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| <b>Ekyrail Enterprises inc.</b>                       |             |                 |             |
| Doc. N° :1020140085                                   | Révision :A | Date 18-12-2013 | Page i de 2 |
| Sujet : <b>Battery Charger/Booster service manual</b> |             |                 |             |



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# PART – 1 : INSTALLATION

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## INSTALLATION

## 1. INTRODUCTION

This user manual contains important technical instructions to be followed by qualified personnel responsible for the installation, start-up and maintenance operations and knowledgeable on batteries and safety requirements/precautions involved. We recommend this manual to be read attentively to ensure safe and reliable operation of this equipment. Should you require any assistance, please call our service department.

## 2. IMPORTANT SAFETY INSTRUCTIONS

**Keep these instructions in a safe place: this manual contains important safety and operating instructions**

AC and DC currents are present in this system **even** with indicators and breakers are in “**OFF**” position.

Before performing any maintenance on this system, make sure that the **battery** and the **AC** power are disconnected.

- Only experienced and qualified personnel must perform maintenance.
- Electrostatic sensitive components are used in this equipment. Proper ESD (electrostatic discharge) procedures must be followed to prevent any severe damage to electronic components.
- Working in the vicinity of Lead Acid or Nickel Cadmium batteries is dangerous: **batteries generate explosive gases** during normal operation. Therefore, **never smoke** or allow an **open spark** or **flame** in the vicinity of the battery or engine.
- To reduce risk of battery explosion, follow these instructions and those on the battery.
- Never charge a **frozen** battery.
- Do not expose charger/rectifier to rain or snow unless it has the appropriate NEMA/IP rating.
- Do not install or operate chargers if they have been dropped or damaged.
- Refer to your local/national electrical code for installation

## 3. STORAGE / MAINTENANCE DURING STORAGE

If the charger/rectifier has to be stored before commissioning, it should be stored in a dry place, in the ambient temperature within  $-40^{\circ}\text{F}$  to  $185^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ), not exposed to direct sunlight, on the same pallet, protected against moisture, dust, dirt and damage. Do not use the charger/rectifier as a stocking shelf.

Remember that storing the charger/rectifier for a long period (**5 years or more**) can deteriorate performance of the filter capacitors and can cause also contact oxidation for relays, breakers, contactors... Filter capacitors shall be replaced after storing the charger/rectifier 5 years or more.

Please contact the manufacturer for capacitor specifications and installation.

### Warning

For batteries and other accessories (UPS...), please refer to the specific manufacturer indications for battery periodical recharge and powering up procedure after storage.

## 4. PLACEMENT AND INSTALLATION

FOR INSTALLATION, PLEASE REFER TO NATIONAL AND/OR LOCAL ELECTRICAL CODES.

Chargers/rectifiers are very heavy. To prevent personal injury or equipment damage, use appropriate lifting devices and execute extreme care while handling the equipment.

The following instructions are very important to satisfactory operation. Changing the settings voids the warranty.

## Warning

Battery application and maintenance:

Your battery is a crucial back up for your critical application. Special care and appropriate safety and maintenance procedures must be implemented.

Please refer to the battery manufacturer instructions and the applicable battery installation, maintenance, testing and replacement standards for stationary application in order to optimize the life of the battery as well as to determine when the battery should be replaced.

VRLA case (Lead Acid battery incorrectly called "maintenance free"): As this battery is sealed not allowing visual inspection or water addition, dry out and thermal runaway inside the battery can happen resulting to an unpredictable failure occurrence. Great care in installation, maintenance, testing and replacement is required to insure availability of backup power.

The manufacturer instruction, your local standards and the following standards can be your guide to help to apply proper procedures: (other standards may apply).

IEEE484: IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications.

IEEE450: IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary applications.

IEEE1188: IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications.

IEEE1106: IEEE Recommended Practice for Installation, Maintenance, Testing and Replacement of Vented Nickel-Cadmium Batteries for Stationary Applications.

## 5. VENTILATION AND COOLING

The rectifier/charger is rated to better perform within 18°F (−10°C) and 122°F (+50°C) temperature range. To calculate the required air displacement (exchange) volume, please use the following equation:

$$V = BTU \frac{e^{0.125 H \frac{T_k}{T_0}}}{T_r - T_k}$$

**V** = air flow: [cubic meter/hour]

**BTU**: Total dissipated heat

**T<sub>r</sub>**: Maximum allowed room temperature [°K] {i.e. 50°C = 323°K}

**T<sub>k</sub>**= Temperature of input cooling air

**T<sub>o</sub>**= 273 °K

**H** = Altitude [km]

### WARNING!

**Avoid** placing the system in **direct sunlight**

The **adequate ventilation** and safe access require that the following clearances are respected:

- 3 in. (10 cm) on the sides and top;
- 3 feet (1 meter) in front of the unit;
- **DO NOT INSTALL OVER COMBUSTIBLE SURFACES;**

Should seismic conditions require a more secure installation the unit can be **bolted to the floor**. Four (4) holes are provided for this purpose.

## 6. ELECTRICAL CONNECTIONS AND WIRING

Before connecting the battery charger ensure that:

- The battery is disconnected (if applicable)
- The circuit breakers are OFF
- The relays, fuses and circuit boards are installed
- The unit is wired in accordance with the instructions (refer to the wiring connections and electrical diagram)

The appropriate cable sizes are very important. The **nameplate** provides the essential information regarding the input and output voltages and currents.

Use a branch feeder (circuit breaker or fused disconnect switch), sized to the maximum input current.

Refer to your Local or **National Electrical Code** for LOCKOUT, WIRE GAUGE and GROUNDING instructions.

The ampacity of the power cables must be sized to the maximal correspondent current.

Correct voltage and polarity are of critical importance. Check all connections for tightness and polarity. Connect battery (if applicable to the output terminals observing its polarity).

## 7. POWERING UP

After the installation of all wires is completed and has been double checked, the unit may be powered up as follow:

- Before connecting a load to a charger, compare the critical characteristics of the load against those of the charger (i.e. **measure** ripple, line-neutral voltage, positive-neutral voltage).
- Keep a log of the values entered for  $V_{\text{FLOAT}}$  and  $V_{\text{EQUALIZE}}$  values entered, alarm messages, alarm and SCR blinking LEDs, etc.
- All input and output breakers must be in **"OFF"** position
- Apply power to the equipment from a source
- Turn on AC breaker (if supplied) (**"ON"** position)
- Turn on DC breaker (if supplied) (**"ON"** position)
- Green LED must light up
- Wait 5 seconds until the LCD display will show the system's output voltage and status
- The system soft starts by rising the output current and the voltage

If an adjustment or calibration of the unit is necessary, refer to the **field programming** section for more information.

## 8. SYSTEM POWERING OFF PROCEDURE

- Open the DC breaker (if supplied) (OFF position);
- Open the source panel's AC breaker (if supplied) (OFF position);
- Open the AC breaker feeding the powering the battery charger from external distribution panel;
- If work inside a unit has to be performed, wait 5 minutes to let the filter capacitors to discharge or use bleeding resistors of the correct rating to discharge the capacitors;

After following all previous steps, the battery charger can be considered de-energized.

# PART – 2: THEORY OF OPERATION

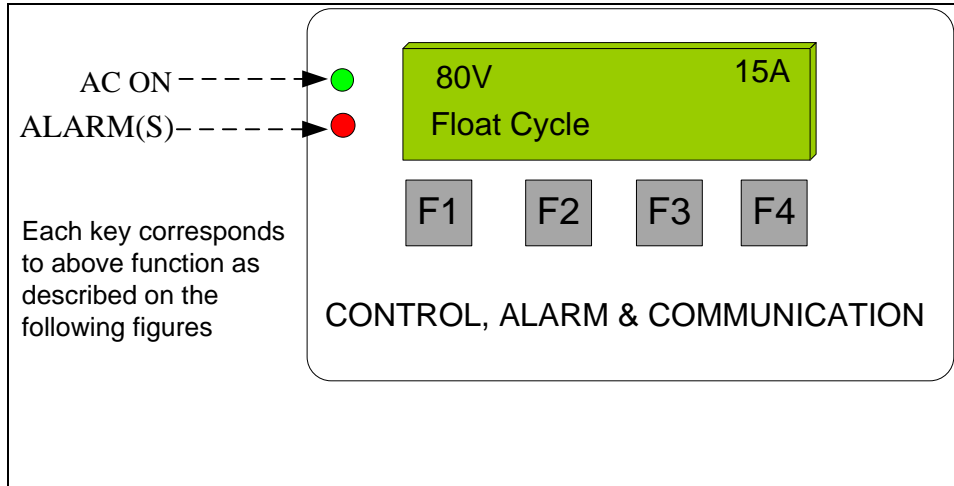
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## THEORY OF OPERATION

# 1. THEORY OF OPERATION

The battery charger provides a fully regulated and Isolated DC output from the main AC input. The LCD show continuously the battery charger status: DC Voltage, DC current, alarms ....

## 1.1 LCD DISPLAY AND KEYPAD



**Figure 1 : Battery charger home screen.**

The LCD display and keypad provide very flexible and user friendly interface. The standard display is a high visibility backlit two-line LCD display. Four (4) long life membrane switches are used as the keypad buttons.

## 1.2 GETTING FAMILIAR WITH BATTERY CHARGER LCD INTERFACE

All adjustable values and readings are displayed on the first line. Ex.: alarm activation status, voltage and current readings...

On the second line, soft keys are used: each keyboard button's function is displayed. The assignment of a button to a function can change as needed by different menus or at different levels of access. The Red LED will blink when any alarm occurs. A corresponding alarm message will also be displayed on the second line. If more than one message is to be displayed then the messages will scroll sequentially.

All settings can be saved individually. The lit green LED indicates that the AC is on. The LCD back lighting will turn off after 5 min of inactivity, if the power save function is selected. It will turn back on whenever a button is pressed or any alarm occurs. The accuracy of all readings is 0.5% +/- 1digit.



## 2. ACCESSING MENU VIA KEYPAD

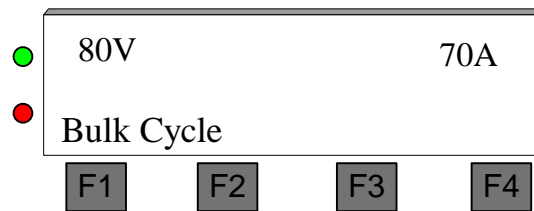
All gray buttons in all figures inside this manual mean that this button is pressed and activated. When more than one button is gray, this means that we have a choice to press any button on keypad.

### WARNING!

*All values indicated in the following figures are given as examples. These values don't apply necessarily to your system. For more information about the real values and options set for your application, please refer to the test report at the end of this manual.*

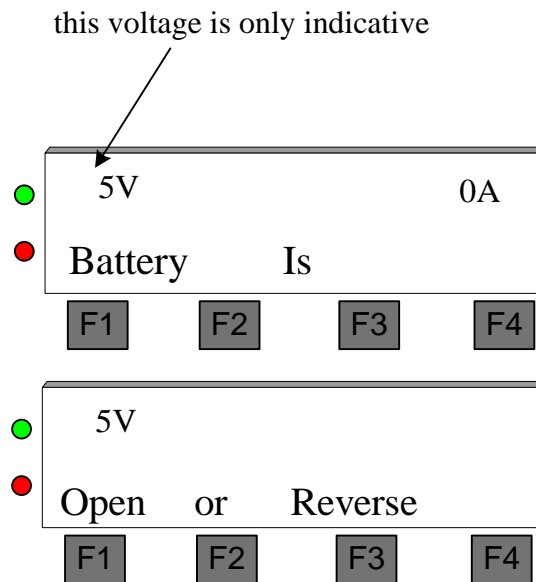
On power-up, there are two different cases.

First case: If the battery voltage is higher than 10V, the following message is displayed.



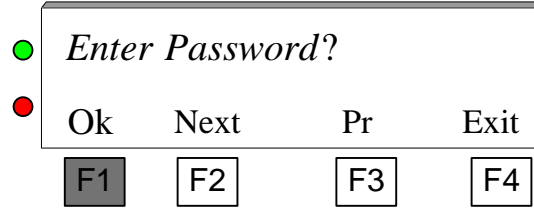
**Figure 2 : first case: Home screen example after turning ON the battery charger.**

Second case: If the battery voltage is lower than VshutDown (default value 10V), or if the battery polarity is reversed, the following message is displayed, and the red LED in keyboard blinks.



**Figure 3: Second case: Home screen example after turning ON the battery charger.**

From that point, if you press any button once from **F1** to **F4**, you reach the menu screen:



**Figure 4 : LCD Display after pressing any button.**

From this menu, buttons F2 and F3 allow us to navigate all other menus and sub-menus, adjustments and enable or disable functions. A detailed description of all menus and sub-menus will be provided in the following paragraph.

**Important!**

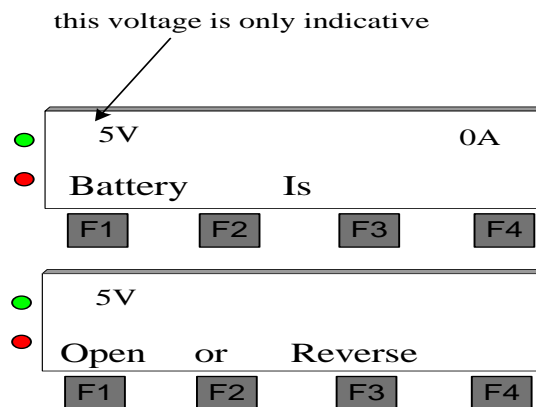
All adjustments of your battery charger are made in our service department. Some sub-menus are password protected. Only authorized personal will be able to access these sub-menus.

### 3. CHARGING MODE

On the first start of the charger, the charger passes in the bulk cycle. In the bulk cycle, if the current is less than 50A the charger passes to absorption cycle. In the absorption cycle, if the current is less than 15A, the charger passes to float cycle. Float cycle is the default operation of the charger.

#### 3.1 "Shut down " Mode

The image below shows the LCD display when the charger is in "shutdown" mode.

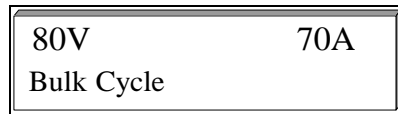


**Figure 5: Shut down mode display.**

If the battery voltage is lower than VshutDown (default value 10V), or if the battery polarity is reversed, the charger is on mode shut down. The charger remains in this mode until the battery voltage is greater than VshutDown.

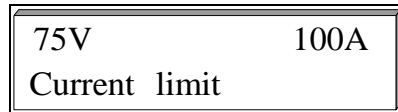
### 3.2 "Bulk" Cycle

The image below shows the LCD display when the charger is in "Bulk" cycle.



**Figure 6 : Bulk Cycle Display.**

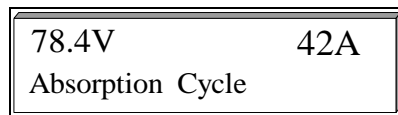
When the charger is in the current limit. The message "current limit" scroll sequentially with "Bulk Cycle" message.



**Figure 7 : Bulk current limit Display.**

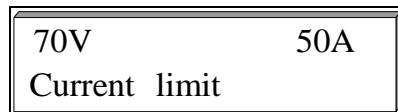
### 3.2 "Absorption" Cycle

The image below shows the LCD display when the charger is in "Absorption" cycle.



**Figure 8 : Absorption Cycle Display.**

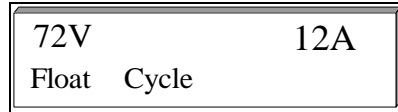
When the charger is in the current limit. The message "current limit" scroll sequentially with "Absorption Cycle" message.



**Figure 9 : Absorption current limit Display.**

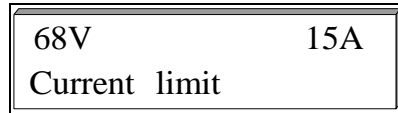
### 3.3 "Float" cycle

The image below shows the LCD display when the charger is in "Float" cycle.



**Figure 10 : Float Cycle Display.**

When the charger is in the current limit. The message “current limit” scroll sequentially with “Float Cycle ”message.



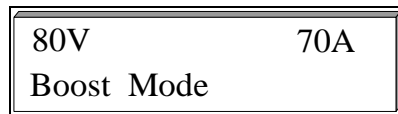
**Figure 11 : Float current limit Display.**

## 4. BOOST MODE

Boost mode is activated when the button boost in the front door is pressed.

During the boost mode, the charger passes 5mn with a current limit of 100A, and a red light blinks on the front door. After 5 min, the red light stays on and charger checks if the output voltage is less than a 60V. If the voltage drops to 60V, the current limit is 400A for 20s. After 20s, the charger passes to bulk cycle. The maximum time for boost mode, is 8 minutes.

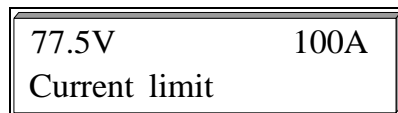
The image below shows the LCD display when the charger is in “Boost” mode.



**Figure 12 : Boost Mode Display.**

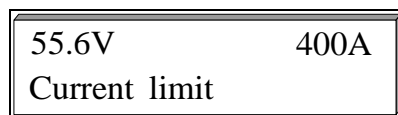
When the charger is in the current limit. There are two cases:

During the first 5 minutes in boost mode, the current limit is 100A.



**Figure 13 : Boost current limit Display.**

After 5mn in boost mode, If the charger output voltage is less than 60V, the current limit is 400A for 20 seconds.



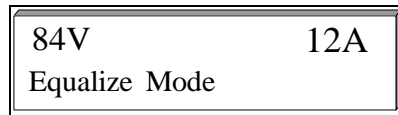
**Figure 14 : Boost current limit Display.**

## 5. EQUALIZE MODE

Equalize mode is activated when the button equalize in the front door is pressed. In the equalize mode, after 2 hours, the charger passes to bulk cycle.

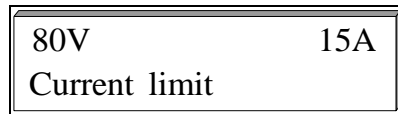
The equalize mode can be activated, only when the charger is already in float cycle.

The image below shows the LCD display when the charger is in "Equalize" mode.



**Figure 15 : Equalize mode Display.**

When the charger is in the current limit. The message "current limit" scroll sequentially with "Equalize Mode" message.



**Figure 16 : Equalize current limit Display.**

## 6. ALARMS

When the fan is out, the charger shut down the output voltage, the red LED in keyboard blinks, and a message "Fan out" is displayed in the LCD Display.



**Figure 17 : Alarm message Display.**

## 7. The Menu

The menu is divided into two levels: Level-1 for Adjustments and Level-2 for Advanced Settings.

**LEVEL-1 (Adjustments):** This level is protected by a password and reserved for charging parameters adjustments such as float voltage, current, alarms, etc. The user can disable / enable this password in Level 2.

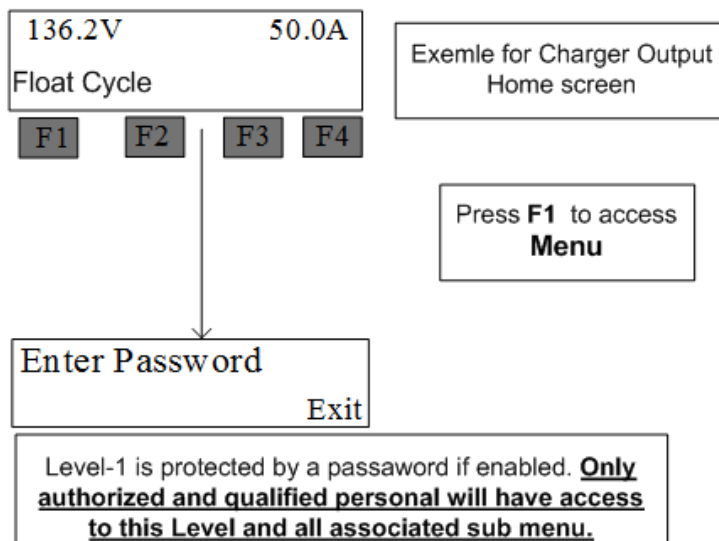
**LEVEL-2 (Advanced settings):** This level is reserved for Factory calibration purpose and protected by a password. This level is to adjust, calibrate, enable or disable different charger functions.

### 7.1 Level-1 (Adjust)

Level-1 is protected by a password. It's reserved for charging parameters adjustments such as Float and Equalize voltages, current, alarms....

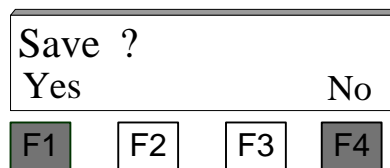
#### Warning!

Level-1 is password protected. Only authorized and qualified personal will be able to access this Level. The user can disable this password in the Level-2 of the menu.



**Figure 18 : Procedure to access Menu.**

If a parameter is modified, the LCD will display the following screen to confirm changes. If the modification is not saved or canceled, the battery charger will keep the old value.

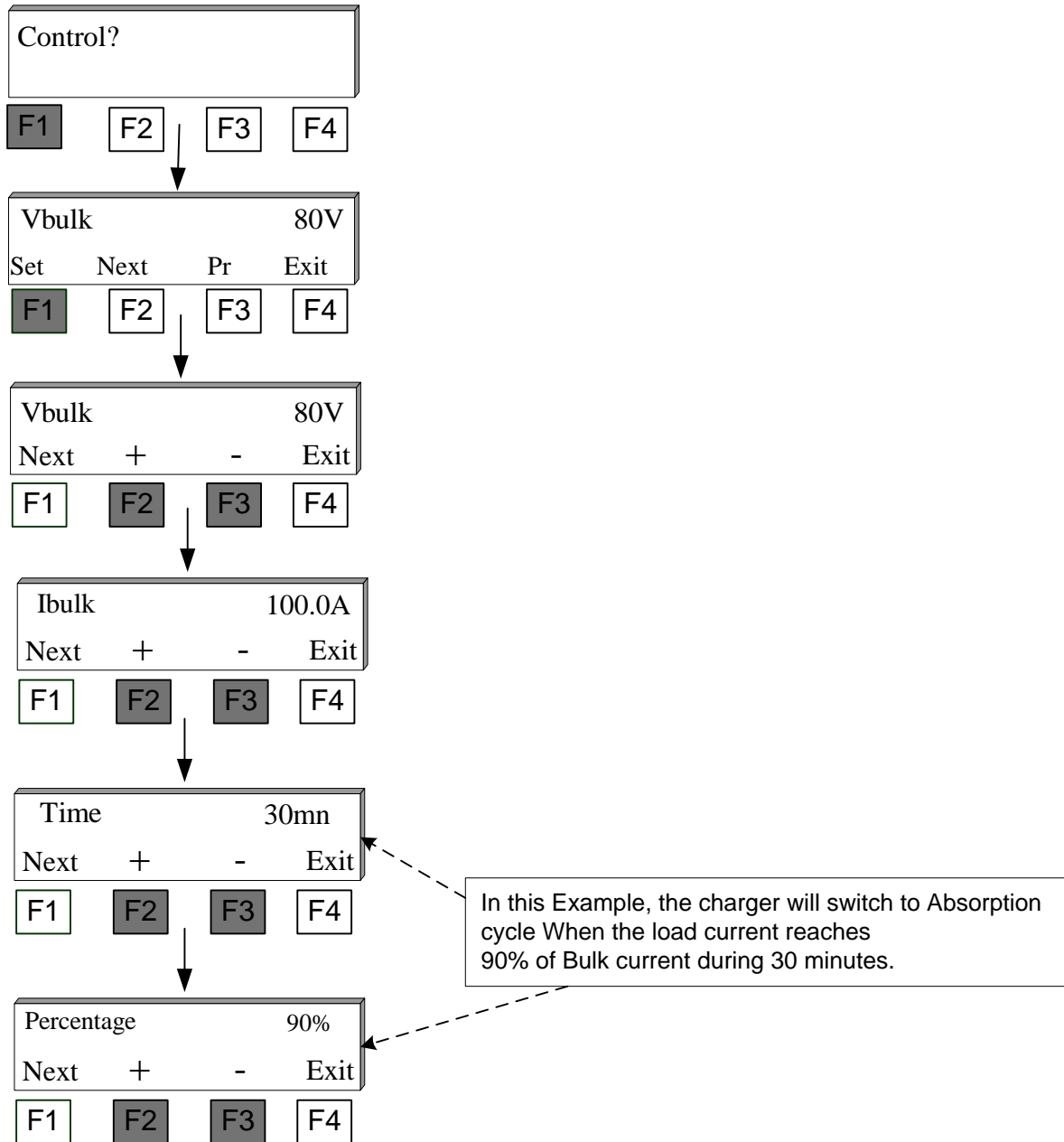


**Figure 19 : Display after modifying a parameter.**

**7.1.1 Control**

**a. Setting Voltage and Current for Bulk Cycle**

The Bulk Voltage, Current, Time and Percentage are adjusted as follows:



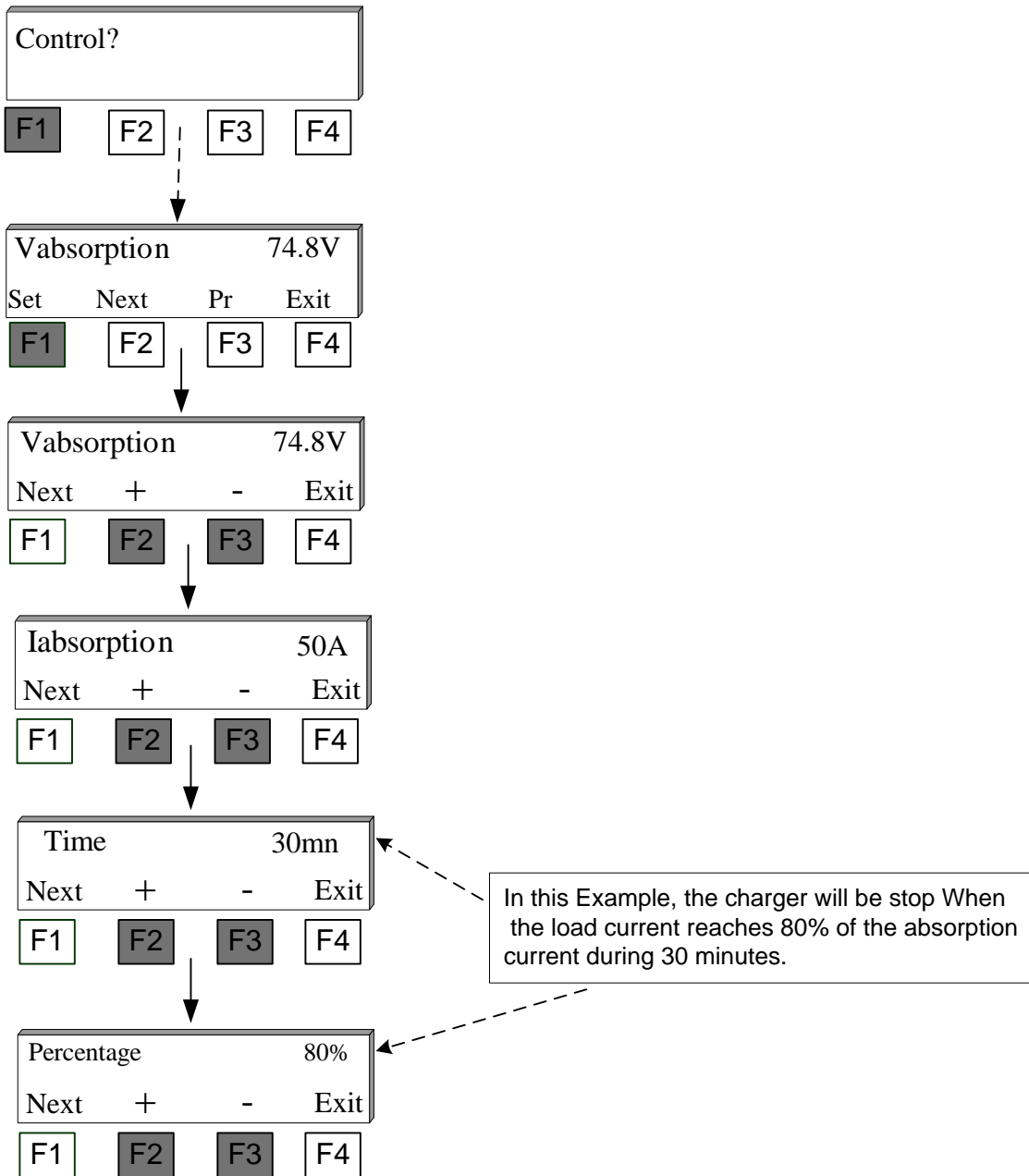
**Figure 20 : Procedure to adjust Bulk Cycle Voltage and Current.**

- Vbulk: The voltage bulk reference, default value 80V.
- Ibulk: The current bulk reference, default value 100A.
- Time : Bulk duration, default value 30mn.
- Percentage: Bulk percentage, default value 90% .

If the load current persists more than the preset percentage of Bulk current (charger current > percentage \* Ibulk) during a preset time, the battery charger will switch automatically to Absorption cycle.

**b. Setting Voltage and Current for Absorption Cycle**

The absorption Voltage, Current, Time and Percentage are adjusted as follows:

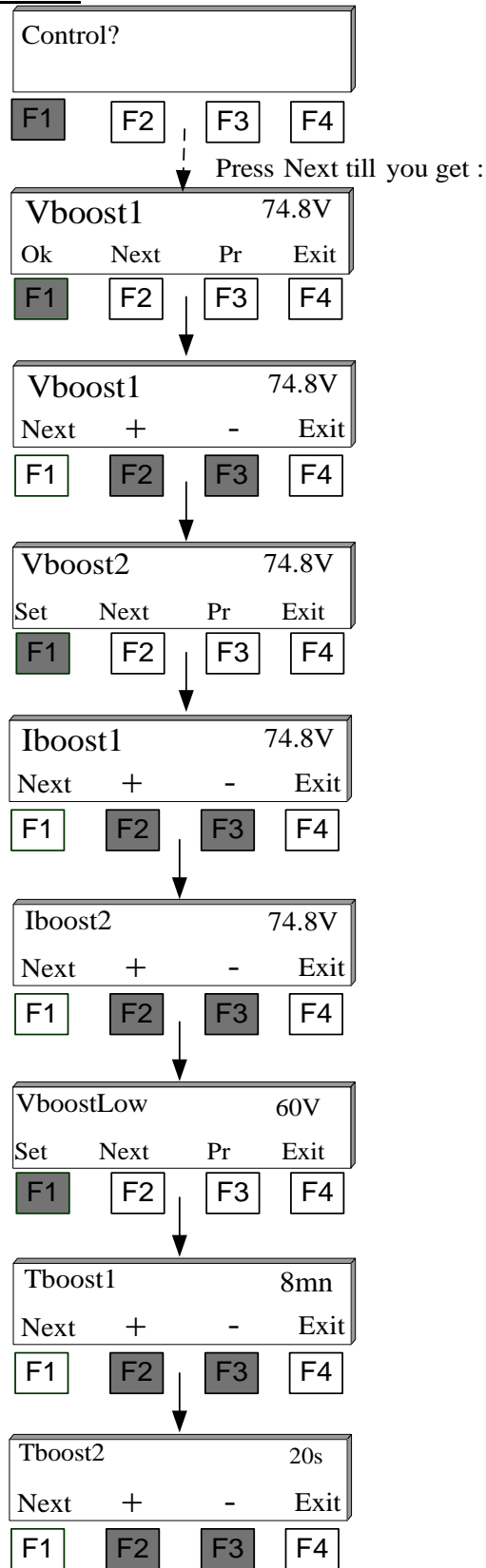


**Figure 21 : Procedure to adjust Absorption Cycle Voltage and Current.**

- Vabsorption: The voltage absorption reference.
- Iabsorption: The current absorption reference.
- Time : Absorption duration, default value 30mn.
- Percentage: Absorption percentage, default value 80% .



d. Setting Voltage and Current for Boost Mode



The boost Voltage and Current are adjusted as follows:

**Figure 23 : Procedure to adjust Boost Voltage and Current.**

Vboost1: The voltage boost reference (default value 80V) in first, 5mn in boost mode.

Vboost2: The voltage boost reference (default value 60V), after 5mn in boost mode.

VboostLow: The minimum threshold voltage (default value 60V) at which the charger passes at 400A current limit.

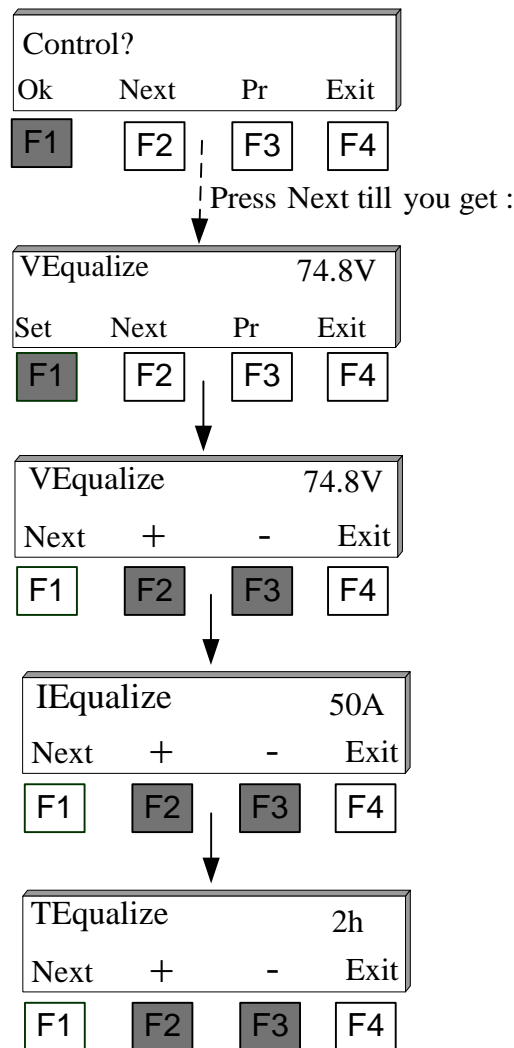
Iboost1: The default boost current reference, default value is 100A.

Iboost2: The extra boost current reference. When the charger is in boost mode for 5 minutes. If the voltage drops less than 60V, the charger current limit is Iboost2 (default value 400A), for 20s.

***e. Setting voltage and current for Equalize Mode***

This mode can be activated only if the charger is in float cycle. ☒

The equalize Voltage and Current is adjusted as follows:



**Figure 24 : Procedure to adjust Equalize Mode Voltage and Current.**

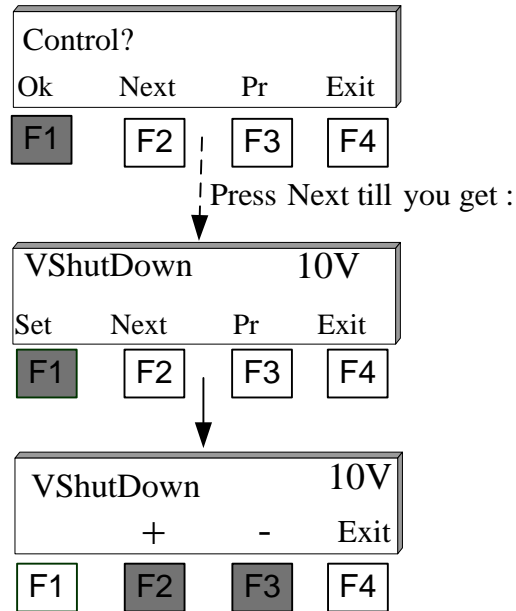
VEqualize: The equalize voltage reference, default value 80V.

IEqualize: The equalize current reference, default value 15A.

TEqualize: Equalize time duration, default value 2h.

*f. Setting shutdown voltage*

The shutdown voltage is adjusted as follows:



**Figure 25 : Procedure to adjust shutdown voltage.**

VshutDown: The shutdown voltage reference, default value 10V.

## 8. TROUBLESHOOTING

Should any problem occur with your charger/rectifier, please, read the following.

### **Warning!**

*Insure that qualified electricians perform all electrical work or properly trained persons, under direct supervision of a qualified electrician, service this equipment. The battery and AC supply must be disconnected before replacing any component. After disconnecting AC supply and batteries, wait 10 minutes to allow internal capacity to be completely discharged.*

*Observe all safety precautions!*

| Fault                             | Possible root cause  | Recommendation  |
|-----------------------------------|--|---|
| No DC Output                      | <ol style="list-style-type: none"> <li>1. Open AC Breaker;</li> <li>2. AC Input failure;</li> <li>3. DC fuse blown;</li> <li>4. Open blocking diode;</li> <li>5. Open or loose connection;</li> <li>6. Control board failure;</li> <li>7. SCR module failure;</li> <li>8. High Volt Shutdown alarm;</li> </ol> | <ul style="list-style-type: none"> <li>- Verify that AC breaker is closed ("ON"). Check for AC voltage on both sides of the breaker;</li> <li>- Verify that the AC supply is of correct voltage and frequency;</li> <li>- Verify the DC output fuse;</li> <li>- Check blocking diode (if provided);</li> <li>- Check all wiring from Input to Output for open or loose connections (Refer to schematic);</li> <li>- Replace control board;</li> <li>- Verify SCR modules and replace if needed;</li> <li>- In case of High Voltage Shutdown Alarm: Turn OFF the AC and DC breakers for 5 minutes then restart;</li> </ul> |
| DC fuse blows or DC breaker trips | <ol style="list-style-type: none"> <li>1. Freewheeling diode failure;</li> <li>2. Control board failure;</li> <li>3. SCR module failure;</li> <li>4. Battery connections reversed;</li> <li>5. DC filter failure;</li> </ol>   | <ul style="list-style-type: none"> <li>- Check the freewheeling diode for short circuit;</li> <li>- Replace control board;</li> <li>- Verify SCR modules and replace if needed;</li> <li>- Verify polarity of battery connections;</li> <li>- Check for shorted DC filter Capacitor;</li> </ul>   |
| AC breaker trips                  | <ol style="list-style-type: none"> <li>1. Short circuit;</li> <li>2. SCR, Diode or control board failure;</li> </ol>   | <ul style="list-style-type: none"> <li>- Check for shorts from Input to Output connections (Refer to schematic);</li> <li>- Replace defective component;</li> </ul>   |
| Low voltage alarm                 | <ul style="list-style-type: none"> <li>- Charger overload;</li> <li>- AC Input failure;</li> <li>- Float, equalize and/or low voltage alarm adjustments affected;</li> </ul>   | <ul style="list-style-type: none"> <li>- Check if the charger is in the current limit mode. Check the load for problems;</li> <li>- Verify that the AC supply is of correct voltage and frequency;</li> <li>- Refer to the adjustment procedures to reset;</li> </ul>   |
| High ripple voltage               | <ol style="list-style-type: none"> <li>1. AC line is too high;</li> <li>2. Defective filter capacitor;</li> <li>3. SCR, Diode or control board failure;</li> </ol>   | <ul style="list-style-type: none"> <li>- Read Input voltage and rectify the problem. Verify that the AC supply is of correct voltage and frequency;</li> <li>- Disconnect the capacitor(s) to observe any change in the output voltage ripple. Replace capacitor(s) if needed;</li> <li>- Replace defective component;</li> </ul>   |

| Fault               | Possible root cause   | Recommendation  |
|---------------------|---|---|
| High Output Current | <ol style="list-style-type: none"> <li>1. Float and (or) Equalize Current limits improperly set;</li> <li>2. Shunt signal problem;</li> <li>3. Affected calibration;</li> </ol>   | <ul style="list-style-type: none"> <li>- Refer to the adjustment procedures to reset;</li> <li>- Check shunt signal connection to control board (Refer to schematic);</li> <li>- Check with an external ammeter and compare reading with current value on the display;</li> </ul>   |
| Low Output Current  | <ol style="list-style-type: none"> <li>1. Float and (or) Equalize Current limits improperly set;</li> <li>2. Affected calibration;</li> <li>3. Loose connection;</li> </ol>   | <ul style="list-style-type: none"> <li>- Refer to the adjustment procedures to reset;</li> <li>- Check with an external ammeter and compare reading with current value on the display;</li> <li>- Check power wiring for loose connection (Refer to schematic);</li> </ul>  |
| Abnormal noise      | <ol style="list-style-type: none"> <li>1. SCR firing circuit problem;</li> <li>2. Unbalanced current at the AC Input / Output of power transformer;</li> <li>3. SCR module failure;</li> <li>4. Control board failure;</li> </ol> | <ul style="list-style-type: none"> <li>- Check if all LEDs on control board are ON: One LED blinking, 2 solid for 1Phase system and 6 solid for 3Phase system;</li> <li>- Check if current is balanced at the Input and the Output of Power Transformer</li> <li>- Verify SCR modules and replace if needed;</li> <li>- Replace control board;</li> </ul> |

If the problem persists, contact our service department.

## 9. REGULAR PREVENTIVE MAINTENANCE

Regular maintenance is required to ensure reliable operation of your system.

|      | <b>Action</b>  | <b>Frequency</b>   |
|------|--|--|
| B    | Measure and record voltage across each battery cell and across the entire battery  | monthly  |
| B    | Verify and record the level of electrolyte in each battery cell. If necessary top off with distilled water.  | monthly  |
| B    | Verify and record the specific gravity of each battery cell  | monthly  |
| C    | Verify the operation of all indicators   | monthly  |
| B, C | <b><i>VERY CAREFULLY</i></b> (especially if you are dealing with the conductive substances) remove the accumulated dust around the ventilation openings, charger interior, surfaces of circuit boards & electrical connectors/terminals. | As needed, depending on the environmental conditions of the site, but <b>minimum once a year</b> |
| B, C | Visually verify the condition of all components  | yearly   |
| B, C | Verify all bolted connections. If necessary, use a torque wrench to retighten to manufacturers specifications  | yearly   |
| B    | Clean and grease all battery connections   | As needed, depending on the environmental conditions of the site, but <b>minimum once a year</b> |
| B    | Wash the battery cells using distilled water only  | As needed, depending on the environmental conditions of the site, but <b>minimum once a year</b> |

**B = battery**      **C = charger**

For systems supplied with lead acid batteries, a partial discharge of the battery is recommended on an annual basis, to verify the battery and charger performances. For systems supplied with nickel-cadmium batteries a complete discharge and decommissioning charge is recommended on a bi-annual basis.

## **ELECTRICAL / ELECTRONIC PRODUCTS WARRANTY**

The Manufacturer Warrants to the original user that its rectifying equipment, load banks, DC-DC converters, chargers and UPS systems are free from defects in factory workmanship and materials, such warranty being conditional upon the product having been installed, commissioned, operated and maintained by qualified personnel and according to manufacturer instructions.

Our liability is limited to repairing or replacing without charge at its factory any product or component which at user's expense has been returned to our plant or authorized service center within 1 year from date of commissioning or 18 months from shipment, whichever occurs first. The manufacturer repair or replacement of any defective product shall constitute fulfillment of his obligations.

This warranty applies to manufacturer products which are shown by the purchaser to have been originally defective and shall not apply to products which must be repaired or replaced due to normal wear, misuse, negligence, wreckage, accident, any Act Of God or to products which have been repaired or altered outside of seller's factory or one of its authorized service centers unless authorized solely by the manufacturer.

The manufacturer shall not be liable for loss, damage, or expense, consequential or otherwise from the use of its products or from any other cause.

This warranty supersedes and is given in place of all other warranties expressed or implied or conditions whether statutory or otherwise as to quality and fitness for any purpose for which the products are supplied. No person, agent or dealer is authorized to give any warranty on behalf of manufacturer or to assume for seller any other liability in connection with any of its products unless made in writing and signed by an officer of the manufacturer.

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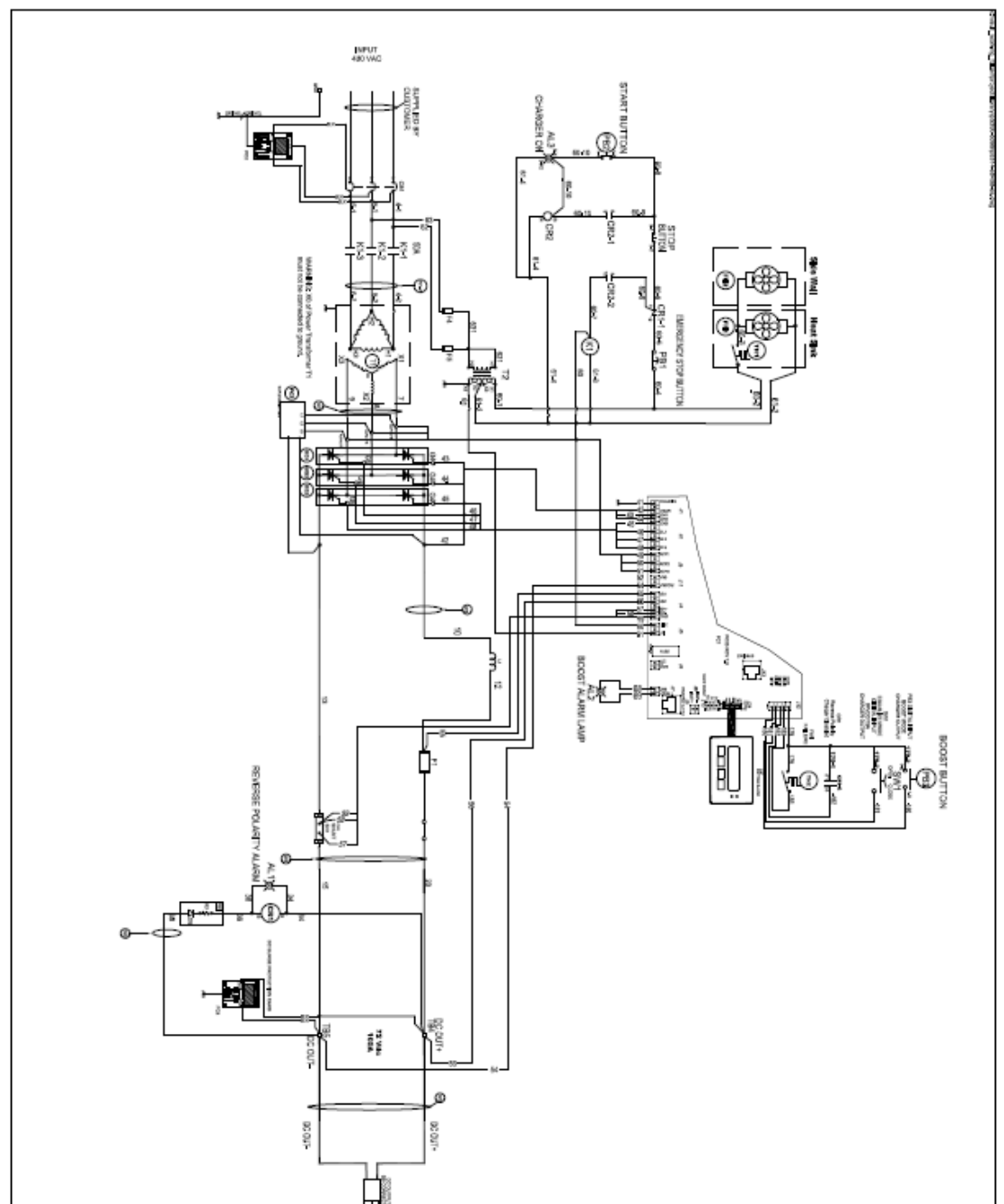
# APPENDIXES

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- Appendix-1 : Level-2 (Advanced Level);
- Appendix-2 : Battery Capacity Test;
- Appendix-3 : Communication;
- Appendix-4 : Ampere-Hour meter;
- Appendix-5 : Digital Inputs;
- Appendix-6 : Web Page;
- Appendix-7 : Signal Transducer;
- Bill Of Material;
- Electrical Schematic;
- Mechanical Drawings;
- Test Report;

## **Important!**

- *Appendix-1 is included only for qualified expert users or authorized manufacturer trained service personnel or distributors / sellers.*
- *Other Appendixes listed above, but not limited to, are included if the respective options have been purchased.*



| No. | Revisions       | Date       | By/Per |
|-----|-----------------|------------|--------|
| 01  | Initial Release | 11/12/2013 | LA     |
| 02  | As Built        | 12/18/2013 | LA     |

| Symbol | Description | Rating    |
|--------|-------------|-----------|
| Q      | Charger     | AL 1 Lamp |
| Q1     | Charger     | AL 1 Lamp |
| Q2     | Charger     | AL 1 Lamp |
| Q3     | Charger     | AL 1 Lamp |
| Q4     | Charger     | AL 1 Lamp |
| Q5     | Charger     | AL 1 Lamp |
| Q6     | Charger     | AL 1 Lamp |
| Q7     | Charger     | AL 1 Lamp |
| Q8     | Charger     | AL 1 Lamp |
| Q9     | Charger     | AL 1 Lamp |
| Q10    | Charger     | AL 1 Lamp |
| Q11    | Charger     | AL 1 Lamp |
| Q12    | Charger     | AL 1 Lamp |
| Q13    | Charger     | AL 1 Lamp |
| Q14    | Charger     | AL 1 Lamp |
| Q15    | Charger     | AL 1 Lamp |
| Q16    | Charger     | AL 1 Lamp |
| Q17    | Charger     | AL 1 Lamp |
| Q18    | Charger     | AL 1 Lamp |
| Q19    | Charger     | AL 1 Lamp |
| Q20    | Charger     | AL 1 Lamp |
| Q21    | Charger     | AL 1 Lamp |
| Q22    | Charger     | AL 1 Lamp |
| Q23    | Charger     | AL 1 Lamp |
| Q24    | Charger     | AL 1 Lamp |
| Q25    | Charger     | AL 1 Lamp |
| Q26    | Charger     | AL 1 Lamp |
| Q27    | Charger     | AL 1 Lamp |
| Q28    | Charger     | AL 1 Lamp |
| Q29    | Charger     | AL 1 Lamp |
| Q30    | Charger     | AL 1 Lamp |
| Q31    | Charger     | AL 1 Lamp |
| Q32    | Charger     | AL 1 Lamp |
| Q33    | Charger     | AL 1 Lamp |
| Q34    | Charger     | AL 1 Lamp |
| Q35    | Charger     | AL 1 Lamp |
| Q36    | Charger     | AL 1 Lamp |
| Q37    | Charger     | AL 1 Lamp |
| Q38    | Charger     | AL 1 Lamp |
| Q39    | Charger     | AL 1 Lamp |
| Q40    | Charger     | AL 1 Lamp |
| Q41    | Charger     | AL 1 Lamp |
| Q42    | Charger     | AL 1 Lamp |
| Q43    | Charger     | AL 1 Lamp |
| Q44    | Charger     | AL 1 Lamp |
| Q45    | Charger     | AL 1 Lamp |
| Q46    | Charger     | AL 1 Lamp |
| Q47    | Charger     | AL 1 Lamp |
| Q48    | Charger     | AL 1 Lamp |
| Q49    | Charger     | AL 1 Lamp |
| Q50    | Charger     | AL 1 Lamp |
| Q51    | Charger     | AL 1 Lamp |
| Q52    | Charger     | AL 1 Lamp |
| Q53    | Charger     | AL 1 Lamp |
| Q54    | Charger     | AL 1 Lamp |
| Q55    | Charger     | AL 1 Lamp |
| Q56    | Charger     | AL 1 Lamp |
| Q57    | Charger     | AL 1 Lamp |
| Q58    | Charger     | AL 1 Lamp |
| Q59    | Charger     | AL 1 Lamp |
| Q60    | Charger     | AL 1 Lamp |
| Q61    | Charger     | AL 1 Lamp |
| Q62    | Charger     | AL 1 Lamp |
| Q63    | Charger     | AL 1 Lamp |
| Q64    | Charger     | AL 1 Lamp |
| Q65    | Charger     | AL 1 Lamp |
| Q66    | Charger     | AL 1 Lamp |
| Q67    | Charger     | AL 1 Lamp |
| Q68    | Charger     | AL 1 Lamp |
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| Q70    | Charger     | AL 1 Lamp |
| Q71    | Charger     | AL 1 Lamp |
| Q72    | Charger     | AL 1 Lamp |
| Q73    | Charger     | AL 1 Lamp |
| Q74    | Charger     | AL 1 Lamp |
| Q75    | Charger     | AL 1 Lamp |
| Q76    | Charger     | AL 1 Lamp |
| Q77    | Charger     | AL 1 Lamp |
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| Q79    | Charger     | AL 1 Lamp |
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| Q81    | Charger     | AL 1 Lamp |
| Q82    | Charger     | AL 1 Lamp |
| Q83    | Charger     | AL 1 Lamp |
| Q84    | Charger     | AL 1 Lamp |
| Q85    | Charger     | AL 1 Lamp |
| Q86    | Charger     | AL 1 Lamp |
| Q87    | Charger     | AL 1 Lamp |
| Q88    | Charger     | AL 1 Lamp |
| Q89    | Charger     | AL 1 Lamp |
| Q90    | Charger     | AL 1 Lamp |
| Q91    | Charger     | AL 1 Lamp |
| Q92    | Charger     | AL 1 Lamp |
| Q93    | Charger     | AL 1 Lamp |
| Q94    | Charger     | AL 1 Lamp |
| Q95    | Charger     | AL 1 Lamp |
| Q96    | Charger     | AL 1 Lamp |
| Q97    | Charger     | AL 1 Lamp |
| Q98    | Charger     | AL 1 Lamp |
| Q99    | Charger     | AL 1 Lamp |
| Q100   | Charger     | AL 1 Lamp |