

Full tank please

Any charging/discharging related wishes? Pulsar will fulfill them all

Everyone knows it: Just before new purchase he starts to compare, read and check technical data according to his needs and wishes. Usual, there's a compromise at the end. I think, that it don't have to be a rule and dreams about charging don't have to be a dreams only, especially when I read a technical data of Pulsar 2.

- Charging voltage 0,5-60V (1-32 NiCd & NiMH, 1-18 Pb, 1-26 RAM, 1-12 Lilon LiPo & LiTa);
- Accu types: NiCd, NiMH, Pb. Lilon, LiPo, LiTadiran, RAM (rechargeable alkaline batteries);
- Voltage converter step-down type for maximal current (even for single cells);
- Charging current 0,2-9,9A from single cell;
- Max. charging power 250W;
- Max. Discharging Power with AC Power supply 35W;
- Max. Discharging power with reverse function (return of current to car battery) 250W;
- Max. Discharging current for single cell 9,9A;
- Recognition method of charging finish: Delta-Peak, 2-stage for battery type;
- 8 program memory (user's data isn't cleared);
- Programs combinations for charge/discharge and discharge/charge with separately set current up to 9.9A;
- Charging / discharging with capacity limit 0,1Ah up to 12Ah;
- Charging in reflex mode;
- Charging in inflex mode: process will be stopped before cells would be overloaded;
- „fast mode” for Lilon, LiPo, & Pb up to 9,9A;
- Pb, RAM, LiOn, LiPo; Li-Manganoxid (tadiran), charging / discharging voltage can be set in 0.2V steps;
- Internal resistance measuring for compare – up to 4A of control current;
- Formatting with current up to 4A,(using of

- “cells regeneration” mode possible);
- Car battery is protected against overcharging in reverse mode;
- Alert of too low car battery voltage - can be set In range 10 to 11,5V;
- Reverse polarity protection on In, Out and cooling fan socket;
- Backlit display (switchable);
- Built-in cooling fan with smooth speed control;
- Set contains: PC-Software, PC cable, temperature sensor
- Small dimensions, low weight and lack of heat sink sticking out of case;

When I read list like this one, I'm asking myself: Why should we look in Poland to be heard? pp-rc Modellbau (www.pp-rc.de) is a dealer of these very attractive chargers (with full set of accessories) for 269 €. That's all about theory. Now, it's time to check it in practice.

In general

Just after opening of the box – surprise! Small, (let's say: tiny) but very elegant charger. It makes you think: how it's possible to achieve 250W of charging power and 35W (or even 250W in reverse mode) of discharging with such small device? One look inside of case makes everything clear: first: industrial technology standard with flat laying heat sink, second: thermally controlled cooling fan, and third: step-down, step-up voltage converter make possible it all. Pulsar 2 is protected against reverse voltage on input and outputs. Everything is controlled by PIC processor, which can be reprogrammed (flash memory). To do this, you need to send charger to authorized service.

Cooling fan starts almost unheard near 36°C (very nice) prevents against overheating (over 45°C) of back plate. Voltage converter



Pulsar 2 - top view



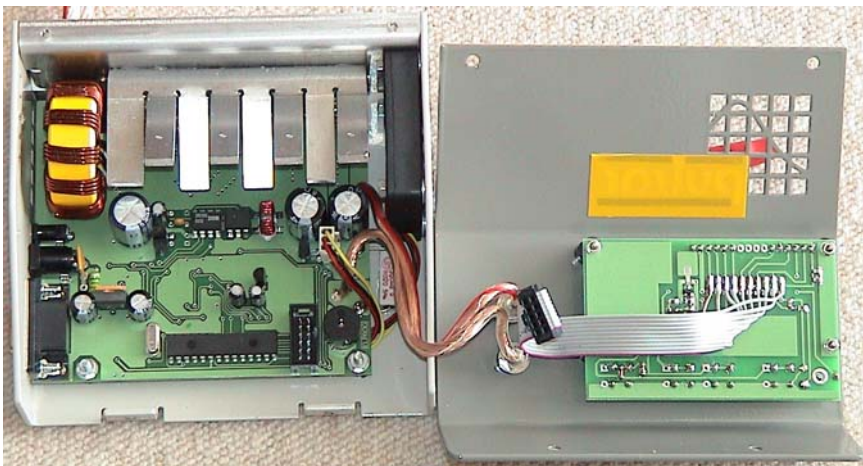
full set



Left side: sockets for temperature sensor, external cooling fan and PC



Right side: Laser cut intake for internal cooling fan



Inside view: Printed circuit board and user panel

There is a rule: "M" button select "what" you want to do (charging, discharging, cell type etc.), "E" button select "how" you want to do it (fast, reflex, inflex etc) and "+" / "-" select value. 8 program memories are independent from each other, same as combined functions (charge/discharge and discharge/charge) who's using single memory cell. The best is possibility of current being set-up independently individual. After start of combined program you can break actual step and go directly to next step. Capacity limiter during charging / discharging is a positive surprise. It wasn't mentioned in manual (in my opinion it was overlooked by author). Actual versions of manual (sold with new Pulsar's) are corrected and capacity limiter is described as well. This function can be activated before connecting (during setup of cells number) of accu pack using "M" button. It can be set up in range 0.1-12Ah – great! Very good idea! Results of last 8 processes could be read in "mem" function.

Charging of Ni-Xx cells

In general, Pulsar 2 is charging NiXx cells using constant current, without automatic currents select. Delta peak (dP) values (available at the moment are preselected to be safe for cells) for NiCd/NiMH "low": -7mV/-3mV and "high": -10mV/-5mV. For example: charging using 6.6A (2C) and dP=high was finished when NiMH GP3300 pack was completely full and had temperature of 41°C. I would wish to have "extended" setup possible: up to -20mV dP. With low dP (under 2C) Pulsar 2 had a tendency to finish charged cells too early. So I would suggest to use dP=high for current 0.5-2C and dP=low for current over 2C.

Charging in Inflex/Reflex mode

Inflex is a Fast charging mode for NiXx cells with very interesting identification of fully charged pack. There is no overcharging possible like in dP mode, because charging will be switched off in the highest voltage increment point, just before full charge of accu. Officially called: voltage gradient method d^2U/dt^2 .

makes possible charging / discharging with full range of current (up to 9.9A) – even single cell (minimal voltage is 0.9V per cell) which is great help in cells selection. I can recommend to power of few Pulsar's with one car battery. Voltage converter has very short reaction time which helps to flatten sudden mains voltage oscillation.

LCD display can be backlit for period of ab. 20s. Short "flash" shows every change in charge/discharge. 1.5m long mains cable (6 mm² cross-section) is perfectly chosen (it prevents voltage drop-outs even with 25A) Overloading is signaled by displaying of bold "A" letter.

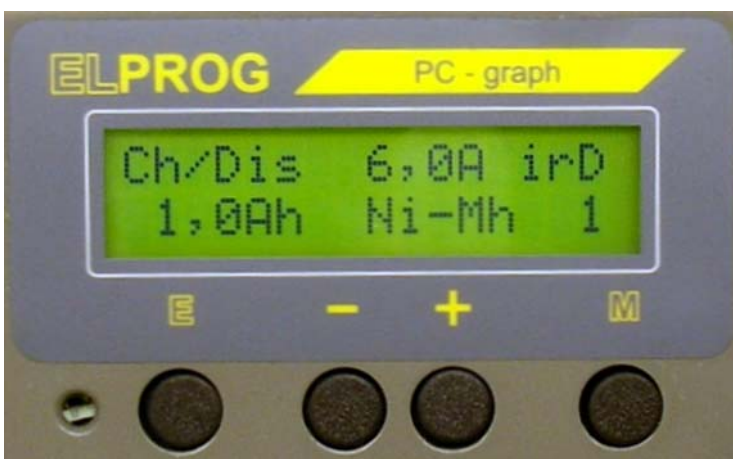
After charging is started, there is no immediate current flow. So called "soft-start" is splitting current on 5 steps. Every step lasts 12sek, so after 1 minute current reach its programmed level. Advantage of this method is more precise error detection. "Waking up" of deeply discharged cells is not a problem as well with this method. Soft start assures gentle start of Li-Po charging (which is suggested by manufacturers of cells). There is possible a forced start of charging of diode protected transmitter packs. In Pulsar 2 current is flowing in pulses (0.5-2sec long), depending on mode. Between pulses, charger is doing measurements and tests of cells, so we get real information about charging. Standard

multimeter would show slightly higher – than on Pulsar's display - voltage level (it doesn't mean that Pulsar 2 is improperly calibrated!). I was amazed by accuracy of Pulsar's measurements, whose fulfills common 1% of inaccuracy with big margin (average: below 0.5%).

For those wanting to check temperature for more safety, there is external temperature sensor included. It can be activated in setup menu. Tmin/Tmax temperatures are setting up separately. Times of cycles in Pulsar 2 are dependant on functions and are properly chosen (from 5h up to 2x14h). Arrow on display shows growing/falling tendency of voltage.

Menu

Thanks to 12 page A5 manual and practical tests, just after short period of time there were no riddles and I could start to use charger. Pulsar 2 is operated using four buttons with logical input of parameters depending on charging/discharging function. Just after power on, display shows software version (v.2.05). Here we can "start" charger or enter parameters "setup" menu, where is possible to set temperature range, beep signal on/of and minimal voltage of a car battery. In "start" mode using "+" & "-" buttons we can choose one of eight program memories or one of two special functions.



Control buttons and display. From the left: Charge/discharge, 6A, Inflex, Reflex, dP=High, limiter, NiMH, Memory nr 1



Li-Ion 3S: measurement of Ri



Measurement done after few seconds



Software - charging/discharging example shown with Data window

Technical Data of Pulsar 2 V2.05
(measured - March 2005)

Powering voltage	10V - 16V
Current consumption (without load)	0,12mA
Output voltage	0,5V do 60V
Power of charging	250W (248W)
Voltage converter / efficiency	step-up/step-down / ETA: >85%
Power of discharging	250W (244W)
Charging current	0,2A do 9,9A
Discharging current	0,2A do 9,9A
Delta Peak - low / high values	Ni-Cd: -7mV / -10mV Ni-Mh: - 3mV / -5mV
Ni-Xx number of cells	1 do 32
Li-Po number of cells	1 do 12
Max. charging current for NiMh	1 to 18 cells = 9,9A > 19 cells - smaller
Max. charging current for Li-Xx	1 to 6 cells = 9,9A > 7 cells - smaller
Li-Po cut-off voltage	Umax: 4,204V/cell Umin: 3,004V/cell
Li-Ion cut-off voltage	Umax: 4,106V/cell Umin: 2,705V/cell
Pb cut-off voltage	2,15V to 2,35V/ cell
Max. return voltage in "Revers on" mode	15,3V
Range of measured temperature	0°C to 99°C
Display	LCD, 2 * 16 signs with backlight
Alarms	Acoustic and optical
Charging sockets	4mm
Powering / charging cables	1,5m/6mm ²
PC connection	D-SUB 9 (RS-232)
Buttons	4
Main CPU	PIC processor
Standard accuracy	<0,5%
Updatable	Yes
Dimensions (mm)	120x130x58
Weight	850g
Price	269,-€

This method prevents packs against overheating and prolongs their life (our own "marathon test" here: <http://www.elektromodellflug.de/ladeverfahren.htm>). We got following results: fully charged GP 3300 NiMH was warm a little bit (ab. 36°C) after 44 minutes and 1.5C (5A) of charging current. Who wants higher temperatures, should raise current to 2.7C. For tested GP 3300 it was 8.8A. Result was exceptional short time of conservative charging of this pack – temp. ab. 45°C, This is achieved for a cost of small (measured) drop of capacity (ab. 2-4%) which in practice is not essential. When we add discharge impulse, Pulsar 2 is charging in real reflex mode against his counterparts, whose are using only discharge impulse calling it "reflex mode". However, inflex mode yields place

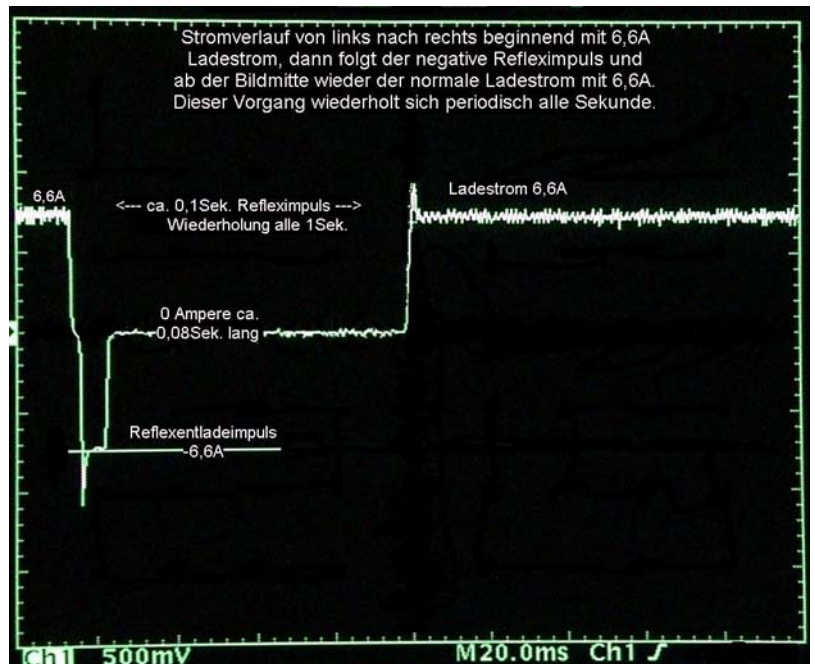
for conventional dP. Diagram shows results of comparison of different charging method for Pulsar irD (Inflex/Reflex/dP=high), Megra Reflexlader and automatic charger (Power Cube). This cycle is very well designed in Pulsar 2. Discharge impulse with ratio 1:2.5 (i.e.: charging 6.6A – 16A of discharging impulse) is a standard.

Fast/Normal charging of Li-Xx & Pb-Bat (Li-Ta & RAM)

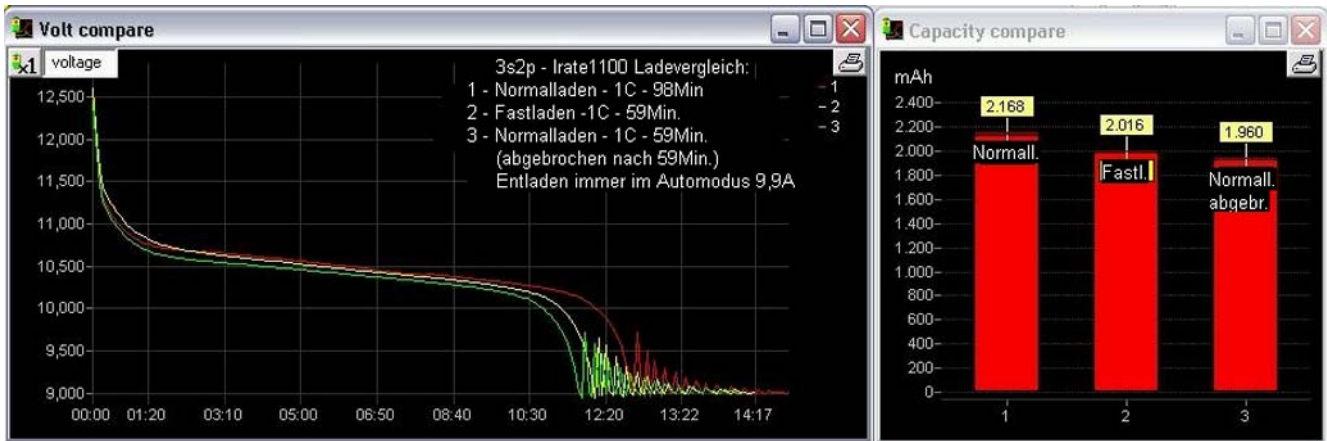
Main idea of "fast" mode is the best charging of accu pack in shortest period of time. Result, measured by me is time of charging shortened to 50 min, but it was achieved by pulse overloading of Li-Po cells until voltage measured between pulses reach 4.2V per



Charging of GP3000 pack in Inflex , Reflex with 8.2A



Pulsar: Reflex impulse



Comparison of Li-XX charge modes. Discharge always with 9.9A auto

cell. Simultaneously, final voltage in pulses reaches 4.3V per cell (max 12.85V for 3 cells). Maximal voltage claimed by manufacturers is 4.235V per cell (relatively 12.7V for 3 cells). Is very noticeable, that after fast charging, cells are "harder" which is visible on voltage curve diagram. Alternative for this would be standard, 1C charging interrupted, when charger reduce current to 1/2C or 1/3C. A diagram shows these 3 methods and their results.

Caution! We were assured, that fast charging have no negative impact on Li-Xx cells. Charging until final voltage is reached is identical, so please charge with current allowed by manufacturers – most common 1C. Please, don't use any balancers (which are reducing voltage) during fast charging, because charger can damage them.

Due to high accuracy of measured voltage, standard charging with balancers is not a problem. Measured charging voltage is 4.106V/cell for Li-Ion and 4.204V/cell for Li-Po. Maximal voltage for both types of Li-Xx cells can be reduced in charging program with steps of 0.01V in range from 4.2V to 4.0V. Standard charging of Li-Xx is finished when current drops to 0.2A.

Is it ok until we use cells with lower capacity (<0.8Ah) because we lose ab. 10% then. It would be better to use lower charging current (under 0.1A), so even cells with low capacity could be charged in 100%, what could allow serial connected Li-Xx cells to better balance of voltage. It's possible with lower current. I like number of cells recognition very much, which is raised to perfection in new version. I highly recommend for users of older version to update to 2.06. Final voltage for Pb batteries is adjustable in range 2.15 to 2.35V/cell which is perfect for gel cells and almost too careful for Pb-acid (2.4V), but not too low! Li-Tadiran and RAM cells weren't tested.

Discharge

Pulsar 2 can directly discharge with up to 35W of power or (using return of current to car battery) up to 250W of power with maximal current 9.9A starting from single Ni-Xx cell. Threshold voltages are very well chosen: 0.9V/cell for Ni-Xx, 2.7V/cell for Li-Ion and 3V/cell for Li-Po. There is "auto" discharging mode available, but it takes a bit longer time, because discharging current is slowly reduced until it reach 0.2A.

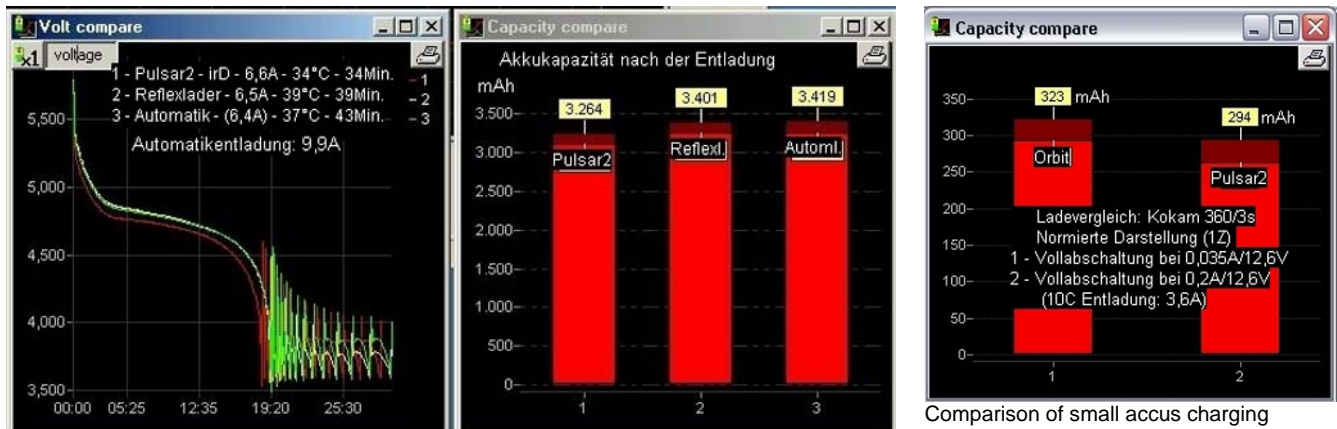
Discharged capacities are consistent with manufacturer's claims. In new Pulsars, return of energy to the powering battery is automatically reduced when voltage reach 15.3V/6 cells (2.25V/cell) to prevent overloading. It's highly recommended, to update older versions to actual v.2.06.

Test

Using chosen current we can measure of internal impedance (Ri) of cells. New version of Pulsar 2 allows to set current up to 4.A – max 35W (older Pulsars only 1A max), which give us realistic values of Ri with slight tendency to underrate the value. Anyway, this measuring helps to compare particular cells or packs charged with the same level. During this measurement, cells have to be fully charged or discharged. Lower Value of Ri in the same type of pack means better quality, better, voltage (in modeler's slang: "higher pressure"). Value of adjusted current should be 1C of single cell.

Pack forming

Time controlled 1/10C charging/discharging is the most commonly used method – a



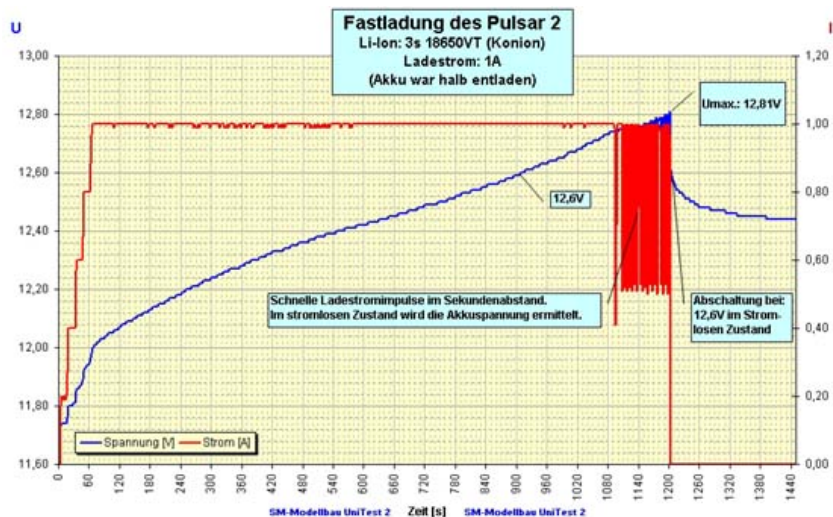
Comparison of charging between Pulsar 2 and Reflexlader (mega) - Automatiklader (PC)

Comparison of small accu charging (Kokam 360/3S)

today's standard, but additional cycle-regeneration and then discharging with higher current impulses – isn't! My worn out, 4 cells "extra-bad" pack was noticeable rejuvenated after three cycles. Unluckily, due to error I lost a diagram with cycle graph. These Sanyo 3000 NiMH had noticeable higher capacity ab. 0.23Ah (2.32Ah before and 2.55Ah after cycles). Until the end of tests, this capacity was held.

Software

Software installation goes without problems – the only thin, you should be aware of is setup of COM port. You have to choose an existing one; otherwise, the only way to correct is reinstallation of software and change in "config" file located in C:\temp folder. Software is very intuitive and all English menus are easy understandable. Very clear graphs show voltage, current, temperature and voltage increase mV/min. Few graphs can be placed on screen to compare. Voltage and capacity could be visualized on column graph. Export of data (for example to Excel) isn't possible. Results on graph can be shown recalculated for single cell. Progress curve can be zoomed in for better evaluation of problematic points. All graphs can be grouped (for multi cycle progress) and scaled. Resizing of "data window" isn't possible. Graphs visible here were taken from Graf-PC v.2.12 (on the end of test I got v.2.27 beta). Actually final v. 2.27 is available for free download on the Pulsar 2 web site.



Voltage graph of Li-XX charging in Fast mode

Conclusions

Pulsar 2 is really nearly an ideal charger (with minimal current limited to 0.2A), so I can highly recommend this charger. Usage of this device - which fulfills wishes related to charging/discharging - at home or at the field is very pleasuring. Price of 269€ for full set (incl. software, PC cable, temperature sensor) can help to make decision about purchase. Technical parameters that's not all. Service is very important as well, what was proven by Mr. Piotr Piechowski. Always

available and surprisingly spontaneous during solving of tests problems. He also announced continuation of works to make Pulsar 2 more perfect, which was realized during the test period yet! In the time of publication of this test, v.2.06 of Pulsar 2 will be available in the market.

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