

## PULSAR 2+ V10



**PULSAR 2+** is a fast, microcontroller-based charger suitable for use with various types of batteries. Special design of hardware and software makes it possible to charge batteries with high currents without risk of damage and in some cases even improving their durability. During charging process all important parameters are displayed on LCD and transmitted via serial port (RS232) to a desktop computer. Additional software allows visualization of changes in voltage, current, voltage time derivative and temperature during whole charging process which allows user to determine precisely status of batteries and decide whether they need conditioning or not. A data communication between **Pulsar 2+** and **Pulsar-EQUAL** Equalizer (Balancer) is possible and increases the safety of working with Li-Xx packs. Firmware of Pulsar 2+ can be updated via serial port.

Technical specification	
Supported accu types	Ni-Cd, Ni-MH, Pb-bat, RAM, Li-Ion, Li-Pol, Li-Tadiran, Li-Ph ( <i>Li-Ion FePO4</i> )
Supply voltage	10 – 16V DC ( car battery min 30Ah - 100Ah recommended) or power supply 14V/40A)
Input power	max 400W, adjustable in 50 – 400W range
Low voltage alarm level (and switch off)	min 10,5 – 12V adjustable in <i>Setup</i> menu max 16V
Charging voltage	0.5 - 60V 1 up to 32 cells Ni-Cd
Charging current	200mA – 12,0A (350W)
Discharging current	200mA – 12,0A (250W) with energy return 200mA – 12,0A (50W) with heat dissipation
Temperature measurement	0 - 99°C with 0,1°C accuracy
Voltage measurement	0,1 – 60V
Current measurement	0,1 – 14A
Time measurement	Up to 14 hours
Max voltage on supply battery	<i>Revers</i> - On 15,3V

# Starting-up Pulsar

PULSAR charger is designed to work with car battery, but it is possible to use it with DC power supply with output voltage 12-14V and output current at least 5A (40A recommended).

Red cable +12V

Blue cable -12V, ground

There are three connectors on the left side of the device:

- temperature sensor connector (and **Pulsar Equal** communication socket)
- cooling fan connector (max. 1.2A) – for cooling battery pack
- serial port connector (RS232 – DB9) – to connect to PC (9 pin)

After turning the charger on you can enter **Setup** by pressing ‘**M**’ key and switch on/off sound signal and adjust minimum input voltage level, which protects car battery from discharging - if supply voltage fall below desired level charging is stopped and alarm is being initiated (protection against excessive discharge of car battery).

Pressing **Start** (‘**E**’ key) takes you to the main menu.

P	U	L	S	A	R	2	+	V	1	0		
S	t	a	r	t				S	e	t	u	p

Mode	Key	Action
Start	E	Main menu <i>Mem 1-8.; Store; Format; Test</i>
Setup	M	Global parameters: 1. <b>Bib On/Off</b> – sound signal (+, -); E 2. <b>T max On/Off</b> – thermal protection (+, -); E • <b>T on</b> < from 30 to 45 °C – start on T<Ton (+, -); E • <b>T off</b> < from 50 to 65 °C – interrupt on T>Toff (+, -); E 3. <b>P low On/Off</b> – power restriction (+, -); E • <b>Power</b> from 50 to 400W – power restriction on the power input (+, -); E 4. <b>Voff</b> from 10,5 to 12,0V – minimal voltage (+, -); E

(+, -); E - choose a parameter with ‘+’ or ‘-’ keys and confirm selection with ‘E’ key.  
Adjusted parameter is blinking on LCD panel.

**T max On** – Start analyzing temperature Ton and Toff.

Ton – if battery pack temperature exceeds adjusted **Ton** temperature, process will start only after cell temperature falls to **Ton** temperature.(forced start using “+” button).

Toff – if battery pack temperature exceeds adjusted **Toff** temperature, process will be stopped and sound alert is being generated.

**P low On** – switch on power restriction to the value adjusted in the Power parameter. This function is useful when using not powerful enough power sources. Charger will automatically restrain charging current to avoid exceeding of adjusted power.

## Current adjust and limiter function

Briefly pressing **E** key you can change process current. If it's the complex process (Dis/Ch. discharging/charging) different current value can be set.

D	i	s	c	h	.	1	2	,	0	A	R	A	
-	-	,	-	A	h	L	i	-	l	i	o	n	8

In current adjust mode it is possible to set the maximal battery pack capacity (0,1 – 24.0 Ah),When it is reached the process will be terminated – *limiter*. After the “**M**” key is pressed, +,- keys are used to change value. “**E**” key is used to confirm selection (--,-Ah means function isn't used).

## Process Initialization

Right after connecting packet to charger, connection test will be started. Next, charger estimates the number of cells in the packet. If battery pack is charged or excessively discharged number of cells should be corrected (+,-). Confirmation with **E** key will start appropriate action, depending on currently chosen mode.

D	i	s	c	h	.	1	1	,	6	V	R	A		
S	t	a	r	t		0	3	L	i	-	l	i	o	n

## Process finish

Process finish is signaled by blinking the data being displayed, blinking of display and sound signal (short beeps). After 30s beeps are replaced by silent “knocking”. Display shows last data measurement results

Reprocessing of the same battery pack is only possible after reconnecting of that pack!

## Main menu (battery is disconnected)

Main menu contains 11 windows.

- M 1-8 process memory, storage, format/regeneration and battery test

## Process memory M1-8

Memory number – at the bottom-right corner of display.

There are 8 memories. Each can save:

### Process parameters

Main parameter is charging/discharging current. In the complex processes (discharging/charging, charging/discharging) there is a possibility to set up different value of charging/discharging current.

### Work mode

discharging – *Disch.*, charging – *Charge*,  
discharging /charging – *Dis/Ch.*, charging/discharging – *Ch/Dis*.

### Cell type

Ni-Cd, Ni-MH, Pb-bat, RAM, Li-Ion, Li-Pol, Li-Tadiran, Li-Ph

## Information window (battery is disconnected)

To open information window press the **M** key.

V	b	=	1	2	,	5	V	T	c	=	2	3	,	7
	M	e	m					2	,	1	3	1	A	h

Vb=12,5V - supply voltage  
Tc=23,7 - battery pack temperature (--,- - sensor not connected)  
Mem - saved data from 8 previous processes  
2,131Ah - energy load measurement from last process (“-” means discharging)

To read data from 8 previous press the **E** key.

M	8					1	6	N	i	-	C	d	
	M	e	n	u		-	2	,	1	3	1	A	h

M8 - memory nr 8  
16 - cells number  
Ni-Cd - cells type  
Menu - return to main menu (E)  
-2,131Ah - energy load, mark (-) means discharge

Info.	Keys	Function
Battery disconnected	+ or –	Program change
	M	Information window
Info window	M	Return to main menu
	E	saved data from 8 previous processes
Saved data	+ or –	Change memory cell
	E	Return to main menu
	M	Return to information window

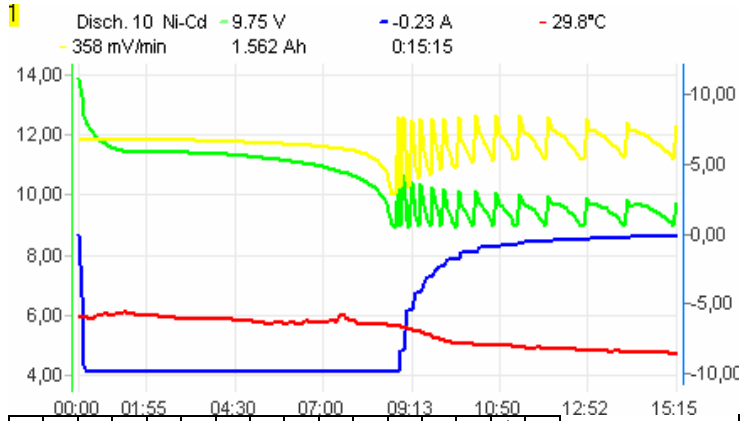
# Discharging *Disch.* (0,2 – 12,0A; *Revers, Auto*)

D	i	s	c	h	.	1	0	,	0	A	R	A	v
-	-	,	-	A	h				N	i	-	C	8

R - *Reverse* mode is ON

A - *Auto* mode is ON

V/v - Changed voltage values *Vend* (no letter – recommended value; **V** - higher, **v** - lower)



Discharging lasts until battery voltage reaches threshold voltage for given cell type. In *Auto* mode current is decreased by ¼ each time the threshold voltage is reached. Discharging process ends when discharging current is less than 200mA. *Reverse* mode – energy from discharging battery is transferred back to the supply car battery.

D	-	1	0	,	0	A	7	,	2	V	↓	E		
0	0	:	1	2	:	3	4	2	,	0	1	5	A	h

Every 5s

0	8	-	1	0	,	0	A	7	,	2	V	↓	E
V	b	=	1	3	,	5	V	4	4	,	7	°	C

Bold 'A' after beside current value indicates that charger has limited current due to maximum power.

- D - discharging
- 10,0A - actual, measured current
- 7,2V - actual, measured voltage
- ↓ - marker of voltage drop
- E - marker of current limit (blinking)
- 00:12:34 - time passed from the process start
- 2,015Ah - discharged energy

- 08 - 8 cells
- Vb=13,5V - power supply voltage
- 44,7°C - battery pack temperature

Disch.	Keys	Function
Battery disconnected	+ or -	Program change
	E	Current adjustment (+, -); E; M <i>Limiter</i> (+/-) capacity adjustment
	E (1 s)	Remaining parameters adjustment <ol style="list-style-type: none"> <li><b>Revers</b> <i>On/Off</i> – energy return to the car battery(+, -); E</li> <li><b>Auto</b> <i>On/Off</i> – auto current decrease (+, -); E</li> <li><b>V end</b> – threshold voltage adjustment (+, -); E</li> </ol>
	M (1 s)	change work mode and cell type
	M	Information window
Battery connected	E (1 s)	Process interruption
	M	LCD backlight

### Important notices:

Maximum duration of this process is 14 hours.

You must NOT use *Reverse* function when powering Pulsar with DC power supply!

While working in reverse mode (reverse – on) discharging current will be limited if voltage on supply battery exceeds 15,3V (protection from overcharging)

V end – threshold voltage can be decreased by 200mV or increased by 100mV with 10mV steps.

V end – threshold value corresponds to the single cell voltage.

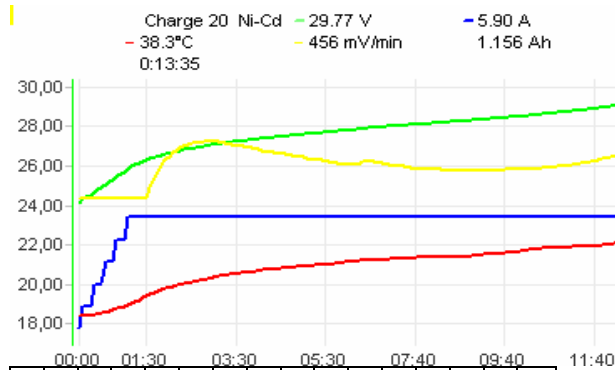
# Charging Ni-Cd & Ni-MH (0,2 – 12,0A; Inflex, Reflex, Delta peak)

C	h	a	r	g	e			8	,	0	A		i	r	d
-	-	,	-	A	h			N	i	-	C	d			7

i - Inflex mode is ON

r - Reflex mode is ON

D/d - Delta value is changed (no letter – recommended value; **D** - higher , **d** - lower)



Charging ends when voltage drop ( $-\Delta V$ ) or inflex point is detected.

The *Inflex* mode allows finishing charging process before unnecessary heating of charged battery (inflex point marker – vertical line on the current graph).

The *Reflex* mode makes it possible to recharge batteries and avoid *memory effect* (charging with short compensatory discharging pulse)

C				8	,	0	A		1	2	,	9	V	↑	i
0	0	:	1	6	:	0	0		2	,	3	2	6	A	h
Every 5s															
0	8			8	,	0	A		1	2	,	9	V	↑	i
V	b	=	1	2	,	1	V		4	0	,	0	°	C	

A bold 'A' beside of current value indicates that charger has limited current due to maximum power reached.

- C - charging
- 8,0A - actual, measured current
- 12,9V - actual, measured voltage
- ↑ - marker of voltage increase
- i - marker of inflex point being reached (blinking)
- S - marker of slow start mode (blinking)
- 00:16:00 - time passed from the beginning of process
- 2,326Ah - energy loaded

- 08 - number of cells
- Vb=12,1V - power supply voltage
- 40,0°C - battery pack temp.

Charge	Keys	Function
Battery disconnected	+ or -	Program change
	E	Current adjustment ( + , - ); E; M <i>Limiter</i> (+/-) capacity adjustment
	<b>E</b> (1 s)	Remaining parameters adjustment 1. <b>Inflex</b> <i>On/Off</i> – stop charging at inflex point ( + , - ); E 2. <b>Reflex</b> <i>On/Off</i> – equalizing impulse ( + , - ); E 3. <b>Delta</b> – value adjustment $-\Delta V$ ( + , - ); E
	<b>M</b> (1 s)	change work mode and cell type
	+ or -	*forced start
Battery connected	M	Information window
	<b>E</b> (1 s)	Forced process interruption
	+	Exit of slow start mode (only when S is blinking)
	M	LCD backlight

## Important notices:

Maximal duration of process - 14hours

\*) Forced start – to charge battery packs protected by diode (like RC transmitter). Reflex function will be automatically disabled! Charging currents > 1,2 A should not be used.

Delta Ni-Cd – recommended 4,0mV per cell; adjustable in the range of 1,0 to 15,0mV by 0,5mV .

Delta Ni-Mh – recommended 8,0mV per cell; adjustable in the range of 4,0 to 25,0mV by 0,5mV .

Delta – value  $-\Delta V$  is meant “per single cell”.

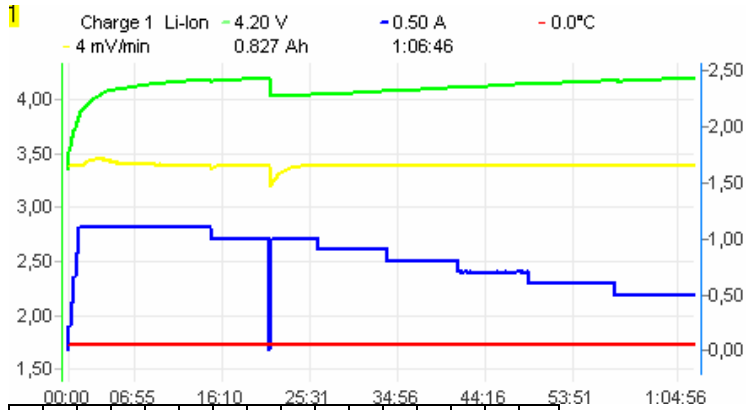
# Charging PB-bat, RAM, Li-Ion, Li-Pol, Li-Ta, Li-Ph. (0,2 – 12,0A; Fast, Reflex, V end)

C	h	a	r	g	e			6	,	0	A		F	r	v
-	-	,	-	A	h			L	i	-	P	o	l		6

F - Fast mode is ON

r - Reflex mode is ON

V/v - voltage value V<sub>end</sub> changed (no letter – recommended value; V – higher, v - lower)



Charging ends when threshold voltage is detected and simultaneously charging current is decreased to 1/10-th (1/5-th for PB-bat) of adjusted value. When Fast mode is on charging current is controlled with pulses, which makes it possible to reduce charging time more than twice. Current limitation can occur when voltage overstep maximal value for given cell types.

C				1	,	0	A					8	,	2	V	E		
0	1	:	2	3	:	2	5					1	,	2	9	8	A	h

Every 5s

0	2			1	,	0	A					8	,	2	V	E	
V	b	=	1	2	,	5	V					2	3	,	7	°	C

A bold 'A' beside of current value indicates that charger has limited current due to maximum power reached.

C - charging

1,0A - actual, measured current

8,2V - actual, measured voltage

E - marker of current decreasing (blinking)

S - marker of the slow start mode (blinking)

01:23:25 - time passed from the start of process

1,298Ah - energy loaded

02 - number of cells

Vb=12,5V - power supply voltage

23,7°C - battery pack temp.

Charge	Keys	Function
Battery disconnected	+ or -	Program change
	E	Current adjustment (+, -); E; M Limiter (+/-) capacity adjustment
	E (1 s)	Remaining parameters adjustment 1. <b>Fast*</b> On/Off – fast charge (+, -); E 2. <b>Reflex</b> On/Off – equalizing impulse (+, -); E 3. <b>V end</b> – value of threshold voltage (+, -); E
	M (1 s)	change work mode and cell type
	+ i -	forced start
	M	Information window
Battery connected	E (1 s)	Forced process interruption
	+	Exit of slow start mode (only when S is blinking)
	M	LCD backlight

## Important notices:

Maximal duration of this process is 14 hours.

Reflex makes charging period of constant current charging longer (it can result in charging process shorter), decreases effect of sudden internal resistance raise, allows higher charging current to be used.

\*) Function can't be used when cell balancer (using current limit method) is connected. The only allowed balancers are those equalizing voltage during charging. We highly recommend using **Pulsar EQUAL** from ELPROG.

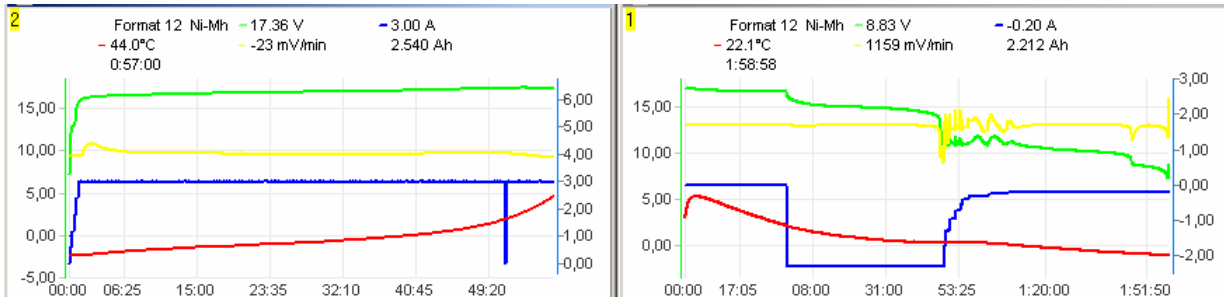
V end – threshold voltage can be decreased by 200mV or increased by 100mV with 10mV steps.

V end – threshold value is meant for the single cell voltage.

# Formatting / Regeneration *Format* (0,2 – 6,0A; cell type, *Regen.*, *Cycle*)

F	o	r	m	a	t			1	,	8	A		*	8	C
-	-	,	-	A	h			N	i	-	C	d			

\*8 - no. of cycles – 8  
 C - *Regeneration is ON*



Formatting a battery means to perform demanded number (1 to 8) of discharging-charging cycles. Discharging is performed in *Auto* mode until threshold voltage is reached, which depends of cell type. Reconditioning a battery – special formatting mode which allows repairing the battery.

F				1	,	8	A		1	2	,	8	V		i
0	1	:	1	0	:	0	4		2	,	0	8	2	A	h

Every 5 s

0	8			1	,	8	A		1	2	,	8	V		i
V	b	=	1	2	,	5	V		3	6	,	6	°	C	4

A bold 'A' beside of current value indicates that charger has limited current due to maximum power reached.

- |          |   |  |          |   |                      |
|----------|---|--|----------|---|----------------------|
| F        | - | formatting   | 08       | - | number of cells      |
| 1,8A     | - | actual, measured charging or discharging (-) current | Vb=12,5V | - | power supply voltage |
| 12,8V    | - | actual, measured voltage                             | 36,6°C   | - | battery pack temp.   |
| 01:10:04 | - | time passed from the start of process                |          |   |                      |
| 2,082Ah  | - | energy loaded or discharged                          |          |   |                      |
| C4       | - | number of remaining cycles                           |          |   |                      |

Format	Keys	Function
Battery disconnected	+ or -	Program change
	E	Current adjustment (+, -); E; M <i>Limiter</i> (+/-) capacity adjustment
	E (1 s)	Remaining parameters adjustment 1. <b>Cells type</b> (+, -); M or E 2. <b>Regen. On/Off</b> - cells regeneration (+, -); M or E 3. <b>Cycle 1-8</b> - number of cycles (+, -); E
	M (1 s)	change work mode and cell type
Battery connected	M	Information window
	E (1 s)	Forced process interruption
	+	Exit of slow start mode (only when S is blinking)
	M	LCD backlight

**Important notice:** Maximal duration of this process (1 cycle) – 2\*14 hours.

## Storage Store Lithium cells only (0,2 – 6,0A; cells type, $V_{end}$ )

S	t	o	r	e				6	,	0	A			v
-	-	,	-	A	h			L	i	-	P	o	l	6

**V/v** - Voltage value  $V_{end}$  changed (no letter – recommended value; **V** – higher, **v** - lower)

Lithium cells shouldn't be stored as fully charged (or, what's more critical, discharged). It is best to keep them charged to ab. 50-75% of their capacity or with voltage on the recommended for given cell type level (see: *Nominal voltage of cells* table)

Program *Store* adjusts voltage (by charging or discharging) to the recommended value (number of cells \* nominal voltage).

$V_{end}$  – threshold voltage can be decreased by 200mV or increased by 100mV with 10mV steps.

$V_{end}$  – threshold value is meant for the single cell voltage.

## Test (0,2 – 6,0A max 50W, cells type)

T	e	s	t					1	,	0	A			
								N	i	-	C	d		

Battery test is performed for each cell type at three steps.

- precise voltage measurement
- voltage measurement loaded with set circuit for 10 s.
- internal resistance measurement of the packet

Right after battery is connected exact voltage and no. of cells will be shown.

Next step is to correct no. of cells and start battery test by pressing **E** key (Start).

T	e	s	t					1	2	,	9	3	3	V	
S	t	a	r	t				1	0		N	i	-	C	d

T	e	s	t							1	,	0	A							
								0	,	0	0	0	Ω	1	2	,	5	5	8	V

10s test of battery under load using adjusted current and then 5s test using pulse load. After this test an internal resistance will be calculated.

After M button is pressed, internal resistance and voltage of single cell will be displayed.

**VC** - says that this value is calculated for a single cell.

T	e	s	t							1	,	0	A							
								0	,	0	3	2	Ω	1	2	,	6	3	7	V

T	e	s	t							1	,	0	A									
								0	,	0	0	3	Ω			1	,	2	6	3	V	C

You can re-run test pressing **E** button.

Battery's internal resistance measurement method is different than method used by cell producers. This could cause variance in received results. The resistance of wires connected to battery is not measured too (variety types of cables and connections exclude that possibility), that's way measurement of single cell could be affected with big error.

Internal resistance measurement should be regarded as a comparative measurement of multiple packets.

Measurement should be taken by the same cable.

## Alarm messages (sound alarm)

- Tc=50,0 - *Toff* („Tc=" blinking ) temperature is overstepped  
 Vb=16,0V high - supply voltage is too high („high" is blinking)  
 Vb=10,5V low - supply voltage is too low („low" is blinking)  
 VC=high - maximal voltage for single cell is overstepped („VC=" is blinking)  
 Ti =high - temperature of charger's heat sink exceeded („Ti=" is blinking)

**In those cases process will be stopped. Pressing any key will stop the alarm.**



## Cells parameters

	Ni-Cd	Ni-MH	Pb-bat	RAM	Li-Ion	Li-Pol	Li-Ta	Li-Ph
Name	nickel-cadmium	nickel-metal-hydride	lead-acid	alkaline	lithium-ion	lithium polymer	lithium tadiran	lithium phosphate
Voltage	1,2V	1,2V	2V	1,5V	3,6V	3,7V	3,0V	3,3V
Discharging voltage	0,9V	1,0V	1,8V	1,0V	3,0V	3,3V	2,4V	2,8V
Max. charging voltage	1,85V	1,85V	2,45V*	1,65V*	4,1V*	4,2V*	3,45V*	3,65V*
Charging current	0,2 – 2C max 4C	0,2 – 1C max 2C	0,1 – 0,4C	0,2 – 1C	0,1 – 1C	0,1 – 1C	0,1 – 0,4C	1-4C
no. of cells	1 - 32	1 - 32	1 - 18	1 - 26	1 - 12	1 - 12	1 - 12	1 - 14

\*- voltage can be decreased by 200mV or increased by 100mV by 10mV steps.

^~ similar as above (\*), voltage can be adjusted in the program Storage (*Store*).

C means capacity of a battery pack (1C for 2400mAh capacity is equal to 2,4A current).

Values shown in the table are characteristic for particular types of cells, but it is recommended to check which parameters are admissible by producer of the cell. Ex. to charge propulsive Ni-MH cells with 2C circuit battery needs to be cooled. Using *inflex* mode will decrease heat diffusion near the end of charging process. Generally propulsive cells (which small internal resistance) could be charged with higher circuit. Cells which are used with transmitter/receiver in RC devices should be charged with maximum 1,2A circuit. That restriction is a result of thickness of the wires used with that packets and construction of battery containers.

**Ni-Cd, Ni-MH** – The memory occurrence which appears in that cell types needs full discharging battery before charging process. That discharging process (*Auto* mode) should be done every 5 – 10 charges. One *Format* cycle with *Regen* function will give good effects.

Formatting new packets should be done with 0,2 – 0,3C (3 – 5 *format* cycles)

Regeneration of the packed should be done in 3 – 5 cycles with 0,2 – 0,5C (*Format, Regen - on*).

*Inflex* – On for currents over 1C and for no less than 4 cells.

**Li-Ion, Li-Pol** – each cell in packets could be parallel (to extend maximal circuits and capacities) and then serial connected to receive suitable voltage. Number of cells set up at charger is equal to the number of serial connected cells. For example for 2P3S packet (2 parallel and 3 serial connections) 3 cells should be set up. Cells (or groups of parallel connected cells) in the time of using could be discharging in various measure. That leads to considerable decreasing of cell capacity. Following discharging/charging cycles increases that occurrence. At the extreme cases this could damage or even auto-ignite the packet. To avoid that danger voltage at every cell should be measured time to time. When the differences in charged batteries are greater than 0.1 V it is recommended to charge each cell separately with maximal 0.5 C current and turned off *Fast* mode. It is possible to do 1 – 2 *Format* cycles with active *Regen* mode for each cell separately.

Regeneration of whole packets (*Format, Regen - on*) make sense only when cells are equated. This mode can improve parameters of used packet, but not as effective as regeneration of Ni-Cd packets. For some Li-Ion packets it is advised to charge them to 4,2V each cell.

**Li-Ph** (Li-Ion FePO<sub>4</sub>) – new lithium cells (lithium phosphoride) can be charged very fast and discharged using very high currents (some cells this type can be charged in less than 7 minutes). These are less sensitive for deep discharge and overcharge.

## Pulsar EQUAL - working in connection with ELPROG's equalizer/balancer

The main purpose of balancer is voltage equalization of single cells in the battery pack to avoid min/max voltage to be exceeded (max. during charging and min. during discharging). Connecting of **Pulsar Equal** balancer to the **Pulsar 2+** (using thermal sensor socket of **Pulsar 2+**) ensures communication link between both devices. It will allow to control voltage on each single cell in the battery pack (charge or discharge current will be reduced automatically by **Pulsar Equal**) during *Fast* charging. You'll find more detail in the **Pulsar Equal** manual.

# Graf PC software v 2.40

PULSAR charger supports serial port (RS232), which allows you to transmit data. Graf PC is capable of drawing graphs of changes during charging or discharging process. Analysis of voltage, current, voltage time derivative ( $dV/dt$ ) and temperature curves makes it possible to determine precisely status of batteries and decide whether they need conditioning or not.

## Installation

GraphPC is a Windows application. When you start GraphPC for a first time, you will be asked to choice serial port which is used to connect Pulsar Charger (COM 1- 11).

**Zooming and Moving the graph** – Press left mouse button and drag mouse to right-down direction. Rectangle will be drawn and view inside rectangle will be zoomed after the button is released. To move the graph move the mouse with pressed right button in needed direction. Double clicking left mouse button will return to default view.

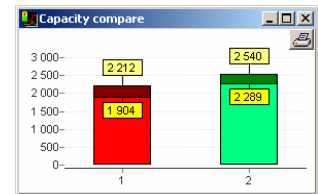
## Data Window - Displays numerical data

After clicking **Data** button window with numerical data will appear (voltage, increase of voltage, current, temperature, time and capacity). Pressing button with single cell icon, displays the voltage and the increase of voltage count for single cell.



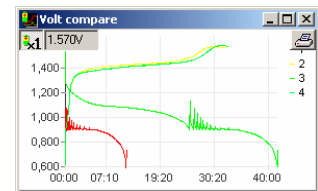
## Capacity comparison Window – comparison of battery capacity from several processes.

A column graph allows for quick data comparison, i.e. format or regeneration of packet. Red column shows discharging process (light red to the first change of voltage with *Auto* function). Green column shows charging process (light green to the inflexion point detection or first current decrease).



## Volt. compare Window - comparison of battery voltage from several processes.

When cursor is placed on the voltage line (cross hair cursor) and the left mouse button is clicked a value of voltage will be shown in the *Voltage* window. Pressing button with single cell icon, displays the voltage value of single cell.



**The T i dV Buttons** - turn on/off drawing the temperature and increase of voltage curves

**Rec Button** – Start/Stop of data recording

**Multisession record** – auto record of data being transmitted from device (i.e. from the format process.)

**Save All** (File name format - name#01.acp – where #01 is a number of the next saved window)

**Opening multisession files** – automatic opening all data i.e. from the format process.

Opening file saved as name#01.acp causes opening all files which the same name with numbers after ‘#’ sign.

**Graph description** – in each window with graph there is Txt button in upper right corner. After pressing it editor window emerges where data could be inserted:

Producer – name or type of cell

Capacity – packet capacity

User description – graph description

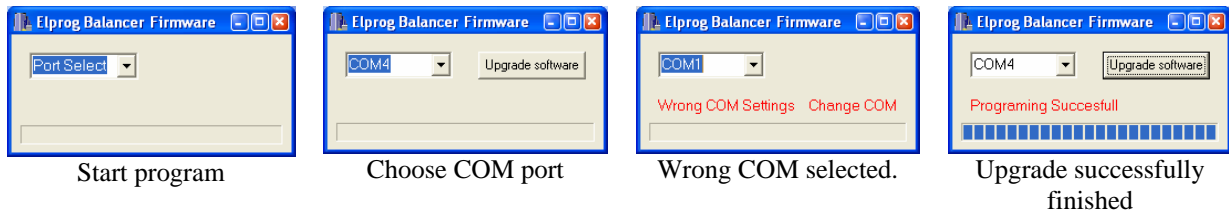
Data will be show after moving mouse over Txt button..

## Firmware – upgrade

Firmware of **Pulsar 2+** can be upgraded by user. To perform upgrade, first download firmware file (.exe) to the hard disk. To avoid problems you should close all other programs. Next, connect your **Pulsar 2+** to the PC using serial COM or USB-COM cable. Now, you can connect power source to the device.

### WARNING!

**Charger has to remain in the start-up mode – do not press buttons after power supply is connected! Any interruption of firmware upgrade or power loss can lead to the device damage!**



## Additional notices

- **To stop charging process, press the E key for 1s not by disconnecting the battery.**
- Disconnecting a battery pack during work should be as quick as possible. It is unacceptable to reconnect the battery pack without entering main menu of the charger.
- **Correction of cell quantity should be done always after start of charging process. It is important especially with Li-Ion, Li-Pol, Li-Ph, Li-Ta and Pb-bat cells, when battery is not fully discharged. Overestimate of the cells number will damage battery or even in some cases it could cause fire.**
- Analysis of Inflexion point and Delta peak starts after 2 minutes for Ni-Cd and 4 minutes for Ni-MH batteries. After that time period charging can be stopped automatically.
- **Pulsar** charger must be protected from water. You must not use **Pulsar** charger during the rain – water can get inside and cause severe damage.
- **Pulsar** charger must be protected from dust. Built-in cooler fan can draw dust into the device. Electronic parts can be damaged if there is too much dust in the charger. You must not use **Pulsar** charger laying directly on a sand, ground or grass.
- The openings in the case must never be covered or sealed. **Pulsar** charger works with heavy loads so it becomes hot - it is essential to provide proper ventilation.
- Do not replace power supply cables. These are designed to work with currents up to 40A.
- When using a car battery, you have to connect **Pulsar** directly to the car battery. It is not allowed to connect charger to the car lighter socket – this can severely damage car electric circuit.
- Make sure all cables connecting a battery pack are at least 2mm in diameter and are not longer than 20cm. It is related with sometimes high current and possibility of wires being excessively hot.
- **Charger should be used under supervision. Li-Xx batteries should be charged in fire resistant container and under permanent supervision. We recommend the Pulsar EQUAL which is optimized for using with Pulsar 2+.**

# Pulsar 2+ – first steps

**Pulsar 2+** is a professional device which needs proper handling. This information is provided to guide you through the first steps, to help to achieve routine in handling faster and to prevent from problems.

## Basic settings

After turning on, **Pulsar 2+** displays first menu, in which we can set basic functions, which are common for all process. To set them - press M key. Pressing E key you're moved directly to next level. Blinking parameter is selected for adjusting by +/- keys.

1. Turn on charger (battery not connected)
2. Press **M** (setup)
3. Bib on/off (acoustic signal on/off) choose required option using keys +/-
4. Press **E**
5. **T max** (temperature control on/off) choose required option using keys +/-
6. Press **E**
  - **T on** < (start temperature – after the battery will be cooled to this temperature process will be activated) choose required option using keys +/- (in range 30-45°C only if **T max** is -on!)
  - Press **E**
  - **T off** > (in this temperature process will be terminated) choose required option using keys +/- (in range 50-65°C only if **T max** is - on!)
  - Press **E**
7. **P low** – input power restriction lets you to use weaker power supply.
8. Press **E**
  - If **P low – On** , you can adjust:
    - Power = 150W Max input power (to remain on the safe side, don't set more than 80% of the power supply can deliver).
    - Press **E**
9. **V off** – adjusting of min. voltage level of the car battery to prevent from deep discharge (10,5V - 12,0V)
10. Press **E** to finish set-up

After step 10 you'll be brought back to the main menu.

## Process setup

This example shows setting up of Ni-Cd charging process.

1. Turn on the charger (battery not connected)
2. Press M (start)
3. +/- choose position (number) in memory in which we want to save process options
4. Press and hold M (over 1s) move to settings
5. +/- choose required process – in this example “Charge” charging
6. Press M
7. +/- choose required type of batteries (in this example Ni-Cd)
8. Press M

At this step we are in programmed process memory and if we don't want to change parameters, we can connect battery and start charging.

However, if you want to change or just check parameters:

1. Press and hold **E**(over 1s.)
2. Inflex on/off
3. Press **E**
4. Reflex on/off
5. Press **E**
6. Delta 8mV (Delta Peak – adjust value)
7. Press **M**

Now, you're again in the selected memory cell with adjusted parameters. Before you start charging is it possible to adjust charging current or battery capacity:

8. Press **E**
9. +/- set required charging current
10. if necessary set cells capacity\* (press **M** and with +/- set the demanded value, "--,-" - capacity control disabled)
11. Press **E**

Up to this moment we passed through all possibilities of setting up a process. Analogical, we can set up every other process (for example discharge). Serial processes (for example discharging/charging) are adjusted individually, that means we can set different parameters for discharge and charge. For example we are able to discharge and charge using different current values.

Beware of the basic rule: **M** button selects **WHAT** you want to do, **E** button selects **HOW** you want to do it. Brief pressing (below 1s) of **M** key opens information window (access to the last, 8 processes), brief pressing of **E** button changes value of current.

\*) Capacity adjusting of battery can be used as a "limiter". This function is really useful when we want, for example, prepare battery for a longer storage. Then we can charge previously discharged battery up to for example 10% its capacity. When process will reach properly set capacity (for example 240 mAh with 2400mAh battery) process will be automatically stopped.

Capacity setting can be also used as additional charging control. For this purpose we recommend to set capacity to about 10-15% more than battery has. Other way the battery may not be fully charged. **Caution** – this function is important when we are charging new (formatting) or long stored cells Ni-Cd and Ni-MH.

## Charging

1. Turn on charger (battery not connected)
2. Press **E (start)**
3. Choose the program memory number or set-up your process – described above)
4. Connect battery and if necessary +/- correct number of cells (**Caution!!!** – correct setting has impact on using safety!!!)
5. Press **E (start)** – **process initiated**

## Forced start

Battery packs built into various devices (transmitters, servo programmers etc.) are often secured from improper voltage polarity by built-in diode. If we connect such secured device (i.e. transmitter) to the charger, it won't be able to measure the voltage of cells or detect number of them. To charge batteries in this situation is it necessary start charging process manually. To do this Reflex function must be disabled (discharging pulses would be anyway blocked by diode). After choosing suitable process connect device to charger and then press +/- buttons simultaneously. Next, number of cells must be set manually and charging process started by pressing **E** key. **Caution** – battery voltage will be displayed with the 0,6 V diode voltage drop added to the measured value!

We highly recommend shorting this diode whenever possible (like Graupner transmitters). **Pulsar 2+** is protected against reversed polarity and can't damage transmitter. The advantage of this solution is access to all Pulsar 2+ functions (like reflex, discharge etc.).

**Caution** – we recommend to pay attention to acceptable maximal charging current (i.e. Graupner's transmitters: 1 – 1,2 A).

## Symbols and markers used by *Pulsar 2+*

1. --,-mAh - control of battery capacity is inactive
2. --,- C - control of temperature is inactive (sensor not connected)
3. ↑ - voltage increase marker (voltage is measured with resolution of 0,01 V !)
4. ↓ - voltage drop marker (voltage is measured with resolution of 0,01 V !)
5. **1 ... 8** – memory number
6. **A** – during discharge – *Auto* function is On.
7. **A** (bold) – current reduction by charger (maximal charger power was reached/passed)
8. **C1 ... C8** - Format – number of remaining charging cycles during battery formatting
9. **d** – Delta set lower than recommended
10. **D** – Delta set higher than recommended
11. **E** - flashing – current reduction initiated (near the end of process)
12. **i** – Inflex On
13. **i** - flashing – Inflex point detected (only, when Inflex is On – Pulsar is still charging if delta peak is used to finish charging process)
14. **r** – Reflex active
15. **R** – Reverse is active (return of discharged energy to the car battery)
16. **S** - flashing – Slow start active (charging current is slowly increased to the adjusted value)
17. **v** – Voff active (only for Li-xx)

## Recommended settings

1. **Inflex** - for Ni-Cd & Ni-Mh it makes sense to use it only when charged with current higher than 1C. If you want your battery pack to be fully charged, switch the Inflex function OFF.
2. **Reflex** – It's always recommended to be used!
3. Function "**auto**" (while discharging) extend time of discharging, but discharge battery completely. If you care about time just turn this function off.
4. **Delta**; for lower value '**d**' charging process will be finished faster than with higher value '**D**'. If you set recommended value of Delta Peak, there will be no d/D marker displayed.
5. Battery pack temperature – many modelers wants their battery packs warm for flying / driving / swimming. Pulsar 2+ is in general set to economical usage of the battery which causes only slight increase of battery temperature. So you can adjust charging current (experimental) to achieve needed battery pack temperature (alternatively, you can increase Delta Peak value).
6. **Fast** with Li-xx. Saving time is considerable by charging with currents over 1C. Please obey battery producer recommendations. This function can be used with a special balancer (e.g. Pulsar EQUAL from Elprog).
7. **Format** – is it recommended to use relatively low current but not lower than 0,1C and not higher than 1C with 4 – 8 cycles. When older battery has to be regenerated 0,5 – 1C should be used with regeneration function enabled. In this case 4 – 5 cycles are enough.
8. During current adjustment we ask you to pay attention on maximal duration times of the processes. When charging/discharging Ni-Cd and Ni-MH it is 5 hours. When charging Li-xx it's 14 hours. One cycle when formatting can take maximum 2 x 14h. Always adapt current settings to these times.
9. **CAUTION** - always pay attention that number of cells setting is correct! Li-Xx cells should be charged under permanent supervision and on inflammable surface.

## Alarms

- |               |   |
|---------------|---|
| Tc=50,0       | - Temperature limit exceeded („Tc=" is blinking)  |
| Vb=16,0V high | - too high voltage of power supply ("high" is blinking)   |
| Vb=10,5V low  | - too low voltage of power supply („low" is blinking)   |
| VC=high       | - Battery pack voltage exceeded. Wrong number of cells, battery is damaged or too high charging current.  |
| Ti =high      | - Chargers heat sink temperature exceeded („Ti=" is blinking), too high charging / discharging current and too high environment temperature or cooling holes covered. |

ELPROG S.Krymski

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English translation: M.Szulen

# Warranty

ELPROG guarantees this product against defective components and faulty workmanship for a period of 24 months. Any defect in materials or workmanship occurring within 24 months from the date of purchase subject to the following conditions will be rectified free of charge by ELPROG within 14 working days.

## Conditions

1. This guarantee must have been completed at time of purchase (this is your proof of the date of purchase).
2. The guarantee applies only to faults caused by defective components, or faulty workmanship on the part of the manufacturer.
3. The guarantee does not cover failures caused by accident, misuse, neglect, normal wear and tear, alternations and/or adjustment made to the charger.

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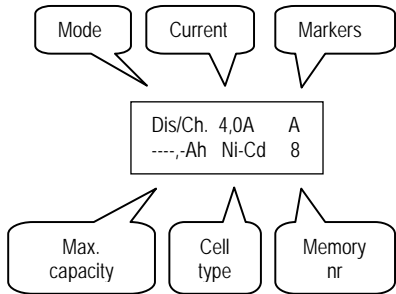
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Notes:

### Menu



### Current adjustment

Dis/Ch 4,0A RA  
----,-Ah Ni-Cd 8

(E)

Disch. 4,0A RA  
----,-Ah Ni-Cd 8

Charge 2,0A ird  
----,-Ah Ni-Cd 8

MAX capacity  
(M)

Disch. 4,0A RA  
2,4Ah 08 Ni-Cd

### Memory 1-8

Disch. 4,0A RA  
----,-Ah Ni-Cd 1

(M) 1s

Disch. 4,0A RA  
Mode Disch.

Disch. 4,0A RA  
accu Ni-Cd

Disch. Charge  
Dis/Ch Ch/Dis

NiCd, NiMh, PB-bat,  
RAM, Lilon, LiPol, LiTa, LiPh

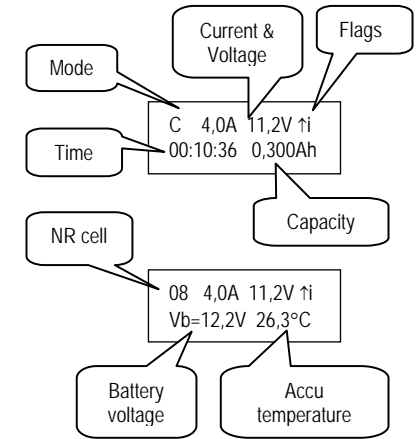
### Start of process

Correct NR cell

Charge 10,0V rd  
Start 08 Ni-Cd

(E)

Start process



Accu connet

## Pulsar 2+ V10

