Cuk Converter with Integrated Magnetics

Last updated in PLECS 4.3.1

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1 Overview

This model highlights the PLECS magnetic domain components using a complex isolated Čuk converter which is capable of zero-ripple operation. A more thorough analysis and discussion of this demo model can be found in [1].

![Figure 1: Čuk converter with integrated magnetics](image)

2 Model

Due to a proper winding turn-ratio, this Čuk converter can achieve zero ripple in both input and output currents. The magnetic circuit consists of two opposing E-cores spaced by air gaps. These air gaps are represented with three permeances $P_{g1}$, $P_{g2}$ and $P_{g3}$. The two chokes and the transformer are combined into a single magnetic structure modeled as separate permeances $P_1$, $P_2$ and $P_3$. The leakage fluxes are bundled and simplified to a single flux path $P_4$.

3 Simulation

In this example, the core material saturates around 0.4 Tesla leading to spikes in the output current. The spikes occur when the magnetic flux in the output leg $P_3$ gets close to 5 $\mu$Wb. Increasing $B_{sat}$ to 0.5 Tesla removes the output current ripple (as does replacing Saturable Core components with Linear Cores).

4 Conclusion

The permeance-capacitance analogy implemented in PLECS provides an intuitive and geometry-based approach to modeling magnetic circuits like the one for this Čuk converter.
References

Revision History:

PLECS 4.3.1 First release

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PLECS Demo Model
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