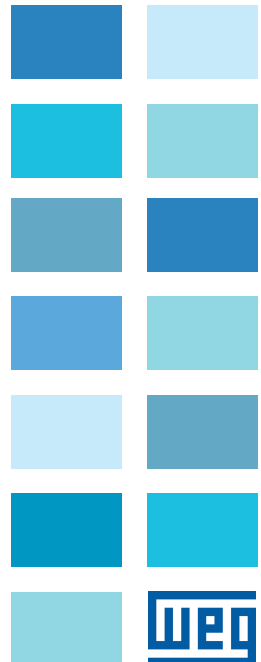


# Rectifier

Digital Three-Phase Rectifier | Battery  
Charger

## User's Manual





# **User's Manual**

Series: Digital Three-Phase Rectifier | Battery Charger

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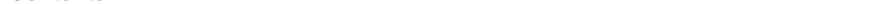
## Summary of the Revisions



The information below describes the revisions made to this manual.

<b>Version</b>	<b>Revision</b>	<b>Description</b>
-	R00	First edition
-	R01	General revision

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## 1 SAFETY INSTRUCTIONS

This manual contains the information necessary for the correct use of the Digital Rectifier. The following instructions are extremely important for the good performance of the Digital Rectifier and must be fully observed during the system installation, maintenance and operation. Failure to comply with the product instructions may cause operating accidents and damage to the environment, to the Rectifier and to the equipment connected to it, in addition to voiding the warranty.

After reading the user manual, keep it in a place with easy access for the users.

### 1.1 SAFETY WARNINGS IN THE MANUAL

The following safety notices are used in this manual:

**DANGER!**

Failure to comply with the procedures recommended in this warning may lead to death, serious injuries and considerable material damage.

**ATTENTION!**

Not following the procedures recommended in this warning may cause material damage.

**NOTE!**

The text aims at providing important information for the full understanding and proper operation of the product.

### 1.2 PRELIMINARY RECOMMENDATIONS

**DANGER!**

- Make sure the power is disconnected before installation. (Otherwise, electric shock may cause serious injury or death).
- Always work with the equipment disconnected from the power supply. (Otherwise, electric shocks or short circuits may occur.)
- When performing any tests, maintenance or repairs, first disconnect the power supply and then disassemble the equipment.
- Do not install the product, unless you hold a national certification and have received relevant information on the product. (Otherwise, electric shocks or short circuits may occur.)

**ATTENTION!**

- Before installation, make sure the used voltage matches the rated voltage.
- When you are installing or testing this product, check the ratings and specifications.
- Do not disassemble the product when it is energized or running.
- Dispose of the product as industrial waste.



**NOTE!**

Read the entire manual before installing or operating this Digital Rectifier.



**DANGER!**

When in operation, electric energy systems – such as transformers, converters, motors and cables – generate electromagnetic fields (EMF). Therefore, there is risk for people with pacemakers or implants that stay in close proximity to those systems. Thus, such people must stay at least 2 meters away from those devices.

## 2 GENERAL INFORMATION

The generation of Digital Three-phase Rectifiers (RTD, or *Retificador Trifásico Digital*) has double energy conversion and full digital control.

Thanks to those innovations, the new RTD presents significant improvement in performance, efficiency, operation and reliability in comparison to conventional rectifiers.

### 2.1 ABOUT THE MANUAL

This manual briefly describes the operation and technical characteristics of the controlled rectifier.

This manual is available for download at WEG website: [www.weg.net](http://www.weg.net).

### 2.2 TERMS AND DEFINITIONS USED IN THE MANUAL

**Amp, A:** Ampere.

**°C:** Degrees Celsius.

**°F:** Fahrenheit degree.

**AC:** Alternating current.

**DC:** Direct current.

**cm:** Centimeter.

**Hz:** Hertz.

**kg:** Kilogram = 1000 grams.

**m:** Meter.

**mA:** Milliampere = 0.001 ampere.

**min:** Minute.

**mm:** Millimeter.

**rms:** Root mean square; effective value.

**V:** Volts.

**RTD:** from Portuguese "Retificador Trifásico Digital"; Digital Three-phase rectifier.

**UCQ:** from Portuguese "Unidade Conversora de Queda"; Voltage drop converter.

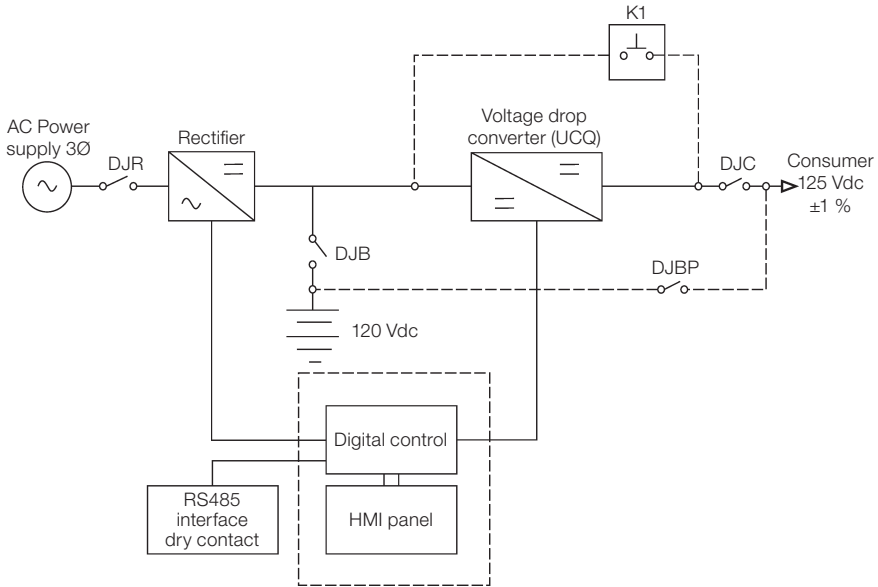
**Date and time format used in this manual and on the equipment:** dd/mm/yy hh:mm.



## 2.3 SYSTEM COMPONENTS

The system is basically composed of:

- Isolated three-phase rectifier.
- Battery (outside the panel; sold separately).
- Voltage drop converter UCQ.



*Figure 2.1: Digital rectifier*

## 2.4 OPERATION

In Normal mode (AC power supply present), the first converter (rectifier) supplies energy to charge/maintain the battery bank and simultaneously supplies energy to the output converter (UCQ), which supplies the consumer.

In case of an AC power supply outage, the consumer starts receiving uninterrupted power from the batteries through the output converter (UCQ) or directly via Bypass. When the AC power supply is restored, the rectifier returns to normal operation, charging the battery bank if necessary and powering the rest of the system.

The digital rectifier has a dedicated circuit that detects occasional leakage currents from the equipment positive and negative terminals or from the loads.

With automatic operation, it provides isolation between the positive/negative terminals and the equipment grounding, generating events and alarms when faults occur.

In case of a long AC power supply outage, the battery discharges to a minimum voltage limit; at this moment, the consumer is shut down.

The supervisory system works as redundancy in case of failure in the consumer's power supply.

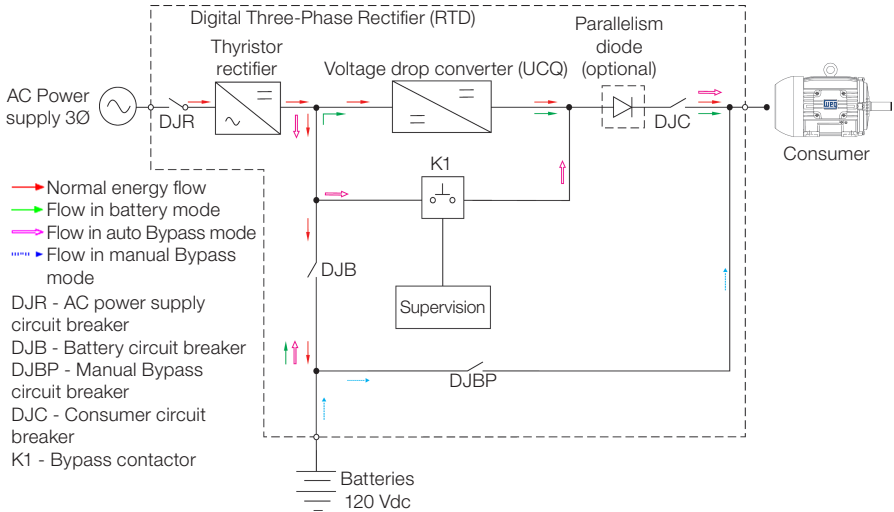


Figure 2.2: One-line diagram

## 2.5 RECEPTION AND STORAGE

When opening the package, visually check for signs of violation or points that may indicate any damage to the equipment during transportation.

Report any problems immediately to the carrier.

If the equipment will not be installed after the delivery, some safety measures should be taken in order to ensure the integrity and warranty of your product during storage:

- a) The air must be free of corrosive chemicals.
- b) The place must not present water infiltration or dripping.
- c) Good ventilation.
- d) The panel must be kept on the wooden base (pallet).
- e) The packages must not be removed.
- f) The air relative humidity level must be low (see [Section 3.2 SPACE HEATER AND THERMOSTAT on page 3-5](#) of this manual).
- g) Vermin must not be present.

**Handling:**

Transportation must be done in the vertical position with the panel door locked.

The handling is done by means of the lifting lugs on top of the panel with the aid of a lifting beam with the cables at its ends connected to each lug.

The panels must be lifted by the lifting lugs with lifting equipment of capacity above 2000 kg.

### 3 INSTALLATION AND OPERATION

Make a visual inspection so as to make sure no damage occurred during transportation and check the tightening of screws and electric connections.

Mount the equipment in a ventilated place free of explosive gases.

#### Temperature Sensor Connection

- Install one end of the 5-meter cable of the temperature sensor near the batteries.
- Connect the other cable end to connector CN11 of the relay board.

In case the temperature sensor is not connected, the equipment will set the standard temperature of 25 °C (77 °F).

#### Dry Contacts

RTD 15 A to 500 A	
<b>RL1</b>	Consumer turned on
<b>RL2</b>	AC Fault
<b>RL3</b>	Rectifier turned on
<b>RL4</b>	Low voltage in the consumer
<b>RL5</b>	High voltage in the consumer
<b>RL6</b>	Low voltage in the batteries
<b>RL7</b>	Current limitation
<b>RL8</b>	Overload
<b>RL9</b>	Earth leakage + or -
<b>RL10</b>	Ventilation fault 1 or 2
<b>RL11</b>	Circuit breakers open (input power supply, battery or consumer) or Bypass circuit breaker closed

#### Power Connections

The following care must be taken:

- Make sure the AC power supply and battery cables have no power and will not be inadvertently energized.
- Make sure the AC input, batteries and consumer circuit breakers are open.

For AC power supply, battery and consumer, use the minimum gauges indicated in the table below:

RTD Model	AC Power Supply		DC Power Supply
	Output (A)	220 V	380/440 V
15		4 mm <sup>2</sup>	
25		4 mm <sup>2</sup>	
35		4 mm <sup>2</sup>	
50		4 mm <sup>2</sup>	10 mm <sup>2</sup>
75		4 mm <sup>2</sup>	16 mm <sup>2</sup>
100	16 mm <sup>2</sup>	6 mm <sup>2</sup>	25 mm <sup>2</sup>
125	16 mm <sup>2</sup>	10 mm <sup>2</sup>	35 mm <sup>2</sup>
150	25 mm <sup>2</sup>	10 mm <sup>2</sup>	50 mm <sup>2</sup>
200	35 mm <sup>2</sup>	16 mm <sup>2</sup>	70 mm <sup>2</sup>
300	70 mm <sup>2</sup>	25 mm <sup>2</sup>	120 mm <sup>2</sup>
400	95 mm <sup>2</sup>	50 mm <sup>2</sup>	185 mm <sup>2</sup>
500	120 mm <sup>2</sup>	70 mm <sup>2</sup>	300 mm <sup>2</sup>

- Start by connecting the grounding cable that will be fastened to the corresponding terminal or bar.
- Introduce the power supply cables and connect them to the DJR circuit breaker in the lower part of the panel, observing the correct phase sequence of the three-phase AC power supply. R, S and T.
- Connect the battery cables to the corresponding terminals, observing the correct polarity.
- Connect the consumer cables to the corresponding terminals, observing the correct polarity.



**ATTENTION!**

Whenever you have to handle the DC link, disconnect the battery cable, since a pre-charge voltage is present even with the circuit breakers open.

**Thermal dissipation**

RTD (A)	15	25	35	50	75	100
<b>Cooling (kW)</b>	0.6	0.9	0.85	1	1.5	1.9
<b>BTU/h</b>	2050	3070	2900	3400	5100	6480

RTD (A)	125	150	200	300	400	500
<b>Cooling (kW)</b>	2	2.5	2.7	3.75	5	6.25
<b>BTU/h</b>	6820	8530	9210	12790	17060	21320

### 3.1 INITIAL SETTINGS

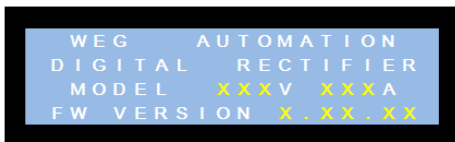
#### Input voltage configuration



**ATTENTION!**

Before closing the DJR, check with a multimeter if the AC input voltage is compatible with the voltage set in the terminals and if the battery voltage polarity is correct.

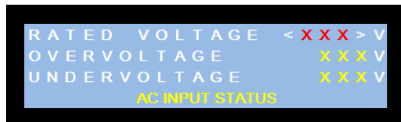
- Close the DJR and check if the display turns on with the opening menu.



- After some seconds, the opening menu changes to the clock setting menu. Set the date and time using the navigation keys. After one minute without any changes in date and time, the clock adopts the factory settings.



- Configure the equipment input voltage. Navigate in the “ROOT” menu up to the “AC INPUT” menu.
- In the “AC INPUT” menu, press the “ENTER” key for three seconds in order to enter the Submenu (1<sup>st</sup> level) of the input voltage selection.
- In the Submenu (1<sup>st</sup> level) of the input voltage selection, press the arrows to select the input voltage from the options 220 V / 380 V / 440 V. In order to confirm, press "ENTER" for three seconds.



**Note:** In case an alarm occurs indicating phase loss, change the input phase sequence on the DJR circuit breaker until the phase fault indication is cleared.



**ATTENTION!**

Make sure the cables are not energized.

### Battery charger configuration

- Navigate in the “ROOT” menu up to the “BATTERIES” menu.
- In the “BATTERIES” menu, press the “ENTER” key for three seconds so as to access the submenu (1<sup>st</sup> level) with the battery charger settings.
- If the charger settings are correct, exit the submenu by pressing “ENTER” for three seconds or wait for thirty seconds, and the system will go back to the main menu.
- If necessary, in order to make the modifications, press the “ENTER” key again for ten seconds within the submenu (1<sup>st</sup> level) until the modification menu (2<sup>nd</sup> level) appears.

Root Menu



Submenu (1<sup>st</sup> level)



Submenu (2<sup>nd</sup> level)



Submenu (3<sup>rd</sup> level)



- Within the modification menu (2<sup>nd</sup> level), choose the parameter to be changed by pressing the “ENTER” key to navigate the options.
- In order to change the chosen parameter, press the arrows to increase or decrease the values.
- Choose the charging current.

It is recommended to select a charging current equivalent to 10 % of the battery bank capacity.

**E.g.:** For batteries of 100 Ah, the recommended charging current is 10 A.

**Note:** The battery charging current will be discounted from the maximum limit of the consumer's current.

Choose the charger operating mode from:

- Forced float:  
In this mode, the charger will keep the battery bank in float until the operating mode is manually changed.
- Forced Equalization:  
When selected, this mode will execute a recharge cycle (or equalization) in the battery bank. After the cycle, the equipment will go into the float mode and remain in such mode until it is manually changed. The equipment can remain in this mode for up to six hours; after that, the forced float mode is activated to protect the batteries.
- Automatic (factory default):  
In this mode, the equipment will keep the battery bank in float, and whenever a relevant discharge of the batteries is detected, a recharge cycle (or equalization) is executed after the normalization of the situation that caused the battery bank discharge.


**NOTE!**

Regardless of the operating mode, the rectifier voltage for the batteries will be regulated observing the current limitation selected in the BATTERIES menu by the "CHARGING CURRENT" parameter.

- In order to "SAVE" the changes, press the "ENTER" key to access the menu with the "SAVE" or "CANCEL" options (3<sup>rd</sup> level).
- Confirm the desired operation.

### 3.2 SPACE HEATER AND THERMOSTAT

The digital rectifier has an internal heating system which can be adjusted by means of a thermostat in order to keep the equipment properly warm and free of humidity. This circuit is designed to be used during the equipment storage, installation or maintenance.


**NOTE!**

The system must not be used with the equipment in operation, which may cause overtemperature, output voltage drop (consumer), operation above the recommended temperature with damage to the internal parts, and so on.

### 3.3 OPERATION

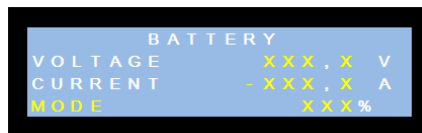
#### Activation of the Rectifier/Charger

- Energize the equipment via the input circuit breaker DJR.

Upon energization, the boot menu with the equipment data is displayed for four seconds.

- Check if the pre-charge occurred.
- Close the battery circuit breaker DJB.

Observe the parameters of the batteries on the "Batteries" menu, and if it is necessary to check or change the charger configuration, see the "installation" chapter.



- Press the rectifier key on the panel until you hear the sound signal and see the corresponding LED turn on.

**Note:** The LED of the rectifier key will flash when the rectifier is without AC power supply.

#### Activation of the Consumer

- In order to turn on the Consumer, press the panel key until you hear the sound signal and see the key LED turn on.



Check the output voltage of 125 Vdc  $\pm$  1 % on the “Consumer” menu and the load consumption percentage, which must be below 100 %.



- Connect the load and close the consumer circuit breaker DJC.
- Under those conditions, the equipment will be in normal operating condition, supplying the battery and the consumer.

### Shutdown of the consumer

It is only possible to interrupt the consumer's supply by opening the consumer circuit breaker (DJC). Once the consumer button is activated, it can only be deactivated by carrying out the full system shutdown procedure.

The Rectifier may remain turned on in order to maintain the battery charge.

### Shutdown of the Rectifier/Charger

It is possible to turn off the rectifier by pressing the corresponding key on the panel for four seconds.



#### **ATTENTION!**

Under that condition, the batteries will discharge if the consumer is turned on.

### Full system shutdown

In order to shut down the system completely, the three circuit breakers must be open and the batteries disconnected from the rectifier terminals.

## DISPLAY MENUS

Lettering					
Text in white font	Fixed text				
Text in yellow font	Dynamic text				
Text in red font	Values that can be modified by the up and down buttons				
Root	Submenu level 1 (3 s)	Submenu level 2 (10 s)	Submenu level 3		
WEG AUTOMATION DIGITAL RECTIFIER MODEL XXXV XXXA FW VERSION 0.0.0					
OPERATION MODE CONSUMER XXX% BATTERY XXXV XX/XX/XX.XX-XX XXX°C	ADJUST DATE / TIME <XX>/<XX>/<XX> <XX>><XX> + NEXT -				
CONSUMER VOLTAGE XXX.XV CURRENT XXX.XA CAPACITY XXX%	VOLTAGE REF XXX.XV CURRENT LIMIT XXXA UV XXX.V OV XXX.V LOW BAT BYP XXX.V	VOLTAGE REF <XXX.X>V CURRENT LIM <XXX>A UV <XXX.X> OV <XXX.X> LOW BAT BYP <XXX.X>	ATTENTION! SAVE PARAMETER CHANGES SAVE CANCEL		
BATTERY VOLTAGE XXX.XV CURRENT XXX.XA MODE XXX%	FLOAT REF XXX.XV EQUAL REF XXX.XV CHARGE CURRENT XXXA OPERATION XXXXXXXXXXXX	FLOAT REF <XXX.X> EQUAL_REF <XXX.X> CHARGE CURRENT <XXX> OPERATION <XXXXXXXXXX>	ATTENTION! SAVE PARAMETER CHANGES SAVE CANCEL		
AC INPUT P-R XXXV XXX.A P-S XXXV XXX.A P-T XXXV XXX.A	RATED VOLTAGE <XXX>V OVERVOLTAGE XXXV UNDERVOLTAGE XXXV MAXIMUM PERCENTAGE	RATED VOLTAGE <XXX>V OVERVOLTAGE <XXX>V UNDERVOLTAGE <XXX>V	ATTENTION! SAVE PARAMETER CHANGES SAVE CANCEL		
LAST EVENT EVENT DESCRIPTION XX/XX/XX XX:XX EVENT LOG ->	EVENT LOG EVENT DESCRIPTION XX/XX/XX XX:XX #XX <- BACK ->				
MAINTENANCE REVISION 1 XXX DAYS REVISION 2 XXX DAYS OPERATING DAYS XXXX	MAINTENANCE PRESS THE BUTTON FOR 3 SECONDS TO RESTART REVISION1 REVISION2	MAINTENANCE RESTORE FACTORY DEFAULT VALUES ENTER TO CONTINUE	ATTENTION! ALL CHANGES WILL BE LOST CONTINUE CANCEL		
COMMUNICATION MODBUS-RTU PROTOCOL ADDRESS XX SERIAL XXXX.X.X.X	ADDRESS XXX STOP BIT X PARITY NONE/EVEN/ODD BAUD RATE 9600/19200				
IMPORTANT EVENT EVENT DESCRIPTION XX/XX/XX XX:XX PRESS ENTER	This screen is not normally accessible via navigation keys. It appears when an important event occurs. And it disappears after pressing enter.				

### Event Log

The Digital Three-Phase Rectifier has a system which allows recording 200 events with date and time.

The last event will appear on the display and will disappear after pressing the “ENTER” key.

In order to check the event list, navigate on the “ROOT” menu up to the “LAST EVENT” menu. In the “LAST EVENT” menu, press the “ENTER” key for three seconds in order to access the event sequence on the Submenu (1<sup>st</sup> level).

Submenu (1<sup>st</sup> level)



Table 3.1: Event identifiers

RTD	N <sup>o.</sup> (1)	Event
<b>Normal</b>	0	Rectifier turned on
	1	Rectifier turned off
	2	Consumer turned on
	3	Consumer turned off
	4	Consumer overvoltage
	6	Battery overvoltage
	7	Battery undervoltage
	8	Input overvoltage
	9	Input undervoltage
	11	Normal mode
	12	Battery mode
	14	Charger mode
	15	OFF mode
	16	Clock set
	26	Normal battery temperature
	27	Consumer parameter set
	28	Battery parameter set
	29	Input parameter set
	30	Communication parameter set
	31	Reset revision 1
32	Reset revision 2	
33	Reset to factory definition	
36	Input circuit breaker closed	
39	Bypass circuit breaker open	
40	Battery circuit breaker closed	

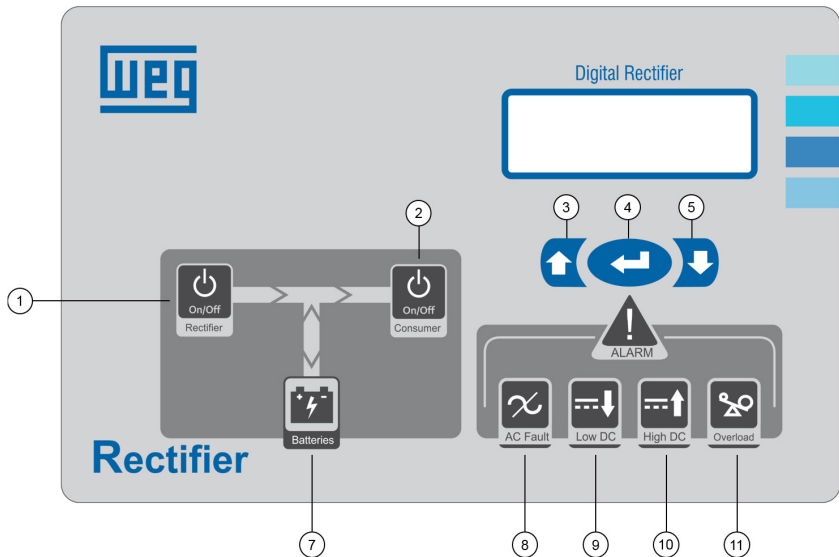
RTD	N <sup>o.</sup> (1)	Event
<b>Critical</b>	5	Consumer undervoltage
	10	Consumer overload
	13	Manual Bypass mode
	17	Overtemperature
	18	Phase sequence fault
	19	Low battery Bypass
	20	Battery overload
	21	Positive earth leakage
	22	Negative earth leakage
	23	Consumer current limitation
	24	Auto Bypass mode
	25	High battery temperature
	34	Ventilation 1 failure
	35	Ventilation 2 failure
	37	Input circuit breaker open
38	Bypass circuit breaker closed	
41	Battery circuit breaker open	
43	Consumer circuit breaker open	

(1) Number that identifies the event when read via Modbus RTU communication.

## 4 CONTROL PANEL

The control panel contains:

- LED-backlit LCD with 4 lines x 20 columns.
- Five keys.
- Eight indication LED.



### 4.1 MANUAL COMMANDS

- ① Rectifier Power Switch.
- ② Consumer Power Switch.

**Note:** by holding keys 1 and 2 simultaneously pressed, it is possible to activate/deactivate the manual Bypass, as well as to deactivate the automatic Bypass.

Navigation commands:

- ③ UP key.
- ④ ENTER key.
- ⑤ DOWN key.

## 4.2 INDICATIONS

The LEDs on the control panel warn the operator of the current state of the equipment as follows:

LED	Name	Color	State	Indication
①	Rectifier	Green	Off	Rectifier turned off
			On	Rectifier turned on
			Flashing	Rectifier turned on, but not operating
②	Consumer	Green	Off	Consumer turned off
			On	Consumer turned on
⑥	Alarm	Red	Off	No active alarms
			On	One or more active alarms
⑦	Batteries	Yellow	Off	Batteries charging or idle
			On	Batteries supplying power to the consumer
			Flashing	Batteries in critical level
⑧	AC Fault	Yellow	Off	AC power supply is normal
			On	AC power supply is abnormal or phase sequence fault
⑨	Low DC	Yellow	Off	Normal DC voltage in the consumer and battery
			On	Low DC voltage in the consumer or battery
⑩	DC high	Red	Off	Normal DC voltage in the consumer and battery
			On	High DC voltage in the consumer or battery
⑪	Overload	Red	Off	Consumer current is normal
			On	Overload (load > 125 %)

## 4.3 MEASUREMENTS

### AC Input:

- True rms AC voltage of the three phases.
- True rms AC current of the three phases.
- AC power supply frequency (Hz).

### Batteries:

- DC voltage (Vdc).
- Charging and discharging DC current (Adc).
- Charge percentage (%).

### Consumer:

- DC voltage (Vdc).
- DC current (Vdc).
- Percentage of charge in the consumer (%).

**NOTE!**

Due to the tolerance of the transducers and other parts used in the measurement system, the readings may show a deviation in comparison to measurements made with other devices.

**4.4 ALARMS**

In addition to the current state of the equipment shown by the LEDs on the panel, the HMI indicates when an Alarm is activated. Those alarms are listed in [Table 4.1 on page 4-4](#).

Table 4.1: Alarm List

Alarm	Event Shown on the HMI	Critical ?	Condition for Alarm	Condition to Exit the Alarm
Input overvoltage	"INPUT OVERVOLTAGE"	N	$V_{R,S \text{ or } T} > (110 \% V_{Inp})^{(1)}$	$(90 \% V_{Inp} + 5 V) < V_{R,S \text{ or } T} < (110 \% V_{Inp} - 5 V)^{(1)}$
Input undervoltage	"INPUT UNDERVOLTAGE"	N	$V_{R,S \text{ or } T} < (90 \% V_{Inp})^{(1)}$	
Battery overvoltage	"BATTERY OVERVOLTAGE"	N	$V_{Battery} > 148 V$	$V_{Battery} < 148 V$
Battery undervoltage	"BATTERY UNDERVOLTAGE"	N	$V_{Battery} < 105 V^{(1)}$	$V_{Battery} > 125 V$
Consumer overvoltage	"CONSUMER OVERVOLTAGE"	N	$V_{Consumer} > 132 V^{(1)}$	$111 V < V_{Consumer} < 131 V^{(2) (3)}$
Consumer undervoltage	"CONS. UNDERVOLTAGE"	Y	$V_{Consumer} < 110 V^{(1)}$	
Limiting the consumer current	"CONSU. CURRENT LIMIT"	Y	$I_{Consumer} > \text{HMI Setting}$	$I_{Consumer} < \text{HMI Setting}$
Consumer overload	"CONSUMER OVERLOAD"	Y	$I_{Consumer} > 125 \% \text{ HMI Setting}$	
Battery high temperature	"HIGH BATTERY TEMP."	Y	$T_{Batteries} > 45^{\circ} C (113^{\circ} F)$	$T_{Batteries} < 40^{\circ} C (104^{\circ} F)$
Equipment overtemperature	"OVERTEMPERATURE"	Y	Activated by a Thermostat installed in the panel	
Manual Bypass mode	"MANUAL BYPASS MODE"	Y	Press the Rectifier and Consumer keys simultaneously for three seconds	
Automatic Bypass mode	"AUTO BYPASS MODE"	Y	Activated by other alarms	
Input phase sequence fault	"PHASE SEQUENCE FAULT"	Y	Detected by an electronic circuit	
Negative earth leakage	"N EARTH LEAKAGE CURR"	Y		
Positive earth leakage	"P EARTH LEAKAGE CURR"	Y		
Ventilation 1 failure	"VENT 1 FAILURE"	Y	Detected by fan 1 feedback	
Ventilation 2 failure	"VENT 2 FAILURE"	Y	Detected by fan 2 feedback	
AC power supply circuit breaker closed	"INPUT C BREAKER ON"	N	Detected by the circuit breaker auxiliary contact	
AC power supply circuit breaker open	"INPUT C BREAKER OFF"	Y		
Bypass circuit breaker closed	"BYPASS C BREAKER ON"	Y		
Bypass circuit breaker open	"BYPASS C BREAKER OFF"	N		
Battery circuit breaker closed	"BAT CIRC BREAKER ON"	N		
Battery circuit breaker open	"BAT CIRC BREAKER OFF"	Y		
Consumer circuit breaker closed	"CONS. C BREAKER ON"	N		
Consumer circuit breaker open	"CONS. C BREAKER OFF"	Y		

**Note:**

(1) Factory default value; however, the user can change it via HMI.

(2) The 111 V value refers to the consumer undervoltage +1 V, and the 131 V value refers to the consumer overvoltage -1 V.

(3) Two attempts to return in 30 seconds. Then, only via manual Bypass.

## 5 SUPERVISORY SYSTEM

It is a redundant protection system that monitors the battery and consumer voltages, ensuring the correct voltage on the loads connected to the Digital Rectifier.

### Operation

When an event that compromises the specified output voltage is generated, the system activates the Bypass and connects the rectifier/battery to the consumer output.

The Supervisory System is composed of two protection levels; the first by means of the control firmware itself, and the second via dedicated circuit, ensuring even more robustness to the Digital Rectifier.

**1<sup>st</sup> Level - Protection via microcontroller:** the firmware activates the Bypass according to the events shown in [Table 5.1 on page 5-1](#) - Bypass Conditions. After the issue that activated the bypass is solved, the equipment returns to the normal operating mode at the end of the return time countdown.

**Note:** In case the batteries discharge, they will go into the recharging mode.

**2<sup>nd</sup> Level - Protection via dedicated circuit:** likewise, the circuit monitors the battery and consumer voltages, with the protections actuating when necessary.

*Table 5.1: Bypass conditions*

Level	Event	Time for Actuation	Return Time
1 <sup>st</sup>	Loss of AC power supply	10 s <sup>(2)</sup>	10 s
	Output overcurrent	< 25 %	30 s
		> 25 %	Immediate
	Output overvoltage	5 s	Immediate
	Overtemperature	5 s	5 s
2 <sup>nd</sup>	Fault in the output	< 110 V	10 s <sup>(1)</sup>
		< 105 V	Follow the instructions: operation to return from protection by 2 <sup>nd</sup> level

(1) Two attempts to return in 30 seconds. Then, only via manual Bypass.

(2) The BYPASS actuates in case of an AC power supply outage after ten seconds when the battery bank voltage is low.

*Table 5.2: Output voltages in Bypass mode*

Protection	Minimum Voltage	Maximum Voltage
1 <sup>st</sup> Level – Microcontroller	> 105 V	< 128 V
2 <sup>nd</sup> Level – Dedicated circuit	> 80 V	

**Minimum voltage:** below this value, the equipment will shut down to ensure the integrity of the batteries.

**Maximum voltage:** in case the equipment is in overload, this voltage value will be proportionally equal to the battery voltage.



## Indications and working voltages of the dedicated circuit

The dedicated circuit works with different voltage levels on the battery and on the consumer, indicating the operating conditions via two LEDs and dry contacts, as follows.

Once the board is energized and the battery voltage is above 80 V, the circuit goes into operation, indicating via dry contact. Only after the battery and consumer voltage exceeds the value of 110 V will the circuit be enabled and start supervising the output voltage, with minimum limit of 105 V to activate the Bypass.

*Table 5.3: Reference voltages – dedicated circuit*

Reference	Voltage	Condition
$V_{\text{battery}}$	< 80 V	Disabled
	> 110 V	Enabled SUPERVISING
$V_{\text{consumer}}$	< 105 V	BYPASS ACTIVATED

*Table 5.4: LED indicators and dry contacts – dedicated circuit*

Indication	De-energized	Not Enabled	Supervised	Bypass Activated
<b>LED - Green</b>	Off		On	On
<b>LED - Red</b>			Off	
<b>Dry Contact BYPASS ACTIVATED</b>	Common + NC			Common + NO
<b>Dry Contact ON</b>	Common + NC	Common + NO		

## Operation to RETURN from the protection by 2<sup>nd</sup> level – Dedicated circuit

This instruction informs the correct way to return to the normal operating mode after a possible activation of the supervisory system via dedicated circuit:

1. Open the AC POWER SUPPLY circuit breaker (DJR).
2. Close the MANUAL Bypass circuit breaker (DJBP).
3. Open the BATTERY circuit breaker (DJB) and the CONSUMER circuit breaker (DJC).
4. Disconnect the power supply of the Supervisory Board (CN2).
5. Execute the necessary repair or inspection.
6. CONNECT the power supply of the Supervisory Board (CN2).
7. CLOSE the AC POWER SUPPLY circuit breaker (DJR).
8. Set the clock or wait for thirty seconds.
9. Navigate through the display menus to set the configurations if necessary.
10. PRESS the RECTIFIER button for two seconds.
11. Check the battery voltage; it must be equal to the setting of the float parameter.
12. CLOSE the BATTERY circuit breaker (DJB), and check the battery charging.
13. PRESS the CONSUMER button for two seconds.
14. Check the Consumer voltage; it must be equal to the setting of the reference parameter.
15. CLOSE the CONSUMER circuit breaker (DJC), and check if the voltage is equal to the battery voltage.
16. PRESS the equipment Bypass Reset pushbutton.
17. Open the BYPASS circuit breaker (DJBP).

## 6 PREVENTIVE MAINTENANCE

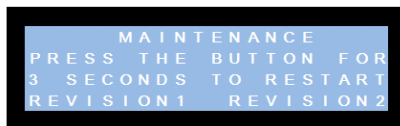
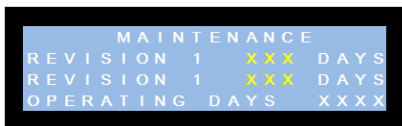
We recommend the periodical preventive maintenance so as to increase the operation reliability of the system and the useful life of components and integrated circuits.

Navigate on the “ROOT” menu up to the “MAINTENANCE” menu. On the “MAINTENANCE” menu, you can check:

- Remaining time to the next Revision I.
- Remaining time to the next Revision II.
- Accumulated operation time of the equipment.

After finishing the revision, the user may reset the timers on the “Maintenance” submenu.

### Submenu



#### Revision I - Every 365 days (one year)

Keep the screen openings clean in order to enable the air inflow and outflow so as to keep the equipment cooled, thus preventing the internal temperature from rising and ensuring proper operation.

Keep the electronic boards always clean in order to avoid short circuits. Check the mechanical connections whenever possible, or at least once a year.

#### Revision II - Every 730 days (two years)

Keep the screen openings clean in order to enable the air inflow and outflow so as to keep the equipment cooled, thus preventing the internal temperature from rising and ensuring proper operation.

Keep the electronic boards always clean in order to avoid short circuits. Check the mechanical connections whenever possible, or at least once a year.

- Check or replace the internal fans.
- Check the batteries and replace them if necessary.



#### ATTENTION!

Before beginning the maintenance jobs, check if voltage is not present on the terminals.

## 6.1 PROCEDURE TO ENTER THE MAINTENANCE MODE (MANUAL BYPASS)



### ATTENTION!

During this operation, the consumer will be supplied by the batteries; therefore, check the battery conditions.

1. Open the AC POWER SUPPLY circuit breaker (DJR).
2. Close the MANUAL Bypass circuit breaker (DJBP).
3. Open the BATTERY circuit breaker (DJB) and the CONSUMER circuit breaker (DJC).
4. Disconnect the power supply of the Supervisory Board (CN2).

## 6.2 PROCEDURE TO EXIT THE MAINTENANCE MODE (MANUAL BYPASS)



### ATTENTION!

Check the connections and fastening of the replaced components.

1. CONNECT the power supply of the Supervisory Board (CN2).
2. CLOSE the AC POWER SUPPLY circuit breaker (DJR).
3. Set the clock or wait for thirty seconds.
4. Navigate through the display menus to set the configurations if necessary.
5. PRESS the RECTIFIER button for two seconds.
6. Check the battery voltage; it must be equal to the setting of the float parameter.
7. CLOSE the BATTERY circuit breaker (DJB), and check the battery charging.
8. PRESS the CONSUMER button for two seconds.
9. Check the Consumer voltage; it must be equal to the setting of the reference parameter.
10. CLOSE the CONSUMER circuit breaker (DJC), and check if the voltage equal to the battery voltage.
11. OPEN the Bypass circuit breaker (DJBP).

## 6.3 RESET TO THE FACTORY SETTINGS

The Digital Rectifier has a function which resets all the configuration values to their factory settings. In order to access it, follow the steps below:

- Navigate on the “ROOT” menu up to the “MAINTENANCE” menu.
- On the “MAINTENANCE” menu, press the “ENTER” key for three seconds so as to access the submenu (1<sup>st</sup> level) with the options to reset the maintenance dates.
- Press the “ENTER” key again for 10 seconds in the submenu (1<sup>st</sup> level) to access the reset menu (2<sup>nd</sup> level).
- Press “ENTER” to access the confirmation screen.
- Press “UP” for three seconds in order to reset all the parameters or wait for 30 seconds to return to the root menu.

## **6.4 REVISION TIME RESET**

- Navigate on the “ROOT” menu up to the “MAINTENANCE” menu.
- On the “MAINTENANCE” menu, press the “ENTER” key for three seconds.
- Press the “up” key for three seconds to reset revision1 or “down” to reset revision2.
- In order to exit, hold “ENTER” pressed for three seconds.



## 7 COMMUNICATION

### 7.1 MODBUS-RTU COMMUNICATION

The Digital Rectifier with Modbus-RTU communication has two different physical interfaces: USB and RS485. Both physical interfaces share the same communication port and, therefore, only one of them can be active. The selection of the interface is done by means of a sliding switch located on the equipment door, and it can be accessed through the side opening on the control module protection, next to the USB connector.

The USB interface is located inside the equipment door and has a USB type B standard connector. This interface enables local communication with the equipment.

The RS485 interface can be accessed on the dry contact terminal block, and it has a SAK connector. This interface allows the creation of a network with more devices compatible with the Modbus-RTU.

#### 7.1.1 Installation of the Modbus-RTU Network

For the connection of the Digital Rectifier using the Modbus-RTU interface, the following points must be observed:

### COMMUNICATION PARAMETERS

The Modbus-RTU communication of the Digital Rectifier operates with rates of 9600 bps or 19200 bps, with 8 data bits, adjustable parity (even, odd or none) and 1 or 2 stop bits, with minimum time between frames of 50 ms, configurable via the equipment HMI. In case the stop bit is set to 2, the Parity will be disabled.

#### Configuration of the communication parameters

- Navigate on the “ROOT” menu up to the “COMMUNICATION” menu.
- On the “COMMUNICATION” menu, press the “ENTER” key for three seconds in order to access the submenu (1<sup>st</sup> level) with the communication settings.
- If the communication parameters are OK, exit the submenu by pressing “ENTER” on all parameters without changing them.
- Within the configuration menu (1<sup>st</sup> level), choose the parameter to be changed by pressing the “ENTER” key in order to see the options.
- In order to change the chosen parameter, press the arrows to increase or decrease the values.

### ADDRESS

Every device on the Modbus-RTU network, whether master or slave, is identified by means of an address. This address must be different for each device. Valid values: 1 to 247. This address can be modified on the equipment panel, on the communication submenu.

**NOTE!**

The address effectively changes when you return and exit the communication submenu.

## TERMINATION RESISTORS

For each segment of the Modbus-RTU network using RS485, it is necessary to enable a termination resistor at the ends of the main bus. It is worth to mention that, in order to allow the disconnection of the element from the network without damaging the bus, it is interesting to put active terminations, which are elements that only play the role of the termination. Thus, any device in the supply (network) can be disconnected from the bus without damaging the termination.

The Digital Rectifier has termination resistors that can be turned on and off via the dip switch located next to the sliding switch for physical interface selection.

## USB COMMUNICATION DRIVE

For the computer to recognize the Digital Rectifier when connected to the USB port, it is necessary to install the "Device Driver". This "Device Driver" is available for Windows, Linux and Mac OS operating systems in the 32 and 64-bit versions.

Once the "Device Driver" is installed, the connected Digital Rectifier will be recognized as a Virtual "Com" port, over which the Modbus-RTU protocol will flow.

### 7.1.2 Modbus-RTU Protocol

The Modbus protocol was initially developed in 1979. Currently, it is an open protocol widely used by several manufacturers in different kinds of equipment. The Modbus-RTU communication of the Rectifier was developed based on the following documents:

- MODBUS Application Protocol Specification.
- MODBUS over Serial Line.

Those documents define the formats of messages used by the elements that are part of the Modbus network, the services (or functions) that can be provided via network, and how those elements exchange data on the network. Those documents are available on: [www.modbus.org](http://www.modbus.org).

### Available Functions

For the Digital Rectifier, all the parameters were organized as Input Registers. Those registers may be read by the Read Input Registers function (code 04). In order to keep compatibility with legacy systems, those registers may be accessed as Holding Registers, via Read Holding Registers function (code 03). The writing of parameters may be done via the Write Single Register function (code 06).

The Digital Rectifier also supports the Read Device Identification function (code 43). This function allows the reading of three strings, which represent the manufacturer's name, the product name and product software version.

## Digital Rectifier Parameter Setting

The [Table 7.1 on page 7-3](#) contains the parameters available on the Digital Rectifier. The "Access" column indicates if the parameter is reading/writing (RW), read only (R), write only (W).

Parameter format: 16 bits unsigned integer.

**Table 7.1: Parameters of the digital rectifier**

Address	Access	Name	Value
<b>Operating Parameters</b>			
10	R	Operating Mode	Indicates the current operating mode of the equipment: 0 - OFF Mode 1 - Normal Mode 2 - Battery Mode 3 - Charger Mode 4 - Manual Bypass Mode 5 - Automatic Bypass Mode 6 - Low Battery Bypass Mode 7 - Overtemperature Bypass Mode 8 - Output Overload Bypass Mode
11	R/W	Rectifier State	Indicates the current Rectifier state: 0 - OFF 1 - On 2 - Inhibited The Inhibited State only appears on the reading and indicates that, in spite of being ON, the Rectifier is inhibited by the presence of some alarm.
12	R/W	Consumer Status	Indicates the current state of the Consumer: 0 - OFF 1 - On 2 - Inhibited The Inhibited State only appears on the reading and indicates that, in spite of being ON, the Consumer is inhibited by the presence of some alarm.
20	R	Alarms	In this variable, each bit of the word represents an alarm. Value 1 on the bit represents alarm present and value 0 indicates alarm not present. Bit 0 - High AC voltage Bit 1 - Low AC voltage Bit 2 - Phase sequence fault Bit 3 - High battery voltage Bit 4 - Low battery voltage Bit 5 - High consumer voltage Bit 6 - Low consumer Voltage Bit 7 - Consumer current limitation Bit 8 - Overtemperature Bit 9 - Output overload Bit 10 - Reserved (always 0) Bit 11 - Negative Earth Leakage Bit 12 - Positive Earth Leakage Bit 13 - Manual Bypass Active Bit 14 - Automatic Bypass Active Bit 15 - Reserved (always 0)



AC Input			
100	R	R Phase Voltage	RMS AC Voltage in V
101		S Phase Voltage	RMS AC Voltage in V
102		T Phase Voltage	RMS AC Voltage in V
103		R Phase Current	RMS AC Current in 0.1 A
104		S Phase Current	RMS AC Current in 0.1 A
105		T Phase Current	RMS AC Current in 0.1 A
106		AC Power Supply Frequency	Frequency in Hz
Batteries			
200	R	Battery Voltage	DC voltage in 0.1 V
201		Battery Current	DC Current in 0.1 A
202		Battery Charge	Battery Charge Percentage (%)
203		Battery Temperature	Temperature in °C
Consumer			
300	R	Consumer Voltage	DC voltage in 0.1 V
301		Consumer Current	DC Current in 0.1 A
302		Consumer Load	Consumer load percentage (%)
Time and Date			
400	R/W	Day	Value of the day (1 to 31)
401		Month	Value of the month (1 to 12)
402		Year	Value of the year (0 to 9999)
403		Hour	Value of the hour (1 to 23)
404		Minute	Value of the minute (1 to 59)
Event Log			
1000	W	Index of the event to be Read	The value recorded in this register represents the index of the event to be read. The last registered event receives the index 0, the penultimate registered event receives the index 1, and so on. In case the requested index is greater than the number of registered events, the last registered event will be read. After that registration is written, the data of the requested event can be read in registrations 1001 to 1007.
1001	R	Day of the Event	Day of the Requested Event
1002	R	Month of the Event	Month of the Requested Event
1003	R	Year of the Event	Year of the Requested Event
1004	R	Hour of the Event	Hour of the Requested Event
1005	R	Minute of the Event	Minute of the Requested Event
1006	R	Event Identifier	Number that identifies the event See <a href="#">Table 3.1 on page 3-8</a>
1007	R	Index of the Current Event	It can be compared to the requested index.

## 8 TECHNICAL DATA

### AC Input

<b>Power Supply</b>	220 / 380 / 440 V AC +/- 10 % <sup>(1)</sup> (other on request)
<b>Frequency</b>	60 Hz or 50 Hz +/- 5 %
<b>Power Supply System</b>	Three-phase
<b>Power Factor</b>	> 0.85 (Default) or > 0.92 (Optional)
<b>Protection/Disconnection</b>	Circuit breaker

(1) Rectifier in float.

### Rectifier output

<b>Voltage in Float</b>	136 V (2.27 V / element)
<b>Thermal Compensation</b>	0.4 V / 1 °C (1.8 °F), above and below 25 °C (77 °F)
<b>Ripple</b>	≤ 2 % without battery and ≤ 1 % with battery
<b>Dynamic Regulation <sup>(1)</sup></b>	< 100 ms @ ±30 % overshoot with load step from 0 % to 100 % In
<b>Voltage when Recharging</b>	144 V (2.4 V / element)
<b>Voltage when Discharging</b>	120 V (2 V / element)
<b>Minimum Voltage</b>	105 V (1.75 V / element)
<b>Battery Charge</b>	0.1 x C10 (Ah/10h)

(1) Without battery.

### Consumer output <sup>(1)</sup>

<b>Rated Voltage</b>	125 V
<b>Rated Current</b>	15 A to 500 A
<b>Output Current Limit</b>	Adjustable between 50 % to 100 % of In
<b>Static Regulation</b>	≤ ±1 % for variations from 10 % to 105 % In
<b>Dynamic Regulation</b>	±10 % overshoot for load step from 10 % to 100 % In
<b>Ripple</b>	< 1 % (without battery)
<b>Efficiency</b>	> 85 %
<b>Insulation</b>	> 5 Mega Ohms

(1) For standard equipment with UCQ.

Frame

<b>Model (A)</b>	15	25	35	50	75	100	125	150	200	300	400	500		
<b>Weight (kg)</b>	250	300	310	340	390	460	500	545	600	800	1000	1450		
<b>Dimensions - H x W x D (mm)</b>	1718 x 600 x 450			2208 x 600 x 650			2254 x 800 x 650			2254 x 1000 x 650			2254 x 1600 x 650	
<b>Dissipation (W)</b>	600	900	850	1000	1500	1900	2000	2500	2700	3750	5000	6250		

**Operating conditions**

<b>Operating Duty</b>	Continuous
<b>Temperature Range</b>	0 °C to 40 °C (32 °F to 104 °F)
<b>Relative humidity</b>	0 to 95% non-condensing
<b>Altitude</b>	Up to 1000 m above sea level
<b>Ventilation</b>	Forced with fan
<b>Noise Level</b>	> 60 dB

**Protections**

<b>Circuit breaker</b>	Power supply, batteries, consumer and manual bypass (maintenance)
<b>Current Limitations</b>	Charge/discharge of the battery and consumer <sup>(1)</sup>
<b>Filters</b>	Against AC surges

(1) Below 110 V, the bypass is activated, remaining only the limitations of the battery and circuit breaker.

**Remote interface**

<b>Default</b>	USB communication with Modbus-RTU protocol
	RS485 interface with Modbus-RTU protocol
	NO and NC dry contacts with capacity of 2 A at 250 Vac

