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Battery Chargers



USER'S MANUAL

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1. SAFETY INSTRUCTIONS AND WARNINGS

Before to start using your battery charger, please take the time to read these instructions carefully.

The owner's manual is an important part of the charger. It's recommended to keep it in good condition for the lifetime of the charger. It should be kept in a dry and clean place, always available to the users.

To indicate important instructions, the following blocks are used throughout this manual.

CAUTION!

This operation can be dangerous for the user.

ATTENTION!

This operation is important for the functionality and reliability of the charger.

GENERAL

Battery charging products can cause serious injury or death, or damage to other equipment or property, if the operator does not strictly observe all safety rules and take precautionary actions.

Safe practices must be learned through study and training before using this equipment.

Only qualified personnel should install, use, or service this equipment.

SHOCK PREVENTION

Bare conductors, or terminals in the output circuit, or ungrounded, electrically-live equipments can fatally shock a person. To protect against shock, have competent electrician verify that the equipment is adequately grounded and learn what terminals and parts are electrically HOT.

The body's electrical resistance is decreased when wet, permitting dangerous current to flow through the body. Do not work in damp area without being extremely careful. Stand on dry rubber mat or dry wood and use insulating gloves when dampness or sweat cannot be avoided. Keep clothing dry.

INSTALLATION AND GROUNDING - A power disconnect switch must be located at the equipment. Check the data label for voltage and phase requirements. If only 3-phase power is available, connect single-phase equipment to **ONLY TWO WIRES** of the 3-phase line.

DO NOT CONNECT the equipment grounding conductor to the third live wire of the 3-phase line as this makes the equipment frame electrically **HOT**, which can cause a fatal shock.

If a grounding conductor is part of the power supply cable, be sure to connect it to a properly grounded switch box or building ground. If not part of the supply cable, use a separate grounding conductor. Don't remove a ground prong from any plug. Use correct mating receptacles. Check ground for electrical continuity before using equipment. The grounding conductor must be of a size equal to or larger than the size of the line conductors.

CHARGING LEADS – Inspect leads often for damage to the insulation. Replace or repair cracked or worn leads immediately. Use leads having sufficient capacity to carry the operating current without overheating. Don't replace the original cables with longer cables.

Don't use additional cables to lengthen the original connections.

BATTERY TERMINALS – Do not touch battery terminals while equipment is operating.

SERVICE AND MAINTENANCE – Shut OFF all power at the disconnect switch or line breaker BEFORE inspecting, adjusting, or servicing the equipment. Lock switch OPEN (or remove line fuses) so that the power cannot be turned ON accidentally.

Disconnect power to equipment if it is to be left unattended or out of service. Disconnect battery from charger. Keep inside parts clean and dry. Dirt and/or moisture can cause insulation failure. This failure can result in high voltage at the charger output.

BURN AND BODILY INJURY PREVENTION

The battery produces very high currents when short circuited, and will burn the skin severely if in contact with any metal conductor that is carrying this current.

Do not permit rings on fingers to come in contact with battery terminals or the cell connectors on top of the battery. Battery acid is very corrosive. Always wear correct eye and body protection when near batteries.

FIRE AND EXPLOSION PREVENTION

When batteries are being recharged, they generate hydrogen gas that is explosive in certain concentrations in air (the flammability or explosive limits are 4.1% to 72% hydrogen in air). The spark-retarding vents help slow the rate of release of hydrogen, but the escaping hydrogen may form an explosive atmosphere around the battery if ventilation is poor.

The ventilation system should be designed to provide an adequate amount of fresh air for the number of batteries being charged. This is essential to prevent an explosion.

Always keep sparks, flames, burning cigarettes, and other sources of ignition away from the battery recharging area. Do not break "live" circuits at the terminals of batteries. Do not lay tools or anything that is metallic on top of any battery.

ARCING AND BURNING OF CONNECTOR

To prevent arcing and burning of the connector contacts, be sure the charger is OFF before connecting or disconnecting the battery. The ammeter should NOT indicate current flow.

MEDICAL AND FIRST AID TREATMENT

First aid facilities and a qualified first aid person should be available for each shift for immediate treatment of electrical shock victims.

EMERGENCY FIRST AID: Call physician and ambulance immediately and use First Aid techniques recommended by the American Red Cross.

DANGER: ELECTRICAL SHOCK CAN BE FATAL.

If person is unconscious and electric shock is suspected, do not touch person if he or she is in contact with charging equipment, battery, charging leads, or other live electrical parts. Disconnect power at wall switch and then use First Aid.

Dry wood, wooden broom, and other insulating material can be used to move cables, if necessary, away from person.

IF BREATHING IS DIFFICULT, give oxygen.

IF NOT BREATHING, BEGIN ARTIFICIAL BREATHING, such as mouth-to-mouth.

IF PULSE IS ABSENT, BEGIN ARTIFICIAL CIRCULATION, such as external heart massage.

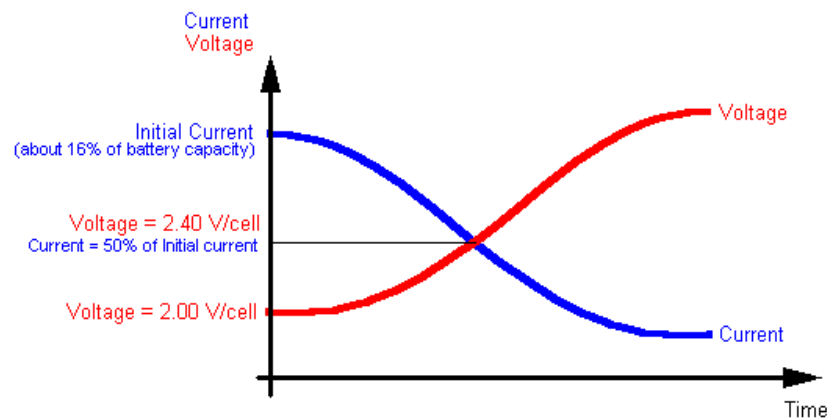
In case of acid in the eyes, flush very well with clean water and obtain professional medical attention immediately.

2. DESCRIPTION OF THE CHARGER

The battery chargers have been designed to charge Pb batteries. These units convert the AC main supply in a DC output at the correct voltage, in order to charge the battery cells.

The microprocessor controlled electronic card is used to monitor the state of the charge, and automatically turn the charger off when the battery is fully charged.

The charge current follows the Wa curve, and the operation is fully automatic.



3. INSTALLATION OF THE CHARGER

Conditions of use:

- Operating temperature: 5°C to 45°C
- Storage temperature: -20°C to 60°C
- Relative humidity: less than 75%

CAUTION!

Risk of electrical shock!
The charger can be installed by qualified personnel only.

To prevent fire or shock hazard, do not expose the unit to rain or moisture.
Don't use the unit in presence of flammable gas, because it can generate sparks.

ATTENTION!

Make sure that the unit's maximum input power (reported on the data label) is available from your power supply, and verify that the unit's operating voltage is correct.

Allow adequate air circulation to prevent internal heat buildup.

Don't place the unit near heat sources such as radiators or air ducts, or in a place subject to direct sunlight, excessive dust, mechanical vibration or shock.

ATTENTION!

The proper setting of the power transformer taps is fundamental for the correct operation of the charger.

If the real AC input voltage is different than the AC nominal voltage to which the charger is set, the charging current of the charger may be significantly different than the nominal.

NOTE

The BOARD FOR INPUT VOLTAGE SELECTION is present only in chargers with 3x 208 / 240 / 480 Vac input, and it's NOT present in chargers with 3x600 Vac input.

The PLUGS FOR INPUT VOLTAGE ADJUSTMENT are present in all the chargers.

AC VOLTAGE SELECTION 3 x 208/240/480 V*(not for 600V input models)**(not for 1x240V input models)*

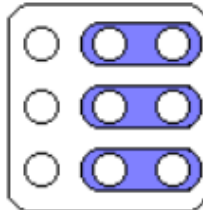
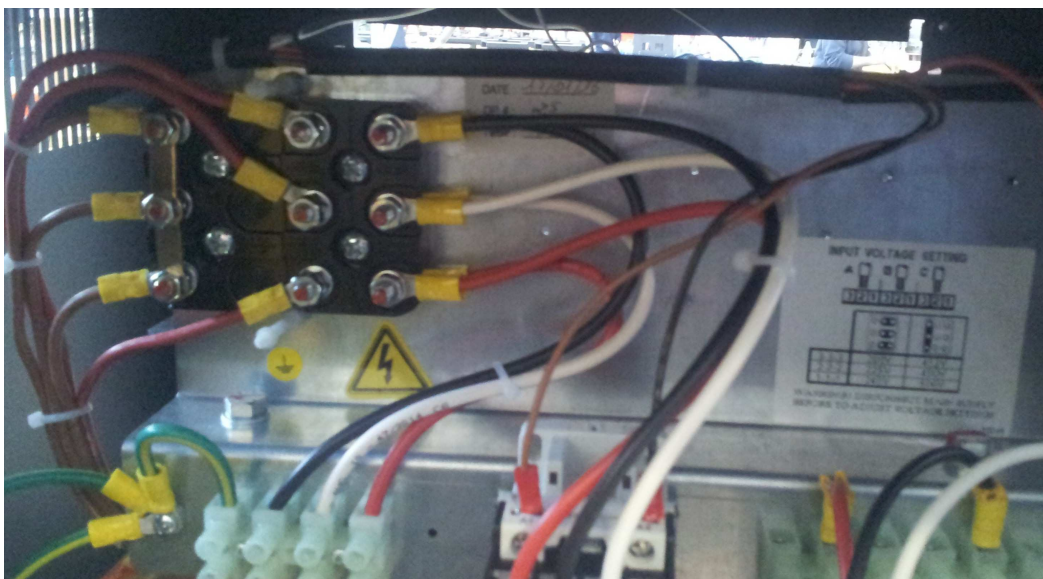
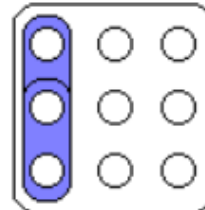
The input voltage setting of the charger is made using two devices:

- 1) BOARD FOR INPUT VOLTAGE SELECTION (BVS)
(two selectable ranges: 200-250V or 440-524V);
- 2) PLUGS FOR INPUT VOLTAGE ADJUSTMENT
(five taps within the selected range, see next chapter).

The BOARD FOR INPUT VOLTAGE SELECTION has three metal bars, to be connected in one of the two configurations represented on the picture inside the charger.

PROCEDURE:

- Check that the charger is disconnected from AC input and battery;
- Open the cabinet and remove the plastic protection over the BVS;
- Remove the metal bars and position them in the correct configuration.
- Fix the nuts carefully;
- Mount the plastic protection over the BVS;
- Close the cabinet.

Metal bars in position 208-240 Vac**Metal bars in position 450-510 Vac**

AC INPUT VOLTAGE ADJUSTMENT

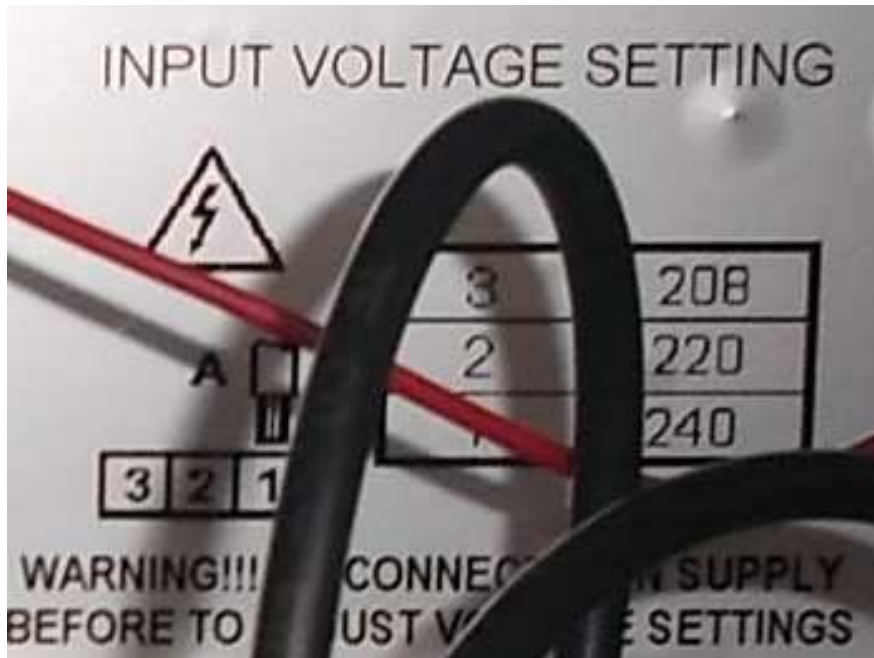
The local AC input voltage must be measured with an adequate voltmeter, then the charger input must be adjusted by moving the three wires marked with the letters A, B, C on the PLUGS FOR INPUT VOLTAGE ADJUSTMENT.

PROCEDURE:

- Check that the charger is disconnected from AC input and battery;
- Open the cabinet;
- Disconnect the wires A, B, C from the original position;
- Connect the wire A, B, C to the desired position.
- Close the cabinet.

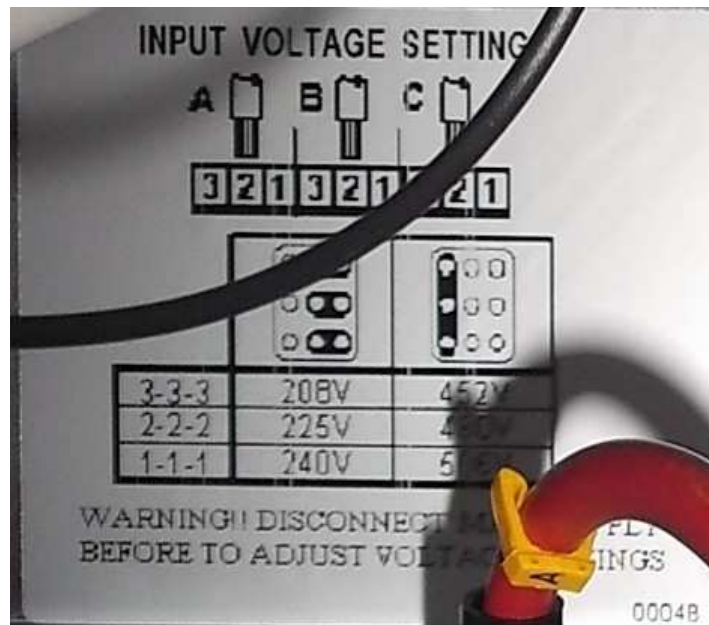
MODELS WITH INPUT VOLTAGE 1x240V

POSITION	3	2	1
VOLTAGE	208V	220V	240V



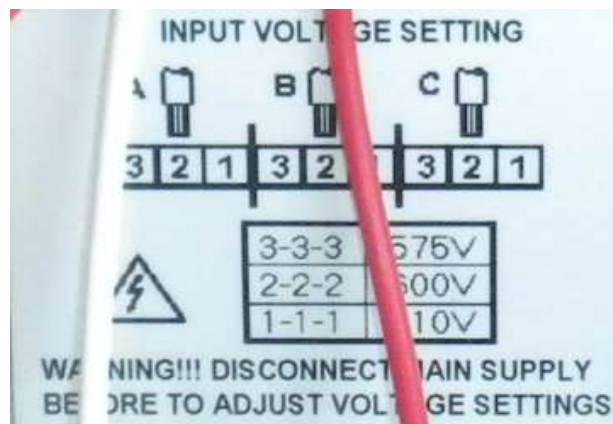
MODELS WITH INPUT VOLTAGE 3x208/240/480V

POSITION	3	2	1
BVS AT 240 Vac	208V	225V	240V
BVS AT 480 Vac	452V	480V	508V



MODELS WITH INPUT VOLTAGE 3x600V

POSITION	3	2	1
VOLTAGE	576V	600V	610V



GROUNDING AND LINE CONNECTION**CAUTION!****Risk of electrical shock!**

The cabinet of the battery charger must be properly grounded to protect personnel against hazard of electrical shock in case of fault on the charger!

The grounding conductor must have a current carrying capacity equal or higher than the current carrying capacity of the AC-input wires.

If the charger is to be connected to the AC power supply with a flexible jacketed cable, one having a separate grounding conductor should be used.

If, for any reason, an input cable which does not include a grounding conductor is used, the equipment must be grounded with separate conductor. Minimum size and color coding requirements must be in accordance with any applicable national or local code.

PROCEDURE

- Read on the data label the AC current value corresponding to the line voltage to which charger is to be connected. Using that current value, select the proper fuses, disconnect switch and power cable sizes, according with any applicable national or local code.
- Check that the charger is disconnected from AC input and battery;
- Open the cabinet;
- Mount the input cable and connect the four power conductors (three phase + ground) to the terminal blocks;
- Close the cabinet;
- With disconnect switch on AC input power line on position "OFF" or "OPEN", connect the power cable coming from the charger to the switch and, then, install the fuses in the switch.

4. HOW TO USE THE CHARGER

CAUTION!

**DON'T connect the battery to the charger if the digital display is ON.
DON'T disconnect the battery from the charger while it is being charged.
ARCING AND BURNING OF CONNECTORS
OR BATTERY EXPLOSION MAY RESULT!**

PRELIMINARY CHECKS

- Inspect the charger completely for loose screws, electrical connections or other damages;
- Check that all the ventilation slots are not obstructed to assure proper air flow;
- Make sure that the charger is installed as instructed in this manual and in accordance with any applicable national or local norm.



- BUTTON START STOP and BUTTON EQ are INCLUDED OUTSIDE THE FRONTAL LABEL BUT INSIDE THE FRONTAL PANEL

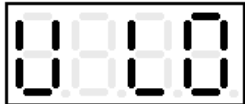
BATTERY CONNECTION, VOLTAGE CHECK AND AUTOSTART**CAUTION !**

Chargers are programmed to do a complete cycle of charge automatically, however it's always recommended to survey the operations, especially when the battery is connected to the charger for more than 12 hours.

- Connect the battery to the charger, using an adequate connector.

When the battery is correctly connected, the display will show the battery voltage.

If the battery voltage is below the minimum threshold of 1,62 V/cell, the charger will not start, and the display will show the error message "Voltage Low":



If the battery voltage is higher than the maximum threshold of 2,60 V/cell, the charger will not start, and the display will show the (flashing) error message "Voltage High":



If the battery voltage is between the minimum and maximum thresholds, the charger will turn on automatically after 5 seconds.

If, during the charge, the battery voltage exceeds the maximum threshold of 2,80 V/cell, the charger will shut down automatically, and the error message "Voltage High" will appear on the display.

CHARGE PROCESS

While the charge is in progress, the following parameters are continuously displayed in sequence:

- Battery Voltage/cell (Output voltage) (U) (Volt);
- Charge current (Output current) (A) (Ampere);
- Capacity charged (C) (Ah);
- Effective time of charge (h) (Hours);

The letter after the value (U-A-C-h) indicates which parameter being is displayed.

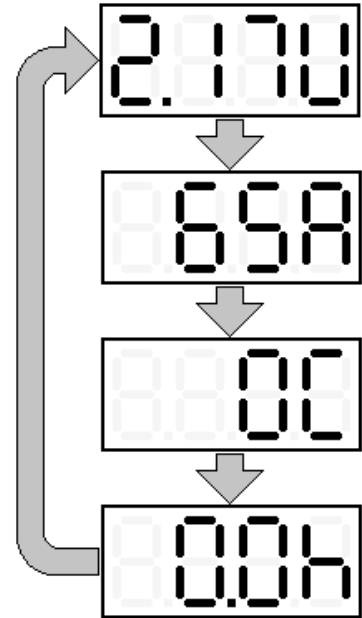
To display the time, the charger uses this format:

(HOURS) . (MINUTE DECADES) h

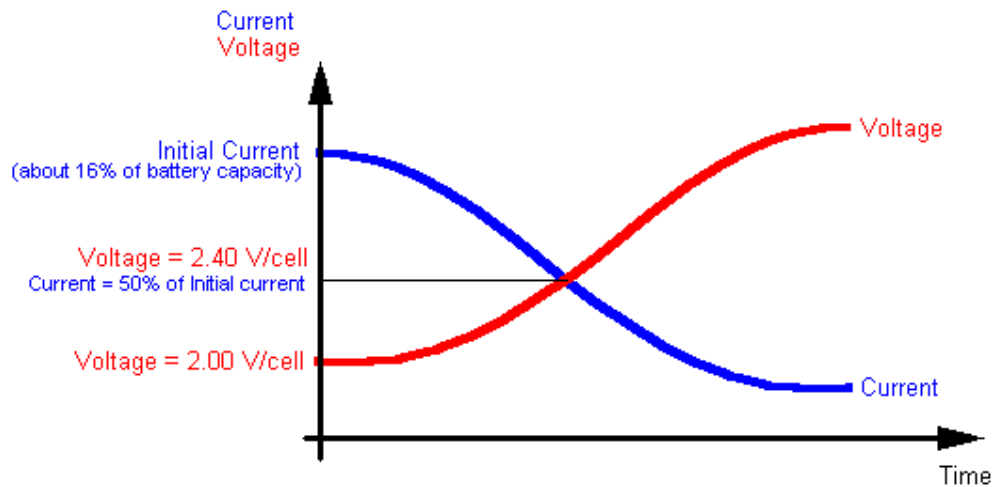
Examples:

Time of charge 3h 30minutes: Displayed 3.3h

Time of charge 7h 50minutes: Displayed 7.5h



- The charge current follows the Wa curve, as described in the norm DIN 41774.



When the battery reaches the gassing voltage, the charge continues for one half of the time needed to reach the gassing voltage, with a minimum total time of 30 minutes.

SAFETY TIMER – EMERGENCY STOP

- If the battery doesn't reach the gassing voltage within 12 hours, the charge is terminated by the Emergency timer. The display will show the error message "Time Error":



If this error message appear, it's recommended to call the service for a complete check of the system.

The cause if this problem may be a wrong setting of the input voltage: if the input is set to a certain value (for example: 610 V) but the real voltage is lower (for example: 575 V), the charging current will be significantly lower than the nominal value, therefore it will take more time to reach the gassing voltage.

AUTOMATIC DATA SAVING

- If, while the charge or the equalization are in progress, a black-out of the AC input occurs, the charger saves automatically all the relevant information about the state of the charge. While the input power is absent, the message "Black Out" is displayed:



- When the power supply will be available again, the charger will re-start automatically from the exact point of interruption, and the charge will be normally completed.

AUTOMATIC AND MANUAL CHARGE TERMINATION**CAUTION!**

NEVER disconnect the battery while it's being charged.
Disconnecting the battery while it's being charged is hazardous
for the user and voids the charger warranty.

- **AUTOMATIC CHARGE TERMINATION:**
When the charge has been normally completed, the charger turns off automatically. The display shows the flashing message "End".



At this point, it's possible to disconnect the battery.

- **MANUAL CHARGE TERMINATION:**

The charge can be manually terminated in any moment, by pressing the red STOP pushbutton. The display will show the message "Stop":



At this point, it's possible to disconnect the battery.

NOTE

After the charge termination, while the battery remains connected, the final values of [Voltage/cell], [Time] and [Capacity charged] remain stored in memory. If the red STOP pushbutton is pressed, the display will show these values in sequence.

If the charge has been terminated manually, equalization and maintenance functions are automatically disabled.

EQUALIZE**ATTENTION!**

The proper programming of the equalize & refresh modes is important for the correct operation of the chargers.

Only expert users should modify these settings.

Chargers have a complete set of programmable equalize & refresh functions:

- **MANUAL EQUALIZE:** 4 hours extension of the charge time (selected by user)
- **DAILY EQUALIZE:** 4 hours extension of the charge time (everyday)
- **AUTO EQUALIZE & REFRESH:** Weekly equalize cycle + long term battery refresh

MANUAL EQUALIZE

The **MANUAL EQUALIZE** function is intended for the users that prefer to manage the equalization of the batteries personally.

It will extend the time of the charge cycle by 4 hours, and it can be enabled by pushing the apposite button, located on the right side of the front panel, during the first minutes of charge.

The display will add the message "Eq. On" to the cyclical visualization of the charge parameters, and the charge will proceed normally.



Once the manual equalize has been selected, the only way to deselect it is to disconnect and re-connect the battery.

DAILY EQUALIZE

The **DAILY EQUALIZE** function will extend all the charge cycles by 4 hours, and it's suitable to recover batteries that are lightly sulphated.

It can be enabled by moving the internal **DIPSWITCH #1** to position **ON** (see the description of the programming dipswitches in the previous paragraphs).

The **DAILY EQUALIZE** function is **DISABLED** by default.

Since the **DAILY EQUALIZE** is a very intense equalize program and may tend to overcharge the battery, it's recommended to limit it to short periods, then to return to a normal equalize program.

It's also recommended to survey the operation of the charger and keep the temperature of the battery under precise control while the **DAILY EQUALIZE** function is enabled.

AUTO EQUALIZE + REFRESH

The **AUTO EQUALIZE + REFRESH** function is totally managed by the MTL2 microcontroller.

It can be enabled by moving the internal **DIPSWITCH #4** to position **ON** (see the description of the programming dipswitches in the previous paragraphs).

The **AUTOMATIC EQUALIZE + REFRESH** is **ENABLED** by default.

If the charge has been completed normally, the charger will add 5 short additional charge cycles of 30 minutes, with 14 hours and 30 minutes interval between each charge.

During the time interval between each equalization charge, the display will show the scrolling message: "End Elapsed x.x h":

A 7-segment display showing the text "End ELAPSED 0.0h". The characters are in a standard digital font, with "End" in smaller characters and "ELAPSED" in larger characters. The "0.0h" part is also in a digital font.

When the equalization chargers are in progress, the display will show the scrolling message: "equalization charge":

A 7-segment display showing the text "EQUAL CHARGE". The characters are in a standard digital font, with "EQUAL" in smaller characters and "CHARGE" in larger characters.

followed by the indication of the charge current.

MAINTENANCE

The MAINTENANCE function is useful to keep the battery in perfect condition when it's not used for an undefined time (weeks, months, ...).

It is sufficient to leave the battery connected to the charger: the control board will keep the battery voltage under control and will activate the charger automatically when the voltage falls below a predefined minimum threshold.

While the charger is off and the battery voltage is being monitored, this message is displayed:




If the voltage falls below the minimum threshold, the charger will give a refresh charge to pull up the voltage to a programmed maximum threshold, and the display will show the message "F2".

**NOTE**

With this "voltage controlled" maintenance/refresh system, the battery will be kept in perfect condition for an undefined time, without any risk of undercharge or overcharge.

*If the battery is in ideal condition (no self-discharge) the refresh charge will never be activated.
If the battery is in bad condition (self-discharge is significant), the refresh charge will be often activated and the battery will be kept charged without problems.*

5. TROUBLE SHOOTING

<i>SYMPTOM</i>	<i>POSSIBLE CAUSES</i>	<i>ACTION</i>
Charger does not react to battery being connected, and display remains OFF.	1 Battery not connected properly.	Check battery connectors/harness.
	2 Charger has been connected to forklift motor connector.	Disconnect forklift motor and connect battery.
	3 Output fuse blown.	Replace output fuse and adjust AC input settings.
	4 Output cables reversed.	Check charger, connectors and battery polarities. Output fuse is probably blown.
	5 Bad control board connection.	Check board connectors (green).
	6 Bad control board.	Replace control board.
When battery is connected, message  appear.	1 AC input is absent.	Check AC input voltage on each phase. Check AC input connections. Check AC disconnect switch and fuses.
	2 Bad contactor.	Replace contactor and freewheeling diode.
Output current is too high	1 Wrong AC input settings.	Adjust AC input settings to higher voltage.
	2 One or more cells are shorted.	Repair battery.
Output current is too low	1 Wrong AC input settings.	Adjust AC input settings to lower voltage.
	2 One AC phase is absent.	Check AC input voltage on each phase.
	3 One or more diodes blown.	Replace rectifier.
	4 Bad contactor.	Replace contactor.
Charger smells hot	1 Bad location.	Install the charger in proper location.
	2 Ventilation slots obstructed.	Remove objects which may obstruct slots.
	3 Wrong AC input settings.	Adjust AC input settings to higher voltage.
	4 Bad or loose power wirings.	Check and tighten all power wirings.
	5 Transformer burned.	Replace transformer.
Charger too noisy	1 Bad contactor.	Replace contactor and freewheeling diode.
	2 One or more diodes shorted.	Replace rectifier.
Battery has low S.G. and/or doesn't last full shift	1 Wrong AC input settings.	Adjust AC input settings to lower voltage.
	2 Battery capacity too low.	Replace battery.
Battery temperature too high.	1 Wrong AC input settings.	Adjust AC input settings to higher voltage.
	2 Battery power demand too high.	Consider purchasing bigger Ah battery.
	3 Insufficient cool down time.	Increase cool down time before/after charging.
	4 Automatic stop doesn't work.	Check and replace board and/or contactor.