



PLECS

DEMO MODEL

Watkins-Johnson Converter

Last updated in PLECS 4.3.1

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1 Overview

This example demonstrates an unregulated, non-isolated Watkins-Johnson or push-pull current-fed converter.

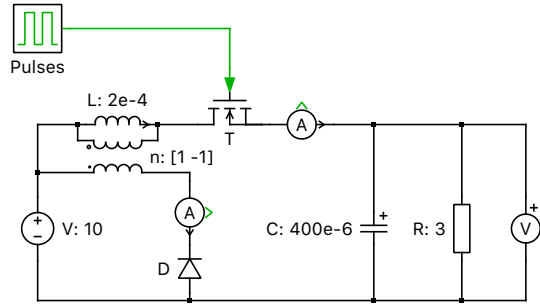


Fig. 1: Watkins-Johnson converter with two-winding inductor

2 Model

The Watkins-Johnson converter is a DC/DC converter with a tapped inductor. While it is based on a boost converter topology, it has a negative tap fraction so it actually operates as a buck converter and steps-down the input voltage. The ideal transformer must be realized with a real inductance in practice, which is represented by a magnetizing inductance in parallel with it. When the switch is off, the load voltage falls but the converter returns current to the source that is stored in the magnetizing inductor. While the switch conducts, energy is transferred to the output via the stored current in the inductor and the load voltage will rise.

The Watkins-Johnson converter has an ideal transfer function of:

$$\frac{V_{\text{out}}}{V_{\text{in}}} \approx \frac{(2D - 1)}{D}$$

where D is the duty cycle. Note, however, that for this particular model the equation is valid for duty cycles in the range of 0.6 to 0.8.

3 Simulation

Run the simulation with the model as provided to view the signals and verify the load voltage regarding the following equation:

$$V_{\text{load}} = \frac{V_{\text{in}} \cdot (2 \cdot 0.6 - 1)}{0.6} = \frac{10 \text{ V} \cdot 0.2}{0.6} = \frac{10}{3} \text{ V}$$

Also notice that the diode current is positive during the part of the cycle that the switch is off.

Revision History:

PLECS 4.3.1 First release

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PLECS Demo Model

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