Matthew R. Cummings

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Summary:

Electronic design engineer and technical project leader specializing in precision instrumentation and control systems with a record of delivering well-documented, robust and cost-effective designs across a variety of industries and applications. An expert troubleshooter and hands-on designer with a broad technical skill set including radio-frequency circuits, precision analog design, high-speed data conversion, power electronics, electrical product safety, embedded control, FPGAs, 8/16/32-bit microcontrollers, firmware, software and programmable logic.

Experience:

T2 Biosystems *(In Vitro Diagnostic Medical Instrumentation)* Lexington, MA
Principal RF Systems Engineer, 2014-Present
Specified, designed, built and tested electronic circuit assemblies used as part of *in vitro* medical diagnostic equipment based on nuclear magnetic resonance. Investigated and corrected circuit and system design problems associated with sensitive front-end electronics to ensure reliable and robust performance of instruments delivered to the field. Provided expert electrical engineering guidance to the company's software, physics and chemistry staff. Responsibilities encompassed analog, RF and embedded digital control technologies including application of Xilinx FGPAs. Contributed as an author to scientific publications highlighting the company's technology (see Luo, Z., Fox, L.,Cummings, M., Lowery, T.J. (2016) "New frontiers in in vitro medical diagnostics by low field T2 magnetic resonance relaxometry" Trends in Analytical Chemistry v. 83, October 2016).

Triple Ring Technologies *(Research and Development Firm)* Newark, CA
Principal Electrical Engineer 2014-2016
Utilized Altium Designer to develop high-performance analog and digital electronics for a novel medical imaging system based on optical tomography. The device exceeded customer expectations and is currently under evaluation for clinical use.

XBO Medical Systems Co. Ltd *(Medical Device Manufacturing)* Langfang, China
Principal Electrical Engineer and Project Leader, 2011-2014
Led the development of an NMR spectrometer for use in a medical imaging system. Worked with the client to develop and validate requirements. Recruited a team of 10 engineers and implemented the design. As an individual contributor to the project, developed the instrument's architecture and designed a set of modular circuit boards that included the following technologies:

- High-speed (128 MB/s) digital I/O based on PCIe
- 14-bit 100 MS/s 4-channel analog-to-digital converter card with FPGA based digital downconverter and associated RF front end electronics
- Precision dual-channel arbitrary RF waveform generator
- Xilinx Spartan 6 FPGA development using Verilog

Coordinated integration of the instrument with the client's hardware and software. The project involved extensive international travel.

American Science and Engineering *(X-ray Inspection System Manufacturing)* Billerica, MA
Principal Electrical Engineer, 2009-2011
As a member of the organization's research and development group, contributed to a wide range of projects involving novel X-ray inspection devices. Worked with high-voltage power supplies, motion control systems, safety circuits and data acquisition electronics. Performed system design, debug, integration and test. Circuit design activities spanned analog, digital and power design disciplines.

Experience, Continued:

Aurora Imaging Technology, Inc. *(Medical Device Manufacturing)* North Andover, MA
Project Manager and Principal Electrical Engineer, 2007-2009
Developed the product specification and architecture for a multichannel RF transceiver and waveform generator system used in a 1.5 T MRI scanner. Worked with senior management to create a project plan consistent with the company's business goals and FDA QSR design controls. Hired staff, managed execution of the project plan and provided technical leadership for the program. Coordinated design and risk management reviews. Designed and built a variety of RF circuits including: filters, amplifiers, mixers and attenuators for a digital receiver and transmitter operating in the VHF band. Designed data conversion and digital interface circuits. Designed, implemented and tested logic circuits with Altera CPLDs for control and data interface circuits. Developed software in C to run on an embedded XScale ARM32 microcomputer under embedded Linux. Created, reviewed and released the complete documentation set for the instrument.

Nanobiosym, Inc *(Research and Commercialization of Nanotechnology)* Cambridge, MA
Senior Electrical Engineer, 2008-2009
Developed instrumentation for capillary electrophoresis and laser-induced fluorescence analytical devices. Specified, procured and integrated lasers, optics, high-voltage power supplies and photodetection electronics. Constructed prototypes and created LabVIEW-based user interfaces.

General Electric Healthcare *(Medical Device Manufacturing)* Waukesha, WI
Consulting Electrical Engineer and Prototype Supplier, 2002-2007
Designed and built RF signal processing and control instrumentation for GE's high-field MRI scanners installed at leading research institutions, including: the National Institutes of Health, Stanford University, Duke University, University of California San Francisco and the University of Niigata, Japan. Specific projects and design activities included:

- 40-channel frequency translator system to adapt 1.5 T electronics for 7 T
- Low-noise, high-linearity RF signal processing design at VHF (300 MHz)
- Application of mixers, filters and low-noise amplifiers
- Digital interface and control circuits
- Firmware for 8051 microcontrollers
- RS-232 communications interfaces
- Transmit/receive switches for 7 T multinuclear NMR spectroscopy

Massachusetts Institute of Technology Cambridge, MA
Contract Design and Prototype Manufacturing, 2003-2006
Contracted by MIT's chemistry department to design and build ultrawideband photodetectors for application in experiments requiring very fast response (3 GHz BW, FWHM of 300 ps) with low noise. Integrated a silicon avalanche photodiode (APD), high-voltage power supply and RF amplifier into a compact package. Provided a detector with bandwidth, responsivity and noise performance that are unmatched by any similar commercially available devices. For an example of some of the work that the MIT group has used the detectors for, see: "A direct test of the correlation between elastic parameters and fragility of ten glass formers and their relationship to elastic models of the glass transition," D. Torchinsky, J. Johnson, and K. A. Nelson, J. Chem. Phys. 130, 064502 (2009).

ONI, Incorporated *(Medical imaging equipment start-up)* North Andover, MA
Senior Electrical Engineer, 1997-2001
Served as lead engineer in the development of high-performance electronic equipment used in a first-of-a-kind magnetic resonance imaging system specifically designed for imaging human extremities. Responsible for many aspects of the design, including: system architecture, specification, detailed design, prototype development, test plans/procedures and regulatory compliance testing. The product was successfully introduced in the market after completion of the 3-year development.

In addition to engineering tasks, played an important role in this start-up company's development and growth. Developed and deployed policies and procedures consistent with the ISO9001 and the FDA's Quality System Regulations. Designed and implemented engineering and manufacturing databases using Microsoft Access that were used throughout the startup phase, saving the business considerable expense. Established and maintained the company's information systems, e-mail, web site and LAN.

Education:

Worcester Polytechnic Institute — Worcester, MA
Master of Science, Electrical Engineering
Thesis – "Modeling and Analysis of a High-Voltage Power Converter"

Babson College — Wellesley, MA
Master of Business Administration, *summa cum laude*
Concentration – Entrepreneurship

Worcester Polytechnic Institute — Worcester, MA
Bachelor of Science, Electrical Engineering, High Distinction

Skill Keywords:

RF design, power electronics design, power supply design, high-voltage design, precision analog design, A-D conversion, D-A conversion, data acquisition, embedded control, microcontrollers, signal processing, CPLD, FPGA, electrical safety, operational amplifiers, DDS, ADC, DAC, DSP, analog/RF filters, RF amplifiers, ISO9001, FDA QSR.

Spectrum analyzers, network analyzers, RF test and measurement instrumentation.

Altium, OrCAD, Xilinx, Altera, Verilog, XScale ARM32, MSP430, Motorola HC11, 8051, C, C++, assembly language, Microsoft Office, Autocad, Mathcad, Matlab.

Languages – English and beginner conversational Mandarin.

Affiliations:

Member, Institute of Electrical and Electronics Engineers
Member, Tau Beta Pi, Eta Kappa Nu and Golden Key Honor Societies