

# DIY: 6 € NiMH batteries charger



It all started with wanting to use the [Ikea BLÅVIK](#) lamp as a bedside light. Lamp operation can be continuous, or timed, with switching off after 15 minutes. The original power supply, with 3 rechargeable AA NiMH batteries, is ideal for intermittent use, less for bed lighting: with 1000 mAh batteries, only 5 hours of light are guaranteed.

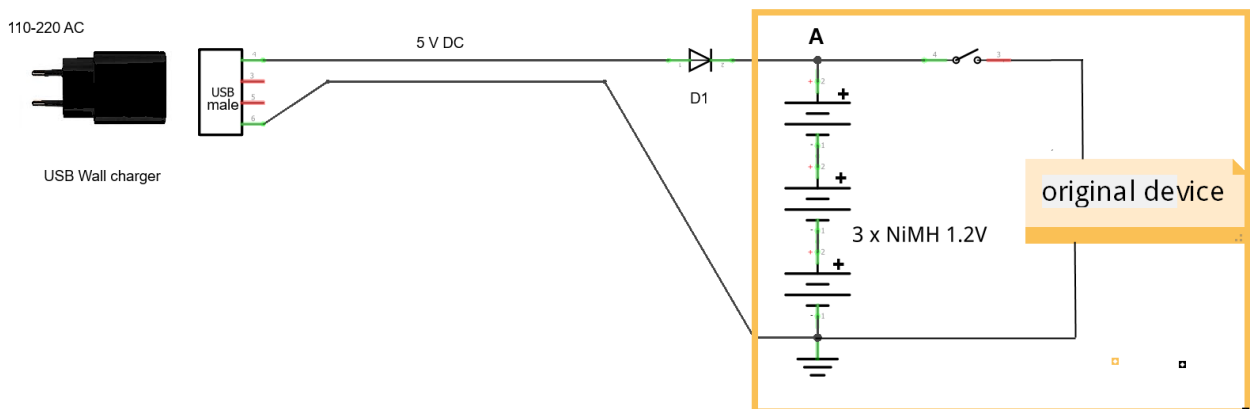
Idea: a mains power supply, using rechargeable batteries as buffer batteries.

The first step was to find out about the needs of NiMH rechargeable batteries, in particular, their use as buffer batteries. Then came calculations, tests, and measurements.

The final result of all this speculation can be found in the programmatic document **e3DHW-Power Management System, an introduction** ([https://github.com/msillano/e3DHW-PMS/blob/master/e3dhw-pms-intro\\_en.pdf](https://github.com/msillano/e3DHW-PMS/blob/master/e3dhw-pms-intro_en.pdf)), where the initial idea developed into a generalized design methodology for DIY power supplies.

## The simplest and cheapest NiMH battery charger

I am always looking for simple, effective and economical solutions and the slow charge circuit for 3 NiMH rechargeable batteries is really simple, it requires only a silicon diode !.



The diode has a dual purpose: it lowers the voltage of the power supply from 5V to 4.4V and excludes the power supply when it is not powered in AC.

The batteries are always on charge: this is not a problem, the charging current has an exponential trend: at 4.4 V it is practically zero, guaranteeing the full charge of NiMH batteries.

The bedside lamp thus modified also acquires the function of an emergency lamp, being able to provide light in the event of a power outage, for a time that varies according to the state of charge of the batteries, while at the same time retaining all the original functions: continuous operation or timed (15 minutes).

Furthermore, the original circuit turns off the light if the battery voltage is lower than 3.0V, perfectly protecting NiMH batteries from the risk of overdischarge.

## Required material

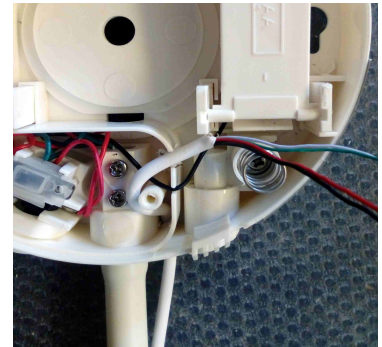
- **3 rechargeable NiMH batteries**, AA. (or AAA for some models of Blåvik lamps). Use three batteries of the same brand and of the same type, and in the same state (all charged or all discharged).
- **A USB power adapter** for smartphones, AC-5V, 1 A or 2 A..
- **A USB power cable**, sometimes sold in a single package with the power supply. (v, photo, CE, 100-240 Vca, 5 V 1 A, € 6, but also [3.65 €](#))
- **A silicon diode**, 50 + V, 1A (e.g. IN4001, I used a recovery diode).



## Mounting

It's very simple:

1. Prepare the power cord by cutting off the micro USB plug (the one for the smartphone).
2. Strip 5 - 6 cm of the wire: only the red (+) and black (ground) wires are needed.
3. Drill the container to let the wire penetrate the device (I used an electric screwdriver with a 4 mm spindle and bit, so as not to overheat the plastic.).



always inserted to charge the batteries slowly

4. Solder the black wire to the negative contact of the batteries
5. Solder the red wire to the diode and then (if necessary use another piece of wire) to the positive of the batteries. Pay attention to the polarity of the diode: the white band goes towards the batteries.
6. Insert the USB plug into the power supply and a wall socket. The power supply is

## Measurements

Conditions	USB [V]	USB [mA]	A node [V]
Without batteries, light off	4,99	$\approx 0$	4,30
Without batteries, light on	4,03	75	3,20
Batteries charged, light on	4,86	10	4,09
Low batteries, light on	4,18	50	3,31
Low batteries, light off	4,27	30	3,53

*Using the power supply in photo, nominally 5V 1A, we can see from the measurements that it is not a very stable power supply: it supplies 4.99V without load, but the voltage drops to 4.03V with a current of 75 mA (the absorption of the Led). In these conditions, the voltage at node A is 3.2 V, just enough not to trigger the protection (3.0 V).*

*With the batteries charged, the current required for the lamp (75 mA) is supplied in part by the power supply (10, 50 mA) and partly by the batteries that discharge slowly.*

*When the battery voltage reaches 3.20 V, the power supply supplies all the necessary current (75 mA) and the batteries do not discharge any further.*

*This ensures that, with the mains adapter, the lamp never goes off and that the batteries are protected against the risks of both overcharge and overdischarge.*

*When the light turns off, the power supply charges (slowly) the batteries (30 mA @ 3.53V) with an exponential trend up to the final value, nominally 4.4 V.*

*Without the power supply, the batteries discharge more quickly. When they reach 3V the protection is triggered and the light goes out, avoiding overdischarge.*

*Consumption is never higher than 0.5 W.*