Aerospace Consulting LLC

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Edward S. Troy

- INTERNET OF THINGS (IoT)
- PRIOR ART ANALYSIS
- RF, MICROWAVE, ANALOG DESIGN
- SYSTEM DESIGN AND ANALYSIS
- DIRECT DIGITAL SYNTHESIS
- TELEMETRY EQUIPMENT
- POWER AMPLIFIERS
- VCO's
- TRANSMITTERS
- SAW CIRCUITS
- RECEIVERS
- DETECTORS
- WIRELESS DEVICES
- FILTERS
- AVIONICS
- GPS APPLICATIONS TECHNOLOGY
- EVALUATION EXPERT WITNESS
- TECHNICAL WRITING
- FPGA DEVELOPMENT
- MATLAB & SMULINK SIMULATION
- SOFTWARE DEFINED RADIO (SDR)
- ELECTRONIC WARFARE
- CIRCUIT ANALYSIS / OPTIMIZATION
- LOAD-PULL MEASUREMENTS
- LOW-NOISE AMPLIFIERS
- BROAD-BAND AMPLIFIERS
- SYNTHESIZERS
- KEYFOBS & RELATED CIRCUITS
- FCC COMPLIANCE / PRE-COMPLIANCE
- PATCH AND PRINTED ANTENNAS
- CIRCUIT BOARD LAYOUT
- DESIGN TROUBLESHOOTING
- EMBEDDED SOFTWARE DEVELOPMENT
- MODULATORS
- SPREAD-SPECTRUM EQUIPMENT
- LITERATURE RESEARCH/ RETRIEVAL
- DSP APPLICATIONS
- EMBEDDED C PROGRAMMING
- PROPOSAL CONSULTING / ASSISTANCE
- ANTENNA DESIGN & SIMULATION

Ed Troy is an electronics engineer with decades of experience in RF, microwave, wireless, and analog circuits and systems, as well as antenna design, development, simulation, and prototyping. His strong background in engineering, from both a design and production point of view, as well as his practical knowledge and formal education in the fields of engineering, business, and marketing, allow him to assist engineering and management to achieve their program and corporate objectives. Furthermore, by receiving his Master's degree in Electrical Engineering 22 years after receiving his BSEE, and performing Ph.D level research after receiving his Master's degree, he has kept his education and technical knowledge in the field current. He is interested in putting his knowledge (and/or facilities) to work for clients who require technical assistance, or consulting advice, on any programs that may be proving difficult to properly staff with internal personnel. He also performs work for clients who need independent circuit or system design, development, analysis, prototyping, and troubleshooting. Many clients have found his expertise in high speed analog, RF, and microwave circuit board layout to be very useful in helping them to rapidly turn their ideas and schematics into working circuits and systems. Although he has his own facilities, he is also available for consulting at sites almost anywhere in the world for short periods of time. Jobs requiring hours to months of time are considered.

EDUCATION

Ph.D. level research in electrical engineering at Lehigh University performing dissertation research in the area of nonlinear semiconductor and system modeling, as well as in the area of modulation distortion, prediction, and analysis.

Master degree in Electrical Engineering at Lehigh University – 1997

Graduate level courses in the MBA program at Lehigh University 1978 – 1982

B.S. Electrical Engineering, College of Engineering, Lehigh University - 1975

Continuing education courses in spread spectrum systems, microwave circuit design, and thick-film hybrid circuit technology.

EXPERIENCE

Aerospace Consulting LLC, PO. Box 536, Buckingham, Pa. 18912 (1989 - Present full-time 1983 - 1989 part-time) President
Designing and developing wireless, analog, RF, and microwave circuitry for various clients operating at frequencies ranging from DC to over 26.5 GHz. (Recent antenna design and development has extended to over 60 GHz.) Design and development work has been heavily based on circuit simulation and optimization using the latest linear and non-linear circuit design and analysis tools. Circuitry developed or worked on includes high power pulse DME amplifiers, several 900 MHz synthesized transceivers for commercial spread spectrum applications, 225-400 MHz synthesized transmitter, 225-400 MHz 100 watt amplifier, DDS circuits, various lumped and distributed filters, detectors, switching circuitry, low-noise VCO's and synthesizers, low-noise amplifiers, cellular base station receivers, low-power synthesized industrial transmitter, microstrip patch and helical antennas, C and X band transverter, and some unique GPS interference mitigation circuitry. Other work has included performing independent design evaluation and production trouble-shooting for several clients, S-Band telemetry transmitter proposal assistance, GP-IB test equipment programming, system control and test software development using Visual Basic, development of Xilinx FPGA's using Verilog, and embedded microprocessor programming using C, assisting with FCC compliance, RF susceptibility evaluation, low-cost satellite receiver design, as well as double-sided and multi-layer circuit board layout using P/CAD and Altium Designer software for many of the design and development programs mentioned above and for various clients. Extensive work was performed as a principal designer for a major military broadband electronic warfare jamming system. Ed was also a major contributor on a team tasked with putting together a proposal for a major military high capacity digital microwave radio, as well as another team putting together a proposal for a wireless Internet system. Ed also has extensive experience with literature search, research, and retrieval, for various technical and mergers and acquisitions projects, including a study of the state of the art in antenna design, development, and technology. Other work has included extensive design, development, and prototyping of 900 MHz and 2.4 GHZ FCC Part 15 circuits and systems, various GPS-related applications, as well as the evaluation and testing of various low-noise amplifiers for cellular systems and the evaluation of cellular tower coverage. Some recent work has involved working, both for an extended time at a client's location, as well as in my own laboratory, on designing and developing a new, ultra-miniature telemetry transmitter using FQPSK (Fehrer-patented QPSK), as well as work on a GPS translator. These, and other recent designs featured very low phase noise fractional-n synthesizers.
Other recent system and circuit design and development has included designing, developing, prototyping, and now cost reducing, the RF and microwave portions of a radar-like body scanning system. (If you've ever been scanned by the airport system that runs an antenna around you. I was instrumental in developing a similar system for a different market.) This work included all of the frequency generation, up-conversion, and down-conversion over a frequency range from DC to over 22 GHz. Still other work has included the design, development, and range improvement for various key fob and key fob-like systems, as well as troubleshooting and improving the range of various low-cost, low-power transceivers and robotics applications where various transmitters were causing range problems due to receiver overload and compression. I have also designed and developed an active antenna steering system, including the antennas, for interference mitigation of GPS signals.

Some other recent activities has involved the design, development, and prototyping of RF distribution systems, as well as the determination, through simulation, of interference sources for new SDR designs. Through simulation, I was able to absolutely identify the problem areas in a PCB that contributed to catastrophic electromagnetic interference. Relatively simple re-layout efforts were able to resolve these issues.

Some of the most recent work has involved the design and development of a low-cost cellular transmission detection system that might be applied to such people as truck drivers and prisons, as well as extensive work in the area of Software Defined Radio and similar system design, development, and simulation using Matlab, Simulink, and GNU Radio-Companion. Recent antenna design work has centered around 60 GHz antennas. Internet of Things (IoT) development has also taken a significant portion of my time, as well as working with patent attorneys on prior art analysis for various patent litigation. This work was also to include simulations and measurements on various circuits in defense of various patent litigations. Ed has also worked with inventors and patent attorneys to write up patent documents and in patent litigation.

Agilis Corporation, Digital Radio Division, Langhorne, Pa. **(1988 - 1989)** Senior Member, Technical Staff - Responsible for design and development of amplifiers and T/R switches for a FCC Part 15 spread- spectrum modem. These designs included both receiving and transmitting amplifiers operating in the 900 MHz band, as well as the necessary switches and power level shifting circuitry. Other work included circuit board layout and system integration, as well as initial manufacturing coordination and surface- mount vendor selection.

ICI Americas, Valley Forge, Pa. (1982 - 1988) Senior Electronics Engineer-
Responsible for all microwave and RF electronics activities within the Aerospace Division. Activities included design and development of microwave circuits and microstrip patch antennas and antenna arrays, as

well as the coordination of outside microwave and hybrid circuitry design and development. Systems developed included transmitters and receivers operating between 800 and 1900 MHz. Circuitry developed included low noise amplifiers, synthesizers, modulators, microstrip filters, and IF sections.
Other responsibilities included selection and establishment of an IBM PC based electronic CAD facility, as well as establishing, and training technicians to use, a printed circuit board facility capable of going from computer-generated artwork to printed circuit boards in less than 6 hours. Additional work included the successful identification of an acquisition candidate for ICI Americas.

United Technologies Corp., Tele-Dynamics Division, Fort Washington, Pa. (1978-1982) Senior Engineer
Responsibilities ranged from leading an engineering team tasked with taking several complex military telemetry transmitters from the development phase into the production phase, to design and development of an S-Band video transmitter. Other activities included research, development, and the writing of technical proposals, as well as the design and development of amplifiers, multipliers, and modulators for telemetry transmitters.

American Electronics Laboratories, Colmar, Pa. (1975-1978) Electronics Engineer Responsible for design, development, production, and testing of RF components that operated at frequencies ranging from 2 to 18 GHz. These components included video detectors, limiter/detectors, and couplers in both microstrip and stripline. Other work included the development of test stations and programs to allow for the automated testing of microwave components through the IEEE-488 bus.

PUBLICATIONS .

Article in June, 1992 issue of RF Design magazine on the Global Positioning System

Cover feature in September, 2003 issue of RF Design magazine, “Highly Spectrum-efficient Modulation Techniques and Other Technology Advances Take Hold in Aerospace Electronics”. http://mobiledevdesign.com/images/archive/309RF_Troy24.pdf

FACILITIES

Simulation and Analysis Capabilities

- Altium Designer for circuit board layout and FPGA development with Nanoboard
- PCAD for circuit board layout
- IsSpice/386 (non-linear, analog (SPICE) circuit simulation) (ICAPS/4)
- Agilent Genesys Suite with all modules including Spectrasys, Harbec, Cayenne, Momentum GXF, and all synthesis modules
- Modelithics complete library for Genesys – This software provides highly accurate substrate and pad-pattern scalable models for many families of capacitors, resistors, inductors, transistors, diodes, and other devices. With these models, the simulation results are virtually identical to the measured results on an actual circuit board since the models take into account the various stray aspects of real components, including the characteristics of the pads and the circuit board material.
- SolidWorks Professional – 3D mechanical modeling and drafting package
- Mathematica® (mathematical modeling, analysis, and graphics)
- Matlab
- Mathcad
- Keysight SystemVue Linear and Non-Linear system simulation package with DSP, RF, Logic, and Communications toolkits. It can also generate C and C++ code from its models.
- NEC 4 and EZ-NEC 4 for wire antenna design and simulation, as well as the analysis of radiation patterns for antennas placed on various structures (planes, vehicles, ships, etc) at various locations
- Small milling machine and other machine shop equipment for fabrication of boxes and test pallets for RF and microwave circuits

Software that I have used, and can lease, but don’t own

- AWR Microwave Office – linear and non-linear RF and microwave simulator. It also has electromagnetic analysis capabilities. It is very similar to the Genesys suite which I do own.
- Ansys HFSS – 3D electromagnetic analysis package. I have used it, but don’t own it.

- EMPro from Keysight for antenna design and analysis. My main computer was optimized for performing EM (electromagnetic) simulation and antenna design and has a GPU to speed up processing by as much as 10 to 30 times, along with 24 cores
- CST Microwave Studio—I have used it but don't own it

Modern, Fully Equipped Laboratory

Test Equipment covering DC to over 26.5 GHz

- Agilent 8510C vector network analyzer with the time domain option (45 MHz – 26.5 GHz)
  Device characterization
  Load-pull measurements
- Agilent 8970B/8971C noise figure test system covering 10 MHz – 26.5 GHz
- Agilent 8753D vector network analyzer covering 30 kHz – 6 GHz. This also has the time-domain and high stability options
- Computer automated antenna range for antenna analysis and measurement
- Agilent E-4433B ESG-D digital and analog modulation signal generator to support 3G and other wireless communications system development including DECT, GSM, NADC, CDMA, PDC, PHS, TETRA, W-CDMA, CDMA2000, etc.
- Agilent 83630B synthesized sweeper covering 10 MHz – 26.5 GHz with 1 Hz resolution and built- in attenuator options
- Agilent 8350B sweeper covering 10 MHz – 26.5 GHz
- Spectrum Analysis
  HP-8563E 30 Hz to 26.5 GHz spectrum analyzer with phase noise and spurious measurement personalities
- Vector Signal Analysis
  Rohde & Schwarz FSIG vector signal analyzer covering 9 kHz through 13 GHz
- Agilent 54120B/54123A DC – 34 GHz oscilloscope
- General purpose test equipment including arbitrary waveform generator, pulse generator, 2 GSPS 4 channel digital oscilloscope, attenuators running up to 1000 watts
- Phase noise measurement through 26.5 GHz
- Agilent 16702B logic analysis for embedded software development and debug
- Agilent 66332A dynamic measurement DC source for evaluating power draw of battery-operated systems
- Agilent 54120B/54123A DC – 34 GHz oscilloscope
- Tektronix TDS-744A 2 GSPS 4 channel digital oscilloscope
- Agilent 33220A arbitrary waveform generator
- Agilent 437B dual channel power meter
- General purpose test equipment an analog oscilloscope, power supplies, pulse generator, various other RF and low frequency signal generators, and various attenuators rated up to 100 watts
- Phase noise measurement from 10 MHz through 26.5 GHz
- Several slide screw tuners for load pull and various matching tasks covering up to 12 GHz
- 1000 watt attenuator covering DC – 3 GHz for high power amplifier testing and development
- Calibrated horn antenna covering 1 – 18 GHz for antenna range measurements and for FCC Part 15 pre-compliance testing
- Additional RF signal generators covering up to 26.5 GHz

Multiple Development Platforms for Software Defined Radio (SDR) and Internet of Things (IoT) Design

- Analog Devices FMCOMMS3 SDR platform to 6 GHz for Matlab or GNU Radio
- Multiple Raspberry Pi units including the latest version 4

- Analog Devices AD-FMCDAQ2 A/D and D/A platform for Matlab or GNU Radio
- Xilinx ZC706 development platform and Vivado or ISE
- Analog Devices ADALM-PLUTO SDR development platform for Matlab or GNU Radio to 3.8 GHz
- Silicon Laboratories - various key fob and other short range development kits
- Silicon Laboratories EZRadio development system
- Texas Instruments SmartRF/CC13xxEM IoT development platform
- Linksys (Maxstream) 2.4 GHz and 900 MHz Iot (Zigbee) development platform
- Many synthesizer development boards from Analog Devices, Hittite, and others, to over 10 GHz