

# POLARON EX

## 2 CH DC CHARGER

**Graupner | SJ**

### OPERATING INSTRUCTION

Prior to use, please read this manual thoroughly.

Keep this manual in a convenient place for quick and easy reference.



**Graupner | SJ**

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### © BEFORE USE

Thank you for purchasing POLARON EX 2CH DC Charger. This system is extremely versatile and may be used by beginners and pros alike. In order for you to make the best use of your system, please read this manual carefully.

If you have any difficulties while using your system, please consult the manual, our online Frequently Asked Questions (on the web pages referenced below), your hobby dealer, or the Graupner/SJ Service Center.

### © SUPPORT AND SERVICE

#### • Customer support

Please feel free to ask any question by e-mail or phone. We've been trying to deal with your question. We are open from nine to six, Monday to Friday in Korea. We may respond to your question by e-mail as soon as possible when we are close.

#### • Internet sales site

Please feel free to contact "www.openhobby.com" to stay up to date the latest Graupner/SJ Firmware and the newest product line up

#### • A/S regulation

Only when the product is faulty after normal operation within the warranty period, we will repair the product for free based on our regulations. The repair will be paid for by the consumer when the damage is due to use in improper ways or beyond the warranty period.

#### • Warranty regulation

Refer the WARRANTY CARD in a Package

### © OPENHOBBY A/S CENTER

8F, 202 Dong, Chunui Techno-Park II, 18, 198 street, Bucheon-ro, Wonmi-Gu, Bucheon-Shi, Gyungki-Do KOREA 420-857

Phone: 82-32-623-0706 FAX: 82-32-623-0720

Customer Service E-mail: service@openhobby.com

## ☉ BOX CONTENTS

- |                |   |                            |
|----------------|---|----------------------------|
| 1. Charger     | 2. 7Cells Balance board/ Cable (EH to XH) 2 pairs | 3. Temperature sensor 2pcs |
| 4. USB cable   | 5. OUT PUT cable with alligator clip 2 pairs      | 6. Charger rack            |
| 7. User manual | 8. Warranty card                                  |                            |

## ☉ SAFETY PRECAUTIONS

- Do not attach the charger to both of AC and DC power source at the same time.
- Never connect the input jack (DC input) to AC power.
- Make sure to disconnect the docking power supplier when to input DC power source to the rear terminal of charge.
- Make sure to program the input power setup correctly at USER SETUP mode.
- Make sure to program the input power setup correctly at USER SETUP mode when to use the docking power supplier.
- Be cautious about an automobile battery dead, when power source is supplied from an automobile.
- Make sure to supply enough power source to charger. The charger output is maximum 400W for each channel.
- If possible, put the battery in a safety bag when to charge or discharge.
- Make sure to pay attention to charger during use.  
Disconnect the battery and remove input power from charger immediately if the charger becomes hot and keep the charger and battery cool down before reconnecting.
- Do not attempt to charge dead or damaged batteries.
- Make sure to charge the pack consisted of the same type of batteries.
- Do not attempt to charge a battery pack containing different types of batteries.
- Do not use the too shot cable or damaged cable.
- Make sure to charge a pack for each channel.
- Do not use near a flammable object and use in a well ventilated area, the gas in explosion possibilities may be generated during use.
- Do not reverse the positive and negative terminals. Wrong connection will damage the battery and may cause damage to the charger.
- Make sure to use only rechargeable batteries and ensure them meet the requirements of this charger.
- Do not allow water, moisture or foreign objects into the charger.
- Do not use in humid place and do not operate with wet hands.
- Do not attempt to dismantle the charger.
- Do not use on the fleecy material such as carpet, blanket, bed, cushion and make sure to use in a hard and flat surface.

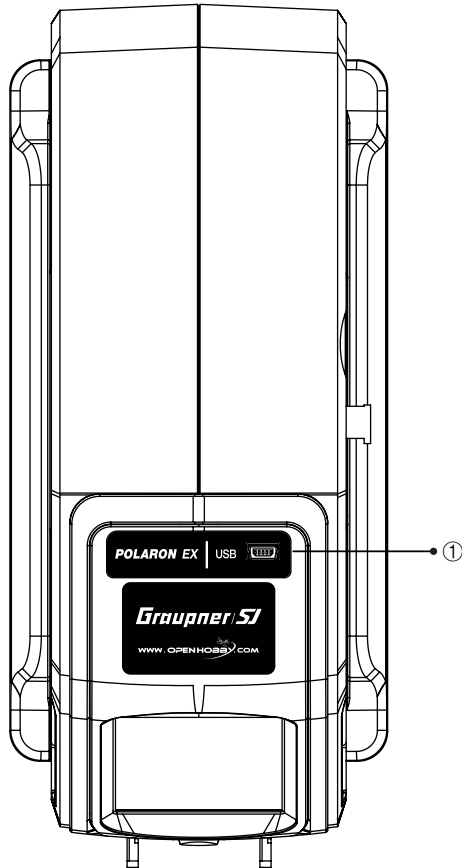
- Do not use in the too cold place or hot place, charge may not output normally or may not be operated.
- Make sure to use in a well ventilated place and do not block the cooling fan (rear) and air inlet (front).
- Make sure to use in the proper place that you can see TFT panel since TFT panel might not be visible under strong sunlight.
- We strongly recommend balancing a Lithium pack, An unbalanced pack can cause damage and in extreme cases can cause a fire.
- Make sure to connect one battery pack to a balance board. If not, battery or charge can get the damage.
- Charger do not charge the battery of which voltage is below 2.8V per cell. If the battery is forced to charge, the pack can cause damage and in extreme cases can cause a fire
- The default charging current is 1C. Make sure to check the voltage and temperature of battery when to charge with more than 1C.
- Do not charge Lithium Polymer battery packs at greater than 4.2V per cell.
- Always disconnect the battery after charging, and let the charger cool between charges.

◎ SPECIFICATION

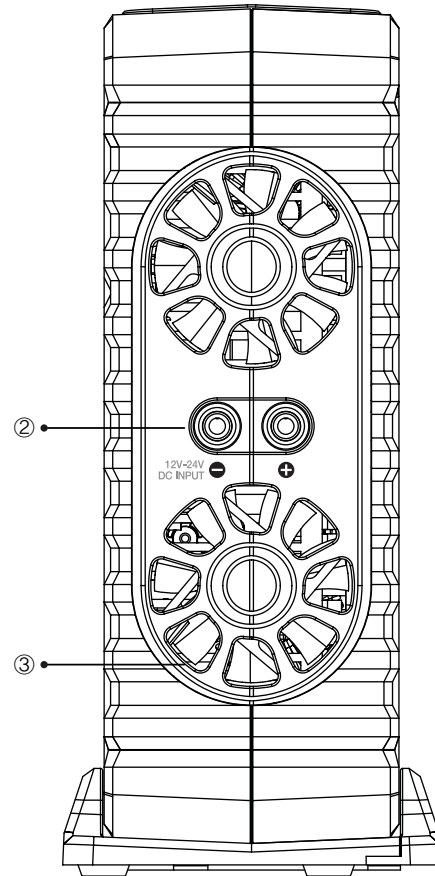
MODE	TYPE	SPECIFICATION
Power Supply	DC Input	11~28V DC/AC by SMPS
Memory	40 (CH1 20/ CH2 20)	
Display	3.0" TFT LCD W/Touch Screen	
Battery Types	NiCd, NiMH, LiPo, Lilon, LiFe, Pb	
Operating Modes	NiCd, NiMH, Pb	Charge, Discharge, Cycle
	LiPo, Lilon, LiFe	Charge, Discharge, Cycle, Store
Operating Modes	Charge (NiCd, NiMH)	Automatic charge
		Normal charge
		Linear charge
	Charge (LiPo, Lilon, LiFe)	CC-CV charge
		FAST charge
		N-STORE charge
		Q-STORE charge
		CV-Link charge
	Charge (Pb)	CC-CV charge
	Discharge (NiCd, NiMH, Pb)	Automatic Discharge
		Normal Discharge
		Linear Discharge
	Discharge (LiPo, Lilon, LiFe)	Normal Discharge
		Linear Discharge
		Link Discharge
	CYCLE Charge (LiPo, Lilon, LiFe, Pb)	CC-CV charge
	CYCLE DisCharge (LiPo, Lilon, LiFe, Pb)	Normal Discharge
		Linear Discharge
	CYCLE Charge/DisCharge (NiCd, NiMH)	Normal Charge/DisCharge
		Linear Charge/DisCharge
Auto Charge/DisCharge		
Number of Cells	NiCd, NiMH	1 ~ 14 Cells/2CH
	LiPo, Lilon, LiFe	1 ~ 7 Cells/2CH
	Pb	1 ~ 12 Cells/2CH (2V~24V)
Charge Current	NiCd, NiMH	0.1A ~ 20.0A (max 400W)/2CH
	LiPo, Lilon, LiFe	0.1A ~ 20.0A (max 400W)/2CH
Discharge Current	NiCd, NiMH, LiPo, Lilon, LiFe, Pb	0.1A ~ 10.0A (max 60W)/2CH
Charge Voltage	LiPo	3.70 ~ 4.30V/cell
	Lilon	3.60 ~ 4.20V/cell
	LiFe	3.30 ~ 3.70V/cell

Discharge Voltage	Pb	1.80 ~ 2.45V/cell
	NiCd, NiMH	0.10 ~ 1.30V/cell
	LiPo	2.50 ~ 4.20V/cell
	Lilon	2.50 ~ 4.10V/cell
	LiFe	2.00 ~ 3.70V/cell
Trickle Current	NiCd, NiMH	Off ~ 500mA
		Auto Mode (Charge Current/20)
Balancing current	LiPo, Lilon, LiFe	MAX 350mA
Cycle Mode	Cycle time	1~10 Cycles
	Cycle delay	1~30 min
	Cycle direction	C>D / D>C / D:C>D
Peak sensitivity	NiCd	5 ~ 25mV/cell
	NiMH	0 ~ 15mV/cell
Temperature Sensor	Centigrade	10 ~ 80° C
	Fahrenheit	50 ~ 176° F
Max charge capacity	NiCd, NiMH	OFF, 10~150%
	LiPo, Lilon, LiFe	OFF, 10~120%
Start delay timer	NiCd, NiMH, LiPo, Lilon, LiFe,	1 ~ 150 min
Safety timer	Pb	10 ~ 900 min & Off
PC communication	NiCd, NiMH, LiPo, Lilon, LiFe,	data logging
Firmware upgrade	Pb	External mini USB
Cooling system	YES	50*50*10mm * 2ea fan
12V output	1368g (48.25 oz)	B terminal in the side, B terminal in the rear
USB	YES	USB B-type-5V 2.5A output
Ext.Module socket	YES	EH 5P
Motor Test socket	YES	ZHR
Servo Test socket	YES	Futaba 3P socket
SMPS Docking terminal		B terminal in the side
Dimensions	88,2x203,4x196,3mm (3.47x8.00x7.73 in)	
Weight	1368g (48.25 oz)	

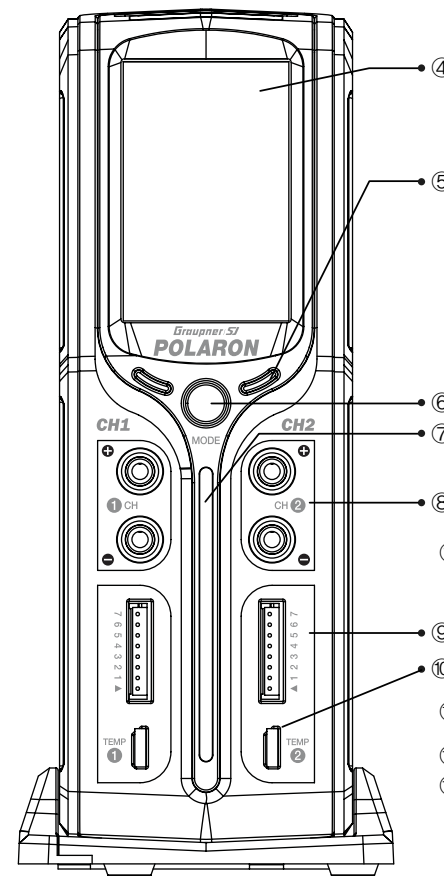
TOP



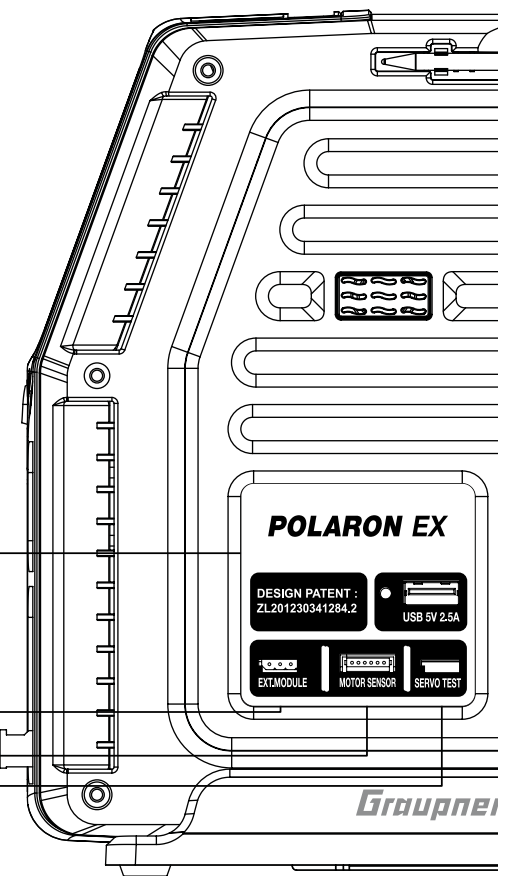
BACK



FRONT



RIGHT



- ① Mini USB
- ② DC Input
- ③ Fan

- ④ 3.0" TFT LCD W/Touch Screen
- ⑤ LED Indicator for Charge/ discharge
- ⑥ Channel selection button
- ⑦ Charge/discharge status LED bar
- ⑧ Battery socket
- ⑨ Balance port
- ⑩ Temperature sensor port
- ⑪ USB +5V 2.5A
- ⑫ EXT Module
- ⑬ Motor sensor
- ⑭ Servo test

## ◎ MENU CONFIGURATION

Graupner/SJ POLARON Series charger is equipped with a highly sensitive touch screen. You just need to tap icons to access to every mode and set up your device.

### ACTION BUTTONS



– ESC button: Getting back to the previous page, store the setup data and etc.



– DEC button: Page transition, Data setup and etc.



– INC button: Page transition, Data setup and etc.



– ENTER button: Accessing to the next page, Completing data setup, Starting/completing to operate, Storing the setup data and etc.

### MENU DESCRIPTION

Main page	Function
PROFILE	Battery name, type, capacity, number of cells, memory number, memory copy
CHARGE	Setup battery charge data
DISCHG	Setup battery discharge data
CYCLE	Setup cycle type and delay time of charge / discharge ( using charge / discharge setup data )
BALANCE	Display cell voltage and related data, setup balance data
DATA	Display the completed data and battery status
MISC	Setup servo, motor and warmer data
USER SET	Setup input data, warning, date, time, user name and etc.

## ◎ BATTERY CONNECTION

POLARON EX 2CH DC charger has two sets of outputs on the front of the charger. Channel 1 is on the left and channel 2 on the right. Each channel has two 4mm banana sockets and 7 cell balance port and a temperature sensor input port. You will need an appropriate charge lead to suit the specific connector on your battery. Connect this charge lead to the 4mm output sockets on the charger channel you want to use, with the positive (+) lead connected to the red socket and the negative (-) lead to the black socket.



Only connect the battery to the charge lead AFTER the charge lead has been connected to the charger, as the connectors on the charge lead could touch together and cause the battery to short circuit.



When charging a Lithium pack, make sure that the balance lead is connected to the charger. The charger has a 'JST-EH' type balance port, but also comes with other balance adaptor boards. To use an adaptor board, connect the supplied balance adaptor board lead to the charger and then connect the board that works with your battery balance connector. If the main battery power leads ONLY are connected to the output banana sockets, without connecting the balancing connector to the balancing port on the charger, the charger will charge or discharge the connected Lithium pack without balancing it. We always recommend balancing a Lithium pack, because some cell may

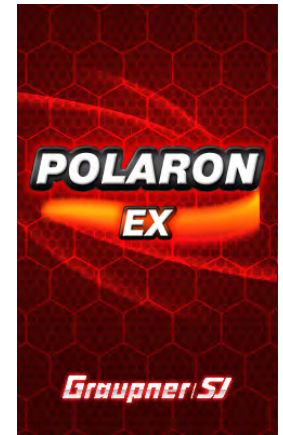
## ◎ INPUT POWER SETUP

This charger has 40 memories (CH1 20 /CH2 20) that each battery can be resisted so the basic programming setup helps you to manage batteries efficiently

The charger should be connected to the docking SMPS or a suitable 11–28V DC power source,

ensuring that the black connector is connected to the negative (-) and the red to the positive (+)

Input voltage and current can be programmed at USER SET (ref 30 page), this charger will control output automatically depending on power input source



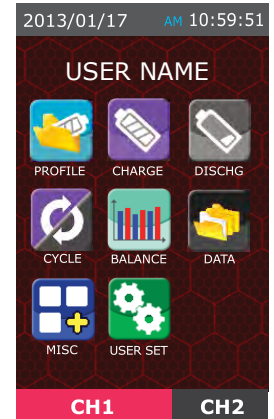
▲ Power on

## ◎ MAIN PAGE

– You may tap channel number on the bottom box to select channel and the main page of the selected channel in red is displayed. Tapping the other channel allows to select other channel.

– The date and time are displayed on the top of main page and the data can be programmed at USER SET

– Tapping icons on main page allows to access to the tapped page. When to tap icons, icon is activated in dark gray and charger beeps



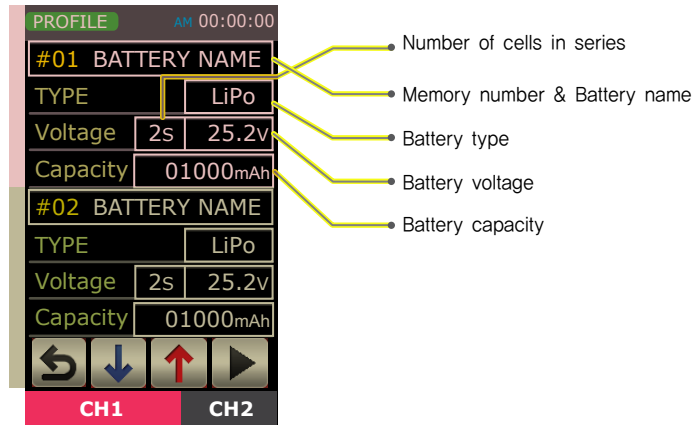
## ◎ PROFILE PAGE

Profile page is the main functional page for this charger. It is used to setup battery name, battery type, capacity, number of cells and set memory number, as well as being used to initiate charging, discharging, cycling and balancing mode functions. The related functions with charge and discharge are operated according to the stored data of charging, discharging, cycling and balancing mode.

• Display

Section 1

Section 2

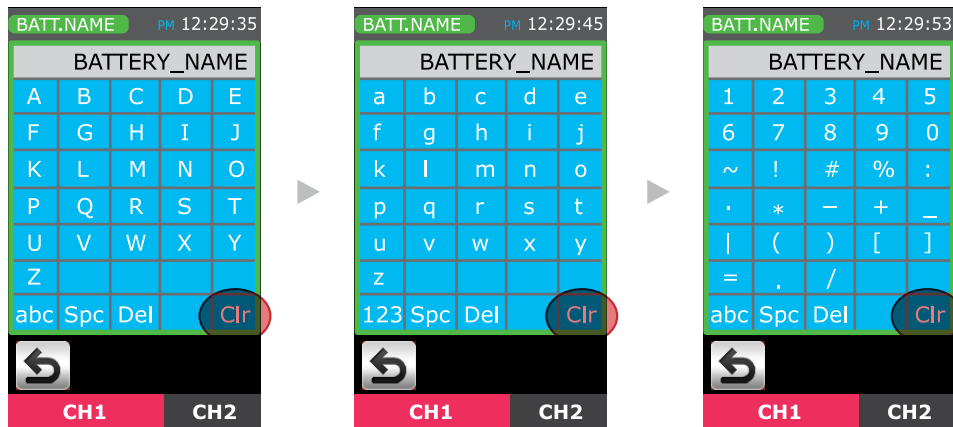


- 1) Tap memory number box in section 1 to activate and tap INC/DNC buttons to set memory number, 1~20 numbers are available and changeable. Press and hold memory number box to access battery name page
- 2) Tap battery type, number of cells and capacity to activate. Tapping INC/DEC buttons edits the battery parameters
- 3) Memory copy  
Tap number box on Section 2 to activate and tap INC/DNC buttons to set memory number. Tap Enter button to copy the battery parameters of Section 1 to the battery parameters of Section 2
- 4) Tap Enter button to store the battery parameters and tap ESC button to get back to the previous page



It is very important that the correct battery parameters are entered, as incorrect values could cause the charger to seriously damage your battery which could result in a fire !

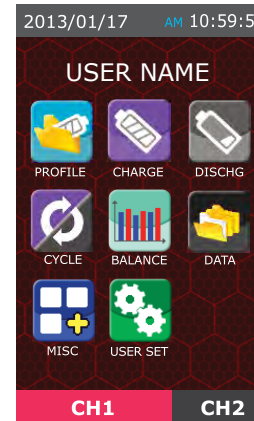
• Battery name editing



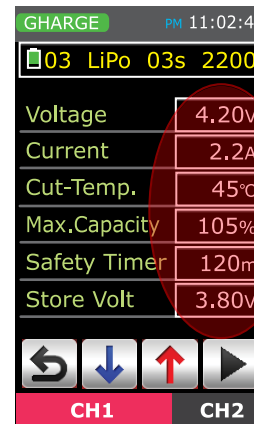
12 characters are available. Tapping Clr in the red circle erases the default name and the new name can be entered. When to tap "ABC", "abc", "123", you may access to each page of upper and lower case, numbers with special characters and tap the character that you want to use as a name. Tapping ESC button makes you get back to the previous page.

© CHARGE PAGE

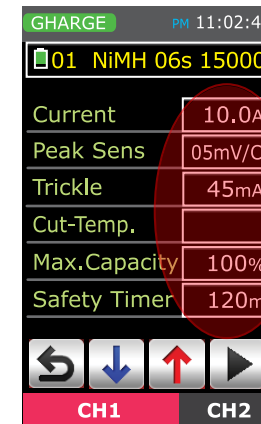
When to tap CHARGE icon on main page, you may access to charge mode. The parameters in this mode depends on the selected battery type at profile page



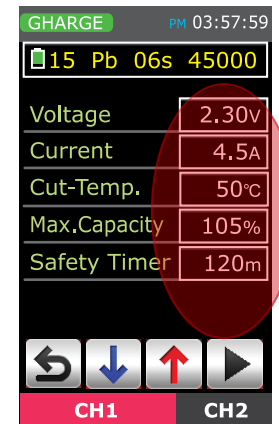
Tap CHARGE icon on main page to charge



The battery parameters on charge page when to select LiPo, Lilon, LiFe



The battery parameters on charge page when to select NiCd, NiMH



The battery parameters on charge page when to select Pb battery

It is used to program the battery parameters. Tap each data box to activate in blue and tap INC/DEC button to edit the battery parameters.

• LiPo, Lilon, LiFe battery charge setup

- Voltage : Maximum cell voltage, CV (Constant Voltage)
- Current : Charge current, tapping INC/DEC buttons can activate and edit the parameter  
The default charge current is set to 1C (1 x capacity), however this can be adjusted from 0,1 to 20 Amps and operated within 400W

- Cut-Temp : Cut off temperature. When used with the optional temperature sensor, a safety cut-off temperature can be set, so that charging or discharging is terminated automatically if the temperature sensor detects the battery temperature rising above the preset temperature.
- Max Capacity : The maximum capacity setting is used to terminate a charge if the charger exceeds the preset percentage of the battery capacity since the batteries that are decrepit or in bad balancing or programmed improper parameters can be overcharged
- Safety Timer : The safety timer can be used to terminate a charge if it is not completed within the preset time period. It is used to protect battery
- Store Volt : The battery voltage in store mode. It is used to terminate a charge if it is reach the preset voltage

• NiCd/ NiMH battery charge setup

- Current : Charge current, tapping INC/DEC buttons can activate and edit the parameter The default charge current is set to 1C (1 x capacity), however this can be adjusted from 0.1 to 20 Amps and operated within 400W
- Peak Sens : Delta-peak cut-off voltage. It is used to charge NiCd/ NiMH battery. When the pack voltage peaks, the pack becomes hot and the pack voltage drops off. This charger terminates a charge using Delta-peak cut-off. The default parameter is 3mV/cell for NiMH and 7mV/cell for NiCd
- Tricke : Trickle charge current, With NiCd and NiMH type batteries, it is recommended that the pack is trickle charged after the main charge has completed, so that the battery is kept fully charged and is ready to be used. Therefore, we suggest setting the trickle charge current to around 10% of the pack capacity (Possible to set max 500mA)
- Cut-Temp : Cut off temperature. When used with the optional temperature sensor, a safety cut-off temperature can be set, so that charging or discharging is terminated automatically if the temperature sensor detects the battery temperature rising above the preset temperature.
- Max Capacity : The maximum capacity setting is used to terminate a charge if the charger exceeds the selected percentage of the battery capacity since the batteries that are decrepit or programmed improper peak sens can be overcharged
- Safety Timer : The safety timer can be used to terminate a charge if it is not completed within the preset time period. It is used to protect battery

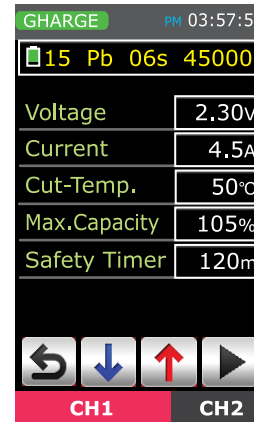
• Pb battery charge setup

- Voltage : Maximum cell voltage, CV (Constant Voltage)
- Current : Charge current, tapping INC/DEC buttons can activate and edit the parameter The default charge current is set to 1C (1 x capacity), however this can be adjusted from 0.1 to 20 Amps and operated within 400W
- Cut-Temp : Cut off temperature. When used with the optional temperature sensor, a safety cut-off temperature can be set, so that charging or discharging is terminated automatically if the temperature sensor detects the battery temperature rising above the preset temperature.
- Max Capacity : The maximum capacity setting is used to terminate a charge if the charger exceeds the preset percentage of the battery capacity since the batteries that are decrepit or in bad balancing or programmed improper parameters can be overcharged
- Safety Timer : The safety timer can be used to terminate a charge if it is not completed within the preset time period. It is used to protect battery

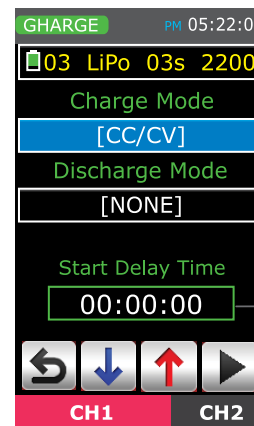
The programmed data is stored to memory and ready to charge battery now. Tapping Enter button makes the charger initiated to charge battery after the process of balance connector checking, charge mode checking, number of cells checking, delay time setup. If the programming setup is performed properly, the charger shows 5 seconds countdown without any control of it

Below picture shows the sequence of charging

• LiPo, Lilon, LiFe, NiCd, NiMH, Pb battery charge process




The charger checks whether balance board is connected. It is automatic process



Charge mode selection

Charge mode and delay time are programmed. Tap the box to activate in blue and tap DEC/INC button to select the desired mode. Charge modes are explained below

The charger initiates to charge after 5 seconds countdown and when to tap Enter button  the charger initiates to charge immediately

Delay time setup

1~150 minutes can be set. The charger initiates to charge battery after the lapse of the preset time.

• Charge mode per battery type

< AUTOMATIC >

NiCd/NiMH : This is an automatic charge, which checks the number of cells and discharge current. The charger calculates the internal resistance and charge current for every period of time and then automatically adjust the discharge current to make sure the best discharge current is delivered to your pack. PEAK SENS, NiCd=7mV/cell, NiMH=4mV/cell are applied automatically and only CUT-TEMP can be programmed



< NORMAL >

NiCd/NiMH : The charger will charge the pack with the preset charge current, but will stop charging every minute to calculate voltage and detect Delta peak. This allows for better peak detection so it is better to for the time worn battery and unstable charge cable

< LINEAR >

NiCd/NiMH : The charger will charge the pack with the preset charge current and detect Delta peak every second without stopping to charge. Since changing the charge cable contact point might terminate charging, make sure not to touch charge cable during charging. The charger will stop charging for a few seconds in 10 minutes to calculate the internal resistance. This method allows to detect ZEROpk (0mV/cell) and terminate without temperature rise

< CC/CV >

Lilon/LiPo/LiFe/Pb : The charger will charge the pack with the preset charge current and detect Delta peak every second without stopping to charge. Since changing the charge cable contact point might terminate charging, make sure not to touch charge cable during charging. The charger will stop charging for a few seconds in 10 minutes to calculate the internal resistance. This method allows to detect ZEROpk (0mV/cell) and terminate without temperature rise

< FAST >

Lilon/LiPo/LiFe : The charge will charge the pack with constant current after constant voltage charging. The calculated voltage from balance cable is used to control so the pack can be charged safely (Only the battery equipped with balance cable should be charged, excluding Pb battery)

< STORE >

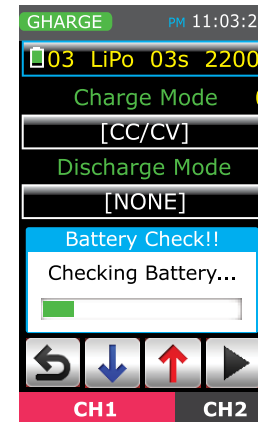
Lilon/LiPo/LiFe : The charge will charge/discharge to store the pack with constant voltage after constant current charging/discharging. CC/CV is applied to N-STORE and FAST is applied to Q-STORE


Charge mode of POLARON EX CHARGER

LiPo, Lilon, LiFe	CC-CV : Normal charge
	FAST : Fast charge
	N-STORE : Normal store charge
	Q-STORE : Quick store charge
	CV-LINK : The packs that has the same number of cells and capacity can be charged simultaneously (If the cells are different, error is occurred)
NiCd, NiMH	AUTO : The charge will automatically adjust the charging condition
	NORMAL : Normal charge
	LINEAR : The preset current is maintained throughout the charge.
Pb	CC-CV : Normal charge

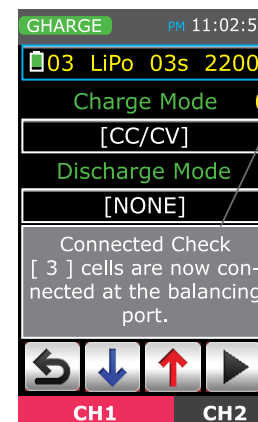


In CV-LINK mode, the packs should have the same voltage, capacity and number of cells. Since the charging parameter is different, it causes the damage to batteries. Please install balance cable to CH1, CH2




→ This page shows the process of battery check when the balancer is connected. The next page is accessed automatically when you tap the Enter button  the charger initiates to charge immediately

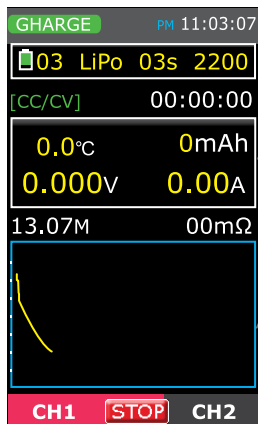
Battery Cell Checking



Number of cells checking

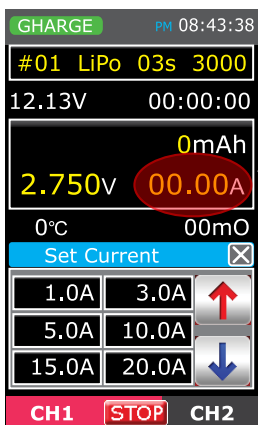
When to connect balance board, the charger can only check the number of cells. If the confirmed number of cells is not correct, tap ESC button to get back to the previous page and check the parameters again. If the number of cells is correct, the next page is accessed automatically. When to be initiated without balance board, it is activated for you to check and decide the number of cells. When to tap Enter button,  the charger initiates to charge immediately

(This page doesn't appear when NiCd, NiMH batteries is connected)



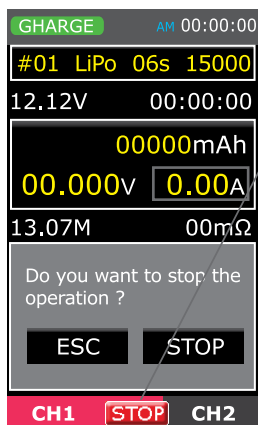
This page shows the charging process with parameters and graph. Voltage and current will reach to the preset parameters. The preset current might have limitation depending on charge/discharge capacity and input voltage setup. Max charge is 400W and max discharging is 60W

When to tap graph, the data view page is accessed. The operating data is shown. Please refer page (27~29 page)



When to tap the part in red circle, Set current window appears and you may change the charge current during operating and set current window disappears when to tap X button.

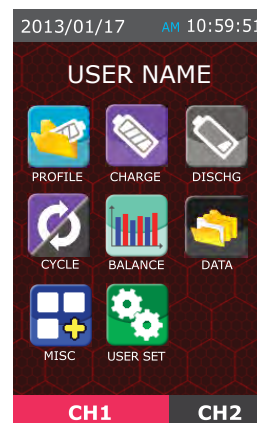
This setup is applied to the charger that is charging and it is not stored to memory



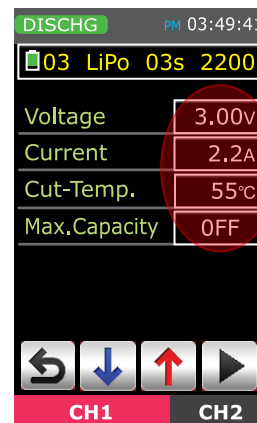
When to STOP button, the pop up window appears which asks whether to stop operating. When to tap STOP or ESC button, the charger will stop or continue the charge

## DISCHARGE PAGE

When to tap DISCHARGE icon on main page, you may access to discharge mode. The programming setup and page transition is the same with CHARGE mode



Tap DISCHARGE icon to discharge at main page



This page shows discharge setup when to select LiPo, Lilon, LiFe, NiCd, NiMH, Pb batteries

When to tap the part in red circle, it is activated in blue and the parameters can be programmed

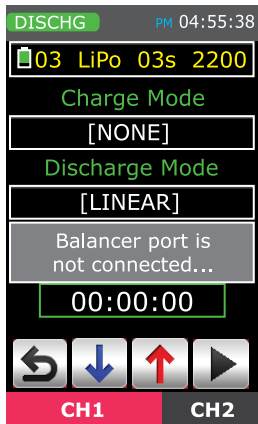
### • LiPo, Lilon, LiFe, NiCd, NiMH, Pb battery discharge mode

- Voltage : Final discharge voltage for each cell can be programmed
- Current : Discharge current, this can be adjusted from 0.1 to 10 Amps and operated within max 60W
- Cut-Temp : Cut off temperature, When used with the optional temperature sensor, a safety cut-off temperature can be set, so that charging or discharging is terminated automatically if the temperature sensor detects the battery temperature rising above the preset temperature,
- Max Capacity : The maximum capacity setting is used to terminate a charge if the charger exceeds the preset percentage of the battery capacity since the batteries that are decrepit or in bad balancing or programmed improper parameters can be over discharged

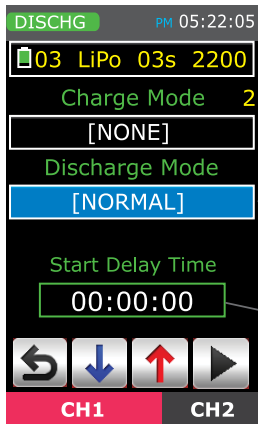
The programmed data is stored to memory and ready to charge battery now. Tapping Enter button makes the charger initiated to charge battery after the process of balance connector checking, charge mode checking, number of cells checking, delay time setup.

If the programming setup is performed properly, the charger shows 5 seconds countdown without any control of it. Below picture shows the sequence of charging

• LiPo, Lilon, LiFe, NiCd, NiMH batteries discharge process




The charger checks whether balance board is connected. It is automatic process



Discharge mode selection

Discharge mode and delay time is programmed. Tap the box to activate in blue and tap DEC/INC button to select the desired mode. Discharge modes are explained below

The charger initiates to discharge after down counting and when to tap Enter button,  the charger initiates to charge immediately

Delay time setup

1~150 minutes can be set. The charger initiates to discharge battery after the lapse of the preset time.

• Discharge mode per battery type

< AUTOMATIC >

- This is a automatic discharge that checks the number of cells and discharge current. The charger calculates the internal resistance and discharge current for every period of time and then automatically adjust the discharge current to make sure the best discharge current is delivered to your pack.
- Cutoff voltage, NiCd=0.9V/cell, NiMH=0.8V/cell, Lilon/Po=3.0V/cell, LiFe=2.5V/cell, Pb=1.8V/cell, are applied (Charging Lithium and Pb batteries after discharging don't affect to battery performance)
- The preset CUT-TEMP is applied

< NORMAL >

- The charge will stop discharging and calculate the average resistance every minute

< LINEAR >

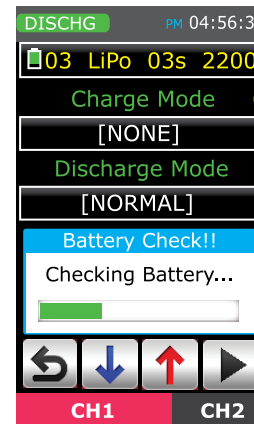
- The charger will discharge the pack without stopping. The charger calculates the internal resistance once by stopping the discharge in 3 minutes since the charge started


Discharge mode of POLARON EX CHARGER	
LiPo, Lilon, LiFe	NORMAL : Normal discharge LINEAR : The preset current is maintained throughout the discharge. LINK : The packs that have the same number of cells and capacity can be discharged simultaneously
NiCd, NiMH, Pb	AUTO : The charge will automatically adjust the discharging condition NORMAL : Normal charge LINEAR : The preset current is maintained throughout the discharge.

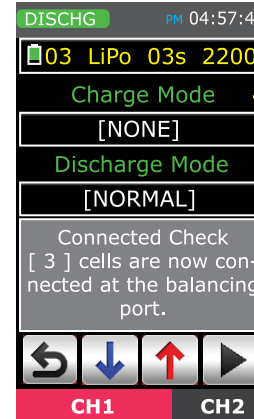


In LINK mode, the packs should have the same voltage, capacity and number of cells. Since the charging parameter is different, it causes the damage to batteries.

\* Please install balance cable to CH1, CH2

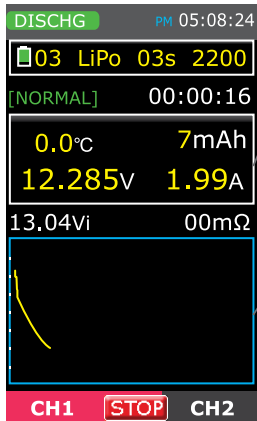


→ This page shows the process of battery check when the balancer is connected. The next page is accessed automatically When to tap Enter button  the charger initiates to charge immediately



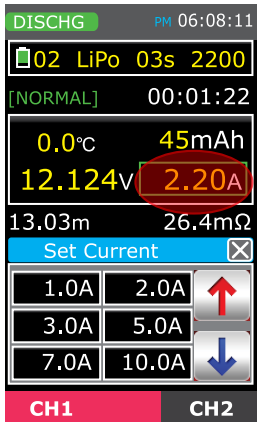
Number of cells checking

When to connect balance board, the charger can only check the number of cells. If the confirmed number of cells is not correct, tap ESC button to get back to the previous page and check the parameters again. If the number of cells is correct, the next page is accessed automatically. When to be initiated without balance board, it is activated for you to check and decide the number of cells. When to tap Enter button, the charger initiates to discharge immediately

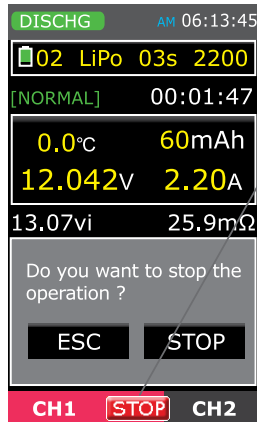


This page shows the discharging process with parameters and graph. Voltage and current will reach to the preset parameters. The preset current might have limitation depending on charge/discharge capacity and input voltage setup. Max charge is 400W and max discharging is 60W

When to tap graph, the data view page is accessed. The operating data is shown. Please refer page (27~29 page 참조)



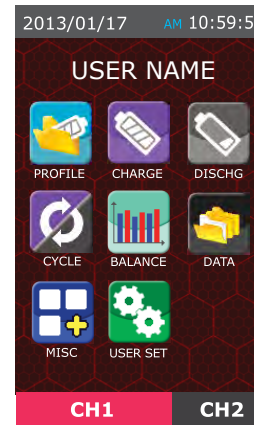
When to tap the part in red circle, Set current window appears and, you may change the discharge current during operating and set current window disappears when to tap X button. This setup is applied to the charger that is discharging and it is not stored to memory



When to STOP button, the pop up window appears which asks whether to stop operating. When to tap STOP or ESC button, the charger will stop or continue the discharge

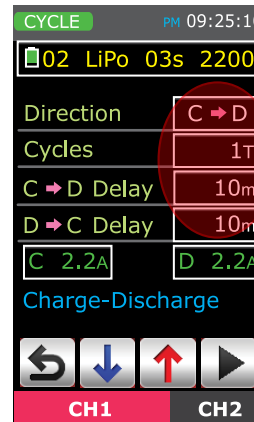
#### • CYCLE PAGE

When to tap CYCLE icon on main page, you may access to cycle mode. When to tap the data box, it is activated in blue and tap DEC/INC buttons to program the parameters



Tap CYCLE icon at main page to access to cycle mode

#### • LiPo, Lilon, LiFe, NiCd, NiMH, Pb batteries cycle page



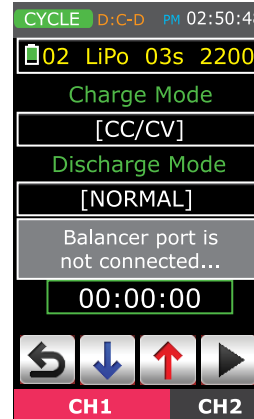
Tap the part in red circle then it is activated in blue and can be programmed. The applied parameters of charge/discharge current came from Charge and Discharge mode. When to tap Enter button, the next page is accessed.

- 1) It is the operating sequence of cycle mode
  - C > D - Discharge after charge
  - D > C - Charge after discharge
  - D:C > D - 1 time discharge: Discharge after charge
- 2) Cycle - The number of operating cycle setup (1~10 times)
- 3) C->D Delay - Time interval setup after charge (1~30min)
- 4) D->C Delay - Time interval setup after discharge (1~30min)

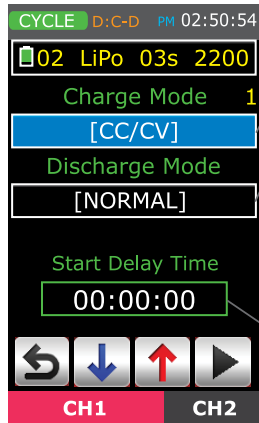


The parameters of charge, discharge came from Charge and Discharge mode. The charge/discharge current can be changed at Charge and Discharge mode

#### • LiPo, Lilon, LiFe, NiCd, NiMH, Pb batteries cycle process




The charger checks whether balance board is connected. It is automatic process



Charge mode selection in cycle mode

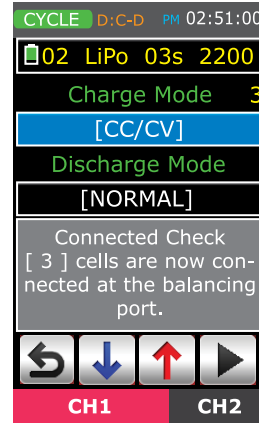
Discharge mode selection in cycle mode

Charge mode and start delay time is programmed. Tap the box to activate in blue and tap DEC/INC button to select the desired mode. Discharge modes are explained below


The charger initiates to discharge after down counting and when to tap Enter button,  the charger initiates to charge immediately

Start delay time

1~150 minutes can be set. The charger initiates the cycle charge/discharge after the lapse of the preset time.

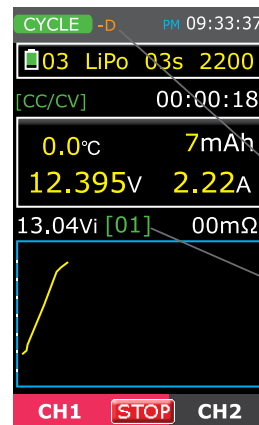


Number of cells checking

When to connect balance board, the charger can only check the number of cells. If the confirmed number of cells is not correct, tap ESC button to get back to the previous page and check the parameters again. If the number of cells is correct, the next page is accessed automatically. When to be initiated without balance board, it is activated for you to check and decide the number of cells. When to tap Enter button,  the charger initiates to charge immediately

• Cycle operation mode per battery type

Cycle charge discharge mode of POLARON EX	
LiPo, Lilon, LiFe, Pb	CC-CV : Normal charge mode NORMAL : Normal discharge mode LINEAR : The preset current is maintained throughout the discharge.
NiCd, NiMH	AUTO : The charge will automatically adjust the charge/discharge condition NORMAL : Normal charge/discharge LINEAR : The preset current is maintained throughout the chage/discharge.

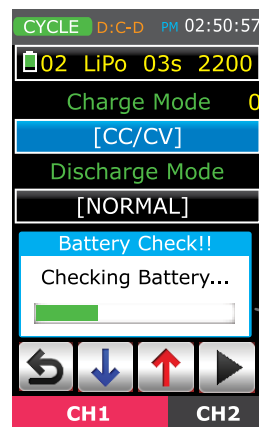



This page shows the cycle process with parameters and graph. Voltage and current will reach to the preset parameters. The preset current might have limitation depending on charge/discharge capacity and input voltage setup. Max charge is 400W and max discharging is 60W

Cycle operating screen  
The operating indicator blinks on the top

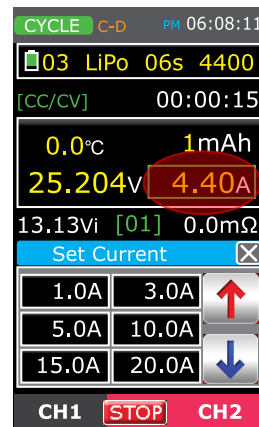
The number of operating cycle is shown

When to tap graph, the operating data is shown

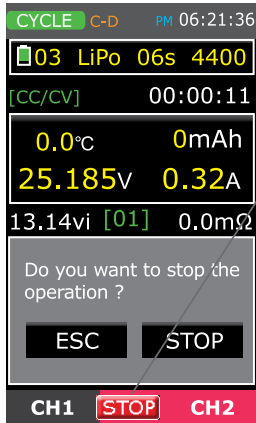


This page shows the process of battery check when the balancer is connected. The next page is accessed automatically. When to tap Enter button  the charger initiates to charge immediately

Battery Cell Checking



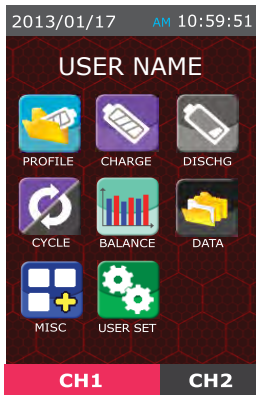
When to tap the part in red circle, Set current window appears and, you may change the charge/discharge current during operating and set current window disappears when to tap X button. This setup is applied to the charger that is operating and it is not stored to memory



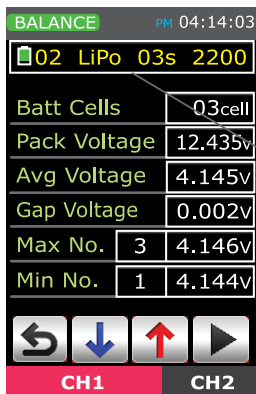
When to STOP button, the pop up window appears which asks whether to stop operating. When to tap STOP or ESC button, the charger will stop or continue the cycle

### ◎ BALANCE PAGE

When to tap BALANCE icon on main page, you may access to balance mode. When to tap DEC/INC Buttons, the below 3 modes are transited each other. Tap Enter button to initiate balancing. The mode is applied to the battery that is equipped with cell balance connector such as LiPo, Lilon, LiFe batteries,

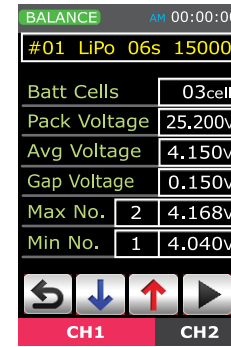


Tap BALANCE icon to access balance mode (Balance connector should be installed)

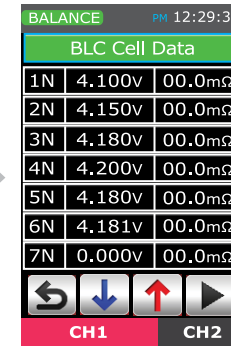


• LiPo, Lilon, LiFe battery balance page  
This page shows the parameters of the connected battery

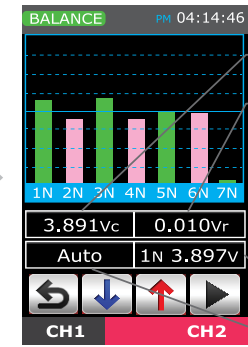
When to tap the box, it is activate in blue and you may select battery memory



▲ BALANCE MODE 1



▲ BALANCE MODE 2



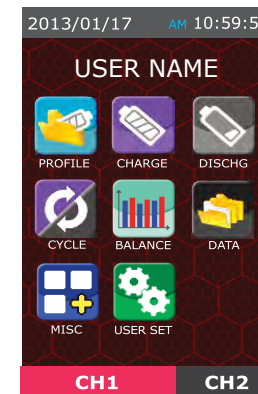
▲ BALANCE MODE 3



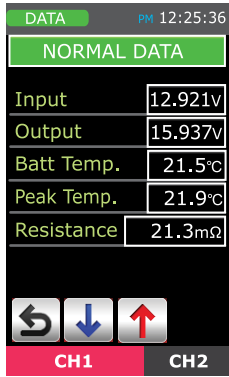
- 1) BALANCE MODE 1 : This page shows the basic date of battery
- 2) BALANCE MODE 2 : This page shows each cell voltage and internal impedance
- 3) BALANCE MODE 3 :
  - Center Voltage(Vc): It is the center voltage of Y axis
  - Range Voltage(Vr) : It is the voltage range of every section in Y axis
  - Manual / Auto
    - Manual: You can set the graph operating. Tap the data box to activate and tap DEC/INC buttons to program the parameters. Center Voltage and Range Voltage can be activate and programmed at manual setup
    - Auto : This is an automatic setup of the graph operating. Each cell voltage is activated and checked
  - Cell Voltage : it shows each cell voltage. Tapping makes it activated and you may check each cell data

### ◎ DATA VIEW PAGE

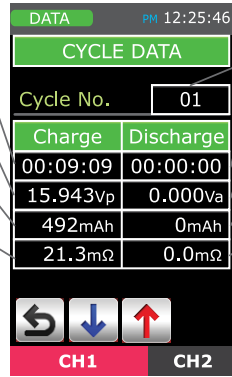
When to tap DATA icon on main page, you may access to data view mode. There are 3 view modes The data can be programmed tapping DEC/INC buttons after activating in the case of Cycle data and Graph data modes, but the data in the Normal data mode can not be programmed



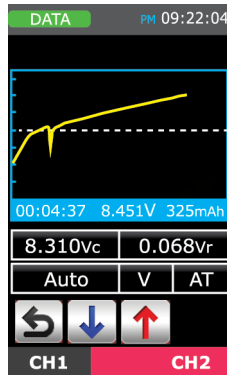
Tap DATA icon to check the charge/discharge data at main page



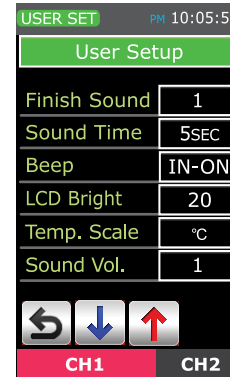
▲ NORMAL DATA



▲ CYCLE DATA



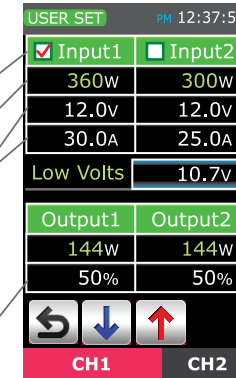
▲ GRAPH DATA



▲ CONFIG MODE 1

Finish Sound : 10 kinds of sound is available  
 Sound Time : The time that the charger sounds ON, OFF, 5sec, 15sec, 1min are available  
 Beep : It can be turned on/off to select internal or external button  
 LCD Bright : Brightness of backlight can be adjusted, 1~20 steps  
 Temp. Scale : The temperature unit can be changed  
 Sound Vol. : The sound level can be adjusted, 1~5 steps

- 1) NORMAL DATA : It shows input/output voltage, temperature, resistance of battery in real time
- 2) CYCLE DATA : It shows the data according to cycle number
  - Charge/discharge time: It shows the time of charge/discharge termination
  - Peak voltage : It shows the max voltage during charging
  - Charge/discharge capacity: It shows the charge/discharge capacity when the operation is terminate
  - Internal impedance of battery: It shows the internal impedance during charging/discharging
- 3) GRAPH DATA : It shows the graph of voltage, current, temperature during operating.  
 The graph is accordance with the programmed data automatically or manually



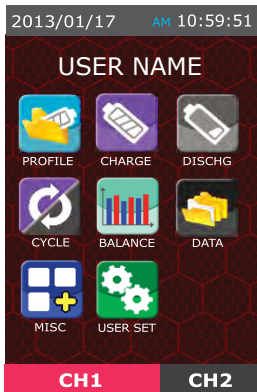
▲ CONFIG MODE 2


Input1 : Input in the rear of charger  
 Input power source wattage  
 Power supplier voltage, current  
 Wattage sharing percentage between 1CH and 2CH

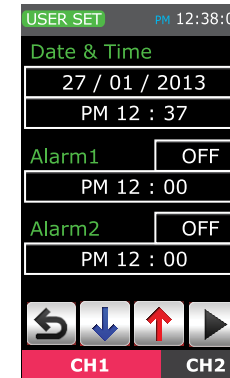
Input2 : Input by side SMPS, it hasn't been activated  
 Low voltage error setup

◎ USER SETUP PAGE

When to tap USER SET icon on main page, you may access to user setup mode. It is consisted of 4 modes The data can be programmed and page can be transited tapping DEC/INC buttons




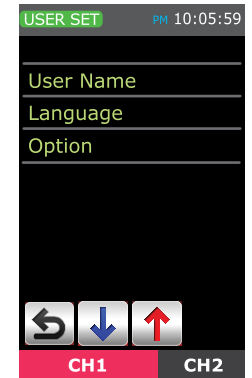
 Tap USER SET icon to program user setup at main page



▲ CONFIG MODE 3

Date & Time : Date, month, year, time setup  
 Alarm 1 : The first alarm time setup.  
 When not to use, set to OFF  
 Alarm 2 : The second alarm time setup.  
 When not to use, set to OFF

  
 CH1 user setup of can be set at CONFIG MODE 1~4,  
 Only Finish sound of CONFIG MODE in CH2 user setup can be set

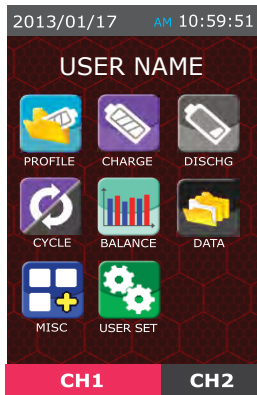


▲ CONFIG MODE 4

User Name : Enter user name  
 Language : Not applied yet  
 Option : Not applied yet

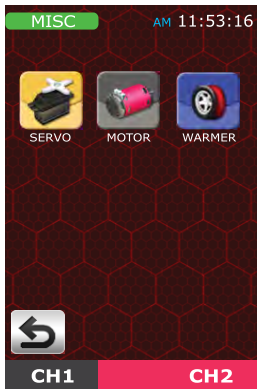
© MISE PAGE (Addition function)

When to tap MISE icon on main page, you may access to MISE mode and program Servo, Brushless/Brushed power motor, Warmer function.



Tap MISE icon to program MISE setup at main page

You may use the additional function at CH1 or CH2, which is not operated.



→ This is MISE setup page. When to tap 3 icons, each mode can be accessed and tap ESC button to get back to the previous page at each mode



- It is used to test Servo and Brushless Motor



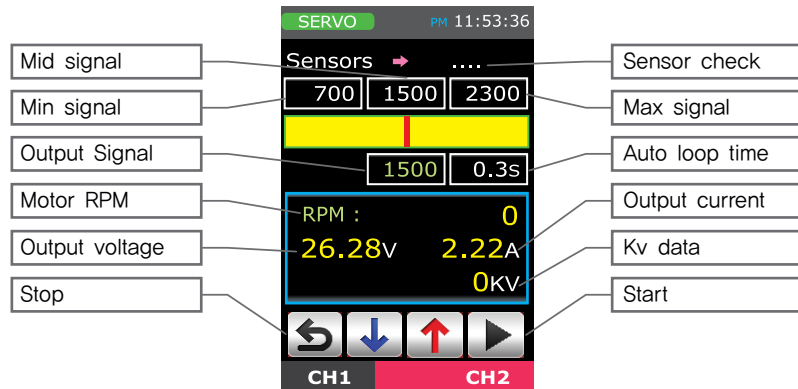
- It is used to test and tame Brushed Motor



- It is used to warm up battery and tire

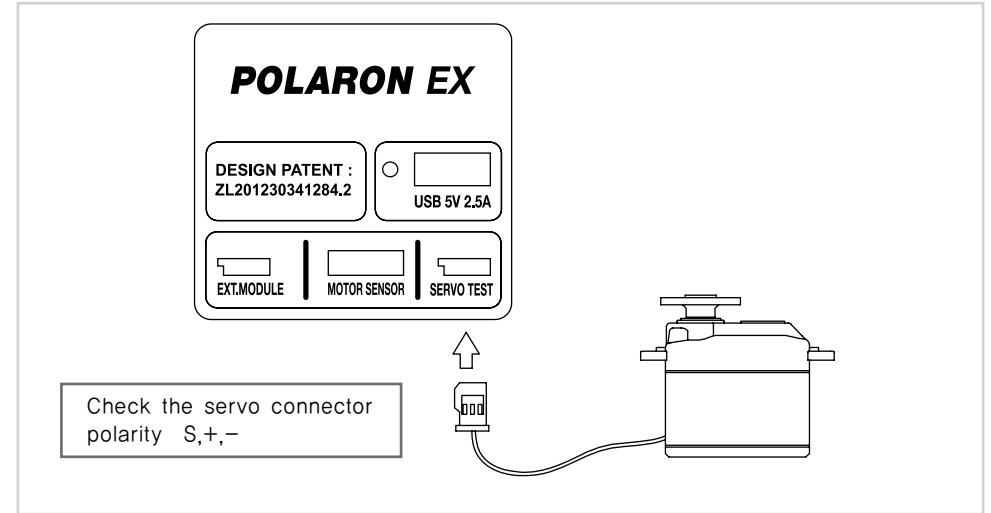


Servo and Brushless motor testing setup



1) Servo test division (Screen top)

- Connect Servo to the connector in the right side of charger, refer below picture

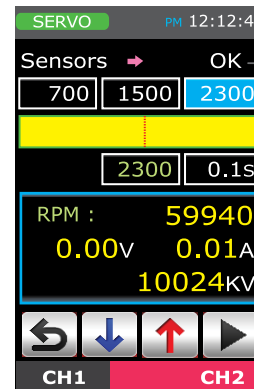


- Min, Mid, Max signal : When to tap the relevant buttons, servo is operated in accordance with the preset signal. The parameters of each article can be changed tapping DEC/INC buttons
- Output signal : It shows the current signal output parameters
- Auto loop time : When to tap Enter button after setting 0.1~5.0sec, Auto loop is operated. The high power servo may not be operated smoothly in the short operating time since it needs much more peak current. In this case, extend the operating time

2) Motor test division (Screen Top and bottom)

- Motor sensor connector and servo test connector are used

- Sensors on the top shows whether 3 sensors in the motor is OK or not
- RPM and Kv are shown in the bottom

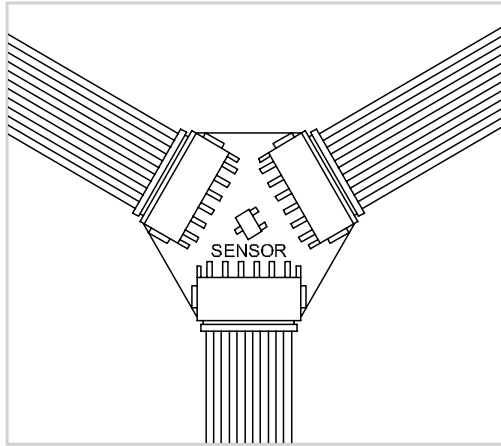


Rotate the motor shaft for about 5 seconds continuously, then the charger shows whether sensor is OK or not. Motor should be connected to motor sensor connector

To check motor RPM and Kv, the optional splitter is needed, refer below picture

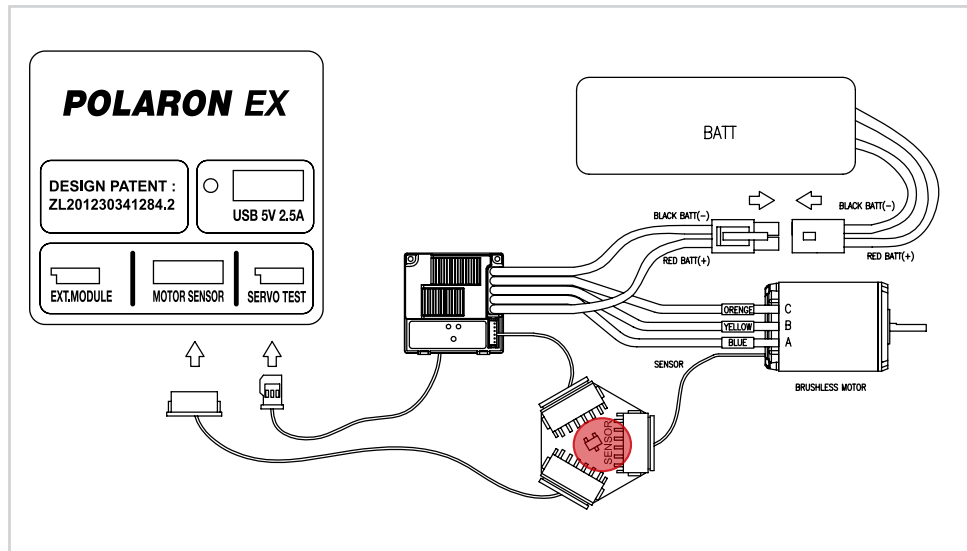


- The optional accessory



Wire splitter for testing motor sensor (S8002)

- Connection configuration for ESC, Motor, Battery, Wire splitter



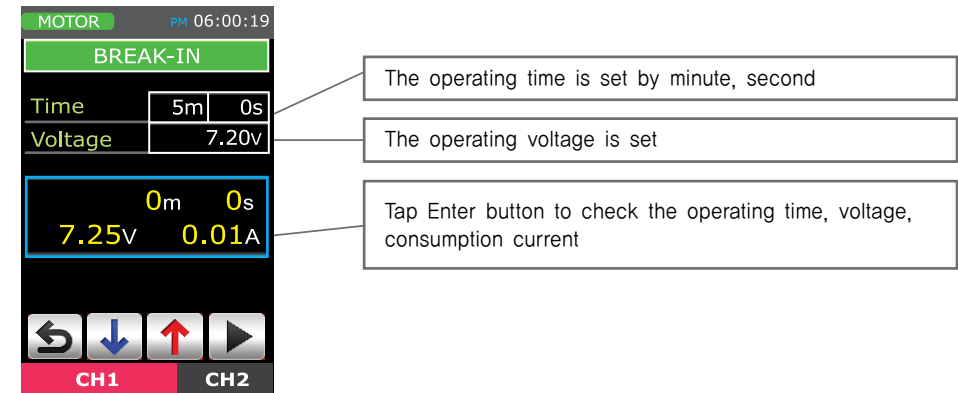
It is for connection of charger side terminal.  
 The connector marked "sensor in the wire splitter is connected to motor and the left 2 connectors are connected to charge and ESC  
 ESC signal connector is connected to charge servo test socket

-  Brushed motor setup

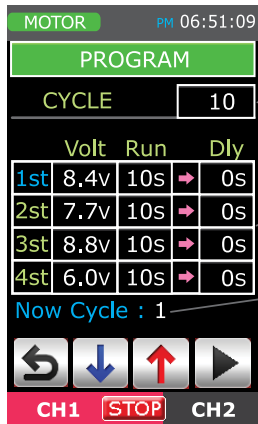
Connect motor to 4mm banana charge socket and tap MOTORicon to access motor setup mode  
 This page is consisted of 3 menus



- 1) Break-In
  - Motor is operated and tamed with the preset voltage for the preset time



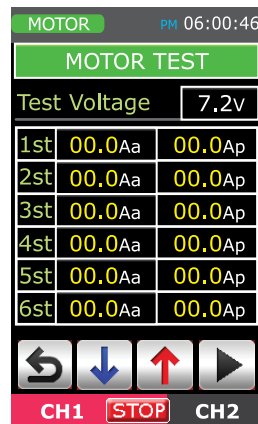
- 2) Program
  - There are 4 steps. Set voltage, operating time, delay time and number of cycle for every 4 steps and tap Enter button. The charge will repeat to tame motor as many as the preset number of cycle. The blue character shows the current process



- Setting the number of cycle, 1~10 cycles
- Setting the operating voltage, operating time, delay time for each 4 steps
- The operating cycle number

### 3) Motor test

- When to operate motor, you may check the average current (Aa) and the peak current (Ap) in 6 steps

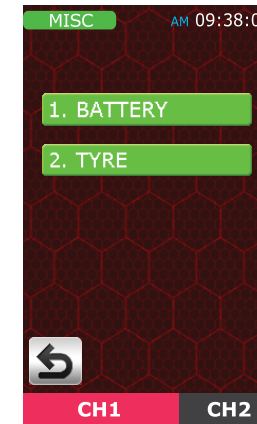
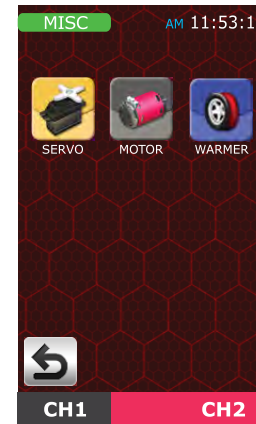


- Test voltage setup, 4.8V or 7.2V
- It shows the average current and the peak current of 6 steps  
Every step is operated in 5sec on/ 3sec off



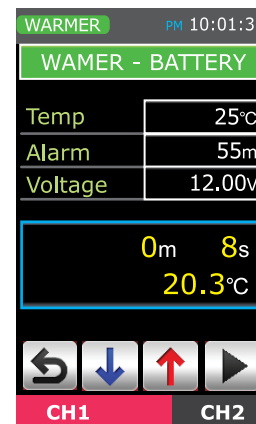
### Warmer setup

Connect warmer to 4mm banana charge socket and tap WAEMER icon to access warmer setup mode This page is consisted of 2 menus



### 1) Battery Warmer

- Lithium type batteries in low temperature tend not to output normally. This function is used to warm battery to lead to output normally when to store batteries outdoor. Connect the exclusive battery warmer bag to the charger output terminal and temperature sensor connector then program the parameters to use



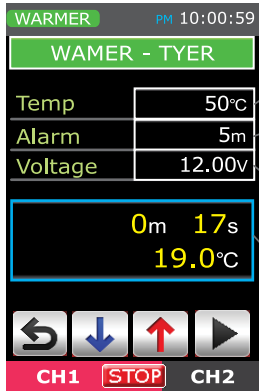
- Temperature setup
- Alarm setup  
Alarm rings on the preset time and the charger still keeps operating. When to tap STOP button, alarm is stopped
- Output voltage setup  
It is controlled automatically when the temperature sensor is installed and the preset voltage is outputted if there isn't temperature sensor.  
The temperature setup range is 5~15V
- Processing time and temperature



Temperature is not controlled automatically when to use a bag that isn't equipped with temperature sensor, so you need to control voltage to keep the desired temperature of a bag inside. Please notice that over voltage setup causes a fire

### 2) Tire Warmer

- It is used to warm rubber tire and gives you an important competitive edge on the track  
Connect the tire cup to the charger output terminal and to temperature connector then program the parameters to use

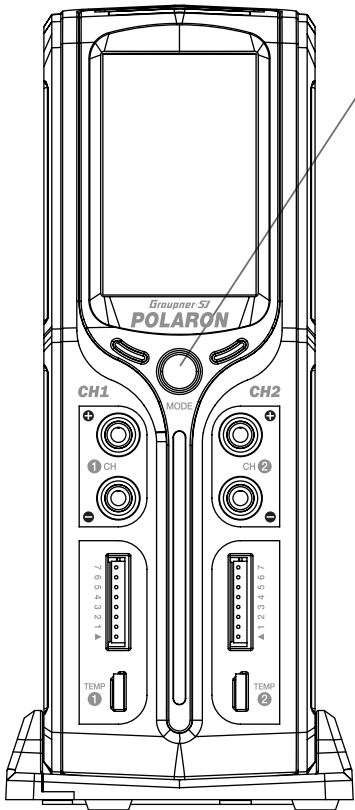


- Temperature setup
- Alarm setup  
Alarm rings on the preset time and the charger still keeps operating. When to tap STOP button, alarm is stopped
- Output voltage setup  
It is controlled automatically when the temperature sensor is installed and the preset voltage is outputted if there isn't temperature sensor. The temperature setup range is 5~15V
- Processing time and temperature



Temperature is not controlled when to use a warmer that isn't equipped with temperature sensor, so you need to control voltage to keep the desired temperature of tire. Please notice that over voltage setup causes a fire

© FACTORY SETUP AND SCREEN CALIBRATION



Button for Channel changing and initializing

< Factory Setting >

- 1. Data Initialization
- 2. Touch Calibration
- 3. Resource Upgrade
- 4. BLC Port Test

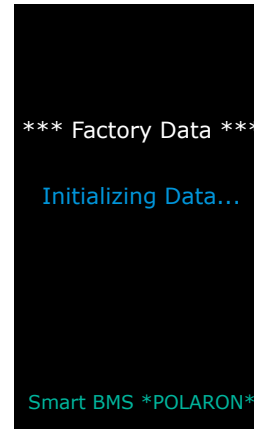
Smart BMS \*POLARON\*

Press and hold button and turn on the charger's power

- Returning to factory setup
- Touch screen compensation
- Image and sound update
- Checking balance port

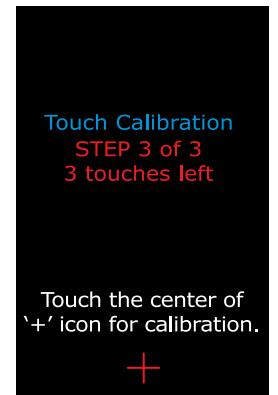
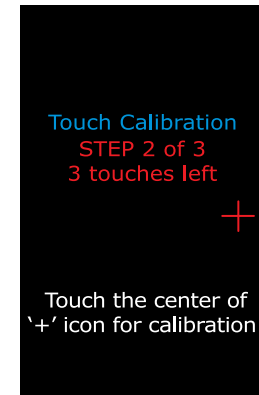
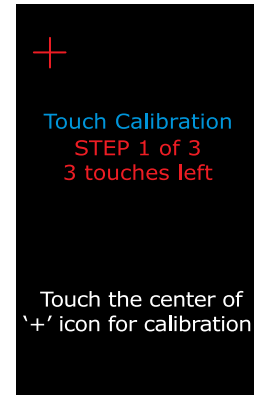
The user can adjust No 1,2,3 and manufacture can adjust No 4 (The user can't adjust)

1. Data Initialization

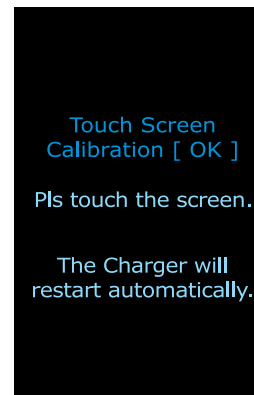


When to tap No1, you may access to factory data mode. The characters blink red and blue by turns indicating that it is operated. You may return to Start up page automatically after Data Initialization is completed

2. Touch Calibration



When to tap "+" icon 3 times on the screen, the screen is arranged.



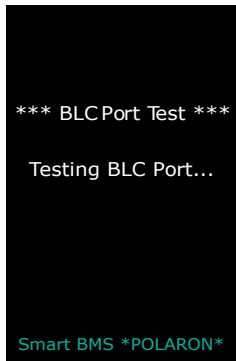
When to tap anywhere on the screen, Touch calibration is completed and return to Start up page

### 3. Resource Upgrade



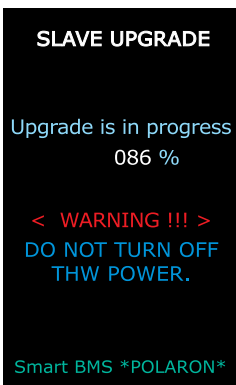
1. This screen is for image and sound download to flash memory in the charger from PC
2. The way of update is introduced at [www.openhobby.com](http://www.openhobby.com) and [www.graupner-sj.com](http://www.graupner-sj.com)

### 4. BLC Port Test (Checking balance port)



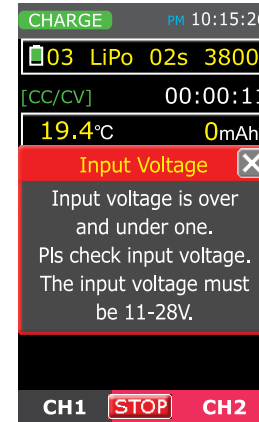
1. The update is processed at charge main page and PC software is needed
2. Select the file at PC software and tap execute button, the update is processed
3. The progress is shown as percentage
4. The status LED of charge blinks at 100ms intervals

### © PIC SLAVE MICOM UPGRADE (Product Update)



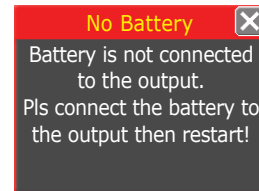
1. This screen is for product update from PC
2. The way of update is introduced at [www.openhobby.com](http://www.openhobby.com) and [www.graupner-sj.com](http://www.graupner-sj.com)

### © ERROR MESSAGE

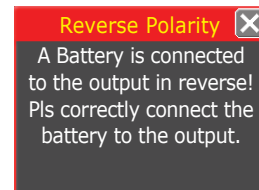


POLARON EX DC charger has a number of error and warning messages that are designed to advise the user of any problems. When applicable, tapping error message clears the message and get back to previous page

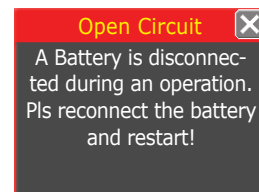
- ▶ Input voltage is lower than 11V or higher than 28V



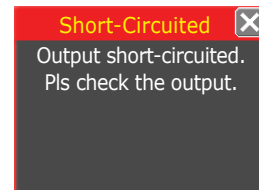
- ◆ There is no battery connected to charger




- ◆ The battery is plugged in "backwards," positive to negative.



- ◆ The charging/discharging battery is disconnected during use




- ◆ There may be a fault at the charger' s output leads, the battery' s leads, and plugs for the cause of the short circuit or an internal fault within the

**Low Output-Volt** 


Output voltage is lower than the selected cells or voltages.  
Pls select proper cells or voltages.

- ◆ The out voltage setup is lower than charging/discharging battery or the number of cells is improperly selected

**High Output-Volt** 


Output voltage is higher than the selected cells or voltages.  
Pls select proper cells or voltages.

- ◆ The out voltage setup is lower than charging/discharging battery or the number of cells is improperly selected

**Temp. Sensor** 


A temperature sensor is connected in reverse or is defective.

- ◆ The temperature sensor is plugged in "backwards," positive to negative or there is a fault in the sensor

**Bat.Temp Too Low** 


Battery temp is too low to be operated !

- ◆ The battery temperature is too low the be charged

**Bat.Temp Too High** 


Battery temp is too high to be operated !

- ◆ The battery temperature is higher than the preset temperature

**Internal Temp.** 


Internal temp is too hot!  
Contact Hobby Services if this message appears often.

- ◆ The charger' s internal temperature is too high

**BLC Volt High** 


Balancer cell voltage is too high !  
Over cell is [0]

- ◆ Balancer cell voltage is too high

**BLC Volt Low** 


Balancer cell voltage is too low !  
Low cell is [0]

- ◆ Balancer cell voltage is too low

**Calibration** 


Either calibration data or internal circuit might have been damaged.

- ◆ There is a fault in the default calibration date or charger' s internal circuit

**No Sensor** 


A temp-sensor is not connected to the port.  
Pls connect the sensor to the port then restart!

- ◆ Temperature sensor is disconnected

**Connection** 


Selected cells and cells connected to the balancing port are different !  
Pls recheck and restart!

- ◆ The preset number of cells and the detected number of cells are different

**Motor Current** 


Pls reconnect the moto rand restart !

- ◆ The operating current is much higher at MISC MOTOR function

**Balancer Port** 

BLC Port is opened.  
Pls check the BLC port.

- ◆ The balance connector is disconnected

**Sync. Command** 

Sync order failed.  
Error occured in the counterpart channel !

- ◆ The preset number of cells and the number of cells of CH1, CH2 are not matched at Charge/dischage and Sync mode

## © USE OF PROBLEM AND PRECAUTION FOR POLARON EX DC CHARGER

- Turning on the charge, but LCD Screen is off
  - Check if the correct external power source, this charge should be operated only from the type of power source indicated on the specification. In case that the problem is not settled, please contact A/S center
- The charger doesn't recognize battery
  - Check if the battery connection and polarity are correct. Change the cable if the worn out cable is used
  - Change the damaged cell in battery pack if a cell is damaged
- Battery voltage is low after charging (Each cell voltage of NiCd, NiMH is lower than 1.2V or each cell voltage of LiPo, Lilon is lower than 3.6V or 3.7V)
  - Increase the max charge capacity if it is too low.
  - Control Peak sens of NiCd, NiMH if it is too low or high and change the charge cable if the worn out cable is used
- Discharging mode is not accessed
  - Match the preset battery voltage and the cell voltage
  - Change the damaged cell in battery pack if a cell is damaged
- mAh/time is too low after charging
  - Battery might not be fully charged, fully charge battery and discharge again. Perform cycle to improve battery capacity if battery is worn out or not used for a long time.
  - Reduce discharge cut off voltage if it is programmed too high and control the discharge ratio.
  - Match the preset battery voltage and the cell voltage.
  - When to discharge with over current, make sure to discharge the remained current again. For example, when to discharge with higher than 5A, cool down the battery and then discharge with 1A again
- Charge Lithium type battery
  - Make sure to use a balance board and must use EH to XH cable
  - Do not charge Lithium battery packs above their maximum charge rate. This can damage the pack and can be dangerous. Generally, Lithium Polymer packs should not be charged above 3C. However, some newer packs do allow charging at up to 5C, but charging at these higher rates will reduce the life of the pack.

## © NEW BATTERY CHARGE

- When the new NiCd/ NiMH are charged at the first time, charge process might be terminated within minutes, it is not because charger or battery have a problem, but because battery is not stabilized yet. In this case, you need to charge battery after increasing the delta peak value or to charge battery after discharging and cooling down battery.
- Do not use the battery, if the charged capacity of battery exceeds battery capacity in specification. If such a phenomenon arises, repeat to charge and discharge more over 5 times and charge again.

## © Pb BATTERY SAFETY

- Pb battery needs to be charged every day. If the charged capacity of battery is dropped below 50%, this battery might not be recharged. The average charge time of Pb battery is 4~5 hours. Do not charge an automobile battery, the charger might get the serious damage

## © Lilon, LiPo, LiFe BATTREIES SAFETY

- Always charge the batteries that have Lithium ion or Lithium polymer mark and do not charge the batteries that have Lithium mark. Failure to do so will damage the batteries and may cause fire or personal injury.
- Always charge the batteries that the cell voltage ( 3.3V / 3.6V / 3.7V ) is written
- Ensure that the charger and battery are placed on a non-flammable surface whilst charging.
- Never charge Lithium ion/Polymer/Fe batteries inside a vehicle whatever the circumstances.
- Always ensure that the charger is correctly set for the battery being charged, checking both voltage and capacity. Be particularly careful if using a series/parallel battery pack, or if using packs of different specifications with the same charger.
- Never charge at a rate higher than that recommended by the cell manufacturer, this can be very dangerous.
- Do not leave Lithium ion/Polymer/Fe batteries unattended whilst they are charging. Monitoring the batteries during charging is very important.
- Always monitor the temperature of the battery being charged every few minutes. If the battery becomes hot to the touch, disconnect it from the charger immediately and allow to cool. Do not recommence charging until the battery and charger have been checked for compatibility and the charger settings have been confirmed as being correct.
- In the unlikely event of the Lithium ion/Polymer/Fe battery catching fire DO NOT use water to attempt to put the fire out, instead use sand or a fire extinguisher designed for electrical fires.

- When used correctly, Lithium ion/Polymer/Fe battery packs are as safe as any other type of rechargeable battery pack. However they do require different charge regimes to the longer established Nickel Cadmium and Nickel Metal Hydride technologies and have the potential of catching fire if severely mistreated.
- If Lithium Polymer battery packs are short-circuited or severely over-charged elemental Lithium may be deposited internally, and if the battery pouch is damaged this can escape from inside the battery. If this occurs a fire may be caused, as elemental Lithium is highly reactive when exposed to water or moisture, producing flammable hydrogen gas and corrosive fumes. Elemental Lithium is not produced unless the battery pack is severely mistreated, so in normal usage there is no likelihood of explosion or fire.
- Lithium Ion/Polymer battery packs must NEVER be discharged below 3 volts per cell (Li-Fe 2.0V) as this will result in damage to the cells. If the voltage is allowed to drop below 3 volts per cell the battery voltage may seem to recover following a charge, but the battery may not then give its full nominal capacity and a reduction in performance is likely-allowing the voltage to drop below 3 volts per cell will invalidate all warranty claims.
- Never charge Lithium Polymer battery packs at greater than 4.2V per cell, Lithium Ion at 4.1V volts per cell or LiFe at greater than 3.7V per cell as this will cause irreversible damage to the cells and will invalidate all warranty claims.
- Never charge Lithium battery packs above their maximum charge rate. This can damage the pack and can be dangerous. Generally, Lithium Polymer packs should not be charged above 2C (2 x Capacity). However, some newer packs do allow charging at up to 5C, but charging at these higher rates will reduce the life of the pack.  
e.g Pack of 2500mAh capacity : 2C = 5000mAh = 5A max
- Do not use discharge rates in excess of those specified with the battery pack as this will result in a significant drop in voltage under load and will dramatically reduce the number of charge/discharge cycles the battery pack will give. If disposing of Lithium battery packs ensure that the pack is fully discharged by using a light bulb, electric motor or similar to completely discharge the pack.



Do not allow any Lithium battery pack to short-circuit as this is likely to result in a minor explosion and consequent fire.

- Before charging any Lithium battery packs they should be closely inspected for any damage, such as punctures in the sleeving or if the battery has swollen or expanded in size. If any such damage is detected Do not charge, even if the battery otherwise appears to be brand new.
- Before commencing charging always double check the settings on the charger to ensure it is set correctly for the battery pack to be charged. Using the wrong settings is likely to result in damage to the battery pack being charged and could result in the battery catching fire.

## © COMPLIANCE INFORMATION FOR THE EUROPEAN UNION

### Declaration of Conformity



NO. BCT13CC-0279E

Product(s): POLARON EX DC Battery Charger  
Item Number(s): S2011

The object of declaration described above is in conformity with the requirements of the specifications listed below, and accordance with the following applicable directives: 2004/108/EC Electromagnetic Compatibility

EN55014-1:2006+A1:2011

EN55014-2:1997+A2:2008

### ENVIRONMENTAL PROTECTION NOTES

This product must not be disposed of with other waste. Instead, it is the user's responsibility to their waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service or where you purchased the produce



[www.graupner-sj.com](http://www.graupner-sj.com)  
[www.openhobby.com](http://www.openhobby.com)