Rectifier Filter (Reservoir) Capacitor and Ripple

Reservoir capacitor for a half- or full-wave rectifier from load current, mains frequency and allowed ripple, with the peak and mean DC voltages.

Method: Capacitor-input rectifier filter

Input parameters

Unit system: SI

Parameter	Value	Unit
Rectifier	Full-wave (bridge or centre-tap)	
Secondary RMS voltage	12.000	V
Total diode drop in the conduction path (bridge: 2 diodes)	1.4000	V
Load current	1.0000	A
Mains frequency	50.000	Hz
Allowed ripple (peak to peak)	1.5000	V

Calculated results

Parameter	Value	Unit
Reservoir capacitance	6,666.7	µF
Peak DC voltage √2 V_s − V_D	15.571	V
Mean DC voltage V_pk − ΔV/2	14.821	V
Valley voltage V_pk − ΔV	14.071	V
RMS ripple voltage ΔV/(2√3)	0.43301	V

Notes for this case

- C = I/(k f ΔV), k = 2 for full-wave, assuming the capacitor supplies the load for the whole ripple period (conservative). Allow for mains low line and transformer regulation; the capacitor's ripple current rating is often the real limit.

Formula and method

$$C = \frac{I_{DC}}{k\,f\,\Delta V}\ (k = 2\ \text{full}-\text{wave}, 1\ \text{half}-\text{wave}),\quad V_{pk} = \sqrt{2}\,V_s - V_D,\quad V_{DC} \approx V_{pk} - \frac{\Delta V}{2}$$

Variables

rectifier	Rectifier	-
V_s	Secondary RMS voltage	V
V_D	Total diode drop in the conduction path (bridge: 2 diodes)	V
I_{DC}	Load current	A
f	Mains frequency	1/s
ΔV	Allowed ripple (peak to peak)	V
C	Reservoir capacitance	F
V_{pk}	Peak DC voltage √2 V_s − V_D	V
V_{DC}	Mean DC voltage V_pk − ΔV/2	V
V_{min}	Valley voltage V_pk − ΔV	V
$V_{r,rms}$	RMS ripple voltage ΔV/(2√3)	V

Method and standards

Capacitor-input filter approximation.

Assumptions and limits

- Constant load current; capacitor discharge treated as linear over the period.

References

Capacitor-input rectifier filter

Report details

Report reference	FCC-YSVZ-2MC7 (the same inputs always give the same reference)
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Calculator	Rectifier Filter (Reservoir) Capacitor and Ripple
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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/rectifier-filter-capacitor

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.