"SMART ENERGY CB" CE

SERVICE MANUAL

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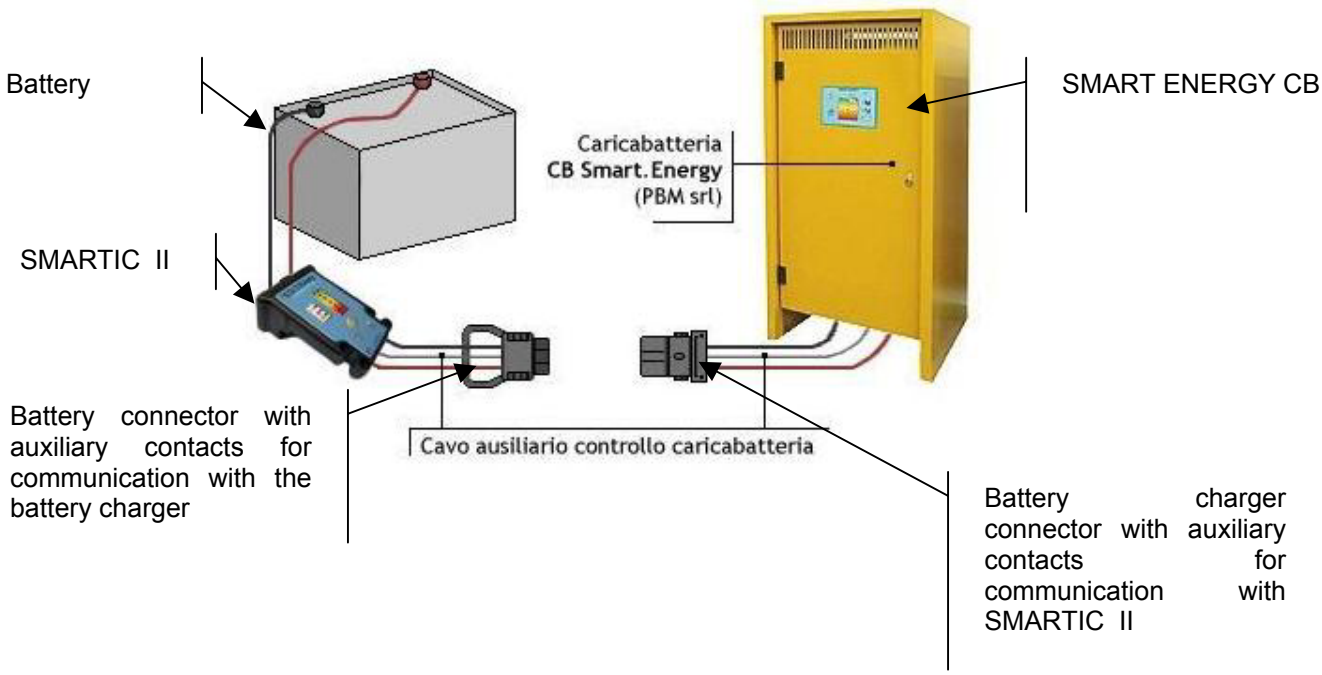
CHAPTER 1: FOREWORD

SMART ENERGY CB battery chargers are controlled by the AP877 electronic card which interfaces with the SMARTIC II connector installed on battery through an RS485 communication bus.
Communication takes place through 2 signals connected to the auxiliary contacts of the battery charger plug, which connecting battery to battery charger interconnect with the corresponding contacts on the battery-side connector, reaching from there SMARTIC II.
Any action performed by the AP877 card, and therefore by the battery charger, is controlled by the SMARTIC II connector. Measured values (like the presence of mains voltage), or any events detected by the AP877 card, are communicated to the SMARTIC II. It uses this info together with the info checked directly, like battery voltage, current, Ah in the battery, to manage the operation of the battery charger.

The charging system is therefore configured as shown in the picture below:



Below you will find basic information concerning SMARTIC II and the programming of charge parameters on it.

For **complete information on the operation of the SMARTIC II connector**, its programming modes, possibility to set times for starting the charging process when energy is cheaper, refer to the user manual of the **SMARTIC II** device enclosed.

The **AP877** card controls **SMART ENERGY battery chargers**, **both single and three-phase.** This card is suitable for chargers charging batteries with different capacities and voltages **from 12 to 96V** and with **Wa or W0Wa charging characteristics.**

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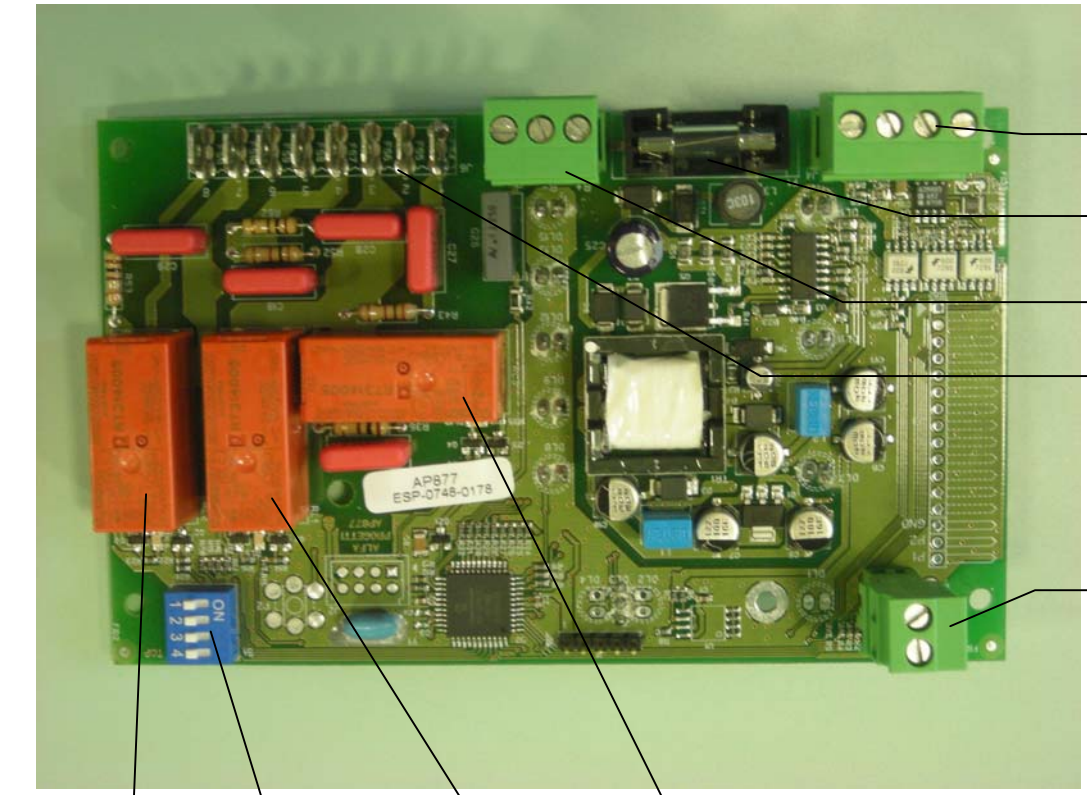
CHAPTER 2: DESCRIPTION OF THE AP877 CONTROL CARD

Pictures below show the layout of the main components both on components and welding sides.

Figure 2.1: layout of components side of the AP877 card



J4: pins nos. 4, 3, 2, 1

F1: fuse for card power supply

J5: pins nos. 3, 2, 1

J6: pins nos. 8, 7, 6, 5, 4, 3, 2, 1

P1: ON/OFF pushbutton

RL2

SW1

RL1

RL3

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Figure 2.2: adhesive panel

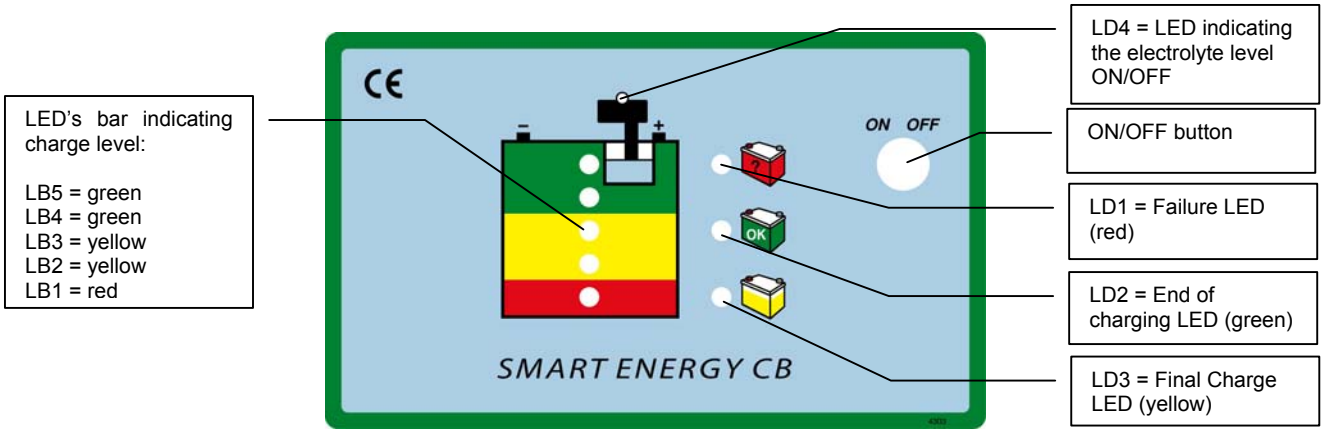
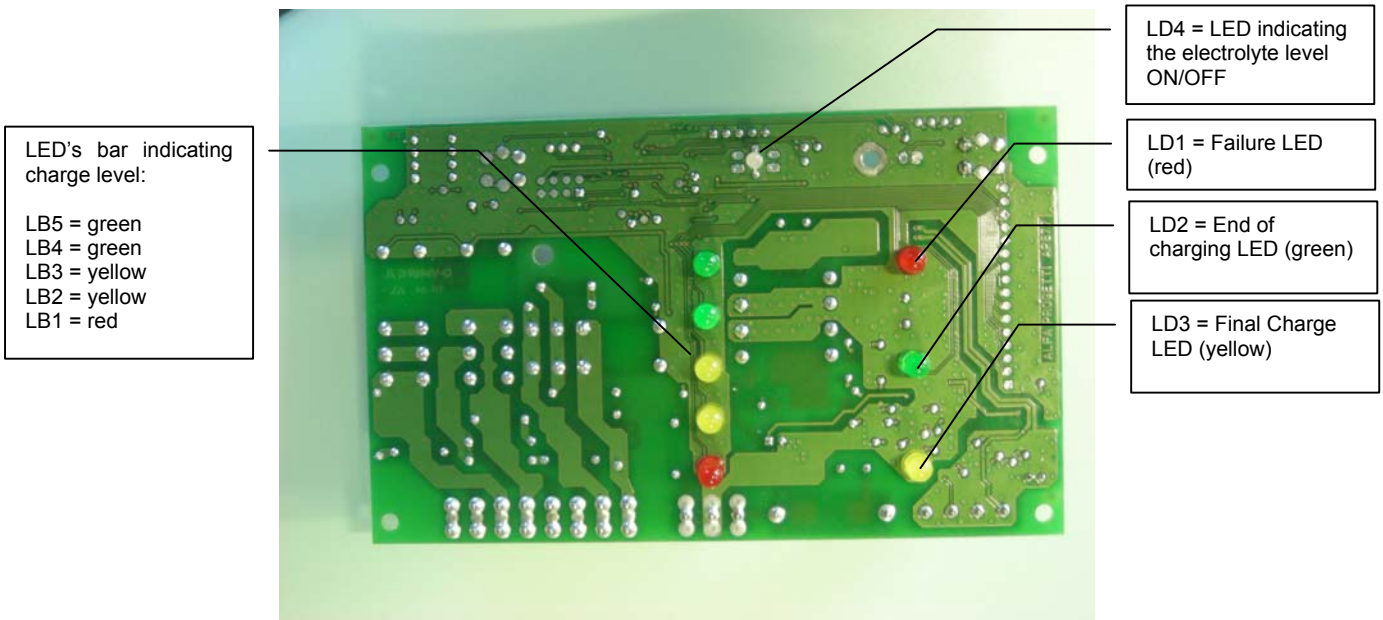


Figure 2.3: layout of welding site



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Below you will find a description of components shown in the figures above.

J4 connector			**Location on battery charger connector**	**Location on battery connector**	**Colour on the CV876 cable**
PIN	**Description**	**Function**			
1	5V	Not connected			
2	GND	Not connected			
3	B	RS485-B line	right	left	White or yellow
4	A	RS485-A line	left	right	Brown or green

Connector L5		
PIN	**Description**	**Function**
1	B + = Battery +	Power supply positive input
2	B - = Battery -	Power supply negative input
3	AC = mains presence	Sensing mains presence

Faston J6			
PIN	**Description**	**Function**	**Reference**
1	1st stage (W0)	Line of 1st stage contactor (WO) if the battery charger is WOWa	RL3.NC
2	2nd stage (Wa)	Line of 2nd stage contactor (Wa) if the battery charger is WOWA	RL3.NO
3	ON	ON/OFF contactor line if the battery charger is Wa	RL3.C = RL1.NO
4	24V AC	Contactor power supply 24V AC	RL1.C
5	OFF	NC contact of ON/OFF relay	RL1.NC
6	AUX-NA	NO contact - auxiliary relay (enabled at charge end)	RL2.NO
7	AUX-COM	Common contact – auxiliary relay (enabled at charge end)	RL2.C
8	AUX-NC	NC contact of the auxiliary relay (enabled at charge end)	RL2.NC

Connector P1		
PIN	**Description**	**Function**
1	Push-button	ON/OFF push-button – pin 1
2	Push-button	ON/OFF push-button – pin 2

DIP SWITCH SW1		
PIN	**Description**	**Function**
1	Not used	Not used
2	Not used	Not used
3	Not used	Not used
4	Not used	Not used

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CHAPTER 3: PROGRAMMING THE SMARTIC CONNECTOR

Below you will see how rated data of batteries and chargers can be programmed on the SMARTIC II connector. You will also find an introduction to basic parameters to be entered for the proper operation of the SMART ENERGY CB battery charger.
Programming can be performed from a PC through the AP160UIR USB cable and the SMARTVIEW II software or, in the case of SMARTIC II GPRS, from the WEB site www.alfaprogetti.com, entering from there the SMART SERVICE area.

Below you will find a description of the programming through SMARTVIEW II.

To perform the programming you need to:

1) Have a AP160UIR cable
2) Install the driver for the USB cable /IR AP160UIR (driver for Operating systems Windows 2000, XP e Vista)
3) Install the SMARTVIEW II software, available at the WEB site www.alfaprogetti.com in the download area, on your PC.

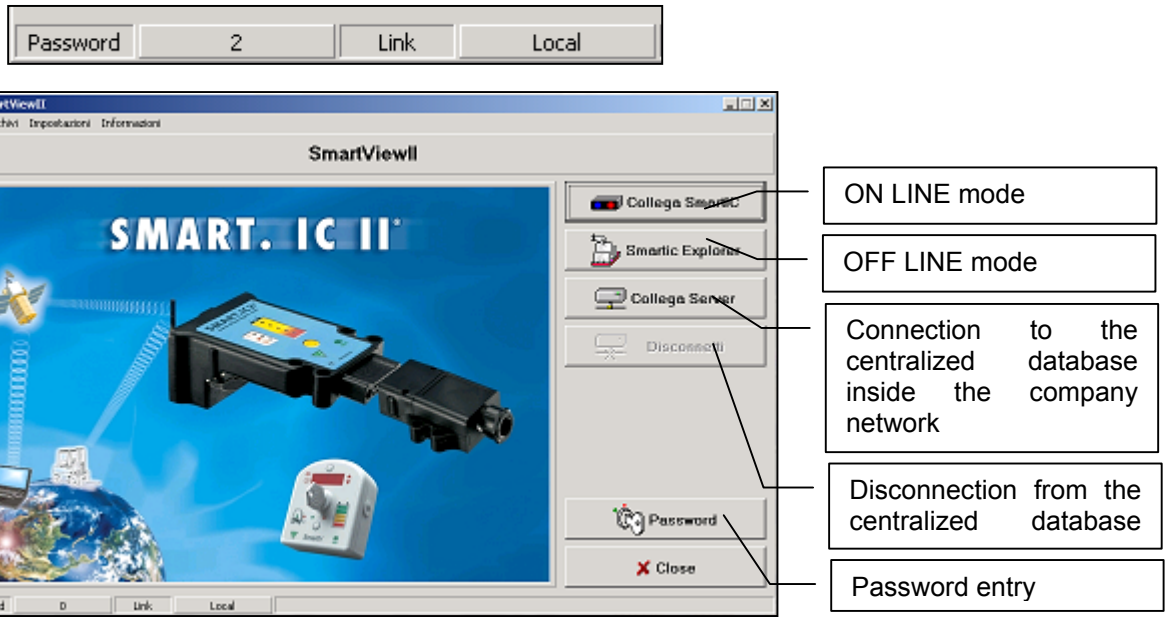
And perform following steps:

- Connect the AP160UIR adapter to an USB port
- Connect the AP160UIR to the IR connector of SMARTIC II
- Execute the *SmartView II* program
- Press the password key and enter a password (PWD) with level 2, enabled to the programming of parameters on SMARTIC II

Note:
The *SmartView II* program has 3 different access levels available:

- Level 0 password: Lowest password level
  The user is authorized only to consult data
- Level 1 password: Middle password level
  Previous level functions and data download onto PC
- **Level 2 password: Highest password level**
  Previous level functions and data writing onto SMARTIC II connector

The authorization level associated with the entered PWD is shown on the status bar of the application package (below SW window)



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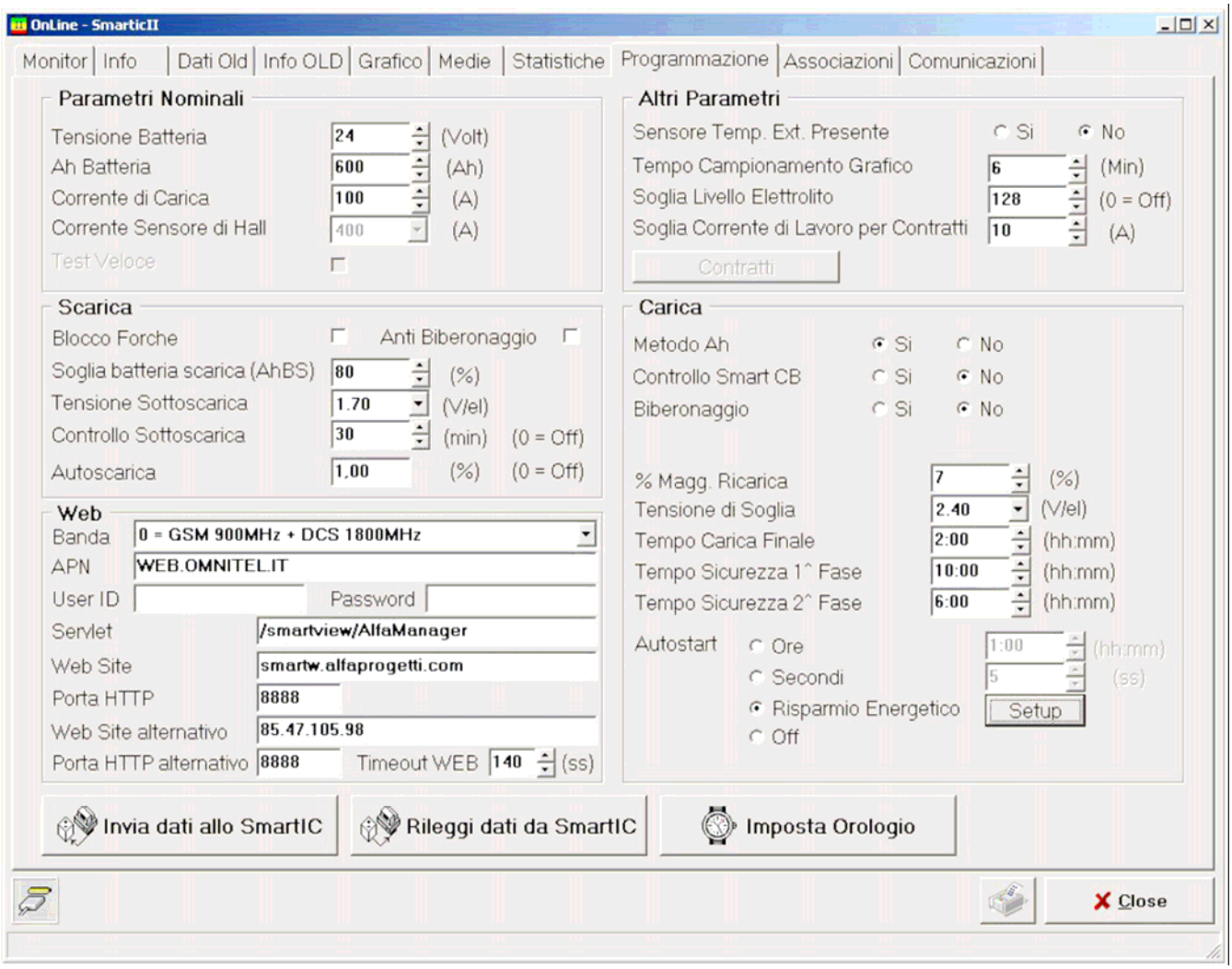
By pressing the CONNECT SMARTIC key, serial ports of the PC are tested looking for a SMARTIC connector connected. In the example to the left, a connected SMARTIC was detected on the COM2 serial port.

Click on a tab on page top to select programming page:



Battery rated parameters:

Rated parameters of the battery on which a SMARTIC II connector is installed and size of current sensor:

- **Battery Voltage** = rated voltage of battery
- **Battery Ah** = rated capacity of battery
- **Charging current** = rated current of the battery charger
- **Rated sensor current** = current size of the Hall Sensor

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Discharge parameters: parameters controlling the discharge stage and enabling the forks lock function under special working conditions of the forklift truck.

- **Forks lock** = Selection of forks lock function
- **Anti opportunity charging** = Selection of anti opportunity function
- **Underdischarge voltage** = Voltage level below which battery is considered as underdischarged

For any other parameter, please refer to the SMARTVIEW II manual.

WEB parameters: configuration parameters providing access to WEB service. The parameters only depend on the contract you made with your telephone company (only for S2GPRS connectors).

Charging parameters: show the operation mode of SMARTIC II connector.

- **Ah-method (enabled for SMART ENERGY CB):** if enabled, it disables the charging method with time-controlled final charge.
- **SmartCB Control (enabled for SMART ENERGY CB)**: it has to be enabled for allowing SMARTIC to control the charging process
- **Opportunity Charging: if enabled, short charging cycles can be performed with a possible advance interruption of the charging process with no indication of failures and collection of data from different consecutive charging processes (used with AGV systems)**
- **Recharging increase %:** energy percentage dissipated during the charging process, that is Ah increase percentage compared to the Ah discharged in the same cycle.
- **Voltage threshold:** Gassing Point: it makes the charging process switch from initial charge to final charge and enables the relevant timers.
- **Final charge time:** time measured after reaching the gassing point in time controlled charging processes and for a safety timeout in Ah controlled charging processes. This time is measured during the first alignment cycle to set a starting point corresponding to a fully charged battery.
- **Safety timer 1st stage: Should voltage not reach the threshold voltage within this time, an alarm is generated and charge is interrupted.**
- **Safety timer 2nd stage: Should capacity not reach the rated value within this time, an alarm is generated and charge is interrupted.**
- **Autostart:** Autostart delay selection.
- **Energy saving:** Enabling of a scheduler where times have to be entered for each single day in order to let charging processes start when the energy cost is low.
- **Setup: Pushbutton for selecting Autostart times for each single day if the energy saving function has been enabled.**

Writing of energy save parameters

If the "**Energy Saving**" entry has been selected in the charge section, the relevant Setup mask can be accessed. Once data have been changed, press the OK key to close the mask.

Press the "Send data to SMARTIC " key to transfer data to the SMARTIC device.

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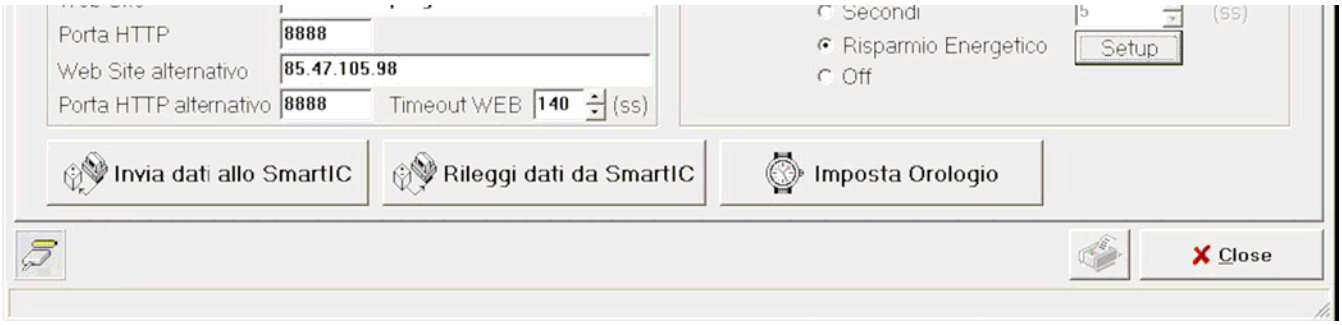
Example: if you want to set the timeband 20:00 → 6:00 for weekdays and 0:00 → 23:59 (the whole day) for Saturdays and Sundays, you need to set it as follows:

Once data have been entered in the scheduler, press the OK key to exit from it.

Once configuration parameters have been entered, press the "SEND DATA TO SMARTIC " key and "SET CLOCK" key.



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CHAPTER 4: OPERATION

- **On connecting Smart Energy to battery** by means of a SMARTIC II connector, communication between the 2 devices begins. This is indicated by a green blinking LED, located next to the circular connector, which the communication cable is connected to, on SMARTIC II. This is also indicated by the battery charger performing an **Autotest**, where **all LED's light up in sequence**. Afterwards only will the LB1…LB5 LED's remain lit, depending on the charge state of the battery. When Smart Energy is connected to battery for the first time, the red **LB1 LED** will blink, which indicates that **battery is empty**.
- **The red FAULT LED will blink** after the Autotest, **if connection to mains is not performed**.
- **Once connection to mains has been performed, the charging process starts as indicated by the LB1, LB2…LB5 LED's, which will light up in sequence from the bottom to the top.**
- After a certain amount of time, depending on the initial discharge state, battery will reach the gassing threshold and final charge will begin, as indicated by the yellow **LD3** LED lighting up.
- On charge completion, the green **L2** LED, indicating end of charging, will light up.
- The charging process can be stopped anytime by pressing the ON-OFF button on the battery charger. Charge interruption will be indicated by a failure to light up in sequence of the LED's (**LB1 …LB5).** Pressing the button again, the charging process is restarted and the **LB1…LB5 LED's** will light up in sequence from the bottom to the top.
- All LED indications described above correspond to identical indications given by homologous LED's on the SMARTIC II connector.
- For further information on operation, programming modes, possibility of setting times of the **SMART.IC®** connector in order to charge batteries taking advantage of low-cost energy, please refer to the **User Manual of the SMART.ICII® device.**

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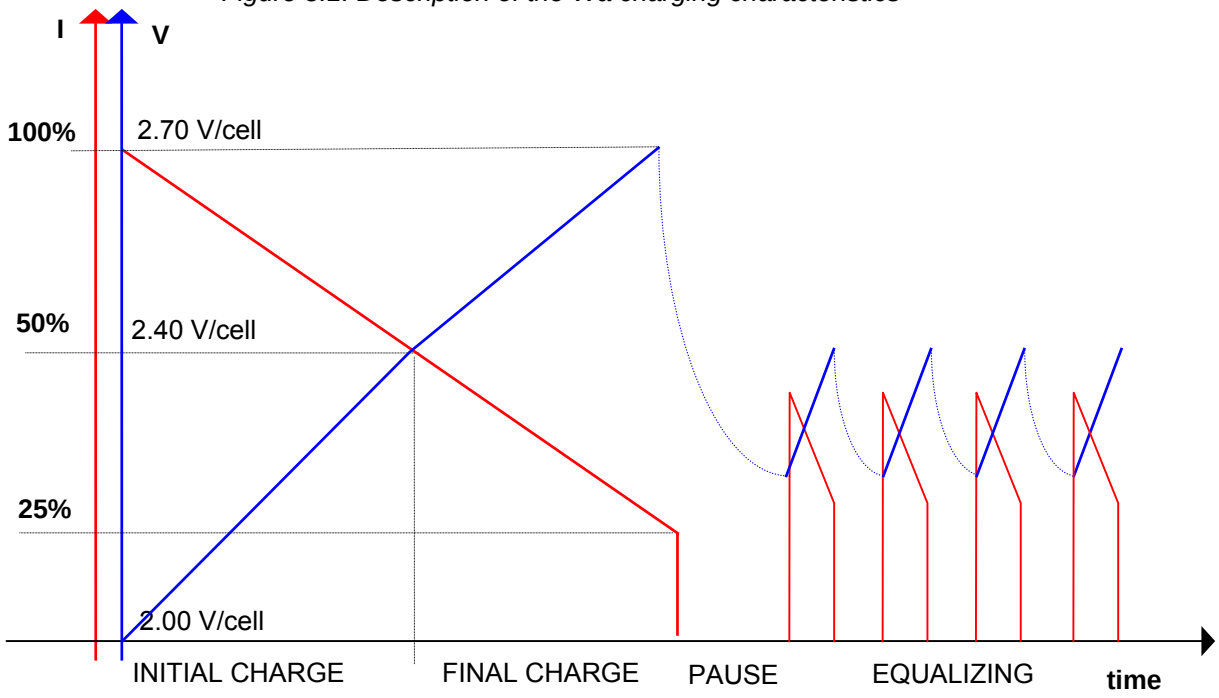
CHAPTER 5: DESCRIPTION OF THE Wa-CHARGING CHARACTERISTIC

Figure 5.1: Description of the Wa charging characteristics



The charging characteristic shown above is made up of the following stages:

- **Initial charge** with decreasing current until the set gassing point is reached. Should this stage last longer than 10 hours (settable time), the charging process is stopped and a fault is signalled (**safety time exceeded** during stage 1).
- **Final charge**: it is performed in different ways depending on the status of the Ah control.
  If it is enabled the final charge is performed following a special algorithm, thanks to which it is possible to determine how many Ampere-hours have to be reinstated into the battery. If the charging time exceeds 6 hours (settable time), the charging process is stopped and a fault is signalled (**safety time exceeded during stage 2**).
  In a time controlled charge, the charging process is stopped after a set time (standard setting: 3h).
  The first charge after disconnection of SMARTIC II from power supply is time controlled.
- **Pause:** waiting for battery cooling down ((**6 hours** long).
- **Equalizing charge:** Equalizing is made up of a certain amount of pulse packages, each of which consists of **charges (T.ON=5 min.) and pauses (T. OFF=55min.). Goes on, until battery is disconnected from battery charger.**

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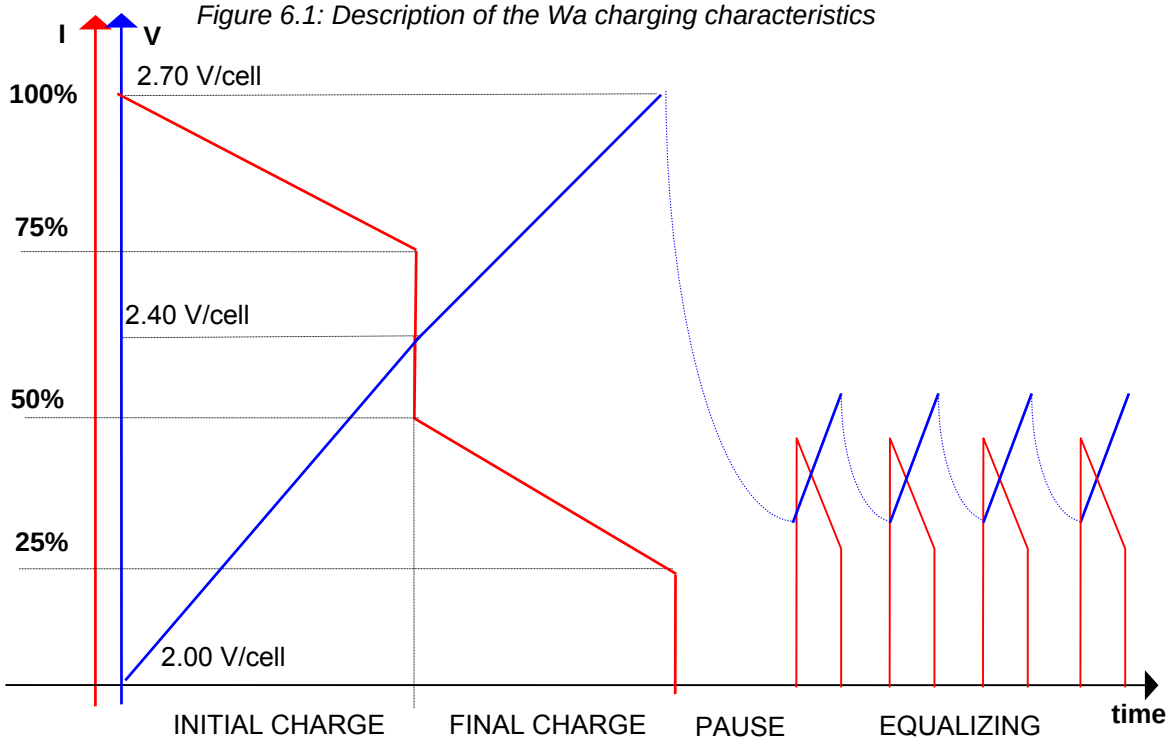
CHAPTER 6: DESCRIPTION OF THE W0Wa-CHARGING CHARACTERISTIC

Figure 6.1: Description of the Wa charging characteristics



The charging characteristic shown above is made up of the following stages:

- **Initial charge** with a higher current (equal to 1/5 of the battery capacity) for a faster charging process. This is obtained by connecting the mains voltage to a primary winding with fewer turns, thus obtaining a higher output current on the secondary winding.
  Should this stage last longer than 10 hours (settable time), the charging process is stopped and a fault is signalled (**safety time exceeded** during stage 1). If the charge has been programmed in Ah and the capacity in the battery exceeds the rated value by 10%, the charge stops and a failure is signalled (**safety amperehours** exceeded).
  Final charge begins on reaching the threshold set by means of the JA1-JA7 jumpers and adjusted, if needed, by means of the **P1** trimmer.
- **Final charge:** at the beginning of the final charge the mains voltage is disconnected from the primary winding of the WO transformer, then it is connected to the Wa primary winding which allows the charging current to be reduced by 20% compared to the rated current.
  It is performed in different ways depending on the status of the Ah control.
  If it is enabled the final charge is performed following a special algorithm, thanks to which it is possible to determine how many Ampere-hours have to be reinstated into the battery. If the charging time exceeds 6 hours (adjustable time), the charging process is stopped and a fault is signalled (**safety time exceeded** during stage 2).
  In a time controlled charge, the charging process is stopped after a set time (standard setting: 3h).
  The first charge after disconnection of the SMARTIC II connector from power supply, is time controlled.
- **Pause:** waiting for battery cooling down ((**6 hours** long)
- **Equalizing charge**
  Equalizing is made up of a certain amount of pulse packages, each of which consists of **charges (T.ON=5 min.) and pauses (T. OFF=55min.). Goes on, until battery is disconnected from battery charger.**

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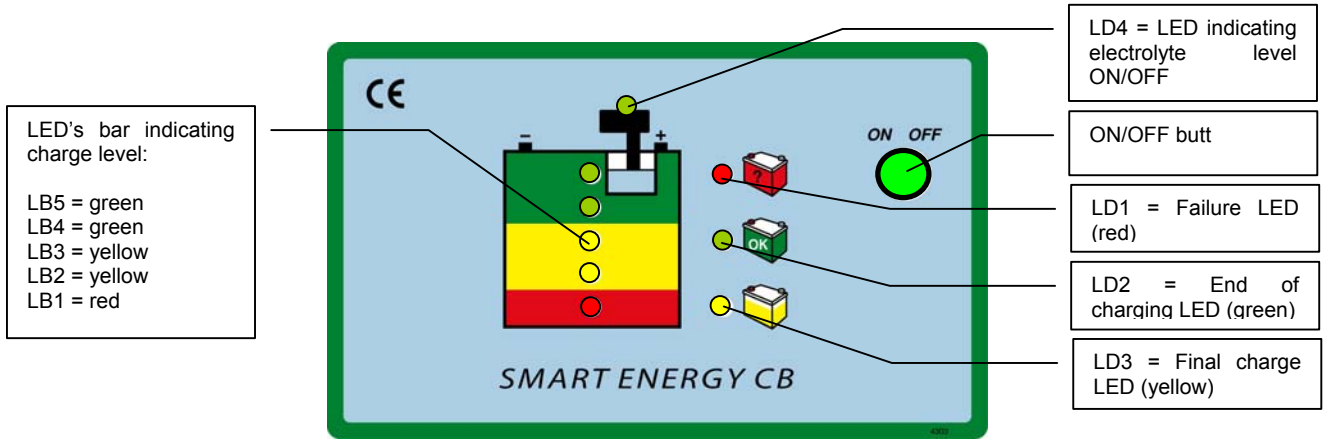
CHAPTER 7: LIST OF LED INDICATIONS



The table below show indications given through LED's.

Table 7.1: Description of LED's indications

LED indications	LD1 RED	LD2 GREEN	LD3 YELLOW	LD4 GREEN/ RED	LB1,LB2,LB3, LB4,LB5
Only mains power supply	OFF	OFF	OFF	OFF	OFF
Only battery power supply with empty battery (first switch on)	BLK	-	-	-	LB1 BLV
Autostart	BLK	BLK	BLK	-	-
Initial charge	OFF	OFF	OFF	-	SCORR.
Final charge	OFF	OFF	ON	-	SCORR.
End of charging	OFF	ON	ON	-	ON
Pause during equalizing or floating charge	BLK	-	-	-	-
Charge during equalizing or floating charge	BLF	OFF	OFF	OFF	OFF
Mains failure	BLK	-	-	-	-
Communication failure with SMARTIC II	ON	-	-	-	-
Overload cutout failure*	ON	-	-	-	-
Safety timer fault, 1st stage	ON	-	-	-	-
Safety Ah fault, 1st stage: 110% battery charge during 1st stage	-	-	-	OFF	-
Safety timer fault 2nd stage with Ah control	-	-	-	GREEN	-
Electrolyte control not programmed	-	-	-	RED	-
Electrolyte control programmed and level above threshold (standard value 128)	-	-	-	GREEN	-
Electrolyte control programmed and level below threshold (standard value 128)	-	-	-	RED	-

Legend:

OFF = LED is OFF
ON = LED is constant
BLK = LED is blinking slowly (T = 1 sec)
BLV = LED is blinking quickly (T = 0.2 sec)
BLF = LED flashes (for 0.2 sec) every 2 seconds
* = refer to Chapter no. 8 as for faults
\- = LED can be in different conditions
SCORR = lights up from the bottom to the top (= during the charge)

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CHAPTER 8: INSTALLATION, SAFETY, FAILURE DETECTION, AND MAINTENANCE

In this chapter the main info are provided, necessary to the **Service Personnel** to carry out a correct installation of the battery charger, a quick detection of the most common failures, and a proper maintenance of the unit.

8.1. INSTALLATION

The general notes on installation are already provided in the user manual enclosed to each battery charger.
Below only the basic info are summarized.

- It is essential to connect the charger to a mains supply of standards corresponding to the power of the battery charger installed to be sure that the charger functions properly.
- The charger is equipped with taps to adjust the charger to mains, compensating for possible differences between the voltage available at the user's site and the rated voltage.
- Single-phase chargers are preset for a rated voltage of 230V AC.
- Three-phase chargers are preset for a rated voltage of 400V AC.
- **Checking the mains voltage is essential**: a mains voltage which is too high or too low compared to the rated value, may result in a big different current delivered by the battery charger with following malfunctions of the charger and lower performances of the battery.

8.2. SAFETY NOTES

1) Ensure that the battery charger is positioned onto a solid and flat and even floor, and is protected against possible impacts from forklift trucks and other vehicles.
2) The battery charger has to be installed in a site free from materials which may prevent its natural ventilation, necessary to dissipate the produced heat.
3) Do not position the charger near explosive, inflammable, and/or dangerous materials.
4) Make sure that the battery charger is neither exposed to rain, moisture or fog, nor splashed with water. Do not install it outdoor*, under unstable sheds or shelters.
   * with the exception of special versions with protection class IPX3 or higher.
5) Check condition of sockets, fuses and/or switches present at user's site and of connection cables. Do not use additional cables to prolong the existing power cord!!
6) Make sure that battery charger is equipped with an electrical connector suitable for its power and current and is connected to an adequate mains socket!! (check inputs and power on the rating plate).
7) Check connections between battery and charger: if they are damaged and/or worn-out they may produce dangerous overheatings.
8) **All checks and/or settings have to be performed by qualified, skilled, and authorised personnel only.**

8.3 FAILURE DETECTION

Below you will find only general information. Since different kinds of failures and/or malfunctions may occur, please refer to experienced Service Technicians for any problem.
As for the battery chargers in question, the following is true:
Wa- or WOWa-chargers with decreasing currents may also show *seeming malfunctions* due to external causes, such as electrical systems and/or batteries in bad conditions. Take this into account when checking them.

8.3.1. NECESSARY INSTRUMENTS

- Handheld multifunctional digital tester
- DC clamp meter

8.3.2. FIRST CHECKS TO BE PERFORMED

- Preliminary check on the general conditions of battery charger and battery (see previous paragraph).
- Make sure that the power cord of the charger is properly connected to the mains socket and that the mains switch is OFF.
- Check the mains power supply inside the battery charger.
- Make sure that charger has been properly connected to battery and check the condition of connectors.

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8.3.3. FAILURE DETECTION AND MEASURES

FAILURE	POSSIBLE CAUSES	REMEDIES AND/OR CHECKS TO BE PERFORMED
BATTERY IS CONNECTED BUT THE CARD DOES NOT SIGNAL IT (CHARGER OFF)	- Blown fuses - Defective connections and/or contacts - Defective card	1) Check the protection fuse on DC output (battery side). 2) Check the fuse on the AP877 card. 3) Check charging cables path making sure that there are neither bad contacts on plugs nor overheatings on cable segments or terminals. 4) Make sure that the digital tester detects battery voltage presence on the card connector (follow the relevant wiring diagram). 5) Check and, if needed, replace the AP877 control card.
BATTERY IS CONNECTED BUT THE CHARGER DOES NOT START THE CHARGE AND THE CARD SIGNALS A SERIAL ERROR (red flash)	- Defective connections and/or contacts - Defective card - Defective SMARTIC II	1) Check charging cables path making sure that there are neither bad contacts on plugs nor overheatings on cable segments or terminals. 2) Check and, if needed, replace the AP877 control card. 3) Check if the green LED on SMARTIC II blinks (LED on AP876 card, next to serial connector).
BATTERY AND MAINS ARE CONNECTED, THE CONTACTOR OR RELAY CLOSES BUT THE CHARGER DOES NOT DELIVER ANY CURRENT	- Power failure - Blown fuses - Defective connections and/or contacts - Defective rectifier bridge	1) Check the phase voltage output from the contactor contacts and phase voltage input to main Transformer (TR). 2) Check that cables are in good conditions and there are no defective cables and/or terminals. 3) Check the output fuse on battery side (F2) 4) Check the efficiency of the rectifier bridge* (RD).
THE BATTERY CHARGER DELIVERS LITTLE CURRENT	- Power failure - Blown fuses - Defective connections and/or contacts - Defective rectifier bridge - Low mains voltage - Wrong wiring of the Main Transformer	1) Battery already charged or not completely discharged. 2) Failure of one or more mains phases; check the mains fuses and the contacts of the contactor (TL). 3) Check that the pin for adjustment to mains (CM) is in the correct position as to the mains present. 4) Check the integrity of cables making sure that there are no burnt wires or oxidized terminals in the power circuit up to the charging cables. 5) Check the condition of the rectifier bridge***** (RD).
THE CHARGER DELIVERS TOO MUCH CURRENT	- Mains very high - Adjustments not correct - Battery too low - Wrong wiring of the Main Transformer	1) Make sure that the charger has a power suitable for the battery to be recharged. 2) Check that the pin for adjustment to mains (CM) is in the correct position as to voltage available. 3) Check that battery does not have too long and/or too strong discharges compared to its own capacity. 4) Check mains voltage. 5) Check the proper connection of the Input Voltage on the input connector of Transformer.

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FAILURE	POSSIBLE CAUSES	REMEDIES AND/OR CHECKS TO BE PERFORMED
ONE OR MORE MAINS FUSES BURN, OR THE CUT-OUT SWITCH ON THE PANEL OPERATES	- Little power available - Short-circuited components	1) Make sure that the power (kW) available at customer's site is corresponding to that needed by the charger. 2) Check the auxiliary transformer (TA) for good working order. 3) Check the TL contactor coil, making sure that there are neither burnings nor short-circuits. 4) Check the Main Transformer (TR), making sure that there are neither short-circuited nor burnt windings. 5) Make sure that the rectifier bridge* (RD) has not short-circuited. 6) Check that charger does not deliver too much current (see the above-mentioned information). 7) If the cut-out-switch on the panel operates after a few minutes, check the switch installed since the charger is a particularly heavy load from an electrical point of view. It is suggested to use automatic and/or differential cut-outs as protections of battery chargers with operation characteristics suitable for the specific load (**K and D curves**).
BURNT FUSE ON CARD	- Defective card or wrong power supply of the card.	1) Make sure that the power supply of the card is lower than 144V. 2) Replace the AP877 card.
BURNT OUTPUT FUSE ON BATTERY SIDE	- Polarity reversal - Defective and/or short-circuited components	1) Check that polarity of the output cables and on battery connector is correct (polarity reversal may occur when maintenance is performed and/or cables and/or battery connectors are replaced). 2) Check that battery charger does not deliver too much current (see the above-mentioned information). 3) Make sure that the rectifier bridge* (RD) is not short-circuited.
THE CHARGER DOES NOT STOP AT THE END OF CHARGING	- Card setting not correct - Battery not in good condition - Defective card	1) Check that SMARTIC II has been programmed correctly related to connected battery (battery voltage, capacity, etc.). 2) Press the ON/OFF key on the battery charger and check the ON/OFF relay for proper operation.
THE CHARGER DETECTS AND SIGNALS AN "ALARM" CONDITION	- Overall check	1) Check mains voltage and working order of the battery charger. 2) Check working order of battery, cell by cell, making sure that there are no short-circuited or low-voltage cells. 3) Check SMARTIC II for proper programming.

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(*) Checking the rectifier bridge (RD)

The rectifier bridge is made up of auto diodes on aluminium sheets which act as dissipaters.
To achieve different current capacities, the bridge is made up of a variable number of diodes, positioned in parallel on the same plate.

To test operation of the Bridge, disconnect it from the charger.

Some diodes have the anode (positive pole) on the phase inputs and the cathode (negative pole) connected to the output positive pole of the bridge (corresponding to the negative pole of the battery).

To check the condition of these diodes, use a Digital tester in “Check-Diode” mode and make sure that a diode voltage (0.4V – 1V) is present by pointing the positive test prod on the Phases and the negative test prod on the output positive pole. Make sure that there is an infinite diode voltage between the output positive pole and each mains input.

The other diodes have the cathode (negative pole) on the phase inputs and the anode (positive pole) connected to the output negative pole of the Bridge (corresponding to the battery negative pole).

To check the condition of these diodes, use a Digital tester in “Check-Diode” mode and make sure that a diode voltage (0.4V – 1V) is present by pointing the positive test prod on the Phases and the negative test prod on the output positive pole. Make sure that there is an infinite diode voltage between the positive output pole and each mains input.

In addition to these instrumental checks, the following empirical checks can be performed:

- Visual checks to exclude that there are blown diodes or an unsoldered rheophore.
- If **strong vibrations** are heard during the charging process and the charging process is not performed regularly because the cut-out-switch or the fuses operate, **it means that the bridge is in short-circuit and needs replacing.**
- On the other hand it is easy to diagnose the **open bridge** failure on a **three-phase charger** by operating the charger without connecting the battery and forcing the power supply of the transformer. If an anomalous transformer voltage, instead of a no-load voltage, is detected under these conditions, it means that the rectifier bridge **is at least partially open and needs replacing.**
- The **no-load output voltage** of chargers corresponds to the values contained in the following table (provided that transformer is correctly powered).

RATED BATTERY VOLTAGE	NO-LOAD OUTPUT VOLTAGE (DC) FOR 1-PHASE BATTERY CHARGERS	NO-LOAD OUTPUT VOLTAGE (DC) FOR 3-PHASE BATTERY CHARGERS
12V	14 ÷ 15V	18 ÷ 24V
24V	28 ÷ 30V	33 ÷ 38V
36V	42 ÷ 44V	50 ÷ 58V
40V	46 ÷ 48V	60 ÷ 70V
48V	56 ÷ 58V	72 ÷ 80V
72V	85 ÷ 87V	100 ÷ 108V
80V	95 ÷ 98V	110 ÷ 120V
96V	112 ÷ 115V	130 ÷ 150V

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8.3.4. MAINTENANCE AND CLEANING

All maintenance and cleaning actions have to be performed by qualified, skilled, and authorised personnel.

- The battery charger is an electrical device with no moving mechanical parts, therefore it does not need any special maintenance.
- It is however suggested to check, inspect, and clean the charger **at least once a year** if it operates in a fairly "clean" environment.
- In "hard" conditions, that is in dusty and wet environments, checks have to be performed **more frequently**.
- The main checks to be performed are the following:
  - Place the charger/s outdoor and remove the closing panel.
  - Wear a faceplate and protection devices. Using compressed air, remove dust accumulated inside the charger.
  - Use non-corrosive detergents to remove sludge deposits or other dirt.

Once the charger has been cleaned, perform the following actions:

- Check the general condition of components and their integrity.
- Replace oxidized cables and/or terminals, if any.
- Use proper sprays to clean electrical contacts on contactors, switches, and selector switches.
- Check the tightening of screws and bolts, replace rusted parts, if any.
- Perform a "dry cleaning" or use proper sprays to clean electronic cards.
- Check the status of both control and power connectors. Check the "wear" of power connectors on battery and replace them, if necessary.
- Check the condition of electrical plugs.

Once all the above-mentioned actions have been taken, close panels, doors and covers again, and place the charger/s in its/their position/s again.

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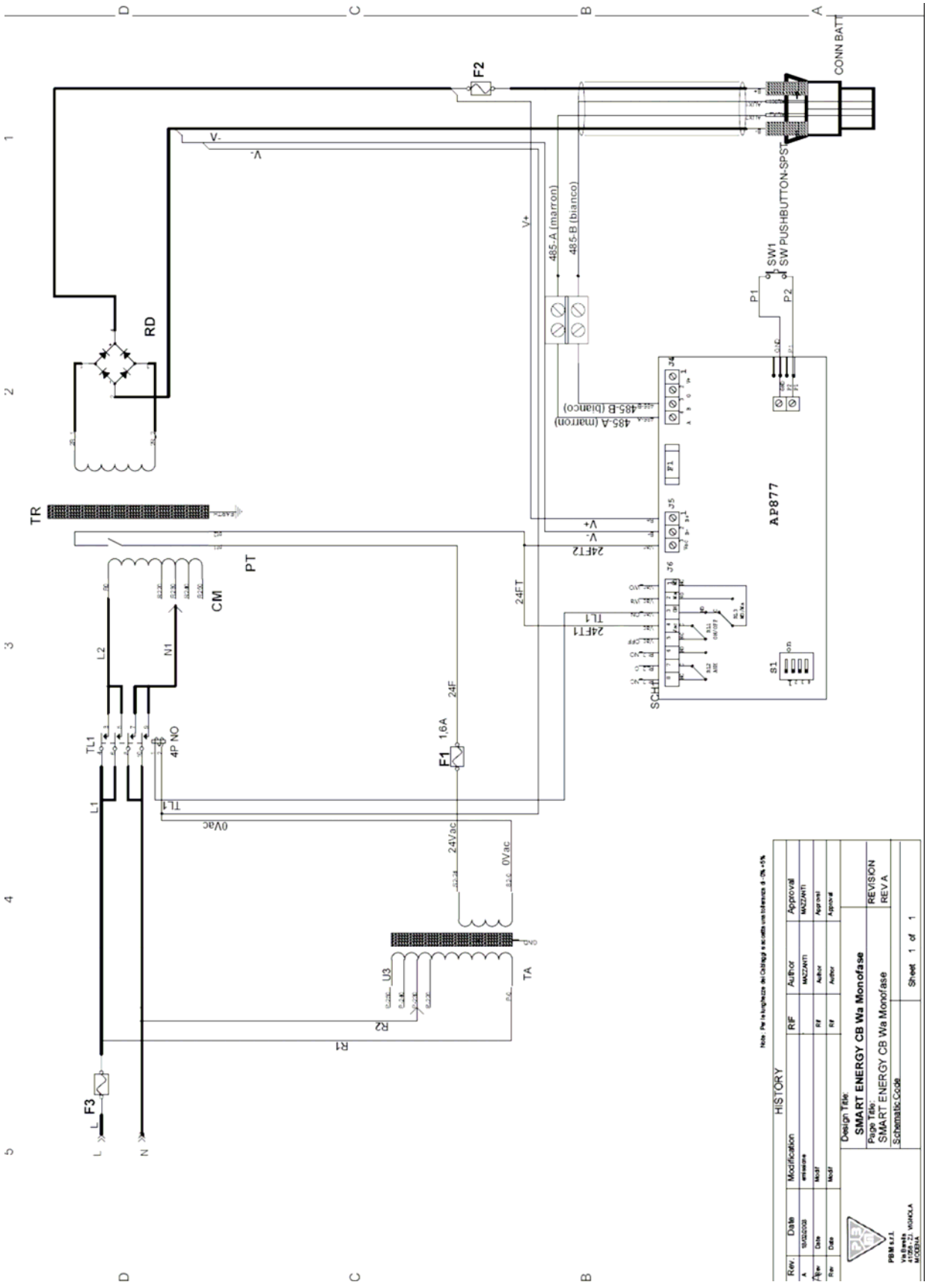
WIRING DIAGRAMS

Smart Energy CB Wa single-phase



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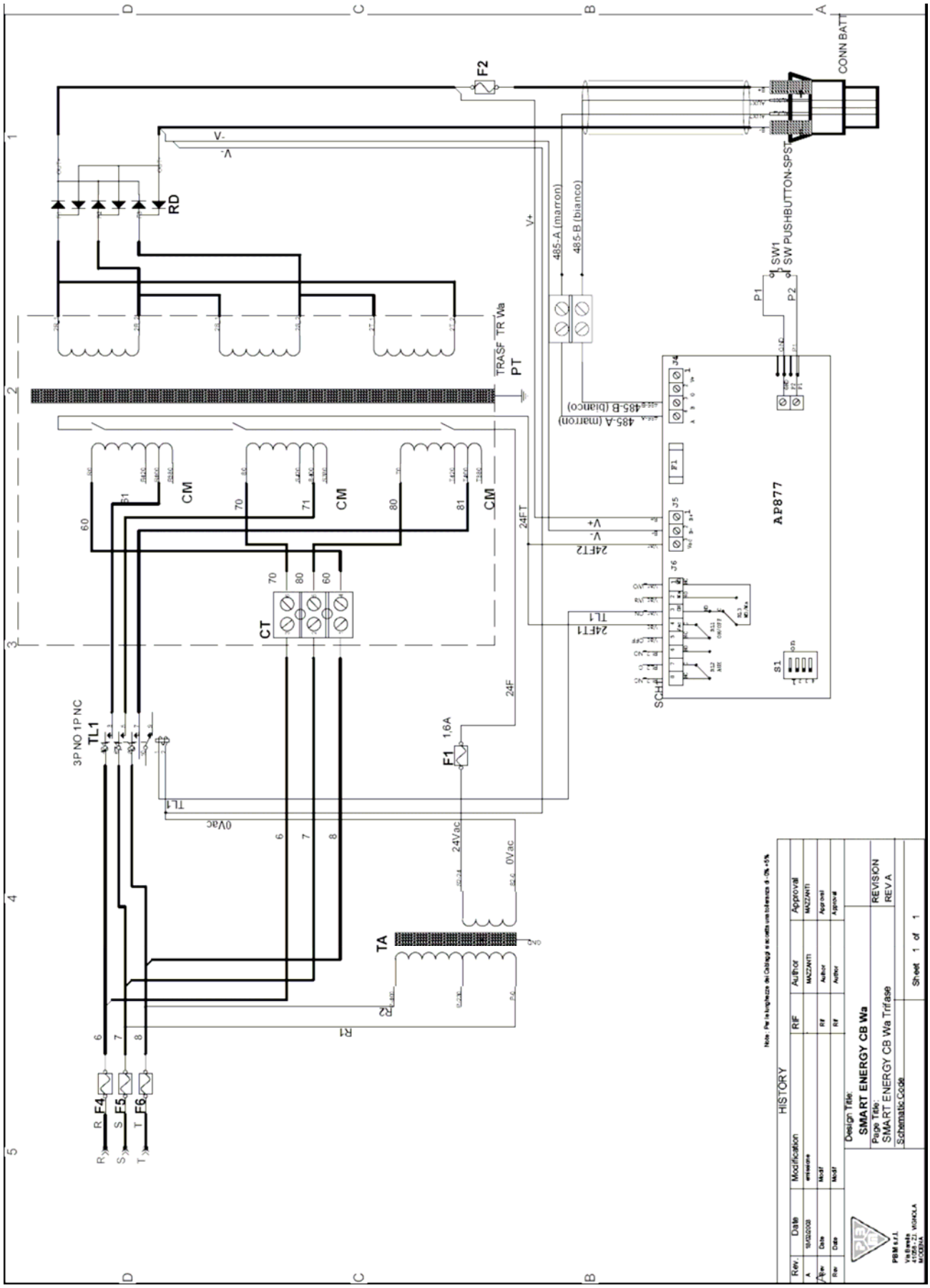
Smart Energy CB Wa three-phase



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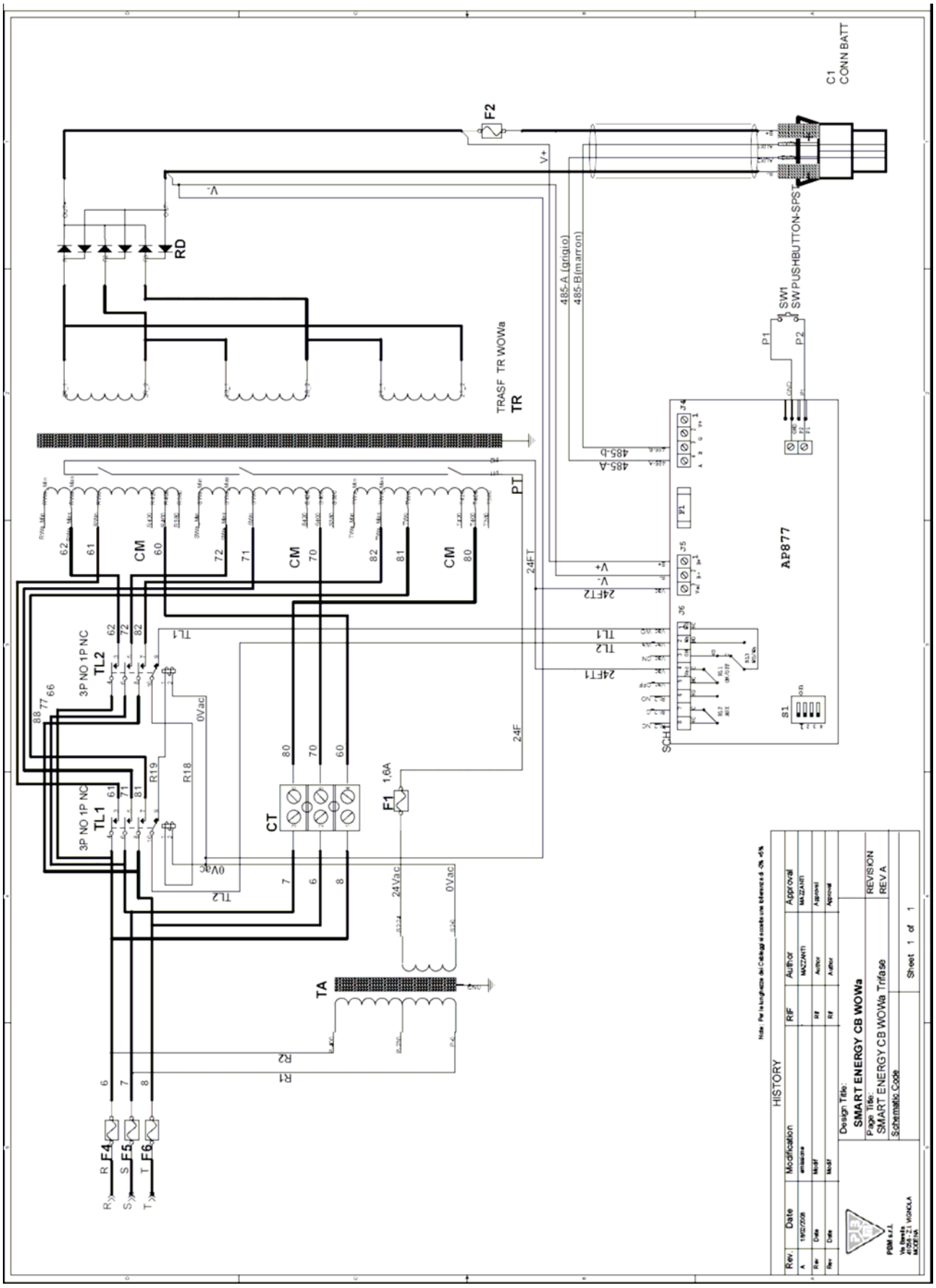
Smart Energy CB WOWa three-phase



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