

# PULSAR 2 User Guide

V 2.05



PULSAR 2 is a rapid, 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 improve 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.

Technical specification	
Battery types supported	Ni-Cd, Ni-Mh, Pb-bat, RAM, Li-Ion, Li-Pol, Li-Tadiran
Supply voltage	10 – 16V DC (car battery min 30Ah (70Ah recommended) or power supply 14V/30A)
Low voltage alarm level (alarm)	min 10 – 11,5V adjustable in <i>Setup</i> max 16V
Charging voltage	0.5 - 60V from 1 up to 30 Ni-Cd cells
Charging current	200mA – 9,9A (250W)
Discharging current	200mA – 9,9A (250W) with energy return 200mA – 9,9A (35W) with heat dissipation
Temperature measurement	0 - 99°C with 0.1°C accuracy
Voltage measurement	0,1 – 60V
Current measurement	0,1 – 11A
Time measurement	up to 14 hours
Max voltage on supply battery	Revers - On 15,5V

# Starting-up Pulsar Charger

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 (30A recommended).

Red cable +12V  
Blue cable -12V, ground

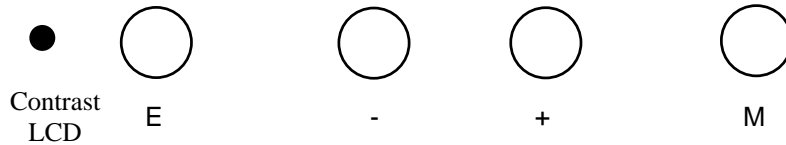
There are three connectors on the left side of the device:

- temperature sensor connector
- 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 supply battery from discharging - if supply voltage fall below desired level charger is stopped and alarm is on (protection against excessive discharge of car battery).

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

-	P	U	L	S	A	R	-			V	2	.	0	5	
S	t	a	r	t						S	e	t	u	p	



Mode	Keys	Action
Start	E	Main menu <i>Mem 1-8; Format, Test</i>
Setup	M	Global parameters: 1. Bip <i>ON/OFF</i> – sound signal (+,-); E 2. T max <i>On/Off</i> – termic protection (+,-); E 3. T on < from 30 to 45 °C – start with T<Ton (+,-); E 4. T off < from 45 to 60 °C – stop with T>Toff (+,-); E 5. Voff from 10V to 12V - min supply voltage (+,-); E

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

- Tmax *On* – Start analyzing temperature Ton and Toff.
- Ton – if packet temperature exceed set up Ton temperature, process will start only after cell temperature fall to Ton temperature.
- Toff – exceeding set up Toff temperature, will stop the process and start alarm

Right after connecting packet to charger, connection test will start. After that charger estimate number of cells in the packet. When battery is charged or excessively discharged number of cells should be corrected (+,-). Confirmation with E key will start appropriate action, depending on a set mode.

D	i	s	c	h	.		9	,	0	V		R	A	
-	-	,	-	A	h		0	7		N	i	-	C	d

During correction of number of cells, we can set maximal capacity of packet (0.1 – 12.0 Ah) after reaching it process will terminate. After pressing M key we will be able to set capacity by pressing + or – and confirm that with E key (--,- Ah, means that function is turned off).

## Main menu (battery is disconnected)

Main menu consist 10 windows.

- M 1-8 memory of the processes, formatting/regeneration and battery test

## Memory of the processes M1-8

Memory number – a digit in the down right corner on display.

There is 8 memories. Each can save:

### Process parameters

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

### Working 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

## Info 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 in last process

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 - save no. 8  
16 - amount of cells  
Ni-Cd - cell type  
Menu - return to main menu (E)  
-2,131Ah - energy, mark (-) mean discharge

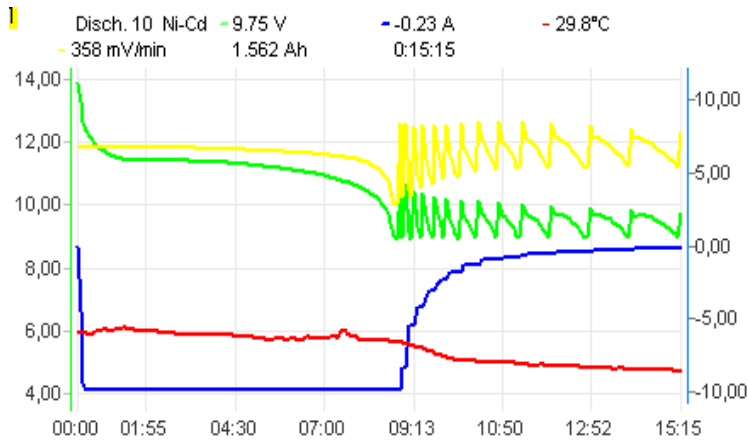
Info.	Keys	Function
Battery disconnected	+ or –	change program
	M	info window
Info window	M	return to main menu
	E	saved data from 8 previous processes
Saved data	+ or –	change save no.
	E	return to main menu
	M	return to info window

# Discharging (0,2 – 9,9A, Revers, Auto)

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

R - Reverse mode is on

A - Auto mode is on



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 accumulator.

D	0	8	-	8	,	0	A			7	,	2	V	↓	E
0	0	:	1	2	:	3	4		1	,	9	1	5	A	h

every 5 seconds – second line

V	b	=	1	3	,	5	V		4	4	,	7	°	C
---	---	---	---	---	---	---	---	--	---	---	---	---	---	---

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

- D 08 - discharging: 8 cells
- 8,0A - actual, measured current
- 7,2V - actual, measured voltage
- ↓ - mark of decreasing voltage
- E - mark of current limit (blinking)
- 00:12:34 - time elapsed from start of the process
- 1,915Ah - energy returned

Disch.	Keys	Function
Battery disconnected	+ or -	change program
	E	current set up (+, -); E
	<b>E</b> (1 s)	odd parameters set up 1. Revers <i>On/Off</i> – energy return (+, -); E 2. Auto <i>On/Off</i> – decreasing voltage (+, -); E
	<b>M</b> (1 s)	change work mode and cell type
	M	info window
Battery connected	<b>E</b> (1 s)	stop discharging
	M	LCD light

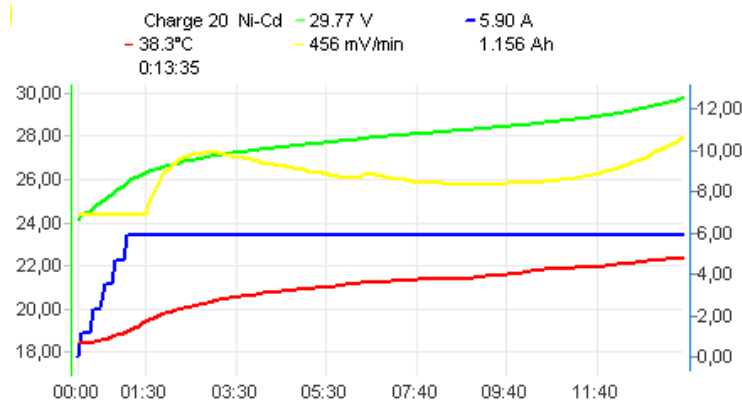
## Important Notices

- Maximal duration of this process – 5 hours.
- You must NOT use *Reverse* function if you are using external DC power supply unit.

# Charging Ni-Cd & Ni-Mh (0,2 – 9,9A, *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 - *Delta* –  $\Delta$  low (D –  $\Delta$  high) function is ON



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*.

C	0	8		8	,	0	A	1	2	,	9	V	↑	i
0	0	:	1	6	:	0	0	2	,	3	2	6	A	h

every 5 seconds – second line

V	b	=	1	2	,	1	V	4	0	,	0	°	C
---	---	---	---	---	---	---	---	---	---	---	---	---	---

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

- C 08 - charging: 8 cells
- 8,0A - actual, measured current
- 12,9V - actual, measured voltage
- ↑ - mark of increasing voltage
- i - mark of inflex point detection (blinking)
- S - mark of slow start mode (blinking)
- 00:16:00 - time elapsed from start of the process
- 2,326Ah - energy taken

Charge	Keys	Function
Battery disconnected	+ or –	change program
	E	current set up (+, –); E
	<b>E</b> (1 s)	odd parameters set up 1. <i>Inflex On/Off</i> – stop at inflexion point (+, –); E 2. <i>Reflex On/Off</i> – equalizing impulse (+, –); E 3. <i>Delta low/high</i> – value $-\Delta V$ (+, –); E
	<b>M</b> (1 s)	change work mode and cell type
	+ and –	forced start
	M	info window
Battery connected	<b>E</b> (1 s)	stop charging
	+	slowly start lessen
	M	LCD light

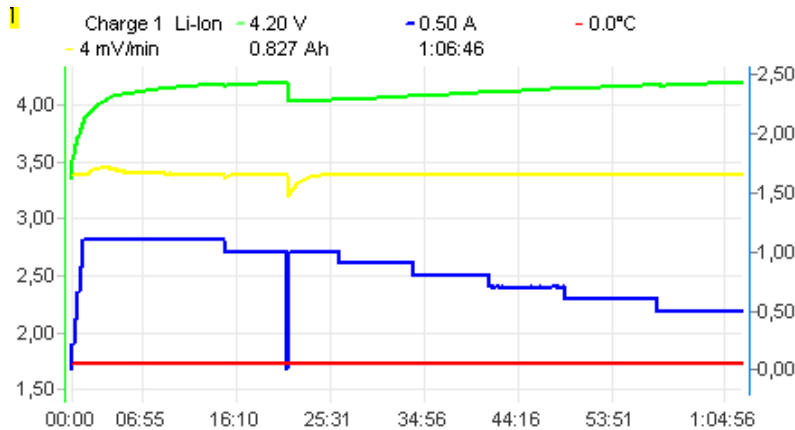
## Important Notices

- Maximal duration of this process – 5 hours.
- Forced start – charging diode protected battery (RC transmitter)
- *Delta low* – 7mV Ni-Cd, 3mV Ni-Mh; *Delta high* - 10mV Ni-Cd, 5mV Ni-Mh
- *Delta high* – rather for currents lower than 1C for Ni-Cd and 0,5C for Ni-Mh
- *Inflex* – switched on for currents higher than 1C for 4 cells

# Charging PB-bat, RAM , Li-Ion, Li-Pol, Li-Ta. (0,1 – 9,9A, 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 ON
- r - Reflex mode ON
- v - corection of threshold voltage is ON (it can be reduced by 200mV with 10mV step)



Charging ends when threshold voltage is detected and simultaneously charging current is decreased. When *Fast* mode is on charging current is controlled with pulses, which makes it possible to reduce charging time more than two times. Current limitation could be occurred when voltage overstep maximal value for given cell types

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

every 5 seconds – second line

V	b	=	1	2	,	5	V		2	3	,	7	°	C
---	---	---	---	---	---	---	---	--	---	---	---	---	---	---

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

- C 02 - charging; 2 cells
- 1,0A - actual, measured current
- 8,2V - actual, measured voltage
- E - mark of current limitation (blinking)
- S - mark of the *slow start* mode (blinking)
- 01:23:25 - time elapsed from start of the process
- 1,298Ah - energy taken

Charge	Keys	Function
Battery disconnected	+ or -	change program
	E	current set up ( + , - ); E
	<b>E</b> (1 s)	odd parameters set up 1. Fast <i>On/Off</i> – fast charging mode ( + , - ); E 2. Reflex <i>On/Off</i> – equalizing impulse ( + , - ); E 3. V end – corection of threshold voltage ( + , - ); E
	<b>M</b> (1 s)	change work mode and cell type
	+ and -	forced start
	M	info window
Battery connected	<b>E</b> (1 s)	stop charging
	+	slowly start lessen
	M	LCD light

## Important Notices

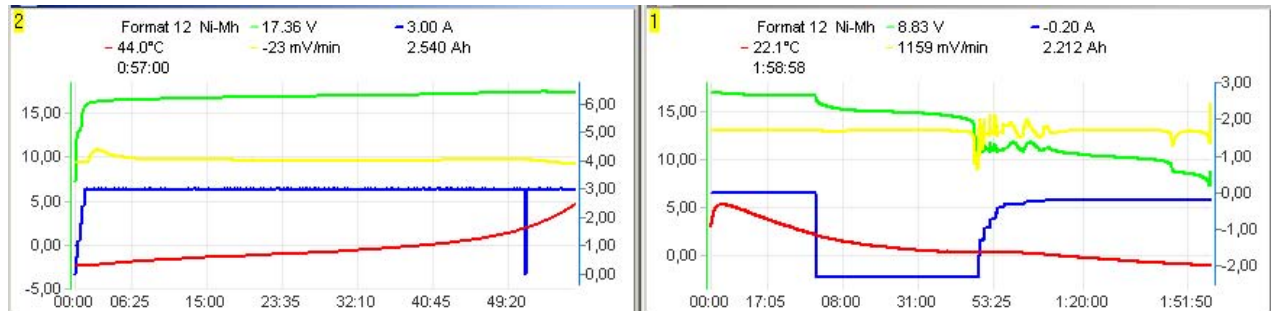
- Maximal duration of this process – 14 hours.
- Reduction of threshold voltage *V end* under standard value (voltage for singel cell) will display “v” mark.
- Switching on *Reflex* mode increases constant current charging phase time (that could shorten charging time), reduces sudden increase of internal resistance effect, cell pressure and temperature, lets using higher charging currents.

## Formatting / Conditioning (0,2 – 4A, 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 - conditioning 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 to repair the battery.

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

every 5 seconds – second line

V	b	=	1	2	,	5	V	3	6	,	6	°	C	4
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

A bold '**A**' after a value of current indicates that charger has limited current due to maximum power.

- F 08 - formatting; 8 cells
- 1,8A - actual, measured charging or discharging current
- 12,8V - actual, measured voltage
- 01:10:04 - time elapsed from start of the process
- 2,082Ah - energy taken or returned
- C4 - no. of chargings before process finish

Format	Keys	Function
Battery disconnected	+ or –	change program
	E	current set up (+, –); E
	<b>E</b> (1 s)	odd parameters set up 1. typ ogniw (+, –); M lub E 2. Regen. <i>On/Off</i> - regeneracja ogniw (+, –); M lub E 3. Cycle 1-8 – ilość cykli (+, –); E
	<b>M</b> (1 s)	change work mode and cell type
	M	info window
Battery connected	<b>E</b> (1 s)	stop charging
	+ or –	slowly start lessen
	M	LCD light

### Important Notices

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

## Test (0,2 – 1A, cell type)

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

Battery test is done for each cell type at three stages.

- 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	

10 s battery loading with set circuit will start.

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

For next 5 s impulse loading. After that battery's internal resistance will be calculated.

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

To see internal resistance and voltage of the battery counted for each cell press **M** key.

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

C - mark inform that value is counted for single cell.

Again pressing **E** key will repeat the test.

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 neither (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)

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



## Cells Characteristic parameters

	Ni-Cd	Ni-Mh	Pb-bat	RAM	Li-Ion	Li-Pol	Li-Ta
Name	nickel-cadmium	nickel-metal-hydride	lead-acid	alkaline	lithium-ion	lithium polymer	lithium tadiran
Voltage	1,2V	1,2V	2V	1,5V	3,6V	3,7V	3,0V
Discharging voltage	0,9V	0,9V	1,8V	1,0V	2,7V	3,0V	2,4V
Max. charging voltage	1,85V	1,85V	2,35V*	1,65V*	4,2V*	4,2V*	3,45V*
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
no. of cells	1 - 30	1 - 30	1 - 18	1 - 26	1 - 12	1 - 12	1 - 12

\*- it can be reduced by 200mV with 10mV step

Where C is capacity of battery (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 with 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 highly decrease heat diffuse at late 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 come off 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 – 0,5C circuit (3 – 5 *format* cycles)

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

**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 cells parallel connected) 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 menaces voltage at every cell should be measured between-whiles. 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 circuit 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 calls are equated. This mode could improve parameters of used packet, but not as that range as regeneration of Ni-Cd packets.

## Graf PC software v 2.12

PULSAR charger supports serial port (RS232), what enables 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

GrafPC is a Windows application. When you start GrafPC for a first time, you will be asked to choose serial port which is used to connect Pulsar Charger (COM 1-4).

**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** - Shows numerical data

After clicking **Data** button window with numerical data will appear (voltage, increase of voltage, current, temperature, time and capacity).

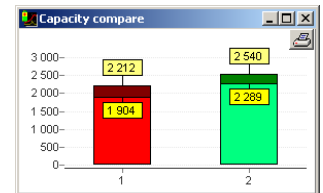
Pressing button with single cell icon, displays the voltage and the increase of voltage count for single cell.



**Capacity compare 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)

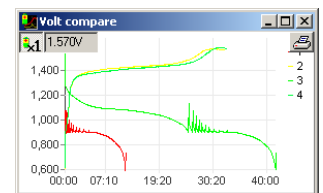
Green column shows charging process (light green to the inflexion point detection).



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

When cursor is placed on the voltage line (cursor – cross) and we click left mouse button a value of voltage will be shown in the *Voltage* window.

Pressing button with single cell icon, displays the voltage count for single cell.



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

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

**Multisession recording** – automatic recording of all data i.e. from the format process.

*Save All* (Filename 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.

## Additional Information

- **Stop of the charging process should be done by pressing the E key for 1s and 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-Ta and Pb-bat cells, when battery is not totally discharged. Overstate cell quantity will damage battery or even in some cases it could cause auto-ignition of the battery.**
- Analysis of Inflection point and Delta peak starts after 2 minutes for Ni-Cd and 4 minutes for NiMh batteries. After that time automatic stop of charging could occur.
- PULSAR charger must be protected from water.  
You must not use PULSAR charger during rain – water can get inside and cause severe damage.
- PULSAR charger must be protected from dust.  
Built-in fan cools internal radiator and DC/DC converter's coil. 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 heated - it is essential to provide proper ventilation.
- It is not allowed to change supply cables. They are designed to endure currents up to 30A.
- You must supply PULSAR directly from a car accumulator. It is not allowed to supply charger from car lighter socket – this can severely damage car wiring system.
- Make sure all cables connecting a battery pack are at least 2mm in diameter and are not longer than 20cm.

## Examples Setting process parameters – memory 1 – 8

- **Setting up current**
  - E - current value is blinking
  - + or - - set up needed current value
  - E - confirm and return to menu or set up current (in complex processes)
- **Setting up working mode and cell types**
  - M (1s) - name of working mode is blinking (*Disch.*; *Charge*; *Dis/Ch*; *Ch/Dis*)
  - + or - - set up working mode
  - E or M - confirm, type of cell is blinking
  - + or - - set up proper cell type
  - E or M - confirm and return to menu
- **Setting up additional parameters – charging NiCd or MiMh cells**
  - E (1s) - the *On/Off* is blinking for *inflex* mode (decreasing heat of the packet)
  - + or - - set up working mode
  - E or M - the *On/Off* is blinking for *Reflex* mode (charging with equalizing impulse)
  - + or - - set up working mode
  - E or M - the *d/D* is blinking for *Delta* parameter (d – more sensitive Delta Peak threshold)
  - + or - - set up working mode
  - E or M - confirm and return to menu

# Warranty

ELPROG guarantees this product against defective components and faulty workmanship for a period of 12 months. Any defect in materials or workmanship occurring within 12 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.

Type Pulsar ver. 2.05

Date \_\_\_\_\_

\_\_\_\_\_

Notes: