How To Calculate Battery Run Time

There are just too many questions you will wonder when designing your device with a battery inside it.

The boss just want a cheap and small battery with it, but with no further information on how long does the end customer wants, how small can it be.

in this article, we will show you:

Ready for your battery design?
Let's go.

In the ideal/theoretical case, the time would be Time(H) = Capacity(Ah)/Current(A).

If the capacity is given in amp-hours and current in amps, time will be in hours (charging or discharging).

Product information

Lithium ion Battery Pack
Li-Polymer Battery Cell
ultra thin lipo Cell
Small Lipo Battery Cell
LiFePO4 Battery
12v LIthium Battery Packs
18650 Battery Pack
Medical Battery Pack
Ebike Battery Pack
Solar Power Battery Pack
CCTV Camera Battery Pack

Contact Info

Mail : sales@dnkpower.com

Feel Confused ?

So how to calculate how long a battery will last?

Throw away how long will a battery last calculator, and let's see an actual case, 10 Ah battery delivering 1A, would last 10 hours. Or if delivering 10A, it would last for only 1 hour, or if delivering 5A, it would last only for 2 hours.

In other words, you can have "any time" as long as when you multiply it by the current, you get 10Ah (the battery capacity).

It is that simple.

so no more confusion on how to calculate battery life.

For a 18650 2500mAh(2.5Ah) battery with a device that draws 500mA(0.5A) you have:

2.5Ah/0.5A=5 Hours

Please take note that most batteries, especially those with circuits, will not work down to 0 Volts as a power supply (if it goes to zero, it will have shorter battery life, or even become dead battery if not charged in time), that's to say,your circuit will stop working at a set voltage before the battery is fully drained.

see below dischaging chart

it will not go to zero(totally empty)

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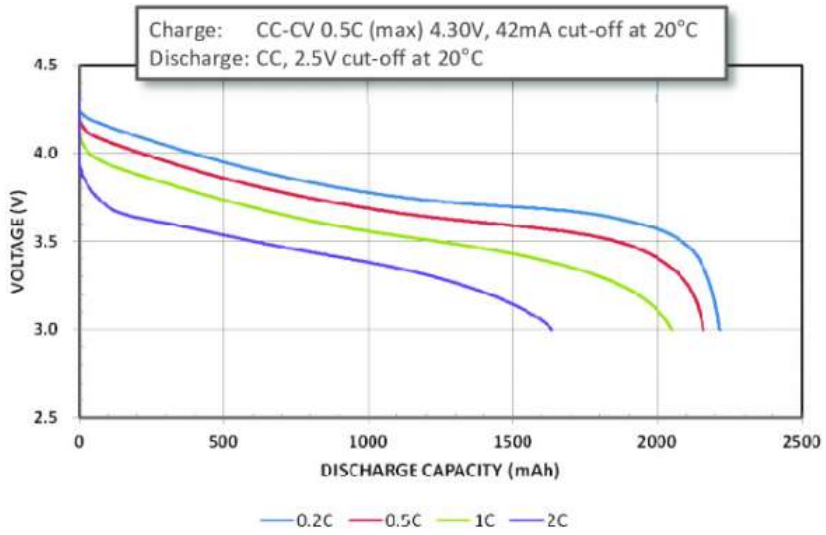
Battery Design Guide

News updates

- Lithium ion battery State of Charge
- Why are There Stages in Lithium Battery?
- All Things You Need To Know about Lithium Battery Energy Density
- All Things You Need To Know about Ternary Lithium Battery



› How to Estimate Life Span of Your Lithium Battery

We, therefore, will need to times 0.8-0.9 for the calculation:

that's 2.5Ah/0.5A*0.9=4.5 Hours

What if you know Watts only, you will notice that every device use watt to determine it's main specifications.

5 Watt bulb,

20W Laptop,

100W Motor,

200W Solar Street Light

Just name a few.

In Theory, that's:

Discharging Time=Battery Capacity*Battery Volt/Device Watt.

Say, 5AH*3.7V/10 Watts = 1.85 hrs

With 90% Power efficiency for Li-ion/LiPo batteries. Then Discharging Time=Battery Capacity * Battery Volt*0.9 / Device Watt

5Ah*3.7V*0.9/10W = 1.66 hours

Let's explain with more examples:

for a 1800mAH 3.7v 18650 battery to power a 3.7V 10W digital device, how to calculate the running time?

for 3.7V 10W device， working current would be 10÷3.7 = 2.7027A = 2702.7 mA
In theory that's: 1800mAh ÷ 2702.7 mA = 0.666 h = 40 min
In reality that's: 1800mAh ÷ 2702.7 mA*0.9 = 0.599h = 36 min

Quick Notes: 1A=1000mA (mA is current, mAh is Capacity)

Or you can use
3.7V*1.8Ah(1800mAh)*0.9/10W=0.599h=36min

Another example: 12V 60Ah battery pack to power 220V 100W light
Working time: 12V*60Ah*0.9/100W=6.48 H

Want More Details: Download our battery design ebook.
Lithium Battery Design Design Ebook Download(2M, 20 pages, PDF)

How to Calculate Battery Capacity ?

Things would be quite complicated as the battery would be in different shape(Curved shape, Round,Rectangular etc) and different discharging current(5C, 30C, or even up to 100C) or even temperature requirement(like low temperatu

feel frustrated?

We here have 2 ways for you to get the battery capaicty.

let's start from simple ways
1 Get Battery Capacity Based on Size
if size are given or can be checked by a ruler, we can then get the battery capacity.The size of Lithium polymer battery has a great impact on its capacity, that's the thickness, width, and length of a battery. The material and Production technology will have an effect on the lipo cell capacity.
The actual capacity will be very complex, but luckily we have a simple and fast calculate formula.

Capacity= Thickness*Width*Length*K

K= mah/mm^3, which is a parameter that ranges from 0.07-0.12. for a general calculation, we will set it to 0.1

take **103450 battery cell for example** (T=10mm, W=34mm, L=50mm)
that's 10*34*50*0.1=1700, in reality, it's about 1800mAh or more.

what **about 603450**(also called 063450 603450LP)?
that's 6*34*50*0.1=1020 in actual it will be about 1050mAh

2 Get Battery Capacity by Energy Density

The lithium battery usually comes with a pouch or cylindrical form.

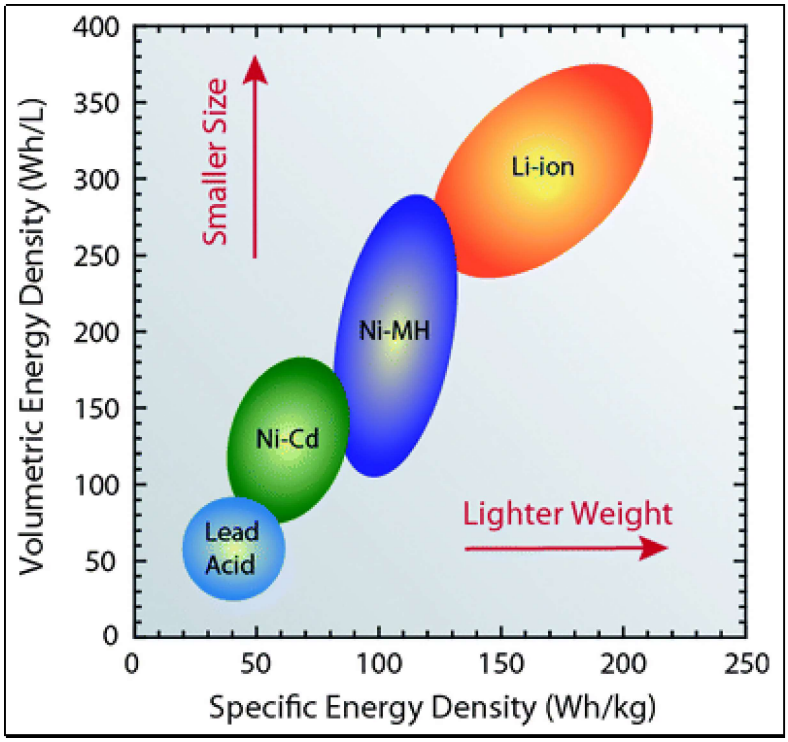
in cylindrical form there is capacity listed for each size:

like for lithium 18650 battery: 2000mAh, 2600mAh,3000mAh, 3350mAh,4050mAh

for lifepo4 26650 battery:2500mAh, 3000mAh,3500mAh

PS: quick notes: if space allows, cylindrical battery cells will always be your first consideration on the table. They are on the shelf and therefore has short lead time and sm

so we can quickly get battery capacity(max capacity) based on battery energy density. for lithium battery it would be 100-265 Wh/kg or 250-670 Wh/L.



Energy Density of Different Battery Types

Let's say what would be the battery capacity at 11.1V 7kgs

it would be 7kgs*265 wh/kgs=1855Wh

so that's 1855 Wh/ 11.1V=167Ah

Impotant note: above are max capacity as there is BMS and wiring cables included for a battery pack.

Online Size Battery Capacity Calculator

capacity less than 500-2000mAh

Thickness (mm)	Width (mm)	Length (mm)
3.5	40	50

capacity from 2000mah to 10000mAh

Thickness (mm)	Width (mm)	Length (mm)
6	50	90

Capacity (mAh)	Capacity (mAh)
0	0

Remarks:

1 the calculator does not apply to capacity less than 500mAh or 2mm less in thickness cells
2 If the capacity is not within the stated capacity range, try the other calculator
3 the capacity if for your reference, given the size, thickness, width, material, voltage, the capacity will still vary greatly from each other.

Battery Run Time Calculator(Battery Life Calculator)

How long will my battery run, this is a big question for many end users and even for some electronics engineer.

We here come with a simple battery time calculator that will tell you how long your battery will run.

Battery Run Time= Battery Capacity in mAh / Load Current in mA

Let's see one real example

How long will a 2000mAh battery last for a 100mA current cell phone? How to calculate my cell phone's life?
Can you make it?

it's 2000mAh/100mA= 20 Hours

Battery life=Battery Capacity(mAh)/Load Current(mAh)

Important: Don't mess mAh and Ah , 1Ah=1000mAh

for a 500mAh battery, that runs at 0.1Ah device,that's 0.5Ah/0.1Ah

Or 500mAh/100mAh= 5 Hour

if the battery has Wh information on it, convert it to mAh

Convert Watts to Amps

Some customers asks for **12v battery run time calculator**,

Actully the formula works for all volts including 12V rechargeable battery

Let's say a 12V 100Ah solar lithium battery to be used for a 12V 30A device
the battery run time calculation would be
100Ah/30A=3.3 Hours

Here we come some key importace take aways

1 when you convert the battery with the same volt and same Ah or mAh, you can use the fomula and just ingore the volt
2 To check how to calculate how long a battery will last, the difficult part would to define the consumption of the device, as it's changing all the time
3 No matter if you are trying to find 12v battery pack run time calculator or 24V or 36V, it actully didn't influence our formula of how to decide the run time for each device or battery.

Want More Details: Download our battery design
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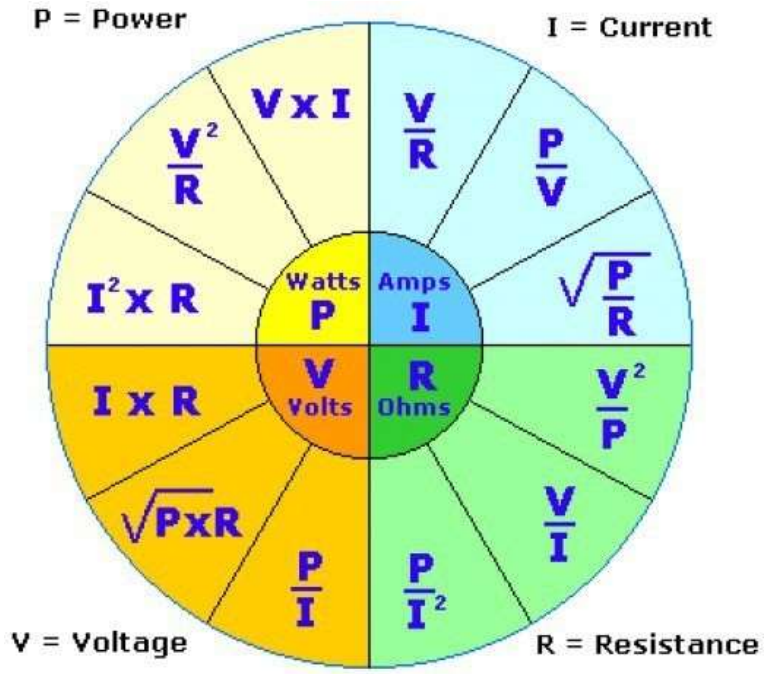
How to convert Watts to Amps or Amps to Watts or Volts to Watts?

You cannot convert watts to amps, HOWEVER, if you have at least two of the following three: amps, volts or watts then the missing one can be calculated.



The Following Equations can be used to convert between amps, volts, and watts.

Convert Watts to Amps
Convert Amps to Watts
Convert Watts to Volts
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Converting Watts to Amps

Basic equation: Amps = Watts/Volts

For example: 12 Watts/3 Volts = 4 Amp

100W/12V=8.33A

500W/36V=13.88A

Converting Amps to Watts

Basic equation Watts = Amps * Volts

For example 2amp * 100 volts = 200 watts

3A(3000mAh)*3.7V=11.1W

0.5A(500mAh)*5V=2.5W

Converting Watts to Volts

Basic equation: Volts = Watts/Amps

For example 100 watts/10 amps = 10 volts

150W/5A=30V

500W/5A=100V

Converting Volts to Watts

Basic equation: Watts = Amps * Volts

For example 3amps *5 volts = 15 watts

1A*5V=5W

10A*24V=240W

Converting Volts to Amps at a fixed wattage

Basic equation: Amps = Watts/Volts

For example 100 watts/10 volts = 10 amps

25W/5V=5A(5000mah)

30W/3.7V=8.1A(8100mah)

Converting Amps to Volts at a fixed wattage

Basic equation: Volts = Watts/Amps

For Example： 48 watts/8 Amps=6Volts

100W/10A=10V

1000W/10A=100V

Related Article: How to Calculate 18650 Battery Pack

Related Lithium Battery Packs

18650 Lithium Battery Pack

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Rechargeable Li-Polymer Battery

CCTV Battery Pack

Ebike Lithium Battery

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12V Lithium Battery Pack

48V Battery Pack

Summary	
Rating	★★★★★
Aggregate Rating	4.5 based on **98** votes
Brand Name	DNK