Battery State of Charge by Coulomb Counting

Battery state of charge after charging or discharging at a constant current for a time, with coulombic efficiency, and the time to reach empty or full.

Method: Coulomb counting

Input parameters

Unit system: SI

Parameter	Value	Unit
Battery capacity	100.00	Ah
Initial state of charge	80.000	%
Current (positive discharge, negative charge)	20.000	A
Time	2.0000	h
Coulombic efficiency on charge	99.000	%

Calculated results

Parameter	Value	Unit
State of charge after t	40.000	%
Charge moved	40.000	Ah
Time to empty (discharge) or full (charge)	4.0000	h
C-rate	0.20000	

Notes for this case

- SOC = SOC_0 − ∫ I dt / C with charge current scaled by the coulombic efficiency. Counting drifts with current-sensor offset; real battery management systems correct it with voltage at rest.

Formula and method

$$SOC(t) = SOC_0 - \frac{1}{C}\int_0^t I\,dt$$

Variables

C	Battery capacity	C
SOC_0	Initial state of charge	-
I	Current (positive discharge, negative charge)	A
t	Time	s
η_c	Coulombic efficiency on charge	-
SOC	State of charge after t	-
ΔQ	Charge moved	C
t_{limit}	Time to empty (discharge) or full (charge)	s
I/C	C-rate	-

Method and standards

Coulomb counting.

Assumptions and limits

- Constant current; capacity independent of rate.

References

Coulomb counting

Report details

Report reference	FCC-5EY8-3DY1 (the same inputs always give the same reference)
Generated	23 November 2026, 18:08 UTC
Calculator	Battery State of Charge by Coulomb Counting
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/batteries-ups/battery-soc-coulomb-counting

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.