



PLECS

*DEMO MODEL*

## Cuk Converter with Integrated Magnetics

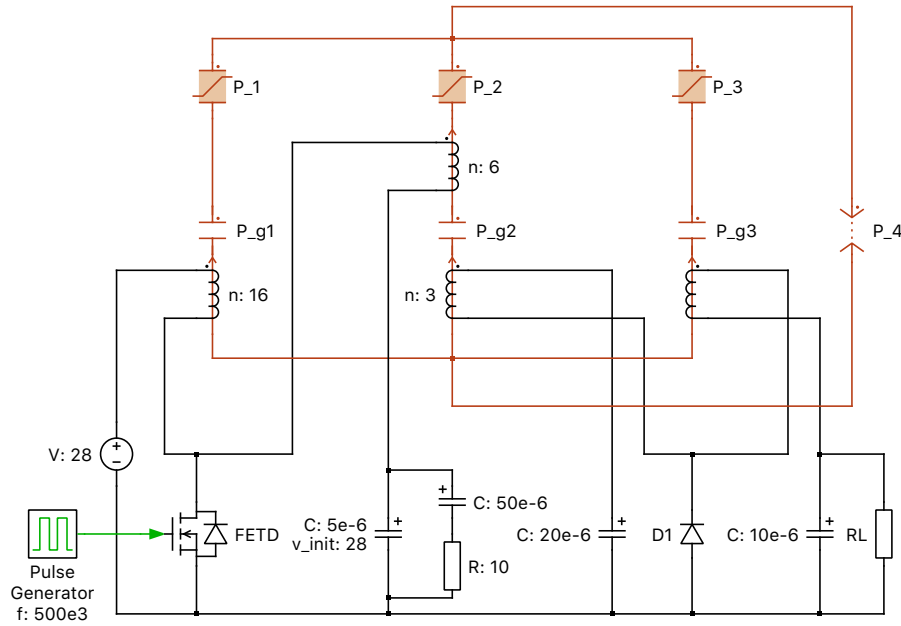
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# 1 Overview

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].



**Fig. 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  $5 \mu\text{Wb}$ . Increasing  $B_{\text{sat}}$  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.

## 5 Bibliography

- [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*

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