

# QADEER AHMAD KHAN

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## **Assistant Professor**

Department of Electrical Engineering  
Indian Institute of Technology Madras  
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More than 15 years of Design, Development and Research experience in the field of Analog/Mixed Signal ICs/Systems with specialization in Power Management and User Interface which include DC-DC Converters (Buck, Boost, Buck-Boost), Charge-pumps, Motor Drivers, Haptics Drivers (ERM and LRA), LED Drivers, Smart Battery Interface and LCD/AMOLED display power supplies for Mobile Phones and Automotive Industry. Holding Ph.D. in Electrical and Computer Engineering with 16 U.S. Patents and 20 IEEE publications.

## **EDUCATION**

- Ph.D. in Electrical and Computer Engineering (Sept 2007 - May 2012) from Oregon State University.  
GPA: 3.79  
**Major Advisor:** Pavan Kumar Hanumolu  
**Thesis Title:** Digitally Assisted Control Techniques for High Performance Switching DC-DC Converters
- Bachelor of Technology in Electronics & Communication Engineering (July 1995 - June 1999) from Jamia Millia Islamia, New Delhi with percentile of 89.23.

## **ACADEMIC EXPERIENCE**

July 2016 – Present **Dept. of EE, Indian Institute of Technology Madras** (*Asst. Professor*)

May 2016 – July 2016 **Dept. of EE, Indian Institute of Technology Madras** (*Visiting Asst. Professor*)

Sept 2008-May 2012 **Dept. of EECS, Oregon State University** (*Graduate Research Assistant*)

- Research in power management circuits with emphasis on DC-DC converters
- Design and layout of full chip Buck and Buck-Boost DC-DC converters using innovative control techniques
- Modelling of DC-DC converter in MATLAB and Simulink
- Selecting package, BOM and designing test boards for taped out DC-DC converter chips
- Preparing test plan and perform testing of the DC-DC converters

Sept 2007-June 2008 **Dept. of EECS, Oregon State University** (*Graduate Teaching Assistant*)

- Preparing and checking assignments for undergraduate courses ECE322-ELECTRONICS I and ECE323-ELECTRONICS II
- Holding weekly TA hours to take students questions/problems and provide solutions
- Taking lectures in absence of the course teacher
- Holding course lab and checking experiments
- Helping teacher to prepare and checking mid-term and final exams
- Preparing and maintaining grade sheets

## INDUSTRY EXPERIENCE

Feb 2015-Mar 2016 **Qualcomm India Pvt. Ltd., Bangalore, India** (*Staff Engineer*)

- Defining architecture and specifications for power management modules which include switching converters, smart battery interface, motor drivers, ERM/LRA haptics driver, LCD/AMOLED display power supplies (WLED backlight, +VDD, -VDD, SWIRE interface)
- Modeling of power management module using Matlab and Simulink
- Component selection for different power modules
- Debugging customer issues and provide solutions
- Provide guidelines and review board level schematic and layout
- Competitive Analysis of power and user interface modules
- Define new power modules and features based on market trend and customer requirements

Jun 2012-Feb 2015 **Qualcomm Technologies Inc., San Diego, CA, U.S.A** (*Staff Engineer*)

- Defining architecture and specifications for power management modules which include switching converters, smart battery interface, motor drivers, haptics driver, LCD/AMOLED display power supplies (WLED backlight, +VDD, -VDD, SWIRE interface)
- Defining hardware/software interfacing for various power management modules
- Modeling of power management module using Matlab and Simulink
- Managing project from start of the design to silicon tape-out and lab testing
- Component selection for different power modules
- Debugging customer issues and provide software/hardware based solutions
- Provide and review board level design and layout guidelines
- Preparing HW demo for customers

Jun 2011 – Aug 2011 **National Semiconductor (Texas Instruments), Longmont, CO, U.S.A.** (*IC Design Intern*)

- Design of digitally tunable analog PID controller for DC-DC Converters

Jun 2010 – Sept 2010 **National Semiconductor, Longmont, CO, U.S.A.** (*IC Design Intern*)

- Auto tuning of digital PID controller for DC-DC Converters

Jun 2008 – Sep 2008 **National Semiconductor, Santa Clara, CA, U.S.A.** (*IC Design Intern*)

- Digitally assisted analog PWM controller for Buck-Boost DC-DC Converter

Dec. 2005 – Aug 2007 **Siways Microelectronics Pvt. Ltd. New Delhi, India** (*Engineering Lead*)

- Defining IP/Product roadmap and specification
- Defining Architecture of Power Management ICs
- Active participation in Design of DC-DC Converters and LED Drivers
- Selection of process technology
- Managing projects
- Mentoring fresh hires

Apr 2004 – Nov. 2005 **Freescale Semiconductor India Ltd., Noida, India** (*Lead Engineer*)

- Design and Layout of Analog and Mixed Signal Circuits for network processor and motor driver chips
- Top level floor planning and integration
- Participation in defining architecture and specification of analog blocks
- Mentoring fresh hires

Sept. 1999 – Mar 2004 **Semiconductor Product Sector, Motorola India Ltd., Gurgaon, India** (*Senior Design Engineer*)

- Design and Layout of Analog and Mixed Signal Circuits for Baseband Processor
- Design of integrated power management and motor driver chips

## EDA TOOLS, MODELLING AND MEASUREMENT SKILLS

- *Cadence*: Analog Artist Environment, Spectre Simulator, Diva DRC/LVS, Assura DRC/LVS, Virtuoso layout/schematic editor, AMS designer
- *Mentor*: Design Architect, Calibre DRC/LVS, Eldo Simulator
- *Other Tools*: HSPICE, OrCAD, Simetrix, Simulink, MATLAB, PCB Artist
- *Instruments*: Agilent Oscilloscopes, Agilent Power Supplies, Keithley Voltage/Current sources, Digital Multi-meter, Calorimetry CR-100 LCD/AMOLED Photometer/Flicker meter, Konika Minolta CA-310 LCD Photometer, Accelerometer for Haptics Driver

## UNITED STATES PATENTS (Pending)

1. M. Bansal, **Q. Khan**, C. Shi, Average Current Mode Control of Multi-Phase Switching Power Converters, US 20150263614, Sept. 17, 2015.

## UNITED STATES PATENTS (Issued)

1. **Q. Khan**, S. Dhar, J. Zazzera, T. Sutton, Circuits and Methods for Driving Resonant Actuators, US 20150069939, March 12, 2015.
2. **Q. Khan**, S. Wadhwa, D. Tripathi, G.K. Sidhartha, K. Misri, PVT Variation Detection and Compensation Circuit, US 7495465, Feb. 24, 2009.
3. D. Tripathi, G.K. Sidhartha, **Q. Khan**, K. Misri, S. Wadhwa, US 7446592, PVT Variation Detection and Compensation Circuit, Nov. 4, 2008.
4. **Q. Khan**, G.K. Sidhartha, Sequence-independent Power-on Reset for Multi-Voltage Circuits, US 7432748, Oct. 7, 2008.
5. D. Tripathi, J. Banerjee, **Q. Khan**, Differential Receiver Circuit, US 7414462, Aug. 19, 2008.
6. S. Gupta, **Q. Khan**, Miller Capacitance Tolerant Buffer Element, US 7400172, Jul. 15, 2008.
7. **Q. Khan**, H. Fukazawa, T. Nandurkar, Charge Pump Circuit for High Side Drive Circuit and Driver Driving Voltage Circuit, US 7388422, Jun. 17, 2008.
8. G. K. Sidhartha, Q. Khan, D. Tripathi, S. Wadhwa, K. Misri, PVT Variation Detection and Compensation Circuit, US 7388419, Jun. 17, 2008.
9. **Q. Khan**, D. Tripathi, Transmission Line Driver Circuit, US 7292073, Nov. 6, 2007.
10. D. Tripathi, **Q. Khan**, K. Misri, Transmission Line Driver, US 7187197, Mar. 6, 2007.
11. S. Wadhwa, **Q. Khan**, K. Misri, D. Muhury, Digital Clock Frequency Doubler, US 7132863, Nov. 7, 2006.
12. **Q. Khan**, D. Tripathi, K. Misri, High Voltage Level Converter Using Low Voltage Devices, US 7102410, Sep. 5, 2006.
13. **Q. Khan**, S. Wadhwa, K. Misri, Bandgap Reference Circuit, US 7084698, Aug. 1, 2006.
14. **Q. Khan**, S. Wadhwa, K. Misri, Bidirectional Level Shifter, US 7061299, Jun. 13, 2006.
15. **Q. Khan**, S. Wadhwa, K. Misri, Single Supply Level Shifter, US 7009424, Mar. 7, 2006.
16. S. Wadhwa, **Q. Khan**, K. Misri, Switched Capacitor Current Reference Circuit, US 6784725, Aug. 31, 2004.

## PUBLICATIONS (Journals)

1. S. J. Kim, R. K. Nandwana, **Q. Khan**, R. Pilawa-Podgurski, and P. K. Hanumolu, "A 4-phase 30–70 MHz switching frequency buck converter using a time-based compensator," *IEEE J. Solid-State Circuits*, vol.50, no.12, pp.2814-2824, Dec. 2015.
2. S. J. Kim, **Q. Khan**, M. Talegaonkar, A. Elshazly, A. Rao, N. Griesert, G. Winter, W. McIntyre, and P. K. Hanumolu, "High frequency buck converter design using time-based control techniques," *IEEE J. Solid-State Circuits*, vol. 50, no. 4, pp. 990-1001, Apr. 2015.
3. S. Rao, **Q. Khan**, S. Bang, D. Swank, A. Rao, W. McIntyre, P.K. Hanumolu, "A 1.2-A Buck-Boost LED Driver With On-Chip Error Averaged SenseFET-Based Current Sensing Technique," *IEEE Journal of Solid-State Circuits*, Volume: 46, Issue: 12, pp 2772- 2783, Dec. 2011.

## PUBLICATIONS (Conferences)

1. S. J. Kim; R. K. Nandwana, **Q. Khan**, R. Pilawa-Podgurski, P. K. Hanumolu, "A 1.8V 30-to-70MHz 87% Peak Efficiency 0.32mm<sup>2</sup> 4-Phase Time-Based Buck Converter Consuming 3 $\mu$ A/MHz Quiescent Current in 65nm CMOS, " *2015 IEEE International Solid-State Circuits Conference Digest of Technical Papers (ISSCC)*, San Francisco, 22-26 Feb. 2015.
2. **Q. Khan**, S. J. Kim; M. Talegaonkar, A. Elshazly, A. Rao, N. Griesert, G. Winter, W. McIntyre and P. K. Hanumolu, "A 10–25MHz, 600mA buck converter using time-based PID compensator with 2 $\mu$ A/MHz quiescent current, 94% peak efficiency, and 1MHz BW," *VLSI Symp.*, June 2014, Honolulu.
3. **Q. Khan**, A. Elshazly, S. Rao, R. Inti and P. K. Hanumolu, "A 900mA 93% Efficient 50 $\mu$ A Quiescent Current Fixed Frequency Hysteretic Buck Converter Using a Highly Digital Hybrid Voltage- and Current-mode Control," *VLSI Symp.*, June 2012, Honolulu.
4. **Q. Khan**, S. Rao, D. Swank, A. Rao, W. McIntyre, S. Bang, P.K. Hanumolu, "A 3.3V 500mA Digital Buck-Boost Converter with 92% Peak Efficiency Using Constant ON/OFF Time Delta-Sigma Fractional-N Control," *37th European Solid-State Circuits Conference (ESSCIRC)*, 12-16 Sept. 2011, Helsinki, Finland.
5. S. Rao, **Q. Khan**, S. Bang, D. Swank, A. Rao, W. McIntyre, P.K. Hanumolu, "A 1.2A buck-boost LED driver with 13% efficiency improvement using error-averaged SenseFET-based current sensing," *2011 IEEE International Solid-State Circuits Conference Digest of Technical Papers (ISSCC)*, San Francisco, 20-24 Feb. 2011.
6. S. Bang, D. Swank, A. Rao, W. McIntyre, **Q. Khan**, P.K. Hanumolu, "A 1.2A 2MHz Tri-Mode Buck-Boost LED Driver With Feed-Forward Duty Cycle Correction," *IEEE Custom Integrated Circuit Conference (CICC-2010)*, San Jose, California. September 2010.
7. K. Jayaraman, **Q. Khan**, B. Chi, W. Beattie, Z. Wang, P. Chiang, "A Self-Healing 2.4GHz LNA with On-Chip S11/S21 Measurement/Calibration for In-Situ PVT Compensation," *Radio Frequency Integrated Circuits (RFIC) Symposium*, Anaheim, CA, May 2010.
8. **Q. Khan**, G. K. Siddhartha, "A Sequence Independent Power-on-Reset Circuit for Multi-Voltage Integrated Systems, *2006 IEEE International Symposium on Circuits and Systems (ISCAS-2006)*," Mar, 2006, Greece.
9. **Q. Khan**, G. K. Siddhartha, D. Tripathi, S. K. Wadhwa, K. Misri, "Techniques for on-chip Process, Voltage and Temperature Detection and Compensation," *19th International Conference on VLSI Design*, Jan. 2006, India.
10. **Q. Khan**, S. K. Wadhwa, K. Misri, "A single Supply Level Shifter for Multi-Voltage Systems," *19th International Conference on VLSI Design* Jan. 2006, India.

11. S. K. Wadhwa, **Q. Khan**, K. Misri, D. Muhury, "Digital Clock Frequency Doubler," *IEEE International SoC Conference*, Sep. 25-28, 2005, Washington DC.
12. **Q. Khan**, S. K. Wadhwa, K. Misri, "A tunable gm-C filter with low variation across process, voltage and temperature," *17<sup>th</sup> International Conference on VLSI Design*, Mumbai, India, Jan, 2004, pp. 539-544.
13. **Q. Khan**, D. Dutta, "A Programmable CMOS Bandgap Voltage Reference Circuit using Current Conveyor," *10<sup>th</sup> IEEE International Conference on Electronics, Circuits and Systems – ICECS 2003*, UAE, Dec. 2003, pp. 8-11, vol.1.
14. **Q. Khan**, S. Wadhwa, K. Misri, "Low Power Startup Circuits for Voltage and Current Reference with zero steady state current," *International Symposium on Low Power Electronics and Design (ISLPED)*, Seoul, Korea, August 2003, pp. 184-188.
15. **Q. Khan**, S. Wadhwa, K. Misri, "A Low Voltage Switched-Capacitor Current Reference Circuit with low dependence on Process, Voltage and Temperature," *16<sup>th</sup> International Conference on VLSI Design*, New Delhi, India, Jan, 2003, pp. 504-506.
16. D. Dutta, **Q. Khan**, S. Banerjee, "Design of Continuous-Time Filter for Hearing Aid application using Current Conveyors," *9th IEEE International Conference on Electronics, Circuits and Systems – ICECS 2002*, Croatia, pp. 169-172, vol.1
17. **Q. Khan**, D. Dutta, "Optimized Realization of Kerwin-Huelsman-Newcomb biquadratic filter using Current Conveyors," *International Conference on Communication, Computers and Devices (ICCCD-2000)* held at Indian Institute of Technology (IIT), Kharagpur. (Dec 2000).

## WEB ARTICLES

1. **Q. Khan**, S. Bang, "Energy Harvesting for Self Powered Wearable Health Monitoring System," *EE Times* (<http://www.eetimes.com>), April 2009.
2. **Q. Khan**, S. K. Wadhwa, K. Misri, "Reducing system complexity by using a single-supply logic-level shifter," *EE Times* (<http://www.eetimes.com>), July 2008.

## RECOGNITIONS/ACHIEVEMENTS

1. Serving as reviewer for IEEE Transaction on Power Electronics, IEEE Journal of Solid-State Circuits, and IEEE Transaction on VLSI Systems for Power Management related papers
2. Paper selected among top 10 in worldwide Qualcomm's internal Technology Forum
3. Received 3 different recognitions from Qualcomm for outstanding contribution in various projects
4. Served as reviewer for International Conference on VLSI Design, India from 2003 to 2006.
5. Chaired a session on analog circuits in 10th International Symposium on Integrated Circuits, Devices and Systems, Singapore, Sept. 2004.
6. Received BRAVO award from Freescale India for outstanding contribution to Network Processor Chip.
7. Received BRAVO award from Freescale India for outstanding contribution to Baseband Processor Chip.
8. Received 3<sup>rd</sup> prize for presenting paper entitled "Digital Clock Frequency Doubler" in 5th Freescale India technical symposium held in Mar. 2005.
9. Received 2<sup>nd</sup> prize for presenting paper entitled "Tunable gm-C filter with low variation across Process, Voltage & Temperature" in fourth Motorola India technical symposium held in Nov. 2003.
10. Received BRAVO award for from Motorola for successful completion of a low power motor driver chip.

11. Received BRAVO award from Motorola for getting first pass silicon success of MPC175xx series of motor driver ICs.
12. Received 1<sup>st</sup> prize for presenting paper entitled "Fire Driver Circuit for an inkjet color printer in SmartMOS technology" in third Motorola India technical symposium held in Oct. 2002.
13. Received 3<sup>rd</sup> prize for presenting paper entitled "Optimized Realization of Kerwin-Huelsman-Newcomb biquadratic filter using Current Conveyors" in the first Motorola India technical symposium held in Dec. 2000.
14. Received Merit Scholarship from Jamia Millia Islamia in 1995.
15. Received CWC Scholarship from CWC, India in undergraduate studies during 1995-1999.