JOSEPH S. SHOR, Ph.D

RESEARCH INTERESTS

- Sensor Interfaces for physical parameters, such as temperature, voltage, current, process, etc.
- Voltage Droop Detectors
- Ultra Low-Power and Low Voltage Analog Circuits
- Methodologies and building blocks for analog circuits in pure digital processes
- Area-scaling of analog circuits
- Power management Circuits, such as LDO's, Voltage Regulators, and DC-to-DC converters
- Security Circuits, such as Physical Uncloneable Functions (PUF)
- Energy-Efficient Circuits
- Novel Memory Circuits
- High Frequency Circuits
- Microsensors

SUMMARY

Joseph Shor received his Ph.D from Columbia University and was a researcher in the area of Device Physics for several years afterwards. After immigrating to Israel, he moved to the field of analog design and was a lead analog designer and manager in several High Tech companies. His last position was at Intel, where he was the Principal Analog Engineer for the Microprocessor Products Group. In 2015, he transitioned to academia where he established an analog design group at Bar Ilan University.

EDUCATION

Columbia University, School of Arts and Sciences, NY, NY:
Ph.D, M.Phil, and M.S in Electrical Engineering, 5/93 and 1/88
Queens College of CUNY, Queens, NY: B.A. in Physics

PROFESSIONAL HISTORY

2015-present Associate Professor, **Bar Ilan University**, Faculty of Engineering

2013-2015 Adjunct Associate Professor, **Bar Ilan University**

2003-2015 **Intel Corporation**, Yakum, Israel

2010-2015 Principal Engineer - **Analog**

2004-2010 Senior Analog Engineer

- Manager and Lead analog designer– Led a team of 4 analog engineers
- Developed many novel analog circuits used across Intel worldwide
- Developed among the first ever analog circuits in 22nm and 14nm FINFET technologies. These were published in ISSCC, JSSC and TCAS.
- Developed new thermal sensors for measuring on-die hot spots
- Developed filtered power supplies for analog and digital PLL's
- Developed analog circuits for power management and voltage regulation
- Developed techniques and methodologies for implementing analog circuits in pure digital processes. This included process-independent analog.
- Developed architecture and circuit techniques to scale analog circuits. This resulted in a thermal sensor which was 10x smaller than the previous generation and a BGREF which was 3X smaller. This type of scaling is very unusual in analog.

Saifun Semiconductor, Netanya, Israel (now Cypress Semiconductor)

2003-2004 Staff Engineer (Senior Principal Engineer)

1999-2003 Principal Engineer

- Lead analog designer and manager.
- Developed analog circuits for the NROM memory- 2 physically separated bits/cell.
- Ramped up the analog field in Saifun nearly from scratch
- Developed power supply circuits, voltage regulators, on-die charge pump, sense amplifiers, filters, bandgap circuits, Class AB drivers, etc.
- Some of these circuits were published in ISSCC and ISCAS.

- Mentored many young engineers and trained them in analog design. This included teaching circuit/analog courses.
- Member of the Saifun Corporate Staff.

1994-1999 **Motorola Semiconductor Israel**, Herzlia, Israel

Principal and Senior Circuit Design Engineer

- Designed analog and digital circuits for DSP applications
- Circuits included amplifiers, gm/C filters, off-chip drivers, process independent analog circuits, etc.
- Designed high-speed digital IO buffers and memory circuits

1988-1994 **Kulite Semiconductor Products**, Inc., Leonia, NJ

Senior Research Scientist

- In this 2.5 year period following my Ph.D., I worked on several government-funded research programs which I initiated (see below). This included conceiving and writing research proposals, leading their implementation, and publishing the results in top journals such as Journal of Applied Physics, J. Electrochem. Soc., Applied Physics Letters, and IEEE Transactions on Elec. Dev.
- Led a team of 3 engineers and several technicians.
- Conducted several collaborations with Universities (see below) and government agencies.
- Research programs initiated:
  - Semiconductor Pressure sensors for high temperature environments
  - Novel Materials characterization including SiC, Semiconducting Diamond, Porous Si and SiC.
  - Semiconductor processing
  - Optoelectronic materials processing and characterization
  - Silicon-on-insulator structures for microsensors.
- The research done in this program is still being cited today and several of the papers have over 100 citations.

- The research was conducted while I was concurrently pursuing my Ph.D at Columbia University.
- During this period I recruited research funding from Government programs and Industry for over $2M.

1/2-1993 **Technion, Israel Institute of Technology**, Haifa, Israel
Department of Materials Engineering
Visiting Scientist

1987-1992 **Columbia University**, New York, NY Microelectronics Sciences Laboratories
Graduate Research Assistant

1987-1988 **IBM, T.J. Watson Research Center**, Eastview, NY
Research Assistant

SPECIAL RECOGNITIONS

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- **EE Times** Article "**Dispelling the myth about analog scaling"**, based on an ISSCC 2012 paper, Feb 2012.
- **EE Times** Article "**Intel details Sandy Bridge at ISSCC**", based on an ISSCC 2011 Paper, Feb, 2011.
- SBIR Program" 6H-SiC Pressure Sensors for High Temperature Applications" which I initiated was listed as an "SBIR Success Story"- 1996.
- NASA Certificate of Recognition for "Making SiC Semiconductor Devices Containing Porous Regions"- included in NASA Tech Briefs, 1996, based on SBIR Program I led.
- Trade Journal Note - "Porous SiC Expected to Yield Innovative Devices" in Technology Newsletter - "Electronic Design", Oct 24, 1996 based on SBIR Program Shor initiated.
- Trade Journal Note – "6H SiC Pressure Sensors aim for High Temperature Operation at up to 600C" in Technology Breakthrough Section, "Electronic Design", Jan 6, 1997, based on SBIR Program Shor initiated.
- **EE Times** Article "Single chip answers base-station needs" – highlight from ICSPAT '96, Oct 17, 1996, which Shor was a co-author.
- Recipient of Kulite Scholarship – 1990 –Columbia University and Kulite Semiconductor
- Paul Klapper Physics Prize – Queens College of CUNY, 1986

ISRAELI RESEARCH GRANTS AWARDED

These research grants have been awarded since I joined the Engineering Faculty at BIU.

Grant Title	**Agency**	**Award Date**	**# of years**	**Total Budget (NIS)**
Ultra-Low Power, Configurable, nano-Watt level Bandgap Voltage and Current References for IOT	Israel Science Foundation (ISF)	Jul-18	4	260k x 4 (NIS)
Individual Faculty Equipment Grant	ISF	Jul-18	3	760k (NIS)
Advanced Droop Detection and Correction Method for Improved Energy Efficiency and Performance in Integrated Circuits	Ministry of Science	Oct-17	3	200k x 3 (NIS)
Highly Reliable SRAM PUFs for Secure Key Generation and Authentication	Kamin	Jul-17	2	400k x 2 (NIS)
Thermal Sensors and Process Monitors	Hiper Consortium	Jul-15	4	320k x 4 (NIS)
Process Monitors for Near Vth Power Management	GenPro Consortium	Sep-18	1.5 extendable to 3	320k
Intel Donation	Intel	June 18		$38k
Huawei - High Frequency next Gen VCO	Huawei/Toga	Jan-19	2	$400k
Cryogenic EDRAM and Support Circuitry for Smart IR Imaging Applications (PI: Joseph Shor; Co –PI's: Adam Teman and Alex Fish)	Smart IR Consortium	Aug 2019	1.5 extendable to 3	1.285 Million NIS
Multi-Mode Circuit for Image Sensor Readout (PI: Joseph Shor. Co-PI: Alex Fish)	Huawei/Toga	Sep-19	2	$390

INTERNATIONAL AND NATIONAL COLLABORATIONS

[1] Collaborated with many Intel groups in Portland and Folsom on the development of analog circuits for microprocessors. 2004-present.

[2] NASA Lewis Research Center (now NASA Glenn) – Collaborated on the use of SiC for sensor and optoelectronic applications. This led to funding from them as well (see above). 1989-1994.

[3] Technion IIT, Dept. of Mats. Eng. – Collaborated with Prof. B.Z. Weiss (now deceased) – TEM characterization of the microstructure of Monocrystalline and Porous SiC. 1989-1994.

[4] University of Pittsburg, Physics Dept. – Collaborated with Prof W.J. Choyke on the Luminescence properties of Porous SiC. 1992-1994.

[5] Vanderbilt University, Dept. of Elec. Eng. – Collaborated with Prof. J. L. Davidson on the use of semiconducting diamond for sensors. 1992-94.

AFFILIATIONS AND INTERNATIONAL ACTIVITIES

- **Member ESSCIRC Technical Program Committee (TPC) - Power Management Subcom** -since 2018
    - Guest Associate Editor – Solid State Circuits Letters – ESSCIRC 2019 Special Issue.
    - Session Chair - "LDO Techniques", ESSCIRC 2018
- **Member ISSCC International Technical Program Committee (ITPC) – International Solid State Circuits Conference, 2014-2018**
    - Guest Associate Editor - Journal of Solid State Circuits - JSSC - ISSCC 2017 Special Issue
    - Session Co-Chair - ISSCC 2016 - Sensors and Displays
    - Member of ISSCC 2014-2018 IMMD Subcommittee
    - Member of ISSCC 2014-2018 European Regional Committee

    - Member of ISSCC 2015 Demo Committee
    - (ISSCC is the world's foremost Circuit/Analog International Conference)
- **Senior Member IEEE**
- **Associate Editor - IEEE Sensors**
- IEEE Solid State Circuits Letters – Editorial Review Board
- Member IEEE Solid State Circuits Society
- Member of American Institute of Physics
- Member – American Physical Society
- Reviewer for IEEE Journal of Solid State Circuits
- Reviewer for IEEE Transactions on Circuits and Systems 1 and 2
- Reviewer for IEEE Transactions of VLSI Systems
- Reviewer for IEEE VLSI Circuits Symposium
- Reviewer for Applied Physics Letters
- Reviewer for Materials Research Society
- Reviewer for ISCAS (International Conference of Circuits and Systems)
- Reviewer for Sensors Journal
- Reviewer for IEEE Access
- Reviewer for Microelectronics Journal
- Guest Editor in the 2014 Sensors Special Issue of the Journal of Low Power Electronics and Applications.
- IEEE FTFC 2014– Member of the Technical Program Committee.
- Member of Intel's International Circuit IP Patent Committee 2004-2015.
- Reviewer for the Intel International Design and Test Technology Conference 2013-2015
- Member of US Karate Team to Maccabia Games, 1985, 1981
- Member of Israel Traditional Karate Team, 2011, 2009.
- Certified Sports Coach and Instructor according to the Israel Sports Law