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NOTE :

This document has been written in several iterations.

I have not rearranged it completely, and some paragraphs could be moved or suppressed.

Charge limiting of HP Spectre x360

This document is available here:

https://bit.ly/charge_limiting_HP_Spectre_x360

Problem

Impossible to limit the charge of the battery of my HP Spectre.

If I leave it connected to the charger, the battery stays at 100% charge and it is very bad for its health.

It is well known that the best state of charge to preserve Li-ion batteries life is mid range.

There is no option in the BIOS to limit the charge.

There is no software to do the work.

My computer

HP Spectre x360 15-eb1006nf

BIOS : originally F.08. Updated to F.09, and then to F.10

Discussions

See for instance these discussions

<https://h30434.www3.hp.com/t5/Notebook-Hardware-and-Upgrade-Questions/Add-quot-Battery-Care-Function-quot-battery-charge-limit-to/td-p/7329598/page/8>

https://www.reddit.com/r/spectrex360/comments/ml0ofu/how_can_i_limit_battery_charging_to_80/

https://www.reddit.com/r/spectrex360/comments/zc711x/a_solution_to_limit_the_charge_of_the_battery/

Solution

How it works

The HP original charger delivers 19.5V and up to 6.9A.

I tried to feed the computer using a stabilized power supply of this kind



My idea was to supply only the voltage sufficient to give around 50% charge.

The relationship between the percentage of charge and the battery voltage can be obtained using the free software BatteryMon. It appears that the optimum voltage of the battery should be between 11 and 12V (mid range level of charge), and my initial objective was to impose the battery charge level via the source voltage.

The power supply voltage is not directly applied to the battery (there is some complex BMS - Battery Management System - inside), but I hoped that there was a simple relationship between the power supply voltage and the final level of charge of the battery.

In fact not. But I observed an interesting feature, and globally 3 different situations:

1. If the power supply voltage is too low, it will not charge, the computer will drain the battery, and the battery will discharge until 0.
2. If the power supply voltage is intermediate, (between 12V and 16V), there is a very interesting situation where the BMS takes the power from the power supply and do not apply any charge to the battery. It means that if the power supply gives enough power to feed the computer, the battery level will stay constant at the level where it is. And almost forever... At the present time my computer is in this stage since more than 2 days and has kept a constant level of charge of 52%, whatever I do with it.
3. If the power supply gives 18V or more (since the original HP charger is given for 19.5V, I did not try to apply more than 19.5V, since I do not want to damage the computer), the BMS will start to charge the battery, exactly like with the original charger. But if the power supply cannot give the 6.9 A of the original charger, you can get a warning telling you that the power supply is weak and you should replace it by an original HP one. No problem. If it is the case, you can change the notification parameters in order to never see this message again. The only consequence is that it will charge a little bit slower than with the original charger. If you are not in a hurry, it is better for the battery. If you are in a hurry, use back the original HP charger.

Using adjustable charger 12/15/16/18/19/20/24V and 96W

This charger is given for 96W.

I have a wattmeter able to measure up to 70W. I checked that the 70W are there. But I cannot check if the 96W are there.

On the side of the charger there is a slider that permits to change between these voltages: 12/15/16/18/19/20/24V.

On the top of the charger there is a green LED that says which voltage is applied (only one led is enlighten at a time, contrary to the image below).

I checked that the voltages are good, and that they do not go down when the charger delivers power.

The charger is sold with a set of plugs for various connections. The one for the HP Spectre (it is the one with the blue plastic with dimensions is included).

Charger's specifications (written on the charger):

Max output at 12/15/16/18/19V : 4.5 A

Max output at 20/24V : 5 A

<https://fr.aliexpress.com/item/1005001393053034.html>

23.58 € on Dec. 1st, 2022

UPDATE : the charger died after about 30 minutes of charge at 18V and around 88W.



I opened the charger and it contains a PCB with the following reference

HHW-96W PCB REV3.5

2022.03.12

The main component has 8 pins and has exploded.

It seems that there are also 2 resistors that have burned, and perhaps one diode.

Using adjustable charger 12/15/16/18/19/20/22/24V and 100W

I ordered this one on December 4th, 2022.

<https://fr.aliexpress.com/item/4000583568547.html>

Seems more seriously build. Can be powered by 12V (car) or 110-240V. Note that the input AC cable is not sold by the vendor. It should be a standard one, and perhaps you have already one of this kind at home...



Received and tested on December 13th, 2022

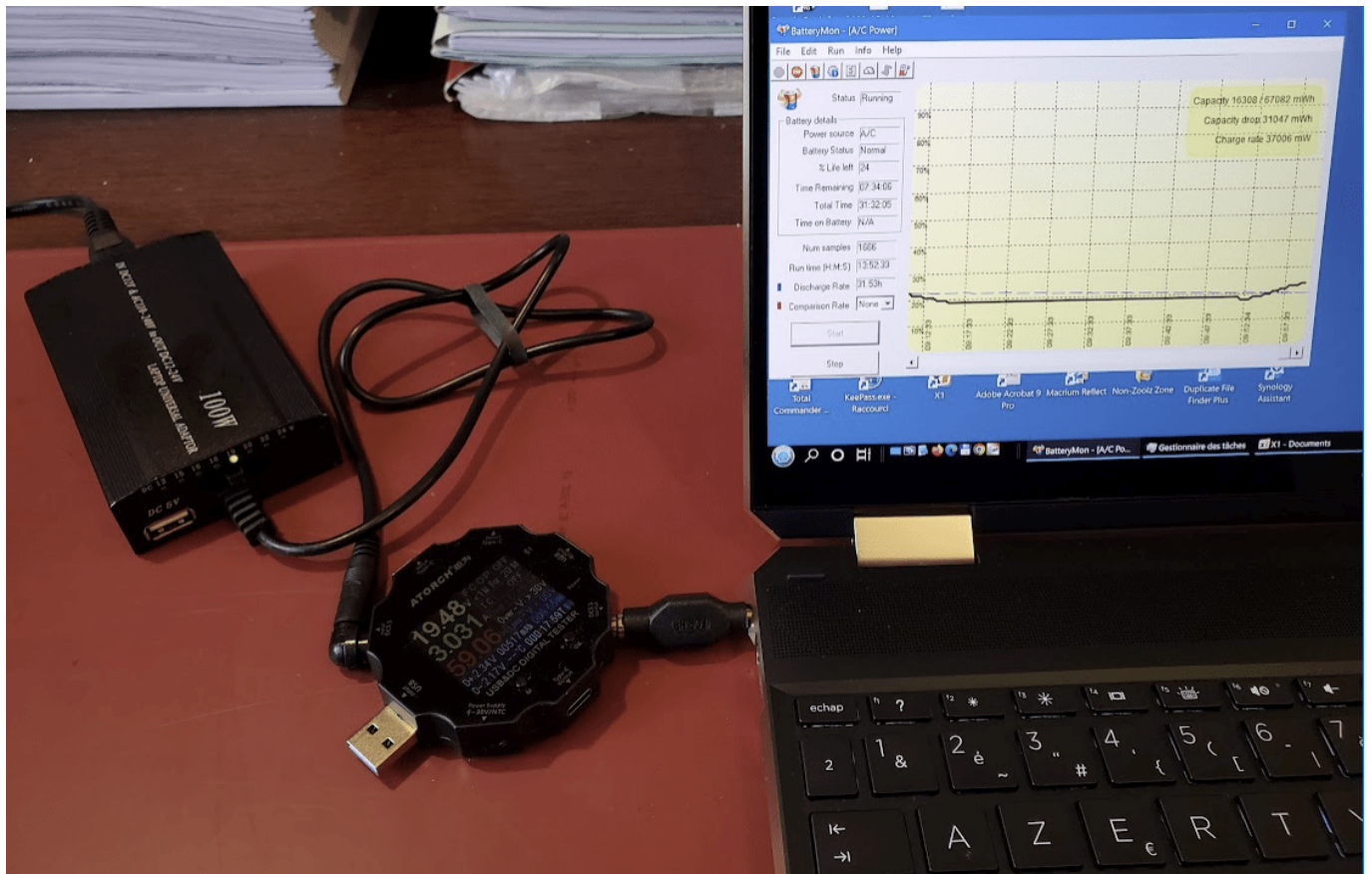
Seems OK

It becomes hot when charging, but the case is metallic and seems to support it.

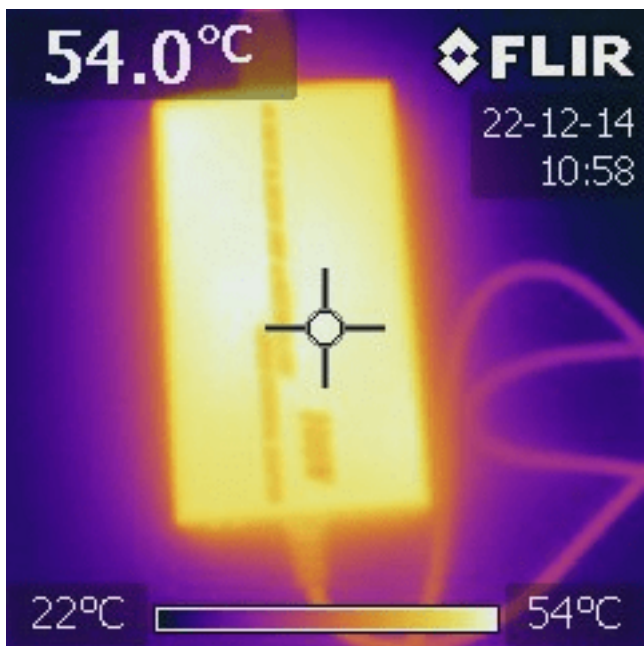
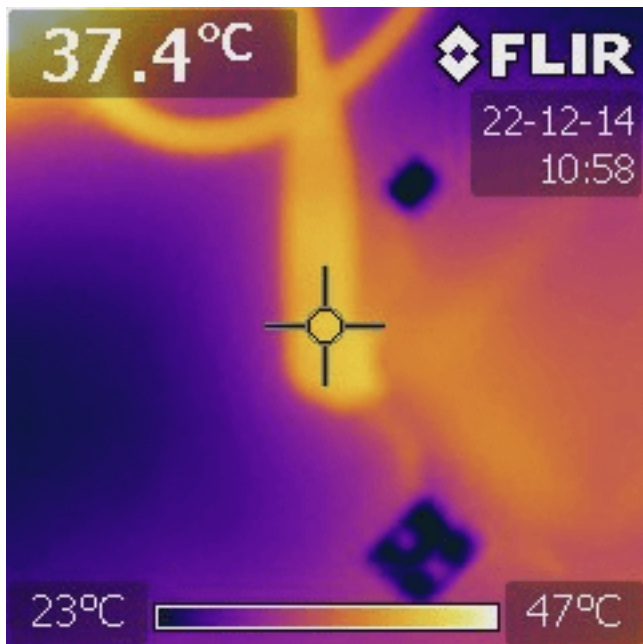
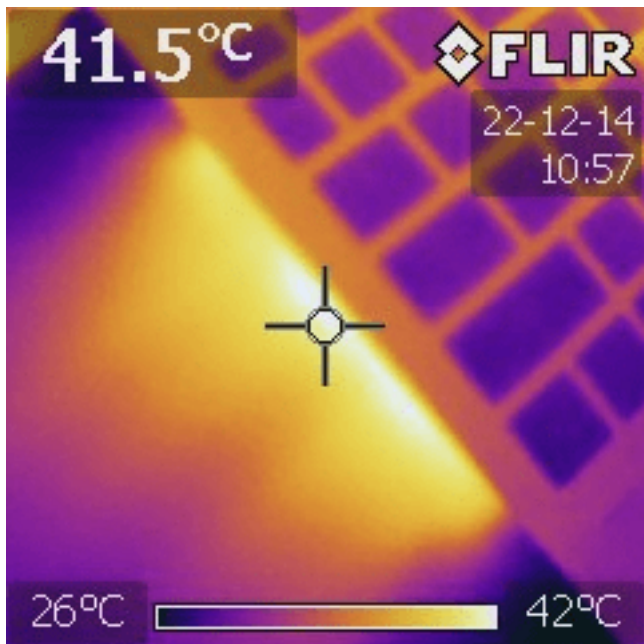
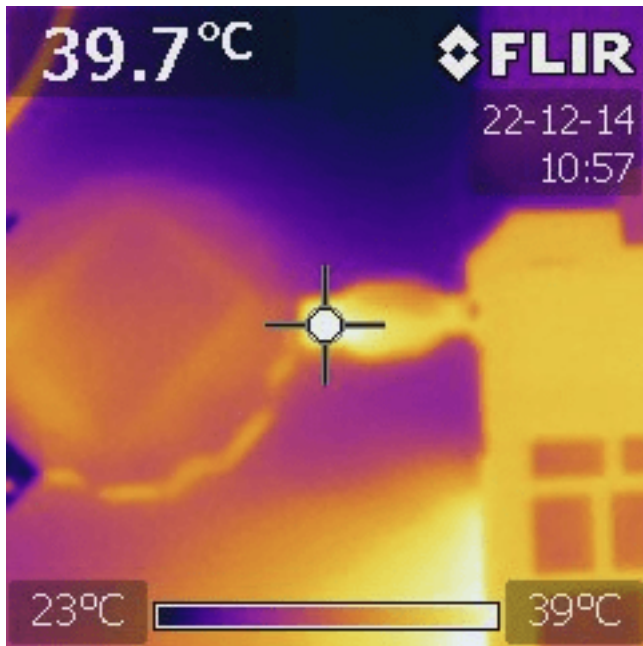
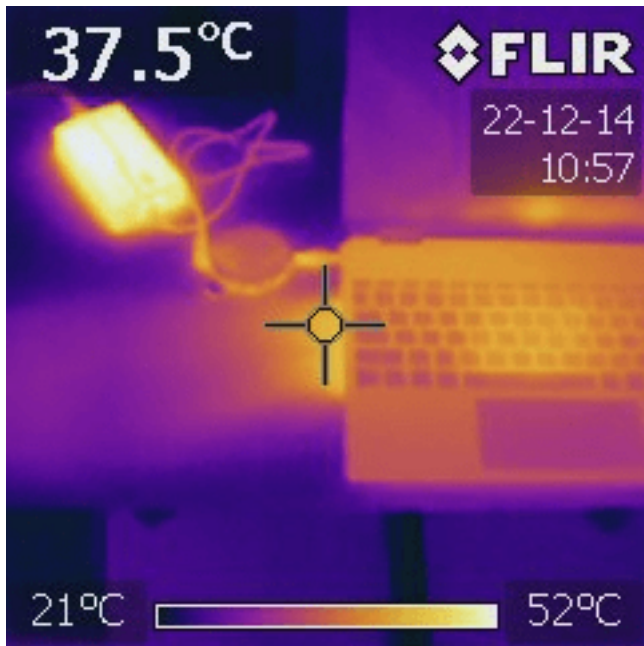
It passed the test of charging for around 1 hour at 19v (where the above charger died).

Use it at 15V or 16V to maintain the battery at a constant level of charge.

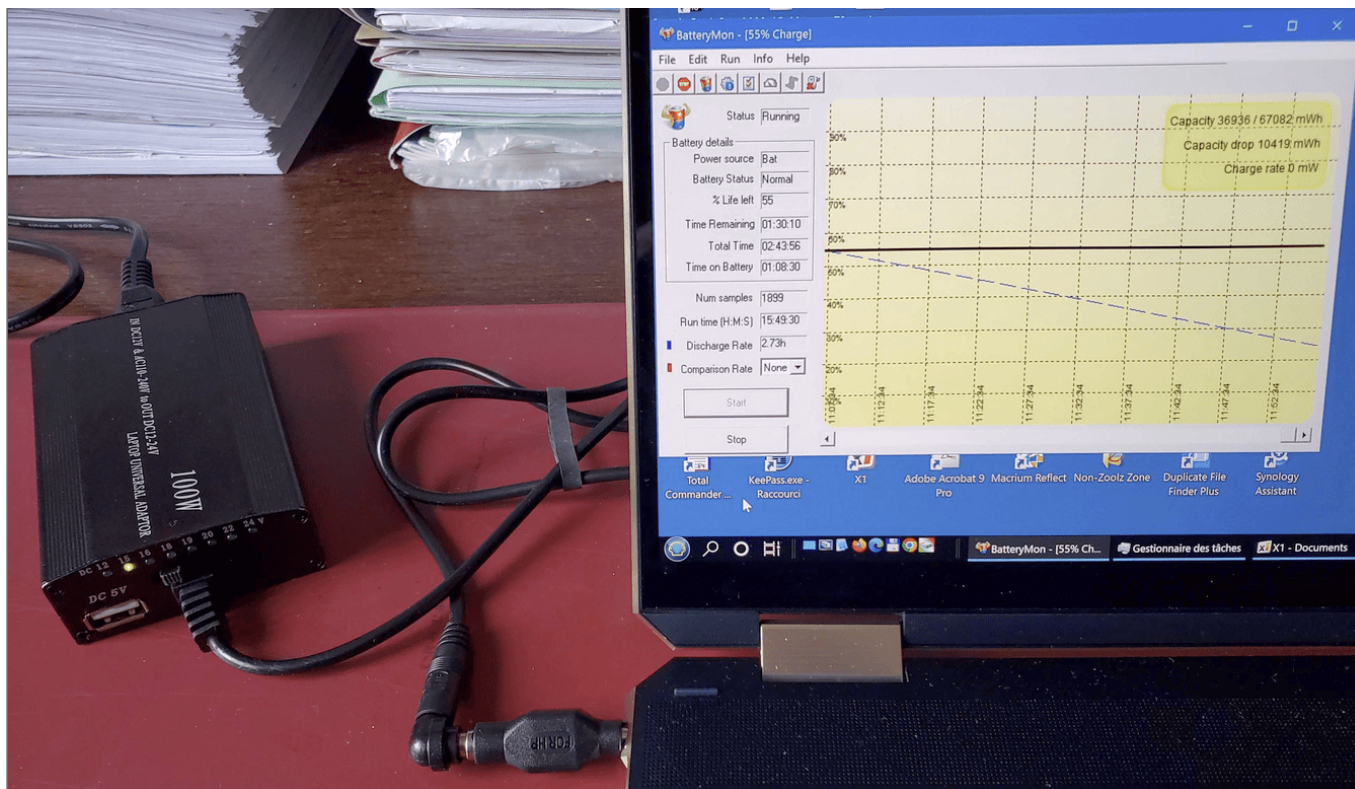
Use it at 19V to charge the HP Spectre (it gives 19.5 V, which is exactly the nominal voltage of the original HP charger)



Thermal images after 30 minutes of charge at 19V (around 60W delivered by the charger) :

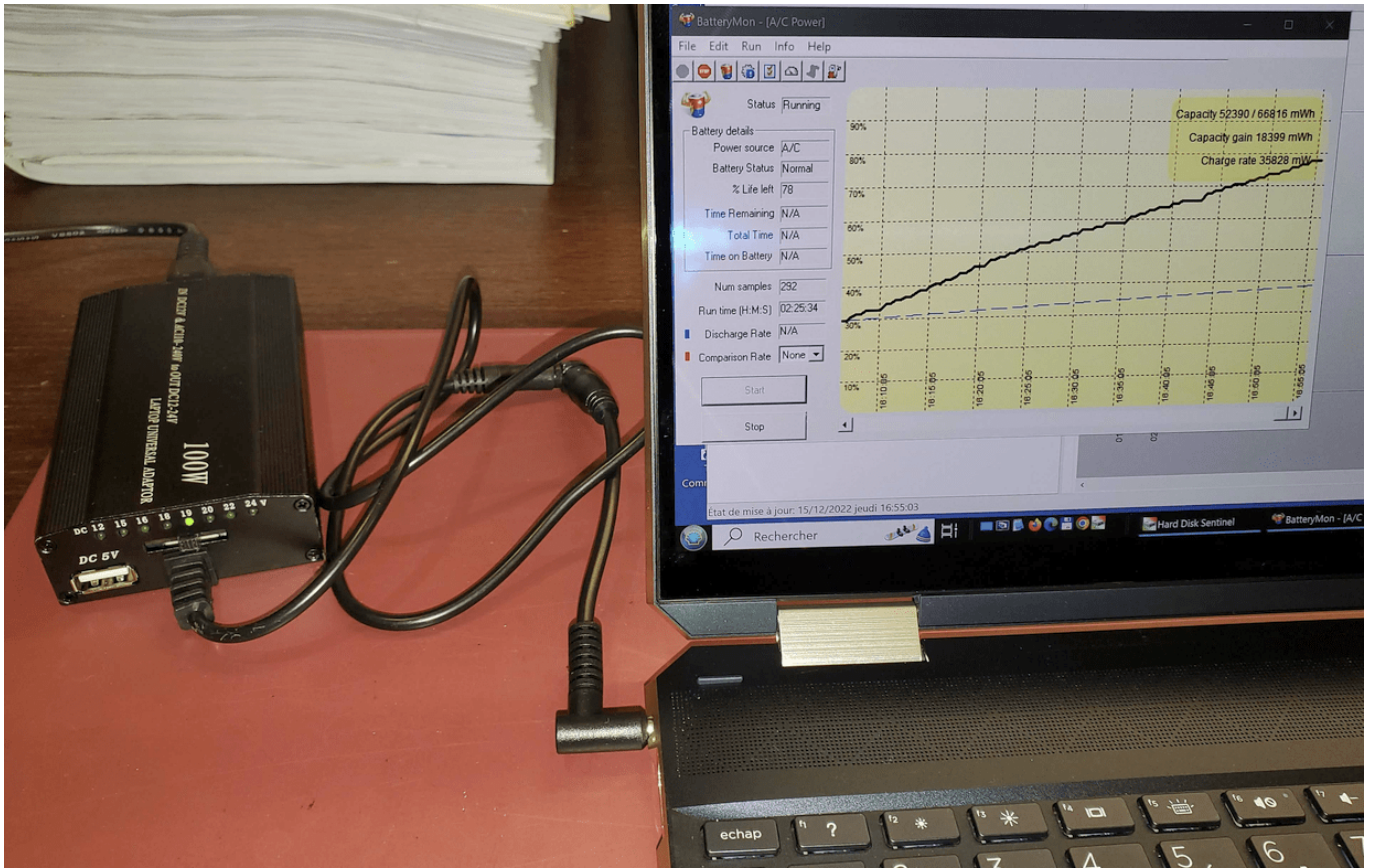


The HP adapter that is sold with this charger (in the option "For HP, for Dell") is bulky. There is a risk that you jostle it with a wrong move, and you risk damaging the computer :

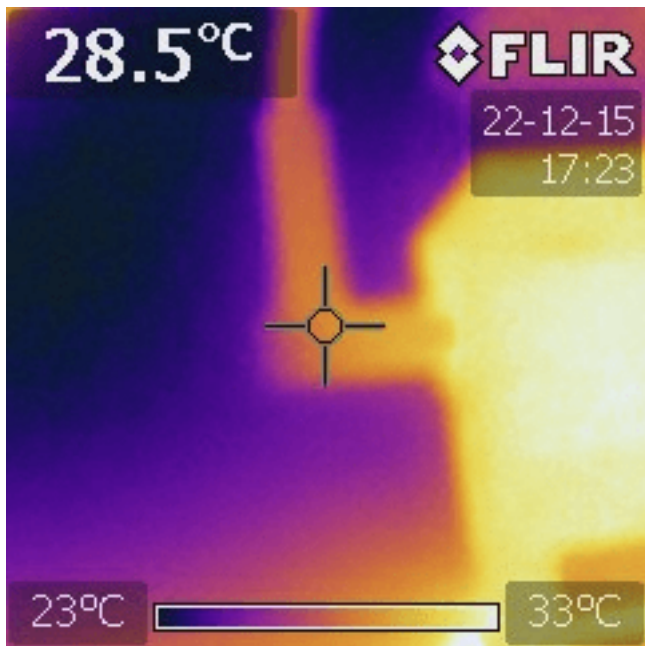
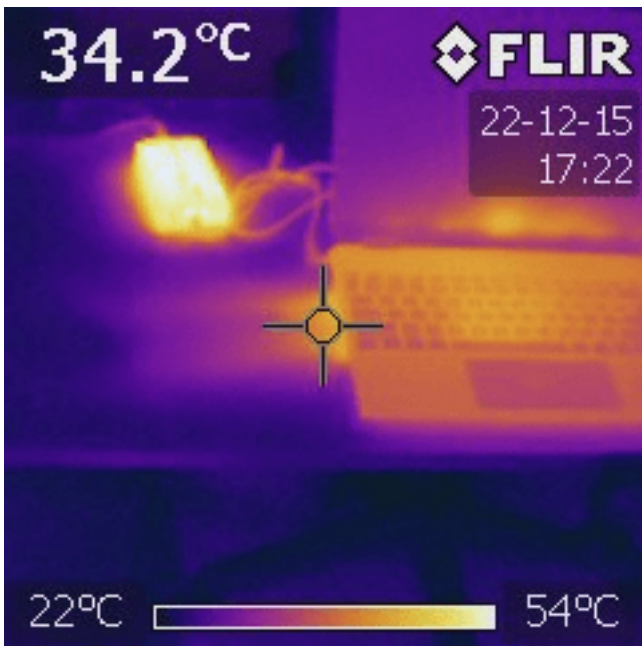


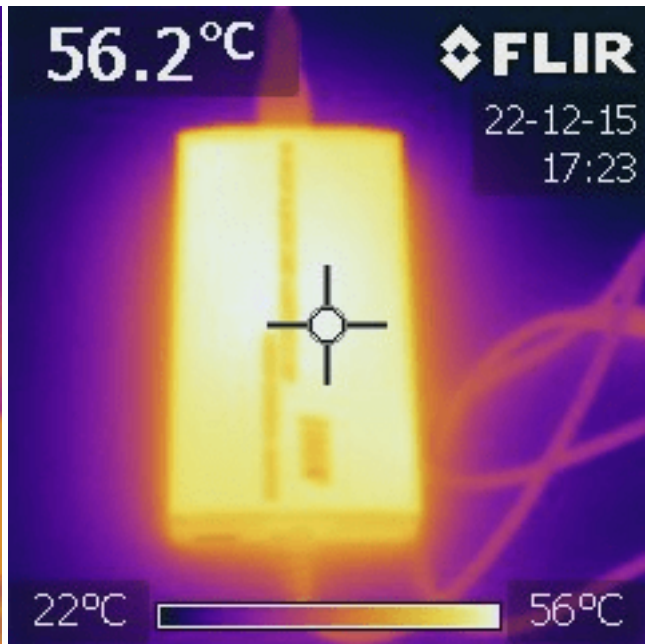
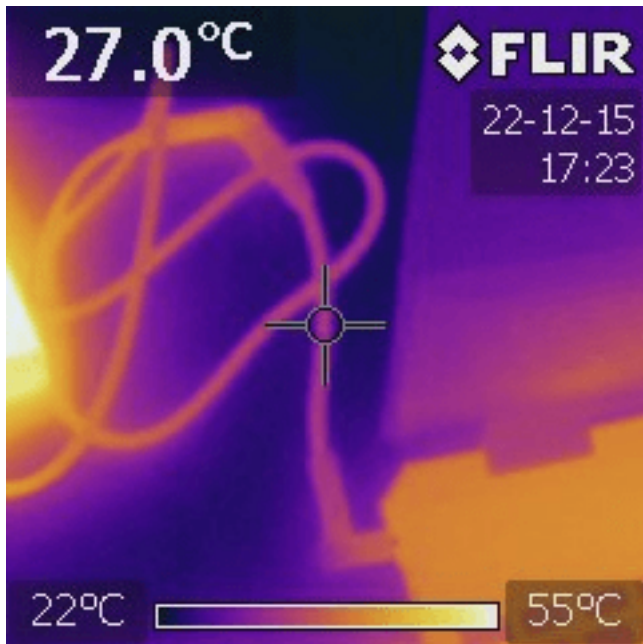
That is why I have bought this adapter
<https://fr.aliexpress.com/item/32753689136.html>





This adapter does not get hot when charging. Here are thermal images after 50 minutes of charge at 19V :





Other chargers ?

From searching a little bit, it seems that the aliexpress adjustable charger that I got (on the bottom, the reference is MODEL: GX-96W) exists in several copies.

For instance a Minleaf version : <https://www.google.com/search?q=Minleaf+96W+12V-24V>

Or this "120W" version with red LEDs: <https://fr.aliexpress.com/item/1005002766891434.html>

But they all seem cheap plastic chargers similar to the one that burned. I will not experiment twice these chargers.

<https://fr.aliexpress.com/item/1005004504494486.html>

9-24V / 5A

Should be better to replace the potentiometer by a switch, because if somebody turns the potentiometer to 24V while charging, it could damage the computer

I have a 3-24V / 2A of this kind and it becomes quite hot. I do not trust these chargers very much.



This KPS305D (adjustable power supply 0-30V, 0-5A) is the cheapest of its kind and can be used for a lot of other purposes:

<https://fr.aliexpress.com/item/1005002318823745.html>



Operation

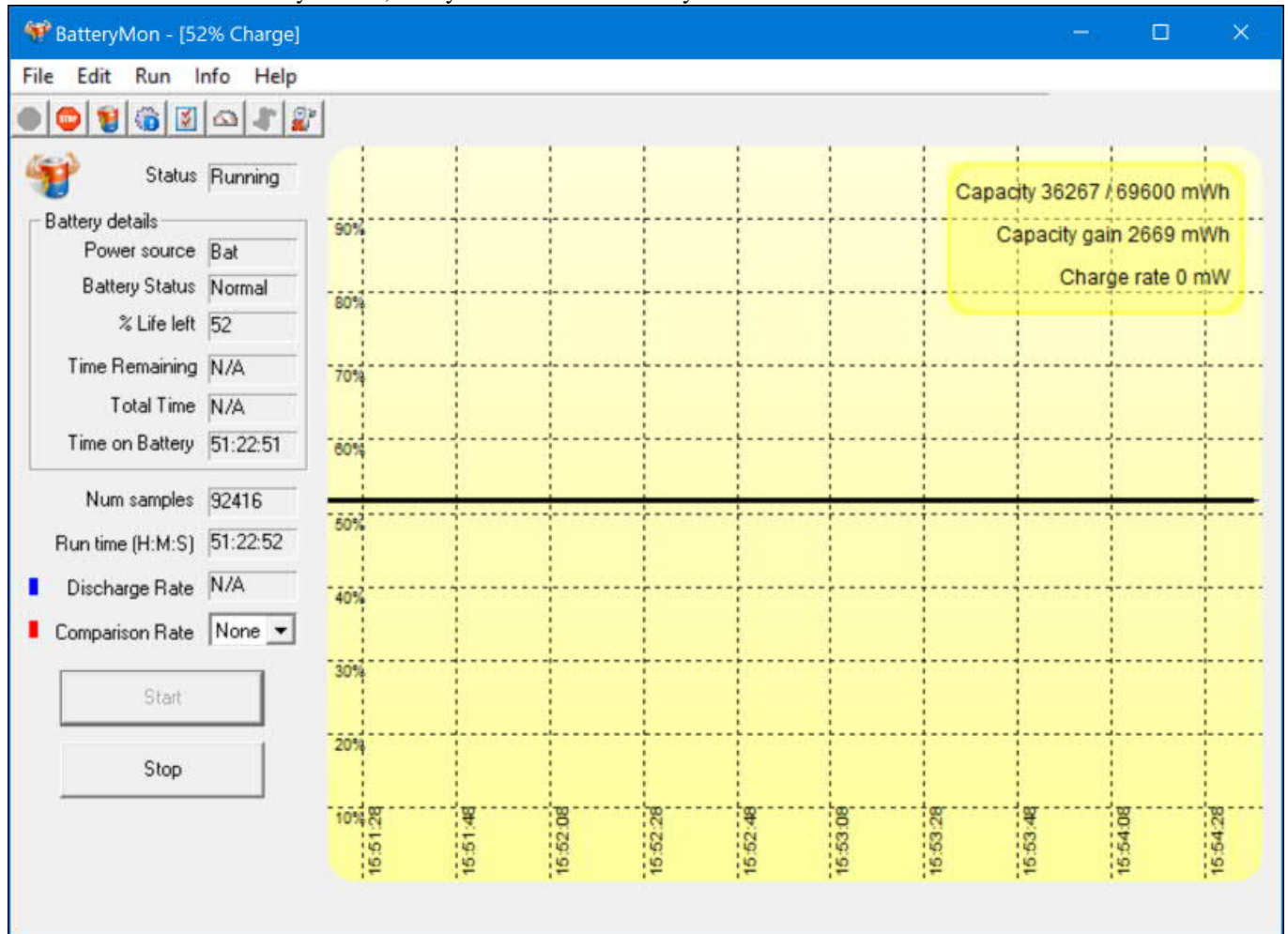
You need to install a free application like BatteryMon in order to follow in real time the state of charge of the battery, if it charges, discharges, or stays at a constant level of charge.

Using the charger at 12V, 15V or 16V, the HP will not charge its battery, but it will take its power from the charger and keep the state of charge of the battery constant.

You should before charge the battery to the level that you want to keep in order to preserve the battery (knowing that Li-ion batteries like to stay at mid charge, any level around 50% is good, and personally I try to stay between 40% and 70%).

If you use the computer too "hardly", it is possible that at 12V the charger will not give enough power and in that case the computer will take the remaining power on the battery. In that case, switch to 15V or 16V.

At 15V since more than 2 days of use, it stayed to 52% continuously :



At 18V, the charger begins to charge.

By default, you will get notifications telling that the charger is too weak and it is recommended to use a HP original one.

But you can adjust the notification parameters in order to suppress this notification.

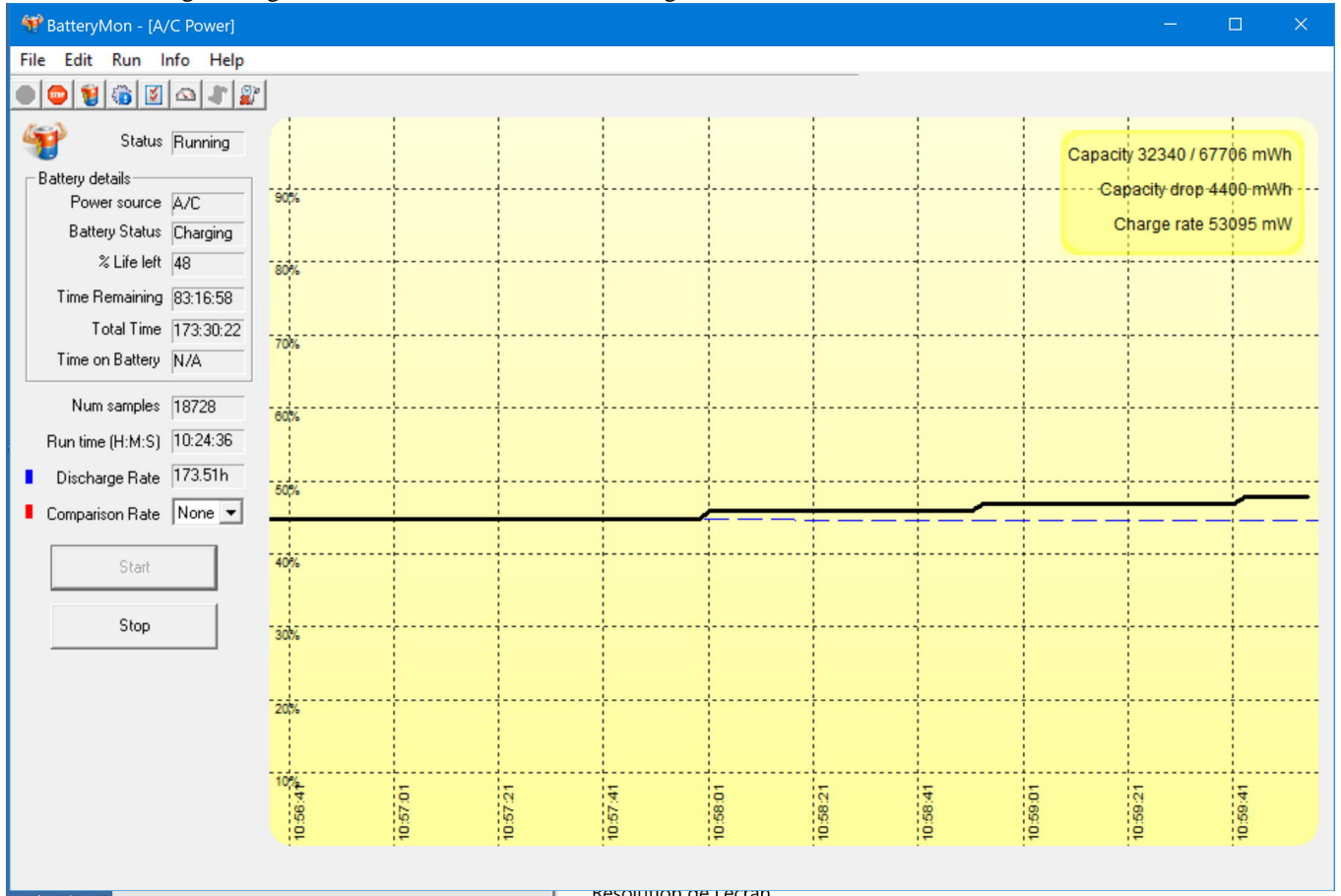
In my case, at 18V, it charges 2% in 100 seconds (see image below), i.e. a full charge in 83 minutes. That is perfectly correct.

Note that in this case the charger and the cable become pretty hot (much more than with the original charger). I have this charger since one week, and I cannot tell if it is a symptom of bad construction or if it can support this heat for a long time.

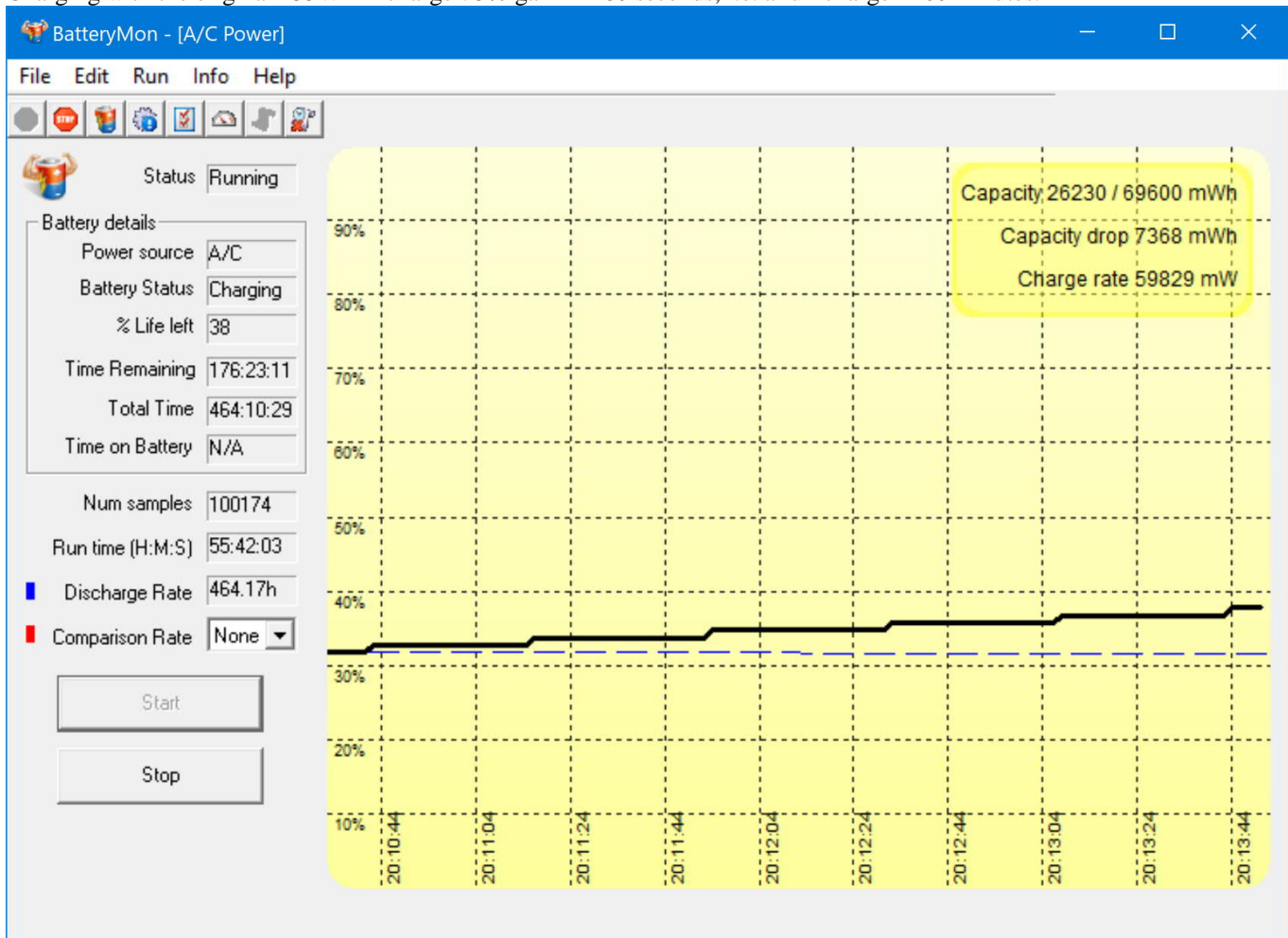
That is to say that if you really want to charge, perhaps it is better to go back to the HP charger.

=> update: indeed, the charger burned some time later !

At 18V, the charger charges 2% in 100 seconds, i.e. a full charge in 83 minutes



Charging with the original 135W HP charger: 5% gain in 180 seconds, i.e. a full charge in 60 minutes.



Other images with the first charger which died just after

Checking voltages, intensity and power :



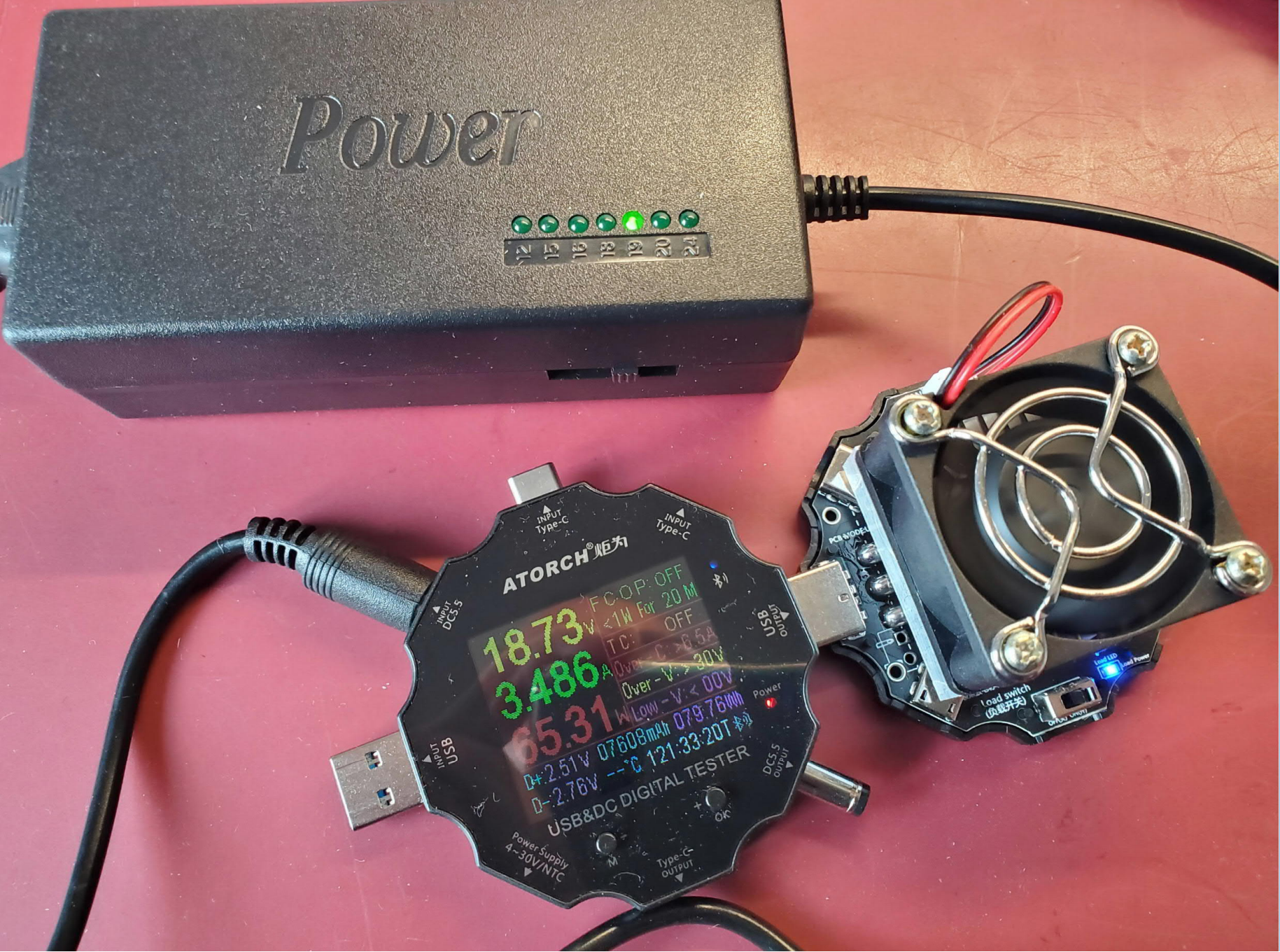
Normal use :



Charging at 18V . in that case the tester displays 17.42V, 5.097A, and 88.81W



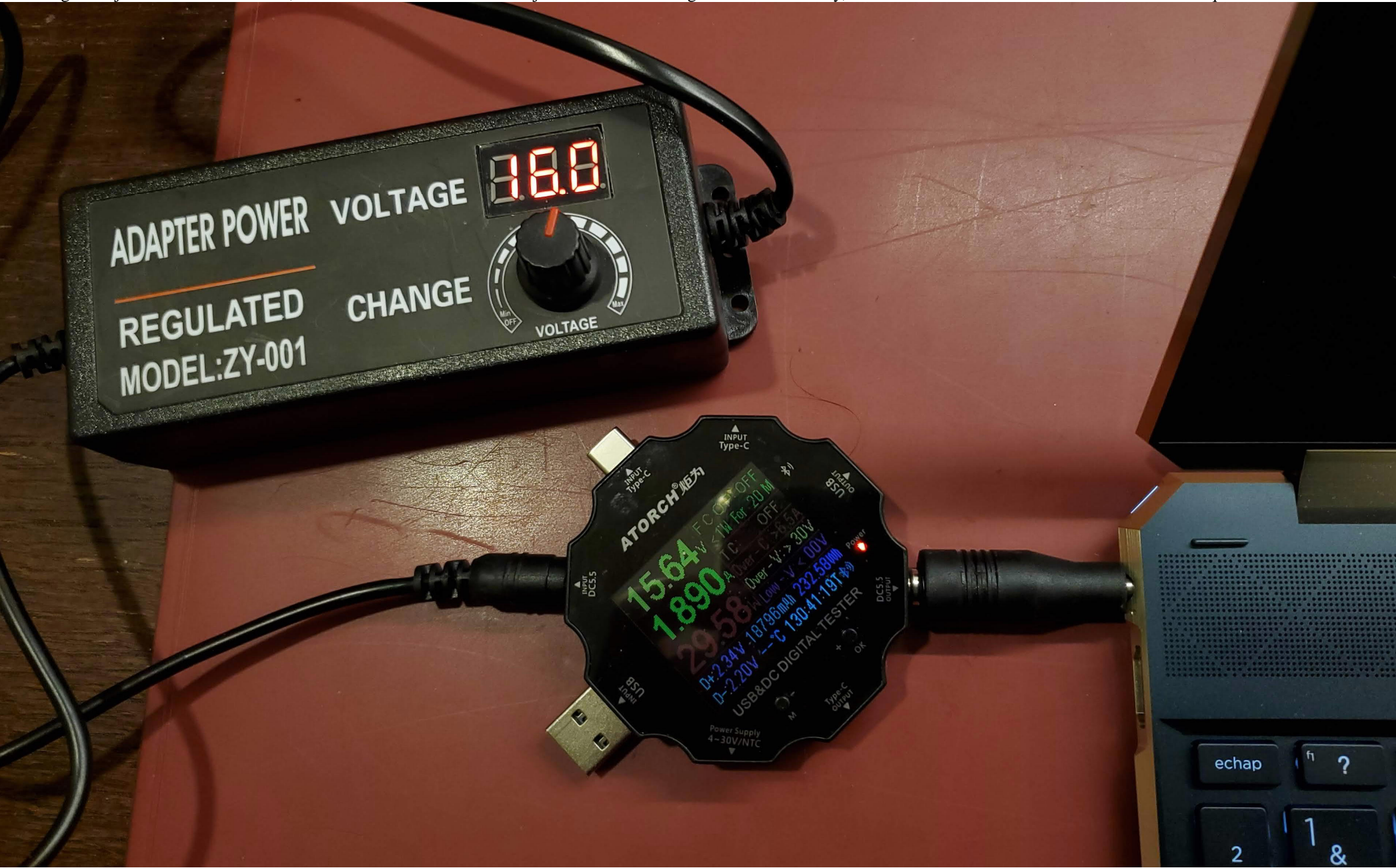
Power supply tested on an electronic charge at 19V. In that case the power is limited by the electronic charge that is given for 65W and that I did not want to stress too much:



Power supply tested on an electronic charge at 20V. In that case the power is limited by the electronic charge that is given for 65W and that I did not want to stress too much:



This other power supply has a red display and with a normal lighting it is impossible to distinguish the display on the pictures. I had to darken a lot to see that it is set to 16.0V. It's voltage is adjustable from 3V to 24V, and its current limit is 2A. It can just maintain the charge level of the battery, but is not convenient for this use. And it becomes quite hot also...



Solution in very short

Buy this charger <https://fr.aliexpress.com/item/4000583568547.html>



And this adapter <https://fr.aliexpress.com/item/32753689136.html>



Use it at 15V to maintain the battery charge level at the level where it is for as long as necessary.
Use it at 19V to charge the battery at a slower rate than the original HP charger

You can follow what happens in detail using the free software BatteryMon.

Or you can simply look at the small orange LED that is just close to the DC plug of the HP Spectre:

- if it is orange, the battery is charging
- if it is off, the battery is not charging (either keeping a constant level, either discharging)