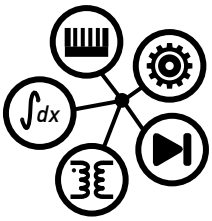

PLECS

DEMO MODEL

Cuk Converter with Integrated Magnetics

Last updated in PLECS 4.3.1

1 Overview

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

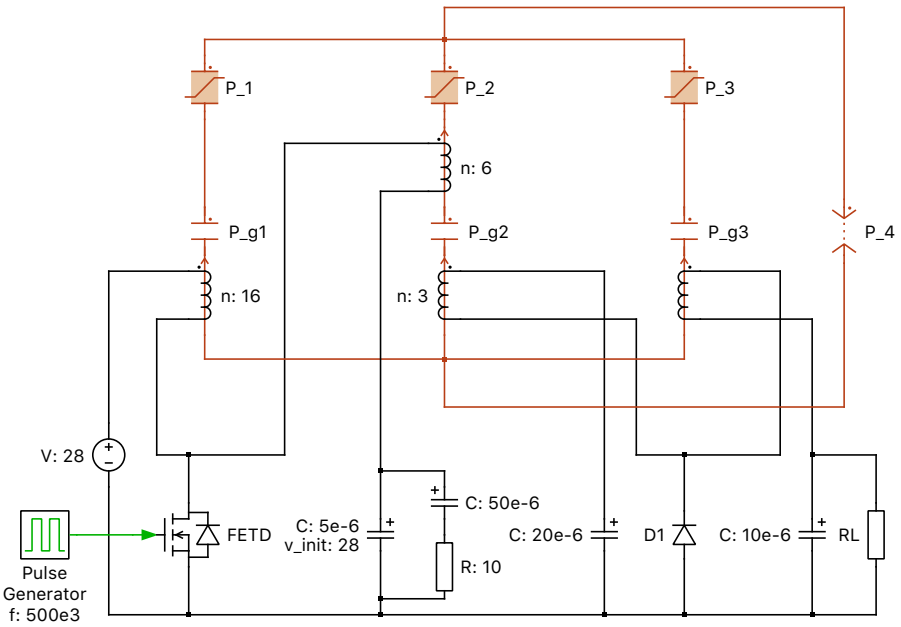

Figure 1: Ćuk converter with integrated magnetics

2 Model

Due to a proper winding turn-ratio, this Ćuk 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 $5\,\mu\mathrm{Wb}$. 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 Ćuk converter.

References

[1] J. Allmeling, W. Hammer and J. Schönberger, *Transient simulation of magnetic circuits using the permeance-capacitance analogy*, 2012 IEEE 13th Workshop on Control and Modeling for Power Electronics (COMPEL), Kyoto, 2012, pp. 1-6.

Revision History:

PLECS 4.3.1	First release

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PLECS Demo Model