Book Explains How To Obtain Transfer Functions Of Popular SMPS Topologies

From Faraday Press comes the latest text by Christophe Basso, *Transfer Functions of Switching Converters, Fast Analytical Techniques at Work with Small-Signal Analysis*. The book teaches readers how to determine transfer functions of switching power supplies commonly encountered in consumer and industrial markets (see the figure).

As the author explains, "This project took me more than three years of personal work to complete and I have derived the four transfer functions of the basic switching cells operated in voltage- and current-mode control, working in discontinuous, continuous and borderline conduction modes. I have also explored the control-to-output transfer functions of the constant on- and off-time converters plus many more topologies whether they are nonisolated or isolated like the flyback, active-clamp forward, power factor correction and so on."

"This book represents an ideal companion for the young or seasoned engineer willing to study and stabilize her or his switching converter. Finally, BSEE, MSEE or Ph.D students will also find many useful descriptions and methods they can later apply during their studies or when facing their first industrial projects," says Basso.

The book comes with a free set of 60+ ready-made SIMPLIS simulation templates available from Basso's webpage, which should help designers come up to speed on their next switching converter project. The web page also contains the Mathcad files used by the author for illustrating this work.

Transfer Functions of Switching Converters starts with a smooth introduction to switching cells, going into the details of the first steps of linearization and small-signal modulation. It then explains how the PWM switch model was derived and how to apply it to the basic structures operated in fixed switching frequency and various operating conditions like continuous and discontinuous modes in voltage- or current-mode control. The model is extended to other control schemes like quasi-resonance, constant on- and off-time converters, all with an associated small-signal version.

The chapters that follow explore the founding structures like the buck, the boost and buck-boost cells, later covering their isolated versions like forward or flyback converters. The last chapter deals with more complicated structures like Ćuk, Zeta, SEPIC and LLC. There's also an appendix offering instruction on fast analytical circuits techniques. For chapter summaries, see the table.

Faraday Press has opened a pre-order page for the book at a discounted price with domestic and international shipment options. Major on-line distributors like Amazon will also distribute the book worldwide starting June 22nd. The links also will appear on Basso's webpage where you'll find the SIMPLIS simulation templates and Mathcad files as previously mentioned.

Figure. Christophe Basso's new book on small-signal modeling of switched-mode power supplies teaches designers how to derive transfer functions for a wide range of topologies and control schemes, including the most popular types as well as some of the more exotic ones.

Table. Basso's *Transfer Functions of Switching Converters* is organized into five chapters and an appendix.

Chapter	Summary
1	A guided introduction to small-signal modeling, why you need it and how to apply it. Once the foundations are laid out, the chapter explores the basic switching cells and determines their basic transfer characteristics like conversion ratios for isolated and non-isolated structures. Operating schemes like voltage- and current-mode control are detailed as well as quasi-resonance operation. The PWM switch model is then introduced and its small-signal model derived for future use in the subsequent chapters.
2	This chapter is dedicated to the buck converter whose four transfer functions are determined for voltage- and current-mode controlled switching cells operated in the two conduction modes, CCM and DCM. Quasi-resonance is not forgotten as well as more exotic modes like COT and FOT or even the tapped version are covered. Isolated versions are also described such as push-pull, half- and full-bridge versions as well as active-clamp.
3	The boost converter increases the input voltage and can be found in many applications like dc-dc and power factor correction circuits. The chapter starts with the dc-dc version and determines all the needed transfer functions as in the buck converter case. After the description of the tapped version, the boost operated in quasi-resonant current-mode version is also detailed. Finally, power factor correctors working in boundary control mode are described and operated in application examples.
4	The buck-boost converter is well known when operated in its isolated version, the flyback converter. This chapter demonstrates how to determine the four transfer functions of the buck-boost converter and extends the analysis to the flyback version. The popular quasi-resonant version is not forgotten and is described here too. Finally, the popular single-stage converters are described.
5	This section deals with more complex higher-order converters like the Ćuk, SEPIC, Zeta and LLC. The analysis gains in complexity and the simulation examples help in verifying the results obtained analytically. An LLC transfer function is proposed for the VCO-based control while the more recent current-mode version is also explored.
Appendix A	This appendix can be seen as a crash course in fast analytical circuits techniques to help readers acquire a basic set of skills to understand how the author derived all the transfer functions. Mastering this tool will require more effort but the companion books given in the reference should help the readers to strengthen their knowledge for a complete and firm acquisition of the method. All examples and steps are thoroughly documented then verified through SPICE and SIMPLIS simulations. For that purpose, the author has released a set of 60+ ready-to-use SIMPLIS simulation templates to help readers get up to speed for their next switching converter project.