Boost Converter Duty Cycle, Inductor and Output Capacitor

Duty cycle, average and peak inductor current, inductance for a chosen ripple and output capacitance for a ripple voltage of a boost (step-up) converter.

Method: Steady-state boost converter relations

Input parameters

Unit system: SI

Parameter	Value	Unit
Input voltage	5.0000	V
Output voltage	12.000	V
Output current	0.50000	A
Switching frequency	400.00	kHz
Inductor ripple ratio ΔI/I_L	30.000	%
Allowed output ripple (peak to peak)	50.000	mV
Estimated efficiency	88.000	%

Calculated results

Parameter	Value	Unit
Duty cycle	63.333	%
Average inductor (input) current	1.3636	A
Inductor ripple current	0.40909	A
Inductance	19.352	µH
Peak inductor and switch current	1.5682	A
Minimum output capacitance (ignoring ESR)	15.833	µF

Notes for this case

• Continuous conduction: L = V_in D/(f ΔI), C ≥ I_out D/(f ΔV). The output capacitor carries pulsed current; its ESR and ripple current rating usually decide it.

Formula and method

$$D = 1 - \frac{\eta V_{in}}{V_{out}}, \quad I_L = \frac{V_{out} I_{out}}{\eta V_{in}}, \quad L = \frac{V_{in} D}{f_s \Delta I_L}, \quad C_{out} = \frac{I_{out} D}{f_s \Delta V_{out}}$$

Variables

V_{in}	Input voltage	V
V_{out}	Output voltage	V
I_{out}	Output current	A
f_s	Switching frequency	1/s
r	Inductor ripple ratio ΔI/I_L	-
ΔV_{out}	Allowed output ripple (peak to peak)	V
η	Estimated efficiency	-
D	Duty cycle	-
I_L	Average inductor (input) current	A
ΔI_L	Inductor ripple current	A
L	Inductance	H

I_{pk}	Peak inductor and switch current	A
C_{out}	Minimum output capacitance (ignoring ESR)	F

Method and standards

Boost converter steady-state analysis.

Assumptions and limits

- Continuous conduction, steady state.

References

Steady-state boost converter relations

Report details

Report reference	FCC-K2VZ-ZZ81 (the same inputs always give the same reference)
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Calculator	Boost Converter Duty Cycle, Inductor and Output Capacitor
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/electrical/electronics/boost-converter-design

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.