The article was published in 11/2003 issue of modelers magazine “RC REVUE”

Pulsar I – a Polish pike on Czech market

PRODUCER : ELPROG, SŁAWOMIR KRYMSKI, POLAND

We, constructors and model makers, got used to the thought, that all electronic devices we use are made in Western Europe, USA or countries like China or Taiwan. But this time we had a chance to look at a charger made by Polish company Elprog – totally unknown in our country – kindly delivered to us by Jispro from Ostrava . At first we were quite distrustful to it but after a while this changed into huge respect and admiration owing to a load of features this charger has. Let’s see it in details.

Pulsar is a microprocessor-based rapid charger, designed to operate with a large variety of batteries: from NiCd and NiMH through Pb to Li-Ion and Tadiran. It can charge and discharge batteries consisting of 1 to 16 cells with an admirable current of 8Amps. Although it does not recognize number of cells and control charging current fully automatically, a bunch of tricks suggests to call it a semiautomatic charger. The package we have tested includes also detachable thermal sensor and a PC programme, which is used to visualize charging process.

When we saw this charger for the first time we noticed some contradictions in it’s design and workmanship. On one hand the top of the charger is dark and plain with brief description in Polish. On the other there are laser-cut ventilation holes and a fancy Pulsar logo.

Pulsar has a 2x16 characters, backlit LCD display with fantastic contrast, which is covered by a bit protruding, but well glued material. It is definitely a best solution, because after even a short period of time plexi will be scratched and protruding edges will be damaged. Backlit is on only when we work with the charger and turn of after few seconds.

Below the display there are four keys (beginning from the left): “E” – setting and confirming values (Enter), “+” i “-“ – changing current value of the parameter, “M” – gives you the info box describing current activities. . Description of the keys on a case are placed to far to the left, but apart from this LCD “shield” is symmetrical. Next to the control keys there is a small hole and when you look inside of it you will find a small trimmer. We couldn’t found any information about its purpose but producer states that it can be used to control contrast of the LCD.

In the right side panel of the charger there is a fan guard and behind it, inside the case there is a fan, which blows air inside. On the right side of the charger there are three connectors: one is for thermal sensor, one for supplying additional fan and a DB9 connector, which enables communication with a computer. Both sides of the charger have a colour of aluminium alloy without finishing surface treatment.

A glance at the back of the charger, which is also a radiator for FET transistors, gives the impression of a negligent, amateur product. Two parts of the case are screwed together around perimeter, there is a thermal conductive paste coming out of the holes.

On the bottom of the case there are small but very functional stands, which prevents charger from sliding off smooth surfaces.

Interior of Pulsar is clean, precise and amazingly simple. There is a huge toroidal coil of a DC-DC converter, which dominates the space inside the charger. Cooling of the charger is incredible in its simplicity and efficiency: a stream of air from the intake fan flows round FET radiators then converter’s coil and leaves through the openings in the bottom-left part of the case.

Pulsar charger uses Microchip microprocessor, PIC16F873 with a built-in, programmable Flash memory. There is no IC socket for it, the chip is soldered directly to the board. There are no further information in the manual whether it is possible to reprogram the chip in future (update of the firmware) or not but as far as manufacturer states it can be done via a connector used for communication with display.

After turning the charger on you are asked to set global settings. However, there are only two of them: first one is switching on/off sound signal and the other is adjustment of the minimum input voltage level (10 to 12V, in 0,1V steps), which protects supply battery from discharging. Maximum input voltage level is fixed and set on 16V. These settings are saved in non-volatile memory, which means they are remembered even if the charger is turned off and they are loaded at each start of the device.

When charging NiCD or NiMH batteries you have two modes to choose from. In the *Simple* mode batteries are charged with a constant current, whereas in *Reflex* mode there is also short pause and a compensatory discharging pulse. Using *Reflex* mode gives much clearer characteristics of charging process and observing a specific part of it is much easier, especially for cells in a bad condition. This method of charging batteries is in many ways better than *Simple* mode but at the cost of being 10% slower. However, it is worth mentioning that this mode is rarely available in "entry-level" chargers – only more expensive products are equipped with this feature.

Charging current can be set from 0.1A to 8A and efficiency is limited by capability of the converter. By pressing "+" or "-" button you can quickly set value of current. When the maximum/minimum value is exceeded it automatically starts from the beginning/end. It means that after pressing "+" for a while, instead of setting current for maximum value, we end up on 0.1A current, what is a bit illogical.

In both charging modes you can decide whether to detect voltage drop with higher or lower accuracy but an explicit value is not shown. This feature allows to finish charging process in the inflexion point of voltage characteristic before voltage starts to rise. It means that on one hand we will not use a whole available capacity and on the other it will significantly reduce growth of pressure and temperature in the cell at the end of charging process.

If we want to charge batteries very fast we should choose *Reflex* mode, finish at inflexion point and raise the current. During our test we managed to charge Sanyo battery, model Cadnica N-500AR with such settings and current set on 8A (equivalent of 16C in this particular test!) in less than 5 minutes (4:20s) and reached 95% of its capacity (measured after the test). Of course, it was warm, but its temperature was not much higher than while conventional charging with 2A (4C) current with voltage drop detection. However, I do not know if such brutal treatment is possible with every battery.

The active cooling of the charger works really terrific. The fan works only when it is really necessary, it has soft on and off and it can change its rate of rotation. It is not coincided with charger activity program, but it controls internal temperature of the charger very effectively. It runs silently, without vibrations. Openings in the bottom of the case, through which it sucks in air, are very useful.

Charging starts when we choose the mode for connected battery. At first there is a short connectivity test with countdown timer and afterwards charging starts with low current at the beginning and reaching the demanded value during the first minute. We can speed up this whole procedure and charge with demanded current from the beginning by pressing "E" button. We should use it also when we want to force start charging battery protected with a diode (typical for RC transmitters).

Pulsar detects level of charge right from the beginning, so even when we accidentally connects to it fully charged battery it will not do any harm because whole process will finish

in one minute. On the other hand, this could be the beginning of detection of undulated voltage drop. I managed to create such an incident by setting current to 4C and connecting previously discharged and cooled down accumulator.

In our tests Pulsar performed very well also with only one NiCd cell charging it with maximum current of 8A. It is possible to charge with such high current up to 12 cells – a battery consisting of 16 cells was charged with 4A current. There were also no problems during charging of NiMh batteries, no matter what mode (NiCd/NiMH) was chosen. It is probably caused by the fact, that by choosing type of battery we determine only the expected voltage drop, and if charging ends in *Inflex* point we are not able to see the difference.

Pulsar automatically detects number of cells and presents the result on the display. However for deeply discharged or fully charged batteries the result may be wrong. In such situation you should correct number of cells by pressing "+" or "-" button. Although this parameter is not very important for charging NiCd/NiMH batteries, it is important to monitor it when charging Pb or Li-Ion batteries.

Charging current for Pb, Li-Ion and Tadiran batteries is limited in comparison with that for NiMH/NiCd ones, and ranges from 0.1 to 3A. The manual does not distinguish Li-Ion and Li-Pol cells with the same nominal voltages. Batteries are charged with current at constant voltage until threshold voltage is detected and then charging current is reduced. In *Fast* mode we have pulse current control, what makes it two times faster then normal mode. This feature is very interesting and convenient for modern devices with Li-Pol accumulators.

During our tests Pulsar worked flawlessly with Pb batteries ranging from 4V/1Ah to 12V/40Ah, also Li-Ion and Li-Pol accus from 500mAh to 2Ah were not a problem for it. We have tested it even with old cells with extended internal resistance – charging lasted a bit longer but apart from this everything was perfect. No tests were performed with Tadiran batteries.

Charging is finished, when current falls below 100mA. This simple rule is very useful when charging commonly used Li-Pol batteries or smaller Pb ones, but for 20Ah Pb accu the last part of charging process may last up to maximum time of 14 hours.

Once charging process is started it can not be stopped by pressing any button, the manual recommends quick disconnection of the charged battery. Once charging (discharging) is finished LCD starts to blink and shows previously measured values. If the charger changes its activity i.e. from charging to discharging during execution of previously specified number of reconditioning cycles, LCD is automatically backlit and there is a silent beep.

Very interesting and technically advanced subject is discharging of NiCd/NiMH accus. By measuring voltage on the connected battery the charger detects number of cells (which we can correct if it is necessary) and after soft start it begins to discharge it with desired current until voltage of 0.9V/cell is reached.

Pulsar charger is able to dissipate 30Watts of heat, so with the current of 8A it is able discharge 1 to 3 cells. It can discharge with full current until minimum voltage is reached even a single cell, what is rarely seen in many other chargers! If you turn on *Reverse* mode DC-DC converter works in reverse way, which means it transfers energy from battery to the supply accumulator. Discharging current is limited by power of the converter. In practice it means that you can discharge with 8A current up to 12 cells and temperature of the charger will be still normal. For 16 cells maximum discharging current is 6.7A.

Although this method of discharging have been used for some time and makes a big difference in terms of achieved parameters and power saving, usually only the most expensive chargers have been equipped with it. However, it should be used carefully and you must remember that if Pulsar is powered from power supply you can not use this function at all. Also if the supply battery is fully charged and you start discharging in *Reverse* mode, voltage on it will rise very quickly and gassing of the supply battery will start. In such

situation the charger will end discharging when voltage on the supply exceed 15.1V. In practice it happens not too often and short gassing will not damage an accumulator with liquid electrolyte.

Another interesting feature of discharging process is automation of current control. Pulsar discharges with preset current until threshold voltage is reached but does not finish at that point. It reduces current by 25% and repeats cycle until discharging current is lower than 100mA. Automation of discharging guarantees that the battery is empty and until now it was available only in devices with full automation.

There are few tricks that can make discharging more universal, for example if you want to measure capacity of a Pb battery with nominal voltage of 12V and minimum voltage 1.8V/cell. You should connect it, choose discharging NiCd batteries and set number of cells to 12 (12 x 0.9V = 10.8V = 6 x 1.8V) – discharging and measuring will proceed without any complications.

Another trick gives an opportunity to use Pulsar as a temporary charger for car battery (or any standalone car battery you have on an airfield). For this purposes available current of 3Amps is a bit too low, so you should connect the charger to a discharged car battery (it has got to have output voltage higher than 10V) as if it was a supply battery. To the output of Pulsar you should connect another, charged battery (or power supply with suitable power output) and start discharging at full current with *Reverse* mode on. Energy is transferred back from the charger and quite fast makes the battery usable again. However, if you don't disconnect it manually and let it last too long, it is possible you will damage the battery. This "connection trick" have been tested with full success, but consider it a presentation of possibilities – the charger have not been designed for such usage and it may damage power supply if you use one. On the other hand the manual does not forbid this.

Another function embedded in Pulsar charger is formatting of NiCd/NiMH batteries. In this mode charger performs demanded number (1 to 8) of discharge-charge cycles with preset current. Discharging is performed in *Auto* mode and charging is performed in *Simple* mode.

A similar function is reconditioning - it also consists of demanded number (1 to 8) of discharge-charge cycles. However, in this mode discharging is performed in two cycles: *Auto* mode until 0.9V per cell is reached and next with constant current of 100mA until 0.6V per cell is reached. Charging is performed in *Reflex* mode. This mode is recommended for brand new or heavily worn out batteries.

Temperature control is the only thing I have found questionable. The manual does not say if the temperature sensor is for informing purposes only or that it has any influence on functioning of the charger. I have heated the sensor to a stable 70˚C and waited about three minutes, but nothing changed in charging process, although the displayed temperature was correct.

Pulsar charger is shipped with user's manual in Polish and English and a CD. The Czech translation I had, was only for the time of testing on my disposal. On eleven pages of the manual you can find information regarding all features of the device. Text is legible, rather comprehensible, perfectly translated and properly ordered. For each mode (always in separate column) there is a graph with explanation of all symbols and description of programming. However, inexperienced user might come across some issues, because technical terms are not always clarified and description are often short.

You will not find in the manual detailed information about functions or restrictions of the charger, there is only basic information regarding handling and maintenance of the charger. The manual is lacking the unambiguous description of short-circuit and reverse-polarity protection or limits of current value depending on number of cells and a description of PC software is summarized in two lines.

On the added CD you can find a program, which can draw graphs, print and save the whole process of charging or discharging. It works under Windows and its disk usage is around 800kB. However, neither the program nor the manual reveals its hardware requirements and does not explain which Windows version it supports.

The program presents current values of voltage, current, voltage time derivative (*dV/dt*), temperature and energy consumed (returned) in a status box. First four parameters are displayed on a graph curves makes and presentation of temperature and voltage time derivative (*dV/dt*) can be turned off. Scale of the graphs changes automatically, so the curves always fill the entire space. Apart from continuous monitoring the program allows saving measured data and opening older ones.

The opportunities of loading data to a computer are sufficient, but as for supplementary functions extremely scanty. I tried to load many saved graphs into one window, in a same scale and compare them. It is possible to use measured data in other programs, loaded data in 5 seconds are in plain text format and in such format it is very easy to use them i.e. in Excel. It is simple, but you have got to find it on your own, because the manual and the program says no word about it.

In the title I compared Pulsar (and accidentally its producer too) to a pike on our market, but I have to add that it is a very young pike. A pike, which has only just started to look around, but it is quite clear that it can grow up unexpectedly and become a strong and talented predator.

When I was preparing this article I expected to find many tiny shortcoming in Pulsar I, and that is partially true, but I must admit that all of them are just a minor mistakes with no influence on functioning of the charger. We have also noticed many advantages, which are very rarely seen in this price section. Chargers with the same current range for charging and discharging, supporting many types of batteries with many cells, *reflex* charging, detection of *inflex* point, automation of discharging, *reverse* function, formatting mode, communication with PC are not hard to buy but their price is two or three times higher.

For those, who want to have an equipment with certain quality and do not pay to much attention to a brand, Pulsar can be a very serious competitor for leading “western” devices of that kind. And you can get it for a very reasonable, “entry level” price. However, it may happen that when Czech modeler shows no interest in the charger, producer will withdraw Pulsar from market. Or it can also happen that Pulsar I will become a star on the whole European market, hopefully without much price increase.

JISPRO Company (www.mujobchod.atlas.cz/jispro)
sells Pulsar I charger for 6900Kc.

Ing. Michal Cerny

(Importer, JISPRO Company did not have any reservations about this article)

THE ARTICLE WAS TRANSLATED WITHOUT ANY CHANGES OR ADDITION IN THE TEXT.

Translated from Czech to Polish by Ludmir Rogalski, 2003-11-20

Translated from Polish to English by Adam Marynowski, 2004-01-20