHF Synthesized Signal Generator, Weather Alert receivers, and Low Cost VHF Portable Receivers. In addition, I spearheaded Regency's development of

microprocessor software development capability. Specific areas of circuit development effort included frequency synthesizers (PLL, 16-160 MHz), receiver design and oscillator development, as well as transmitter and modulator designs. I was involved in antenna development for VHF Automatic Direction Finding equipment.

I supervised and participated in the installation, calibration and certification of three FCC emissions compliance Open Area Test Sites. These conformed to FCC requirements.

Project Engineer (July, 1972 to July, 1976)

Designed VHF Weather Alert Receiver (Patent #3,974,450). Designed crystal controlled FM Broadcast EBS Alert Receiver. Designed VHF scanning receivers with tone alert capability.

Designed 75 watt Deck hailer/Siren Unit for Marine service (used by USCG). Designed portable VHF (150-175 MHz and 30-50 MHz) Scanning Receivers. A novel method of power cycling the receivers in synchronism with the scanning circuitry permitted a substantial reduction in battery requirements (Patent #3,974,452). Responsibilities included circuit design, scheduling, documentation, cost analysis, packaging and product support. Also responsible for EMI testing and certification.

Johns Hopkins University/Applied Physics Laboratory

11100 Johns Hopkins Road
Laurel, Maryland 20810

Associate Engineer, Space Physics Group (December, 1968 - July, 1972)

Designed electronics to be flown on NASA spacecraft. Responsibilities included design of analog and digital electronics for Charged Particle Measurement Experiments for IMP H and J spacecraft and analog, digital, D-A and power supply circuits for Photo-Electron Spectrometers for Atmospheric Explorer Spacecraft.

I was assigned project responsibility for Energetic Particle Experiment for IMP H and J spacecraft. Responsibilities included scheduling, fabrication, calibration, environmental and EMI qualification, component selection, procurement and screening. Responsible for coordination with NASA Project Office and for integration of the instrument with spacecraft.

I also taught courses in solid-state circuit design for newly hired engineers and physicists in the Laboratory's Associate Staff Training Program.

July, 1968 - December, 1968: Assigned to Associate Staff Training program. Undergraduate and graduate course levels in solid-state circuits, controls, aerodynamics, propulsion, guided missiles, satellite technology, information and random signals, radar, microelectronics, structures and programming. Also participated in systems analysis project involving proposals for Advanced Surface Missile System.

September, 1967 - July, 1968: Member of Microelectronics Group. Designed a micropower TTL logic family for satellite applications. An unusual technique was used to form resistors permitting the achievement of very large total resistances for a given die size.

EDUCATION

BSEE with honors, North Carolina State University, 1967. Elected to Tau Beta Pi, national engineering honor society and to Eta Kappa Nu, national electrical engineering honor society. Taught sophomore electrical engineering laboratory classes 1966-67 academic years. During the last three years of college, worked approximately 30 hours per week as an electronic technician and junior engineer.

Was employed by NC State University as Electrical Engineering Laboratory Instructor (September, 1966 - August, 1967) - Conducted sophomore electrical engineering laboratory classes.

Forty-two hours toward MSEE at Johns Hopkins University. Additional courses in math, chemistry and biological sciences taken at Indiana/Purdue University.