TEXAS A&M UNIVERSITY
Department of Electrical and Computer Engineering
College Station, Texas 77843-3128
TEL (979) 845-9583 FAX (979) 845-7161
ella@ece.tamu.edu
http://amsc.tamu.edu

S E M I N A R

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Spur-Free Switching Power Converters for Analog and RF Loads

by

Ayman Fayed, Assistant Professor
Director, Power Management Research Lab (PMRL)
Dept. of Electrical & Computer Engineering
Iowa State University, Ames, Iowa
http://home.eng.iastate.edu/~aafayed/

Abstract: The recent expansion in the use of mobile communication and navigation devices has fueled the demand for more energy-efficient and lower power implementations without compromising performance. A critical aspect of lowering the overall power consumption is the process of converting power from the battery to the various loads in the system. However, the large noise-sensitive RF content in communication and navigation devices is limiting the use of efficient energy conversion schemes, such as switching power converters, due to the significant switching noise associated with such schemes, which degrades the performance of RF circuits. This forces the use of inefficient, but low-noise schemes, such as linear power converters, leading to much higher power consumption. This presentation will discuss various power conversion techniques that are commonly used for powering noise-sensitive analog/RF loads and the advantages and shortcomings of each of them. The presentation will then introduce the results of recent research activities at PMRL that focus on the development of RF-friendl switching power converters for direct powering of noise-sensitive analog/RF loads. We propose a new switching mechanism for buck converters that completely eliminates periodic switching noise at the output of the converter, leading to a spur-free operation. This enables powering noise sensitive RF PAs directly from buck converters without compromising mixing or interference specifications. Moreover, the proposed switching mechanism leads to a significant reduction in EMI without requiring any special filtering or compromising the efficiency of the converter. The theoretical basis along with experimental results of the proposed design will also be discussed.

Ayman Fayed received his B.Sc. degree in Electronics & Communications Engineering from Cairo University in 1998, and his M.Sc. and Ph.D. degrees in Electrical & Computer Engineering from The Ohio State University in 2000 and 2004 respectively. From 2000 to 2009, he held several technical positions at Texas Instruments Inc., wherehe was a key contributor to many product lines for wire-line, wireless, and multi-media devices. From 2000 to 2005, he was with the Connectivity Solutions Dept. at TI, where he led the design of the frontend of many high-speed wire-line transceivers such as USB 2.0, IEEE1394b, and HDMI in several nanometer CMOS technology nodes. He also led the design of fully integrated power management solutions for portable media players including different classes of switching/linear regulators and battery chargers. From 2005 to 2009, he was a member of the technical staff with the wireless analog technology center at TI, where he led several projects in 65nm and 45nm CMOS technologies including baseband sigma-delta data converters for GSM/WCDMA/WIMAX standards, and fully integrated power management solutions for mixed-signal SoCs with mutli-RF cores. Since 2009, Dr. Fayed has been an assistant professor at the Dept. of Electrical & Computer Engineering, Iowa State University, Ames, Iowa, where he is the founder and director of the Power Management Research Lab (PMRL). His research interests include embedded power management/conversion for RF/mixed-signal SoCs and multi-core processors, energy harvesting for power-restricted and remotely-deployed devices, high-speed wire-line transceivers, and data converters. Dr. Fayed has many publications and patents in the field and has authored a book in the area of adaptive systems titled "Adaptive Techniques for Mixed Signal System On Chip" (Springer 2006). He is a senior member of IEEE and serves in the technical program committee of many IEEE international conferences such as RFIC, ISCAS, and MWSCAS. He also serves as a reviewer for many IEEE journals.