Troubleshooting Manual

BATTERY LAWN MOWER

500 Series Mono Battery

500 series Parallel synchronized

(*Push or mechanical Transmission*)

Year of manifacture 2021

Revision 0 (15/12/2020)

1. Index

2. Introduction

This Manual deals with the problems and checks connected with the electrical system.
All work can be done using a tester without having to use special equipment.

The electrical diagrams can be useful to you f for understanding how the system works and to facilitate the pinpointing of any problems.

Faulty electronic cards, batteries and battery chargers must always be replaced without trying to repair them or replace single components.

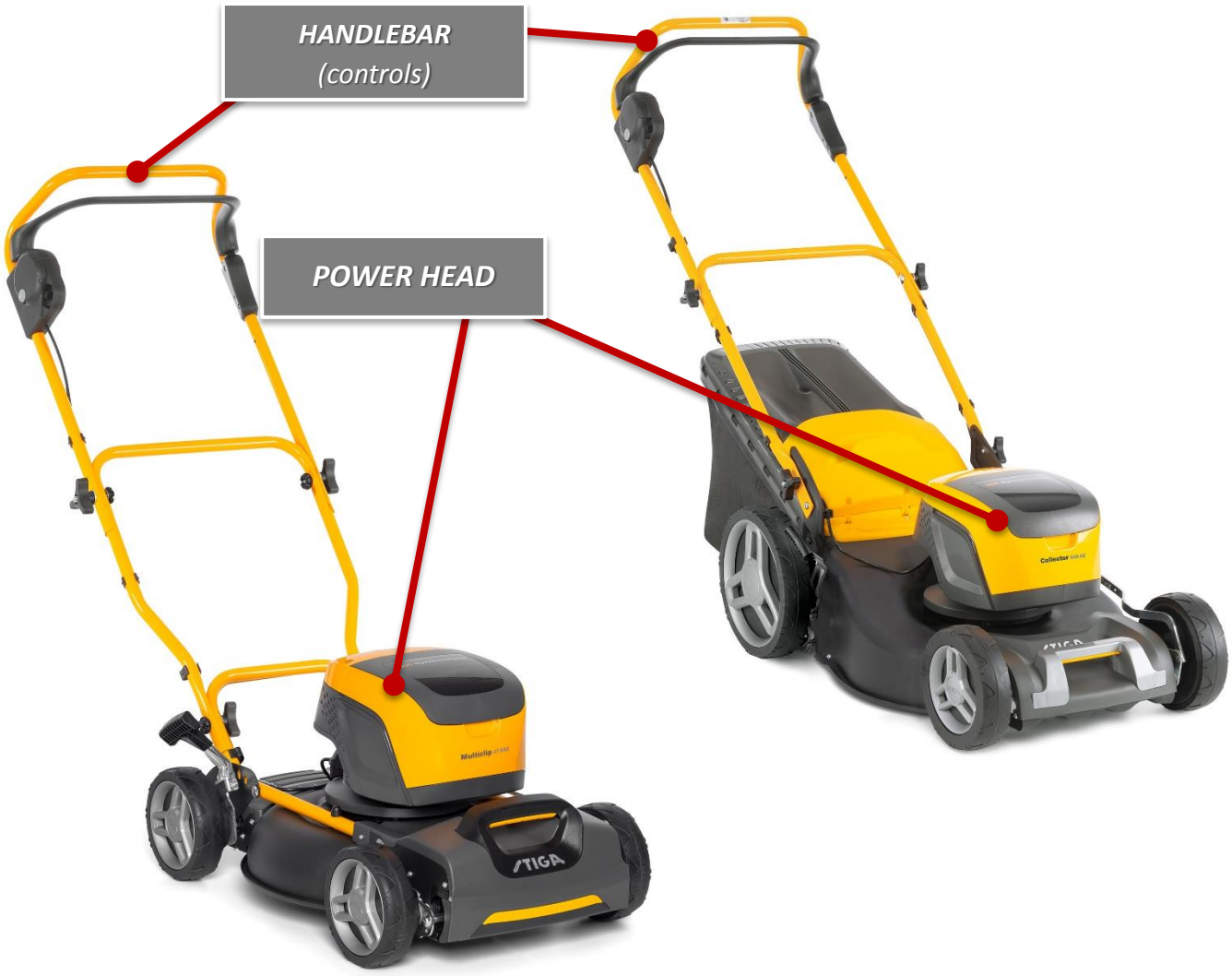
2.1 Electrical Components

General informations:

We can divide electric components into 2 main groups:

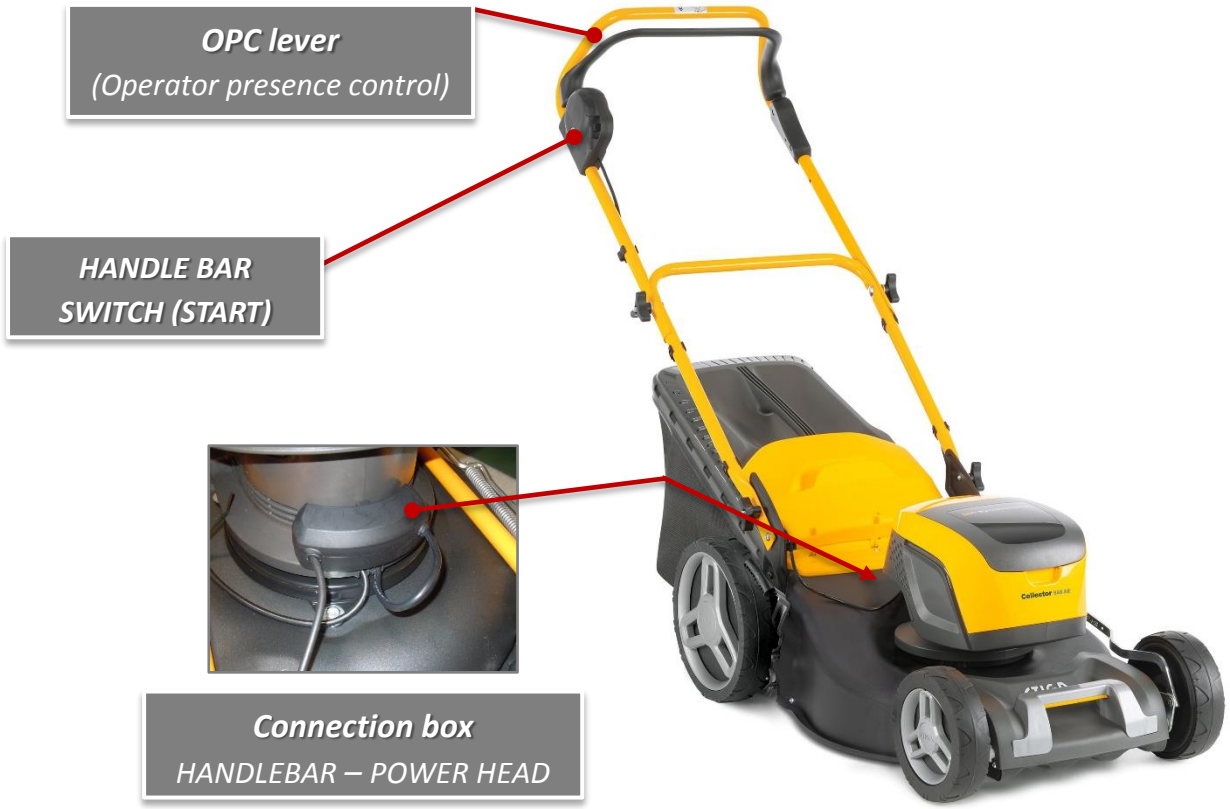
- Handlebar with controls;
- POWER HEAD;

This section details the position of the electrical components:



2.1.1 HANDLE and Controls

All controls for switching on and off are on the handle. Hereafter the main instructions for controls use are indicated; as regards the specific use of the machine please refer to owner's manual provided.



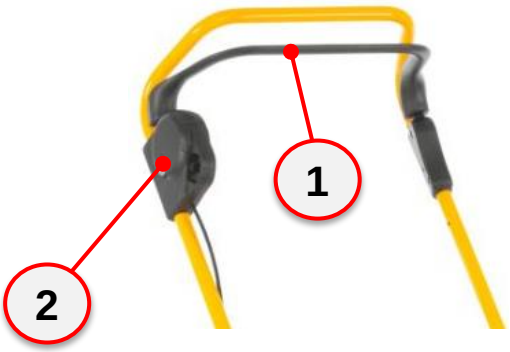
2.1.1.1 Start Button

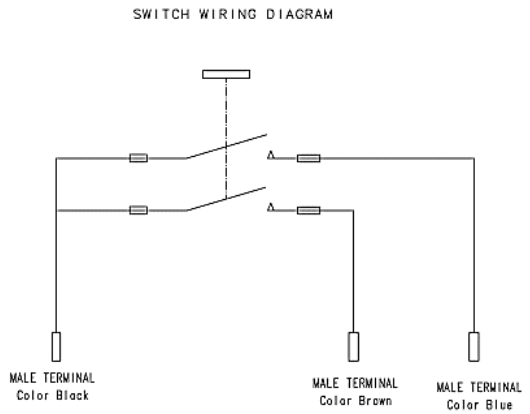
The motor is controlled by a double-action switch in order to avoid the possibility of accidental start.
To start the motor, press the button (**2**), pull the lever (1) and wait 2-3 seconds for the motor to start running.

The motor stops automatically at lever (**1**) release.

2.1.1.2 OPC (Operator Presence Control)

The Operator Presence Control (OPC) is a safety system that enable the activation of motor only if at least one operator hand is on the handlebar. Once switched ON the machine by "Start Button**" (2),** the operator must activate the OPC system by pressing handlebar to enable the START: the motor runs only if the OPC lever (**1**) is pulled.





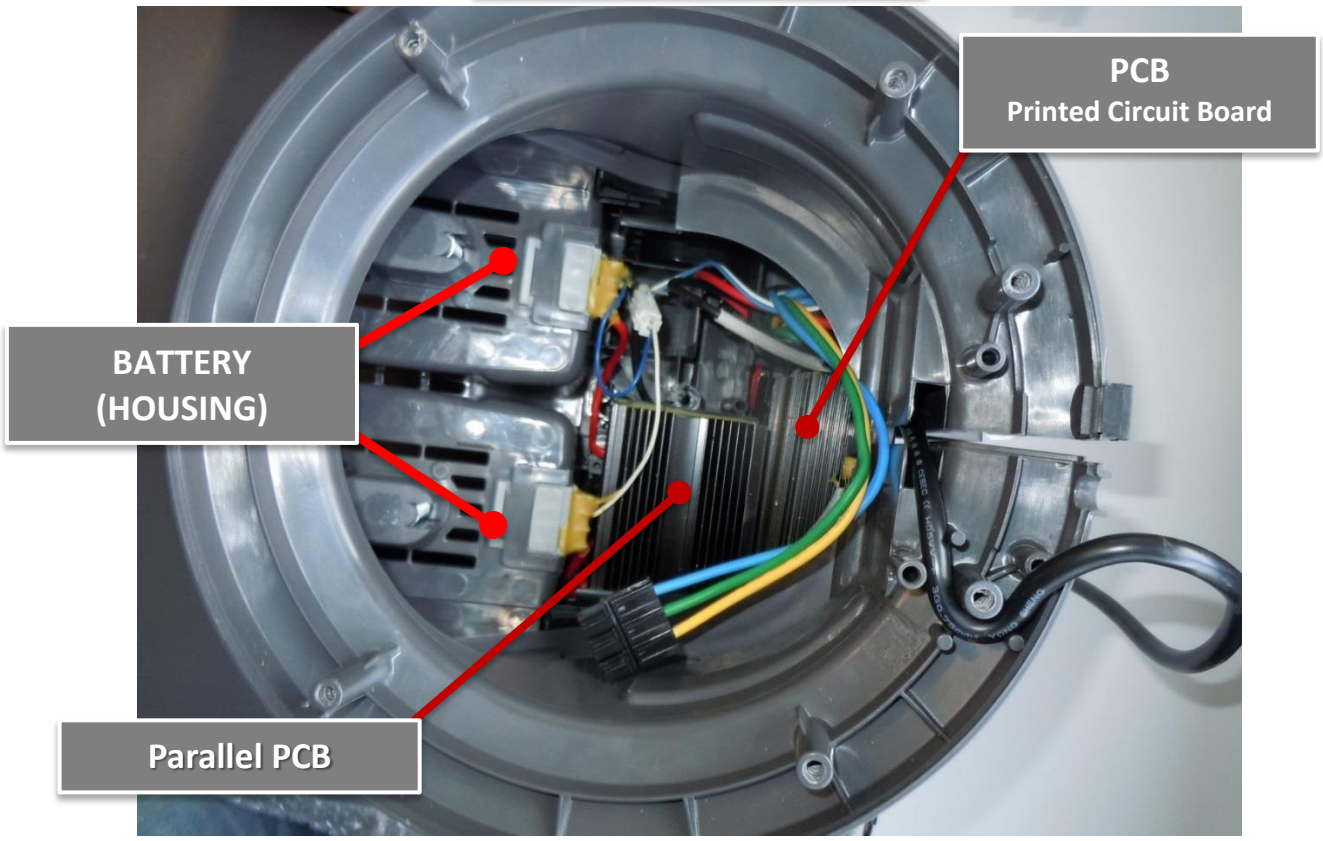
2.1.2 POWER HEAD

The element named “POWER HEAD” consists of three main components: Battery, Motor and Printed Circuit Board (PCB).

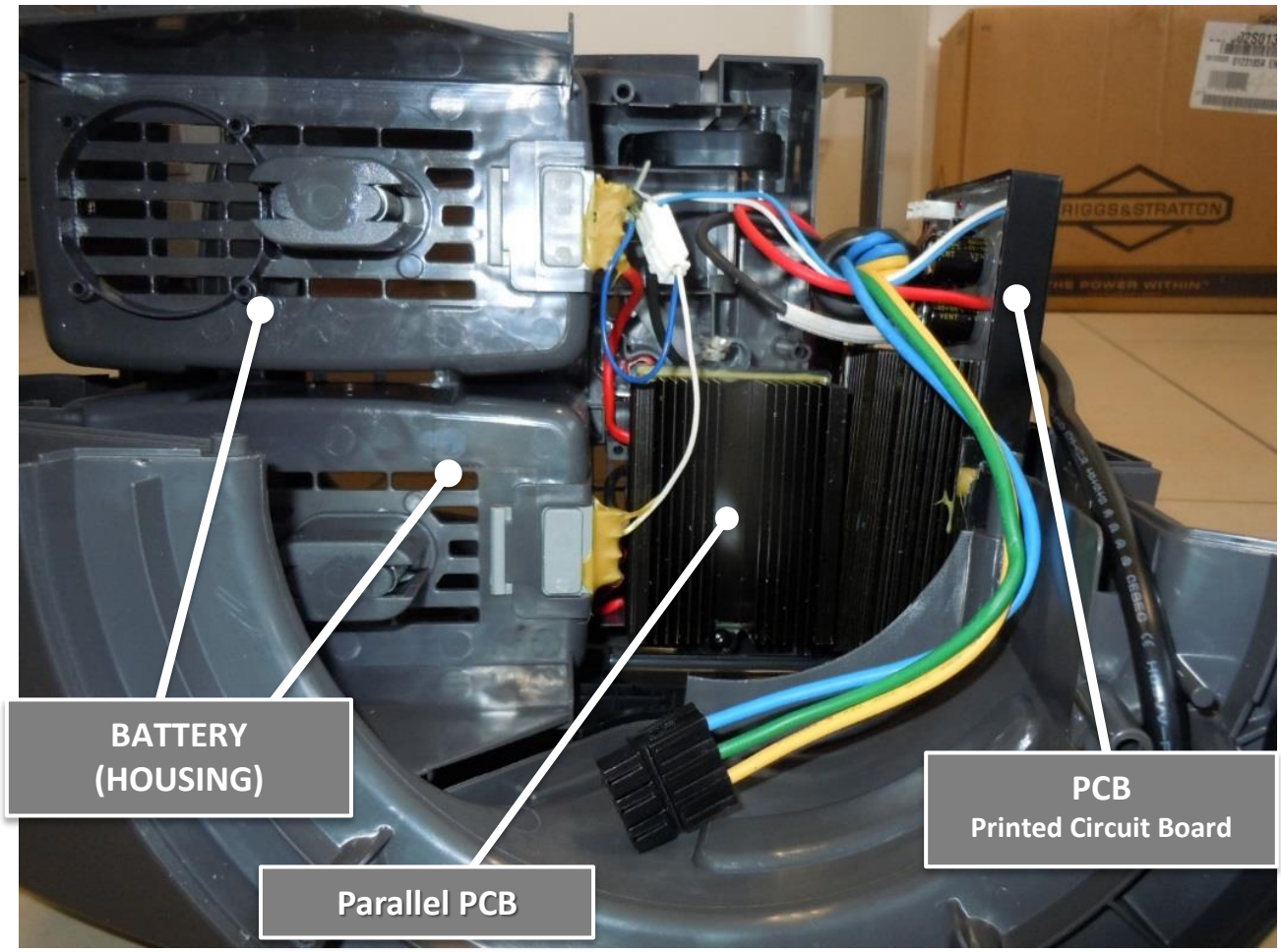
LOWER SIDE

NOTE: pictures below show "Dual Battery" version

VIEW FROM BELOW

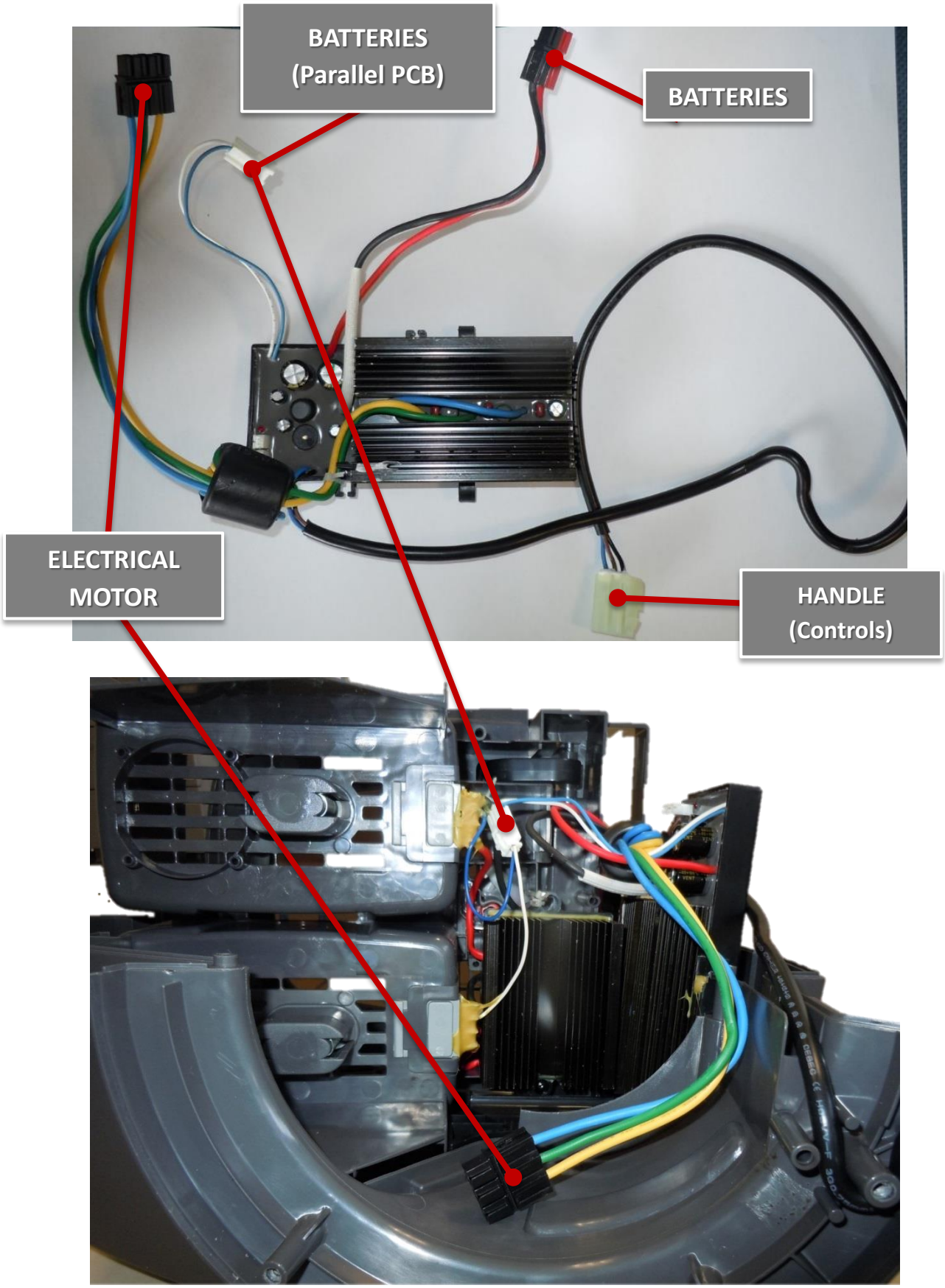


VIEW: laid on right side without left cover



PCB
Printed Circuit Board

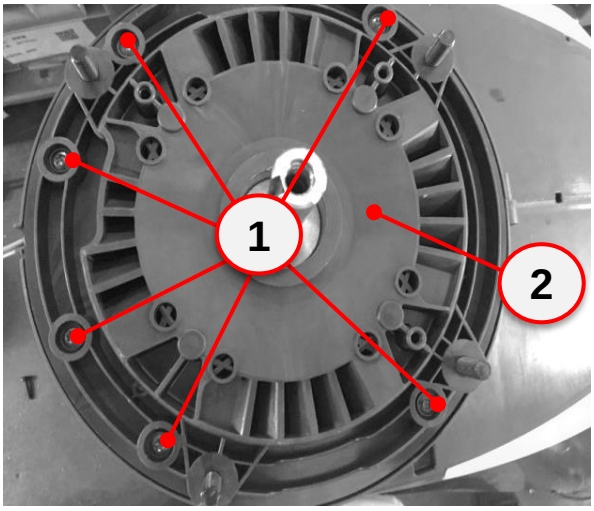
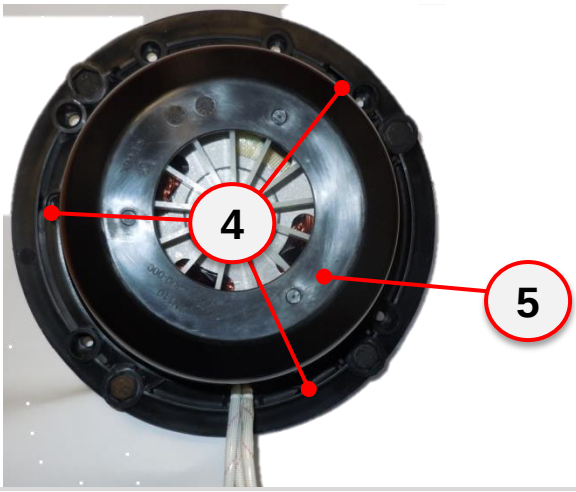
ELECTRONIC CARD (PCB)
PCB Cables, Connectors and Components



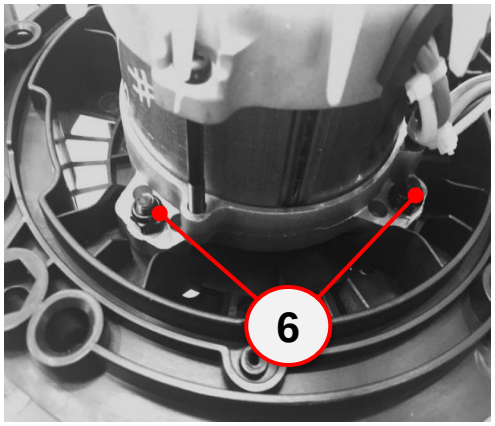
3. Disassembly of the Power Head's components

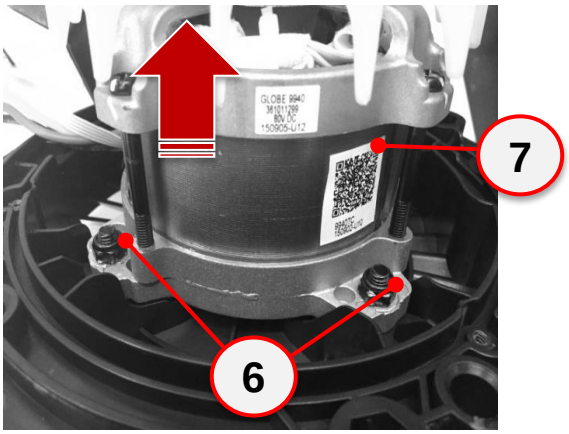
Here below you can find some indications useful for removal of electrical motor and plastic covers of ***"Power Head"***

3.1 Removal of the Electrical Motor

Remove the Power Head from the machine. Unscrew the six screws **(1)** and remove the Motor support **(2)** from ***Power Head***	
Disconnect the three phase line connector **(3).**	
Unscrew the three screws **(4)** and remove the Motor conveyor **(5)**.	

Unscrew the four screws **(6)** and remove the Electrical Motor **(7)**.





3.2 Disassembly of “Power Head” covers

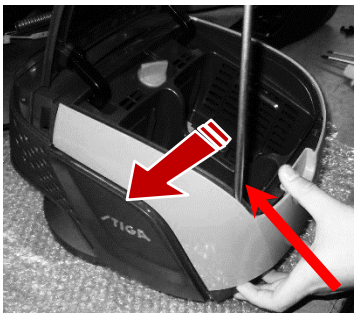
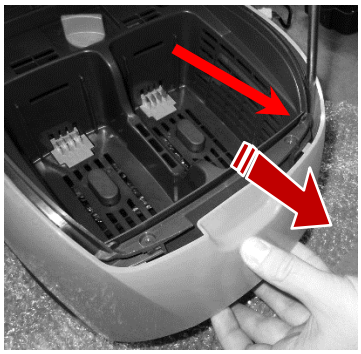
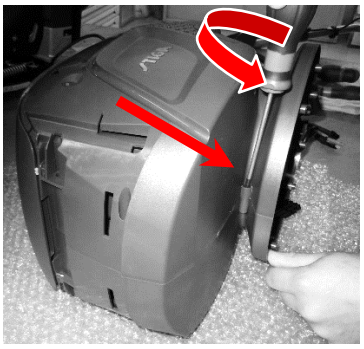
The disassembly of covers lets reach PCB and main connections with other electrical components: battery, electric motor and handlebar (Dashboard and Controls); and allows to perform some of troubleshooting procedures described on following chapters (*See chpt. 4 and 6)*

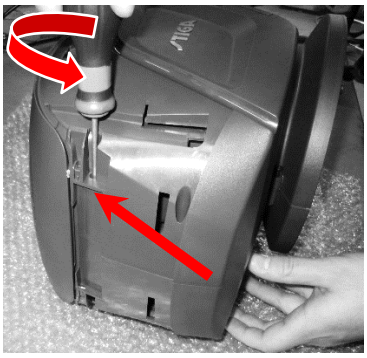
Remove the Power Head from the machine.

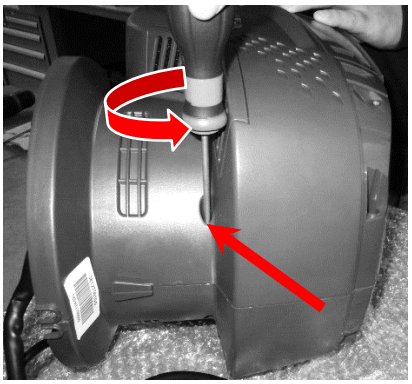
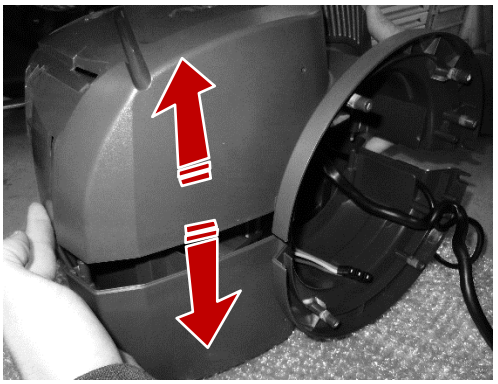
Remove the Motor (*see cap 3.1 Removal of the Electrical Motor.*).

Below a sequence of pictures that highlight fixing points of various covers of ***Power Head***.

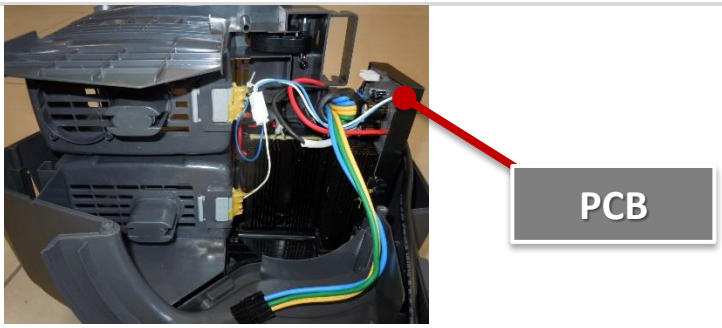




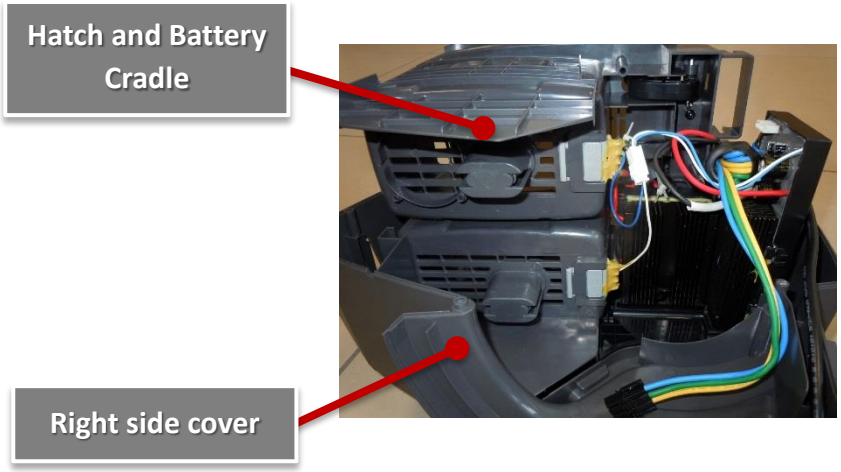
NOTE: as regards the removal of PCB please refer to 3.3 Removal of the Electronic Card (PCB)



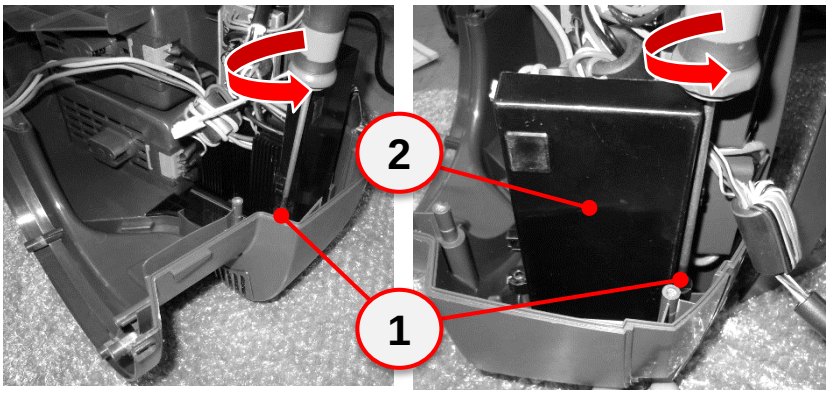
3.3 Removal of the Electronic Card (PCB)

Remove the covers (*see 3.2 Disassembly of "Power Head" covers*

NOTE: *pictures below show "Dual Battery model".*



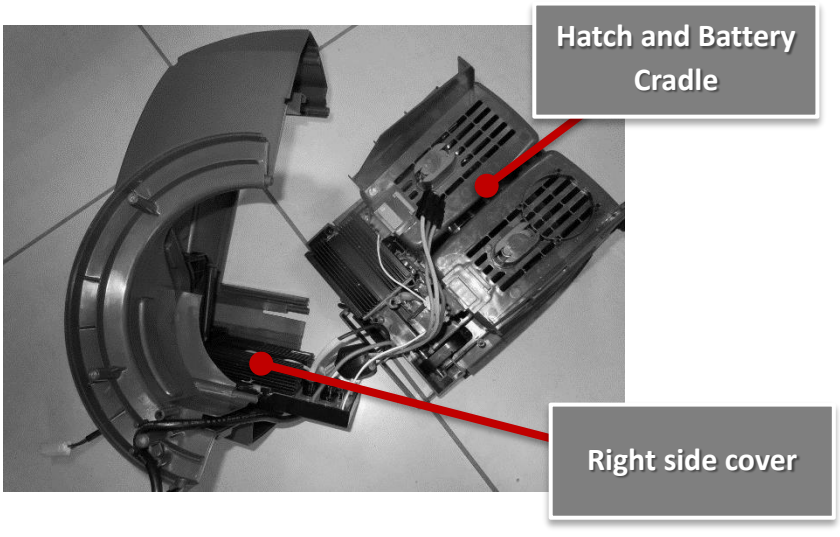
Unscrews the two screws **(1)** and remove the main card **(2)**.



As regards the removal of other components are fitted it's recommended to separate the right side cover from the hatch/batteries' cradle.

IMPORTANT: *before making following operations it is advisable to observe / memorize the positioning and the cables path; this will make assembly operation easier.*

Disconnect all connectors.



4. Electrical Troubleshooting

In the following some of the problems connected to the malfunctioning of the electrical system are shown, with their probable cause and the remedial action to be taken.

4.1 Troubleshooting – Diagnostic Tool

General informations:

As regards "*TT 500 Synchronized*" range of machines, STIGA provided the possibility to use a DIAGNOSTIC TOOL.
The Diagnostic Tool supports connection both to appliance and battery with the main purpose of assisting you with the troubleshooting in case of malfunction of the machine (Battery or Appliance).

The Diagnostic Tool for the 48V lithium-ION rechargeable battery system is composed by the following parts:

1. Hardware Diagnostic Tool SDT500;
   (A) *Main electronic and battery cradle;*
   (B) *Fake battery*
2. Software to be installed on Windows OS.

4.1.1 Use, Connections and Diagnostic

Please refer to Diagnostic Tool manual that you can download together with the software on our STIGA Connect portal:
https://stiga.ev-portal.com/LogIn/Stiga

4.1.2 Missing signal of Diagnostic Tool

- Check that the contact on the battery and the contact of the battery on the machine are intact and clean;
- Check the correct positioning of Fake Battery (B)";
- Check the correct positioning of feeding Battery (A)
- Try to replace the battery;
- Check that USB cables of Diagnostic Tool are intact and clean;
- Perform checks indicated in the following paragraphs *par. 4.2, 4.3 and 6*

4.2 Troubleshooting (machine)

A problem solving session is proposed besides throubleshoot using the Diagnostic Tool.

General information

This chapter deals with the problems connected to the malfunctioning of the machine and with their probable cause and the remedial action to be taken.

The owner's manual already gives a basic troubleshooting guide to help out the user in solving the most common possible malfunctions.

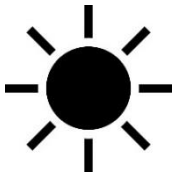
The printed circuit board (PCB) has a LED with various flashing sequences and has an acoustic alarm (buzzer) with various intermittent sequences. These two devices (LED + buzzer) provide useful indications to recognise failures on the electric system.

Alarm BUZZER (BIP) String configuration:

Nr.	"BIPS" STRING	CAUSE
1	3/cycle	Over current
2	5/cycle	Over temperature (whole machine or battery)
3	2/cycle	Others failures

Note: cycle means the number of close "Bips" cyclically repeated. Example: 3/cycle means 3 close Bips, short pause, 3 close Bips and so on.

LED Flash String configuration:



Nr.	FLASH STRING	CAUSE
1	1/cycle	The PCB self-checking failed
2	3/cycle	The communication between PCB and battery pack failed
3	4/cycle	Over current protection
4	5/cycle	Low voltage protection
5	6/cycle	PCB or battery overheating protection
6	8/cycle	Locked-rotor protection

Note : cycle means the number of close flashings cyclically repeated. Example: 3/cycle means 3 close flashings, short pause, 3 close flashings and so on.

The combination between LED Flash and buzzer beep can provide to the user/dealer the information about the problem (see Troubleshooting table below).

PROBLEM	CYCLE		PROBABLE CAUSE	REMEDY
	🔊	☀		
The motor does not start when the Handle Bar Switch is pressed	-	-	Safety key is not inserted or is inserted incorrectly.	Insert the key.
	-	-	Battery is not inserted or is inserted incorrectly.	Open the hatch and check that the battery is fitted into its housing correctly.
	-	-	Motor start-up is slow.	Press and hold the safety button and control lever for 1-3 seconds.
	-	-	Bad connection in Handle Bar Switch connector.	Make sure the Handle Bar Switch connector is properly assembled, dry, not damaged and free from corrosion (*See 6.1*).
	-	-	Internal damage to Handle Bar Switch.	Replace the Handle Bar Switch.
	-	-	Connectors (Motor and Battery) not correctly assembled.	Make sure the connectors are correctly assembled.
	-	-	Short circuit in PCB	Check the PCB *(6.3)* and replace if necessary.
	2	**1**	Auto check fail	• Check electric connection among components • Internal issue of PCB: check a replacing PCB, if necessary.
When the Handle Bar Switch is pressed Electric motor jerks shortly then stops and the machine alarm buzzer is triggered.	**2**	**5**	Low Battery	Check the battery (Batteries) status and recharge if necessary.
	2	**7**	Motor failure	Replace the Electric Motor (See 3.1)
			Locked rotor blade;	Remove the obstructions and then restart the machine.
			Disconnected or cut off phases from PCB.	• Connect the motor cable • Check wiring and connectors
	5	**6**	The thermal protection has tripped due to overheating of the PCB/Battery.	Wait for at least 5 minutes and then restart.
	2	**3**	Battery communication failure	See *6.5 Battery TEST*
The motor shuts down whilst working and the machine alarm buzzer is triggered	**3**	**4**	Current Sensor has tripped due to excessive current absorption caused by: • excessively high grass cutting • obstructions that prevent rotation of the cutting means • too much grass debris accumulated in the chassis and discharge channel	Set a higher cutting height when the grass is very tall, then set a lower height and cut the lawn again. • Remove the obstructions. • Clean the machine. Wait for at least 5 minutes and then restart the machine.
	2	**5**	Low Battery	Check the battery status and recharge if necessary.
	5	**6**	The thermal protection has tripped due to overheating of the motor.	Wait for at least 5 minutes and then restart.

4.3 Troubleshooting (BATTERY and CHARGER)

General informations:
This chapter deals with the problems connected to the malfunctioning of BATTERY & BATTERY CHARGER and with their probable cause and the remedial action to be taken.
The Operator's Manual of BATTERY & BATTERY CHARGER already include most of common possible malfunctions highlighted in this table.

ROBLEM	PROBABLE CAUSE	REMEDY
No LED´s light up on battery when pressing the status button	Low Battery	Recharge immediately the battery
	Faulty battery (*see* 6.5 Battery TEST	Replace battery.
The battery charger is not recharging the battery (NO LEDs on the charger are shown when battery is inserted)	Bad connection between charger and battery	Check it is correctly inserted. Make sure power connectors between charger and battery are not damaged and free from dirt.
	The battery charger is not energized	Check it is plugged in and the power socket is energized
	Faulty battery charger	Disconnect charger from power socket for >1 min then reconnect it to power socket. Make sure the fan and the green LED lights up. If not, replace with an original spare part.
Solid Red LED on charger when battery is inserted.	Battery out of temperature range	Make sure ambient temperature is between 7 °C and 40°C.
Flashing red LED on charger when battery is inserted.	Bad connection between charger and battery	Check it is correctly inserted. Make sure power connectors between charger and battery are not damaged and free from dirt.
	Faulty battery (*see 6.5 Battery TEST*	Replace battery.
	Broken charger	Disconnect charger from mains for >1 min. then reconnect to mains outlet. Make sure the fan and the green LED lights up. If not, replace with an original spare part.
Green LED on charger for approx. 5-15 seconds when battery is inserted, thereafter flashing red LED. The behaviour then repeats from the beginning.	Faulty battery	Place the battery in a **functioning charger.** If same problem occurs replace battery.
	Broken charger	Place a **functioning battery** in the charger. If same problem occurs, replace charger.

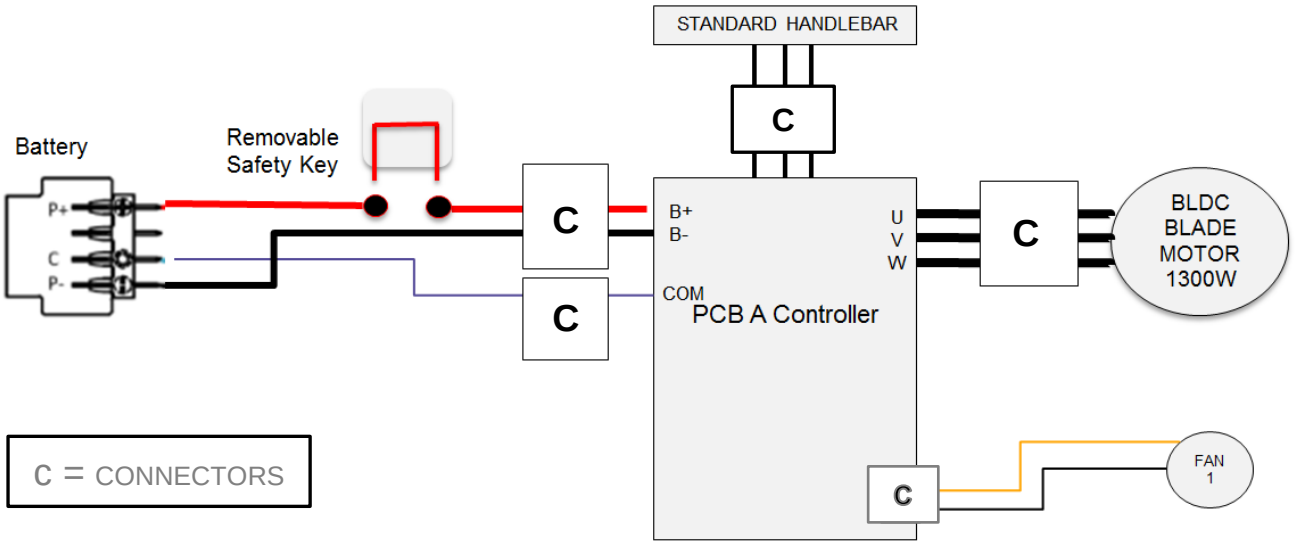
5. Electronic system architecture

Before proceeding to the analysis of the problems related to the malfunctioning of the electrical system and the testing of the various electrical components, below a brief explanation of the operating logic of system and software installed on the PCB.

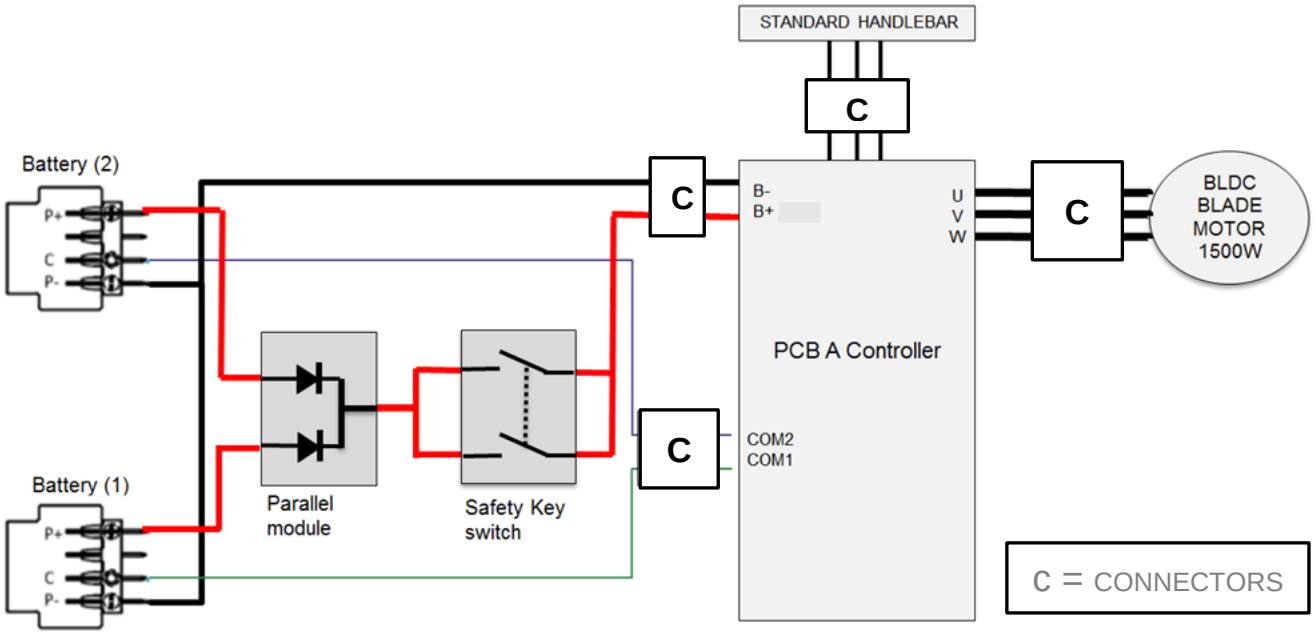
5.1 Electronic Controllers (PCBs): POWER HEAD

The two Powerhead series 500 have different system architecture: **mono-battery and dual-battery**.

- **Mono-battery powerhead architecture**



- **Dual-battery powerhead architecture**



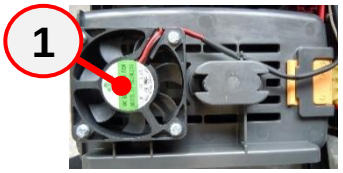
The controller (PCB) manages the following interfaces:

- Battery: power supply
- OPC Switch for Handlebar
- Blade Brushless motor
- Led
- Buzzer
- 12V Battery cooling FAN powered by main controller (for mono-battery only)

5.2 Battery cooling fan management (for mono-battery only)

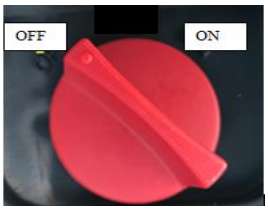
Under the battery cradle, a FAN cools down the battery during working time.

The fan is under the operating battery holder. The fan is powered by PH (Power Head) main controller (PCB).



5.3 Safety Key

MONO-Battery
The Safety Key is composed by a removable plastic key with internal current conductor.
When the safety key is removed the circuit is opened; Key designed to support 35A



DUAL-Battery
The Safety Key is composed by a switch activated by removable plastic key.
While the plastic key is inserted and in “ON position”, the internal Powerhead micro-switch is pressed..

6. Operating check of Electrical components (Handlebar Switch, PCB, Battery, Electric Motor)

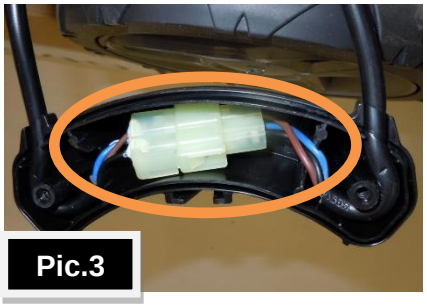
This section completes and develops the previous one "Electrical Troubleshooting".
The purpose is to provide a step by step guide to identify faulty components avoiding the disassemble of the entire machine. All checks can be done with a multimeter without need of special equipments

6.1 Operating check of Handlebar Switch (ON/OFF)

This check has to be done by unplugging the connector of the handlebar switch (**pic.3**) contained inside the connector case (**part 1 on pic. 1**). Use the multimeter in Ohmmeter function.

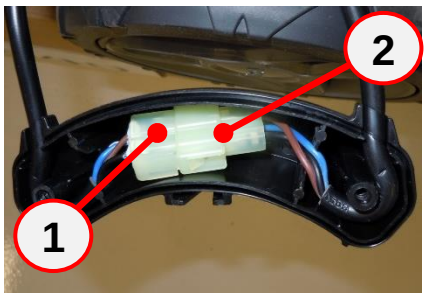
Pic.1

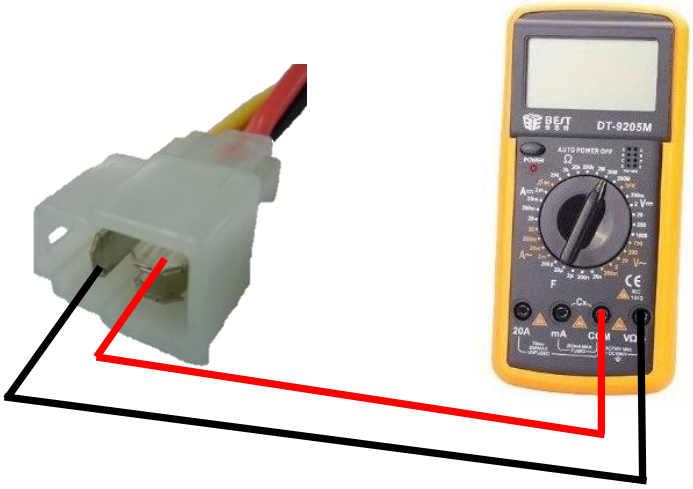

Pic.2

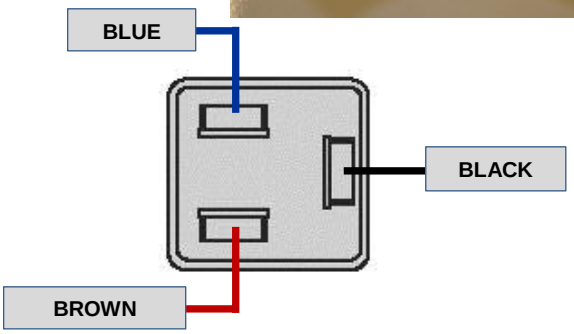

Pic.3

NOTE: Before proceeding with following electrical test, please verify the correct functioning of the handlebar lever activating the microswitch. Engaging the lever you have to hear the "CLICK" of the microswitch, if this does not happen, the microswitch could be faulty. Check also the integrity and functioning of the handlebar lever..

- Unplug connectors 1 and 2
- Test performed in the handle connector with multimeter in Ohmmeter function should give following results







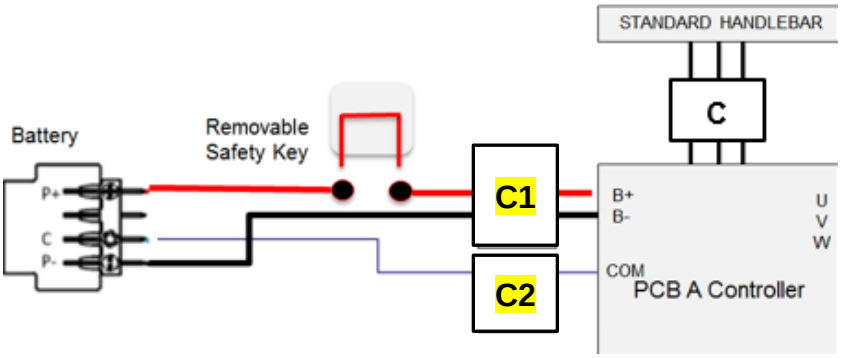
CABLE COLOR	TESTER READING AND HANDLE BAR SWITCH CONDITION (ON/OFF)	
Brown - Blue	∞ (released)	0 (pressed)
Black - Brown	∞ (released)	0 (pressed)
Black - Blue	∞ (released)	0 (pressed)

If the values do not comply with the above table, make sure that the electric cable is not damaged and check the integrity of the handlebar switch.

6.2 Checking the voltage on the battery connectors (power supply)

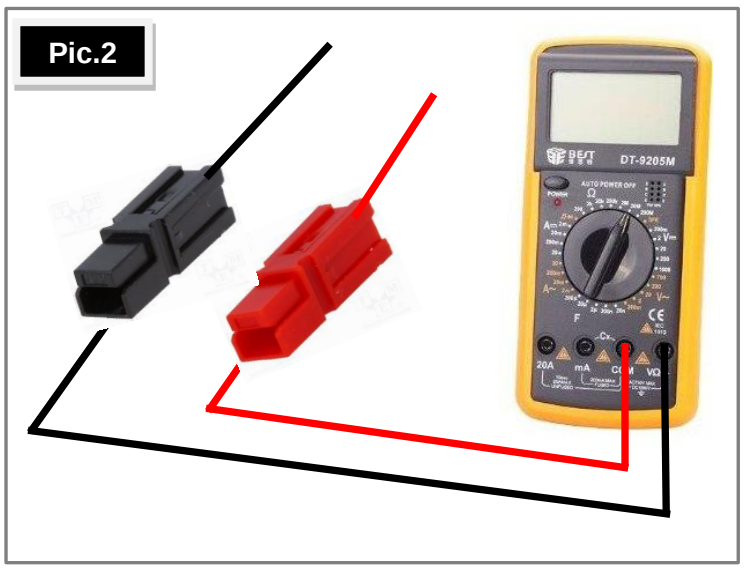
* **Only for mono-Battery**

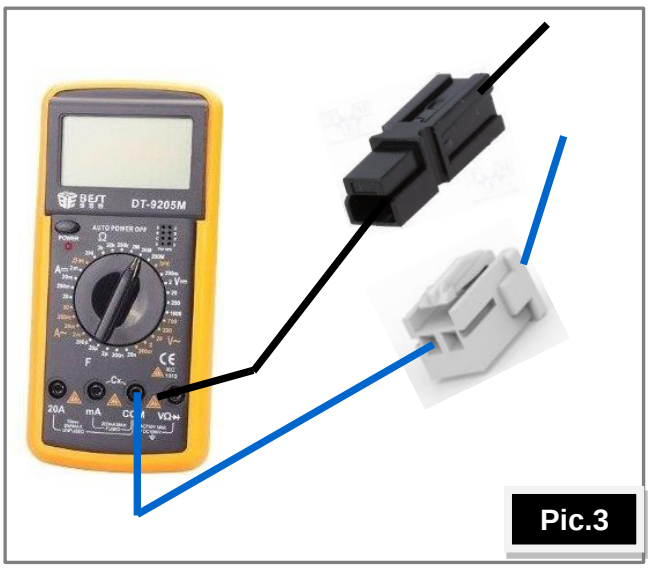
Pic.1



This check has to be done by unplugging the connectors (C1) between battery and PCB (**part 1 in pic. 1**).
Battery and safety key must be in working position.
Set the multimeter in voltmeter function (DC 0-200V)

Check should give this result





CABLE COLOR (Pic.2)	TESTER READING (Volt)
Black – Red	Battery Voltage

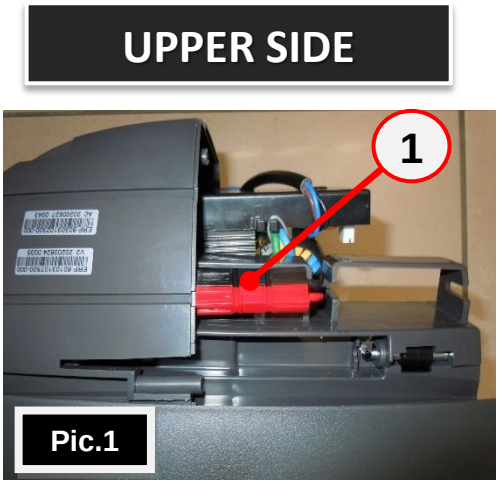
* with multimeter in Ohmmeter function, the impedance must be:

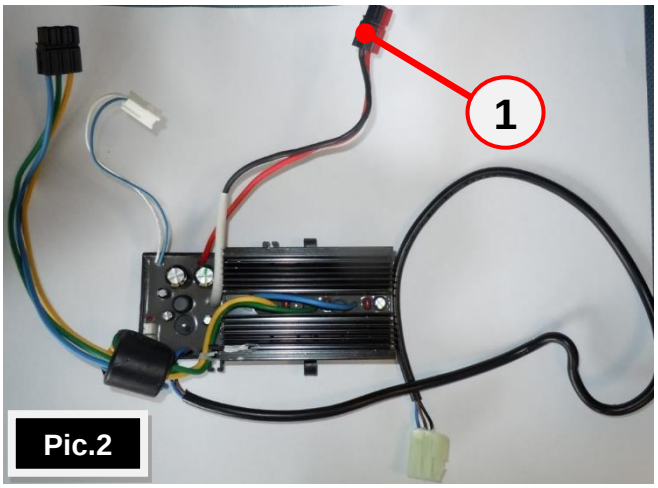
CABLE COLOR (Pic.3)	TESTER READING (Kohm)
Black (**C1**) – Blue (**C2**)	**100 and 200 Kohm**

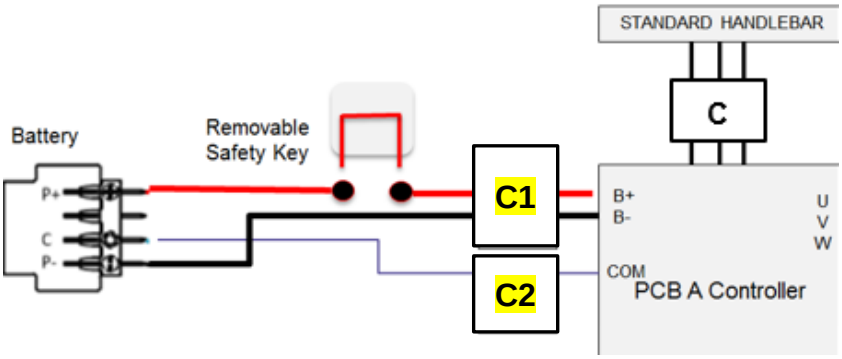
IMPORTANT: before performing the test make sure that the battery is charged and in order.

6.3 Impedance checking on the electronic card (PCB)

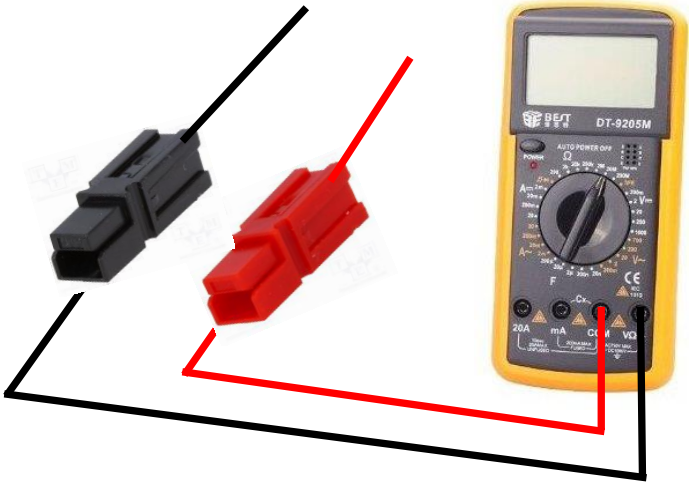
This check has to be done by unplugging the PCB power supply connectors **(part.1**,**Pic.1**).
Perform the check on the PCB side connector (**part.1, Pic.2**), by measuring the impedance between positive and negative with multimeter in Ohmmeter function (KOhm).







Check should give this result:



CABLE COLOR	TESTER READING (Ohm)
Black - Red	**Open circuit**

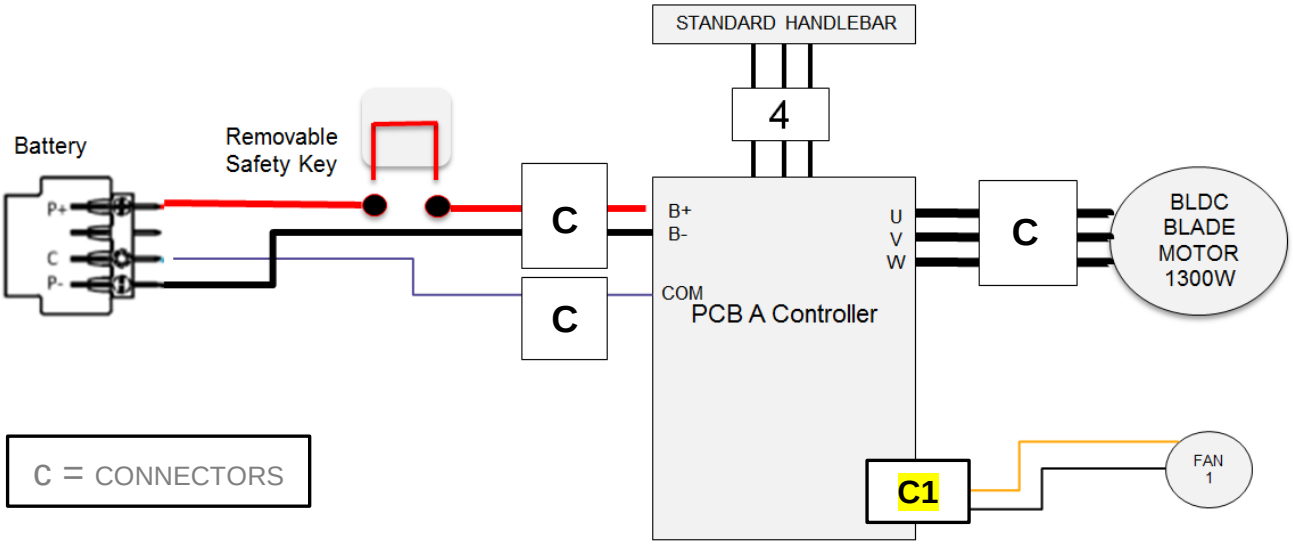
IMPORTANT: if the measured value is 0 it means that the PCB is damaged.

6.4 Checking the voltage on the battery connectors (power supply)

NOTE: Before proceeding with following electrical test, please verify the integrity of the fan and ensure that it is not blocked.

This check has to be done by unplugging the connectors (**C1**) between fan and PCB.
Battery and safety key must be in working position.
Set the multimeter in voltmeter function (DC 0-200V)

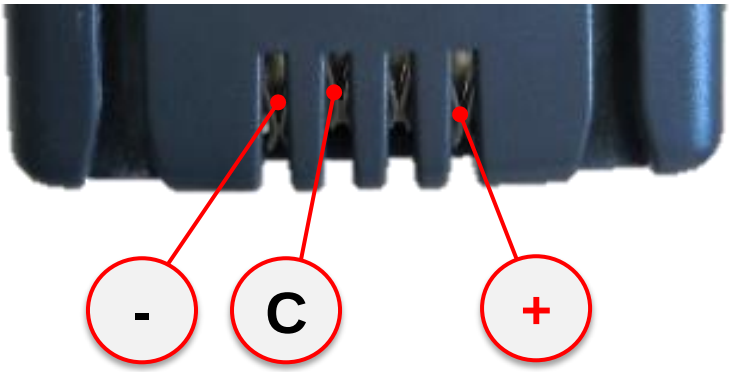
Check should give this result



CABLE COLOR	LETTURA SUL TESTER (Volt)
Black - Red	(12V)

6.5 Battery TEST

In the event that the battery can not be recharged it is recommended to perform the following check with the multimeter..



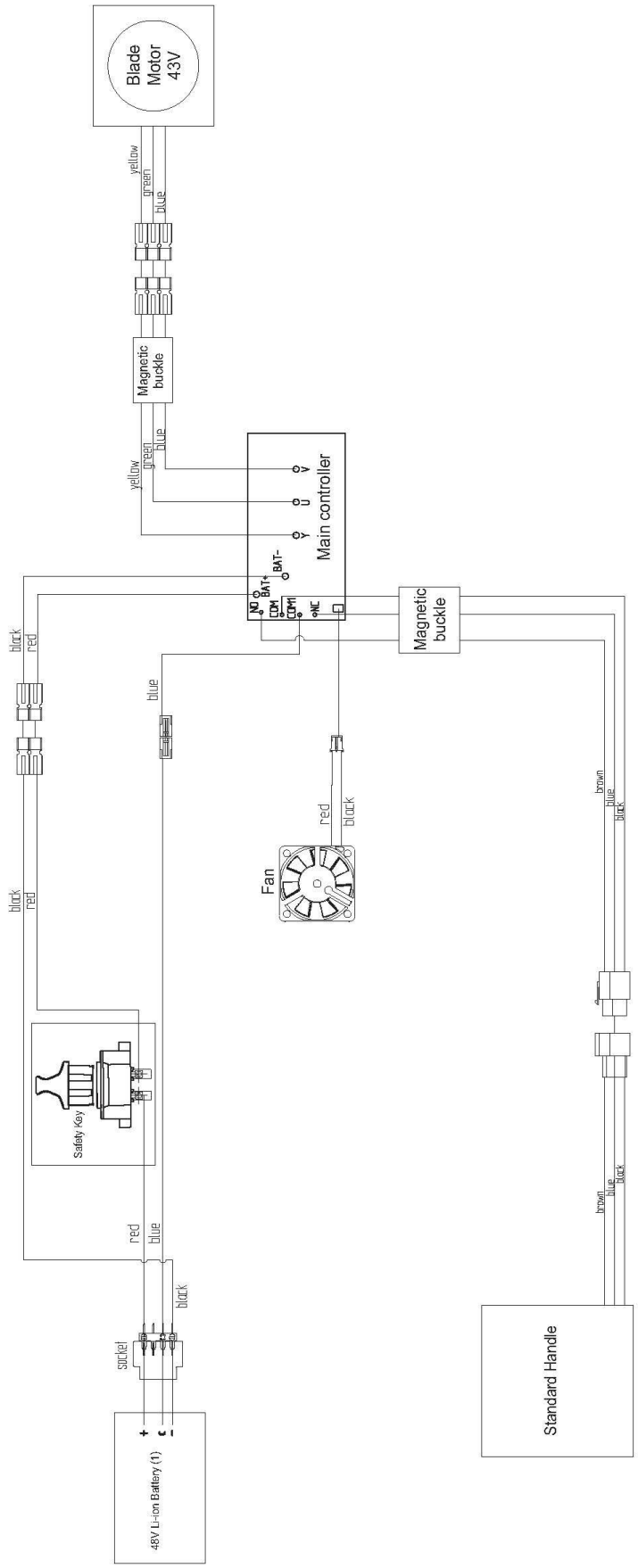
1. Measure the impedance with multimeter in Ohmmeter function between terminals "**C**" and "-" the impedance value must be included between **100 and 200Kohm.**

If the measured value is out of the range given it means that the battery is damaged..

2. Measure the voltage with multimeter in Voltmeter function between terminals "**+**" and "**-**", the value must be higher than 24 V to allow the recharging.

7. Electrical diagram

MONO-BATTERY VERSION



DUAL-BATTERY VERSION