Battery Life of a Duty-Cycled Device (Sleep and Active)

Average current and battery life of a sensor or IoT device that wakes periodically, from the active and sleep currents, active time and usable capacity.

Method: Time-weighted average current

Input parameters

Unit system: SI

Parameter	Value	Unit
Battery capacity	2,400.0	mAh
Usable share (self-discharge, cut-off and temperature)	80.000	%
Current while active	25.000	mA
Active time per wake-up	0.50000	s
Current while asleep	0.008000	mA
Time between wake-ups	300.00	s

Calculated results

Parameter	Value	Unit
Average current	0.049653	mA
Active share of time	0.16667	%
Battery life	1,611.2	d
Battery life in years	4.4111	
Share of charge used while asleep	16.085	%

Notes for this case

• The average current is the time-weighted mean of the active and sleep currents; the battery lasts its usable charge divided by that average. With long sleep periods the sleep current often dominates, so a few microamps matter more than shortening the active burst. Self-discharge, cold weather and the device's cut-off voltage reduce usable capacity; the usable share covers them roughly.

Formula and method

$$\bar{I} = \frac{I_a t_a + I_s (T - t_a)}{T}, \quad L = \frac{k_u C}{\bar{I}}$$

Variables

C	Battery capacity	C
k_u	Usable share (self-discharge, cut-off and temperature)	-
I_a	Current while active	A
t_a	Active time per wake-up	s
I_s	Current while asleep	A
T	Time between wake-ups	s
$\bar{I}$	Average current	A
t_a/T	Active share of time	-
L	Battery life	s
L_y	Battery life in years	-
s	Share of charge used while asleep	-

Method and standards

Battery life.

Assumptions and limits

- Constant currents in each state; no pulse-capacity effects.

References

Time-weighted average current

Report details

Report reference	FCC-VABE-8643 (the same inputs always give the same reference)
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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/duty-cycled-battery-life

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.