

SPS 10-80KVA

Sirio Power Supply



User manual




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Thank you for choosing our product.

RPS S.p.A., is highly specialized in the development and production of Power Electronics Devices (UPS, Solar Inverter). The SPSs of this series are high quality products, carefully designed and manufactured to ensure optimum performance.

Symbols used in the manual

In this manual, some operations are shown by graphic symbols to alert the reader to the dangerous nature of the operations:

	<i>Possibility of serious injury or substantial damage to the device, unless adequate precautionary countermeasures are taken.</i>
	<i>This symbol indicates some important information which must be read with care.</i>
	<i>It is recommended to read this part of the manual.</i>








Protective equipment to be worn

No maintenance operations must be carried out on the device without wearing the Personal Protective Equipment (PPE) described below.

Personnel involved in the installation or maintenance of the equipment must not wear clothes with wide sleeves or laces, belts, bracelets or other items that may be dangerous, especially if they are metallic. Long hair must be tied in such a way as to ensure that it is not a hazard.

The following signs show the protective equipment that should be worn. The various items of PPE must be selected and sized according to the nature of the hazard (particularly electrical) posed by the equipment.

	Accident prevention footwear Use: always		Protective eyewear Use: always
	Protective clothing Use: always		Helmet Use: When there are suspended loads
	Work gloves Use: always		



Definition of “operator” and “specialized technician”

The professional figure responsible for accessing the equipment for ordinary maintenance purposes is defined with the term **operator**.

This definition covers personnel that know the operating and maintenance procedures for the equipment, and that have been:

1. trained to operate in accordance with the safety standards relating to the dangers that may arise where electrical voltage is present;
2. trained to use Personal Protective Equipment and to carry out basic first aid.

The professional figure responsible for the installation and start-up of the equipment, and for any extraordinary maintenance, is defined with the term **specialized technician**.

This definition covers personnel that, in addition to the requirements listed above for a general operator, must also:

1. have been suitably trained by the manufacturers or their representative.
2. be aware of installation, assembly, repair and service procedures, and have a specific technical qualification.
3. must have a background of technical training, or specific training relating to the procedures for the safe use and maintenance of the equipment.



Emergency interventions

The following information is of a general nature.

First aid interventions

Company regulations and traditional procedures should be followed for any first aid intervention that may be required.



Firefighting measures

1. Do not use water to put out a fire, but only fire extinguishers that are suitable for use with electrical and electronic equipment.
2. If exposed to heat or fire, some products may release toxic fumes into the atmosphere. Always use a respirator when extinguishing a fire.

GENERAL PRECAUTIONS



This manual contains detailed instructions for the use, installation and start-up of the SPS. Read the manual carefully before installation. For information on using the SPS, the manual should be kept close at hand and consulted before carrying out any operation on the device.

This device has been designed and manufactured in accordance with the standards for the product, for normal use and for all uses that may reasonably be expected. It may under no circumstances be used for any purposes other than those envisaged, or in any other ways than those described in this manual. Any interventions should be carried out in accordance with the criteria and the time-frames described in this manual.

PRECAUTIONS AND SAFETY REGULATIONS



Refer to the “**Safety and Compliance Manual**” supplied with the SPS (OMNA141_NE).

ENVIRONMENTAL PROTECTION



In the development of its products, the company devotes abundant resources to analysing the environmental aspects.

All our products pursue the objectives defined in the environmental management system developed by the company in compliance with applicable standards.

No hazardous materials such as CFCs, HCFCs or asbestos are used in this product.

When evaluating packaging, the choice of material has been made favouring recyclable materials.

For correct disposal, please separate and identify the type of material of which the packaging is made in the table below. Dispose of all material in compliance with applicable standards in the country in which the product is used.

DESCRIPTION	MATERIAL
Box	Cardboard
Protective bag	Polythene
Accessories bag	Polythene

DISPOSING OF THE PRODUCT

The SPS contain electronic cards and batteries which are considered TOXIC and HAZARDOUS waste. When the product reaches the end of its operating life, dispose of it in accordance with applicable local legislation.

Disposing of the product correctly contributes to respecting the environment and personal health.

No reproduction of any part of this manual, even partial, is permitted without the manufacturer. authorization. The RPS reserves the right to modify the product described herein, in order to improve it, at any time and without notice.

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1. Preliminary operations

1.1 Removing the packaging and positioning the device

On delivery, the packaging must be inspected to ensure that it is whole and that it has not been crushed or dented. Check in particular that neither of the two impact resistant devices on the packaging is red; if one of them is red, follow the instructions on the packaging.

The essential details of the device are provided on the shipping document. The marking, weight and dimensions of the various items making up the packing list are shown.

Check the state of the device by means of a visual inspection of both the inside and the outside. Any dents seen mean that it has suffered knocks during shipping, which could compromise the normal operation of the device.

1.2 Storage

In the following situations:

- installation not immediately after delivery;
- de-installation and storage while awaiting relocation,

place the device in covered premises that are protected from direct contact with atmospheric agents and dust. The following environmental values are those allowed in the storage area:

Temperature:	-25 ÷ + 70 °C
Relative humidity:	30÷90 % max.

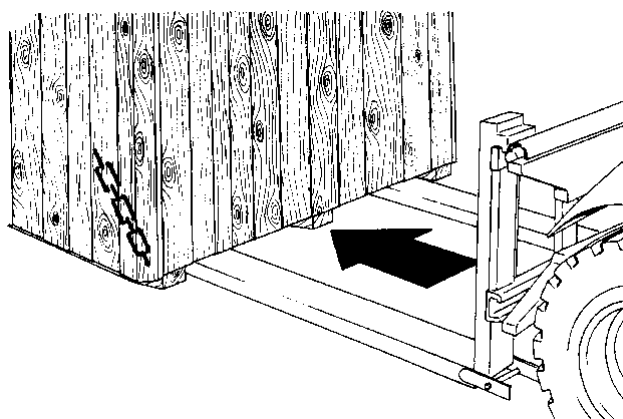


For the installation of a battery cabinet, if provided with the uninterruptible power supply, follow the instructions given in the specific manual.


The list of material provided may vary depending on the order specifications. As a general rule, the packaging should include the following: this manual, the installation drawing, the warranty and eventual accessories.

1.3 Handling

The equipment must only be handled by adequately trained personnel. It can be unloaded from the vehicle and put into place by lifting the box or the wooden deck to which the equipment is secured with a fork-lift truck. A transpallet or fork-lift truck should be used for the permanent positioning of the equipment, in accordance with the instructions provided below.



- 1 Insert the forks of the fork-lift truck in the lower part of the device, from the front or back, and ensure that they stick out about 30 cm on the other side.
If a transpallet is used, raise the device only as much as is strictly necessary.
- 2 Secure the device to the transpallet or fork-lift before moving it.

Risk of overturning	
	<p>In order to avoid the risk of the device overturning, ensure that it is firmly secured to the transpallet or fork-lift truck by means of appropriate ropes before moving it.</p>

When being moved the cabinet should be handled with care; knocks or drops can damage it. Once in position, remove the packaging carefully in order not to scratch the device.

The packaging should be removed as follows:

1. Cut the bands
2. Slide away the carton from above.
3. Remove the screws securing the cabinet to the wooden base.
4. If using a transpallet, remove the device from the pallet and set it on the floor, using the same precautions as set out in the section on Handling.

2. Installation environment

The SPS and the battery cabinet have been designed for indoor installation. The choice of premises for installation should comply with the points set out below.

2.1 Ambient conditions:

- ensure that the floor can support the weight of the SPS and of any battery cabinet that may be used;
- avoid dusty environments;
- avoid narrow environments that could hinder normal maintenance operations;
- avoid placing the device in areas exposed to direct sunlight or heat;
- ensure that the ambient temperature conforms to the following:

<i>minimum operating temperature:</i>	<i>0 °C</i>
<i>maximum temperature for 8 hours a day:</i>	<i>+ 40°C</i>
<i>average temperature for 24 hours:</i>	<i>+ 35°C</i>
- max relative humidity: 90 % without condensation
- Max installation height: 1000 m at rated power
(-1% power for every 100 m above 1000 m) max 4000 m

2.2 Dimensions of the premises

For the mechanical dimensions of the cabinets, refer to the **“INSTALLATION DRAWINGS”** supplied with the SPS and with the battery cabinet, if present. These drawings provide the following data:

- the position of the holes in the base to secure the device to the floor, if applicable;
- the view of the floor support for the sizing of a structure to raise the cabinet, if applicable;
- the position of cable entry;

- the position of the fans on the top of the SPS, for the positioning of a structure to convey the warm air discharged by the equipment outside the premises, if applicable;
- the input, output and battery cables section;
- the power dissipated by the equipment (kW).

2.3 Cooling of the premises

The recommended operating temperature for the lifetime of the SPS and of the batteries is between 20 and 25°C. The lifespan of the battery depends on the operating temperature; with an operating temperature of between 20°C and 30°C, the lifespan of the batteries is halved. A heat dissipation system is required to keep the temperature of the premises housing the equipment within the field 20÷25°C.

The heat dissipation needed for the correct operation of the SPS is brought about by the air current made by the fans located inside the SPS (forced convection) and by the air around the side panels (natural convection).

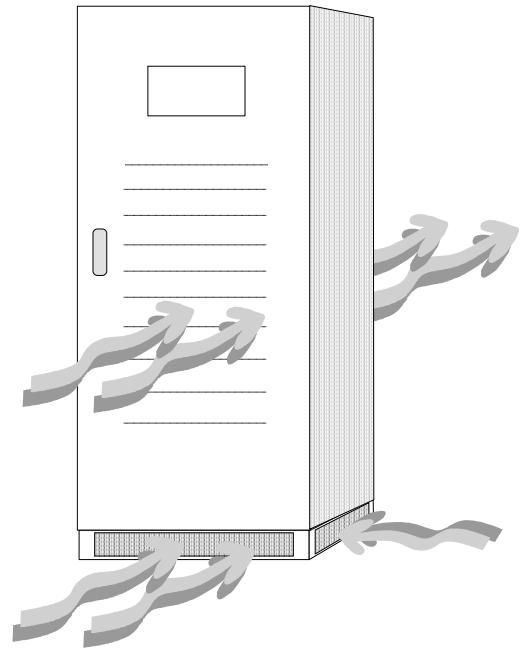
In order to ensure proper air circulation, and therefore the correct operation of the SPS, measures must be taken during installation to avoid any obstructions to the free circulation of air. These include the following:

- Leave a free space of at least 20 cm. must be left between the back of the SPS and the wall so as not to block the flow of air from the fans, and at least 40 cm. for maintenance operations on the fans.
- leave a free space of at least one metre at the front of the equipment to ensure both the circulation of the air and installation and maintenance operations;
- With natural convection the thermal load is dissipated to the outside through the walls; thus a cabinet placed against a wall or in a hollow dissipates less heat than one located in a free environment.

The following rule must be observed:

leave at least one of the three side walls free: right, left or back.

- the side strips must not be mounted for installations where cabinets are placed side by side.



2.4 Air change for battery premises

The premises housing the battery cabinet must have sufficient air circulation to ensure that the concentration of hydrogen issued during battery charging is kept below the danger limit.

The air change in the premises should preferably be provided by natural ventilation, otherwise by forced ventilation.

The standard EN 50272-2 for air change envisages that the minimum opening must satisfy the following equation:

$$A = 28 \times Q = 28 \times 0.05 \times n \times I_{\text{gas}} \times C10 (1/10^3) [\text{cm}^2]$$

where:

A = free opening for air intake and outlet

Q = flow of air to be removed [m³/h]

n = number of battery elements;

C10 = battery capacity over 10 hours [Ah]

I_{gas} = current that produces gas [mA/Ah]

in accordance with the standard: I_{gas} = 1 VRLA type battery (*)

(*) for open vase or nickel batteries, contact the battery manufacturer.

When the equation is applied for 240 element (40 battery) hermetically-sealed lead batteries:

$$A = 336 \times C10 / 10^3 [\text{cm}^2]$$

When using 120Ah batteries, the minimum aperture should be approximately:

$$A = 41 \text{ [cm}^2\text{]}$$



The air intake and outlet must be positioned to ensure the best possible circulation; for example:

- apertures on opposite walls,
- a minimum distance of 2 m when they are on the same wall.

3. USE the SPS



The operations described in this chapter must be carried out exclusively by a **specialized technician**.

Sirio Power Supply (SPS) is a state of the art device that makes it possible to broaden the functions of an on-grid PV system equipped with AROS Solar Technology inverter and to create an off-grid system. Thanks to energy storage, sized according to the features of the load and the battery life, this system allows energy produced by renewable sources to be stored and used during the evening or in poor sunlight conditions. All this makes the system independent from the grid. This is the ideal solution that allows you to manage consumption of the energy produced by your PV system. The battery is charged through PV inverter or by the grid/generator set.

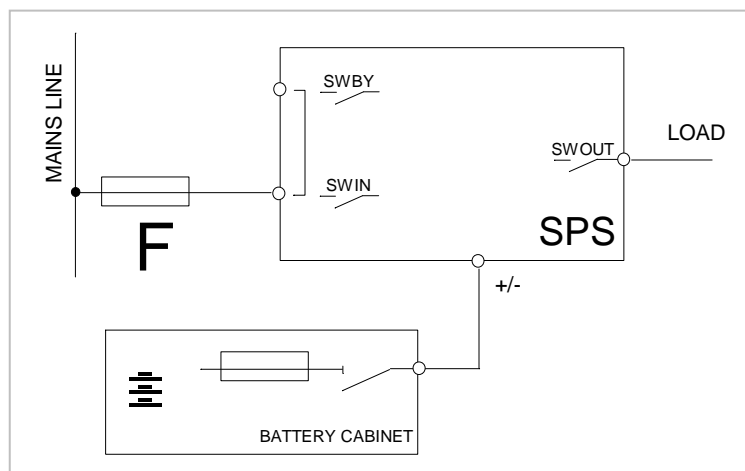
3.1 Set-up of the electrical system

3.1.1 ac Input

The SPS input must have a max. current protection device. The protection device should be sized according to the situation, as follows:

a) Single power line (F input line protection)

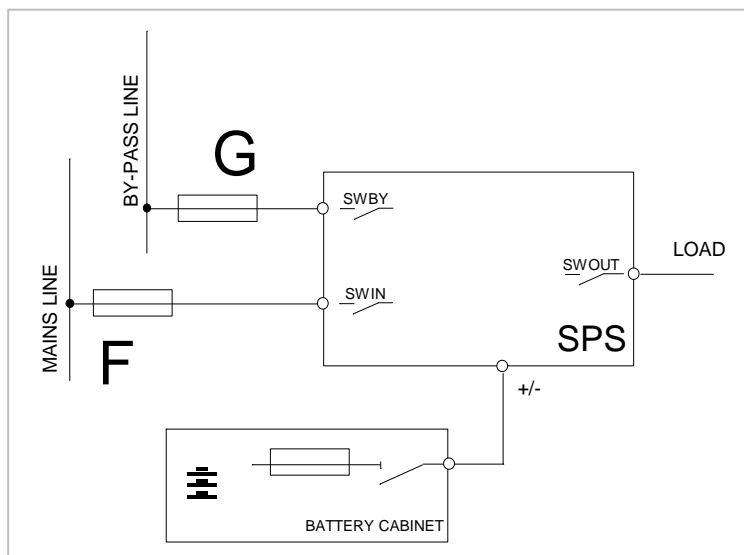
The SPS input must have a max. current protection device for the section of line coming from the distribution panel. The fuse represented with the letter F.



	10	15	20	30	40	60	80
input line							
I _{max} (100% load, and battery recharging)	22	34	45	65	87	131	175
External [F] fuse type gG (*)	32	40	63	80	100	160	200

b) main power supply and by-pass separate (Fmains and G by-pass input line protection)

When there are two separate power lines, the main power line and the by-pass line, two protection devices must be provided (indicated with the letters **F** and **G** in the drawing), one for each line.



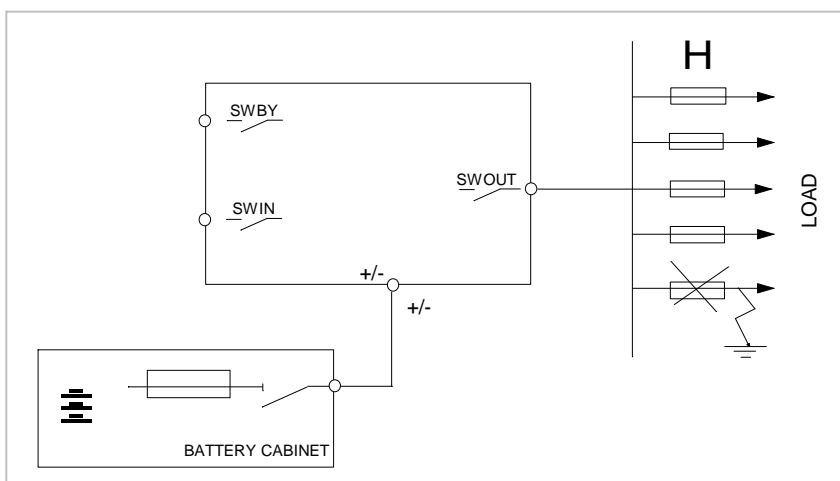
	10	15	20	30	40	60	80
mains line							
I _{max} (100% load, and battery recharging)	22	34	45	65	87	131	175
External [F] fuse type gG (*) [A]	32	40	63	80	100	160	200
By-pass line							
Current	14,5	22	29	43	59	87	116
External [G] fuse type gG (*) [A]	20	25	32	50	80	100	125

(*) or equivalent circuit breakers

3.1.2 Selectivity

The system where the SPS is inserted must be set up in such a way that in the event of a shortcircuit on one of the lines downstream of the SPS, the fuse on the output opens while the upstream fuse normally works. This is known as selectivity, and ensures that the remaining feeders maintain the power supply.

In order to select the correct protection devices to be inserted downstream of the SPS, the following two operating modes have to be taken into consideration: **mains power supply** and **battery power supply**.



With **mains power supply** the output fuse must be selective with the input fuse; the condition is verified for the following values:

kVA	10	15	20	30	40	60	80
rated output current: [A]	14,5	22	29	43	59	87	116
type gG fuse used at the bypass input (as shown in the <i>table of connections</i>) [A]	20	25	32	50	80	100	125
maximum fuse at the UPS output for selectivity:							
fuse size for type gG fuse [A]	10	16	20	32	50	63	80
fuse size for type aM fuse [A]	6	8	10	16	25	36	40

At least two feeders are necessary in order to use the SPS at rated load with fuses of type gG.

With **battery power supply** (first fault) in the event of a shortcircuit on one of the outputs (second fault) it must be possible for the fuse to be open before the inverter shuts down.

If the shortcircuit is of the three-phase type, the inverter can supply a current for 1 second that is 1.8 times the value of the rated current of the SPS output (with a single phase shortcircuit the current is around 3 times the value).

In the worst-case scenario, that is a three-phase shortcircuit then a smaller current, the condition occurs if:

	kVA	10	15	20	30	40	60	80
rated output current:	[A]	14,5	22	29	43	59	87	116
shortcircuit current (three-phase)		1.8 times the rated output current for 1 second						
maximum fuse at the SPS output for selectivity:								
fuse size for type gG fuse	[A]	6	10	12	16	20	25	32
fuse size for type aM fuse	[A]	2	4	4	6	10	12	20

At least three or four feeders are necessary in order to use the SPS at rated load with fuses of type gG.

To sum up, when there is a shortcircuit on the output, there are two alternatives if only the line affected by the shortcircuit is to be isolated; let us consider the example of the 20kVA:



selectivity with both mains power supply and battery power supply:

the load has to be shared between at least three feeders, each sized at 33% of the rated power.



selectivity, with mains power supply only:

since it is considered unlikely that after a first fault a second fault will occur in the limited time of operation from the battery, it is sufficient to share the output between two lines, each sized for 50% of the rated power.

3.1.3 Battery



Battery cabinet

For connection to the SPS, the battery cabinet must have an overcurrent protection device and a disconnecting device.

The function of the fuses is to protect the batteries and the cables from a shortcircuit between the battery cabinet and the SPS. The following rules should be observed for their sizing:

- ***if rapid fuses of the type gI / gG are installed:*** the maximum size of fuse to be used is 2 times the battery capacity in Ah.

- **If ultra rapid fuses of the type aR are installed:** the maximum size of fuse to be used is 2.5 times the battery capacity in Ah.

For example: the following fuses may be used for batteries of the type 65Ah: 125A type gI/gG or 180A type aR.

For the section of the cable for the SPS to battery connection refer to the following current value:

[kVA]	10	15	20	30	40	60	80
battery							
Permanent battery eq. Current [A]	25	38	50	80	109	168	225


3.1.4 Differential (RCD)

If the SPS protection against electric shock uses differential current devices (RCD), these have to have the following characteristics:

- Sensitivity 300mA
- sensitive direct current and unidirectional components (class B)
- insensitive to transient current pulses
- delay greater than or equal to 0.1 s.

In the standard version (SWBY close), without an input separation transformer, the neutral originating from the mains is connected to the SPS output neutral. The system neutral point treatment is not modified:

THE INPUT NEUTRAL IS CONNECTED TO THE OUTPUT NEUTRAL
THE DISTRIBUTION SYSTEM WHICH POWERS THE SPS IS NOT MODIFIED BY THE SPS

neutral	
	<i>The neutral point treatment is only modified if a barrier is present or when the SPS operates with the neutral isolated upstream (SWBY open)</i>

When operating in the presence of mains supply, a differential breaker (RCD) installed on the input will intervene as the output circuit is not isolated (with SWBY close) from the input circuit.

When operating without mains supply (from battery with SWBY) the input differential breaker will intervene only if it is able to switch as a result of leakage current without any voltage at its poles (for example a differential breaker with an auxiliary relay is not suitable). However it is possible to install additional differential breakers on the output of the SPS, possibly coordinated with those on the input, after the PV inverter connection.

3.1.5 Backfeed protection

The SPS is provided with a device to prevent voltage backfeed on the input line due to an internal fault. This protection device works by switching off the inverter if the current flow is faulty, thereby causing voltage backfeed on the by-pass line during operation from the inverter. If the fault occurs when the SPS is operating from the battery, the load will not be powered.

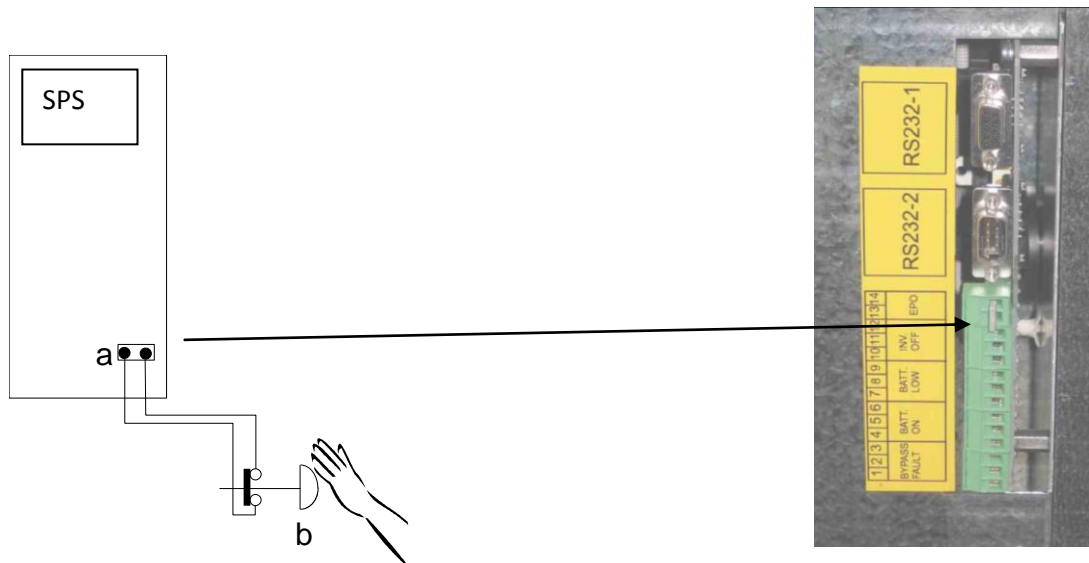
Should it be required to avoid the shutting down of the inverter in order to keep the load powered by the inverter even in the event of a double fault, the system can be customized to control the opening coil of a switch located upstream by reprogramming one of the relays on the "REMOTE COMMANDS AND ALARMS" card.

The control logic allows the function of the relay to be reconfigured, for example for the backfeed alarm, and then the free voltage contact can be used to control the triggering of a switch located on the SPS input.

3.1.6 Emergency power off device (EPO)

The SPS is pre-set to be connected to a remote emergency power off device as laid down in standard EN 62040-1-2. If the remote device (not supplied with the equipment) is activated, the inverter output voltage is cut.

The connection procedure is shown below.



- a - EPO terminal board located on the SPS
- b - EPO switch (not provided).

On the SPS , the jumper on the EPO terminals must be removed, and the wires from the auxiliary contact of the button must be connected in place of the jumper.

The contact must be closed with the button in the rest position and must open when the button is pressed.

3.2 Mains, load and battery connections



The operations described in this chapter must be carried out exclusively by a **specialized technician**. The first connection to be made is the earth conductor.
THE SPS MUST NOT OPERATE WITHOUT AN EARTH CONNECTION

Before making the connection, open all the switches on the device and ensure that the SPS is completely isolated from the power sources: battery and AC power line. More specifically, check that:

- the SPS input line or lines are completely isolated;
- the battery cabinet disconnecter / fuse (if present) is open;
- the solar inverter is switched off
- all the SPS disconnectors - SWIN, SWBY, SWOUT and SWMB - are in the open position;
- check with a multimeter that there are no dangerous voltages on the terminal board.

For connection of the power cables to the terminal boards, refer to the "INSTALLATION DRAWINGS" provided with the SPS and with the battery cabinet.

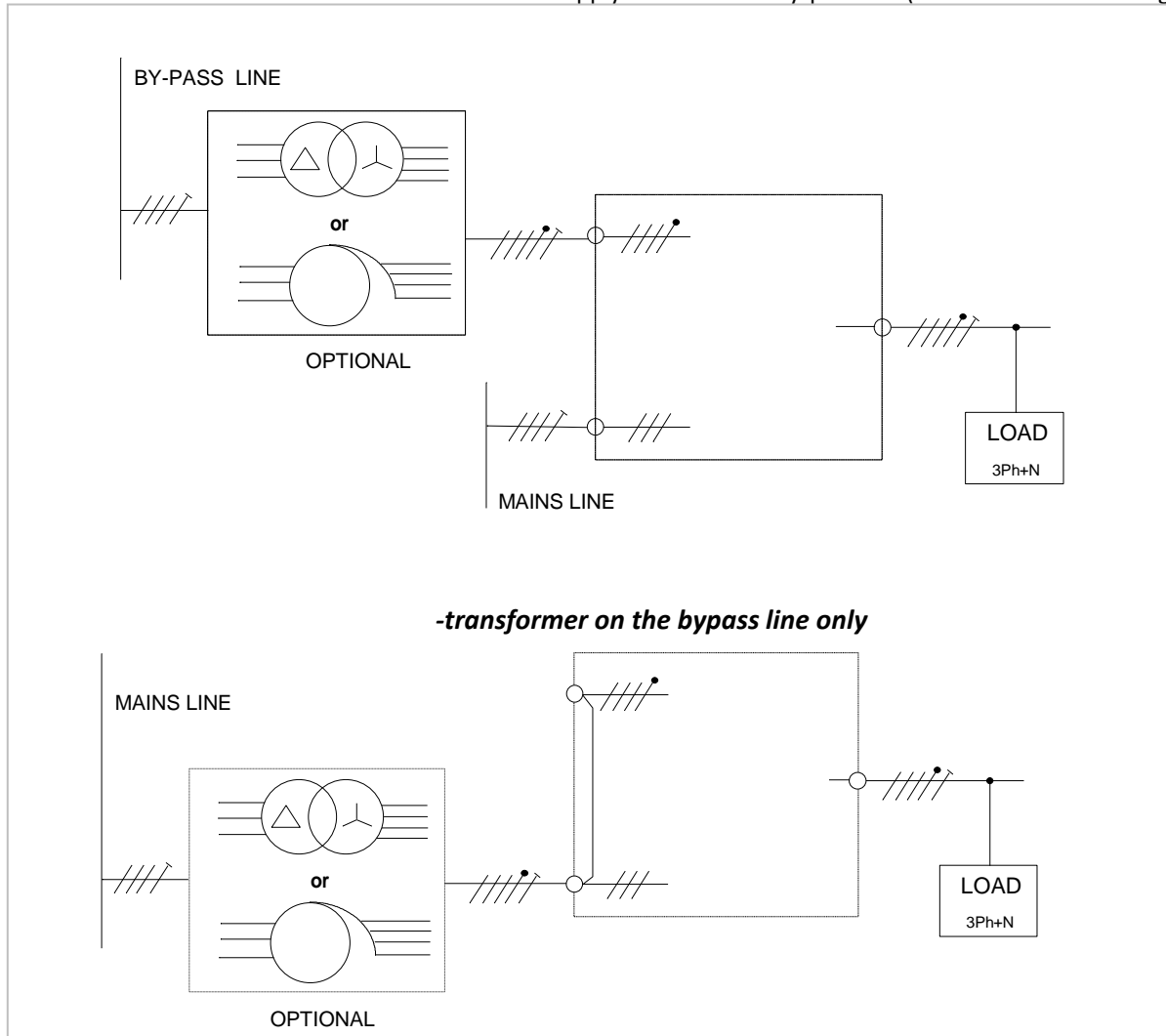
Input neutral



The power supply to the SPS input (by-pass line) must be three-phase with neutral.
The neutral conductor is necessary only on by-pass line.

Input line without neutral.

The transformer must be inserted either on the mains supply line or on the by-pass line (as shown in the drawings).

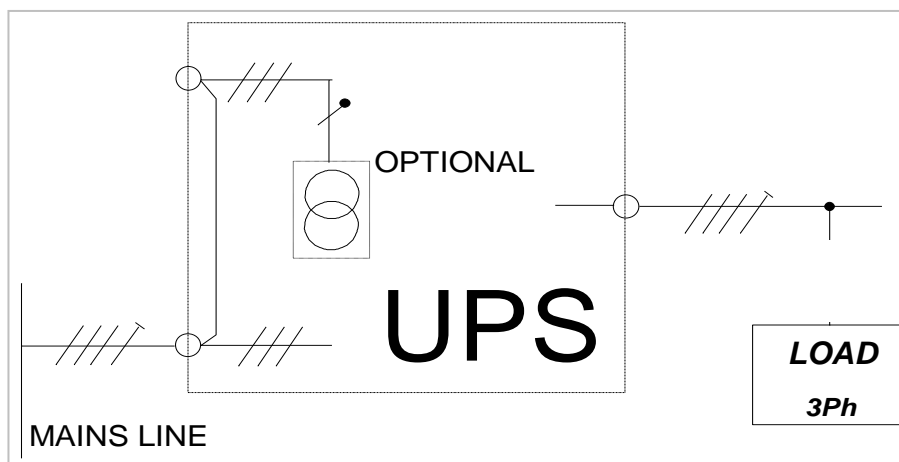


-The transformer supply bypass and mains lines

Input and output line without neutral



If the input line and the load are **three-phase without neutral** type (and only in this case), a kit to create the signal neutral (optional) may be used. The kit may only be used by a specialized technician.



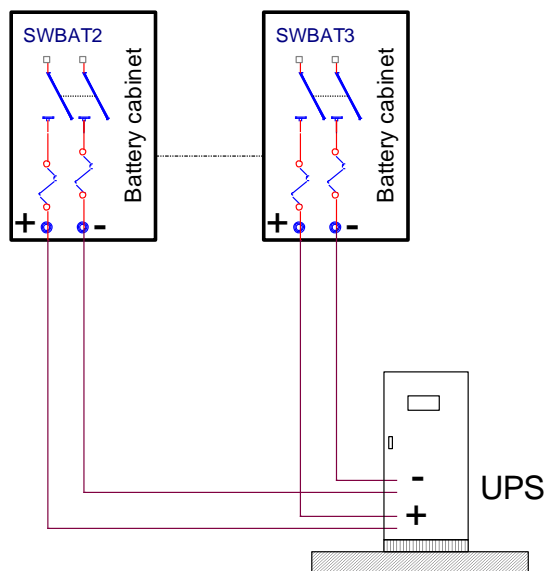
3.3 External Battery connections

BATTERY CABINET:



The battery cabinet **must** be provided with fuses to be connected to the SPS.

Up to 2 battery cabinets can be connected in parallel in accordance with the diagram below.



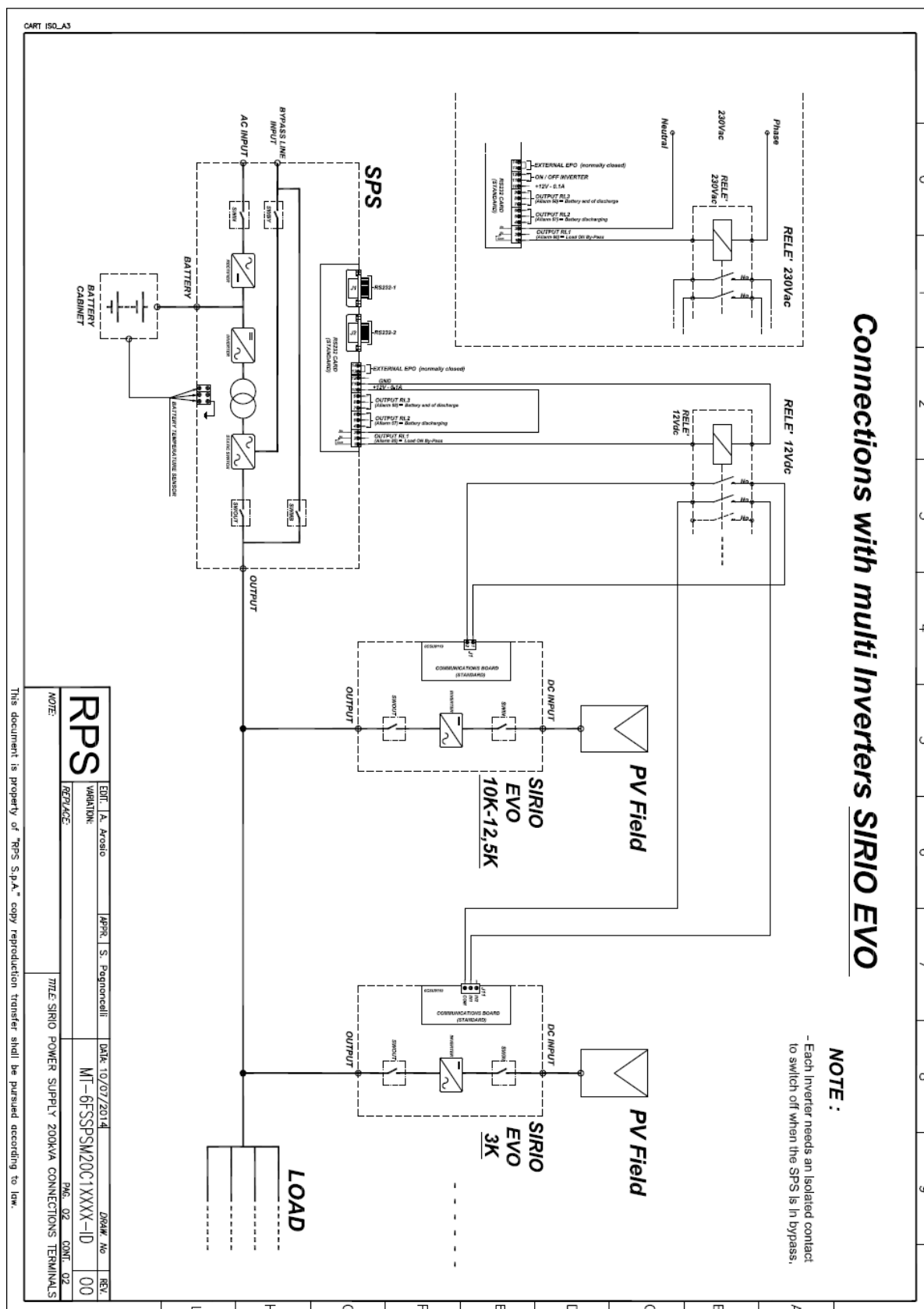
CABINET DISCONNECTOR



For systems with 3 or more battery cabinets, use a **Battery switch cabinet** where the cables can be parallel-connected (refer to the marketing department). For the sizing of the cables and connection procedures, refer to the "INSTALLATION DRAWING" attached to the battery cabinet.

3.4 Solar inverter configuration

SIRIO Solar Inverters connected at the SPS output must be configured in SPS mode and connected with the signal cable according to the provided Connection Diagrams. This is an example when multiple EVO solar inverter are not allowed to inject power into the grid:



The SIRIO solar inverter connected must be configured in “SPS parallel mode. Follow the procedure below.

3.4.1 Centralized inverter (Sirio).

From base menu press: 3 5 151515 + 3 5 367763 and confirm with key 7

Inv.OFF if SPS on bypass=1; SPS MODE: 1
Adjust: 5-6+; 7-8+

Whit the parameter “Inv.OFF if SPS on bypass” it is possible to choose if solar can inject power into the grid when SPS switch the output on bypass line.

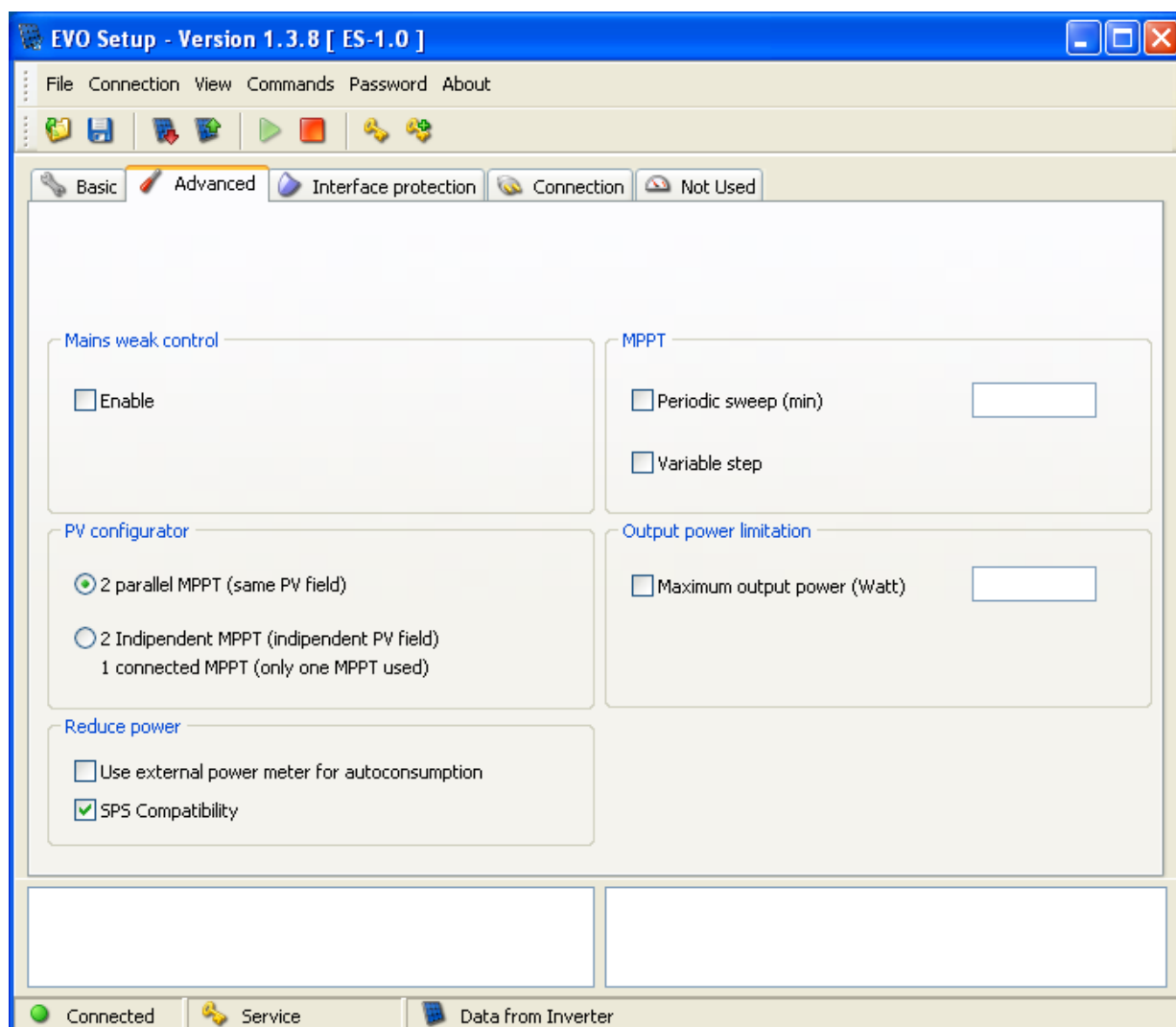
The example above show the case when solar inverter must stop with SPS on bypass line

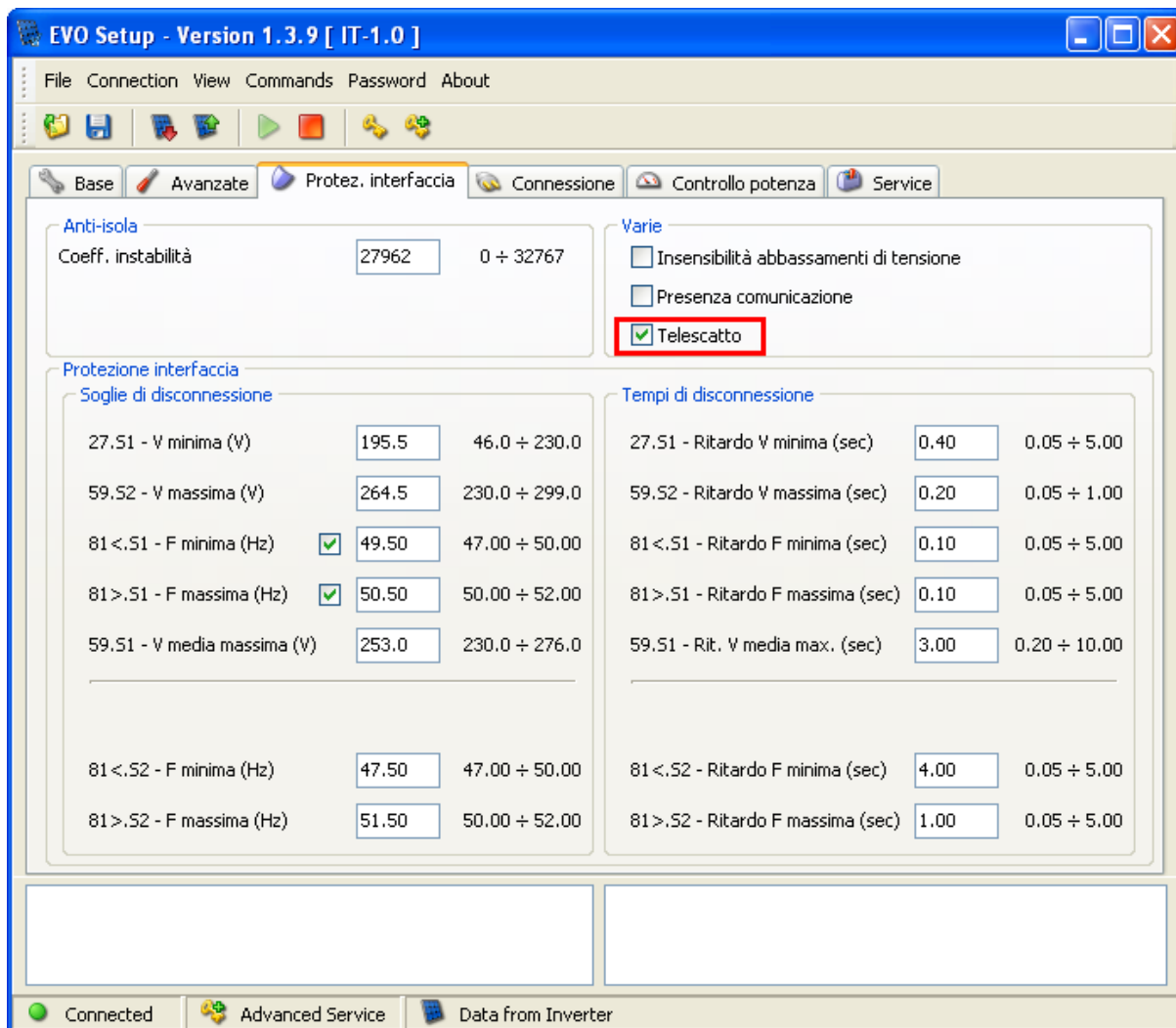
NOTE: if the menu or check box are not available a firmware upgrade is request.

Press the key 8 for the mode activation and 7 for deactivation. Go back with key 1

3.4.2 SIRIO EVO inverter

It is necessary to use the EVO Setup Software available on Aros Solar technology website. In the Advanced folder set the check box “SPS Compatibility”.





With the selected parameter checked, solar inverter stops when SPS switch to bypass line. It is request when non energy can be injected into the grid.

NOTE: if the menu or check box are not available a firmware upgrade is request.

3.5 Connection of signals and remote commands

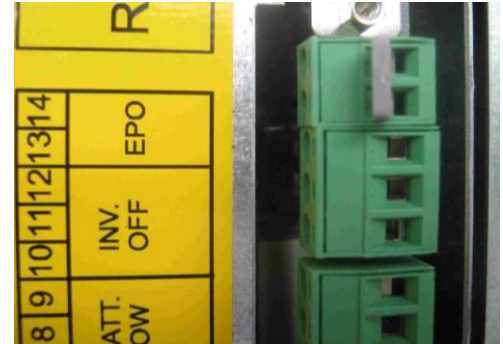
To the position of the signal and remote connection, refer to the **“INSTALLATION DRAWINGS”** supplied with the SPS.

3.5.1 EPO connector (emergency power off control)

If the jumper on the connector is opened, the voltage on the SPS output will be cut and also the PV inverter shut down.

The SPS is factory-fitted with the EPO terminals short circuited. If this input is used, the SPS can be shut down in a hazardous situation from a remote position simply by pressing a button.

If only the power supply is removed, for example by opening the switch of the power supply panel, the SPS will keep the load powered using the energy in the batteries.



3.5.2 REMOTE COMMANDS AND ALARMS

The card is equipped with a terminal board with 12 positions which has the following:

POWER SUPPLY1	power supply 12Vdc 80mA(max.) [pins 10 and 11];
ALARMS	3 potential-free change-over contacts for alarms;
COMMAND	1 command programmable from the panel [pins 11 and 12];

The functions of the three contacts and the command may be reprogrammed via the display panel. The ALARMS and the COMMAND are factory-set in the following way:

- ALARMS AND SIGNAL

- RL1 **Bypass / fault, the contact changes position when the SPS switches the load onto the by-pass line either during normal operation (e.g. due to overload) or as a result of a fault in the inverter stage; IT IS MANDATORY TO CONNECT THIS RELE (PIN 1-2) TO THE SOLAR INVERTER INPUT CONTACT.**
- RL2 Battery discharging, the contact changes position when the load is powered from the battery due to a mains power failure;
- RL3 End of battery discharge, the contact changes position when, during a mains outage, the remaining time for battery discharge has reached the minimum value defined. Once this time has passed, the load will remain unpowered (the factory-set end of discharge pre-alarm value is 5 minutes);

- COMMAND

IN 1 Inverter OFF. Connect pin 11 to pin 12 (for at least 2 seconds).

- In “NORMAL OPERATION”

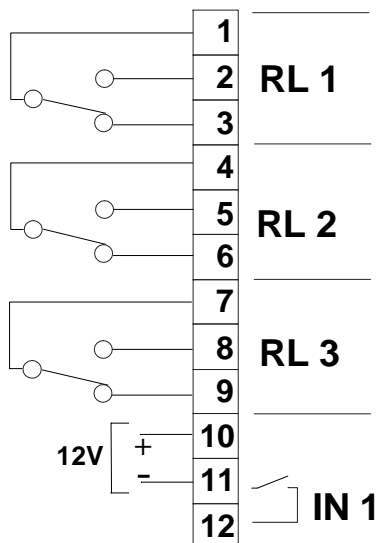
if the INVERTER OFF command is received, the SPS switches the power supply of the load onto the by-pass line (load is not protected should there be a mains outage).

- In “EMERGENCY OPERATION”

if the STOP INVERTER command is received, the SPS shuts down (load is not powered).With

the jumper present, the SPS remains switched on the by-pass line when the mains power supply is restored. With no jumper present, the SPS will restart in NORMAL OPERATION.

The position of the contacts shown is without the alarm present. **The contacts can take a max. current of 1A with 250Vac.**



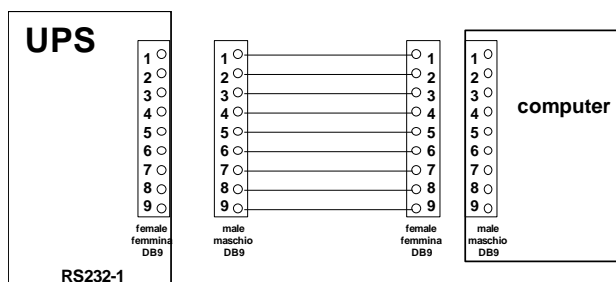
Please refer to APPENDIX A for the list of alarms and commands that can be programmed. The change of function may be made by the technical support personnel.

3.5.3 RS232

Nr. 2 DB9 connectors are available for RS232 connection. The factory-set transmission protocol is the following:

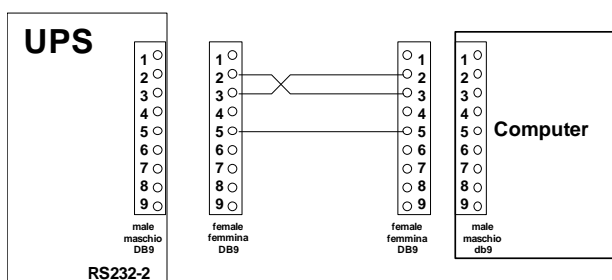
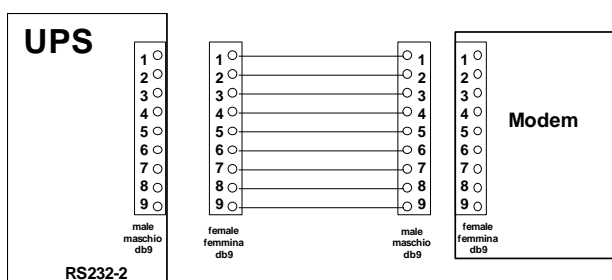
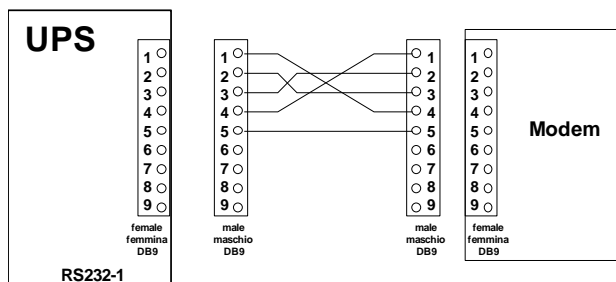
9600 baud, -no parity, -8 bits, -1 stop bit.

The transmission speed may be varied from 1200 to 9600 baud, using the PERSONALIZATIONS menu on the CONTROL PANEL. Depending on the distance of transmission, the recommended values for the transmission speed are: 9600 baud 50m, 4800 baud 100m, 2400 baud 200m, 1200 baud 300m. See the diagrams below for the connection procedure.



DB9 female RS232-2

For connection with a computer use a standard RS 232 cable. See the diagram for connection with a modem.



DB9 male RS232-1

For connection with a modem use a cable standard.

See the diagram for connection with a modem.

3.5.4 SLOTS 1-2 , the following cards may be inserted (optional):

NetMan 102 Plus (on SLOT 1 main or SLOT 2 aux)

Device for the management of the SPSs on the Ethernet. It can send information on the status of the device with various protocols:

- TCP/IP UDP (compatible with Watch&Save);
- SNMP (for communications with NMS or with PowerNETGuard);
- HTTP (to display the status with a browser);
- TFTP (to configure or update the device when connected to the network).

The main function of this device is to integrate the SPS into the LAN network ensuring a high level of reliability of communication with the server to enable full management and control of the SPS.



- MULTICOM card (on SLOT 1 main or SLOT 2 aux)

This device may be used to:

- add a serial port to the SPS;
- monitor the SPS using MODBUS/JBUS protocol on RS485 or PROFIBUS (Multicom 401)

N.B. each card connected precludes the use of a standard RS232 port, as follows.

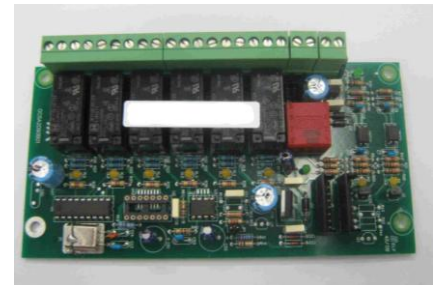
the use of SLOT 2 (aux) inhibits the use of RS232-2



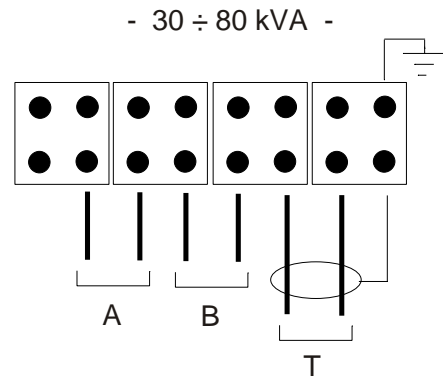
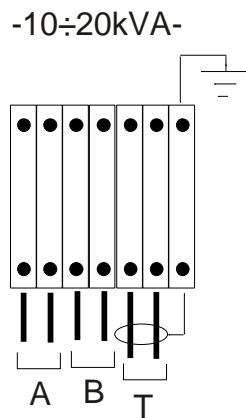
For the full and updated list of communication accessories, please see the website:
www.aros-solar.com

3.5.5 REMOTE ALARMS

Nr. 6 outputs: potential-free contacts for alarms (programmable from the display panel), 2 inputs (programmable from the panel) and one 12V DC maximum 100mA auxiliary input.



3.5.6 SWOUT and SWMB aux - External temperature sensor(optional).



A = connection to external output SPS switch auxiliary;
 B = connection to external bypass SPS switch auxiliary ;
 T = external temperature sensor connection.

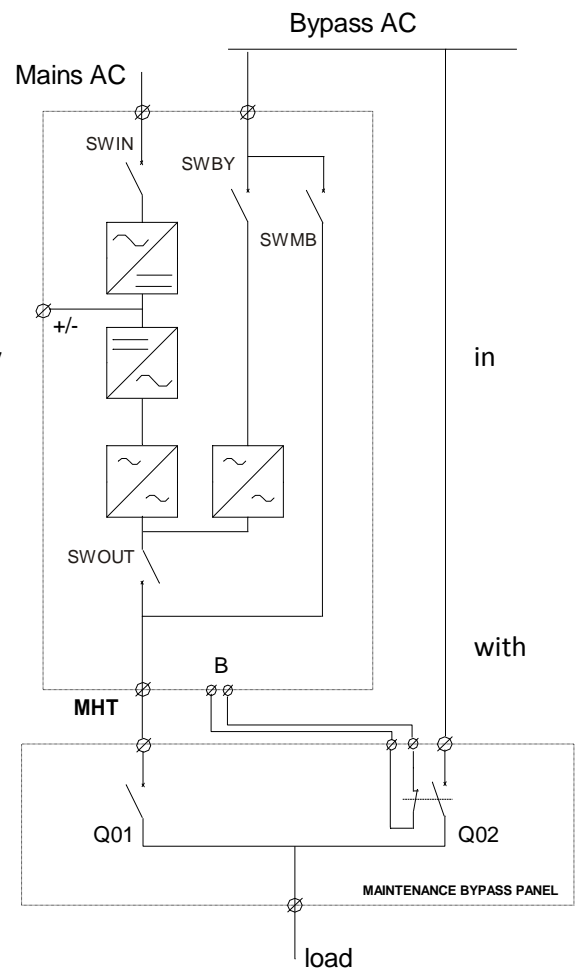
SWOUT and SWMB aux

Terminals to be used for the connection of the auxiliary contacts of switches inserted in the SPS system, see also the section on "Insertion of additional system sectioning devices".

Inserting additional disconnectors to supplement those already the SPS means that the whole equipment can be replaced without interrupting the power supply to the load.

- Q01 additional output disconnector, Q02 additional disconnector of the external maintenance by-pass.

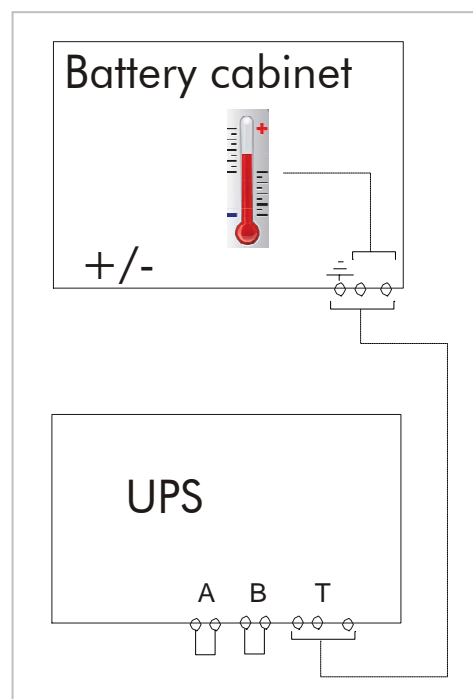
The auxiliary contacts Q02 must be connected to terminals B. Contact Q02 must be in the opposite position (auxiliary open switch closed, vice versa with switch open)



External temperature sensor (terminal T)

The use of the temperature sensor allows the SPS control logic to regulate the charge voltage values and keep the battery working temperature constant

In case of more battery cabinet in parallel the battery temperature sensor is installed in only one cabinet



It is necessary to use the specific kit supplied by the manufacturer only: any uses which do not comply with the specifications may cause malfunctioning or breakage to the appliance.

3.6 Start-up procedure



The operations described in this chapter must be carried out exclusively by a **specialized technician**.



The SPS output terminals will be powered in this phase and all applications connected will receive voltages. All users must therefore be warned before carrying out the start-up procedure.

BATTERY CABINET



The battery cabinet **must be** provided with fuses device for it to be connected to the SPS.

Once the INPUT/OUTPUT and battery cables have been connected to the SPS terminals and before putting the switch cover back in place, check that:

- all the input/output terminals are securely tightened;
- all the fuseholders have the fuse inserted, and are in the closed position;
- the input and output protection conductor is connected correctly (yellow/green earth cable);
- check the polarity of the battery connections.

Replace the switch cover.

For the first start-up, the following operations should be carried out in this order:

- 1) close input disconnecter SWIN,
- 2) press button 1 twice, select the language and then press button 8 to return to the basic menu,
- 3) close by-pass line disconnecter SWBY,
- 4) close output disconnecter SWOUT.
- 5) close the battery cabinet disconnecter

Configure the value of the battery capacity according to the instructions on “Display and control panel” manual.

battery capacity



It is important to insert the correct battery capacity value, since this value is used by the system logic to calculate the backup time.
If not set otherwise, this value is assumed to be equal to the SPS power. e.g. at 80kVA the value set by default is 80Ah .

After the start-up operations have been completed, perform a manual battery test: press button 3 and then 2 on the control panel. At the end of the test, after approx. 8 seconds, with the SPS started correctly and with the battery connected on the signals and control panel, the two green input and output LEDs must be on constant.

SWMB



The disconnecter SWMB must not be closed during normal operation of the SPS. SWMB should only be closed during SPS maintenance operations in order to keep the load powered.

3.6.1 Battery operation check

Carry out only with battery present.

After installation, a mains outage even of just a few seconds can be simulated to check operation (the battery does not need to be charged).

With the SPS in normal operation, open switch SWIN located at the SPS input (rectifier). The buzzer should sound immediately (with 5=ON) while OUT. (green LED) and BATT. (yellow LED) on the Signals and Commands Panel should be constantly on.

Check that the load connected to the SPS is powered. In this state, the power supplied to the load is the same as the energy that was previously accumulated in the batteries. Close input disconnect SWIN to return to normal operation. The IN. and OUT. LEDs on the CONTROL PANEL will be GREEN. The batteries will recharge automatically.

Battery backup time



Before a battery discharge test can be carried out, several hours have to pass (at least eight hours for standard backup times or longer for batteries sized for long backup times) to allow the batteries to charge.

The backup time obtained on the first discharge may be slightly less than expected; a number of charge and discharge cycles are needed to improve this value.

Battery capacity does not remain constant over time, but increases after some charge and discharge cycles; it then remains constant for several hundreds of cycles before decreasing permanently.

3.7 Operating modes with solar inverter

setting



The operating mode is set when the SPS is installed; it may be changed subsequently but this should always be done by a **specialized technician**.

It is possible to set the SPS mode in two different ways:

MODE 0: typically used for grid connected systems

MODE 1: typically used for standalone systems (default setting)

Selection mode procedure:

Starting from base menu

NORMAL OPERATION
S200, OUT= 40%VA, BATT= 32min, 5=ON

Press the key 3 5 436215 and confirm with key 7.

2=Rated Output Voltage 3=Battery 8=SPS
4=Prealarm 5=Cod. 6=Auto-OFF 7=Others

Press the Key 8=SPS

3=Set charge, SPS operation mode = 0
4-/5+:Charge stop=100%ah, 7-8+

- With the keys 7 and 8 select the operation mode.
- With the keys 4 and 5 it is possible to set the battery level % for the battery charging disabling from rectifier
- With the key number 3 it is possible to adjust the charge level that appears in the diagrams in the next pages.

If the operation mode = 0 this menu appears:

Battery charge Min= 30%; Max = 50%
Adjustement: 5=-,6=+; 7=-,8=+

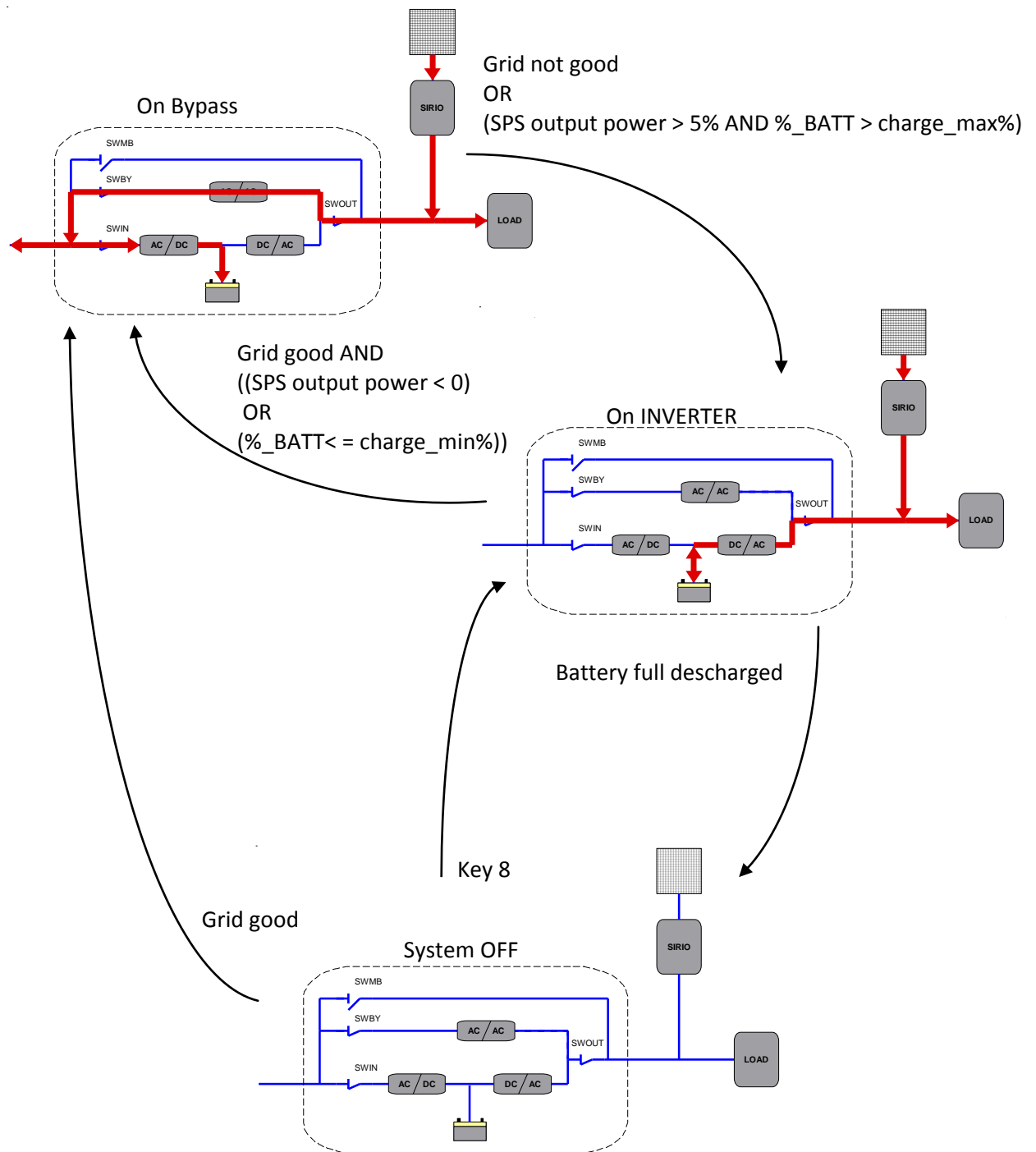
If the operation mode = 1 this menu appears:

Disable Stbyon=0; En. Rect. ah% < 95%
Adjustement: 5-6+; 7=-,8=+

- 5/6 Enable/disable the bypass line when batteries are full charged
- 7/8 Set the charge level at which the rectifier is enabled

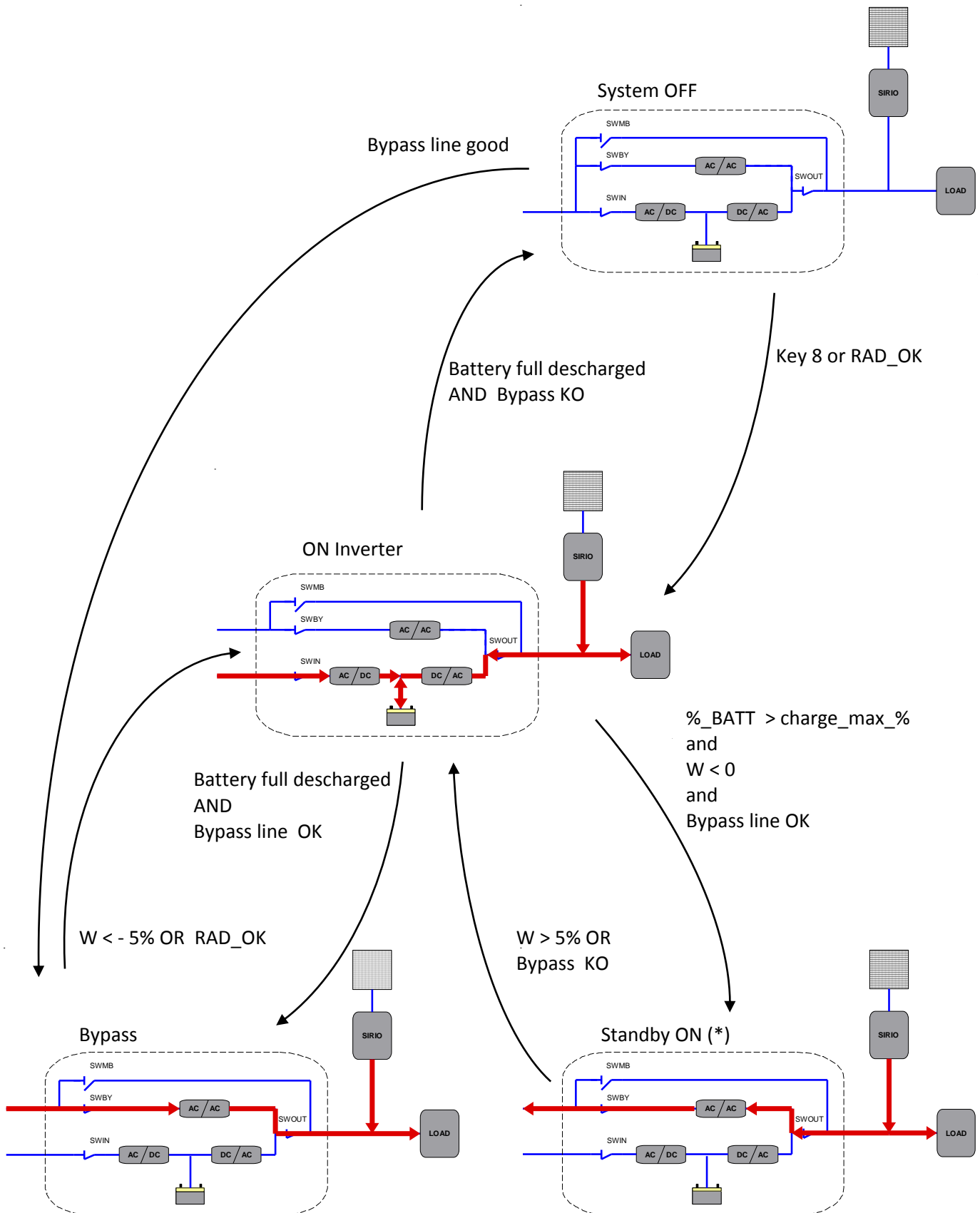
This is a diagram of system function MODE 0:

Rectifier and bypass line must be the same



SPS output power (expressed in %) is positive if exit from SPS and supply the load
 charge_min_% and charge_max_% are the value set in the menu. Standard values are
 respectively 30% and 50%

This is a diagram of system function MODE 1 :



W is SPS output power (expressed in %) is positive if exit from SPS and supply the load
charge_max% is the value set in the menu. Standard value are respectively 95%
When %_BATT > charge_max_% rectifier is disabled.

(*) In this mode energy will be feed into grid. If not allowed deactivate stand-by mode
and set solar inverter for switch off in case of SPS bypass

3.8 Personalizations

Using the CONTROLS PANEL (from the basic menu press keys 3 and 5 and the access code 436215), the following factory-set electrical parameters can be modified within a certain field:

- Language,
- BATTERY parameters,
- end of battery discharge pre-alarm,
- acceptance frequency and voltage field on the BY-PASS line,
- modem configuration,
- RS232-1 and RS232-2 ports,
- date and time.

3.9 Procedure to transfer the load from SPS onto maintenance by-pass.

The sequences of operations to be carried out to place the SPS in maintenance bypass are shown below. The procedure varies depending on the initial state of the SPS.

- SPS in NORMAL OPERATION


procedure a) *the power supply to the load is not interrupted in any way;*

- SPS with output not synchronized with the by-pass line

procedure b) *the power supply to the load is interrupted*

(therefore this operation should be effected only if absolutely necessary).

Procedure a)

	the by-pass line is present and its frequency and voltage are suitable <i>the SPS display panel indicates</i> NORMAL OPERATION.
---	---

- 1) close disconnecting switch SWMB (the control logic automatically disables the inverter)
- 2) open all the switches on the device (SWIN, SWOUT, SWBY and the battery cabinet disconnectors/fuses) and keep only disconnecting switch SWMB (maintenance by-pass line) closed. The control panel remains off.

N.B.: After carrying out the operations indicated above, personnel must wait around ten minutes for the capacitors to discharge before working on the inside of the SPS.

In this situation (during maintenance operations), any disturbance (such as a blackout) on the SPS supply line would have an effect on the equipment powered (since the batteries are deactivated in this state). PV inverter works injecting current to grid.

Procedure b)



The by-pass line is outside the acceptance field; the following message is seen on the display panel: BYPASS VOLTAGE FAIL or SWBY OFF and green LED 1 will flash (See “Display and control panel” manual)

- 1) open all the switches on the device (SWIN, SWOUT, SWBY and the battery cabinet disconnectors/fuses). The control panel will remain off.
- 2) before closing switch SWMB to connect the loads, ensure that both the frequency and voltage of the supply line are sufficient to power the connected loads.

N.B.: After carrying out the operations indicated above, personnel must wait around ten minutes for the capacitors to discharge before working on the inside of the equipment.

After all the maintenance operations, restart the SPS following the instructions in the section on START-UP PROCEDURE (see page 27). Then open disconnecter SWMB (if it was previously closed).
The SPS will return to NORMAL OPERATION.

3.10 SPS and load shutdown

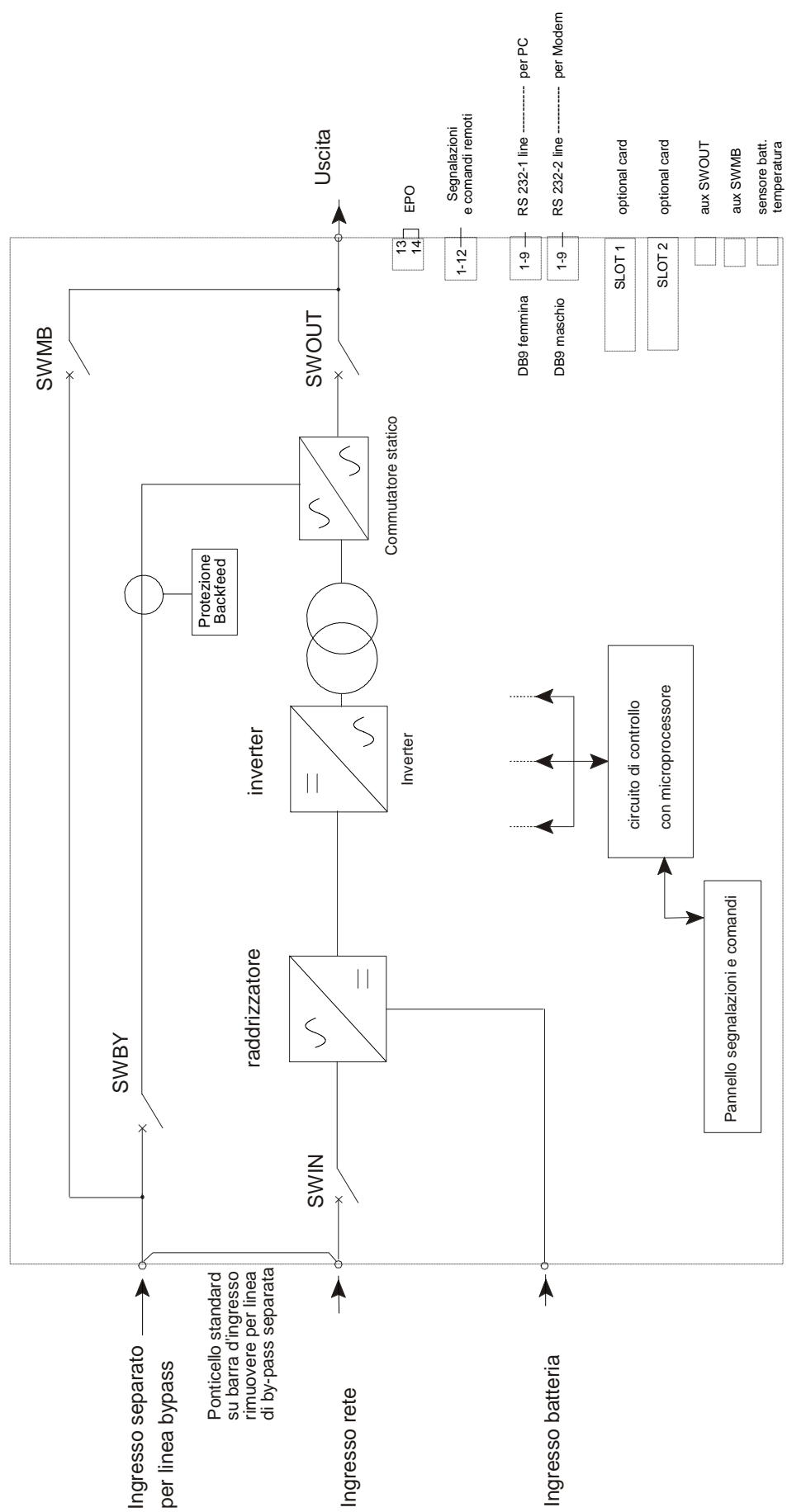
This operation will cause the shutdown of the PV inverter and load connected on the output. In parallel versions each procedure must be carried out on all the SPSs:

- switch off the solar inverter connected
- open the battery cabinet switch/fuse;
- open the switch of the load;
- open SWOUT, output disconnecter;
- open SWIN, input disconnecter;
- open SWBY, by-pass line disconnecter;

The load is no longer powered, and after a few seconds the signal panel will also shut down.
Use a multimeter to check that no voltages are present on the terminal board.

Follow the instructions in the section on START-UP PROCEDURES to restart the SPS.

3.11 Block diagram



3.12 Components of the block diagrams

The SPS is made up of the following sub-assemblies:

RECTIFIER

This represents the input stage and its function is to convert the alternating voltage of the power supply line into direct voltage.

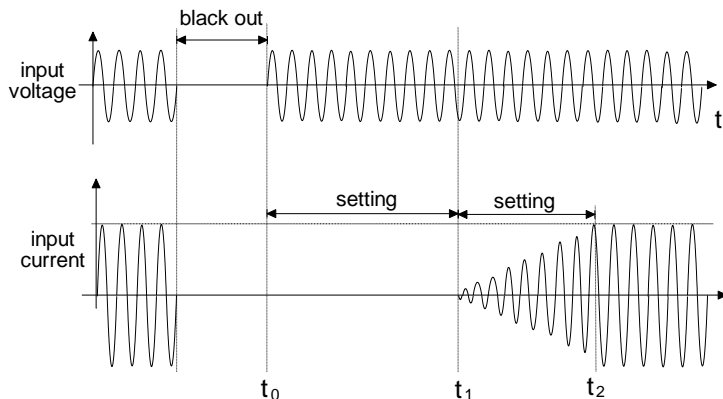
Rectifier start-up can be programmed from the display panel. The following in particular can be set:

The delay in start-up $t_0 - t_1$ (this allows a non simultaneous start-up of several SPSs connected to the same mains);

The time for the start-up, $t_1 - t_2$.

The rectifier carries out the following functions:

- feeds the inverter with direct voltage;
- automatically charges the battery;



The first phase consists in recharging the battery with limited current and increasing voltage (up to the preset charge value "Vb_max"). This phase is maintained until the battery is fully charged (Batt=100%Ah), which is detected by measuring the current entering the battery.

BATTERY

This is the energy reserve to power the load when power is no longer supplied to the SPS. It is housed in one or more additional cabinets. The battery cabinet **must be provided with** a sectioning device and a protection device (magneto-thermal switch or disconnecter with fuses).

The load is powered with the energy accumulated in the battery when there is no MAINS present (black out), or when the mains goes outside the acceptance field (frequency or voltage). In this phase of operation the energy required by the equipment connected to the SPS output is supplied by the battery, which has previously been charged. The alphanumeric PANEL at the front of the SPS shows the expected residual BACKUP TIME, calculated according to the power supplied and the state of charge of the batteries. The value provided is merely indicative, since the power required by the connected load may change during discharging. The backup time can be increased by disconnecting some of the connected equipment. When the remaining backup time goes lower than the value preset as the END OF BACKUP TIME PRE-ALARM (factory-set at 5 minutes), the buzzer increases the sound frequency while the yellow BATTERY LED starts flashing; in these conditions it is advisable to save any work in progress. After this time the will interrupt the power supply to the loads.

When the MAINS is restored, the SPS automatically restarts and starts recharging the batteries.

INVERTER

This is the output stage, the function of which is to convert the direct voltage from the RECTIFIER or from the BATTERY into stabilized sinusoidal alternating voltage. The inverter output is isolated from the input and from the batteries by a galvanic isolation transformer. The inverter is always working, since the load connected to the SPS output is always powered by the INVERTER (in NORMAL OPERATION)

STATIC SWITCH

This device allows the synchronized switch, automatic or manual, and in zero time, of the power supply to the load from a protected line (inverter output) to an unprotected line (by-pass line) or vice versa.

The is provided with a device to prevent the backfeed of voltage to the input line after an internal fault, known as “**BACKFEED PROTECTION**”.

MANUAL MAINTENANCE BY-PASS (SWMB)

This is a maintenance disconnecter. The SPS can be excluded by closing SWMB and opening the other disconnectors SWIN, SWBY, SWOUT while keeping the load on the output powered. This operation is necessary when maintenance operations must be carried out inside the equipment without interrupting the power supply to the load and the PV inverter work.

The disconnecter is sized for the rated power of the SPS.

4. Maintenance



The power supply is designed and produced to last a long time even in the most severe service conditions. It should be remembered however that this is electrical power equipment, which requires periodic controls. Moreover, some components have a limited lifespan and as such must be periodically checked and replaced should conditions so dictate: in particular the batteries, the fans and in some cases the electrolytic condensers. It is therefore recommended to implement a preventive maintenance programme, which should be entrusted to specialized personnel authorized by the manufacturers.

Our Technical Support Service will be happy to recommend the various personalized options for preventive maintenance.

Periodic operations (to be carried out by trained personnel and with doors closed)

The following operations (which must be done with the doors closed) should be carried out periodically (e.g. once a month, or more frequently in particularly difficult environmental conditions):

- Ensure that the air intake slots (located on the front door and at the back of the cabinet) and the output grilles located on the top of the cabinet are clean;
- Ensure that the SPS is working properly (the message “NORMAL OPERATION” will appear on the display panel). If an alarm message is displayed, check the meaning in the manual before contacting the technical support service;
- Perform a battery test with the display panel.

Maintenance inside the SPS (trained personnel only)



Maintenance inside the SPS may only be carried out by trained personnel.
High voltage is present inside the SPS even when the power supply and the battery have been disconnected



An electronic board contains lithium cell, this card and all the other card must be replace only by trained personel.



After disconnecting the power supply line and the battery cabinet, the trained personnel must wait around ten minutes for the capacitors to discharge before working on the inside of the equipment.

Ordinary maintenance for batteries (trained personnel only)

The system automatically controls the efficiency of the batteries every 24 hours, and sounds an alarm when the efficiency is lower than that calculated according to the stored capacity value.

The lifespan of the batteries is linked to the operating temperature and to the number of charge and discharge cycles effected.

The capacity is not constant, but increases after some charge and discharge cycles; it then remains constant for several hundreds of cycles before decreasing permanently.

Preventive maintenance of the battery entails:

- keeping the operating temperature within the field 20 - 25°C;
- performing two or three discharge and charge cycles during the first month of use;
- carrying out this operation every six months after the first month of use.

Since the batteries are a source of energy, opening the battery disconnecter does not eliminate the voltage inside the batteries. DO NOT TRY TO ACCESS THE INSIDE OF THE BATTERY CABINET. THERE ARE ALWAYS DANGEROUS VOLTAGES AROUND THE BATTERIES. If the batteries are thought to be faulty in any way, please contact the technical support service.



If the batteries need to be replaced, this must be done by a **specialized technician**. The replaced parts must be sent to a specialized company for disposal by means of recycling. Batteries are classified by law as “toxic waste”.

5. General characteristics

Mechanical Data		10	15	20	30	40	60	80
Width	[mm]	555			800			
Depth/height	[mm]	740 / 1400						
Ventilation		Forced						
Max current dispersion		300mA max						
Noise at 1m from front (0÷100% load)	[dBA]	60÷62						
Applicable Standards		Refer to the “Safety and Compliance Manual ” supplied with the UPS (0MNA141 NE).						

Electrical Data		10	15	20	30	40	60	80
RECTIFIER INPUT								
Rated voltage		400Vac 3-phase						
Rated voltage tolerance		-25%, +20% (100% load)						
- Battery in charge		-10%, +20% (100% load)						
- without battery		-20%, -10% (100% load)						
contribution								
Rated frequency [Hz]		50/60						
Input frequency tolerance		from 45 to 65Hz						
Rated current absorbed (400 V) [A]		16	24	31	46	62	93	124
Rated power absorbed (400 V) [kVA]		11	16	22	32	43	64	84
Max current absorbed at full load and with battery recharging [A]		22	34	45	65	87	131	175
Monoblocks/ Number of Pb elements		32 / 192						
Ripple voltage with recharged battery [%]		Approx 0						
Max recharge current [A]								
Full load		2	3	4	6	8	12	16
Load 90%		5	7	9	13	18	26	36
Load 80%		7	11	14	21	27	41	56
Load ≤ 50%		15	18	29	37	37	75	75
Progressive start of rectifier (power walk-in 0-100%)		Configurable (0÷120s)						
Delay of progressive start of rectifier (Power Walk-in delay timer)		Configurable (0÷120s)						
current distortion, power factor (*):		30 %, ≥ 0,8						

(*) load 100%, rated input voltage, and full charge battery.

Electrical Data		10	15	20	30	40	60	80
INVERTER								
Rated power Pf 0.9 inductive [kVA]		10	15	20	30	40	60	80
Active power Pf 1 [kW]		9	13,5	18	27	36	54	72
Rated voltage		400Vca 3-phase+N (configurable from 380V to 415V)						
Rated voltage adjustment field		from 360 to 420V						
Rated frequency [Hz]		50 or 60 (configurable)						
Static variation		± 1%						

Dynamic variation	± 5%	
Recovery time within ± 1%	20ms	
	Conforms to standard EN 62040-3, class 1	
Current peak factor (I _{peak} /I _{rms} as per EN 62040-3)	3:1	
Voltage distortion with linear load	1% (typical), 2% (max)	
Voltage distortion with non linear load (EN 62040-3)	< 3%	
Stability of frequency with Inverter synchronized with the by-pass mains	± 2% (adjustable from ± 1% to ± 6% from control panel)	
Stability of frequency with Inverter not synchronized with the by-pass mains	± 0.05%	
Speed of frequency variation	1Hz/sec	
Dissymmetry of the phase voltages with balanced and unbalanced load	≤ 1%	
Voltage phase shift with balanced and unbalanced load	120 ± 1°el	
Overload with reference to the rated power: three phase	110% for 60', 125% for 10' , 150% for 1'	
Short circuit current phase / phase	180% for 1 second with current limiting	
	phase / neutral	300% for 1 second with current limiting

Electrical Data		10	15	20	30	40	60	80
BY-PASS								
Rated voltage	400Vca 3-phase + N (configurable from 380V to 415V)							
Rated voltage tolerance	± 15% (adjustable from ± 10% to ± 25% from panel)							
Rated frequency [Hz]	50 or 60 (auto-sensing)							
Frequency tolerance	± 2% (± 1% ÷ ± 6% from control panel)							
Switching onto by-pass with synchronized Inverter (UPS in "Normal Mode")	No break							
Switching onto by-pass with Inverter out of sync (UPS in "Normal Mode")	~ 100 ms							
Switching from by-pass to Inverter (UPS in "Stand-by On mode")	from 2 to 5ms							
Delay in transfer onto Inverter after switching onto by-pass	4 s							
Power overload capacity of the by-pass line (kVA)	110 % for 60 minutes, 125 % for 10 minutes, 150 % for 1 minute							
i ² t SCR bypass (25°C, 8÷10ms) [A ² s]		11k					20k	
Short circuit capacity of the by-pass line (x rated current): s	1	7	4,6	3,5	5	7	7	7,5
	500ms	7	4,6	3,5	6	8	8	8
	200ms	8	5	4	6	8	8	9
	100ms	8	5	4	7	9	9	9
	10ms	12	8	6	8	12	12	14

6. Appendix A - remote commands and alarms card -

Technical support personnel may give the COMMAND and the three ALARMS functions that are different to the standard configuration of the alarms card.

The options available are listed below:

ALARMS:

- DISTURBANCES ON BYPASS LINE
- MANUAL BYPASS, SWMB ON
- BYPASS LINE VOLT. FAIL OR SWBY, FSCR OFF
- MAIN LINE VOLTAGE FAIL OR SWIN OFF
- PREALARM, LOW BATTERY VOLTAGE
- LOW BATTERY CHARGE OR CLOSE SWB
- LOW INPUT VOLTAGE OR OUTPUT OVERLOAD [W]
- OUTPUT OVERLOAD
- BYPASS FOR OUTPUT POWER "VA" < AUTO-OFF VALUE
- INTERNAL FAULT: number
- TEMPORARY BY-PASS, WAIT
- BYPASS FOR OUTPUT OVERLOAD
- BYPASS COMMAND ACTIVE; 8=COM. OFF
- REMOTE BYPASS COMMAND ACTIVE 8=OFF
- OVERTEMPERATURE or FAN FAILURE
- INPUT VOLTAGE SEQUENCE NOT OK
- OUTPUT OFF, CLOSE SWOUT OR SWMB
- BLOCK COMMAND ACTIVE; 8=OFF
- REMOTE BLOCKING COMMAND: ACTIVE 8=OFF
- MEMORY CHANGED: CODE = number
- AUTO-OFF Timer: Toff= 0: 0', Ton= 0: 0'

See "Display and control panel" manual for an explanation of the alarms.

COMMAND:

<i>name</i>	<i>description</i>	<i>Typical application</i>
Battery charge inhibition (from grid)	Disables the recharging of the battery, keeping the recharge current to a minimum, independently of the load. <i>This is done with the contact kept closed; if reopened, the command is cancelled.</i>	When there is a generator, this allows its output power to be used only to supply the load and not also to recharge the battery.
Inhibition of synchronization with backup mains	Disables the use of the by-pass line and the synchronization of the inverter. In the event of an overload or fault, the SPS blocks and the load remains unpowered. <i>This is done with the contact kept closed; if reopened, the command is cancelled.</i>	To be used when the frequency of the generator or of the backup mains is highly unstable and it is thus preferred to inhibit the synchronization of the inverter.
Battery disconnecter contact	Activates the battery discharging or disconnected alarm. To be used to indicate the opening of a battery switch located external to the SPS. <i>A closed contact must be provided when the external switch is opened.</i>	Displays the status of the battery disconnecter.
Standby ON	Forces the selection of the SPS Standby-ON operation. <i>This is done with the contact kept</i>	To be used when the load may support mains interference or frequency variations and it is

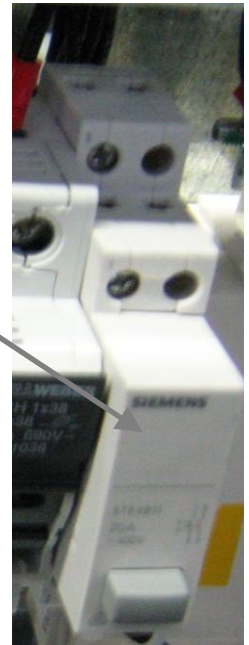
	<i>closed; if reopened, the command is cancelled.</i>	thus preferred to improve system efficiency. The load is powered if there is a mains power failure.
Battery test (grid available)	Starts the automatic battery test when the SPS is in normal operation. Any automatic battery test underway is terminated immediately. <i>This is achieved by switching the contact from open to closed.</i>	Checks state of the battery.
Battery test (with rectifier on)	Starts the manual battery test that continues until a block command is received or until the full discharge of the battery. Terminates any manual battery test underway. <i>This is achieved by switching the contact from open to closed.</i>	Checks state of the battery. N.B.: During this test the rectifier remains on with output voltage low in order to allow the supply of current by the battery and to prevent inverter shutdown after battery discharge.
Manual battery charging (grid available)	Starts the "single first time recharge". Terminates the first time charging underway. <i>This is achieved by switching the contact from open to closed.</i>	Activates manual remote battery charging
Activation of block on Bypass	Bypass command by means of blocking the inverter as a result of switching onto the by-pass line. N.B.: The command is only executed if the by-pass line is present with correct values. <i>This is achieved by switching the contact from open to closed.</i>	Load unpowered in the event of a mains outage. To be used for non-critical loads, the battery does not discharge during a mains power failure.
Inhibition of block on bypass	Resets the bypass command. <i>This is achieved by switching the contact from open to closed.</i>	Cancels the previous action and disables the inverter block.
Inverter ON/OFF	UNCONDITIONAL inverter block command (the command is executed even if there is no by-pass line). The SPS only switches onto by-pass if the by-pass line is present (otherwise the load remains unpowered). <i>This is done with the contact kept closed; if reopened, the command is cancelled.</i>	Load unpowered in the event of a mains outage. To be used for non-critical loads, the battery does not discharge during a mains power failure.
Rectifier off	UNCONDITIONAL rectifier block command. <i>This is done with the contact kept closed; if reopened, the command is cancelled.</i>	Shuts down the rectifier and discharges the battery.

7. **START UP WITH COLD START FROM BATTERY**



Check that all the interrupters (SWIN, SWBY, SWOUT AND SWMB) of the SPS and the switch in the battery cabinet are opened

- A) close all fuses and switch in the external battery cabinet
- B) push the “BATTERY START” push-button, near the fuse in the front panel (see the picture), and keep it pressed for all the starting procedure..
- C) the halogen lamps included in the kit will light for a short period.
- D) wait that on the LCD Display is shown the indication “SYSTEM OFF” as in the normal SPS start-up procedure.
- E) close the SWOUT output circuit breaker
- F) release the “BATTERY START” push-button (see step 3)





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