

# Model Documentation of the Buck Converter

## 1 Nomenclature

### 1.1 Nomenclature for Model Equations

$L$	inductivity of the inductor
$C$	capacity of the capacitor
$R$	resistance of the load
$U_E$	input voltage
$i_L$	current through the inductor
$u_C$	voltage over the capacitor
$d$	duty ratio of the switch

### 1.2 Circuit Diagram

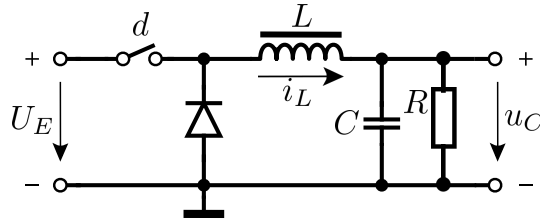


Figure 1: Circuit

## 2 Model Equations

State Vector and Input Vector:

$$\underline{x} = (x_1 \ x_2)^T = (i_L \ u_C)^T$$
$$\underline{u} = d$$

System Equations:

$$\dot{x}_1 = -\frac{1}{L}x_2 + \frac{U_E}{L}u \quad (1a)$$

$$\dot{x}_2 = \frac{1}{C}x_1 - \frac{1}{RC}x_2 \quad (1b)$$

Parameters:  $L \ C \ R \ U_E$

Outputs:  $x_2 = u_C$

## 2.1 Exemplary parameter values

		Symbol	Value
Inductivity	$L$	0.00018	H
Capacity	$C$	$2.0 \cdot 10^{-5}$	F
Resistance	$R$	10	$\Omega$
Input Voltage	$U_E$	24	V

## 3 Derivation and Explanation

See boost converter.

## 4 Simulation

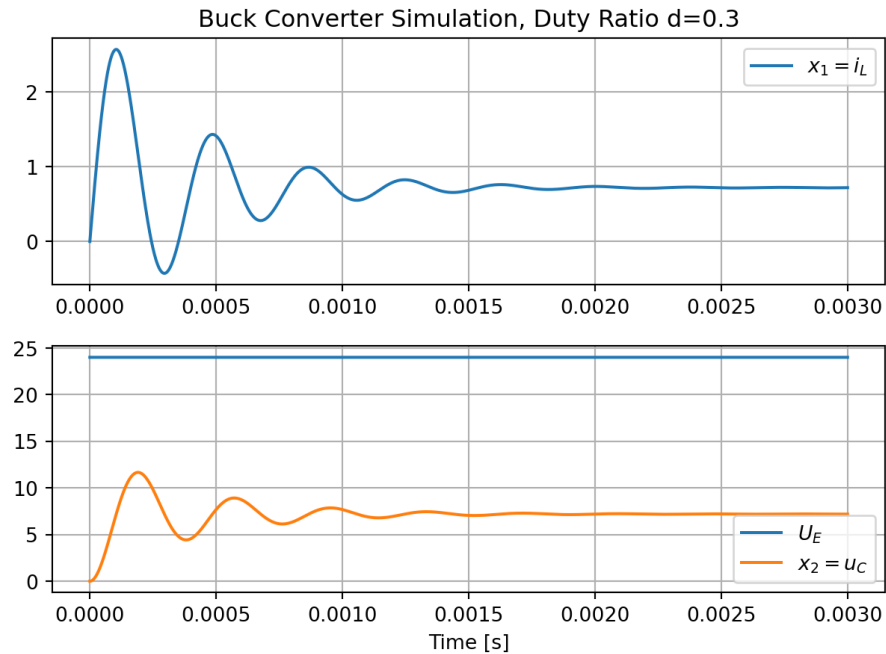


Figure 2: Simulation of the buck converter.

## References

- [1] R. H. G. Tan and L. Y. H. Hoo, DC-DC converter modeling and simulation using state space approach, in 2015 IEEE Conference on Energy Conversion (CENCON), Oct. 2015, pp. 42–47. doi: 10.1109/CENCON.2015.7409511.
- [2] K. Röbenack, Nichtlineare Regelungssysteme: Theorie und Anwendung der exakten Linearisierung. Berlin, Heidelberg: Springer Berlin Heidelberg, 2017. doi: 10.1007/978-3-662-44091-9.