THREE PHASE HF EVOLUTION CHARGER

MAINTENANCE AND USER MANUAL

WARRANTY TERMS

This battery charger is manufactured according to basic standards that assure its good quality and every assembling phase is checked by our skilled technicians.

The warranty is recognized only in case of anomalies caused by manufacturing or components. Complaints recognized in warranty terms cause the restoration or the replacement with an identical product, without expense, provide that the device is brought to our site in Saletto (Pd). **Anything else that is not mentioned above won't be considered** (ex. material or moral damages, stop of devices, ...)

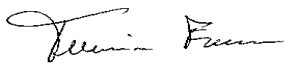
Warranty duration is 12 months after the first use of the product or after 12 months of the date of the VAT invoice.
Warranty duration is calculated according to a standard 12 hours/day job; if the battery charger is exposed to a double turn shift, the duration is proportionally reduced.

Warranty is immediately revoked in these cases: modification without permission, illegible serial number, malfunctions caused by natural events, corrosive or damaging environment for electric circuits, unusual impact, delivery damage and misuse.

Shipment cost is not refunded unless the anomaly or malfunction of the device is caused by bad manufacture or problem related to the components. T.C.E. can modify and update its devices, without noticing to the customers, but guaranteeing replacement parts.

Restorations of replaced parts are guaranteed for 6 (six) months.
The buyer agrees with the terms of warranty.

Relating to the manufacturer's responsibility, T.C.E. would be subjected to obligations on its products only if the technician would correctly execute user instructions and if the user would observe with scrupulousness the instructions found in the technical manual enclosed to the battery charger.



Dear Customer,

Thank you for your trust and for buying this high-quality T.C.E. product. These instructions will help you to know the battery charger. A careful reading of these instructions will assure you to learn about the many different features offered by this T.C.E. product.

Please, note the safety standards to ensure greater safety when using the product. Careful handling of the product will repay you with years of safe and reliable operation.

Safety rules

	**CAUTION!** Indicates a possible dangerous situation that, if not avoided, can provoke mild injuries or material damage.
	**WARNING!** Indicates a dangerous situation that, if not avoided, can provoke serious injuries or death.
	**DANGER!** Indicates a direct and imminent threat that, if not avoided, **will** provoke death or serious injuries.
	**IMPORTANT!** Indicate the correct use of the machine and other useful information. This sign doesn't stand for any dangerous nor threatening situation.

Proper use

The device is manufactured using recognized safety standards. Any incorrect use can cause:
- injury or death to the operator or a to third party
- damage to the device itself and other material or assets belonging to the company
- inefficient operations

All personnel involved in commissioning, operating, maintaining and servicing the device must:
- have suitable qualification
- read and follow these operating manual carefully

All safety and danger warnings on the device must:
- be in a legible state
- not to be damaged
- not to be removed
- not to be covered or painted over.

Before switching on the battery charger, rectify any faults that could compromise its safety.

The device is to be used exclusively for its intended purpose. Any use above and beyond is deemed improper. The manufacturer is not responsible for any damage, unexpected or incorrect results caused by such misuse.
The use includes:
- reading and obeying all operating instructions and safety and danger warnings
- performing all inspection and maintenance work
- following all instructions on the battery and vehicle manufacturers.

Mains line connection

Devices with a higher rating may affect the energy quality of the mains, due to their voltage input.
This may affect a number of battery chargers and cause connection restrictions like:
- insufficient network capacity
- insufficient dimensioning of the electrical system

If one of this things occurs, the plant operator or the person using the device should check whether the device may be connected, asking for a confirmation to a skilled technician.
- Connect the battery charger to a mains plug easily reachable in case of need.
NOTE! Make sure that the mains line connection is grounded properly.

Risks caused by mains voltage and charging current

The user of the charger is exposed to many risks such as:
- risk of electrocution from mains voltage and charging current
- dangerous electromagnetic fields, which can risk the lives of those using cardiac pacemakers
An electric shock can be deadly. To avoid electric shocks while using the charger:
- do not touch any live parts inside or outside the charger
- never touch the battery poles
- do not short-circuit the charger lead or charging terminals.
All cables and leads must be secured, undamaged, insulated and adequately dimensioned. Loose connections, scorched, damaged or inadequately dimensioned cables and leads must be immediately repaired.

Risks from acid, gas and vapor

Batteries contain acid which is harmful to the eyes and skin. Wear protective goggles and suitable protective clothing. In case of direct contact rinse any acid splashes and seek medical advice if necessary.
During charging, gas and vapor are released, that can be harmful and could be highly explosive.
- Only use the charger in well ventilated areas to prevent the accumulation of explosive gases. Battery areas with less than 4% hydrogen are deemed not to be at risk of blast. This environment situation is provided by a good ventilation
- While charging, maintain a distance of at least 50 cm between battery and charger. Possible sources of ignition must be kept away from the battery
- The battery connection must not be disconnected while charging.
- Do not inhale any of the gas and vapor released
- Make sure that the charger and battery area is well ventilated
- To prevent short circuit, do not place any tools or conductive metals on the battery

How to handle the battery

- Protect battery from dirt and mechanical damage
- Store charged battery in a cool place. Self discharge is kept to a minimum at approx. 20°C
- Every week, perform an inspection of the battery to ensure that the electrolyte level is correct
If any of the following occurs, do not start the battery charger and have the battery checked:
- Uneven electrolyte levels or high water consumption in individual cells: possible fault
- Battery is overheating (temperature over 55°C)

Protecting others

While the charger is in function, keep all non-authorized personnel out of the working area.
If there are people in the vicinity:
- Warn them about all the dangers (hazardous acids and gas, danger from mains voltage and charging current, etc.)
- Provide suitable protective equipment
Before leaving the work area, make sure it's safe even if the operator is absent.

Safety measures in normal operation

- The charger must only be operated on a mains supplied with a ground conductor and a socket with a ground conductor contact. The manufacturer will not be held responsible for any damage caused by misusage
- Only operate the device in accordance with the degree of protection IP32 instructions.
- Never operate the charger if there is any evidence of damage
- Any safety devices or parts that are not functioning properly or are in a condition that won't assure its proper functioning must be repaired before switching the charger on
- Never bypass or disable protection or safety devices

Important safety instruction. Keep these instructions. This manual contains important instructions for the safety of the user and operation of the device.

GENERAL WARNINGS

1)Before each use of the battery charger the instructions set out below must be carefully read and abided by.
2)The failure to follow these instruction and or errors in installing or using the battery charger, could lead to endangering the operator and or damaging the device, voiding the manufacturer's guarantee.
3)The battery charger cannot be used as a component in system which provide life support and or medical device , without explicit written authorization from TCE.
4)The battery charger must not be used by person with reduced physical, sensory and mental capacities or with lack of experience and knowledge, unless they are properly supervised by a person responsible for their safety.

WHERE TO INSTALL

5)Never place the battery charger in the immediate vicinity of the battery in order to prevent gases produced or emitted by the actual battery during charging corroding or damaging the battery charger. Place the battery charger as far away from the battery as the length of cables permits.
6)Do not install the battery charger in a closed space or in such a way as to somehow prevent ventilation. For units equipped with fans, at least 30mm clearance must be left around the vents. In order to facilitate the heat exchange of the battery charger it must be positioned vertically, exploiting the fixture holes (where provided).
7)Do not use the battery charger outdoors.
8)Do not expose the battery charger to rain, water splashes or steam.
9)Do not install the battery charger in caravans and similar vehicles.
10)Do not install the battery charger near any heat sources or in areas with high concentrations of dust.
11)Do not install the battery charger near any potential sources of flammable material for example methane gas, pipes or fuel depot.
12)Do not place and or fit the battery charger onto surfaces manufactured out of combustible material, like wooden shelves or walls.

BATTERIES

13)Follow the specific safety instructions provided by the battery manufactured carefully, for example, whether or not remove cell caps during charging and recommended charge rates.
14)Working in the vicinity of a lead-acid is dangerous, as batteries generate explosives gases during charging. Therefore smoking and or generating open flames and or sparks must be avoided.
15)Never charge a frozen battery.
16)Battery must be charging in specific, well-ventilated areas.
17)In order to reduce risk of injury only charge Lead-Acid, GEL, or AGM type, Lithium Polymer or Lithium Ion batteries. Do not charge other types of rechargeable or non-rechargeable batteries as they could explode causing damage or injury.

FURTHER SPECIFICATIONS FOR LITHIUM BATTERIES

18)In order to charge Lithium Polymer and Lithium Ion batteries, a BMS (battery Management System) must always be used, comprising an active and passive safety system, in compliance with safety regulations in force.
19)The possibility of the BMS acting directly on the battery charger operation during cell balancing phase rules out, for any reason whatsoever, that the battery charger is held directly responsible should damage caused to the battery, or even a fire or an explosion, be due to an error in the BMS software.
20)The faculty offered by the materials produced by TCE to select different levels of voltage for charging, is entrusted to the control and supervision of the end user and TCE is not liable for any consequences resulting from the selection of the incorrect level voltage. If in doubt, the user should ask a qualified professional for clarification.
21)The battery charger tolerance thresholds, as far as levels of over-voltage and overcharging are concerned, are used only for the safeguarding of the system of the same and have no safety functions for the battery itself. The safety or which depends solely on BMS even when the battery charger is connected to the battery, whether the latter is being charged or not.
22)Should the client want to use the battery charger on a specific on-board system and in general in any cases of special usage, it is the client's responsibility to inform TCE, so that the latter an draw up any necessary recommendations. In this case, the client must provide TCE with all designs, diagrams and descriptive material necessary. TCE cannot be held responsible for any damage resulting from the use of the battery charger after opening it and modifying it and inserting it into other systems.

23)Under no circumstances can TCE be held responsible for the malfunctioning of the batteries or the incineration/explosion of these, in so much as the safety of the battery is the task of the BMS and not of the battery charger.

CHECKING CABLES, GRID, EARTHING

24)Do not transport the battery charger by pulling on the cables as they could be damaged. Use the handles, if provided.
25)Before using the battery charger, check the the sleeving on the mains cable and battery cables is in good conditions. Should one of the cables be damaged, have it replaced by TCE qualified technician.
26)Check the compatibility of the mains plug supplied with the battery charger: the use of adaptors is not recommended
27)Check that the input voltage of the battery charger given on the data plate is in line with the voltage available.
28)The battery charger must be plugged into a socket fitted with an earth wire. Should the socket not be equipped with an earth connection, do not use the device before having a suitable socket installed by a qualified technician.
29)The power socket to which the battery charger is to be connected must be protected by an electrical device by law (fuse and automatic cut-out) capable of absorbing an electrical current equal the absorption of current stated on the matriculation number of the battery charger, increased by 10%.
30)Do not open the battery charger as there are no parts which can be serviced and replaced by user. Only specialized personnel, authorized by TCE may carry out servicing which involves opening the actual device. Electrical components inside may cause electric shocks even if the device is not plugged in.

CHECKING BATTERY CHARGEE OPERATION AND CURVE

31)Before charging, make sure that the battery charger is in line with the voltage of the battery, that the charging current suits the capacity of the battery and that the selected charging curve (for lead-acid batteries and the batteries, or for airtight GEL or AGM type batteries, Lithium Polymer or Lithium Ion batteries) is correct for the type of battery to be charged.
32)We recommend fitting a fuse between battery charge and battery. The fuse must be installed along the connection to the positive terminal of the battery. The rating of the fuse must be proportionate to the nominal output current of the battery charger, the diameter of the cable used and the environment in which it is be installed.
33)We recommend unplugging it from the mains supply before connecting and disconneting batteries.
34)During normal operation of the battery charger, the external surface may become hot and may remain so for a certain period of time after it has been switched off.
35)The battery charger needs no special maintenance, only regular cleaning procedures, to be carried out according to the type of working environment. Cleaning procedures should only be carried out on the external surface of the battery charger. Before starting any cleaning procedures, the mains supply cable and battery cables must be unplugged. Do NOT use water and detergents in general and pressure washes of any kind when carrying out cleaning.

LACK OF USE

36)If safe operation of the battery charger can no longer be ensured, stop the device and ensure that it cannot be put back into operation.
37)The specifications set out in this manual are subject to change without any notice. This publication replaces any previously supplied information.

USER MANUAL

HF-EVO EVOLUTION SERIES TECHNICAL CHARACTERISTICS

1)Mains supply voltage 400V three-phase. A special version of HF-EVO for 480Vac three-phase mains supply for NON-European countries is available on request.
2)Charge parameters immune to variations in mains supply voltage in the interval ±10%.
3)High frequency modular switching technology.
4) 85% increased efficiency.
5)Charge profile can be programmed for all types of battery on sale.
6)Versatility of use of battery charger due to smartcard programming.
7)Viewing on backlit display of charger current, battery voltage, amp hours absorbed by the battery and charge cycle durations
8)Viewing on the display, alphanumerically, of any error messages.
9)Compensation of voltage drop on battery cables.
10)Charger process start in “Soft star” mode and automatic reset on insertion of a new battery.

11)Charge cycle start also with 4V batteries.
12)Protection against output short-circuit.
13)Protection against polarity reversal with output fuse which cannot be automatically reset and polarized battery connector.
14)Battery charger manufactured I compliance with directive 89/336 EEC regarding ELECTROMAGNETIC COMPATIBILITY.

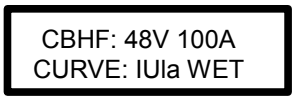
HF-EVO SERIES OPERATION

Turn the general switch into the “OFF” position and plug the mains supply cable into a three-phase socket with adequate power. Connect the battery paying attention to polarity. When turned on, the following information will appear as shown below in sequence:

Information about the manufacturer.

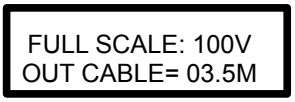
Control circuit board model and firmware version inside the micro-controller (these parameters may be subject to change without any notice)

Voltage, current and charging curve programming. In the example to the right configuration for 48V 100A with charging curve IUIa WET.

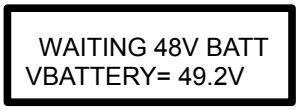


Number of modules detected inside the battery charger. In the example to the right 3 power modules are detected.

Viewing of full scale voltage and length of cables used in order to calculate compensation of voltage drop on the latter. In the example to the right a full scale of 100V and cable length of 3.5m is shown.

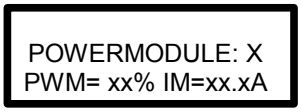


Battery detected. In the example to the right programming for 48V battery is shown whilst 49,2V identifies the voltage measured.

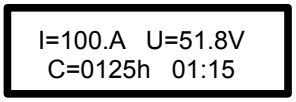


Closure of the power remote control switch for the three-phase circuit.

Test to check if power module X is supplying current. The test is carried out for all the modules.



Display during normal operation of the battery charger. In the example to the right the values given are solely identificatory. Time is always given in the hh:mm format.



During battery charger strat-up various controls are carried out, which, if not returning a positive result, may prevent the battery charger from working.

If, during start-up, the battery is not detected because it is missing or because it is connected with polarity reversal, an output short circuiti s detected or battery voltage measured is 5V higher than the programmed nominal battery voltage, the display will read as shown to the right and the battery charger will not proceed to power module testing.

```
WAITING xxV BATT
VBATTERY= xx.xV
```

If the power module test, which occurs during start-up, does not return a positive result, the error shown to the right will appear on the display, where x indicates the module giving problems.

```
CHECK MODULE X
CHARGER ABORTED
```

If, however, all controls return positive result, the battery charger will start supplying current to the batteries. Current will be brought to the maximum nominal value set by programming, in soft-start mode, in other words slowly, in order to protect the batteries themselves. During normal operation of the battery charger, in addition there are various controls which may interrupt the charge cycle.

If current supplied to the batteries IB is higher than current Ibmax=160A, the error message shown to the right will appear.

```
Srt : IB > IBmax
CHARGING ABORTED
```

Each charging curve can be provided with a safety timer, on reaching which the charge will be interrupted, with the warning shown to the right.

```
SCt:CHARGING TIME
CHARGING ABORTED
```

In the event that the charging cycle is interrupted due to the opening of the output circuit, the error message shown to the right will appear. The display will flash for 60 seconds.

```
E01: OPEN CIRCUIT
WAIT 1 MIN …
```

The battery charger is fitted with a temperature sensor which, engaging on the maximum allowed temperature being exceeded, interrupts the charging cycle and display the error message shown to the right.

```
E02: TEMPERATURE
CHARGING ABORTED
```

In the event that the timer set on the first phase of the charge cycle is exceeded, the error message shown to the right will be appear.

```
E031: timer T1
CHARGING ABORTED
```

In the event that the timer set on the second phase of the charge cycle is exceeded, the error message shown to the right will appear.

```
E032: timer T2
CHARGING ABORTED
```

In the event that the timer set on phase X of the charger cycle is exceeded, the error message shown to the right will be appear. (error valid whenever the charge cycle is made up more than one phase and each phase is set with a safety timer)

```
E032: TIMER Tx
CHARGING ABORTED
```

Should an error occur, for safety reasons the power remote control switch for the three-phase circuit will open, thus interrupting the charge cycle and cutting supply to the power modules.

TROUBLESHOOTING FOR EVO-HV THREE-PHASE

POBLEMS	SOLUTIONS
The battery charger won't turn on .	Check that there is adequate mains supply voltage at the mains socket and that the fuse is working.
The charge cycle won't start and the display reads: WAITING xxV BATT VBATTERY= xx,xV	Check battery connection and correct polarity. Check the battery fuse. Check that the battery voltage does not exceed by more than 5V the battery charger programming nominal voltage.
The yellow led won't come on even 15 hours after the start of the charge cycle.	Check the battery: it could have faulty cells.
If during start-up this error appears on the display: CHECK MODULE: x CHARGING ABORTED	Module x is in short circuit. Turn off the battery charger. Unplug the mains cable from socket. Contact TCE for replacement of the power module
If the following error appears on the display: Srt : IB > Ibmax CHARGING ABORTED	Current supplied to the batteries IB is higher than current Ibmax =160A. Turn off the battery charger. Unplug the mains cable from socket and contact TCE.
If the following error appears on the display: Sct:CHARGING TIME CHARGING ABORTED	The safety timer has interrupted charging. Check the charge current is correctly set. Check that the batteries are in good condition.
If the following error appears on the display: E01: OPEN CIRCUIT WAIT 1 MIN...	The charging cycle has been interrupted following the opening of the output circuit. The display will flash for 60 seconds. At the end of the 60 second reconnect the batteries. The charge cycle will start again from the beginning.

If the following error appears on the display: E02: TEMPERATURE CHARGING ABORTED	The charging cycle has been terminated following the engaging of the thermostat. Turn off the battery charger and wait for it to cool down before starting a new charging cycle. If the problem persist, contact TCE.
If the following error appears on the display: E031: timer T1 CHARGING ABORTED	The charging cycle has been terminated following the engaging of the safety timer in the first phase. Turn off the battery charger. Check the charge current is correctly set. Check that the batteries are in good condition.
If the following error appears on the display: E032: timer T2 CHARGING ABORTED	The charging cycle has been terminated following the engaging of the safety timer in the second phase. Turn off the battery charger. Check the charge current is correctly set. Check that the batteries are in good condition.
If the following error appears on the display: E03: timer Tx CHARGING ABORTED	The charging cycle has been terminated following the engaging of the safety timer in phase x. Turn off the battery charger. Check the charge current is correctly set. Check that the batteries are in good condition.

SECURITY CERTIFICATION

CE Devices with the CE mark satisfy the essential requirements of the low-voltage and electromagnetic compatibility standards