Guest Editorial
Special Issue on Power Supply on Chip, 2018

POWER supply on chip (PwrSoC) is becoming a broader and broader concept from several perspectives. The power supply is no longer just a box or a building block decoupled from the rest of the system it supplies. Energy needs to be supplied ubiquitously to a vast number of sensors, actuators, and processing units, each with unique power delivery requirements. In some cases, the power must be transferred wirelessly. This requires not only a physical but also a functional integration of the energy form and function within the system.

This change of paradigm impacts the whole value chain from the concept to the product. New concepts on how to process the energy need to be elaborated, pushing the technology beyond its current limits toward an effective and realistic implementation and fabrication in a foundry. In the past, power was processed mostly by inductors for nonintegrated converters and by switched capacitors for integrated converters. Today, hybrid architectures take advantage of the high energy density of capacitors, which is combined with the regulation and soft switching capabilities of inductors. The integration of passives, both magnetic and capacitive, continues to be one of the key challenges of PwrSoC.

Active devices are also evolving dramatically. Wide bandgap devices, namely, SiC and GaN, are progressively replacing Si in many power converters, including PwrSoC. In parallel, Si technology is also evolving, enabling better and better converters that operate at higher switching frequency. These higher frequencies enable smaller power converters, but at the same time pose new challenges for the drivers, the dielectrics, and the magnetic materials.

In general, what we find is a great diversity of power supplies on chip, whether they are in the mainstream power of the system or being part of auxiliary circuits and drivers for bigger components or circuits, such as in high-power multilevel converters. The traditional idea that a PwrSoC is a dc–dc converter is also partial now. AC–DC converters are integrated on chip for overall system integration, and power supplies on chip are part of wireless power or RF transmitters.

This diversity of applications, power architectures, level of granularity, technology for the semiconductors, dielectrics, and magnetic materials requires the participation of persons with expertise in a great variety of areas and the coordinated work of large interdisciplinary teams. Therefore, the word "integration" in PwrSoC applies not only to the aforementioned physical and functional integration, but also to the need of integrated education combining power electronics and IC design.

This is the second Special Issue on PwrSoC, following the one in 2013. The path started in 2008 and 2010 with two workshops led by C. O'Mathuna and organized by Tyndall, Cork, Ireland. In 2012, the Power Sources Manufacturer Association and the Power Electronics Society (IEEE) joined efforts to sponsor the workshop series which was held in San Francisco, CA, USA, in 2012; Boston, MA, USA, in 2014; Madrid, Spain, in 2016; and will rotate among continents from now on. This year it will be hosted in Hsinchu, Taiwan, on October 17–19, 2018.

The special issue includes 16 papers of the highest scientific level. A set of papers describe new topological and control ways to process the energy, frequency increase and inductors to create resonances to facilitate control and reduce switching losses in hybrid architectures, assessing centralized versus distributed power conversion. Another set of papers addresses IC design, including both power conversion and power management. The applicability of SiC-MESFET is also addressed in this issue, that covers applications as LED lighting, wireless power transfer, and the generation of dc voltages from ac sources. Finally, four papers focus on magnetic component integration, which is essential for power supplies on chip.

All these papers were reviewed thoroughly by an editorial team of experts who helped with their recommendations to improve the quality of the papers. We would like to recognize and show appreciation for the valuable work to: C. O'Mathuna, B. Allard, J. Oliver, F. Carobolante, R. Pilawa-Podgurski, H.-P. Le, A. Prodic, L. Corradini, C. Fernández, P. Rutter, P. Zou, M. Duffy, M. Jatlaoui, P. Mattavelli, J. Stauth, B. Parkhideh, and S. Mazumder, as well as a number of other reviewers. We would also like to thank JESTPE Editor-in-Chief D. Tan for the guidance and assistance during the course of the special issue development.

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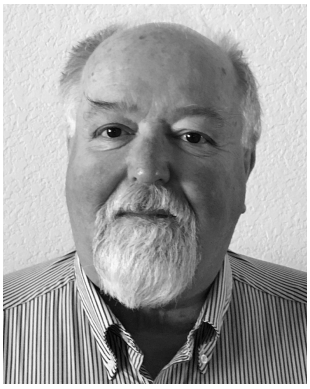
José A. Cobos was the Founder Director of the Centro de Electrónica Industrial, Universidad Politécnica de Madrid (UPM), Madrid, Spain, a university research center leading a strong industrial program in power electronics and digital systems, in 2006. From 2016 to 2017, he was an RCC Fellow at Harvard University, Cambridge, MA, USA. He was a Fulbrighter with the University of California at Berkeley, Berkeley, CA, USA. Since 2016, he has been the Founder President of the Industrial Council, to coordinate education and research with industry. He is currently a Full Professor at UPM. His contributions are focused on power supply systems for industrial, aerospace, telecom, automotive, renewable energy, and medical applications. He has authored over 300 technical papers. He advised over 50 graduate students. He is a co-inventor of patents with six companies. He conducted professional seminars and tutorials in USA, U.K., Austria, Germany, Italy, Sweden, Switzerland, Syria, Mexico, and Macedonia. His current research interests include energy efficiency in digital systems and RF amplifiers, magnetic components, piezoelectric transformers, transcutaneous energy transfer, and the generation of electromagnetic fields for water supercooling and biomedical applications.

Dr. Cobos is a Steering Committee Member of the IEEE Applied Power Electronics Conference. He was an Adcom Member of the Power Electronics Society (IEEE-PELS) and the Chair of the Technical Committee on DC Power Supply systems. He was the General Chair of the PwrSoC 2016 (IEEE-PELS and Power Supply Manufacturers Association). He is an Associate Editor of the IEEE TRANSACTIONS ON POWER ELECTRONICS and the *PELS Letters*.



Matt Wilkowski (M'83–SM'87) received the B.S.E.E. degree from the Stevens Institute of Technology, Hoboken, NJ, USA, in 1979, and the M.S.E.E. degree from Lehigh University, Bethlehem, PA, USA, in 1991.

He was a Consulting Member of Technical Staff with Tyco Electronics Power Systems, which was formed from Lucent Power Systems, from 1983 to 2003, where he was involved in the integration of magnetics into power converters responsible for commercializing ac–dc and dc–dc converters for a wide band of power ranges from 10 W to 10 kW and 20 kHz to 20 MHz to support electronic power delivery for telecommunication, industrial, and commercial applications. He was the Vice President of Technology at Enpirion from 2003 to 2013. He was a Technology Architect at Altera from 2013 to 2016. He is currently a Principal Engineer with Intel. He holds 25 U.S. patents.

Mr. Wilkowski has been involved with standards defining recommended practices and test methods for power magnetic components for over 30 years. He is currently the Chairman of the Electronics Transformers Technical Committee of the IEEE PELS and the IEC Technical Committee 51. He was the Technical Program Chair of the 4th International Workshop on Power Supply on Chip, Boston, MA, USA, in 2014, and has been serving on the Steering Committee of the Power Supply on Chip workshop series since 2013.