

# CHARGER

## HYBRID-IGBT



Revision ver 110  
Oct 2017

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# 1. SAFETY INSTRUCTIONS AND WARNINGS

## GENERAL

Battery chargers can cause injury or death, or damage to other equipment or property, if the user 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 battery charger.

## 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** – Electrical equipment must be installed and maintained in accordance with all the applicable national and local codes.

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 recommended by Code or this manual.

**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.

**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.

Measure voltage on capacitors and, if there is any voltage reading, wait 5 minutes before to proceed.

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.

To prevent arcing and burning of the connector contacts, be sure the charger is OFF before connecting or disconnecting the battery. The digital display must be completely OFF.

## **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.

## **EQUIPMENT WARNING LABELS**

Inspect all precautionary labels on the equipment.

*Order and replace all labels that cannot be easily read.*

## 2. DESCRIPTION

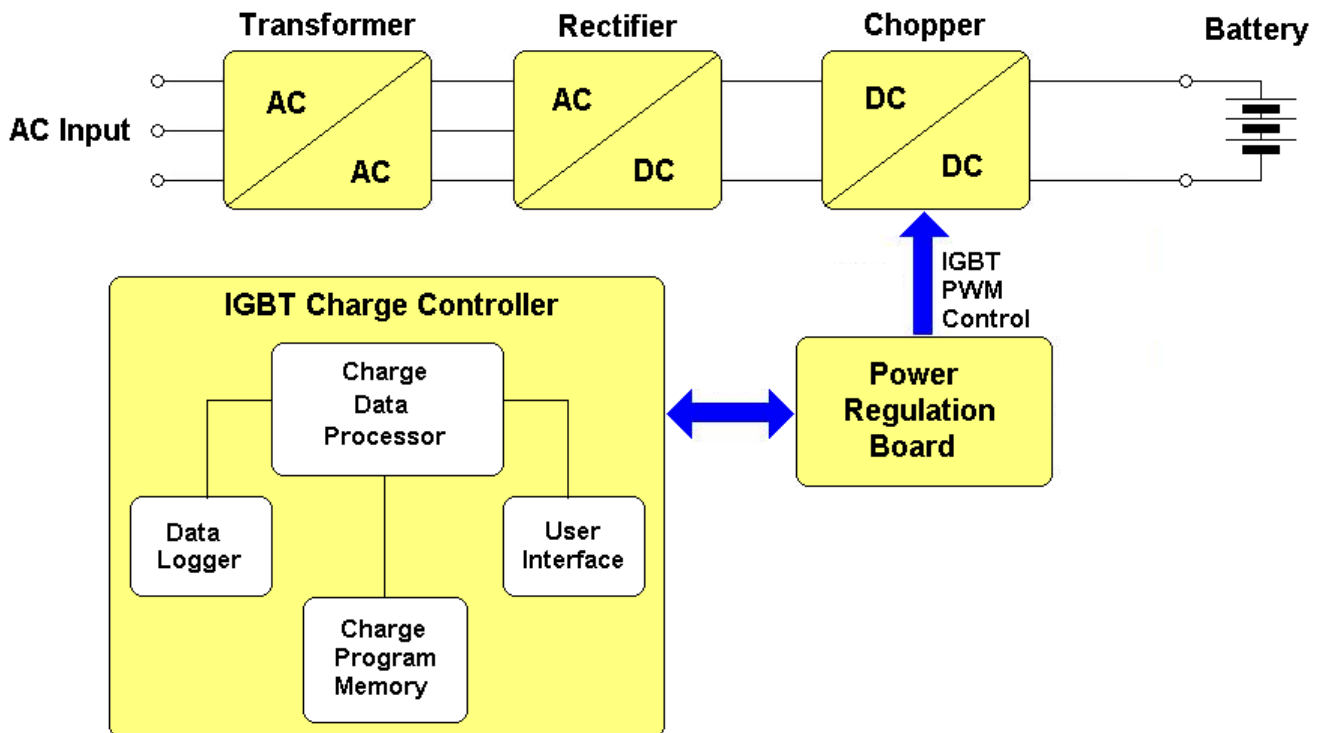
The IGBT-Charger is a series of battery chargers that are based on a new “Hybrid” power conversion system.

The two parts that are combined together to compose this “Hybrid” system are:

- Special isolation transformer, with line frequency multiplication system;
- High frequency switchmode converter, based on IGBT technology.

This system offers very high electrical efficiency, near unity power factor and very low output current ripple, moreover it features a real universal charging capability: multi-voltage, multi-current, multi-application.

The electrical structure of the IGBT charger is represented in the following block diagram.



The **TRANSFORMER** reduces the AC input voltage and provides electrical insulation between the input and the output of the charger. The **RECTIFIER** converts the AC output of the transformer to an unregulated DC voltage.

The **CHOPPER** (operating at high frequency), regulates the output voltage and current to the desired values. It generates a perfectly constant output current, with negligible ripple.

The **IGBT CHARGE CONTROLLER** is the main control unit of the IGBT-Charger. It's a microprocessor based electronic board, and it contains the **USER INTERFACE** (Display, LEDs and Keyboard), the **CHARGE PROGRAM MEMORY** (where all the programmed parameters are saved), the **DATA LOGGER** (where the charge history is saved) and the **CHARGE DATA PROCESSOR**, which manages the entire charge process.

The **POWER REGULATION BOARD** controls the operation of all the power components. It receives command signals from the **IGBT CHARGE CONTROLLER**, and it generates the high frequency PWM control signal that drives the IGBT regulator.

The IGBT chargers are available in a variety of models, with singlephase or threephase input.

The control panel is complete and easy to use: four coloured LEDs indicate the state of the charge, while a 2x20 character dot matrix display gives complete information and error messages in plain text (multilingual).

A three button flat membrane keyboard is used for programming and data review.

A unique feature of the IGBT charger is the automatic recognition of the battery. This functionality can operate in three different modes: it can recognize the batteries by voltage, it can use optional battery identification modules, or it can use a combination of the two systems.

For each battery, the user can program the **TYPE** (Flooded Lead Acid, GEL, AGM), the **CAPACITY** (from 5Ah to 2500Ah) and the desired charging current.

The *IGBT* charger calculates automatically the ideal charge curve for the given parameters.

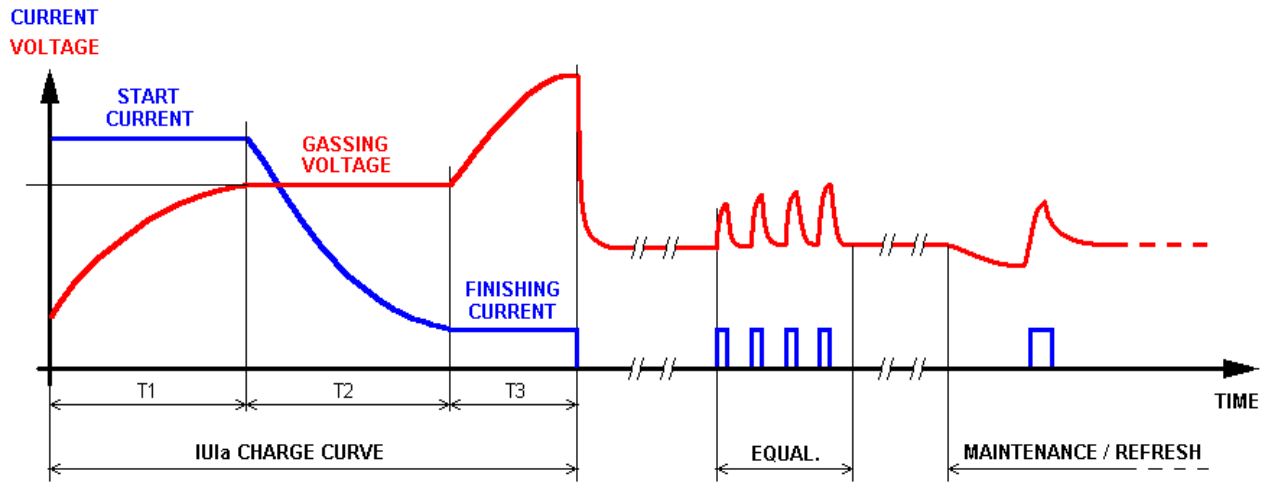
While the programming and operation of the **IGBT CHARGER** can be done using a simplified and automatic form, expert users have the possibility to adjust the charge parameters and options without limits (Gassing Voltage, Temperature Limits, Equalization Mode and much more).

The charging curve of the IGBT charger is based on the "IEI" (or "IUIa") system, but instead of applying a pre-defined charge curve to the battery, the charger calculates all the parameters (Currents, Voltage Limits, Maximum Times) according with the Battery Data and the User programming. Moreover, the curve is dynamically adjusted while the charge is in progress, depending on the real status of the battery.

The IGBT Charger is suitable for Conventional and Opportunity charging applications.

It's equipped with a Real-Time Clock, which allows the user to program the desired start time of the day, the full charge time window and to schedule the weekly equalize cycles.

The IGBT Charger saves the results of the last 250 charge in the built-in data logger.



## 3. INSTALLATION OF CHARGER

**Conditions of use:**

- **Operating /Storage temperature:** -5°C to 55°C
- **Relative humidity:** less than 75%

**WARNING !**

The charger can be installed by qualified personnel only!  
To avoid the risk of injuries, the user is not allowed to open the cabinet.  
Always refer to qualified electricians for installation and service operations.

**WARNING !**

To prevent fire or shock hazard, do not expose the charger to rain or moisture.  
Do not use the e charger in presence of flammable gas, because it can generate sparks!  
Do not install the charger near flammable materials.

**WARNING !**

To reduce the risk of fire, the charger must be installed on a  
floor of non-combustible material.  
If this is not possible, a floor plate of at least 1,6mm steel extended  
at least 150mm beyond the charger on all sides must be installed.

**CAUTION !**

**Before to install the charger:**  
Check that the charger input voltage (V) is identical to your AC power supply voltage.  
Check that the charger max input power (KVA) is available from your AC power supply.

**GROUNDING AND LINE CONNECTION**

**WARNING !**

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.

**CAUTION !**

Allow adequate air circulation to prevent internal heat buildup.  
Do not place the unit near materials that may block the ventilation slots.  
Do not install 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.

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.

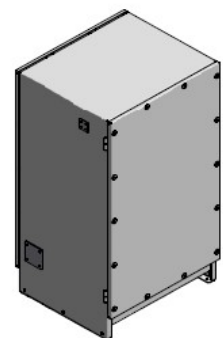
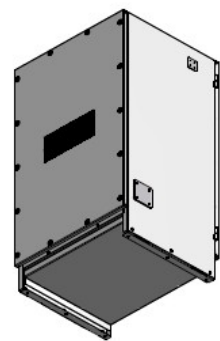
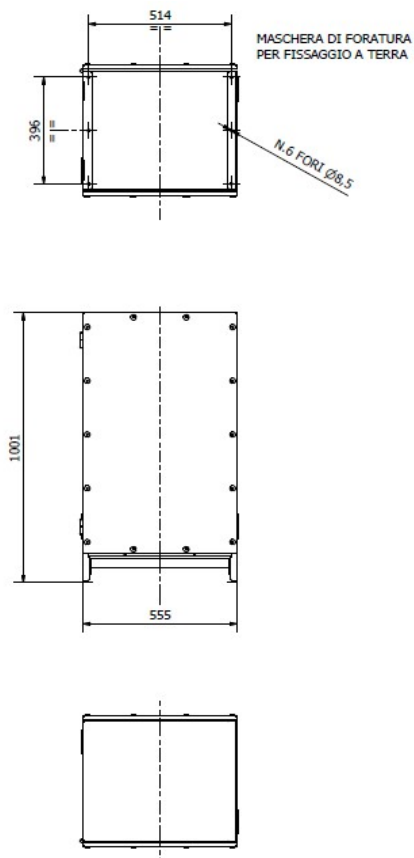
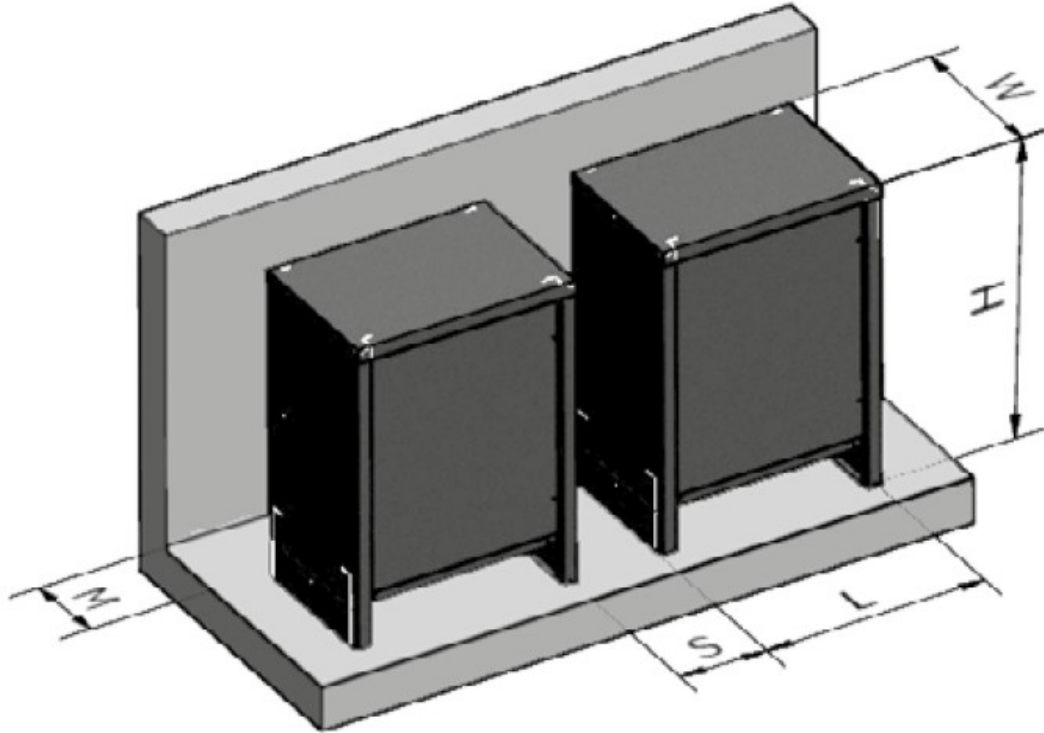
If, for any reason, an input cable which does not include a grounding conductor is used, the equipment must be grounded with separate conductor. Minimum size and color coding requirements must be in accordance with any applicable national or local code.

| CEC                   | CEC-compliance - High Frequency POWER SUPPLY THREE PHASE 60Hz 3x209260480 with 20kV-tolerance cable+standard Euro Din-Malepin+HMS AC Input/IGBT |        |     |  |  |                    |                         |                                |                                |                                |                                       | HOUSING DIMENSIONS |     |       |      | INSTALLATION<br>(Wall-Mount-Fluo) | Weight<br>lb | POWER |    |    |    |    |    |    |
|-----------------------|---|--------|-----|--|--|--------------------|-------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------------|--------------------|-----|-------|------|-----------------------------------|--------------|-------|----|----|----|----|----|----|
|                       | PART NUMBER   | Output |     | T to IMAX<br>SHMS<br>charging time<br>(IDDAC) by<br>Battery<br>Capacity<br>in gH (P4)<br>Rate 10/20% | O P P O R T U N<br>(IDDAC) by<br>Battery<br>Capacity<br>in gH (P4)<br>Rate 2/20% | Wires<br>Available | WATING-DEFAULT<br>(Vdc) | Phase Current Phase<br>(20Vdc) | Phase Current Phase<br>(20Vdc) | Phase Current Phase<br>(40Vdc) | (*) Phase<br>Current Phase<br>(50Vdc) | L                  | W   | H     | type |                                   |              | lb    | kW | VA |    |    |    |    |
|                       |   | V      | A   |  |  |                    |                         |                                |                                |                                |                                       |                    |     |       |      |                                   |              |       |    |    | mm | mm | mm | mm |
|                       |   | mm     | mm  |  |  |                    |                         |                                |                                |                                |                                       |                    |     |       |      |                                   |              |       |    |    | mm | mm | mm | mm |
| Input Vdc 3x209260480 | BDN-C80120T-483+00KTH<br>(CEC)  | 2x     | 12D | 525-75D  | 375-625  | 209260480          | 480                     | 122                            | 106                            | 67                             | 56                                    | 487                | 100 | HMSCR | F    | 35                                | 41           |       |    |    |    |    |    |    |
|                       |   | 3x     | 12D |  |  |                    | 480                     | 183                            | 169                            | 79                             |                                       |                    |     |       |      | 62                                | 60           |       |    |    |    |    |    |    |
|                       |   | 4x     | 12D |  |  |                    | 480                     | 244                            | 212                            | 106                            |                                       |                    |     |       |      | 69                                | 80           |       |    |    |    |    |    |    |
|                       |   | 72     | 70  |  |  |                    | 480                     | 214                            | 185                            | 93                             |                                       |                    |     |       |      | 60                                | 69           |       |    |    |    |    |    |    |
|                       |   | 80     | 70  |  |  |                    | 480                     | 238                            | 206                            | 103                            |                                       |                    |     |       |      | 67                                | 78           |       |    |    |    |    |    |    |
|                       | BDN-C80200T-483+00KTH<br>(CEC)  | 2x     | 20D | 75D-115D   | 575-750  | 209260480          | 480                     | 204                            | 177                            | 88                             |                                       |                    |     |       |      | 88                                | 67           |       |    |    |    |    |    |    |
|                       |   | 3x     | 20D |  |  |                    | 480                     | 306                            | 265                            | 132                            |                                       |                    |     |       |      | 86                                | 100          |       |    |    |    |    |    |    |
|                       |   | 4x     | 20D |  |  |                    | 480                     | 408                            | 363                            | 177                            |                                       |                    |     |       |      | 115                               | 133          |       |    |    |    |    |    |    |
|                       |   | 72     | 100 |  |  |                    | 480                     | 306                            | 265                            | 132                            |                                       |                    |     |       |      | 86                                | 100          |       |    |    |    |    |    |    |
|                       |   | 80     | 100 |  |  |                    | 480                     | 340                            | 284                            | 147                            |                                       |                    |     |       |      | 86                                | 111          |       |    |    |    |    |    |    |

| NOT CEC               | NOT CEC-compliance - High Frequency POWER SUPPLY THREE PHASE 60Hz 3x209260480 with 20kV-tolerance cable+standard Euro Din-Malepin+HMS AC Input/IGBT |        |     |  |  |                    |                         |                                |                                |                                |                                       | HOUSING DIMENSIONS |     |       |      | INSTALLATION<br>(Wall-Mount-Fluo) | Weight<br>lb | POWER |    |    |    |    |    |    |
|-----------------------|---|--------|-----|--|--|--------------------|-------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------------|--------------------|-----|-------|------|-----------------------------------|--------------|-------|----|----|----|----|----|----|
|                       | PART NUMBER   | Output |     | T to IMAX<br>SHMS<br>charging time<br>(IDDAC) by<br>Battery<br>Capacity<br>in gH (P4)<br>Rate 10/20% | O P P O R T U N<br>(IDDAC) by<br>Battery<br>Capacity<br>in gH (P4)<br>Rate 2/20% | Wires<br>Available | WATING-DEFAULT<br>(Vdc) | Phase Current Phase<br>(20Vdc) | Phase Current Phase<br>(20Vdc) | Phase Current Phase<br>(40Vdc) | (*) Phase<br>Current Phase<br>(50Vdc) | L                  | W   | H     | type |                                   |              | lb    | kW | VA |    |    |    |    |
|                       |   | V      | A   |  |  |                    |                         |                                |                                |                                |                                       |                    |     |       |      |                                   |              |       |    |    | mm | mm | mm | mm |
|                       |   | mm     | mm  |  |  |                    |                         |                                |                                |                                |                                       |                    |     |       |      |                                   |              |       |    |    | mm | mm | mm | mm |
| Input Vdc 3x209260480 | BDN-080120T-483+00KTH<br>(NOT CEC)  | 2x     | 12D | 525-75D  | 375-625  | 209260480          | 480                     | 140                            | 120                            | 60                             | 56                                    | 487                | 100 | HMSCR | F    | 35                                | 42           |       |    |    |    |    |    |    |
|                       |   | 3x     | 12D |  |  |                    | 480                     | 200                            | 180                            | 90                             |                                       |                    |     |       |      | 70                                | 63           |       |    |    |    |    |    |    |
|                       |   | 4x     | 12D |  |  |                    | 480                     | 260                            | 220                            | 110                            |                                       |                    |     |       |      | 80                                | 84           |       |    |    |    |    |    |    |
|                       |   | 72     | 70  |  |  |                    | 480                     | 260                            | 220                            | 110                            |                                       |                    |     |       |      | 80                                | 73           |       |    |    |    |    |    |    |
|                       |   | 80     | 70  |  |  |                    | 480                     | 260                            | 220                            | 110                            |                                       |                    |     |       |      | 80                                | 81           |       |    |    |    |    |    |    |
|                       | BDN-080200T-483+00KTH<br>(NOT CEC)  | 2x     | 20D | 75D-115D   | 575-750  | 209260480          | 480                     | 220                            | 180                            | 86                             |                                       |                    |     |       |      | 80                                | 70           |       |    |    |    |    |    |    |
|                       |   | 3x     | 20D |  |  |                    | 480                     | 310                            | 280                            | 140                            |                                       |                    |     |       |      | 110                               | 105          |       |    |    |    |    |    |    |
|                       |   | 4x     | 20D |  |  |                    | 480                     | 410                            | 380                            | 180                            |                                       |                    |     |       |      | 150                               | 140          |       |    |    |    |    |    |    |
|                       |   | 72     | 100 |  |  |                    | 480                     | 310                            | 280                            | 140                            |                                       |                    |     |       |      | 110                               | 105          |       |    |    |    |    |    |    |
|                       |   | 80     | 100 |  |  |                    | 480                     | 360                            | 320                            | 160                            |                                       |                    |     |       |      | 116                               | 116          |       |    |    |    |    |    |    |

**LOCATION - Choose your installation location to:**

- Provide adequate air circulation to prevent the buildup of fumes.
- Suggested  $M = 40\text{ cm}$ ,  $S = 40\text{ cm}$



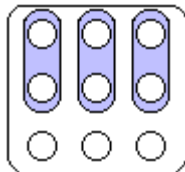
**AC INPUT VOLTAGE SELECTION 208/240 or 480 VAC**

The three-phase models may be configured for 208/240 VAC or 480 VAC nominal input voltage.

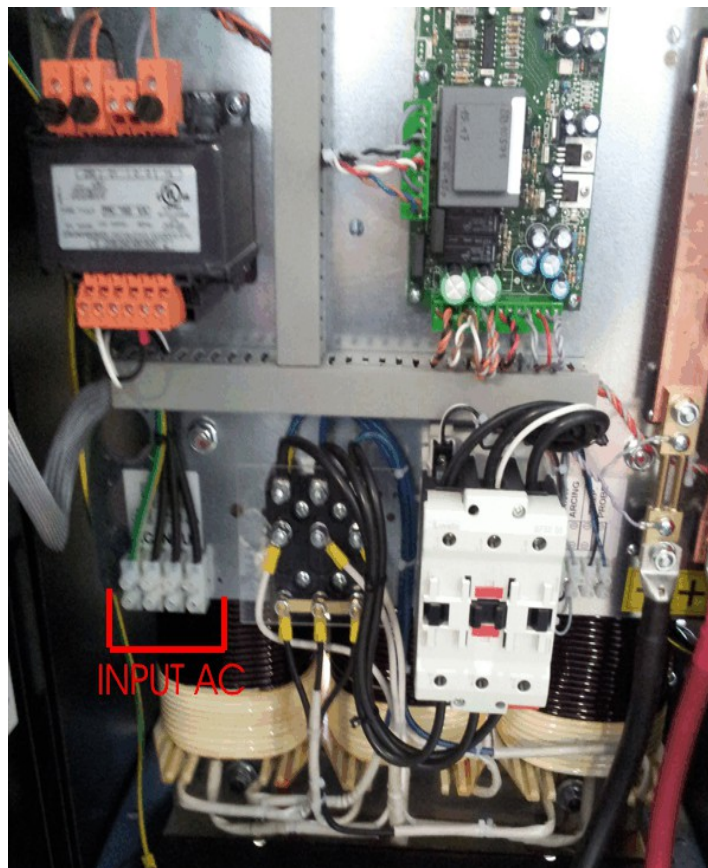
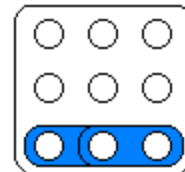
This selection can be done using the AC INPUT VOLTAGE PRESET BOARD 208-240 or 480 VAC, that is located at the center of the internal panel, near the terminal blocks for the AC input wires. In addition, it's necessary to adjust the AC input connection of the AUXILIARY TRANSFORMER to the proper AC input voltage.

- Disconnect the charger from main supply and battery.
- Remove the plastic protection over the AC INPUT VOLTAGE PRESET BOARD
- Remove the three metal bars.
- Place the metal bars in the required position, with ref to the following pictures.
- Tighten the nuts with the proper torque.
- Apply the plastic protection.
- Connect the charger to main supply.

**SELECTION BOARD  
IN POSITION  
208-240 VAC**

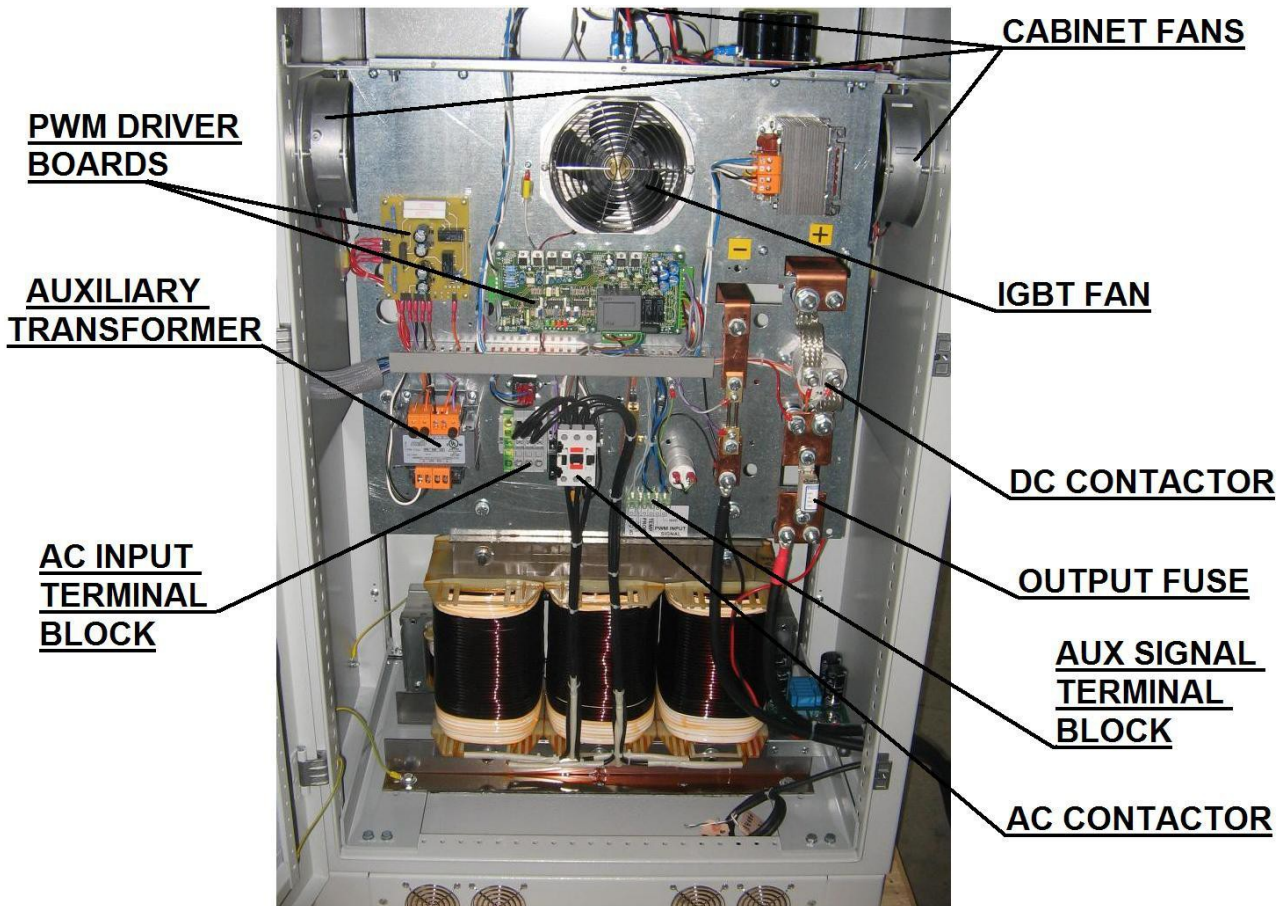


**SELECTION BOARD  
IN POSITION  
480 VAC**

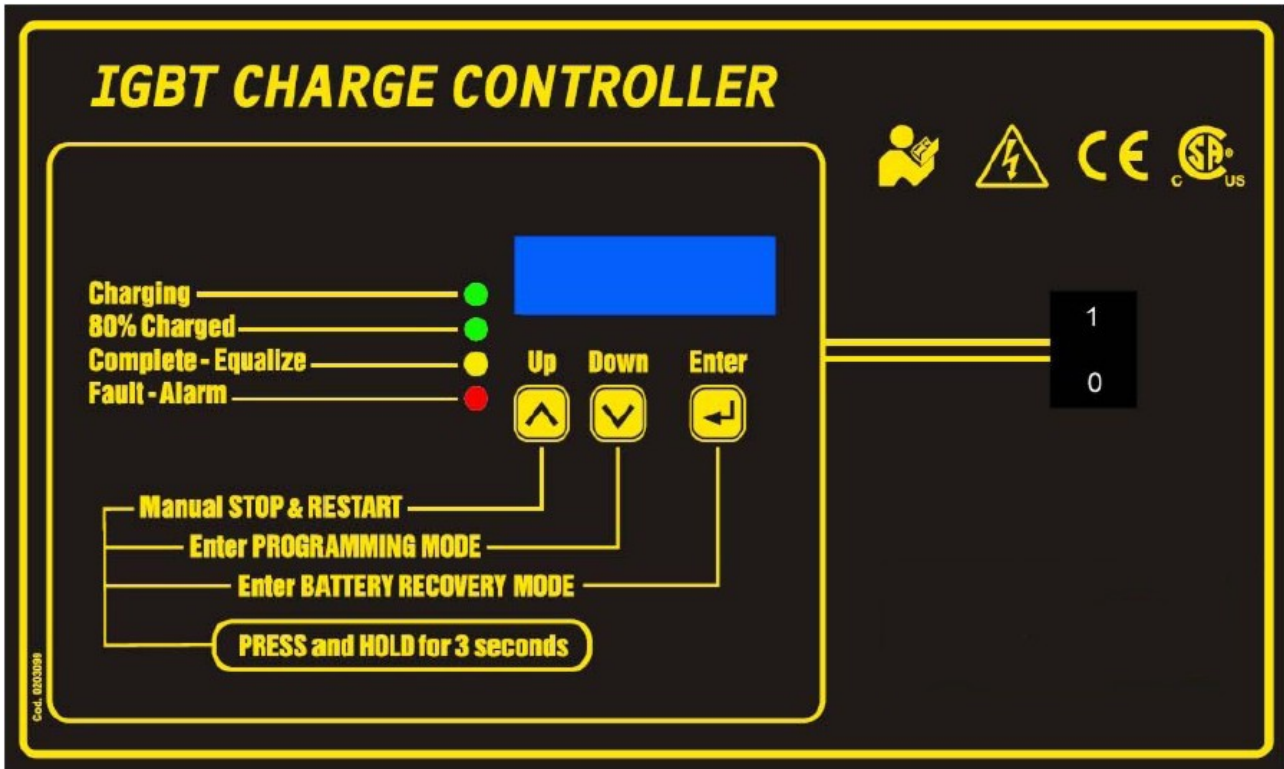


**INTERNAL VIEW – PRINCIPAL PARTS**

Inside of the charger, there are the following devices, not available to the user:



## 4. HOW TO USE THE CHARGER



### 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 Code.

### PROGRAMMATION

Turn on the charger by moving the main switch to position “1”.

The charger will perform an automatic test of the control circuits, and will wait for a random delay on start.

The display will visualize the following messages.

CHARGER  
HYBRID-IGBT

SYSTEM CHECK  
PLEASE WAIT ...

SYSTEM READY  
MAX xxx V - xxx A

SYSTEM READY  
DATE                    TIME

## USER PROGRAMMING MODE

**CAUTION !**

**It's necessary to program the charger BEFORE to connect the battery.  
If the programming is not made properly, the battery can be DAMAGED.**

### HOW TO ACTIVATE USER PROGRAMMING MODE

- Press the button **DOWN** and keep it pressed for 3 seconds  
The display will show the message:



EDIT PASSWORD

- Enter the Programming Password.  
The display will show the message:



MOD. USER

### HOW TO MODIFY A VALUE

- Scroll between the programmable values using the **UP/DOWN** buttons.
- In order to modify a value, press **ENTER** and keep it pressed for 2 seconds, until the cursor will start blinking over the value that can be modified.
- Modify the value using the **UP/DOWN** buttons.
- Confirm the modified value by pressing **ENTER** for 2 seconds, until the cursor will disappear. At this point the new value will be saved.

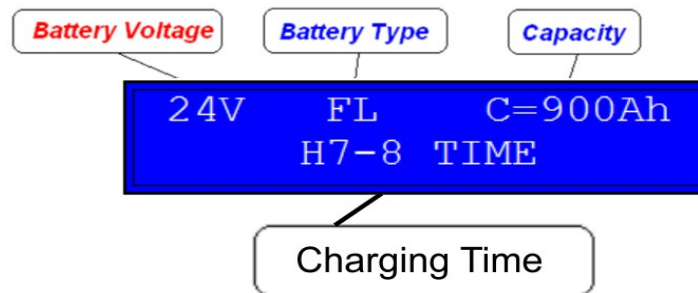
**HOW TO RETURN TO NORMAL MODE**

- Press the buttons UP and DOWN simultaneously.

**PARAMETERS 1 – 2 – 3 – 4 – 5 : BATTERY INFORMATION**

For each battery voltage that is supported by the charger, it's possible to set the TYPE, CAPACITY and desired START CURRENT.

For each supported battery voltage, the display shows this setup page:



It's possible to scroll between each battery voltage using the buttons UP/DOWN.

The fields (Type, Capacity, Charging Time) are editable, while the fields identified by the RED labels are NOT editable, as the battery voltage is fixed.

**Programmable values: TYPE**

FL – Flooded Lead Acid  
GE – Gel Cell  
AG – AGM  
NN – Type Unknown

**CAPACITY**

From 5 to 2500 Ah

**CHARGING TIME**

between 7-8 hours → H 7-8 (16%Ah)  
between 10-12 hours → H 10-12 (10%Ah)

**NOTES:**

The values programmed in these setup pages will be used when the charger recognizes the batteries automatically, using the VOLTAGE DRIVEN MODE (see next pages).

If the battery is equipped with Battery Identification module, (Opportunity/Fast charging Application) the battery module will manage START RATE.

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**EXAMPLE SETTINGS**

Battery A) Lead Acid type, 12 cells, 24 V nominal, 600 Ah, Charging Time H 7-8

```
24V    FL    C=600Ah  
H 7-8  TIME
```

Battery B) Lead Acid type, 18 cells, 36 V nominal, 1000 Ah, Charging Time H10-12

```
36V    FL    C=1000Ah  
H 10-12 TIME
```

In this example, when batteries with nominal voltages 24 V or 36 V will be connected to the charger, they will be always recognized as type A or type B, using the “VOLTAGE DRIVEN” recognition mode.

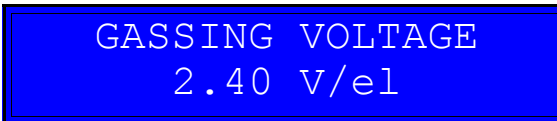
If batteries with nominal voltages of 24 V or 36 V, equipped with Battery Identification Modules, will be connected to the charger, the charger will receive all the information about the battery directly from the Battery Identification Module.

In this case, the battery will be charged using the start rate (A/100Ah) defined from the battery module that has been set for the same voltage.

**PARAMETER 6: GASSING VOLTAGE**

**Programmable values:** from 1.00 to 3.50 V/Cell, or TEMPERATURE COMPENSATED

**Default value:** 2.40 V/cell



GASSING VOLTAGE  
2.40 V/e1

**NOTES:**

The charging algorithm of the IGBT charger is adaptive, so it's capable of adjusting the charging curve even if the gassing voltage of the battery deviates significantly from the programmed value. For this reason, this parameter should be modified only when using non-standard batteries, or if the operating temperature is extremely low or high.

When a battery temperature probe (optional) is used, the charger can calculate the gassing voltage dynamically, in order to compensate the effect of the temperature of the electrolyte.

In order to activate this function, it's sufficient to reduce the gassing voltage below 2.35 V/cell. In this case, the message "TEMP. COMPENSAT." will appear.



GASSING VOLTAGE  
TEMP. COMPENSAT.

**PARAMETER 7: MAXIMUM VOLTAGE**

**Programmable values:** from 2.40 to 2.80 V/Cell, or DISABLED

**Default value:** 2.80 V/cell

**NOTES:**

This parameter sets a maximum limit for the cell voltage. If this limit is reached, the charge is terminated and a specific error message is given.

**PARAMETER 8: MAX TEMPERATURE**

**Programmable values:** from 40 to 70 °C or DISABLED

**Default value:** DISABLED

**NOTES:** This parameter sets a maximum limit for the battery temperature. If this limit is reached, the charge is terminated and a specific error message is given.

This parameter works only if it is installed the temperature sensor probe. In this case the default settings is 60 °C. When the charger read the temperature during the charging it applied a temperature compensation voltage

**PARAMETER 9: EQUALIZE DURATION**

**Programmable values:** from 1 to 23 hours.

**Default value:** 6 hours

**NOTES:**

This parameter allows to adjust the duration of the weekly Equalize cycle. In most of the cases the default value of 6 hours works well, but sometimes it can be useful to modify this setting, depending on the status of the battery and on the operating cycle.

**IMPORTANT:**

The battery will be equalized only during the programmed time window. If the Equalize time window is not set, or it's set too short, the battery will not receive a sufficient Equalize.

**PARAMETER 10: DATE and TIME**

**Programmable values:** Month/Day/Year, Hour/Minutes

**Default value:** Eastern Time (GMT-5)

**NOTES:**

It's fundamental to keep the Real Time Clock set to the correct date and time, in order to use all the time base functions. The Charger calculates the Day of the Week automatically, however it's necessary to adjust the Clock manually in Daylight saving time periods.

**PARAMETER 11: START TIME WINDOW**

**Programmable values:** From 00.00 to 23:59  
**Default value:** From 00.00 to 23:59

```
START BEG<->END
00:00 23.59
```

**NOTES:**

This parameter sets a time window during the day in which the charger is allowed to start a new charge cycle. If a battery is connected outside of this time window, the charger will remain in stand-by mode until the programmed Start time will be reached.

Once the charge cycle has begun, this time window is not considered anymore.

**PARAMETER 12: FULL CHARGE TIME WINDOW**

**Programmable values:** From 00.00 to 23:59  
**Default value:** From 00.00 to 23:59

```
FULLCH BEG<->END
00:00 23.59
```

(disabled change of minutes)

**NOTE:**

This parameter sets a time window during the day in which the charger is allowed to fully charge the battery and to let the battery go through the gassing / overcharge process.

Usually, this parameter is used in opportunity charging applications, with the purpose of avoiding useless gassing of the battery during the opportunity charging cycles, and to program a daily full charge of the battery.

Installation, Settings and Service operations can be done by qualified personnel only

**Special OPPORTUNITY CHARGING settings:**

```
FULLCH BEG<->END
00:00 00.59
```

In this way the charger reach the gassing voltage point and it interrupt the charging.  
 For complete a good OPPORTUNITY CHARGING setting you need to set 1 mn the parameter MAX TIME FULLCH. And you need to increase the hours of EQ weekly.

**PARAMETER 13 and 14:                    EQUALIZE TIME WINDOW**

**Programmable values:** Any day, from 00.00 to 23:59

**Default value:** From SATURDAY at 12.00 to SUNDAY at 22.00

```
EQ BEGIN TIME
SAT 12.00
```

```
EQ END TIME
MON 03.00
```

(disabled change of minutes)

**NOTES:**

These parameters set a time window during the week in which the charger is allowed to fully charge and Equalize the battery. It's recommended to set a minimum Equalize time of 12 hours after the normal completion of the charge cycle.

**PARAMETER 15:                    BATTERY RECOGNITION MODE**

**Programmable values:** - VOLTAGE DRIVEN  
- BATTERY ID MODULE  
- AUTOMATIC

**Default value:** VOLTAGE DRIVEN

```
BATT. IDENTIFIC.
VOLTAGE DRIVEN
```

**NOTES:**

This parameter sets the method that the charger uses for the identification of the battery.

The VOLTAGE DRIVEN mode is based exclusively on the battery voltage at the moment of the connection to the charger.

The BATTERY ID MODULE mode is based exclusively on the presence of a battery ID module, that stores the battery Type, Voltage, Capacity and ID number.

In this operating mode, if the battery ID module is absent the charger will not charge the battery.

The **AUTOMATIC** mode allows to combine the two modes. When the battery is connected, the charger tries to establish a wireless connection with the **WBM (Wireless Battery Module)**.

If the **ID** module is found, the charger proceeds, and it uses the information stored in the module for the calculation of the charging cycle.

If the **ID** module is **NOT** found within 5 minutes, the charger recognizes the battery using the **VOLTAGE DRIVEN** mode, then it uses the default Battery information that have been programmed (Parameters 1 to 5).

---

## 5. OPERATION

### CONNECTION OF THE BATTERY AND AUTOMATIC RECOGNITION

Connect the Battery to the charger, using a connector of adequate size.  
When the battery is correctly connected, the charger visualizes the following message:



BATTERY  
CONNECTED

### RECOGNITION WITH BATTERY ID MODULE (OPTIONAL)

If the Battery Recognition mode is set to BATTERY ID MODULE or AUTOMATIC, the charger will attempt to establish a wireless connection with the ID module. And the display will visualize the message:



SEARCHING  
BATT. ID MODULE

When the wireless connection is active the charger is ready to start the charging cycle. The display visualizes the message:



BATT ID MODULE  
CONNECTED

At this point, the battery information are transferred to the charger and are visualized on the display, and the charger is now ready to start.

#### **NOTES:**

The first time that a battery ID module is installed on a battery, it has to be initialized and programmed. Please refer to Paragraph 7 “PROGRAMMING BATTERY ID MODULES”.

### VOLTAGE DRIVEN BATTERY RECOGNITION

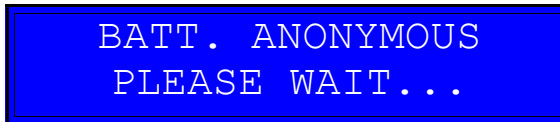
If the Battery Recognition mode is set to VOLTAGE DRIVEN, the display will show the message:



BATTERY  
RECOGNITION

At this point, the battery information are transferred to the charger and are visualized on the display, and the charger is now ready to start.

If the battery voltage cannot be recognized, the charger shows the message:



BATT. ANONYMOUS  
PLEASE WAIT...

In this condition, the charger will wait the battery voltage stabilize, and will retry the automatic recognition.

If the battery voltage is particularly low, due to sulphation or overdischarge, it's possible to activate a DESULPHATATION / RECOVERY cycle, by pushing the button ENTER for 5 seconds. Please refer to Paragraph 8: "BATTERY DESULPHATION".

## **AUTOMATIC START**

Once the battery has been recognized, depending on the programmed start time window (Parameter 11), the charger may enter in stand-by mode, and the display visualizes the message:



DELAYED START  
(hh.mm) A → (hh.mm) B

Where (hh.mm)A represents the clock time at that moment, and (hh.mm)B represents the programmed start time.

When the charge begins, the display visualizes the message:



PREPARING  
TO CHARGE

## **BATTERY VOLTAGE TOO HIGH**

If the battery voltage is higher than a maximum threshold, the charge will not start and the display visualizes the message:



BATTERY VOLTAGE  
TOO HIGH !!!

If this message appears, it's recommended to verify that the nominal battery voltage matches the nominal voltage of the charger.

## **BATTERY VOLTAGE TOO LOW**

If the battery voltage is lower than a minimum threshold, the charge will not start and the display visualizes the message:

**BATTERY VOLTAGE  
TOO LOW !!!**

If this message appears, it's recommended to verify that the nominal battery voltage matches the nominal voltage of the charger.

Probably a wrong or damaged battery has been connected.

It's also possible that the battery has been deeply discharged, bringing the voltage below the minimum value required for the automatic start the charge.

In this case, it's possible to start the charge manually, by pushing the button DOWN for 5 seconds.

## **CHARGE CYCLE**

When the preliminary controls are complete, the charge starts automatically, and the display visualizes the following information:

- Battery Voltage [Volt]
- Charging Current [Amps]
- Time of Charge [hours.minutes]
- Capacity Returned [Ah]

**xx.x V      xxx A  
xxx Ah      x.x t**

The IGBT Charger performs an IEC charge cycle, and the management of the charging curve is totally automatic.

Depending on the programming of the Full Charge time window (Parameter 12), when the battery reaches the 100% state of charge, the charger may suspend the charge (opportunity charge cycle). In this situation, the display visualizes the message:

**DELAYED FULLCH.  
(hh.mm)A → (hh.mm)B**

Where (hh.mm)A represents the real time at that moment, and (hh.mm)B represents the beginning of the Full Charge time window.

While the charge is in progress, it's always possible to scroll between different menu pages, using the buttons UP/DOWN:

- **CHARGE STATE**
  - Identifies the position in the charge curve, with reference to the picture blow.
- **TEMPERATURE**
  - Visualizes the temperature of the battery, if the optional probe is connected.
- **HISTORY LOG**
  - Visualizes the history log of the previous charge cycles. Refer to Paragraph 6 “History Log”

## **EMERGENCY STOP**

If the battery doesn't reach the gassing voltage within a predefined time limit, the charger will suspend the charge, and it will visualize the message

A blue rectangular box with a black border containing the text "EMERGENCY STOP" and "VGAS NOT REACHED" in white, uppercase letters.

EMERGENCY STOP  
VGAS NOT REACHED

In this case, the charge cannot proceed, and it's necessary to disconnect the battery. It's recommended to control the battery for damaged cells.

The IGBT-charger adjusts the maximum time limits automatically, depending on the battery capacity and the programmed charge current.

This function is important to provide the maximum protection for the battery in any type of application.

## **AC INPUT BLACK OUT**

If there is a black-out of the AC input, while the charge is in progress, the charger will shut down, while the charge parameters will remain in memory.

When the AC input will be recovered, the charger will restart the charge cycle automatically, and the display will show the message:

A blue rectangular box with a black border containing the text "RESTART AFTER" and "POWER SUPPLY OFF" in white, uppercase letters.

RESTART AFTER  
POWER SUPPLY OFF

## REVERSE POLARITY PROTECTION

The IGBT chargers are equipped with an active protection against the connection of batteries with Reverse Polarity.

If a battery with reverse polarity is connected, the charger remains in a safe Stand-By mode.

## EQUALIZATION CYCLE – AUTOMATIC – (clock mode)

At the end of the charge, if the battery is left connected to the charger for a sufficient time, the charger activates the Equalize cycle automatically, based upon the programmed schedule.

If the charge cycle ends outside of the programmed Equalize time window, the charger remains in stand-by mode, and the display shows the message:

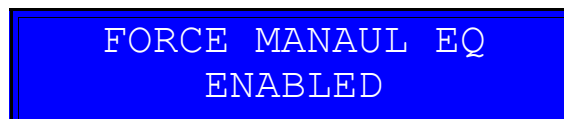


DELAYED EQUALIZE  
DAY TIME

Where DAY and TIME represent the beginning of the programmed Equalize time window.

## EQUALIZATION CYCLE – MANUAL ACTIVATION

During the charging of the battery the operator can scroll the menu of the display, and he can force a EQ manual cycle at the end of this cycle.



FORCE MANAUL EQ  
ENABLED

---

## REFRESH-MAINTENANCE

This function is useful to keep the battery in perfect condition when it's not used for an long period (weeks, months, ...).

It is sufficient to leave the battery connected to the charger. After a normal termination of the charge and the equalize cycle, the control board will activate the charger automatically for 15 minutes of refresh charge every day.

While the charger waits before to activate a Refresh cycle, the display shows the messages:



```
xx.x V      R.END NR
xxx Ah     x.x t
```

- Battery Voltage [Volt]
- Nr of Refresh cycles already given to the battery
- Total Time of Charge [hours.minutes]
- Total Capacity Returned [Ah]

**During cycle Refresh, the display shows the same set of information that are visualized during the normal charge cycle.**

## DISCONNECTION OF THE BATTERY DURING THE CHARGE

### **WARNING !**

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

**If it's necessary to disconnect the battery while it's being charged, press the button UP for five seconds, in order to stop the charger manually.**

The charger will suspend the charge and the display will show the message:



At this time it's possible to disconnect the battery.

Eventually, the charge can be restarted, by pressing the button UP for 5 seconds.

## **ANTI ARCING PROTECTION**

The IGBT charger is equipped with a built-in Anti-Arcing protection.

In order to activate this function, it's necessary to add an optional wire loop, using a battery connector equipped with Auxiliary Pins.

Contact your local dealer for more information.

## 6. HISTORY LOG

The internal memory of the IGBT charger contains a log of the last 250 charge cycles.

The most significant parameters can be visualized on the display of the charger,.

The history log can be accessed at any moment, even while a charge cycle is in progress. It's sufficient to scroll the menu using the UP-DOWN buttons, until the display will visualize the first page of the most recent history log, that will have a format of this type:

```

01    24.0V    31.3V
2009/06/01  10:30
  
```

At this point, press ENTER for 3 seconds, until the cursor will start blinking over the number 01 on the top left of the display.

The results of each charge cycle are represented on two or three pages.  
Use the UP-DOWN buttons to scroll between each record.

### PAGE A (ALWAYS VISUALIZED)

```

No    VSTART    VSTOP
Start Date and Time
  
```

Where:

|                       |  |
|-----------------------|--|
| No =                  | Number of cycle (1 is the most recent)       |
| Vstart =              | Battery Voltage at the connection            |
| Vstop =               | Battery Voltage at the end of the charge     |
| Start Date and Time = | Date and Time of the BEGINNING of the charge |

**PAGE B**

**(Not visualized if the battery recognition is set to VOLTAGE DRIVEN mode)**

```
BATT .   xxxxxxxxxx
TYPE  VOLTAGE  CAP
```

Where:

- XXXXXXX = Identification number of the battery  
(ZZZZZZZ if ID module was not found)
- TYPE = Battery Type
- VOLTAGE= Battery Nominal Voltage
- CAP= Battery Capacity

**PAGE C**

**(Always visualized)**

```
End Date and Time
TT  HH.MM  AHRET
```

Where:

- End Date and Time = Date and Time of the TERMINATION of the charge
- TT = Charge Termination Code (see next paragraph)
- HH.MM= Total charge time
- AHRET= Total capacity Returned to the battery

---

## 7. PROGRAMMING BATTERY ID MODULES

When a battery ID module is installed on a battery for the first time, it must be initialized and programmed, by following this procedure.

Connect the battery to a IGBT charger (the Battery Recognition mode must be set to BATTERY ID MODULE or AUTOMATIC).

The IGBT charger will establish a communication with the New Battery ID module, and it will show the message:



BATT ID MODULE  
CONNECTED

At this point, using the UP/DOWN buttons, it's possible to edit the battery ID information:

- ID Number (8 alphanumeric digits, to be confirmed individually by pressing ENTER for 3 seconds)
- Nominal Voltage
- Capacity
- Type

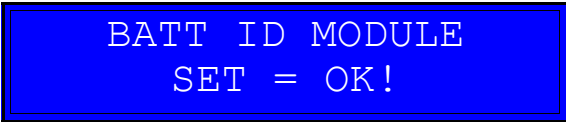
Once all the parameters are set correctly, push the buttons UP+DOWN Simultaneously in order to save the data to the ID module.

The programming sequence may take up to 3 minutes, while the charger display will show the message:



BATT ID MODULE  
PROGRAMMING...

When the programming sequence is completed, the display will show the message:



BATT ID MODULE  
SET = OK!

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

If the battery is left connected, a charge cycle will be initiated.

The Battery ID Module will keep the information in memory for an unlimited time. In order to erase the memory, it's necessary to disconnect the ID module from the battery.

**PROGRAMMING HARDWARE RULES**

During installation and programming activity it is necessary to ensure that the position of the battery power cables and charger cables are correct. As illustrated below, it is important that the cables are not overlapping or entwined in the cables of another battery.

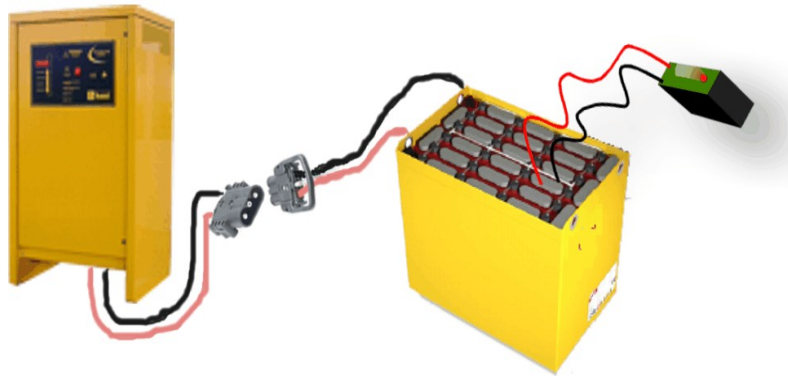


fig.1 correct position of the cables.

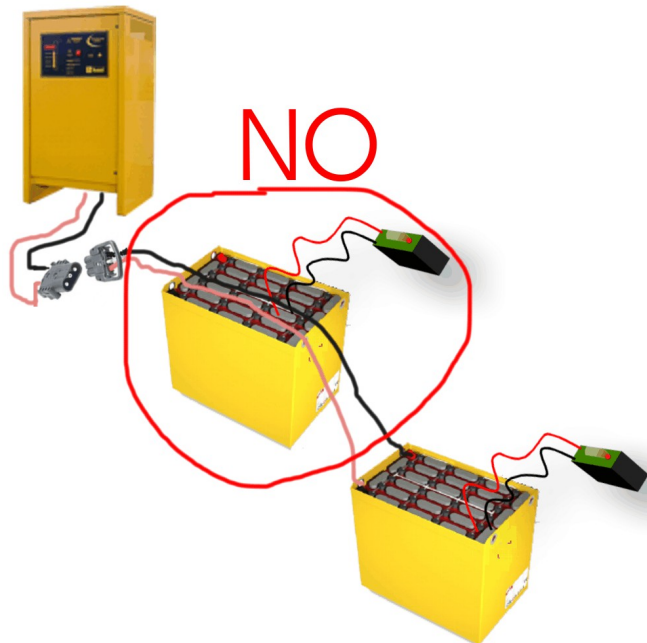


fig.2 incorrect position of the cables.

Failure to comply with these instructions may disturb the communication signals from the battery module, if this occurs the charger will generate the following alarm:

**EMERGENCY STOP  
DRAPED CABLES!**

---

## 8. CHARGE TERMINATION CODES

### **CHARGE TERMINATION CODES**

#### ***GROUP 1: CHARGE COMPLETED***

01

Charge completed successfully.

02

Charge completed successfully.

Equalize NOT executed because battery was disconnected.

03

Charge completed successfully.

Equalize started but not completed, because battery was disconnected during the cool-down time before the Equalize cycle.

04

Charge completed successfully.

Equalize started but not completed, because battery was disconnected while the Equalize was in progress.

06

Desulphation cycle completed successfully.

07

Charge completed successfully.

Equalize completed successfully.

Refresh-Cycle NOT executed because battery was disconnected.

08

Charge completed successfully.

Equalize completed successfully.

Refresh-Cycle started but not completed, because battery was disconnected while the Refresh was in progress.

09

Charge completed successfully.

Equalize completed successfully.

Refresh-Cycle completed successfully.

10

Gassing voltage reached successfully.  
Full charge NOT executed because time window Disabled.

12

Charge completed successfully.  
Equalize completed successfully.

13

Charge completed successfully.  
Termination by maximum time (dV/dt not reached)

14

Charge completed successfully.  
Termination by maximum time limit during the Constant Voltage phase.

19

Charge completed successfully.  
Termination by criteria dv/dt during OverCharge

---

***GROUP 2: MANUAL STOP***

11

Charge stopped manually, during a generic cooling state

20

Charge stopped manually, before to reach the gassing voltage.

21

Charge stopped manually, during the finishing charge.

22

Charge stopped manually, during eq.

23

Charge stopped manually, during refresh.

24

Charge stopped manually, during desulphation.

26

Charge stopped manually, during the constant voltage phase.

---

***GROUP 3: BATTERY DISCONNECTED***

30

The battery has been disconnected before the begin of the charge, while the charger was waiting for the programmed Start Time window.

31

The battery has been disconnected during the first part of the charge, before to reach the gassing voltage.

32

Successful Opportunity charging cycle.

The battery reached the gassing point, the charger entered in stand-by mode waiting for the Full Charge/Overcharge time window, and at that point the battery has been disconnected.

33 - 34

The battery has been disconnected during the finishing charge.

36

Charge never started.

The battery has been disconnected while the charger was trying to establish a wireless connection with the Battery Identification Module (WBM).

37

Charge never started.

The battery has been disconnected while the charger was communicating with the Battery Identification Module (WBM).

38

Desulphation cycle NOT completed.

The battery has been immediately disconnected, at the beginning of the Desulphation cycle

39

Desulphation cycle NOT completed.

The battery has been immediately disconnected, before to complete the programming of the Desulphation cycle.

40

Desulphation cycle NOT completed.

The battery has been disconnected while the Desulphation cycle was in progress.

41

Battery disconnected during the preparation of the cycle. Charge never started.

42

Battery disconnected during the calculation of the cycle. Charge never started.

43

Battery disconnected during the initial identification sequence. Charge never started

44

Battery disconnected during the constant voltage phase.

***GROUP 4: EMERGENCY STOP***

60

Emergency Stop!

Maximum voltage limit exceeded during first part of the charge, before to reach the gassing voltage.

61

Emergency Stop!

Maximum voltage exceeded during the finishing charge.

62

Emergency Stop!

Maximum voltage exceeded during the equalize cycle.

63

Emergency Stop!

Gassing voltage not reached within the predetermined time limit.

64

Charge never started.

Battery voltage was too LOW

65

Charge never started.

Battery voltage was too HIGH

66

Emergency Stop!

Maximum Current Limit Exceeded.

67

Emergency Stop!

Maximum voltage exceeded during the refresh cycle.

68

Emergency Stop!

Maximum temperature exceeded before to reach the gassing voltage.

69

Emergency Stop!

Maximum temperature exceeded during the finishing charge.

70

Emergency Stop!

Maximum temperature exceeded during the equalize cycle.

71

Emergency Stop!

Maximum temperature exceeded during the refresh cycle.

73

Emergency Stop!

The charger was not able to keep the battery at constant voltage.

74

Emergency Stop!

Battery temperature exceeded maximum programmed value during the constant voltage phase.

75

Emergency Stop!

Wrong/Unknown Battery.

76

Emergency Stop!

Maximum temperature exceeded during desulphation.

**GROUP 5:**

**WARNING MESSAGES**

82

The battery has been disconnected while the charge was in progress, in a generic state.

83

Output fuse blown.

85

Communication problem with Wireless Battery Module.

86

Battery temperature probe malfunction

96

Battery voltage anonymous at the connection.

After 1 hour scale voltage to minus battery.

97

Battery voltage anonymous at the connection.

Complete fast charging cycle at low current.

98

Battery voltage out of range at the connection.

Recognition driven by voltage may not work correctly.

99

Black out of the AC input.

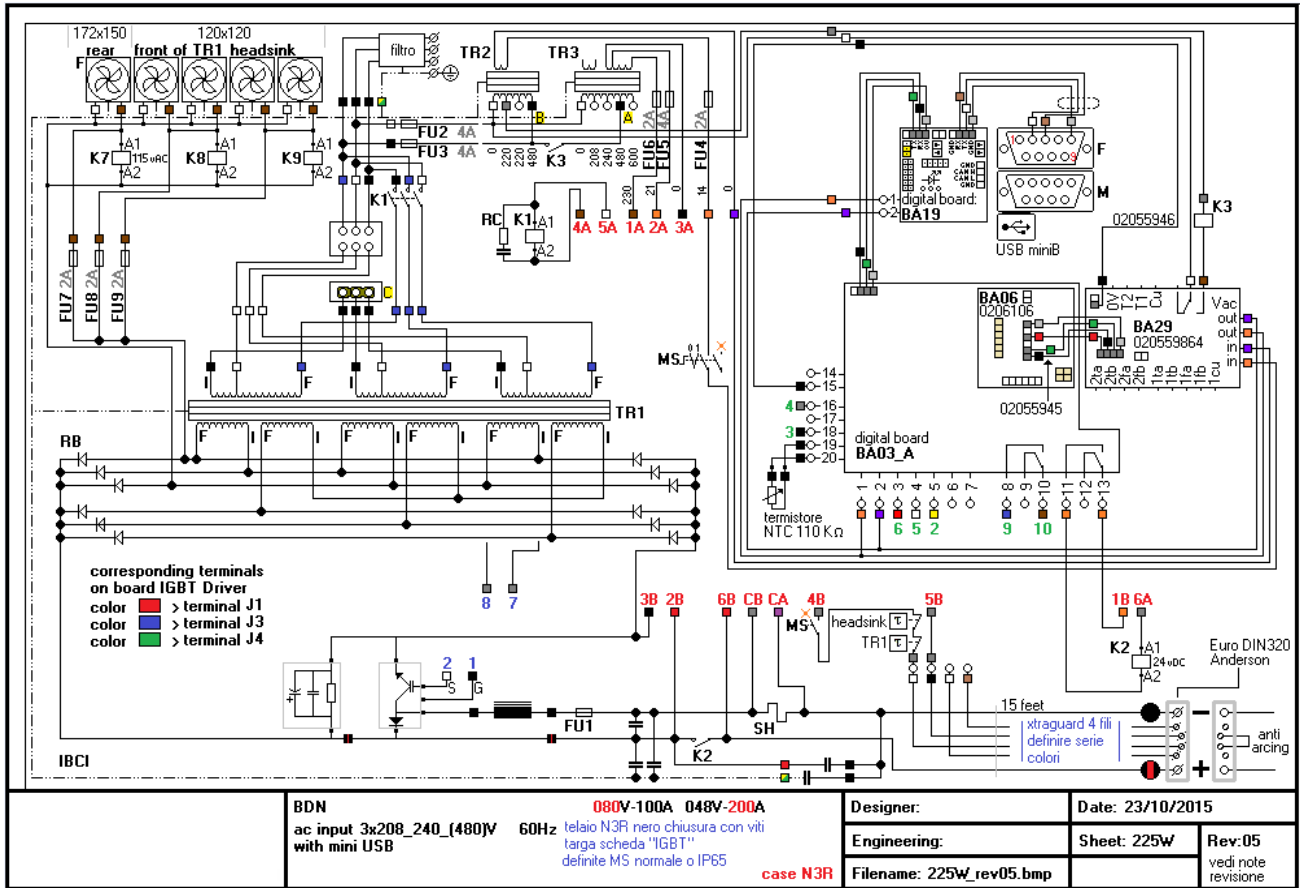
This termination code happened in 2 different cases:

a) The operator interrupt the charger with general interruptor 0-1, normally it is better interrupt the charger with button STOP. But we know that many operators use interruptor 0-1, this is not a problem.

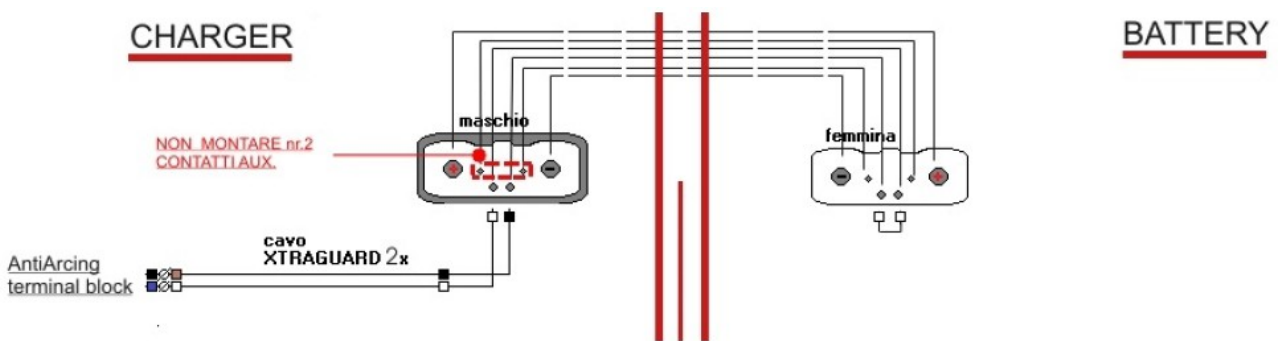
b) external Black out.

Normally it is not a problem, but if we know that the battery was not well charged, this means that the operator unplugged the battery too early. or really there was a black out. (in this case also others chargers had the same termination code at the same time)

# 9. WIRING DIAGRAM



# 10. BATTERY CABLE/DC CONNECTOR



- End of Manual -