

Model Documentation of the:

DC-DC Buck Converter

1 Nomenclature

1.1 Nomenclature for Model Equations

i_L	main inductor current
U_o	output voltage
U_c	inductor voltage
U_{DC}	input voltage
R	resistance of main Resistor
L	inductivity of main inductor
C	capacity of main capacitor
r_L	(parasitic) inductor resistance
r_c	(parasitic) capacitor resistance
r_{son}	(parasitic) switch resistance
d	duty cycle

1.2 Nomenclature for Derivation

2 Model Equations

State Vector and Input Vector:

$$\underline{x} = (x_1 \ x_2)^T = (i_L \ U_o)^T$$
$$\underline{u} = u_1 = d$$

System Equations:

$$\dot{x}_1 = \frac{-(r_{son} + r_L)}{L}x_1 - \frac{1}{L}x_2 + \frac{U_{DC}}{L}u_1 \quad (1a)$$

$$\dot{x}_2 = \frac{LR - C R r_c (r_{son} + r_L)}{LC(R + r_c)}x_1 + \frac{-C R r_c - L}{LC(R + r_c)}x_2 + \frac{R r_c U_{DC}}{L(R + r_c)}u_1 \quad (1b)$$

Parameters: $R, L, C, r_L, r_c, r_{son}, U_{DC}$

Outputs: U_o

2.1 Assumptions

2.2 Exemplary parameter values

Parameter Name	Symbol	Value	Unit
Load Resistance	R	2.345	Ω
Inductivity	L	$4.7 \cdot 10^{-5}$	H
Capacity	C	$6.8 \cdot 10^{-5}$	F
Input Voltage	U_{DC}	3.75	V
switching resistance	r_{son}	2.1	Ω
Inductor Resistance	r_L	0.13	Ω
Capacitor Resistance	r_c	0.055	Ω

3 Derivation and Explanation

References

- [1] M. M. Salih, H. A. Jeiad, A. Al-Araji: *Modeling and Analysis of DC-DC Buck Converter for Mobile Applications*, IJSR, 2020