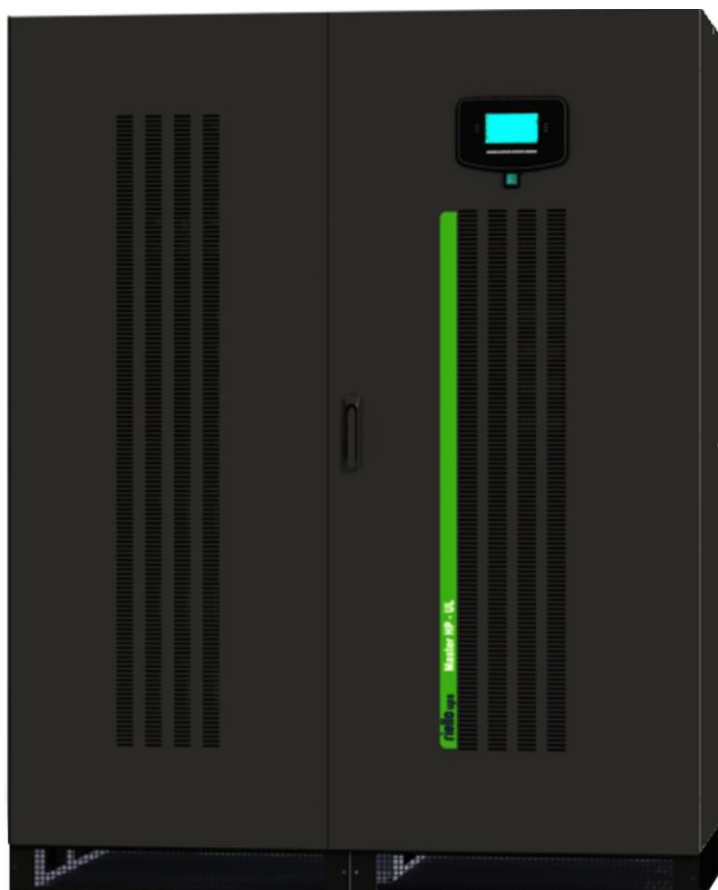


UNINTERRUPTIBLE POWER SUPPLY
300 to 500 kVA Three-Phase Output



MASTER HP-UL

USER MANUAL



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www.riello-ups.com



Thank you for choosing our product.

RPS S.p.A. is highly specialized in the development and production of uninterruptible power systems (UPS). The UPS's of this series are high quality products, carefully designed and manufactured to ensure optimum performance.

Applicability

This manual applies to the following models:

Master-HP 300

300 kVA, 480 V input, 480 V output, 60 Hz, configured as wye-wye or delta-delta (see below); "xx" may be replaced with an alternate two character designator that denotes installed options as described in the order documentation.

Master-HP 400

400 kVA, 480 V input, 480 V output, 60 Hz, configured as wye-wye or delta-delta (see below); "xx" may be replaced with an alternate two character designator that denotes installed options as described in the order documentation.

Master-HP 500

500 kVA, 480 V input, 480 V output, 60 Hz, configured as wye-wye or delta-delta (see below); "xx" may be replaced with an alternate two character designator that denotes installed options as described in the order documentation.

The wye output configuration that provides an output neutral connection is only permitted when an input neutral is provided; that is, the delta-wye configuration is prohibited. The source must have a grounded neutral, even if the neutral is not connected to the UPS; that is, a delta source may not be ungrounded or corner grounded. Please refer to Section 4.4 for additional information.

Safety Warnings

IMPORTANT SAFETY INSTRUCTIONS SAVE THESE INSTRUCTIONS

This manual contains important instructions for Models 300, 400, 500kVA MASTER HP – UL all versions, that should be followed during installation and maintenance of the UPS. Please read all instructions before operating the equipment and save this manual for future reference.

READ AND FOLLOW ALL SAFETY INSTRUCTIONS

- a. Do not use outdoors.**
- b. Do not route wiring across or near hot surfaces.**
- c. Do not install near gas or electric heaters.**
- d. Use caution when servicing batteries. Battery acid can cause burns to skin and eyes. If acid is spilled on skin or in eyes, flush acid with fresh water and contact a physician immediately.**
- e. Equipment should be installed where it will not readily be subjected to tampering by unauthorized personnel.**
- f. The use of accessory equipment not recommended by the manufacturer may cause an unsafe condition.**
- g. Do not use this equipment for other than intended use.**

DANGER



This UPS contains LETHAL VOLTAGES. All repairs and service should be performed by AUTHORIZED SERVICE PERSONNEL ONLY. There are NO USER SERVICEABLE PARTS inside the UPS.

WARNING



To reduce the risk of fire or electric shock, install this UPS in a temperature and humidity controlled, indoor environment, free of conductive contaminants. Do not operate near water or excessive humidity (95% maximum).

Input and output over-current protection and disconnect switches must be provided by others.

High ground leakage current may be present. Do not operate the equipment without a proper protective ground.

CAUTION



Batteries can present a risk of electrical shock or burn from high short circuit current. Follow proper precautions. Servicing should be performed by qualified service personnel knowledgeable of batteries and required precautions. Keep unauthorized personnel away from batteries.



There is a risk of explosion if batteries are replaced by an incorrect type. Replace with same type and rating only.

Proper disposal of batteries is required. Refer to your local codes for disposal requirements.

Never dispose of batteries in a fire



Definition of “operator” and “specialized technician”

The professional figure responsible for accessing the equipment for routine 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 routine or non routine 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.

- 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.










Fire fighting measures

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

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:

	Danger / Risk of Electric Shock <i>Possibility of serious injury or substantial damage to the device, unless adequate precautionary countermeasures are taken.</i>
	Caution <i>This symbol indicates some important information which must be read with care.</i>
	Risk of Explosion
	Note
	"Ground Electrode Terminal"
	Electrostatic Sensitive Device
	<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		

GENERAL PRECAUTIONS



This manual contains detailed instructions for the use, installation and start-up of the UPS. Read the manual carefully before installation. For information on using the UPS, 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.

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

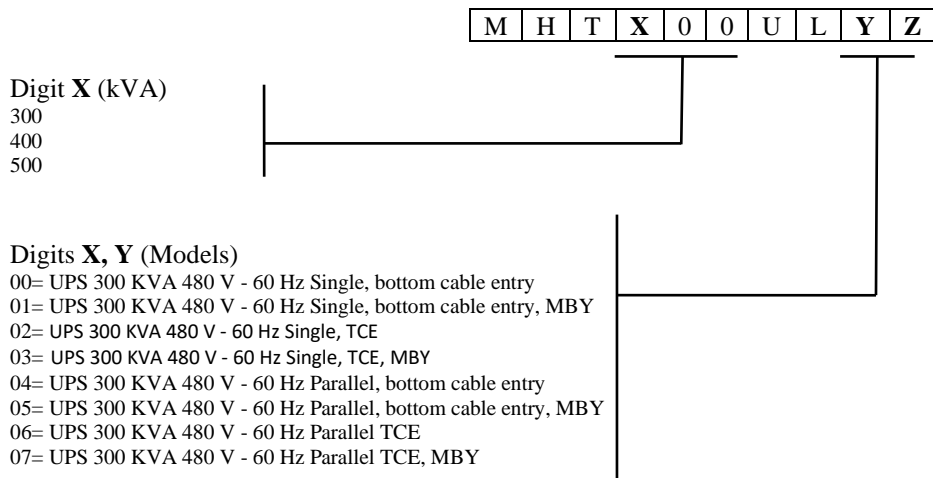
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1 Models

Based on the models ordered, they are configured in factory before shipping. The followings are the configuration codes for any size of UPS:



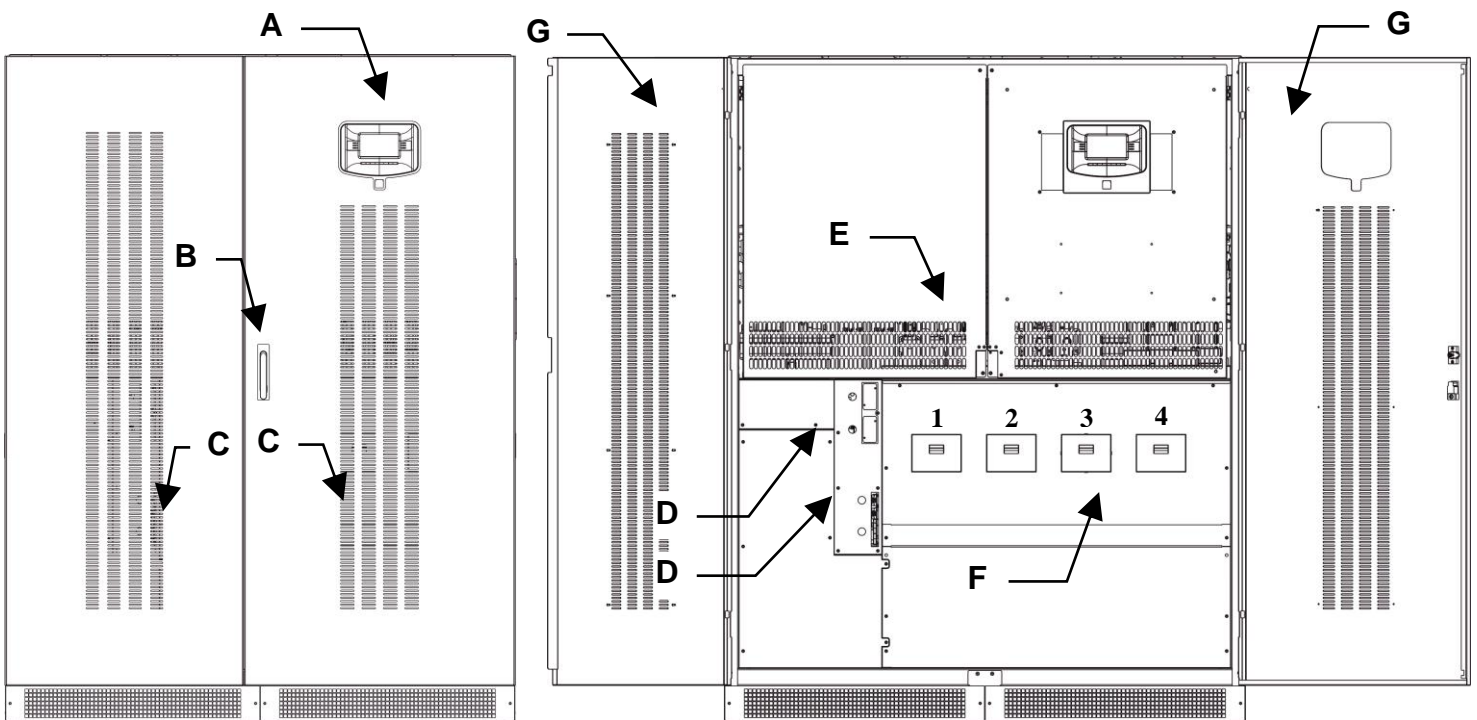
E.g.:

M	H	T	3	0	0	U	L	0	1
---	---	---	---	---	---	---	---	---	---

UPS 300kVA single unit, bottom cable entry, switch maintenance bypass present.

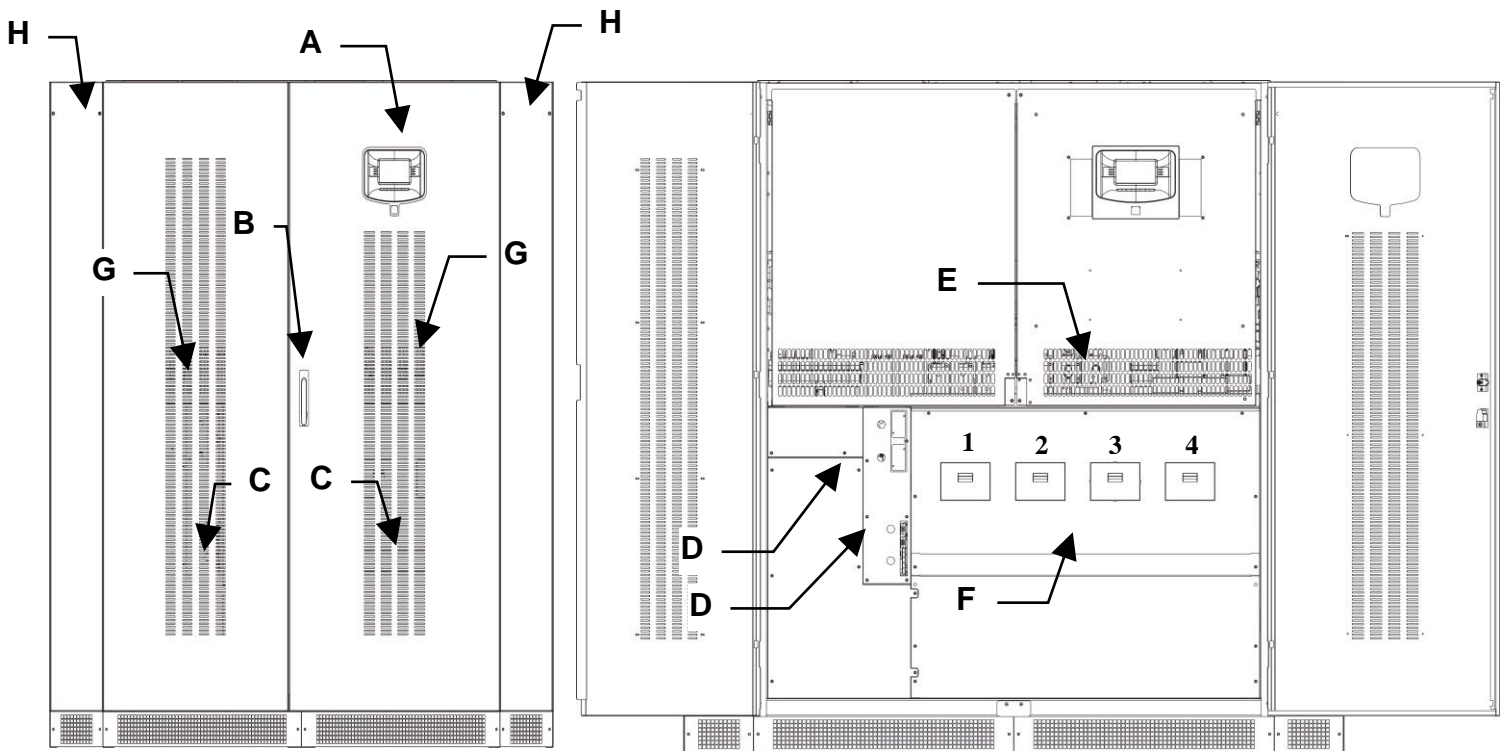
2 Layout

MASTER – HP – UL – Front View



- A Control panel with graphic display
 - B Door handle
 - C Ventilation grilles
 - D Communication area
 - E Front Cover panel with ventilation grilles
 - F Switch cover panel
 - G Door
-
- 1 SWIN: Input power switch
 - 2 SWBY: Static switch bypass input
 - 3 SWMB: Maintenance bypass switch (optional)
 - 4 SWOUT: Static switch output

MASTER – HP – UL (with TCE) – Front View



- A Control panel with graphic display
 - B Door handle
 - C Ventilation grilles
 - D Communication area
 - E Front Cover panel with ventilation grilles
 - F Switch cover panel
 - G Doors
 - H TCE - Top Cable Entry cabinets (Optional)
-
- 1 SWIN: Input power switch
 - 2 SWBY: Static switch bypass input
 - 3 SWMB: Maintenance bypass switch (optional)
 - 4 SWOUT: Static switch output

3 Preliminary operations

3.1 Removing the packaging and positioning the unit

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

3.2 Storage

Place the unit 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:	-13°F to +167°F (-25 to + 75 °C)
Relative humidity:	30-95 % max.

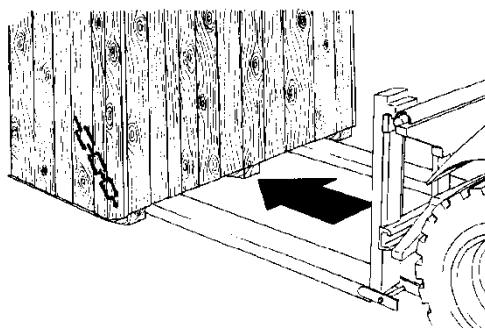


For the installation of a battery cabinet, if provided with the uninterruptible power supply, follow the instructions given in the specific manual.

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.

3.3 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 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 12 inches on the other side.
- 2 Secure the unit to the fork-lift before moving it.



Risk of overturning

In order to avoid the risk of the unit overturning, ensure that the fork-lift truck has the appropriate size for handling the weight of the unit and also that the unit is firmly secured to the fork-lift truck by means of appropriate ropes before moving it.

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

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 Installation environment

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

4.1 Ambient conditions:

- ensure that the floor can support the weight of the MASTER HP - UL and of any battery cabinet that may be used
- avoid dusty environments (the indoor area must be free of conductive contaminations)
- avoid narrow environments that could hinder normal maintenance operations
- avoid placing the unit in areas exposed to direct sunlight or heat
- ensure that the ambient temperature conforms to the following:
 - *minimum operating temperature:* +32°F (0 °C)
 - *maximum temperature for 8 hours a day:* +104°F (+ 40°C)
 - *average temperature for 24 hours:* +95°F (+ 35°C)

4.2 Dimensions of the premises

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

- Position of the holes in the base to secure the unit to the floor, if applicable;
- View of the floor support for the sizing of a structure to raise the cabinet, if applicable;
- Position of cable entry;
- Position of the fans on the top of the UPS, for the positioning of a structure to convey the warm air discharged by the equipment outside the premises, if applicable;
- Input, output and battery cables section;
- Losses of the power dissipated by the equipment (kW).

4.3 Cooling of the premises

The recommended operating temperature for the lifetime of the UPS and of the batteries is between 20 and 25°C. The lifespan of the battery depends on the operating temperature; with an operating temperature increase from 20°C to 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 range of 20-25°C.

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

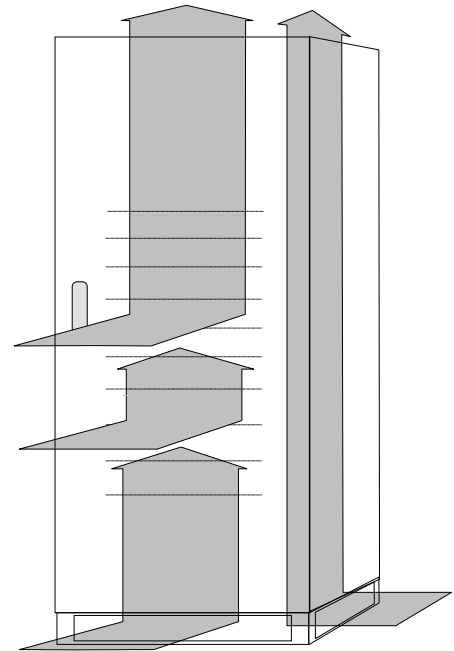
In order to ensure proper air circulation, and therefore the correct operation of the UPS, measures must be taken during installation to avoid any obstructions to the free circulation of air. These include the following:

- Ensure a distance of at least 24 inches from the ceiling, so as not to hinder air extraction,
- Leave a free space of at least 36 inches 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 followed:

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

- The bottom side kick panels plates must not be mounted for installations where cabinets are placed side by side.



4.4 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 recommended that the minimum opening must satisfy the following equation:

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

where:

A = free opening for air intake and outlet

Q = airflow 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 vented types or nickel batteries, contact the battery manufacturer.

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

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

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

$$A = 41 \text{ [cm}^2\text{]} \text{ or (multiplied by .155) = 6.36 in}^2$$



The air intake and outlet must be positioned to ensure the best possible circulation; for example:
- apertures on opposite walls sides,
- a minimum distance of 6 ft. when they are on the same side of the wall.

5 Electrical Connections

ACCESSING THE UPS TERMINALS



The following operations must be performed while the UPS is disconnected from the utility mains power, switched off and all the input and output power switches on the equipment are open. Before performing connection, open all the input and output power switches and check that the UPS is completely isolated from all power sources: battery and AC power line. In particular, check that:

- **the UPS input line is completely isolated;**
- **that the battery circuit breaker/disconnect is open;**
- **all the UPS power and load connection switches (SWIN, SWBY, SWOUT and SWMB if fitted) are in the open position;**
- **no dangerous voltages are present (use a multimeter).**



The first connection to be performed is the protective wire (earth ground cable) which has to be inserted into the terminal labelled "Grounding Electrode Terminal". The UPS must operate with the grounding system connected.



Do not connect the output neutral to the input neutral.



CAUTION: If the input connection is Delta the UPS can supply only Delta load. The output neutral must not be connected unless the UPS is the Wye version supplied with an input neutral. TRANSFORMER BOXES (optional) are available for converting the distribution systems from 3 to 4 wires.



CAUTION: If a three-phase non-linear load is connected to the output, the current on the neutral conductor can reach a value equal to 1.5 times the value of the phase current. Dimension the input/output neutral cable appropriately taking this fact into account .



CAUTION: The UPS cannot feed from a corner ground or mid-point grounded delta supply source.



CAUTION: Use only lugs or cables with tin-plated eyes for the connections.



**CAUTION: Ensure correct phase rotation at the input and output terminals
Ensure correct polarity battery connections**

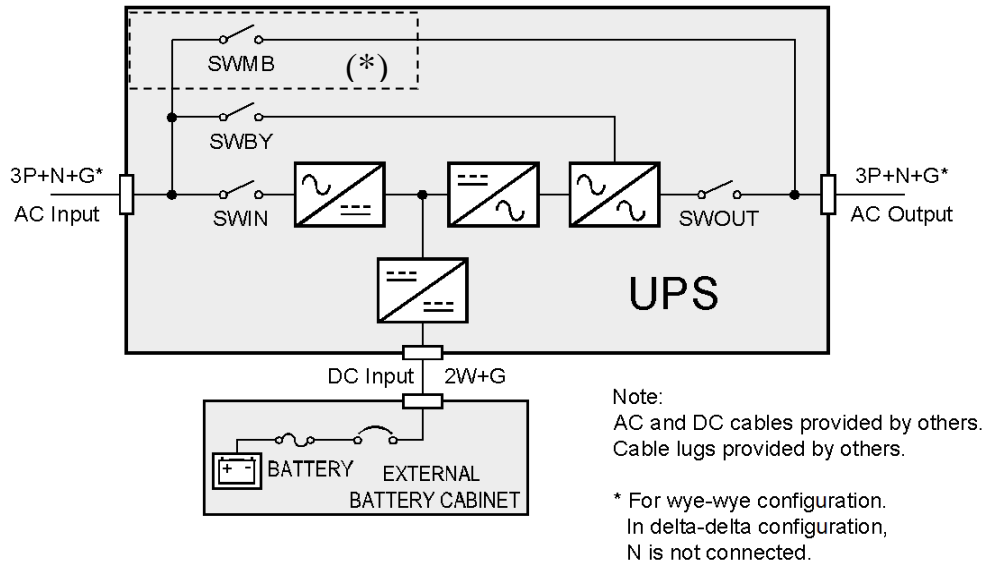


Each model can be configured for a delta input source with a delta connected load or for a wye input with a wye connected load. If the load requires a neutral connection (i.e. wye), then an input neutral must be provided. Refer the Power Connection terminals diagrams later in this section for details concerning configuration of the neutral to ground bond.

5.1 UPS in single configuration

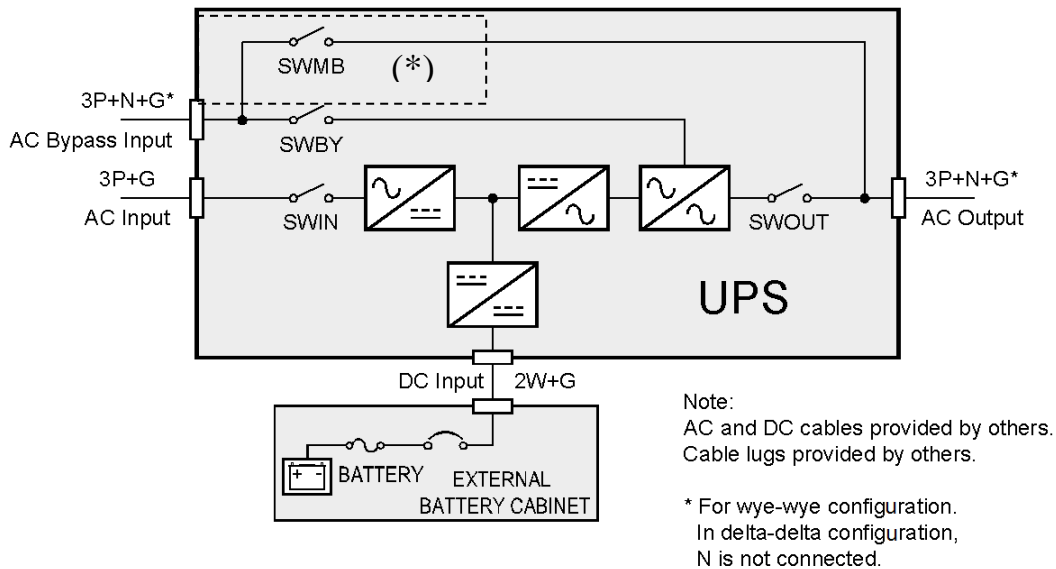
The UPS is designed to work either as Single input Unit or as Dual input Unit.

Schematic diagram: **Single input Unit**



(*) *OPTION*

Schematic diagram: **Dual input Unit**



(*) *OPTION*

5.1.1 Cable Entry

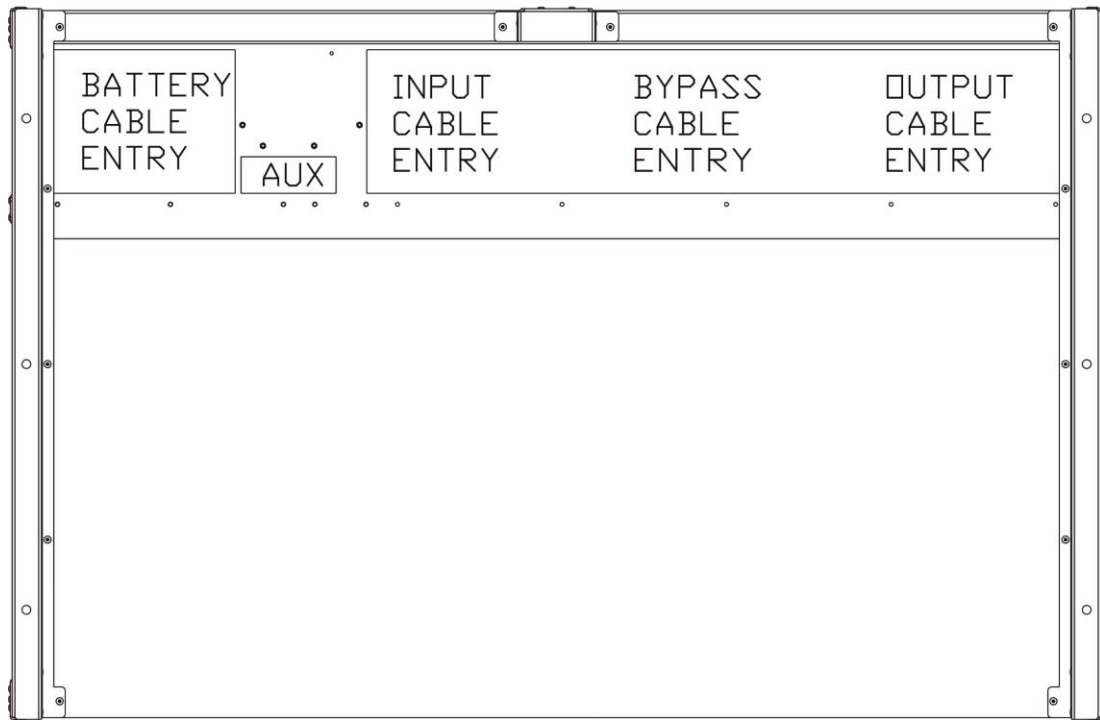
The cables can enter in the UPS from the bottom or the top in the *MASTER HP – UL* it depends on the configuration of the unit.

Proceed as follows in order to open the UPS

- Open the door
- Remove the switch cover panel
- Remove the bottom cable entry cover plates
- Drill or punch conduit holes in the cover plates
- Route the power cable through the bottom to the UPS terminals in base to your configuration (see the next paragraphs)

MASTER HP - UL, bottom cable entry version

FRONT

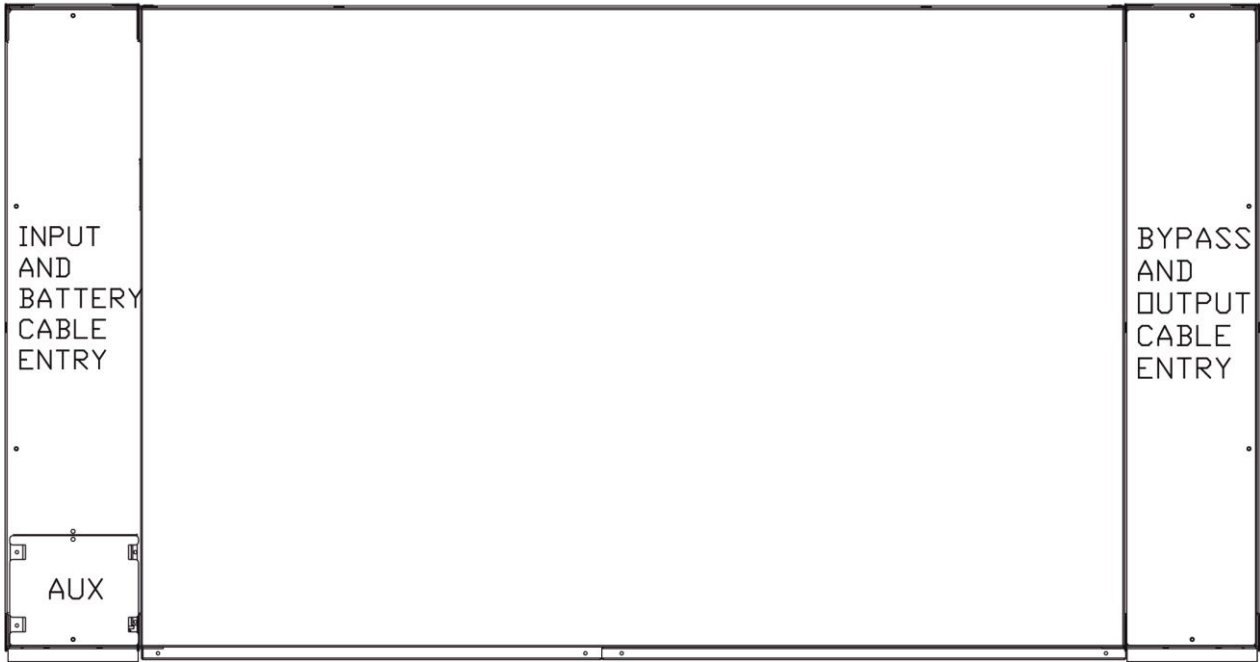


REAR

-bottom view: footprint of cable entry in the UPS from the bottom-

MASTER HP - UL, top cable entry version

REAR



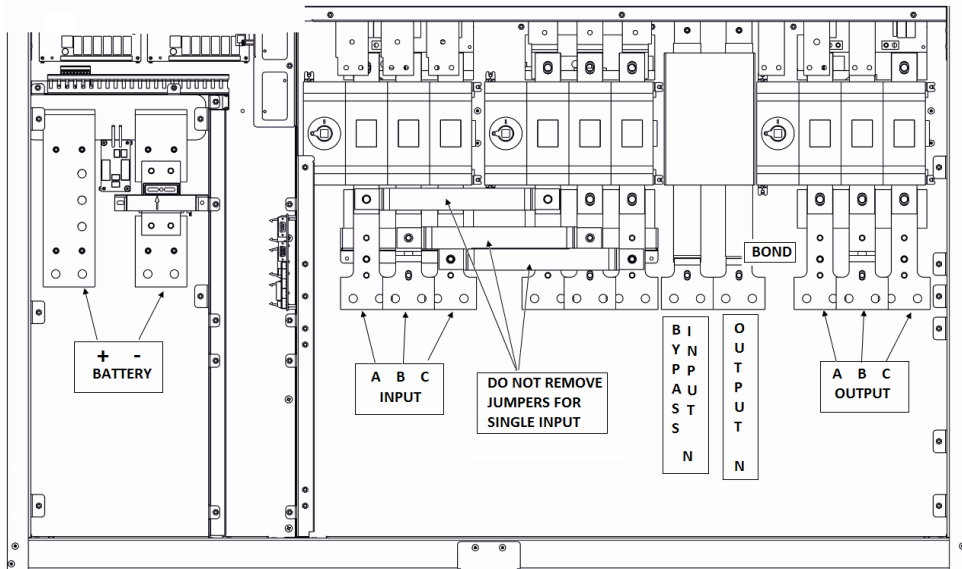
FRONT

-Top view: cable entry in the UPS from the top-

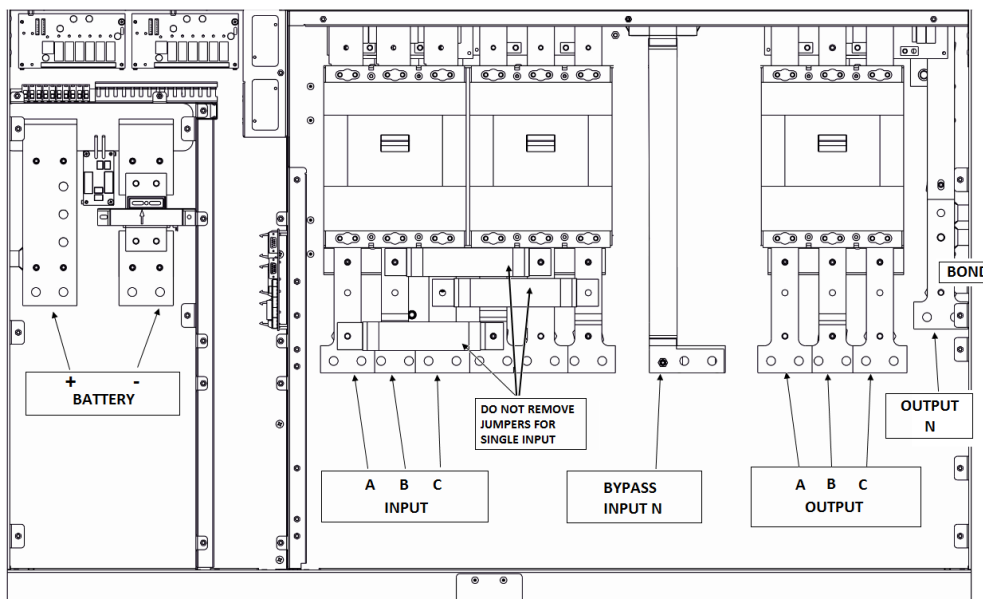
5.1.2 Connection of Power Cables for Single input Unit

Connect the input, output and battery cables to the terminals as shown in the figure below:

MASTER HP – UL 300 kVA Power connection Terminals



MASTER HP – UL 400 kVA and 500 kVA Power connection Terminals



Note: Maintenance Bypass Switch optional.

The single input is a factory default configuration. Do not remove the bypass jumpers. The input phase connections are made using bolts to the bus bar. Do not loosen the bolts that attach the bus bars.

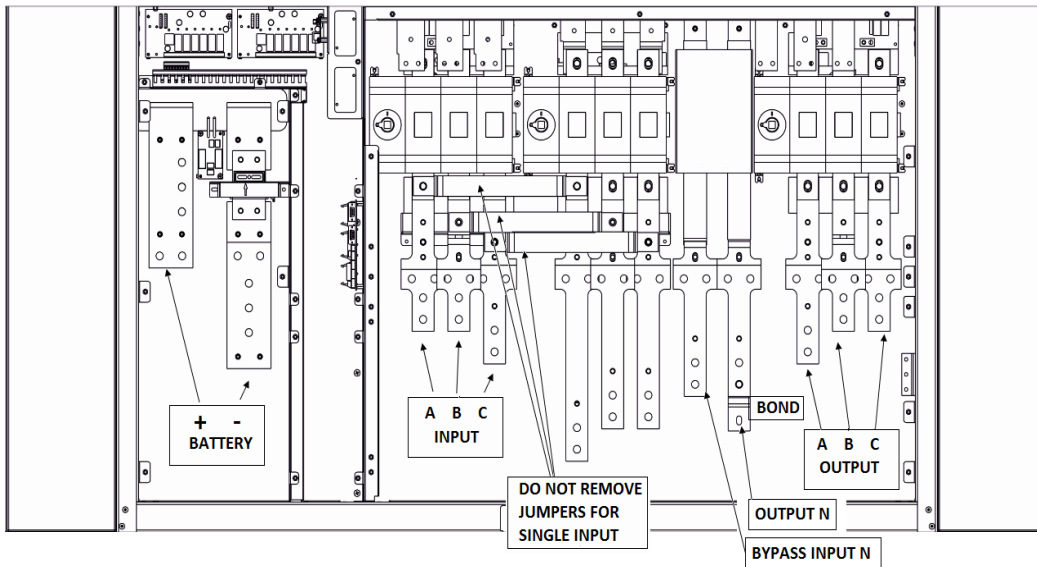


Bond: The UPS is provided with a separate bus bar that connects the Neutral Output to the frame Ground for delta input connection. This is required to meet NEC grounding code for separately derived neutrals. When a Neutral is provided in a Wye configured input connection the bus bar should be removed.

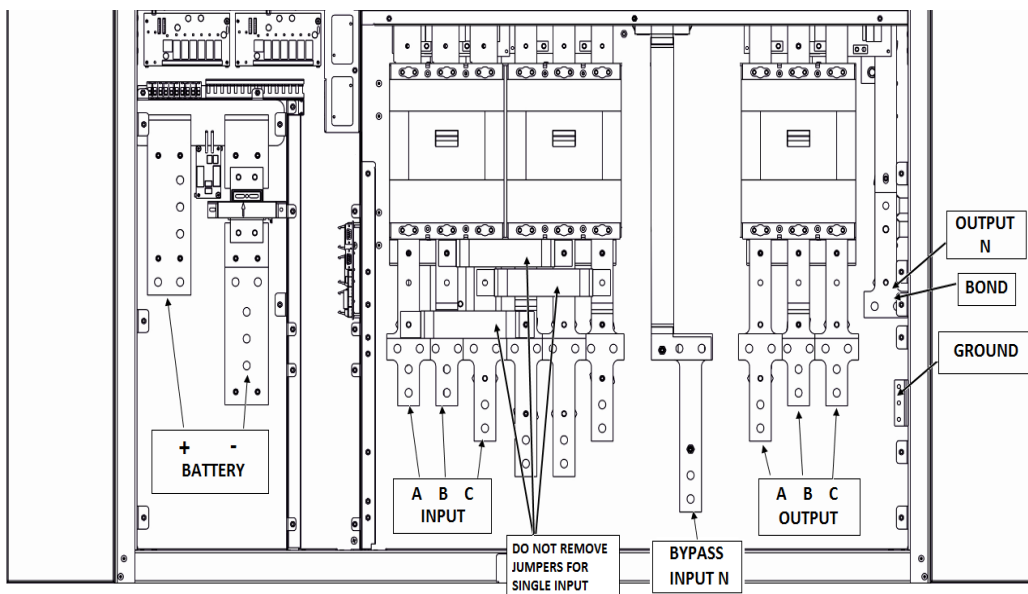
Refer to NEC article 250 (Grounding and Bonding) for identify system of grounding and size of equipment grounding conductor

Once installation has been completed inside the equipment, put the switch cover panel back and close the door.

MASTER HP - UL 300 kVA with TCE Power connection Terminals



MASTER HP - UL 400 kVA and 500 kVA with TCE Power connection Terminals



Note: When cables entering from the top, respect the following order: connecting cables to the Input terminals first and Battery terminals then, and in the same way, connecting cables to the Bypass terminals first and Output terminals then. The label marked “N” present on the terminal identifies the neutral terminal. Maintenance Bypass Switch optional.

The single input is a factory default configuration. Do not remove the bypass jumpers. The input phase connections are made using bolts to the bus bar. Do not loosen the bolts that attach the bus bar.

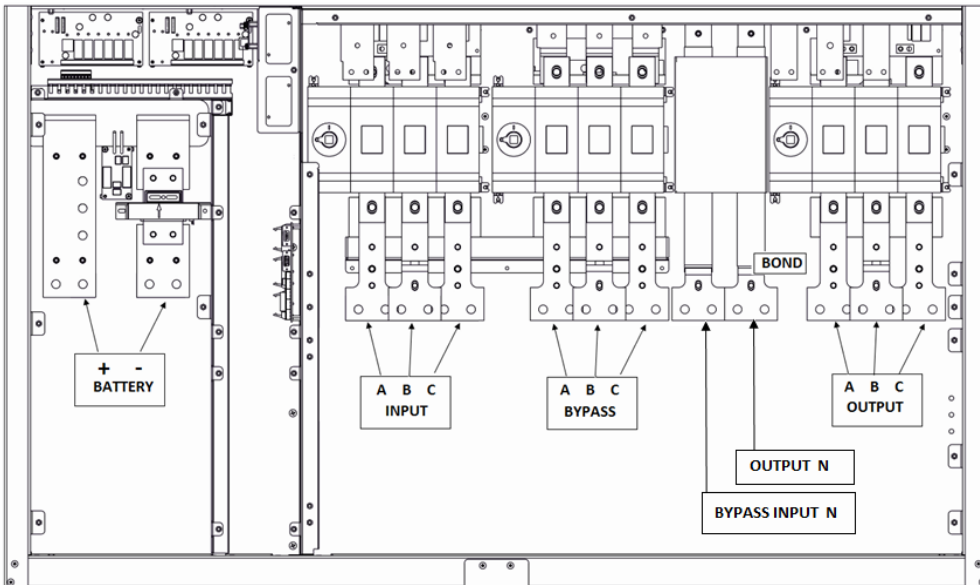
Bond: The UPS is provided with a separate bus bar that connects the Neutral Output to the frame Ground for delta input connection. This is required to meet NEC grounding code for separately derived neutrals. When a Neutral is provided in a Wye configured input connection the bus bar must be removed.

Once installation has been completed inside the equipment, put the switch cover panel back and close the door.

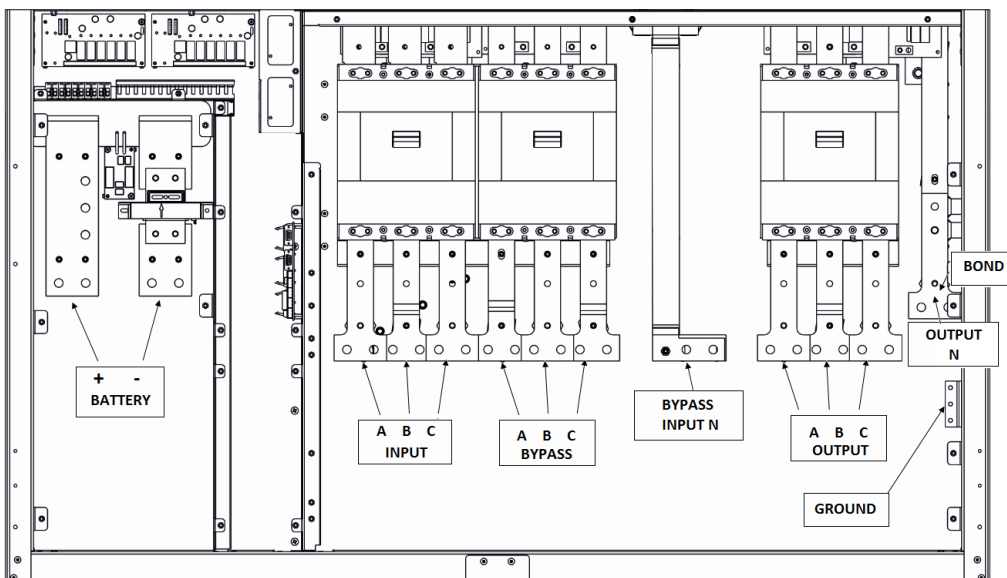
5.1.3 Connection of Power Cables for Dual input Unit

Connect the input, output and battery cables to the terminals as shown in the figure below:

MASTER HP - UL 300 kVA Power connection Terminals



MASTER HP - UL 400 kVA and 500 kVA Power connection Terminals



Remove the jumpers present between the SWIN and SWBY.

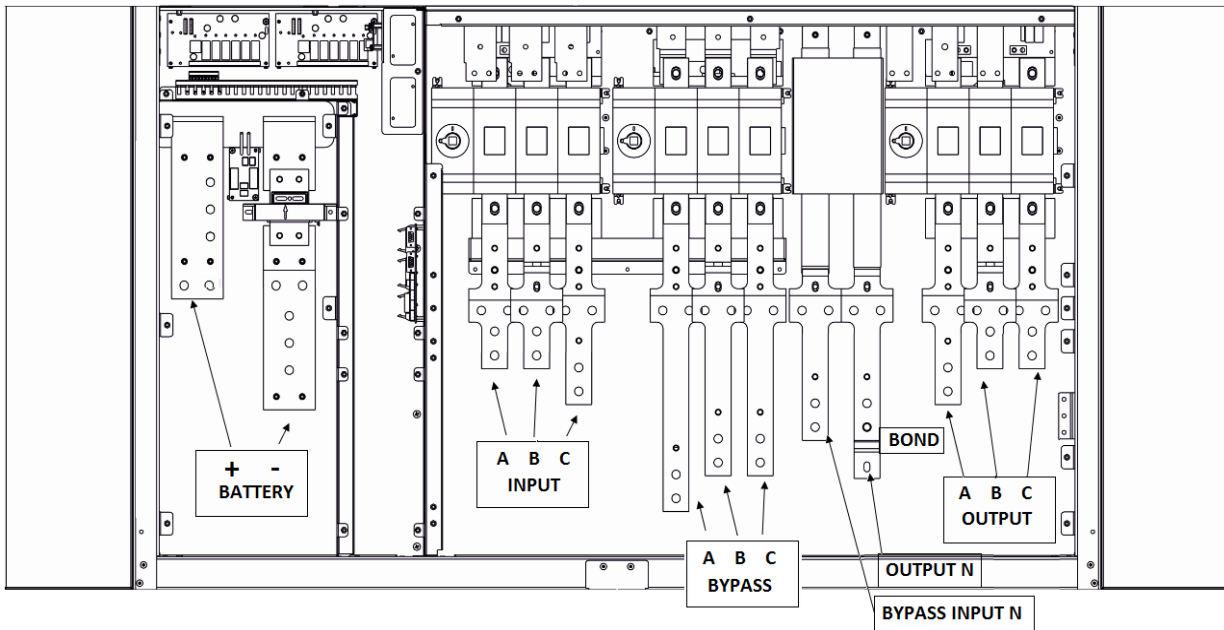
The input phase connections attach using bolts through the holes that were previously used to attach the bus bars. The main (rectifier) input is located on the left and the bypass input is on the right. The neutral input comes from the bypass source; no neutral is to run from the rectifier input source, although the rectifier source must be a grounded wye.

Note: Maintenance Bypass Switch optional.

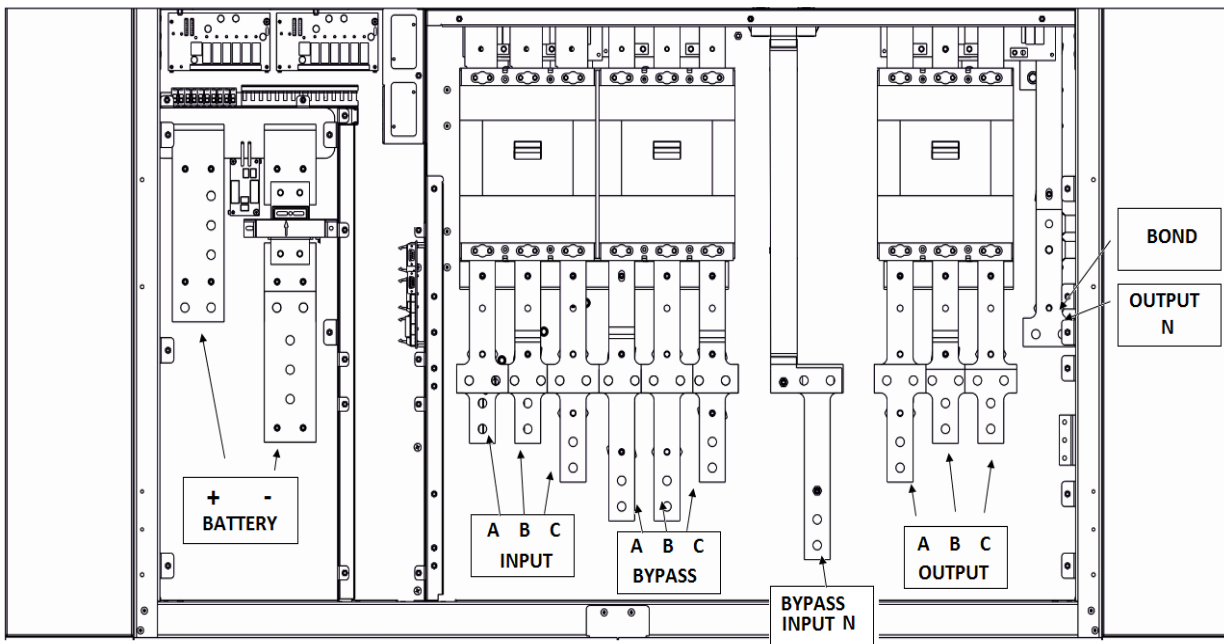
Bond: The UPS is provided with a separate bus bar that connects the Neutral Output to the frame Ground for delta input connection. This is required to meet NEC grounding code for separately derived neutrals. When a Neutral is provided in a Wye configured input connection the bus bar must be removed.

Once installation has been completed inside the equipment, replace the switch cover panel and close the door.

MASTER HP - UL 300 kVA TCE Power connection Terminals



MASTER HP - UL 400 kVA and 500 kVA TCE Power connection Terminals



Remove the jumpers present between the BYPASS and INPUT bars.

Note: When cables entering from the top, respect the following order: connecting cables to the Input terminals first and Battery terminals then, and in the same way, connecting cables to the Bypass terminals first and Output terminals then. The label marked “N” present on the terminal identifies the neutral terminal.

The neutral input comes from the bypass source; no neutral is to be run from the rectifier input source, although the rectifier source must be a grounded wye.

Maintenance Bypass Switch optional.

Bond: The UPS is provided with a separate bus bar that connects the Neutral Output to the frame Ground for delta input connection. This is required to meet NEC grounding code for separately derived neutrals. When a Neutral is provided in a Wye configured input connection the bus bar must be removed.

Once installation has been completed inside the equipment, replace the switch cover panel and close the door.

5.2 Minimum Wire Size Requirements

Input (for single input unit)	
UPS models	Phase and Neutral Conductor
300 kVA	2 x 350 kcmil / (2 x 177 mm ²)
400 kVA	3 x 300 kcmil / (3 x 152 mm ²)
500 kVA	3 x 300 kcmil / (3 x 152 mm ²)

Rectifier Input (for dual input unit only)	
UPS models	Phase Conductor
300 kVA	2 x 350 kcmil / (2 x 177 mm ²)
400 kVA	3 x 300 kcmil / (3 x 152 mm ²)
500 kVA	3 x 300 kcmil / (3 x 152 mm ²)

Bypass Input (for dual input unit only)	
UPS models	Phase and Neutral Conductor
300 kVA	2 x 350 kcmil / (2 x 177 mm ²)
400 kVA	3 x 300 kcmil / (3 x 152 mm ²)
500 kVA	3 x 300 kcmil / (3 x 152 mm ²)

Output	
UPS models	Phase and Neutral Conductor
300 kVA	3 x 2/0 AWG / (3 x 67.4 mm ²)
400 kVA	3 x 3/0 AWG / (3 x 85.0 mm ²)
500 kVA	3 x 4/0 AWG / (3 x 107 mm ²)

Battery	
UPS models	Phase Conductor
300 kVA	3 x 300 kcmil / (3x 152 mm ²)
400 kVA	3 x 400 kcmil / (3 x 203 mm ²)
500 kVA	4 x 400 kcmil / (4 x 203 mm ²)

Note: For 500kVA, when installing copper wires, use a suitable oxide inhibiting compound.



CAUTION: Use at least 75° C rated copper wire. Minimum wire size is based on full load ratings applied to NEC Code Table 310-16. Code may require a larger AWG size than shown in this table because of temperature, number of conductors in the conduit, or long service runs. Follow local requirements. Branch circuit protection must be provided for the input circuits as part of the installation.

Per NEC article 300-20(2), all three-phase conductors must be run in the same conduit. Neutral and ground must be run in the same conduit as the phase conductors.

Conduit is to be sized to accommodate one neutral conductor the same size as the phase conductors and one ground conductor. If two neutral conductors or an oversized neutral conductor are to be installed, check the size of the conduit needed to accommodate the extra wire or size and use that conduit size in place of the conduit size listed. Conduit sizes can be chosen from NEC Table C1, type letters RHH, RHW, RHW-2, TW, THW, THHW, THW-2.

5.3 External Over Current Protection unit and terminals



CAUTION to reduce the risk of fire, connect only to a circuit provided with branch circuit protection with maximum current rating per the table, below, in accordance with the National Electrical Code, ANSI/NFPA 70.

Input (for single input unit)					
UPS models	Nominal Current	Maximum Current	OCP Current	OCP Unit rating	Bolt Size (in. - ISO)
300 kVA	361A	433A	541A	600A	1/2 - M12
400 kVA	481A	640A	800A	800A	1/2 - M12
500 kVA	601A	640A	800A	800A	1/2 - M12

OCPD= Over Current Protection Device, must be rated for branch circuit protection.

Rectifier Input (for dual input unit)					
UPS models	Nominal Current	Maximum Current	OCP Current	OCP Unit rating	Bolt Size (in. - ISO)
300 kVA	361A	433A	541A	600A	1/2 - M12
400 kVA	481A	640A	800A	800A	1/2 - M12
500 kVA	601A	640A	800A	800A	1/2 - M12

Bypass Input (for dual input unit)				
UPS models	Nominal Current	OCP Current	OCP Unit rating	Bolt Size (in. - ISO)
300 kVA	364	455A	600A	1/2 - M12
400 kVA	486	607A	800A	1/2 - M12
500 kVA	607	759A	800A	1/2 - M12

Output		
UPS models	Nominal Current	Bolt Size (in. - ISO)
300 kVA	361A	1/2 - M12
400 kVA	481A	1/2 - M12
500 kVA	601A	1/2 - M12



CAUTION Output circuit protection requirement is determined by distribution circuit. Smaller wire may be used for load wiring if rated load current is not needed and the appropriate circuit protection is applied. Output circuit protection must be provided as a part of the installation.

Battery				
UPS models	Nominal Current	Maximum Current	OCP Device rating	Bolt Size (in. - ISO)
300 kVA	641A@480Vdc	769A@400.8Vdc	800A	1/2 - M12
400 kVA	855A@480Vdc	1025A@400.8Vdc	1000A	1/2 - M12
500 kVA	962A@480Vdc	1154A@400.8Vdc	1200A	1/2 - M12



CAUTION: Input and output circuit protection devices must be provided by others as part of the UPS installation.



NOTE: Cables and lugs are not supplied.

Torque specifications			
Bolt Size	Torque Load	Bolt Size	Torque Load
Inch	lbf-ft	ISO	Nm
5/16	13 ÷ 17	M8	18 ÷ 23
3/8	27 ÷ 34	M10	36 ÷ 46
1/2	44 ÷ 59	M12	60 ÷ 80

5.3.1 Ground Fault Circuit Interrupter (GFCI)

If the UPS protection against electric shock uses a Ground Fault Circuit Interrupter (GFCI), it will have to have the following characteristics:

- Sensitivity > 300mA
- Sensitive direct current and unidirectional components (class A or class B)
- Insensitive to transient current pulses
- Delay greater than or equal to 0.1s.



neutral

In the standard version without an isolation transformer on the bypass line, the neutral from the mains power supply is connected to the output neutral of the UPS.

THE ELECTRICAL SYSTEMS UPSTREAM AND DOWNSTREAM OF THE UPS MUST BE EXACTLY THE SAME (DELTA-DELTA or WYE-WYE)

When operating in the presence of mains supply, a GFCI installed on the input will trip as the output circuit is not isolated from the input circuit.

When operating without mains supply (from battery) the input GFCI will trip only if it is able to switch as a result of leakage current without any voltage at its poles (for example a GFCI with an auxiliary relay is not suitable). However, it is possible to install additional GFCIs on the output of the UPS, coordinated with those on the input.

5.3.2 Backfeed protection

The UPS is provided with a redundant device to prevent voltage backfeed on the by-pass input line due to an internal fault. This protection device works by switching off the inverter if a voltage backfeed on the bypass occurs caused by the flowing of a fault current. If the fault occurs when the UPS is operating from the battery, the load will not be powered.

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

5.3.3 Emergency power off device (EPO)

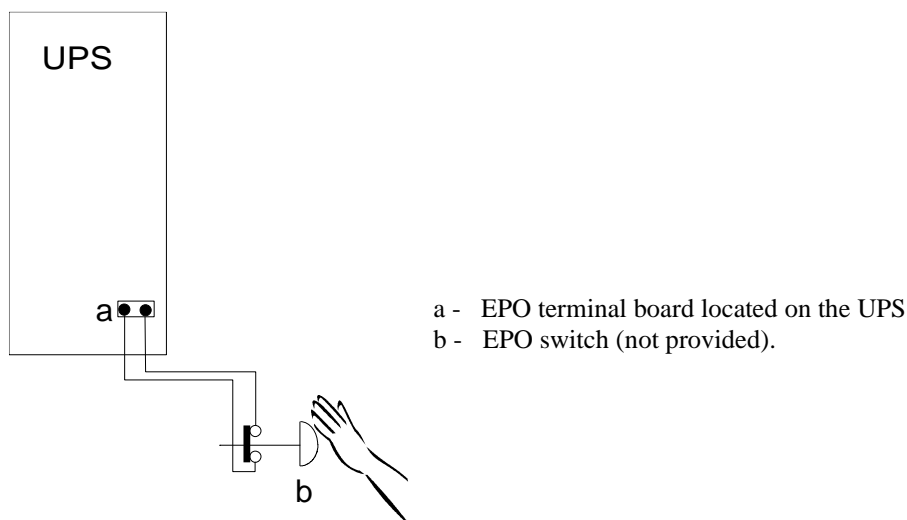
The UPS has an EPO (Emergency Power Off) function.

In the event of an emergency using this function the UPS shuts down the rectifier, inverter, static switch and completely disconnects the power to the load.

The Output circuit of the UPS should not be considered safe, unless the UPS is Off and the input power source to the UPS has been removed by opening the input disconnect devices which are external to the UPS, including the battery.

This function can be activated from the button (under a hinged clear plastic cover) on the control panel or by a remote contact. This button must be depressed and held down until the UPS shuts down.

To connect an external EPO to the remote contact follow this procedure.



On the UPS, 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.

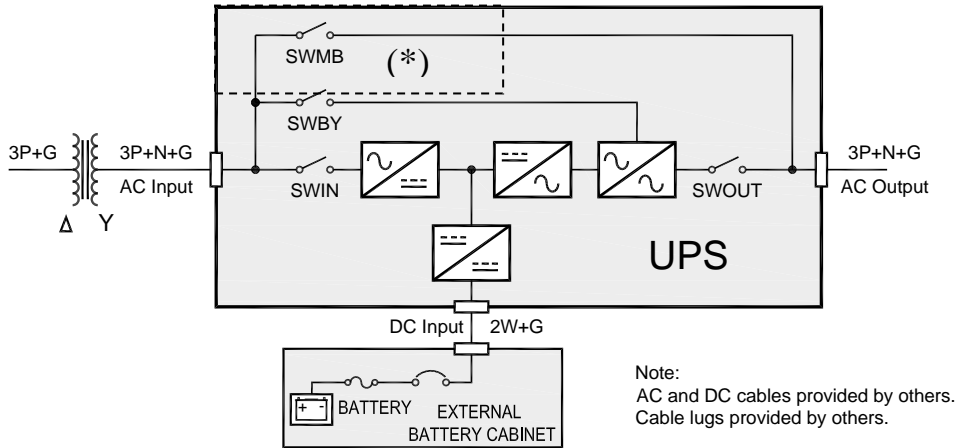
The contact must be normally closed and must open when the button is pressed.

5.4 Mains, load and battery connections

Input line without neutral

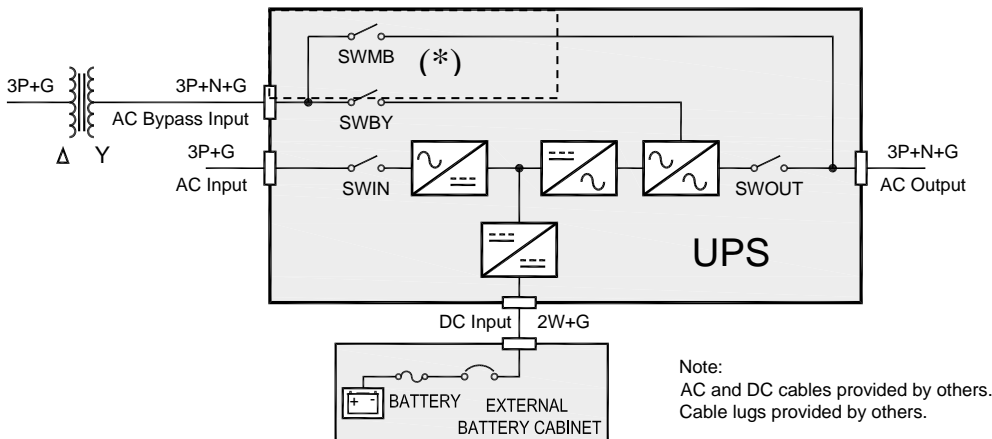
A transformer must be inserted either on the mains supply line or on the bypass line (as shown in the drawings) if the load requires a neutral.

Schematic diagram: **Single power line without neutral from the source**

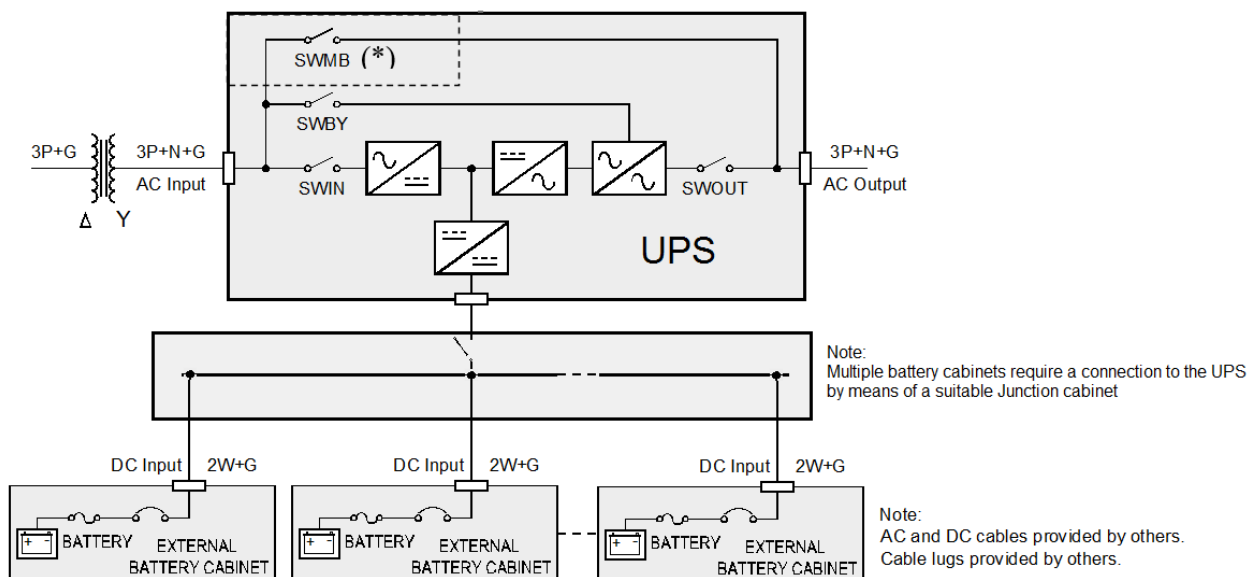


(*) *OPTION*

Schematic diagram: **Main power supply and separate bypass without neutral from the source**



Schematic diagram: **Multiple battery cabinets connected to the UPS by means of a Junction cabinet**



Battery connections



This UPS has been designed to be supplied by a battery consist on 240 Lead Acid Battery cells (40 12Vdc battery blocks).
See “General Characteristics” for voltages and current of charge



If Riello “BBX 1900 480V UL xx” battery cabinets are used, the connection must be made in accordance with the manual for the battery cabinet.
If battery cabinet of other manufacturers or battery room, are provided:
Overcurrent Protection and disconnecting device on both polarities must be provided in accordance with data given in the table “**Battery**” in section **External Over Current Protection device and terminals**
Compliance with safety standard of batteries installation will be care of batteries supplier.
If more than one battery cabinet need to be connected to the UPS, a suitable junction cabinet must be added for making parallel of battery cabinets before connection to the UPS

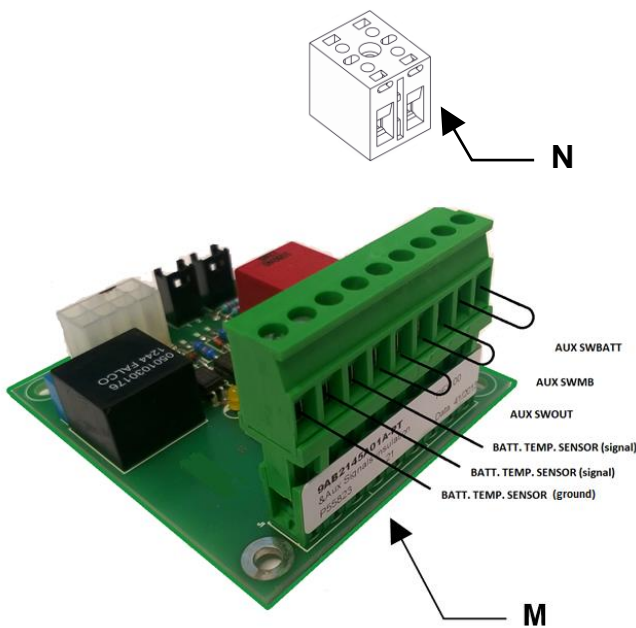
5.5 Connection of signals and remote commands



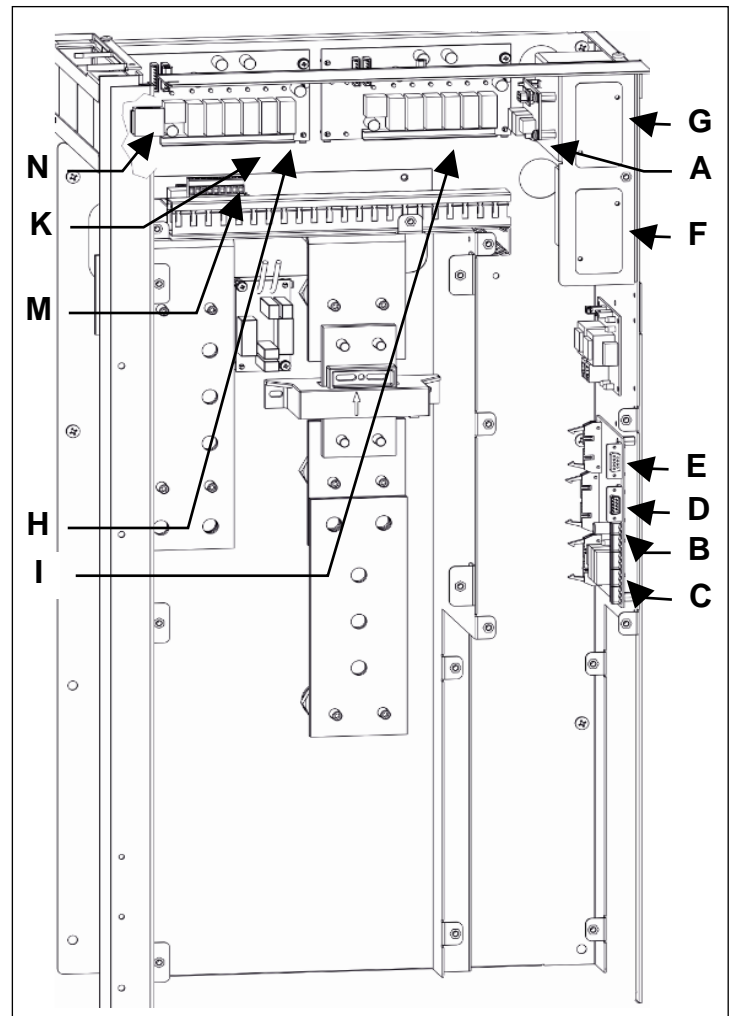
Attention should be drawn to the necessity of maintain the security of any SELV CIRCUIT when connected to other equipment. See the detail in the following points for each type of signal.
Connections to the board and interface terminal connector should be performed by authorized technical support personnel.

In order to access the interface cards, open the door and remove the protection panel (K) secured with screws:

MASTER HP – UL 300 - 400 and 500kVA



- A- PARALLEL BOARD
- B- EPO (emergency power off control)
- C- REMOTE COMMANDS AND ALARMS
- D- RS232-2
- E- RS232-1
- F- SLOT 2 (aux)
- G- SLOT 1 (main)
- H- REMOTE ALARMS (optional)
- I- REMOTE ALARMS (optional)
- M- Aux signals isolation board
- N- Terminal block





NOTE: Aux signals isolation board allows receiving external auxiliary contacts and keeping them isolated from the UPS internal circuits making easier connections in case of paralleling of the units. Jumpers AUX (SWBATT, SWMB, SWOUT) must be connected to the terminal of the board if no external auxiliary contacts are presents.

Connector J1 of Aux signals isolation board			
PIN	NAME	TYPE	FUNCTION
1	AUX SWBATT	INPUT	Normally open: contact used to indicate when SWBATT is closed
2	AUX SWBATT RETURN	INPUT	
3	AUX SWMB	INPUT	Normally close: contact used to indicate when the SWMB EXT is closed
4	AUX SWMB RETURN	INPUT	
5	AUX SWOUT	INPUT	Normally open: contact used to indicate when the SWOUT EXT is closed
6	AUX SWOUT RETURN	INPUT	
7	BAT. TEMP. SENSOR	INPUT	temperature ambient from battery cabinet
8	BAT. TEMP. SENSOR	INPUT	
9	GROUND	INPUT	Cable shield to ground

Terminal block			
PIN	NAME	TYPE	FUNCTION
1	SWBATT coil	OUTPUT	Normally open dry contact: used in a circuit at 24Vdc for supply SWBATT coil.
2	SWBATT coil	OUTPUT	

Torque specifications for connector J1 on aux signals isolation board		
AWG Wire size range	Torque Load	
#30 -12AWG	0.37 – 0.44 lbf-ft	0.5 – 0.6 Nm

Torque specifications for terminal blocks on customer interface board		
AWG Wire size range	Torque Load	
#22 -12AWG	4.4 lbf-ft	6 Nm

5.5.1 REMOTE COMMANDS, ALARMS AND EPO

-C- The card is equipped with a terminal board with 14 positions.



SELV CIRCUIT PROVIDED.

THE FOLLOWING SIGNALS MUST BE CONNECTED TO SELV CIRCUIT ONLY.

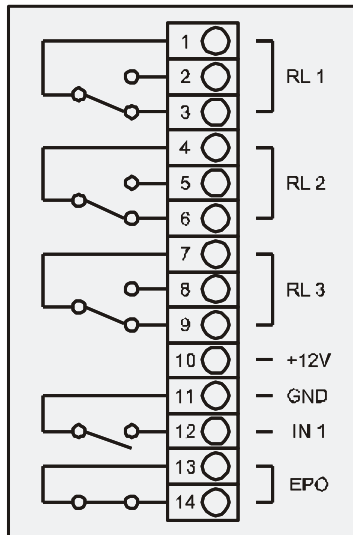
POWER SUPPLY	1 power supply 12Vdc 80mA (max.) [pins 10 and 11];
ALARMS	3 FORM C dry contacts for alarms (they are capable of switching up to 30 V AC or DC and UP to 1 A);
COMMAND	1 command programmable from the panel [pins 11 and 12];


Interface REMOTE COMMAND ALARMS AND EPO			
PIN	NAME	TYPE	FUNCTION
1,2,3	RL 1	OUTPUT 1	Bypass / fault, the contact changes position when the UPS switches the load onto the bypass line either during normal operation (e.g. due to overload) or as a result of a fault in the inverter module. See Note below
4,5,6	RL 2	OUTPUT 2	Battery discharging, the contact changes position when the load is powered from the battery due to a mains power failure
7,8,9	RL 3	OUTPUT 3	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)
10	+12V	POWER	Power supply +12Vdc 80mA (max.) [pins 10 and 11]
11	GND	POWER	
12	IN 1	INPUT 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 UPS switches the power supply of the load onto the bypass line (load is not protected in case of mains outage). - In "EMERGENCY OPERATION", If the STOP INVERTER command is received, the UPS shuts down (load is not powered). See Note below
13,14	EPO	INPUT EPO	If the jumper on the connector is opened, the voltage on the UPS output will shut down. The UPS is factory-fitted with the EPO terminals short circuited. If this input is used, the UPS can be shut down in a hazardous situation from a remote position simply by pressing a button.

Warning: if only the mains power supply is removed, for example by opening the switch of the power supply panel, as a means to shut down the UPS in an emergency the UPS will keep the load powered using the energy in the batteries.

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

The position of the contacts as shown is without the alarm present. **The contacts rating is 24Vac 1A max .**



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

5.5.2 RS232



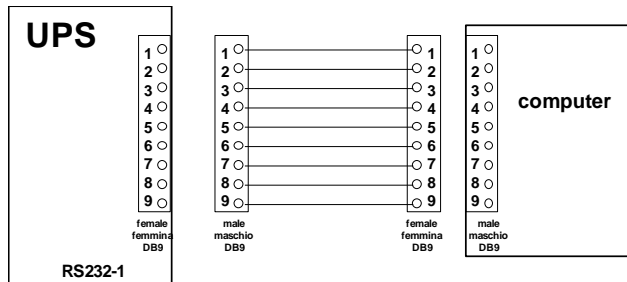
SELV CIRCUIT PROVIDED.
CONNECT TO SELV CIRCUIT ONLY.

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.

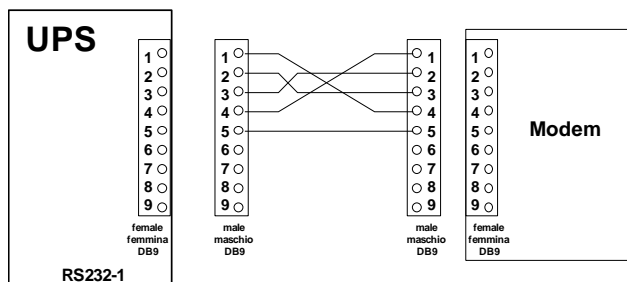
The transmission speed may be set from 1200 to 9600 baud, by using the CUSTOMIZATION menu on the CONTROL PANEL. Depending on the length of the communication line, the recommended values for the transmission speed are 9600 baud 50m, 4800 baud 100m, 2400 baud 200m, 1200 baud 300m.

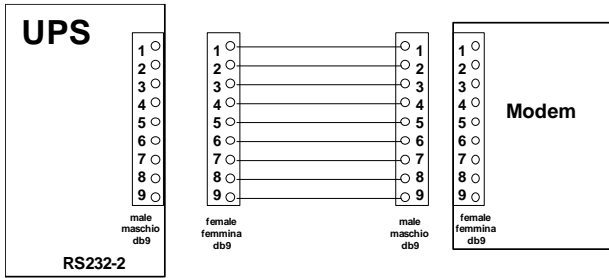
See the diagrams below for the connection procedure.



DB9 female RS232-2

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

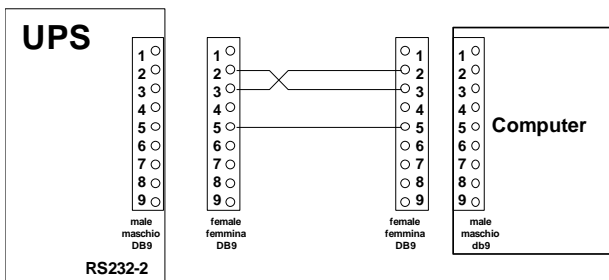




DB9 male RS232-1

- E - For connection with a modem use a cable standard.

See the diagram for connection with a computer.



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

-F, G- NetMan 204 (on SLOT 1 main or SLOT 2 aux)



**SELV CIRCUIT PROVIDED.
CONNECT TO SELV CIRCUIT ONLY.**

Device for management of the UPS's on the Ethernet. It can send information on the status of the device with different 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 UPS into the LAN network ensuring a high level of reliability of communication with the server to enable full management and control of the UPS.



For the full and updated list of communication accessories, please see the website www.riello-ups.com.

5.5.4 REMOTE ALARMS (2 optional cards for the MASTER HP-UL)

**SELV CIRCUIT PROVIDED.
CONNECT TO SELV CIRCUIT ONLY.**



- H, I - 6 outputs: dry contacts for alarms (programmable from the display panel) (they are capable of switching up to 30 V AC/DC and up to 1A), 2 inputs (programmable from the panel) and 1 12V DC maximum 100mA auxiliary input.

5.5.5 Battery temperature sensor (optional)


-M- The UPS has an input available on the auxiliary signals isolation board, for the kit which consists of a sensor to be placed inside the battery cabinet. The use of the temperature sensor allows the UPS control logic to adjust the values of the charge and maintenance voltage according to the actual temperature of the battery.

5.5.6 SWOUT and SWMB EXTERNALS


See section “Parallel”.

5.6 Start-up procedure

mains power supply




The mains power supply has to be present in order to start up the UPS



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

BATTERY CABINET if present:



The battery cabinet ***must be*** provided with a disconnect device for it to be connected to the UPS. This disconnect device ***must*** be closed ***only when*** the UPS is started up regularly. During the UPS start-up phase the disconnect device ***must*** remain in the open position.

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


- all the input/output terminals are securely tightened;
- all the fuse holders have the fuse inserted, and are in the closed position;
- the input and output ground conductor is connected correctly (yellow/green earth grounding 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 power switch SWIN,
- 2) press button 1 twice, select the language and then press button 8 to return to the basic menu,
- 3) after a few seconds, messages on the status of the UPS will start to be shown on the first line of the display panel; these will include the following message relating to the battery disconnect:
Wait: DO NOT connect the BATTERY
- 4) close the static bypass line input switch SWBY,
- 5) close the output switch SWOUT.
- 6) do not close the external battery circuit breaker/disconnect device.

Once these operations have been carried out, the noise of the fans and the sound of the buzzer will be heard.



Close the external battery circuit breaker/disconnect ***only when the following message is no longer shown*** on the first line of the display panel:
Wait: DO NOT connect the BATTERY

Note: If multiple battery cabinets are present, all breakers must be close within one minute after the ***Wait: DO NOT connect the BATTERY*** message disappears. If this time constraint is a problem, do the following:

1. Disable the automatic battery test by pressing button 3 then 5 on the control panel, followed by entering the code 323232.
2. Close all of the battery cabinet circuit breakers
3. Re-enter the code 323232 to enable the battery test.

Configure the value of the battery capacity according to the instructions on page 53.

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 UPS started correctly and with the battery connected on the signals and control panel, the two green input and output LED's must be lit continuously.



SWMB (optional)

The Maintenance bypass switch SWMB must not be closed during normal operation of the UPS. SWMB should only be closed during UPS maintenance operations in order to keep the load powered (see the instructions on page 37).

When the UPS is first started up, it is in on-line mode (see page 36). See pages 36 and 59 to set Standby-on / Smart active operating mode.



configurations

Contact the factory for other operating modes.

Once the UPS has been installed, check that the message NORMAL OPERATION appears on the first line of the display panel.

5.6.1 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 to perform this test.

With the UPS in normal operation, open switch SWIN located at the UPS input (rectifier). The buzzer should sound immediately. The display on the CONTROL PANEL should appear similar to the picture shown on page 43 of this manual (with 5=ON). OUT. (Green LED) and BATT. (Yellow LED) on the Signals and Commands Panel should be ON.

Check that the load connected to the UPS is powered. In this state, the power supplied to the load is being provided by the batteries. Close the input power switch 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 full battery discharge test can be carried out, the battery must be charged to full capacity. Charge for 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.

Battery life will be reduced if the battery is operated at temperatures greater than 20° C.

5.7 Operating modes

The various UPS operating modes are described below.



setting

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

5.7.1 On - line - factory setting -

Load is always powered by the inverter, in the event of an input mains failure the load continues to be powered from the inverter using the energy stored in the batteries.

On – line:

The load is always powered by the inverter, with very stable voltage and frequency, using the energy from the mains power supply (INPUT). If there is a fault in the INPUT, the UPS will switch to the batteries in zero time and the batteries will supply energy to the inverter to keep the load powered for the backup time of the batteries. When the INPUT is restored the batteries will be automatically recharged by the rectifier.

5.7.2 Standby-on / Smart active

Load is powered from the mains, in the event of an input mains failure the load is powered from the inverter using the energy stored by the batteries.

In **Standby On** or **smart active**, the load is powered from the bypass line (if the mains power supply is within acceptable limits); if there is a fault on the mains power supply the load switches automatically onto the inverter, powered by the battery

Standby On mode:

The switch from inverter to bypass line may be immediate (time set = 0) or delayed (up to 180 minutes). Transferring occurs if the bypass line is within the range. In **Standby On** mode, the rectifier remains powered and keeps the batteries charged. If the bypass line is out of range, the load is automatically switched onto the inverter output. With **Standby On** operation, the losses by of the system can be reduced, leading to considerable energy saving. This operating mode is suggested only if in the event of a mains outage, the load powered accepts an interruption of the power supply of around 2-5 ms, and that it accepts any mains interference.

This operating mode is normally used for loads that are not particularly sensitive.

While operating in this mode, the letter ***N*** will be displayed on the second line of the BASIC MENU, near the UPS model.

Smart Active mode:

The UPS autonomously activates **On-Line** or **Standby-On** operation according to the quality of the power supply (see the “PERSONALIZ. SMART ACTIVE OPERATION” menu). When Smart Active mode is activated, the power supply is monitored for a few minutes, after which, if the voltage has remained within the pre-set values, the load is switched onto the bypass line; otherwise the load remains powered by the inverter, while the observation time is approx. one hour. After this time, provided there has been no disturbance, the load switches onto the bypass line; otherwise the logic starts monitoring again for approx. one hour. The advantage of this operating mode is its efficiency, which is greater than 98%.

While operating in this mode ***SMART A*** will be displayed on the first line of the BASIC MENU and the letter ***M*** will appear in the second line of the BASIC MENU, near the UPS model.

5.7.3 Standby-off mode (with mains present the load is not powered)

Load is not powered, in the event of an input mains failure the load is powered from the inverter using the energy stored by the batteries.

Standby-Off mode:

If there is a mains power supply, UPS output is zero. The RECTIFIER remains on and keeps the battery charged. The output voltage is only present when the mains power supply fails. The system remains with output voltage = 0V while the voltage and the input frequency are within an

acceptable range. When the mains power supply is restored, the UPS is automatically reset to **Standby-Off** mode.

When operating in this mode the letter **F** will be displayed on the second line of the BASIC MENU, near the UPS model.

5.7.4 Stabilizer mode (operation in on-line mode without battery)

Load is powered from the inverter, if there is a mains failure the load is not powered, the batteries are not present.

Stabilizer mode:

This mode of operation makes the UPS a power conditioner with no backup capability. The load is always powered through the inverter, with stabilized voltage and frequency, using the energy from the input mains. The batteries are not present. In the event of an input mains failure, the output of the STABILIZER is not powered.

In this mode the letter **S** is displayed on the second line of the BASIC MENU, near the UPS model.

5.8 parameters setting

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

- Language (see page 48),
- value of the RATED OUTPUT VOLTAGE (see page 53) ,
- BATTERY parameters (see page 53) ,
- end of battery discharge pre-alarm (see page 54) ,
- shutdown due to power lower than a set value (AUTO-OFF in power) (see page 56) ,
- daily programmed shutdown (AUTO OFF time) (see page 56) ,
- Frequency and voltage range on the BYPASS line (see page 57) ,
- bypass frequency range (see page 57) ,
- modem configuration (see page 57) ,
- RS232-1 and RS232-2 ports (see page 58) .
- standby-on operation (see page 36) ,
- Smart active operation (see page 59) ,
- date and time (see page 62).

5.9 Procedure to transfer the load from UPS onto maintenance bypass (optional).



With several UPS connected in parallel, follow the procedure described in the section on “bypass for maintenance” of chapter “Parallel version”.

There are two types of bypass switches: static switch and manual switch. The purpose of bypass is to provide a path for power to flow from the bypass input to the load. The bypass path provides no conditioning of the power, so any disturbance at the source will be present at the load. The reasons to use the bypass path include: failure of inverter, overload of inverter, operating with low losses, and to allow maintenance operations on the UPS. If the UPS is part of a parallel system, additional concerns and procedures regarding bypass apply. These issues are covered in Section “Parallel”.

Backfeed protection is provided to assure that the inverter output can never be connected to a de-energized bypass input, even if there is a failed component in the UPS. This is to protect service personnel servicing circuits that connect to the bypass input.

Static switch is an automatic electronically switched bypass path. It transfers load if the inverter is overloaded or if the inverter fails. Also, the static bypass is the normal source of power to the load if the UPS is in “Standby On” Mode or if it is in “Smart Active” Mode, with the inverter feeding the load if the bypass source becomes out of range. Generally, the static bypass is controlled automatically, but some manual control is possible (refer to section 6.1.5.18). The static bypass can be disabled by opening switch SWBY, but this should only be done at the operator’s risk in that power to the load will be lost in the event of an inverter overload or an inverter failure. Also, if the static bypass is disabled, it is not possible to transfer to and from Maintenance bypass without load power interruptions.

The Manual Bypass Switch “SWMB” (optional) is connected in parallel with the Static Switch and it is operated by a manual handle. Before operating SWMB, the operator should verify that the bypass source is within its range: as basic check, verify that the bypass source lamp (LED1 at upper left) on the front panel is steady green and that the legend “BYPASS VOLTAGE FAIL” is not present on the display. If the load is already fed-by the Static Bypass, the yellow “Load on Bypass” lamp (LED4, upper right) will be steady (or flashing if the load exceeds the UPS rating). Refer to Section 6 regarding the indicators. After SWMB is closed, the yellow Load on Bypass lamp will flash and the inverter will stop. If desired, the UPS can be completely shut down without interrupting power to the load: Leave SWMB closed, but open SWIN, SWBY, SWOUT, and all battery disconnect breakers. CAUTION: while operating the load through SWMB, battery operation is not possible, so the power to the load is dependent upon the quality of the source to the bypass input of the UPS. To return to normal operation, close SWIN, SWBY, and SWOUT, then open SWMB. When the display no longer shows: “Wait: DO NOT connect the BATTERY”, the disconnect breakers in each battery cabinet should be closed. Refer to Section 4.6 for the proper and complete procedure for connecting the battery.

5.10 UPS and load shutdown



Caution: To disconnect the load from the output of the UPS, both switches SWOUT and SWMB (if present) must be open (off).

This operation will shutdown the load connected to the output. In parallel versions each procedure must be carried out on all the UPS’s:

- open the load switch;
- open SWOUT, static switch output switch;
- open SWIN, input power switch;
- open SWBY, static switch bypass input;
- open the battery cabinet circuit breaker/disconnect.

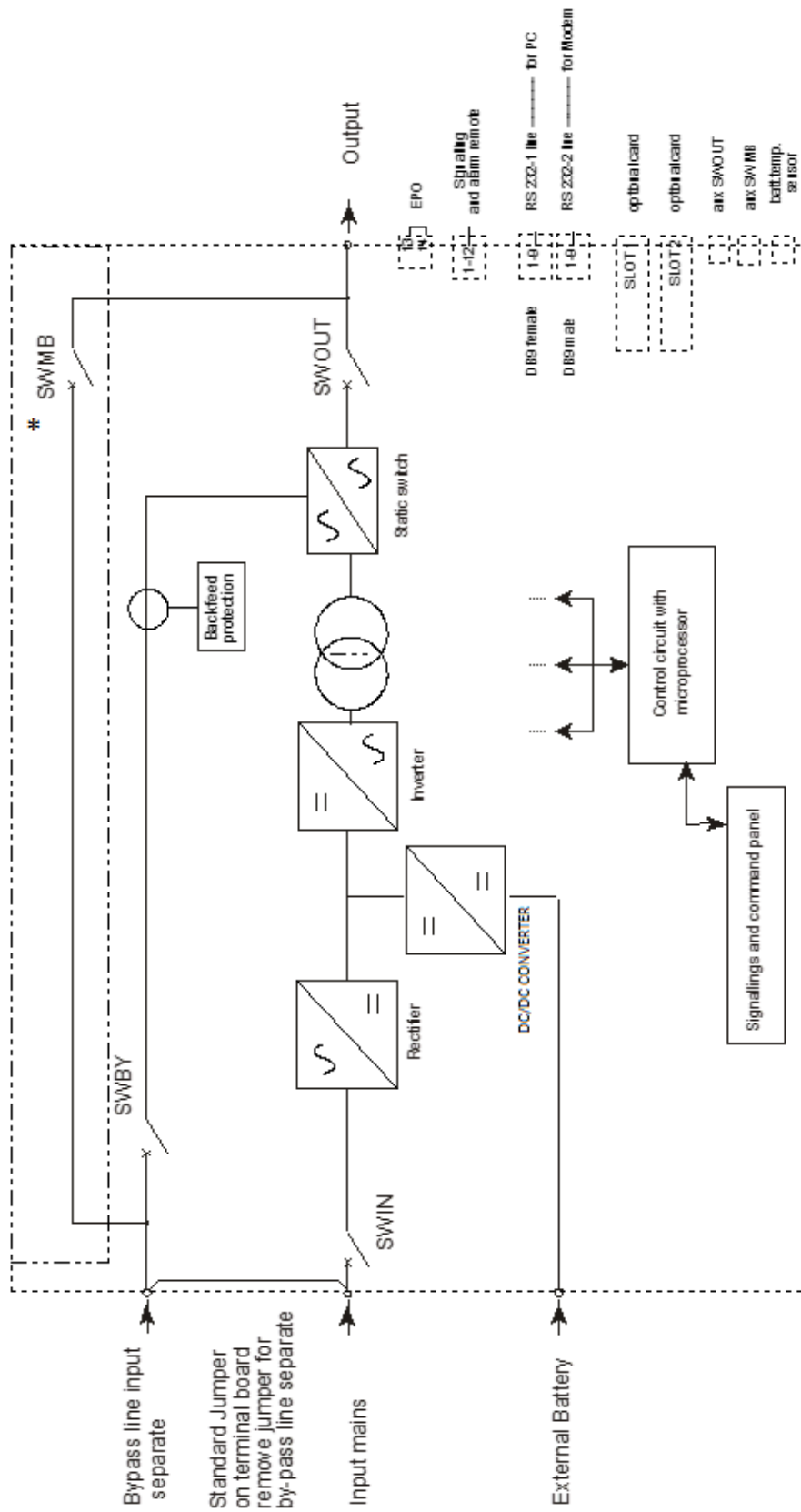
The load is no longer powered, and after a few seconds the UPS display panel will also shut down.

Use a multimeter to check that no voltages are present on the input power terminals.

Note: Neutral is not interrupted by the UPS (the input neutral is also present at the UPS output).

Follow the instructions in the section on START-UP PROCEDURES (see page 34) to restart the UPS.

5.11 Block diagram



* option

5.12 Components of the block diagrams

The UPS is made up the following sub-assemblies:

IGBT RECTIFIER

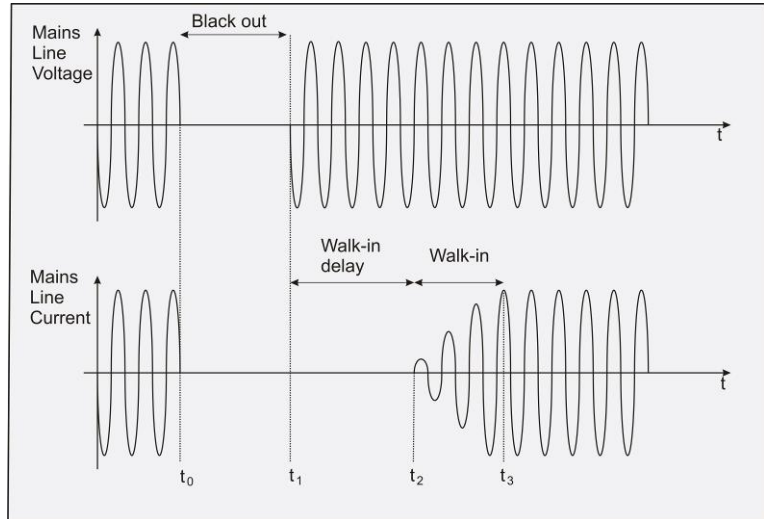
This represents the input stage and its function is to convert the AC voltage of the power supply line into DC voltage.

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

A delay in start-up $t_1 - t_2$ from 0 to 120s (This allows a non simultaneous start-up of several UPS's connected to the same mains);
The time for the start-up, $t_2 - t_3$, from 0 to 30s (this avoids overloading a generator that may be located at the UPS input).

The rectifier carries out the following functions:

- feeds the inverter with DC voltage;
- automatically charges the battery;
- Optimizes the input power factor by means of an automatic charging system.



The system for the cyclical recharging of the battery has two phases.

The first phase consists of 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.

In the second phase, with the battery fully charged, the battery charger is deactivated so as to remove any residual current in the battery in order to increase its lifespan and to prepare the rectifier for the optimization of the input power factor.

At this point a 24 hour cycle is automatically initiated to check the state of charge of the battery, initiate an automatic momentary discharge to verify the condition of the battery, and recharge to full capacity. See page 51 of this manual to customize or disable this function.

BATTERY

This is the energy reserve to power the load when MAINS isn't available to the UPS. Each RPS Battery Cabinet contains both fuses and/ or a circuit breaker disconnect. If a battery pack other than the RPS Battery Cabinet is used make sure that the battery cabinet is **provided with** a disconnect device and a protection device (circuit breaker or disconnect with fuses).

Additional battery cabinets may be required, depending on the UPS size, to provide a minimum BACKUP TIME to the load, in this case it is necessary an interconnect equipment for making the parallel of battery cabinets, before of connecting them to the DC terminals .

When there is no MAINS voltage present (black out), or when the mains goes out of the range (frequency or voltage), the load is powered with the energy stored in the batteries. In this phase of operation the energy required by the equipment connected to the UPS output is supplied by the battery, which has previously been charged. The DISPLAY PANEL located on the front of the UPS shows the expected residual BACKUP TIME, calculated according to the power supplied and the state of charge of the batteries. The value provided is an estimate, 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 this condition it is recommended to save any work in progress. At the end of battery discharge the UPS will interrupt the power supply to the loads.

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

INVERTER

This is the output stage, the function of which is to convert the DC voltage from the RECTIFIER or from the BATTERY into stabilized sinusoidal AC 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 UPS output is always powered by the INVERTER (in NORMAL OPERATION)

STATIC SWITCH

This device allows in synchro transferring, automatic or manual, and in zero time, the load from a protected source (inverter output) to a non protected source (bypass line) or vice versa.

The UPS is provided with “**BACKFEED PROTECTION**” a redundant device to prevent the backfeed of voltage to the by-pass input line in case of an internal fault.

Maintenance BYPASS (SWMB) (Optional)

This is a Maintenance bypass switch. The UPS can be bypassed by closing SWMB and opening switches (SWIN, SWBY and 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.

The Maintenance bypass switch is sized for the rated power of the UPS.

CAUTION – When the Maintenance bypass switch SWMB is closed dangerous voltages are present inside the UPS. Great care must be taken when performing maintenance on a UPS with mains voltage present and the SWMB closed. RPS recommends only using the Maintenance bypass for keeping your load powered if the UPS has failed. For maintenance we recommend the use of a RPS external maintenance bypass switch. Consult the factory for more details.

follows the phase sequence



Phase L1 of the mains source must be connected to input phase L1 on all the UPS's; all the output phases L1 must be connected together and with phase L1 of the load. This convention must be followed for phases L2, L3 and for the input and output neutral.

5.13 Maintenance Bypass (optional)

following the precautions when operating SWMB



SWMB must not be closed on a UPS that is off and that is connected in parallel with other units operating normally. This operation may cause a fault on the UPS's which may create a dangerous voltage at the output. SWMB may be closed with the UPS operating by following the procedure described in the section "Operating modes".

operation not to be executed



If SWMB is closed on any unit, the whole system switches to bypass.

If all the switches are then opened to allow maintenance operations, all the power required by the load will flow onto the maintenance bypass line of the unit in which SWMB has been closed.

WARNING: *both the automatic and the maintenance bypass line of each UPS is sized for the rated power of the single unit.*

NOTE *To set in the maintenance bypass the system, the switches SWMB of all the units must be closed.*

Maintenance bypass on a single unit

This is the procedure to perform a maintenance bypass operation **on a single unit** (e.g. UPS1):

Open switches SWBY, SWOUT, SWIN and the battery cabinet circuit breaker/disconnect on unit 1 only.

If the active UPS's can power the load, the system remains in normal operation and maintenance can be carried out on UPS1.

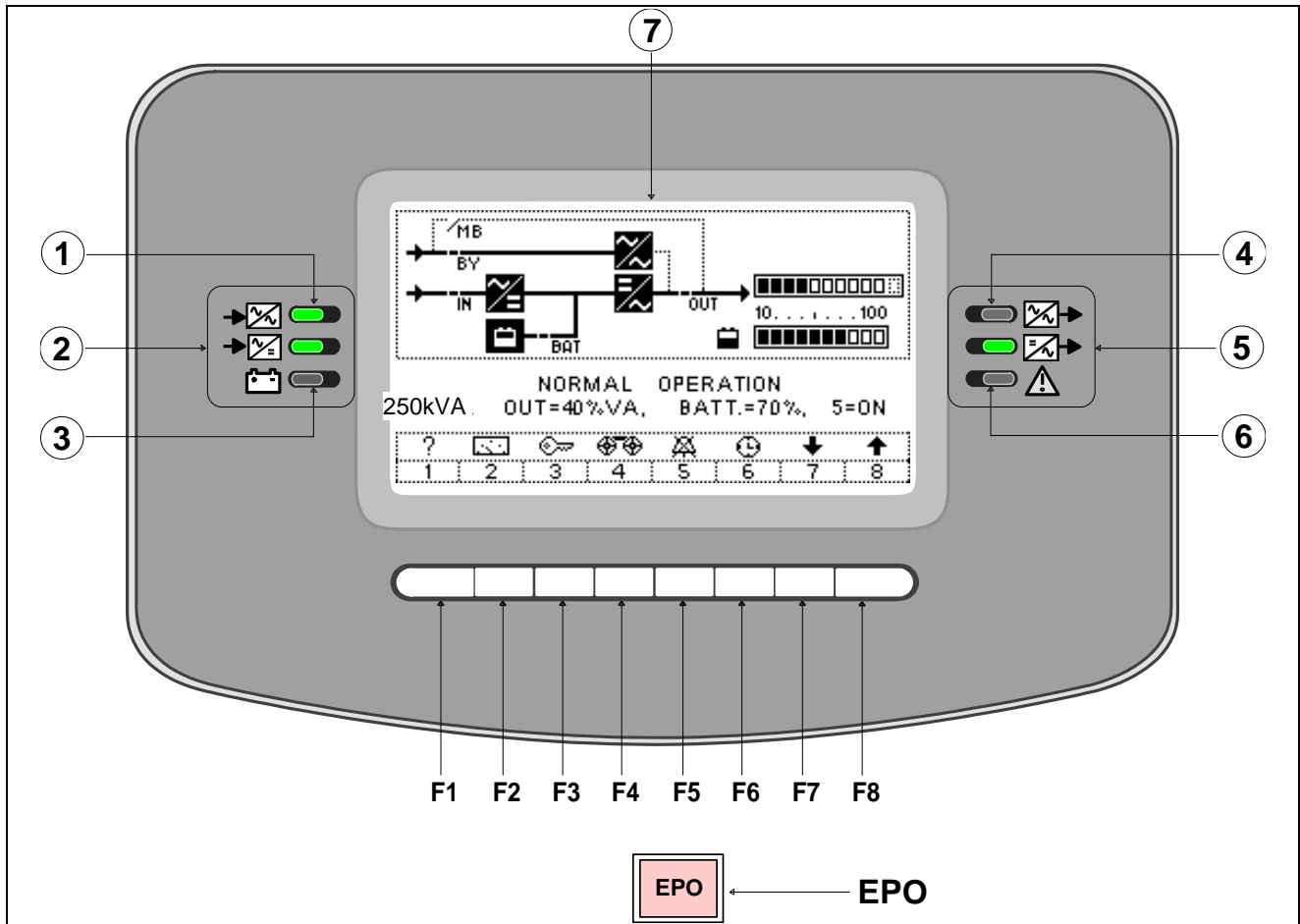
CAUTION – When the maintenance bypass switch SWMB is closed dangerous voltages are present inside the UPS. Extreme care must be taken when servicing UPS with mains voltage present and the SWMB closed. RPS recommends only using the maintenance bypass for keeping your load powered if the UPS has failed. For servicing we recommend the use of a RPS external maintenance bypass switch. Consult the factory for more details.

Maintenance bypass on the parallel system

See section "parallel"

6 Signal panel functions

Control Panel View



- ① LED Bypass line indicator
- ② LED Mains line indicator
- ③ LED Battery powering the load
- ④ LED Load on bypass
- ⑤ LED Normal output
- ⑥ LED Alarm for internal fault
- ⑦ Graphic display

F1, F2, F3, F4, F5, F6, F7, F8 = FUNCTION KEYS. The function of each key is shown at the bottom of the display and it varies according to the menu.

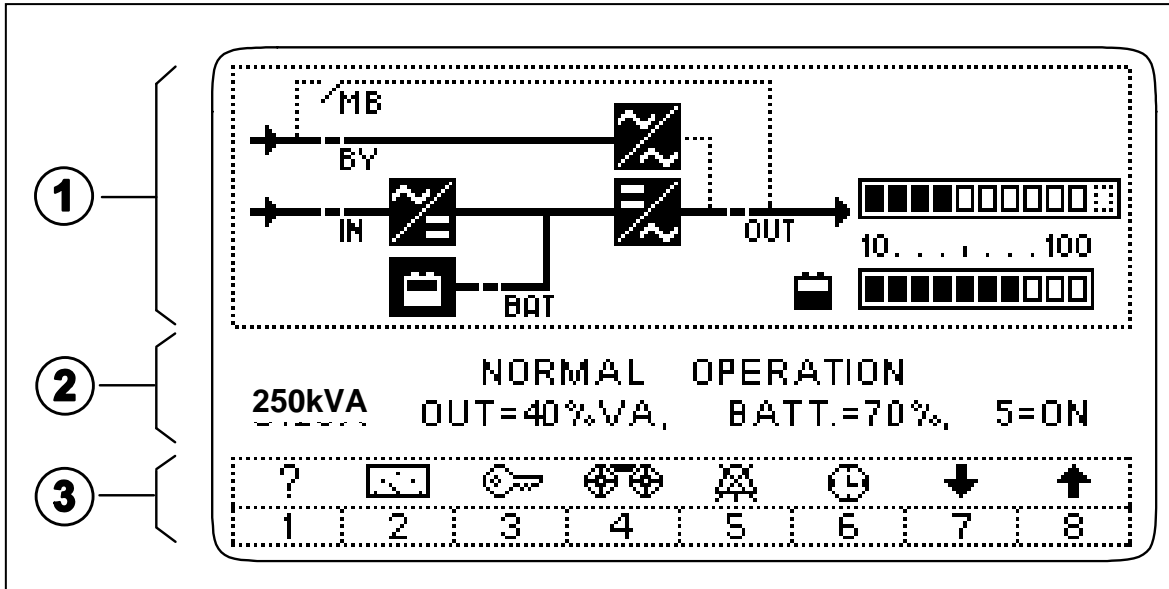
EPO = Emergency Power Off button.

Led status indicators					
Indicator	Symbol	Color	Function	State	Meaning
①		Green	Bypass line indicator	On	Input Bypass line is present and correct
				Flashing	Input Bypass line is present but not correct
				Off	Input Bypass line is not present
②		Green	Mains line indicator	On	Mains is present and correct
				Flashing	Mains is present but not correct
				Off	Mains is not present
③		Yellow	Battery powering the load	On	When the battery is supplying the load
				Flashing	The "LOW VOLTAGE ON BATTERY PRE-ALARM" is active, or the BATTERY DISCHARGE OR SWB OPEN alarm is active
				Off	When the battery is not supplying the load
④		Yellow	Load on bypass	On	The system output is switched onto the automatic bypass line
				Flashing	The system output is switched onto the automatic bypass line with the output power greater than 100%VA, or the manual bypass switch SWMB is closed (optional)
				Off	When the system output is switched onto inverter or the output is switched onto the bypass line and both switches SWOUT and SWMB are open, or when the TOTAL BLOCK command is active
⑤		Green	Normal output	On	The system output is fed from inverter on normal or stand-by operation, the output power is correct since it is less than 100%VA and the output switch SWOUT is closed
				Flashing	The system output is switched onto inverter, the output power is greater than 100%VA, or switch SWMB is closed (if present)
				Off	The system output is switched onto automatic bypass, or switch SWOUT is open.
⑥		Red	Alarm for internal fault	On	An internal fault is present
				Flashing	-
				Off	There are no internal faults.

GRAPHIC DISPLAY

A wide graphic display is present on the UPS door, which allows the user to have a close-up, detailed overview in real time of the status of the UPS. The user can switch the UPS on and off, consult electrical mains, output, battery measurements etc. ⁽¹⁾ and perform the main unit settings.

Picture of a display on the UPS operating on “Normal Operation” with 40% output load and battery 70% charged.



The display is divided into four main areas, each one with its own specific role.

- ① Operation Diagram** Area of the display where the UPS status of operation is shown by means of shapes with filled lines when they are active and with dotted lines when they are inactive.
- ② UPS MESSAGES AND MAIN OPERATING VALUES.** Area where the UPS operating status is displayed by means of two text lines. The first line displays messages that are explained in the “alarm message” paragraph”. The second line displays the main operating values about system, output load, battery, buzzer and alarm message number.
- ③ KEY FUNCTION** Area that shows the key function by means of numbers and icons. The key function is also indicated in the sub menus, on the two text lines with the related number. When a key is pressed the related box change to filled line

¹⁾ The precision of the measurements is: 1% for voltage measurements, 3% for current measurements, 0.1% for frequency measurements. The indication of residual autonomy time is only an ESTIMATE; it must not, therefore, be considered an accurate measuring instrument.

Picture of the UPS display having all items OFF,

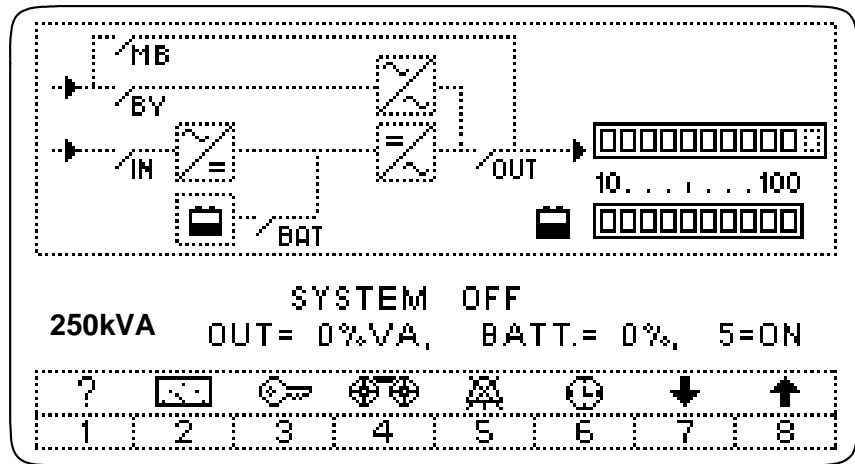
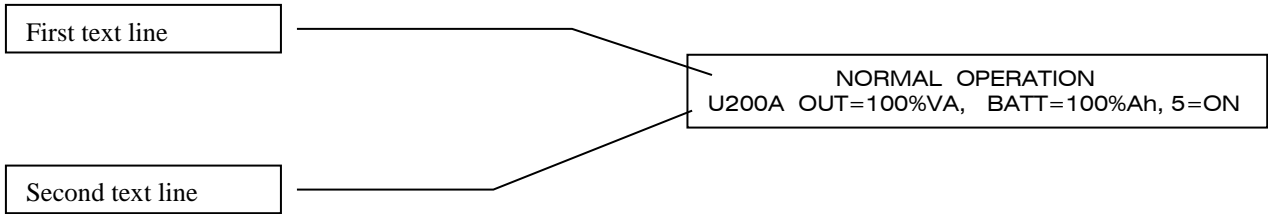


Table of diagram items Shapes		
Active	Inactive	Meaning
		Input converter
		Output inverter
		Bypass line switch
		Battery
		Manual bypass line switch
		Bypass line input switch
		Battery switch
		Output switch
		Main line input switch
		Output load (40% VA or 0% VA)
		Battery(70% Ah or 0% Ah)

Table with keys numbers and Icons		
Key Off/ON	Icon	Meaning
		Information or n. 1
		Measures or n. 2
		Commands or n. 3
		History or n. 4
		Buzzer OFF/ON or n. 5
		Display date/hours or. n. 6
		Decrease value or sub menu or n. 7
		Increase value or previous menu or n. 8

Basic menu (text lines area)

If no commands have been inserted, the first text line shows messages to inform about status of operation.



In each operating condition, the display returns to the "basic menu" after two minutes from the last command inserted with the keys. The basic menu shows the signal messages relating to the current operating state.

The first line of the basic menu shows:

When there are no alarms present the first text line of the main menu shows a fixed message, **“NORMAL OPERATION”**

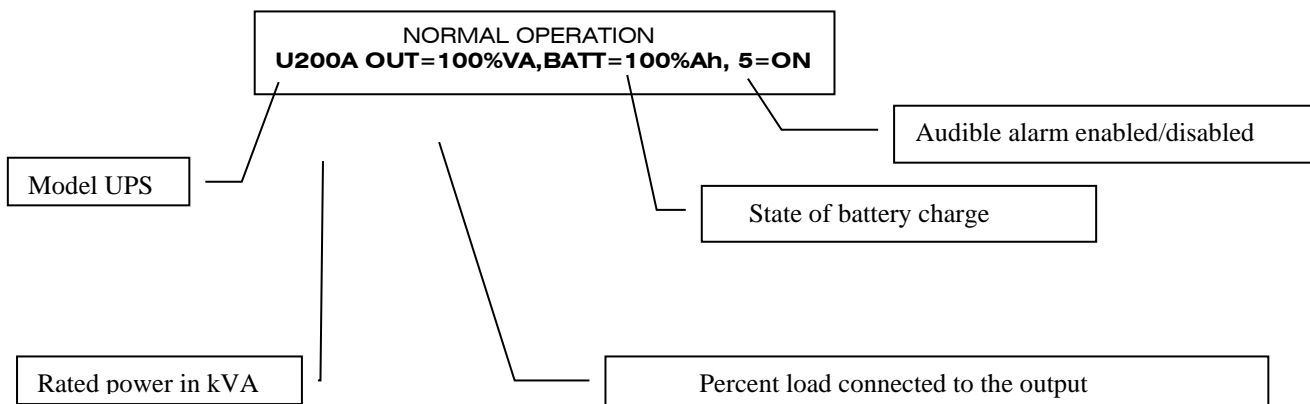
NORMAL OPERATION
U200A OUT=100%VA, BATT=100%Ah, 5=ON

When some alarms are present, the first text line of the main menu shows each active ALARM message, **“ALARM MESSAGES”**, one at a time for a few seconds:

ALARM MESSAGES
U200A OUT=100%VA, BATT=100%Ah, 5=ON

The second line of the basic menu shows:

The second line displays the main operating values about system, output load, battery, buzzer and alarm message number



The message U200A indicates an UPS model with 200kVA rated power, operating with 60Hz output frequency. When the unit is set for the parallel operation the letter “P” is added (U200AP). The letter “P” became lower case “p” when the unit operate as slave.

The message OUT changes to BY when the load is not powered from the inverter (normal operation) but from the mains through the bypass line.

The message OUT=100%VA changes to OUT= SWMB when the load is powered through the maintenance bypass switch, and the output current cannot be provided.

The value 100%VA provided in the example is obtained from the measurement of the output current.

The number indicates the output current with the value relating to the absolute rated value and the value indicated is the greater of the rms current and the peak current.

- **BATT= 100%Ah**: example of the actual state of the percentage of battery recharge.

The value 100%Ah is obtained from the measurement of the charge current and the time taken to recharge.

The number indicates the recharge value as a percentage according to the capacity of the battery connected and to the quantity of charge used during battery operation.

The system automatically remains in rapid charging for all the time needed to supply the battery with the quantity of charge lost during the discharge.

The indication "%Ah" changes to "min." (minutes) during operation in the event of a mains failure or when the battery is discharging. In this case the numeric value refers to the remaining minutes of operation, calculated according to the current supplied by the battery and to the state of charge of the battery.

NOTE:

The backup time shown is calculated according to the measurement of the discharge current present at that time, the stored value relating to the capacity of the battery connected and the stored value relating to the percentage of recharge prior to discharge. The backup time shown should nevertheless be considered as indicative due to the many different factors affecting it. If considerable differences are noted between the expected value and the actual time of a discharge with constant load, the stored data relating to the battery must be checked, as must the state of the battery.

- **5=ON**: example of the message showing whether or not the audible alarm is enabled; if disabled, the message changes to 5=OFF.

6.1.1 Language setting menu (keys 1, 1)

From the keys menu, press **1** twice to access the languages menu.

The following languages are available:

Italian, English, French, German, Spanish, Dutch, Swedish, Polish, Hungarian, Turkish, Czech, Russian, Romanian and Portuguese.

The system will show all subsequent messages using the language chosen. The selected language remains stored even after the shutdown and restart of the system. The current language can only be changed by accessing the LANGUAGES menu.

Use keys **1** and **8** to return to the basic menu.

6.1.2 Measurements menus (key 2)

The measurements with two line displayed, are selected from the basic menu by pressing key 2

IN=100,100,100%V, 60.2Hz

Measurement of the three voltages, neutral phase and input frequency. The voltage is indicated as a percentage of the rated voltage; for example 100% is equivalent to 277V.

101,101,101%A

Measurement of the three input currents. The input currents are expressed as a percentage of the rated value.

BY=277,277,277Vln(480V)

Measurement of the three input phase voltages of the bypass line, with the concatenated voltage (the average of the three values) in brackets.

60.1Hz Frequency of the bypass line.

OUT=277,277,277Vln

Measurement of the three output phase voltages of the UPS, with the concatenated value in brackets.

100,100,100%A

Measurement of the three output currents. The output currents are expressed as a percentage of the rated value.

100,100,100%W

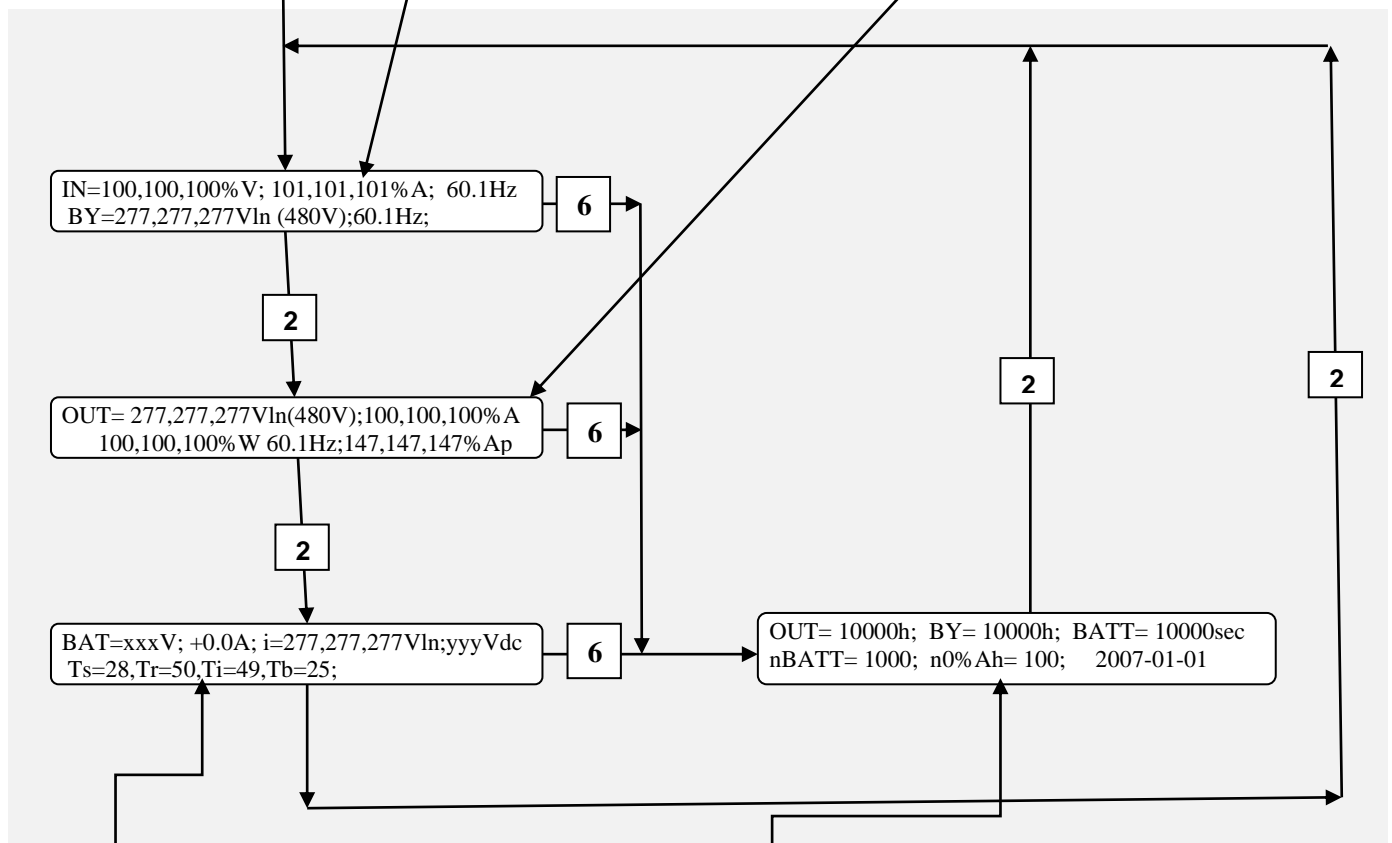
Measurement of the active output power. The power is expressed as a percentage of the rated power.

60.1Hz Output frequency.

147,147,147%Ap

Measurement of the three peak currents as a percentage relating to the three output phases during operation from inverter. During operation from bypass, the message OUT changes to BY.

Basic menu



BATT=xxxV battery voltage value;
+0.0A battery current, positive with
Battery charging, negative
with battery discharging;
i=277,277,277Vln inverter output voltage;
yyyVdc input inverter DC voltage

Ts=28, Tr=50, Ti=49, Tb=25;
Temperature of the system, and of the rectifier
and inverter modules, Tb is present only if the
external temperature the sensor is installed;

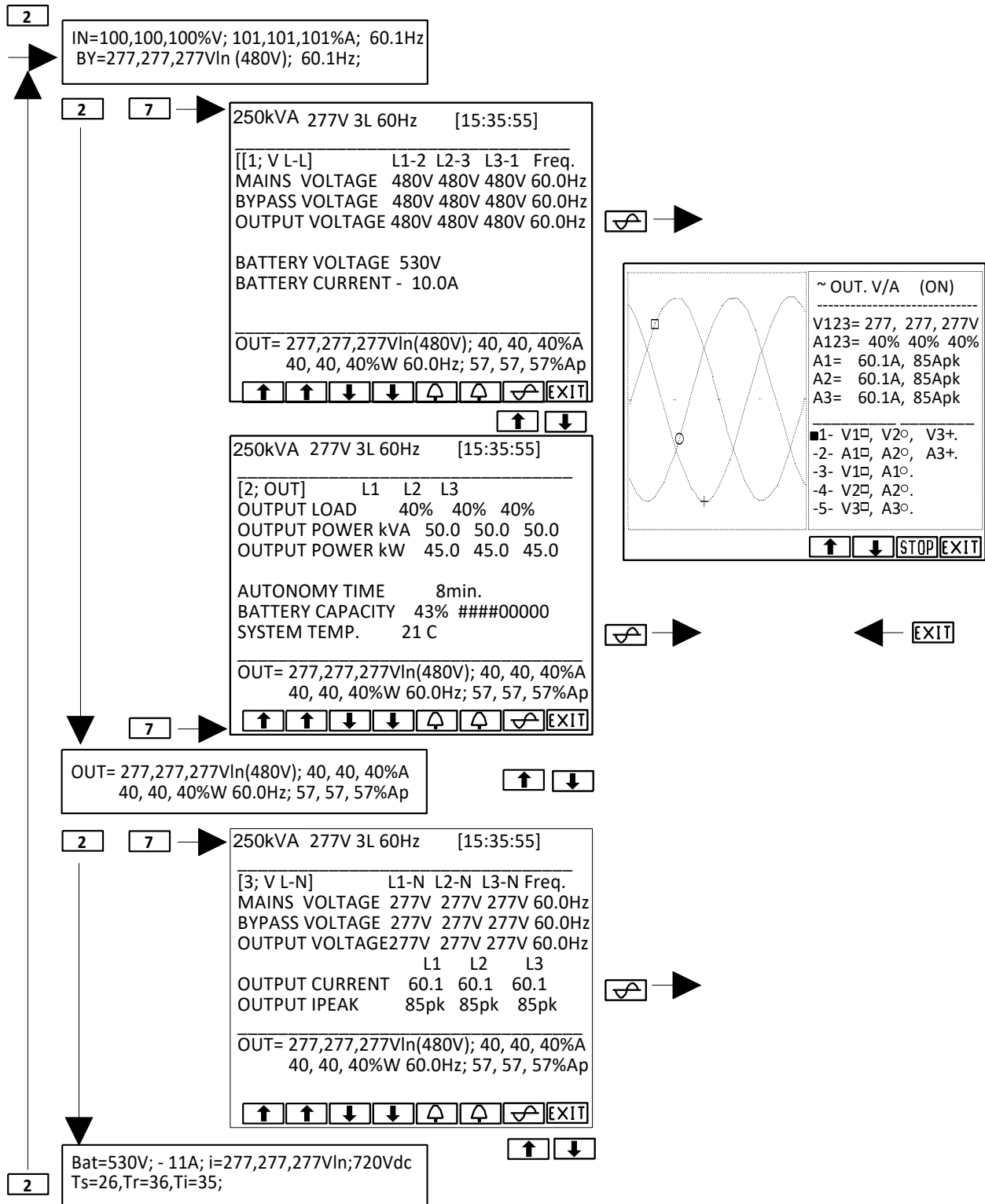
OUT=10000h hours of normal operation
BY=10000h hours of operation from bypass
BATT=10000sec time spent in operation from battery
nBATT = 1000 number of times the battery has discharged
n0%Ah = 100 number of times the battery has discharged
fully

2007-01-01 data stored on first start-up of the UPS.
These are HISTORY data, and remain stored even when the
device is switched off and may not be reset.

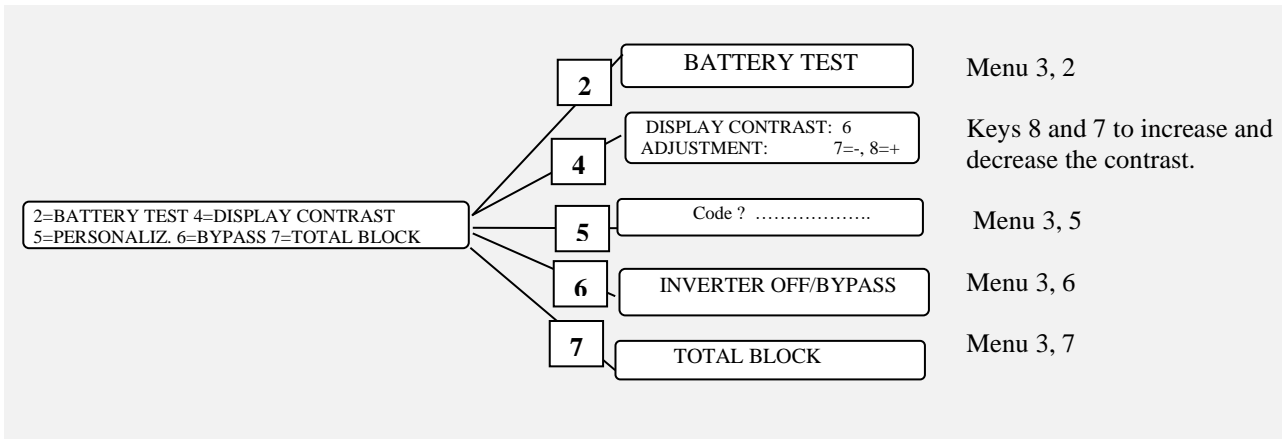
6.1.4 Full page Measurements and output waveforms (key 2, 7)

The full page measurements and output voltage and current waveform are selected by pressing key 7 from the two line measurement menu.

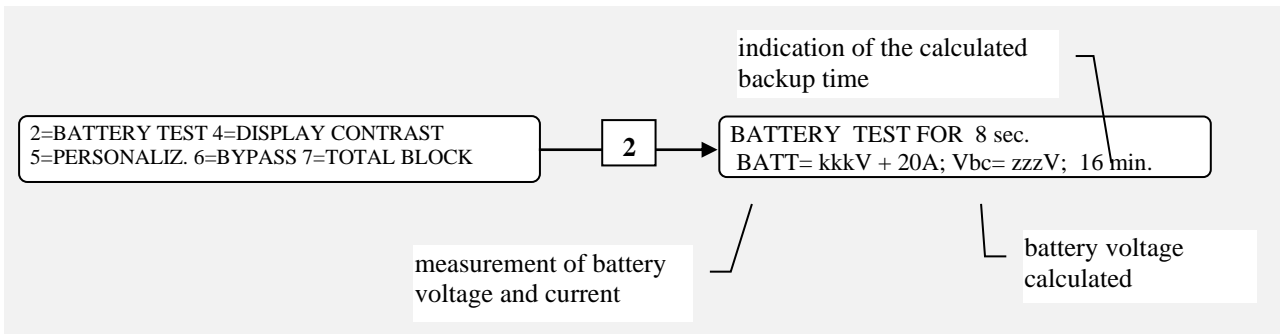
Basic Menu



6.1.5 Controls Menu (key 3),



6.1.5.1 Keys menu 3, 2: battery test



This activates the cycle to check the state of efficiency of the battery, which lasts 8 seconds. Press key 8 to interrupt the test and return to the basic menu before this time has elapsed.

The battery test cycle lowers the rectifier output voltage so that the battery can be evaluated with the real supply on the load even when the power supply voltage is present.

The rectifier output voltage is only lowered if the bypass line voltage is present, in order to avoid any disruption to the output load without the support of the bypass.

The battery test cycle is activated:

- manually;
- automatically every 60 sec. after each failed test (for three times), or each time the system is restarted;
- automatically every 24 hours from system start-up;
- automatically in invisible mode during operation without mains power supply.


At the end of each test, the alarm is activated if the voltage measured is lower than the calculated voltage; the charge value stored and the backup time indicated are subsequently halved. A new test is performed 60 sec. after activation of the alarm and if the result is negative the alarm is activated once again for another 60 sec.

The alarms continue to halve the charge value stored until the calculated battery voltage is less than the voltage actually measured. In practice, this battery control system produces an alarm each time the battery is seen to have less than half of the expected charge. If this alarm is on PERMANENT, it indicates that the battery is inefficient, the battery circuit is interrupted, the battery disconnecter has remained open or one of the protection device fuses has been triggered. If this alarm is on TEMPORARY, it indicates a reduction in the efficiency of the battery; the more frequent the alarm, the more serious the problem.

Disabling the BATTERY TEST: press keys 3, 5: "CUSTOMIZING", insert code 323232, with battery test disabled the code o=02 will be shown in the basic menu of the display. To reactivate the test, insert code 323232 again.

6.1.5.2 CUSTOMIZING

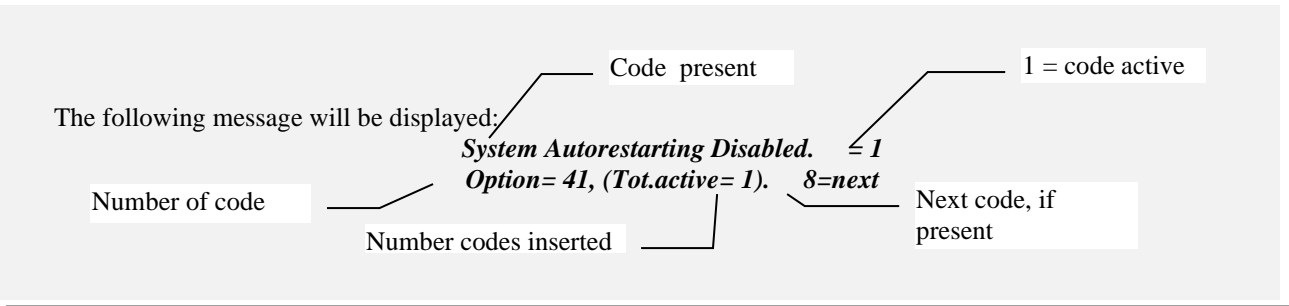
The "CUSTOMIZING" menu is accessed by means of key 5 from the COMMANDS menu; an intermediate menu will then be displayed in which a CODE has to be entered.



Access by CODE ensures that unauthorized persons cannot modify the operating parameters of the equipment.

The use of the codes to modify the operation of the equipment (such as the frequency converter, stabilizer, rectifier start-up delay, etc.) are made by the service personnel.

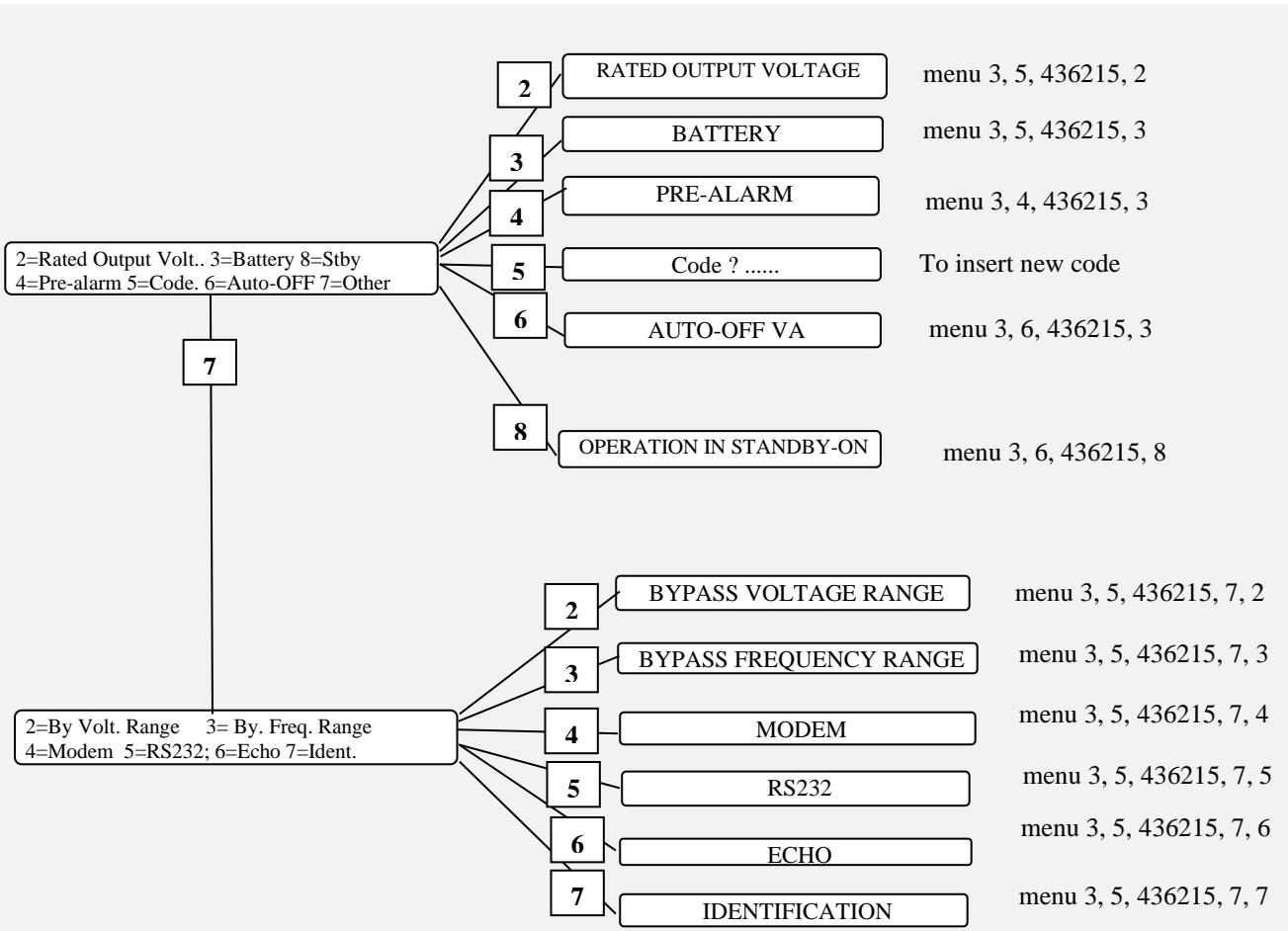
The activated codes may be displayed (if present) with the following sequence of keys from the basic menu: 7 + 4 then by scrolling through the alarms with keys 7 and 8.



6.1.5.3 Keys menu 3, 5: CODE 436215

The code is no longer required for 2 minutes after it has previously been inserted.

The next menu can only be accessed by inserting the correct code, otherwise it returns to the basic menu.



6.1.5.4 RATED OUTPUT VOLTAGE.

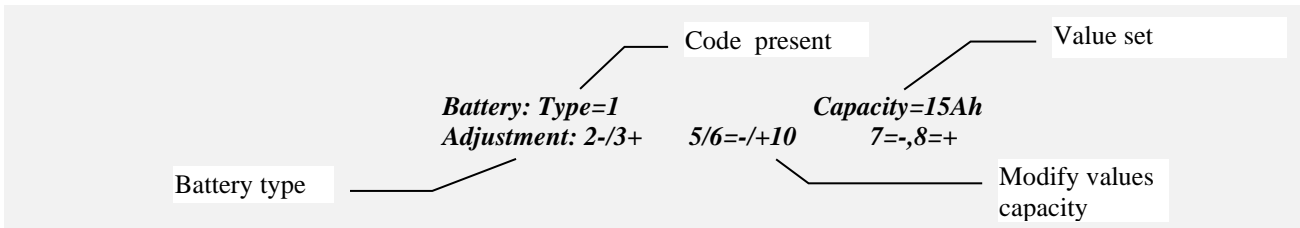
Press the following sequence of keys to access the menu: 3, 5, 436215, 2

Keys 7 and 8 can be used to decrease or increase the rated output voltage.

The value displayed is the voltage between phase and neutral "VIn". The value set modifies the operation of the inverter, during normal operation. The new output value voltage also changes the reference value for the acceptable range of the voltage at the bypass line input.

6.1.5.5 BATTERY

Press the following sequence of keys to access the menu: 3, 5, 436215, 3



On initial installation the rated capacity value of the connected battery must be inserted; this value is usually printed on the battery container.

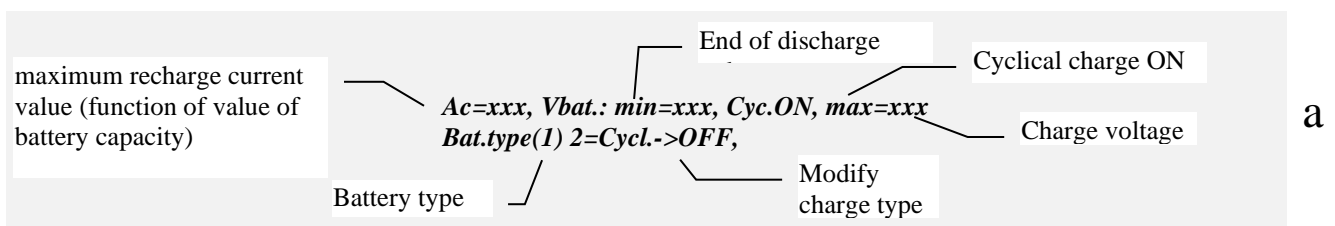
battery capacity

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 UPS power. e.g. at 100kVA the value set by default is 100Ah.

Battery type = for high intensity discharge batteries change from value 1 (normally pre-set for normal batteries) to value 2; value 3 is to be used for open vase batteries.

Cyclical battery recharging (factory-set):

Select type 1 or 2 and then press key 4 to display the pre-set voltage values:



Select type 0 and then press key 4 to modify the voltage values reset by keys 3,4 and 7,8.

Ac=xxx, Vbat.: min=xxx, Cyc.ON, max=xxx
Bat.type(0) 2=Cy., 3-/4+, 7-/8+

Recharging at two voltage levels (configurable):

This type of recharging is effected with two current levels (EN 50272-2); the first phase comprises rapid charging (U1) with limited current, while in the second phase charging is with float voltage (U2).

Type “0” Battery


With the battery set to type 0, the following menu is displayed:

(420Vmin,480Vp,540Vs) Prealarm : 5min
Adjustment: (4=setV), 7=-,8=+

When key 4 is pressed, the program proposes the setting of the three voltage values.

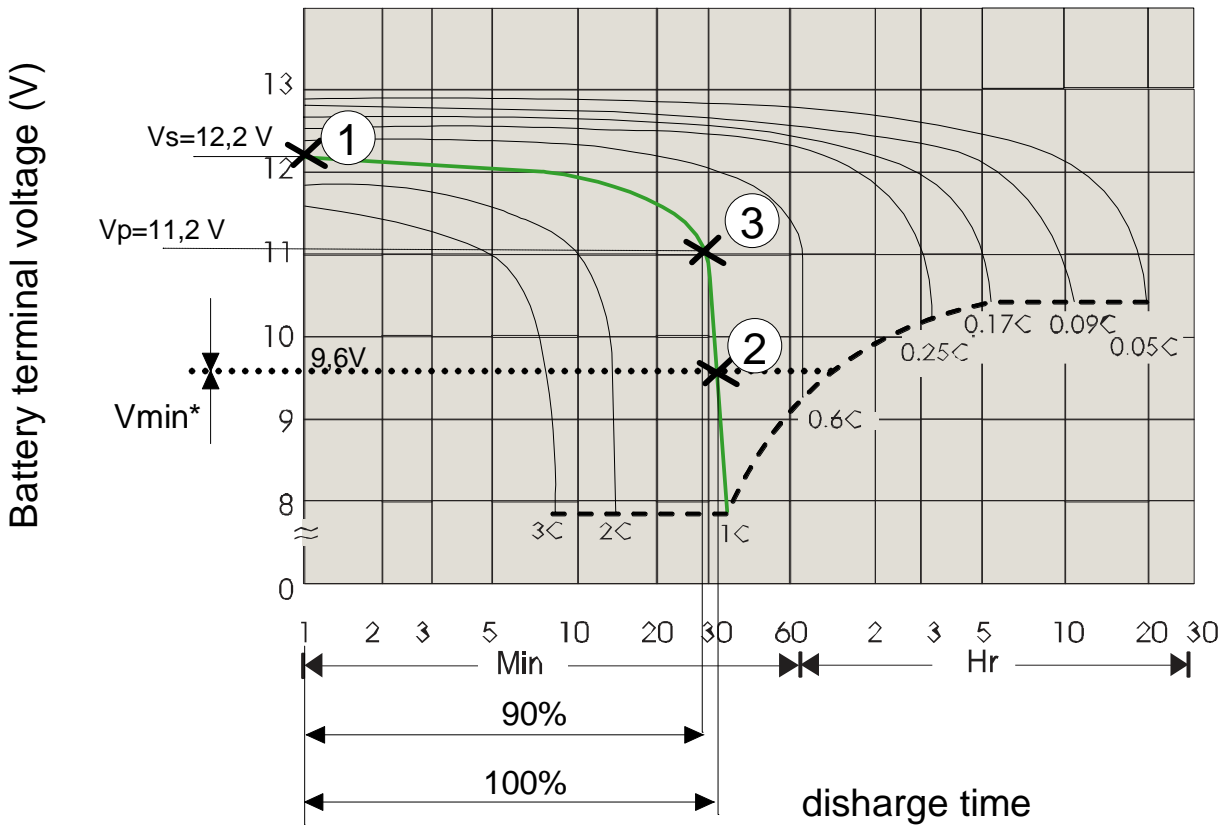
Vbat.test: Vmin., Vp, Vs: 420, 480, 540V
Adjustment: 3-4+, 5-6+, 7-8+

Preset value

 With the three factory preset voltage values, the display panel may indicate an incorrect backup time during discharge.

Battery type “0” setting

The three values to be set are linked to the **battery discharge regime** (relationship between discharge current / battery capacity in Ah). Example: for a 100Ah battery with a discharge current of 100A, the regime is 1.



The three values, Vs, Vmin and Vp, are obtained from the discharge characteristic curve, supplied from manufacturer, relating to the **battery discharge regime** 1C has been determined:

- Vs start of discharge voltage (1), intersection with the x-axis (battery terminal axis),
[the value must be multiply for 40, number of batteries]
- Vmin minimum voltage value (end discharge battery), point of intersection with the dashed curve (if this value is lower than Vmin* set up Vmin=Vmin* (2).
[the value must be multiply for 40, number of batteries]
- Vp battery voltage with discharge at 90% of the total time (3).

6.1.5.7 AUTO-OFF "VA"

Press the following sequence of keys to access the menu: 3, 5, 436215, 6:

Automatic Switch-OFF when Output < 0%VA
Adjustment: (5=Toff,Ton) 7=-,8=+

Press key 1 to exit the menu.

Keys 7 and 8 can be used to decrease or increase the percentage threshold of the output load for the AUTO-OFF function and switching the system to the bypass line; variations of 1% are possible in the field from 0 to 99% of the rated output load.

For shutdown with mains present, when the output power reaches < of the value set, the battery charge value must be > 60%.

Once this value is reached the system is deactivated.

For shutdown with power output < value set, it must be verified that the battery capacity value is > 60%.

Shutdown is not immediate, but is delayed by the time set as the end of battery discharge pre-alarm (standard value 5 minutes); in this phase the "end of discharge pre-alarm" contact of the remote alarms card is switched, after this time the output is switched to the bypass line if this voltage is present and the voltage also remains present at the output.

The load remains switched to the bypass line while the output power remains lower than the "AUTO-OFF" value, then the system waits for an increase in the load before effecting the automatic return to normal operation; The "AUTO-OFF" function may be used to shut down the system during operation from battery, simply by shutting down the output load. In normal operation, the "AUTO-OFF" function may be used to reset consumption since the power circuits are deactivated, the battery remains isolated and only the control circuits, with consumption equivalent to a light bulb, remain active.

6.1.5.8 AUTO-OFF Timer.

Press the following sequence of keys to access the menu: 3, 5, 436215, 6, 5:

AUTO-OFF Timer: Toff >0: 0', Ton= 0: 0'
ADJUSTMENT: (5=Toff, 6=Ton) 7=-, 8=+

Press key 1 to exit the menu.

The keys have the following functions:

- 6 to modify the value Ton
- 5 to modify the value Toff.

Toff and Ton are time values used by the system to affect an automatic daily shutdown and restart cycle.

The timer cycle is inhibited when Toff = Ton.

When the internal clock reaches the time Toff, if the mains voltage is present and the percentage of recharge is less than 60%, only the following is displayed:

AUTO-OFF Timer: Toff= 20:00', Ton= 7:00'
H100, OUT100% BATT= 50%Ah 5=ON

The system waits until the battery recharge exceeds the value of 60% before deactivating.

When the internal clock reaches the time Toff (20:00'), if the mains voltage is present and the percentage of recharge is greater than 60%, or the mains voltage is not present and operation is from battery, the following is displayed:

AUTO-OFF Timer: Toff= 20:00', Ton= 7:00'
H100, OUT100% OFF:4 min 5=ON

The "end of discharge pre-alarm" contact for remote alarms is also switched. In this case the system remains active for the next 4 minutes, after which the system switches onto the bypass line and then deactivates.

There is no output voltage after deactivation.

The interval between the start of the alarm and deactivation is equal to the interval selected as PRE-ALARM. When the internal clock reaches the time Ton (7:00'), if the mains voltage is present, the system automatically reactivates and returns to normal operation.

6.1.5.9 BYPASS VOLTAGE RANGE ADJUSTMENT

Press the following sequence of keys to access the menu: 3,5,436215, 7, 2:

Press key 1 to exit the menu. Keys 7 and 8 can be used to decrease or increase the value, as a percentage, of the acceptable range for the voltage at the bypass line input, with respect to the rated output value. With the UPS in standby-ON mode, the menu is as follows:

(StbyON=15%) BY. VOLTAGE RANGE = +/- 15%
ADJUSTMENT: (5-, 6+) 7=-, 8=+

Keys 5 and 6 can be used to reduce or increase the percentage of the acceptable range of the bypass voltage in STBY ON mode.

6.1.5.10 BYPASS FREQUENCY RANGE ADJUSTMENT

Press the following sequence of keys to access the menu: 3,5,436215,7, 3:

Press any key other than 7 or 8 to exit the menu. Keys 7 and 8 can be used to decrease or increase the value, as a percentage, of the acceptable range for the frequency at the bypass line input. The choice is between the values +/- 1%, and +/- 5% relative to the rated system value of 60 Hz.

6.1.5.11 MODEM

Press the following sequence of keys to access the menu: 3, 5, 436215,7, 4:

MODEM enable = 0,
ADJUSTMENT: (5=dial, 6=send) 7=-, 8=+

Press key 1 to exit the menu.

Keys 7 and 8 can be used to decrease or increase the control value for management of the modem. The choice is between the values of 0 to 5. The initial value is 0.

0 = the modem connected to the RS232 port is deactivated. Terminal 20 of the RS232 connector assumes a low level (-12V) (DTR signal deactivated).

NOTE the configuration MODEM=0 is essential when the modem is not used and the RS232 connector is used for connection to the remote panel.

1= signal DTR is activated (terminal 20 at +12V), the modem is enabled to reply (it should be remembered that a remote panel connected to the RS232 connector in place of the modem remains off).

2= signal DTR is activated, the modem is ready to reply and for automatic calls.

After an "internal fault" alarm has been set for 30 seconds, the system automatically dials the stored "DIAL" number. When it receives the modem's receiving reply it sends a message made up of the UPS acronym, the stored "SEND" number, a copy of the text shown on the display, the alarm code and the date and time of transmission.

NOTE: for correct operation, use a modem that has already been configured to recognize "HAYES" type commands and that is able to dial the telephone number using pulses or tones as required by the telephone line that is to be used.

Example of messages sent to the modem in the event of an "INTERNAL FAULT 5" alarm.
Assuming that the settings are as follows: Modem =2, Dial=23456, Send=123456.
30 seconds after the start of the persistent alarm, the system sends the modem the command:
ATD 23456

On receiving the message "CONNECT" from the modem, the system sends: *UPS 123456*

INTERNAL FAULT: 5

100, OUT=100%VA, BATT= 78%Ah, 5=ON a=00200300 1999-12-21, 13:12:28

The system then sends the sequence to close the communication:

+++ ATH

Lastly, signal DTR is also lowered for 0.5 sec.

If the telephone line is engaged or the remote modem does not reply, the system tries to call again every 5 minutes until it manages to connect, provided that the alarm condition is still present.

3= like 2 with automatic call when any alarm is verified.

4= like 2 with automatic call only for alarm 10, and with sending of message only after the reply from the remote modem has been acknowledged by the reception of the character "}".

This mode ensures that the receiving computer does not lose any messages.

5= like 4 with automatic call when any alarm is verified.

6.1.5.12 "DIAL /SEND" MODEM

Press the following sequence of keys to access the menu: 3, 5, 436215, 7, 4, 5 (6):

MODEM dial n.=6543210//////// <=2..3=>
ADJUSTMENT: (5=dial, 6=send) 7=-, 8=+

Press key 1 to exit the menu.

Keys 7 and 8 can be used to decrease or increase the figure on which the cursor is positioned.

The cursor is moved by means of keys 2 and 3, and is indicated initially by the character '_ '.

Each number may assume values from 0 to 9, the symbol / indicates that the corresponding figure is disabled.

A correct "dial" number must start with a figure from 0 to 9, the setting /6543210 is ignored.

Select menu 35746 or press key 6 when menu 35745 is active to set the "send" number.

6.1.5.13 RS232

Press the following sequence of keys to access the menu: 3, 5, 436215, 7, 5:

Press key 1 to exit the menu. Keys 7 and 8 for RS232-1 (3 and 4 for RS232-2) can be used to decrease or increase the baud value for the transmission speed. The choice is between the values 1200, 2400, 4800, 9600.

6.1.5.14 ECHO.

Press the following sequence of keys to access the menu: 3, 5, 436215, 7, 6:

Press key 1 to exit the menu. Keys 7 and 8 can be used to decrease or increase the number used to enable the "ECHO" function. The number may vary from 0 to 1 to disable or enable the function. When the function is enabled the system automatically sends a copy message of the display with the addition of the code "a=....." and the current date and time to the RS232 output.

The message is sent for each variation in the state of the alarms (that is, any change in code a=.....).

6.1.5.15 IDENT.

Press the following sequence of keys to access the menu: 3, 5, 436215, 7, 7:

Press key 1 to exit the menu. Keys 7 and 8 can be used to decrease or increase the number used for the identification of a single unit in systems with several UPS connected to a single RS232 serial line. The basic number is 0 and may be changed between values from 0 to 7.

6.1.5.16 OPERATION IN STANDBY-ON

Press the following sequence of keys to access the menu: 3,5,436215,8:

Stby= 2sec. Stby_ON= 0
Adjustment: 4=Sma.ON, 5-,6+ 7=-,8=+

Press key 1 to exit the menu. Press key 8 Stby=1 to change the UPS from ON-LINE mode to STANDBY-ON mode. Press key 7 to change the UPS from STANDBY-ON mode to ON-LINE mode. The switch onto the bypass line may be immediate when "Stby = 0 min." or delayed by means of keys 5 and 6. The backup line must be available for the time set within the acceptance field before the switchover can take place (see "PERSONALIZ. BYPASS VOLTAGE FIELD" menu). The setting remains stored even during a shutdown due to a power failure. For a description of the operation see the section "SETTING MODES".

6.1.5.17 SMART ACTIVE OPERATION

Press the following sequence of keys to access the menu: 3,5,436215,8,4:

SMART ACTIVE S. Stby = 5 min. Stby_ON = 1
Adjustment: 4=Sma.OFF, 5-,6+ 7 = -, 8 = +

Press key 1 to exit the menu. When the Smart Active function is activated via key 4, Stby_ON goes to 1. The setting remains stored even during a shutdown due to a power failure. There is a delay of 5 minutes before transfer to SMART ACTIVE mode. For a description of the operation see the section "SETTING MODES".
When the code is inserted the basic menu becomes:

NORMAL OPERATION SMART A.
P200, M OUT= 99%VA, BATT= 100%Ah, 5=ON

6.1.5.18 INVERTER-OFF/BYPASS

Press the following sequence of keys to access the menu: 3, 6 :

Exit the menu by pressing key 8 or any other key with a sequence other than the one described here. Pressing keys 4, 7, 2, 6, 3 in succession as shown on the display activates the command for bypass with shutdown of the inverter. The command is executed after a few seconds' delay to allow for cancellation. When this command is active, the following alarm is shown on the display:

"BYPASS COMMAND ACTIVE; 8=DEACTIV. "

To return to normal operation, including after system shutdown, the command has to be cancelled by pressing key 8, or by sending the key code through the RS232.

NOTE To mask the command code 47263, insert code 436213 on the panel from the PERSONALIZATIONS menu (keys 3, 5). Repeat the operation to display the code again.

6.1.5.19 TOTAL BLOCK

Press the following sequence of keys to access the menu: 3, 7 :

*Total System Shut-OFF Command = 47263
WARNING, the Output Voltage will be OFF*

Exit the menu by pressing key 8 or any other key with a sequence other than the one described here. Pressing keys 4, 7, 2, 6, 3 in succession as shown on the display activates the command for TOTAL BLOCK of the system. When this command is active, the display shows the alarm
BLOCK COMMAND ACTIVE; 8=DEACTIV.

The command is executed after a few seconds' delay to allow for cancellation. This command is useful to achieve full deactivation in an emergency, operating remotely via the RS232 line. To reactivate the UPS, close switch SWBY or, if applicable, press button 8.

NOTE: To mask the command code 47263, insert code 436213 on the panel from the PERSONALIZATIONS menu (keys 3,5). Repeat the operation to display the code.

6.1.6 "RECORDER": RECORDED EVENTS (key 4)

Press the following sequence of keys to access the menu: 4

*message alarm stored
a=FFFF-FFFF; 2005,12,31/14:45:50 n=100*

Return to the basic menu by means of key 1. Key 2 activates the submenu "RECORDED VOLTAGES MEASUREMENTS". Keys 3, 4 and 5 keep their normal functions.

Key 6 activates submenu 4, 6 "RECORDED CODES" and allows the exchange of stored alarm message with the display of the corresponding status codes at the time of the stored event, and vice versa. The status codes allow a more in-depth analysis by the trained personnel.

1.1.1.1 RECORDED VOLTAGES MEASUREMENTS

Press the following sequence of keys to access the menu: 4, 2, 2, 2

*IN=100,100,100%V,50.0Hz; BATT=430V,+100A
BY=400V,50.0Hz;n 35 OUT=400,50.0Hz,100%*

The "RECORDED VOLTAGES MEASUREMENTS" menu is accessed via key 2 (press 2 again to access the other measurement menus from menu 4 "RECORDED EVENTS" or menu 4, 6 "RECORDED CODES" only. Press key 1 to return to the basic menu immediately.

In the example, n 35 (flashing) indicates that the measurements shown refer to the state relating to recorded event number 35. The meaning of the measurements is the same as those in menu 2.

1.1.1.2 RECORDED CODES

Press the following sequence of keys to access the menu: 4, 6

*s=FFFF c=FFFF b=FFFF r=FFFF-FF the=FFFF-FF
a=FFFF-FFFF; n=100, 1992,12,31/14:45:50*

The "RECORDED CODES" menu is accessed with key 6 from menu 4 "RECORDED EVENTS" and menus 4, 2; 4, 2, 2; 4,2,2,2 that is, the recorded measurement menus. Return to the basic menu by means of key 1. Apart from key 6, the other keys have the same functions as those described for menu 4, and the messages on the lower line also remain the same.

The upper line: s=FFFF c=FFFF b=FFFF r=FFFF-FF i=FFFF-FF, shows the internal codes recorded at the time of the event.

Use key 6 to return to menu 4 while keeping the current event; you can then switch several times from the description of the event with the "stored alarm message" to the one with the internal codes.

1.1.1.3 RECORDED value on full page

The "RECORDED value on full page " menu is accessed with key 4 from menu 4.

On this page, when the "stop" key is not cross marked, are shown all present measurements and internal codes, and the past measurements when the "stop" key is marked.

When the "STOP" key is cross marked it is possible to look to the other past value recorded by arrow keys.

NORMAL OPERATION

a=0000-0000 2011- 1-24/15:35: 40;

s=8000 c=0000 b=0000 r=0000-00 i=0000-00

IN=100,100,100%V; 45, 45, 45%A; 60.2Hz
BY=277,277,277Vln (480V);60.0Hz;

OUT= 277,277,277Vln(480V); 50, 50, 50%A
40, 40, 40%W 60.0Hz; 57, 57, 57%Ap

Bat=530V; - 11A; i=277,277,277Vln;720Vdc
Ts=26,Tr=36,Ti=35;

NORMAL OPERATION

a=0000-0000 2011- 1-24/15:35: 40;

s=8000 c=0000 b=0000 r=0000-00 i=0000-00

IN=100,100,100%V; 45, 45, 45%A; 60.2Hz
BY=277,277,277Vln (480V);60.0Hz;

OUT= 277,277,277Vln(480V); 50, 50, 50%A
40, 40, 40%W 60.0Hz; 57, 57, 57%Ap

Bat=530V; - 11A; i=277,277,277Vln;720Vdc
Ts=26,Tr=36,Ti=35;

This key switch to the page showing the message and codes of 4 past events and it is possible to look to the other past events by arrow keys.

NORMAL OPERATION

a=0000-0000 2011- 1-24/13:35: 0;n120

BYPASS LINE VOLTAGE FAIL or SWBY OFF
a=0400-0000 2011- 1-24/13: 5: 5;n119

PREALARM, LOW BATTERY VOLTAGE
a=1C00-0000 2011- 1-24/13: 1: 3;n118

MAIN LINE VOLTAGE FAIL or SWIN OFF
a=1800-0000 2011- 1-24/12: 1: 1;n117

NORMAL OPERATION

a=0000-0000 2011- 1-24/11: 4:18;n116

s=8000 c=0000 b=0000 r=0000-08 i=0000-00
a=0000-0000 2011- 1-24/13:35: 0;n120

s=8000 c=0000 b=3C20 r=0000-08 i=0000-00
a=0400-0000 2011- 1-24/13: 5: 5;n119

s=8000 c=0000 b=0000 r=F881-00 i=0000-00
a=1C00-0000 2011- 1-24/13: 1: 3;n118

s=8000 c=0000 b=0000 r=F881-00 i=0000-00
a=1800-0000 2011- 1-24/12: 1: 1;n117

s=8000 c=0000 b=0000 r=0000-08 i=0000-00
a=0000-0000 2011- 1-24/11: 4:18;n116

This key switch to page with all codes and measurements displayed of 1 event. The key "6" switch from code with message line to full lines code.

6.1.7 DISABLING THE AUDIBLE ALARM (key 5)

Press the following sequence of keys to access the menu: 5

During operation from the basic menu, the operator can permanently disable or re-enable the audible alarm (buzzer) by pressing key 5. "5=ON" is shown in the basic menu when the audible alarm is enabled and "5=OFF" when the audible alarm is disabled. Key 5 in other menus may only be used to disable the sound, when no other functions are envisaged for this key. The command is stored even during a shutdown due to a power failure.

6.1.8 "CLOCK": DATE/TIME (key 6)

Press the following sequence of keys to access the menu: 6

The "DATE/TIME" menu is accessed via key 6 from the basic menu.

The display shows the current contents of the internal calendar and clock with the following format:

DATE/TIME = ymd/h = years, months, days / hours, minutes, seconds.

The contents can be modified via the menu by inserting the personalization code 436215. This code remains active for 2 minutes after it has been inserted.

The next menu can only be accessed by inserting the correct code, otherwise the system returns to the basic menu.

Press keys 2, 3, 4, 5 or 6 to select which value to change.

DATE/TIME = Xmg/h = 2003 12 31/24:60'60
ADJUSTMENT: 7=-, 8=+

In this case the year's value is to be changed; the flashing symbol X superimposed over the letter shows which field has been selected. Press keys 7 or 8 to decrease or increase the selected value by one unit; press any one of the other keys to exit the menu.

6.1.9 "ARROW DOWN": Internal Codes, firmware ver.(key 7)

Press the following sequence of keys to access the menu: 7

s=FFFF c=FFFF b=FFFF r=FFFF-FF i=FFFF-FF
a=FFFF-FFFF; INTERNAL CODES; ver.10.....

The "INTERNAL CODES" menu is accessed from the basic menu via key 7. The codes represented provide information on the operating status of the UPS and about system firmware version. This information is used by the service personnel.

Pushing more key 7 it is shown the page with information about other firmware version, serial number and service telephone number.

200kVA 277V 3L 60Hz [15:35:55]

System: Ver.= 28, rev= 1, ck=A404
Panel: Ver.= 01, rev= 1, ck=B235
DSP: Ver.=3333, rev= 0, ck=1ABC
Serial N.= ML36AP183410001
Dial Tel.= 0201010101010

NORMAL OPERATION

U200AA OUT= 40%VA, Batt= 35% 5

EXIT

7 Parallel (OPTIONAL)

7.1 UPS in parallel configuration

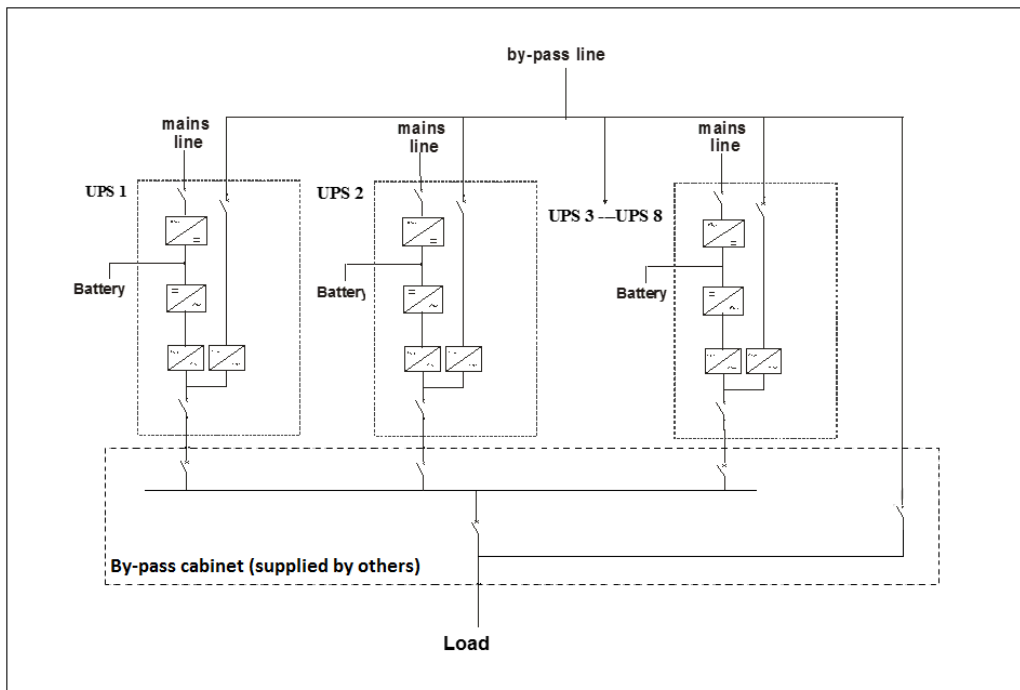
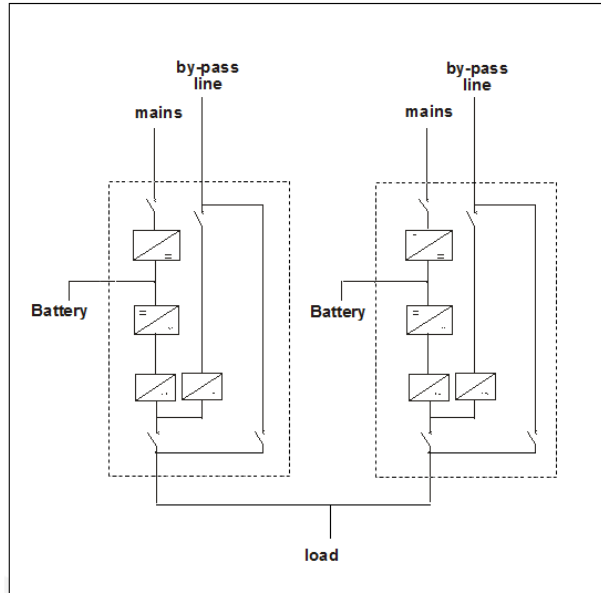
7.1.1 Introduction

UPS's with parallel option fitted may be connected in a parallel configuration to increase both the reliability of the power supply to the load and the available output power. Up to 8 UPS's can be parallel-connected. It is recommended to connect units of the same power.

The load that can be applied to a system with several units connected in parallel may be greater than the load that can be supplied by a single unit, thanks to automatic load sharing. The maximum reliability is achieved when the total power of the system with one unit OFF remains greater than the required power. This condition can be achieved by always adding a redundant unit ($N+1$).

Redundant unit means UPS with more than the minimum number of elements required to power the load, so that if a faulty unit is automatically excluded, rated power is still supplied. The UPS's connected in parallel are managed by a logic board which ensures the interchange of information. The information is exchanged between the UPS's via a cable connecting them in a loop. The loop connection provides redundancy in the network connection cable (communication in the cables between the individual units). This is the most reliable means of connecting the UPS and also allows the "hot" insertion or

disconnection of a UPS. Each UPS has its own controller that continuously communicates with the whole system so as to guarantee the operation of the system. The cable transmits the signals from a "Master" UPS to the other "Slaves" using an optically-isolated system in order to keep the control systems electrically isolated from each other. The logic operate so that the first unit activated becomes the "Master" and takes control of all "Slave" units. In the event of a fault in the "Master" unit, control is immediately switched to a "Slave" which then becomes the "Master". The current system provides basic operation, each unit having its own battery. The system may be customized (by insert a code on the display panel) with all the units connected to a single battery.



Note: For parallel system greater than 1+1 redundant, it's recommended to install the wrap around bypass switch. This is to assure the correct maintenance.

7.2 Electrical system set-up

If the UPS's are required to be configured as "parallel" units in field, the operation requires to install and connect one parallel card and one parallel signal card inside the unit.

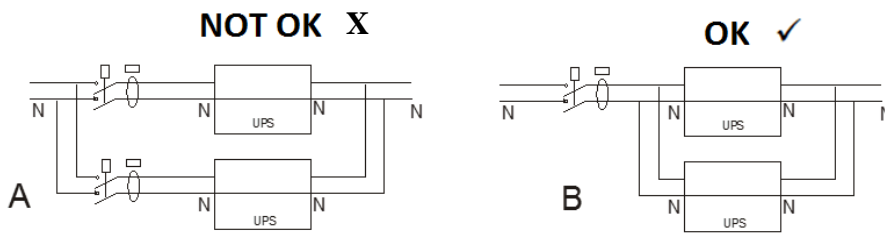


Read the instructions carefully before carrying out installation. All maintenance operations inside the UPS must be carried out only by trained personnel.
inverter must be switched off before operations. After disconnecting the mains lines and the DC power, authorized personnel shall wait at least 10 minutes for capacitors bleed off before servicing inside to the UPS.

7.2.1 Input

The instructions seen in the first part of the manual for a single UPS remain valid; each unit must be protected with equivalent fuses or switches.

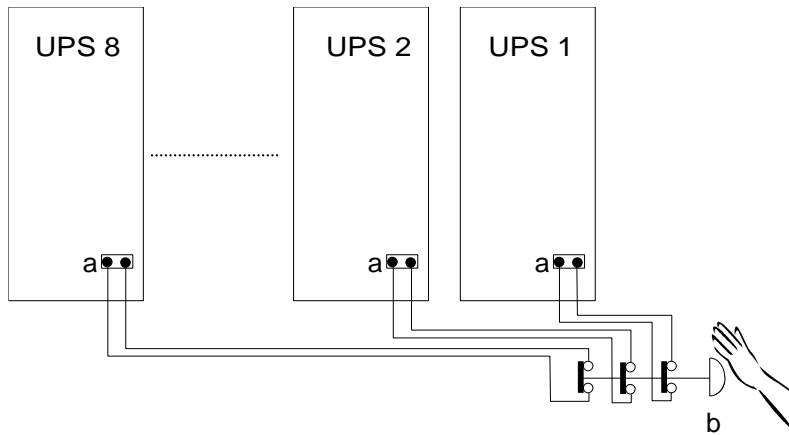
7.2.2 Ground Fault



It is recommended that a Ground Fault Circuit Interrupter (GFCI) is implemented for safety. In order to avoid false interventions, systems with several parallel-connected units must have a single GFCI inserted upstream of the system, as shown in figure B.

7.2.3 Emergency power off device (EPO)

When several units are connected in parallel, the EPO command must be sent to all UPS's simultaneously, as shown in the figure below:



- a - EPO terminal board on the UPS
- b- EPO switch with auxiliary contacts (not provided).

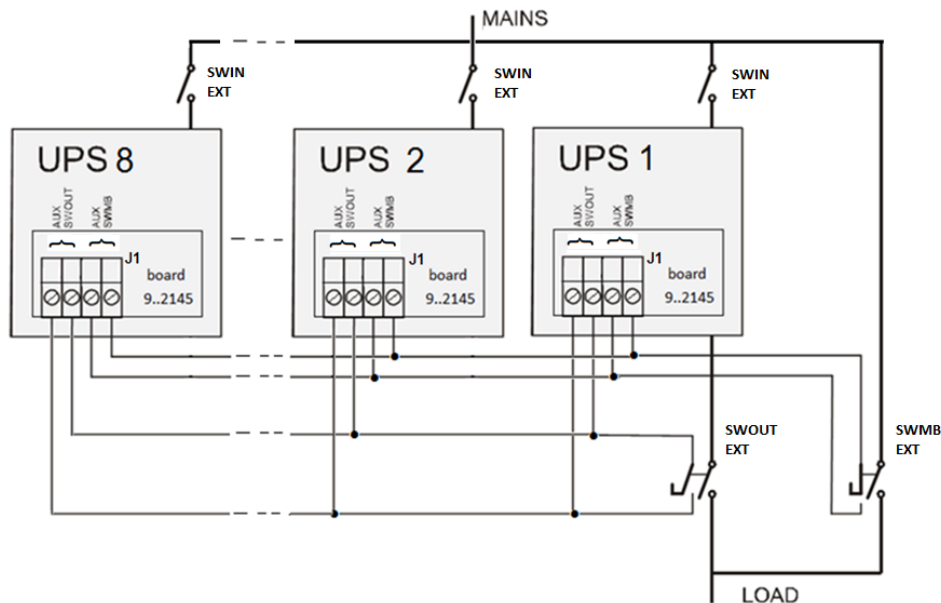
The button must have the same number of auxiliary contacts as the number of parallel UPS's. Each UPS must have the jumper on the EPO terminals removed and the wires from the auxiliary contact of the button must be connected instead of the jumper section 5.5.

The contact must be normally closed with the button in the rest position and be opened when the button is pressed. Installation of the EPO switch must be made with the UPS's turned off.

7.2.4 External maintenance bypass and output switch cabinet

The External Maintenance Bypass should be installed in accordance with the manual for the External Maintenance Bypass Cabinet. The auxiliary contacts of the external SWMB and of the SWOUT shall be connected to the board of each UPS in parallel, as depicted in the diagram below.

Note: MASTER HP-UL series have input terminals (for acquiring the status of aux contacts) galvanically isolated from the internal circuits of the UPS. This will result in to be sufficient a single aux contact electrical connection of the External switch brought to each UPS of the parallel system.



The auxiliary contacts of SWOUT EXT and SWMB EXT must be connected to terminal J1 on the board 9AB2145 (aux signals insulation). The purpose of this board is to galvanically isolate the internal circuits of UPS, so that, in case of parallel of UPS, one auxiliary contact of the external switch is sufficient to be acquired by all the UPS in parallel. For safe removal, the UPS must be placed onto bypass, closing SWMB EXT, opening SWIN EXT and SWOUT EXT and disconnecting the UPS.

Aux Contact SWOUT EXT must be N.O. as the power contacts while aux contacts SWMB EXT must be N.C., in the opposite position of power contacts.

Note:

- 300kVA÷500kVA: Auxiliary switch of SWMB EXT opens simultaneously when closing power contacts
- 400kVA/500kVA: Auxiliary switch of SWOUT EXT opens simultaneously when opening power contacts
- 300kVA only: Auxiliary switch of SWOUT EXT opens in advance when opening power contacts

7.3 Mains, and load connections.

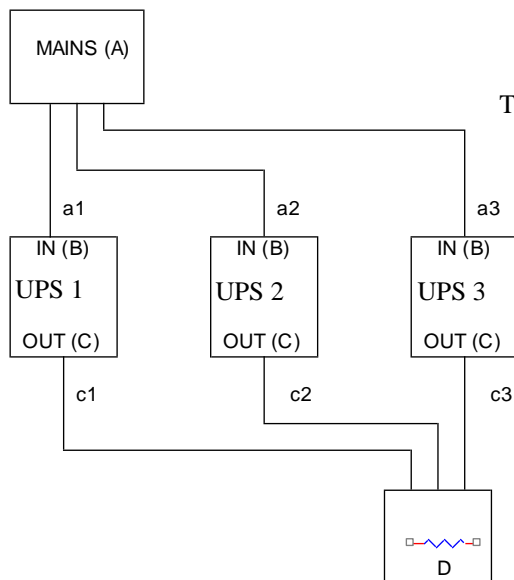
All the information contained in the section “Mains, load and battery connections” (page 28) in relation to the UPS remains valid with the addition of the information set out below.

7.3.1 UPS AC input / output power connection

Refer to the Electrical Connections (Section 5) of this manual for information on how to size the cables for **each UPS**.

Parallel connect the UPS as follows:

- Connect the mains power supply phases L1, L2, L3, N to the **corresponding** input phases of each UPS L1, L2, L3, and N.
- Connect the load phases L1, L2, L3, N to the **corresponding** output phases of each UPS L1, L2, L3, and N.



The figure shows an example of three units connected in parallel.

- A) Mains power supply line
- B) UPS input terminals
- C) UPS output terminals
- D) Load

(a1, a2, a3, c1, c2, c3) length of cables (see below)

Length of cables rule of thumb



The sum of the lengths of the mains power supply and output cables must be the same for all units. With reference to the above drawing, these must be:

$$a1+c1 = a2+c2 = a3+c3$$

a = length of input line cables

c = length of output line cables

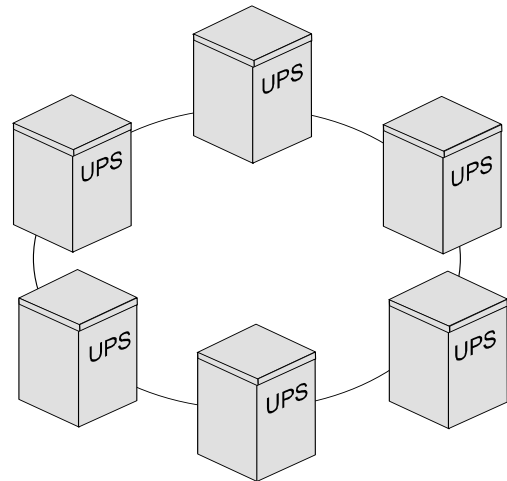


The length of cables rule of thumb must also be followed with separate mains power lines: the lengths of the cables of the bypass line + output line must be the same between all the UPS connected in parallel. Lack of compliance with this rule of thumb may cause a current imbalance between the UPS's when the load is powered through the bypass line. An overload on the bypass line of one UPS will result in a wearing out of the components on that line, both internal and external to the UPS.

7.4 Connection of signals

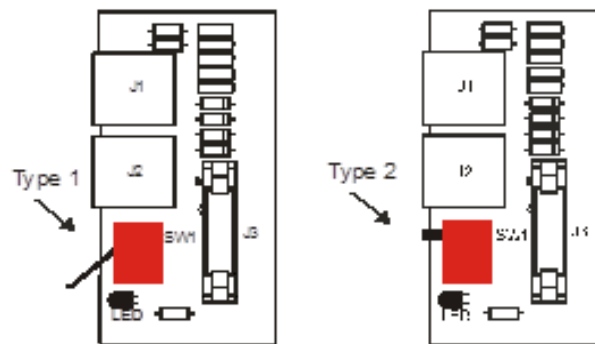
The signals of several parallel UPS's are connected in a closed loop configuration; if the loop is opened at any point, either due to a fault or for maintenance, operation of the system shall not fail, and the system keep going to operate normally, as will be shown repeatedly below.

The UPS's are connected through the "signals RJ45-flat-adapter" parallel card, located in the lower part of the UPS (in the area for signal and command connections as shown in the section on SIGNALS and REMOTE COMMANDS).



- RJ45-flat-adapter signals parallel card.

Note: The UPS may be provided with one of two versions of the parallel card which differ in the type of switch used (type 1 or type 2). The difference between the two switches is the position of the control lever.



J1 RJ45 type connector
J2 RJ45 type connector

SW1	<i>start position</i>	<i>connector side (type 1)</i>	<i>LED side (type 2)</i>
	<i>Cont position</i>	<i>LED side (type 1)</i>	<i>connector side (type 2)</i>

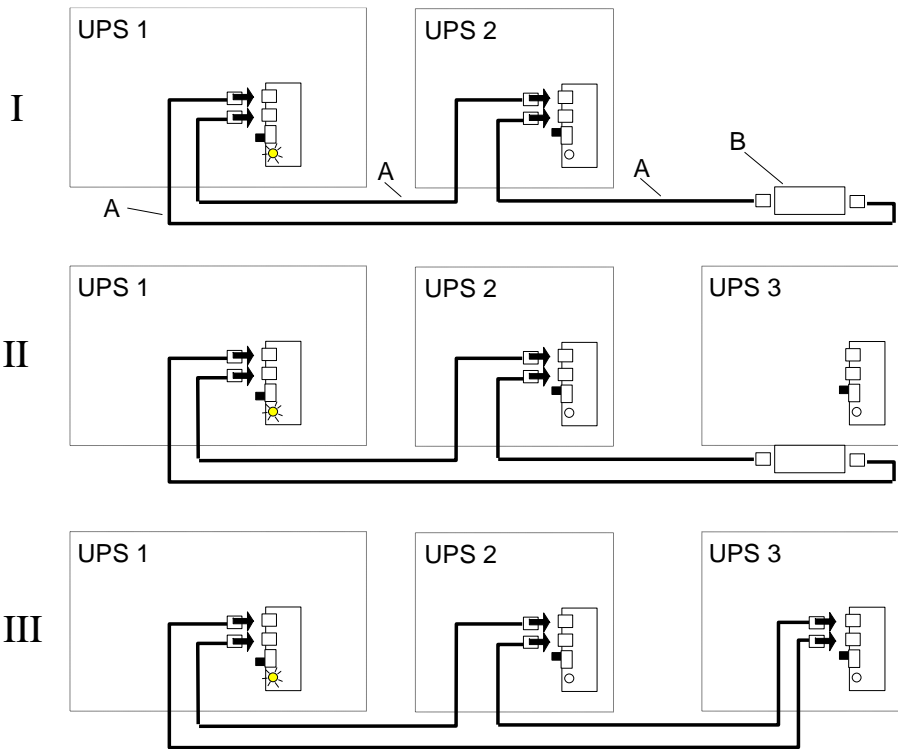
LED	<i>on</i>	<i>SW1 start position</i>
	<i>off</i>	<i>SW1 Cont position</i>

Insertion and removal with UPS's operating (hot swap)

The hot insertion and removal of the UPS can only take place if the system is configured with the **RJ45 female/RJ45 female shielded adaptor cable** (as shown in the figures below).

The hot insertion and removal of the UPS makes technical support easier and improves the reliability of the system. With this procedure it is not necessary to shut down all the UPS's in order to add or remove a unit. Hot insertion and removal can only be done on systems comprising UPS's with the following characteristics:
The UPS system must be prearranged with a distribution panel (for power connections)
The UPS system must be prearranged with a RJ45 female/RJ45 female shielded adaptor cable (not provided with the UPS). All the UPS's in the system must have the same firmware version.

Example of hot insertion



A) UPS parallel cable type RJ45
B) RJ45 female/RJ45 female shielded adaptor cable *UPS BYPASS CABLE*

II - Insert the new UPS (power connections in the distribution panel) and keep it switched off. UPS 3: SW1 cont position.

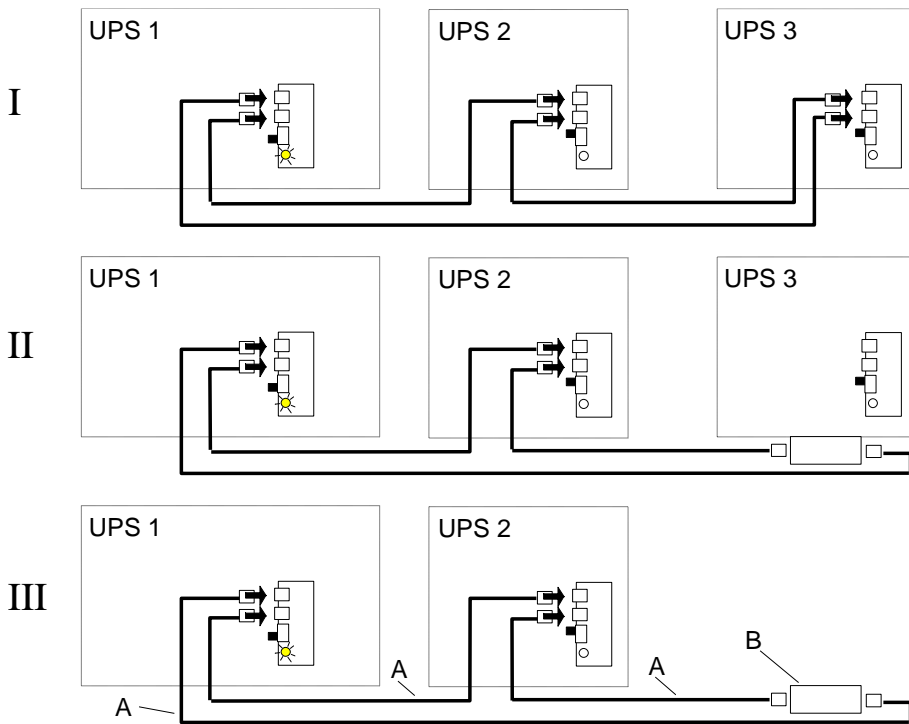
III - Remove adaptor B and insert the new UPS instead of the adaptor.

Now switch on UPS 3 (the added UPS).

With the lever of SW1 in the start position in one UPS only and the lever in the cont position on all the others, check that all the UPS's are operating normally and that the system is sharing the output power.

Example of hot removal

With hot removal, it is not necessary to shut down all the UPSs of the system in order to remove one.



A) UPS parallel cable type RJ45
 B) RJ45 female/RJ45 female shielded adaptor cable *UPS BYPASS CABLE*

NOTE: if the UPS to be removed has SW1 in the start position, one of the other UPS's (UPS 1 or UPS2) must be in the start position.

One UPS in the system must have SW1 in the start position and LED ON.

I - Shut down the UPS (3) that is to be removed. Remove the signal cables of the UPS to be removed.

II, III - Connect the RJ45 female/RJ45 female shielded adaptor cable (not provided) between cables A.

Check that all the UPS are operating normally and that the system is sharing the output power.

Firmware update



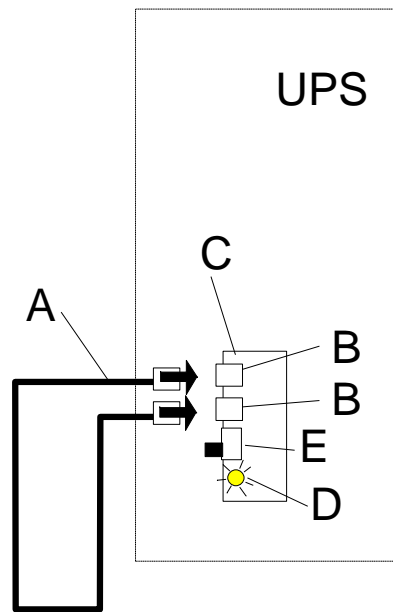
All the parallel-connected UPS's must have the same firmware version. Press key 7 from the basic menu on the display panel to display the firmware version installed.
For the expansion of an existing system, check that the system has the same firmware version as the new UPS. Consult the factory if firmware versions are different.

Using the cable with two RJ45 terminals provided with each UPS (A), make the connections as shown below:

Single UPS configured in parallel

If it is required to use a UPS that has been configured as a parallel unit on its own, the signal card must be jumpered with the cable provided as shown below.

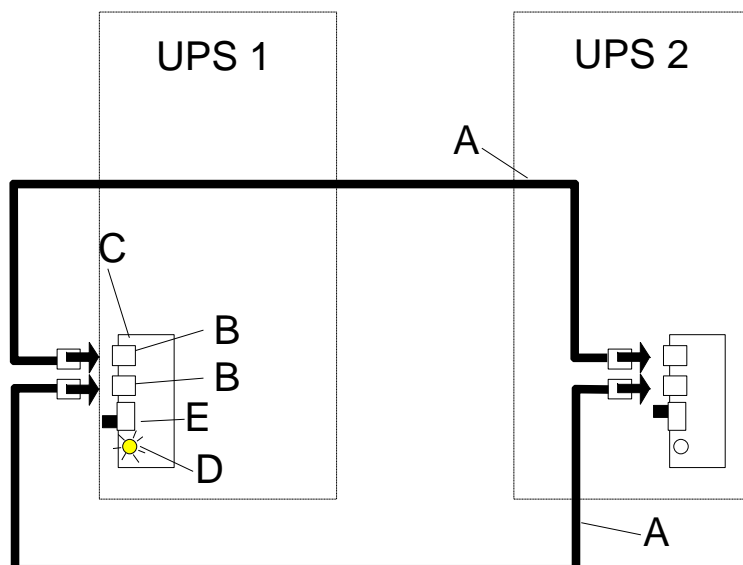
- A UPS PARALLEL CABLE
- B RJ45 type connector
- C RJ45-flat-adapter signal parallel card
- D LED on
- E SW1 in start position



Two UPS in parallel

- D UPS1 LED on, UPS2 LED off
- E SW1 in start position on UPS1, SW1 in cont position on UPS2

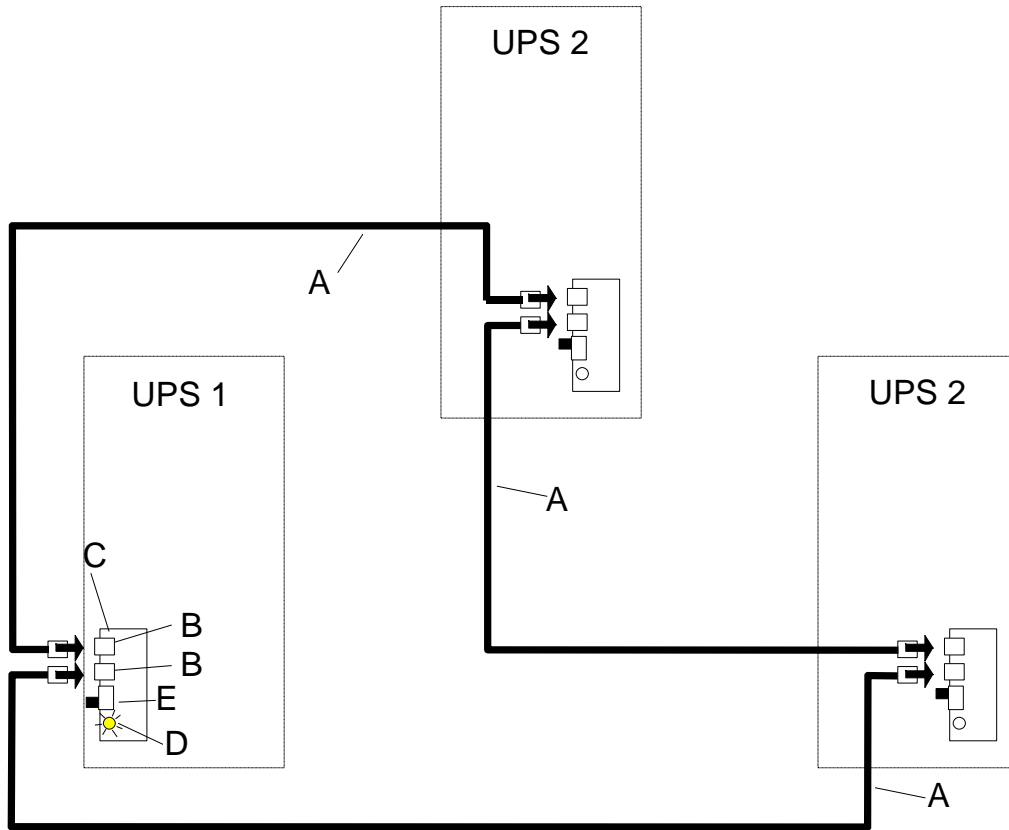
Note: 2 RJ45 cables are required despite redundancy. System will not start up unless 2 cables are installed.



Three UPS in parallel

- D UPS1 LED on, UPS2 LED off, UPS3 LED off
- E SW1 in start position on UPS1, SW1 in cont position on UPS2 and UPS3

Note: 3 RJ45 cables are required despite redundancy. System will not start up unless 3 cables are installed.



To add other parallel UPS's, a "UPS PARALLEL CABLE" must be added for each new UPS connected.



The signal connection must not be removed when one UPS is shut down

7.5 Start-up procedure

Before starting up the whole system for the first time, some tests have to be performed to check that the UPS's are connected to each other correctly.

A) Open all the switches and disconnects on the UPS's (SWIN, SWOUT and SWMB if fitted) and on the battery cabinets.

B) Start up UPS1 by closing SWIN, SWBY and SWOUT. After a few moments, messages on the UPS status will start to scroll across the first line of the display panel. This will include the following message regarding the battery connection:

Low Bat Charge or Close FBAT

- The voltage present between the corresponding input and output terminals (L1-L1, L2-L2, etc.) of each UPS is <5Vac. If isn't, check that the UPS's are connected to each other correctly.
- Once the test is completed

D) Close SWIN, SWBY on all the other UPS's.

E) Check that all the parallel-connected UPS's are on.



Close the circuit breaker/disconnect on the battery cabinets ***only when the following message is no longer shown*** on the first line of the display panel:

Wait: DO NOT connect the BATTERY

FOR OPERATION WITH A SINGLE BATTERY ONLY



Check the letter "X" on the second line of the display panel:

Example: "UPS type", "X" OUT=YYY%VA, BATT=YYY%Ah, 5=ON(or OFF)

Note: the UPS with a capital "X" (B or P) is the MASTER unit

The "X" on the MASTER unit may be:

- X= B, the parallel battery code has already been inserted.

Only the battery capacity value has to be inserted (see below).

- X= P the parallel battery code must be inserted by pressing keys 3, 5 in sequence on the control panel and the code 467123 (repeat the same sequence to disable the parallel).

The UPS's connected to the one in which the code is inserted will be automatically configured through the parallel cable (the letter "b" will be displayed on all the UPS's).

This configures the value of the battery capacity only; this value must be inserted on the MASTER UPS, which will send the information to the other units via the signal cable.

Only for MASTER HP UL with SWMB option fitted:

F) On UPS1 select the transfer of the system on bypass line, by insert command on display panel, before closing SWMB.

G) Close SWMB of UPS 1 (the bypass LED on UPS1 will flash while are steady on the other UPS's), then open switch SWMB again and re-transfer the system on inverter side by inserting command on display panel. Wait a few seconds then check that the UPS1 returns to "NORMAL OPERATION". Repeat this procedure for the other units connected. If this check is positive, close SWOUT on all the units.

H) At the end of the start-up phase, all the UPS's must be in the "NORMAL OPERATION" condition.

I) Wait approx. one minute from the insertion of the last UPS, then check that with the load not connected the output power indicated by each unit is <3%.

L) Connect the load to the output, wait approx. one minute and then check that the power shared between the various units is within $\pm 2\%$.

7.6 Maintenance bypass on the whole system

The sequences of operations to place the system in maintenance bypass are described below. The procedures shall depend-on the initial state:

- All the UPS are in NORMAL OPERATION
procedure a) *the power supplied to the load is not interrupted in any way;*
- All the UPS are in BAD BYPASS VOLTAGE or SWBY OFF with the bypass line
procedure b) *the power supplied to the load is interrupted*
(this operation should therefore be used only if absolutely necessary).

Procedure a)



The bypass line is present and frequency and voltage are within range
display panel indicates NORMAL OPERATION.

1. On display panel, set the command for transfer the load on bypass line.
2. Close all the switches SWMB (the control logic automatically disables the inverter)
3. Open all the switches on the UPS (SWIN, SWOUT, SWBY and the battery cabinet circuit breaker/disconnect) and keep only SWMB (maintenance bypass switch) closed. The control panel remains off.

NOTE: when the operations indicated above are performed, personnel must wait at least ten minutes for the capacitors to discharge before servicing inside of the UPS.

In this situation any disturbance (such as a blackout) on the mains supply line will have an effect on the load (since the batteries are disconnected in this state).

Procedure b)



The bypass line is out of the range; the following message is shown on the display panel:
BAD BYPASS VOLTAGE or SWBY OFF and the green LED 1 will flash

1. Open all the switches on the UPS (SWIN, SWOUT, SWBY) and the battery cabinet circuit breaker/disconnect). The control panel will remain off.
2. Before closing switches SWMB and connecting the loads, ensure that both the frequency and voltage of the mains supply are sufficient to power the connected loads.

NOTE: when the operations indicated above are performed, personnel must wait at least ten minutes for the capacitors to discharge before servicing inside of the UPS.

After servicing, restart the UPS by following the instructions in the section on START-UP PROCEDURE (see page 42) and then open SWMB (if closed).

The UPS will return to NORMAL OPERATION.

7.7 Operating modes

UPS units connected in parallel share the load current.

In a system with several UPS's connected in parallel, there is a single MASTER unit and the remaining units are SLAVES. The UPS's are all exactly the same and the MASTER is chosen on start-up. The MASTER unit is shown on the display panel by the capital letter "P" (or "B" in the case of a single battery). The MASTER and SLAVE units may exchange roles. If a unit goes out of service, e.g. due to an inverter fault, it will automatically be excluded. The load at this point is shared between the units that are still active. If the total load power exceeds the capacity of the remaining UPS's, the system logic switches all the units, including the UPS that was excluded, onto the bypass line.

All the information contained in the section on "operating modes" (page 35) in relation to the UPS remains valid with the addition of the information set out below.

ON LINE OPERATION

The message: "NORMAL OPERATION" is shown on the display panel of each UPS and the letter "P" appears in the bottom left-hand corner near the indication of the model. This letter is in upper case if the equipment in question is the MASTER, while a lower case character is displayed if the UPS is a SLAVE.

STAND-BY ON OPERATION

Sharing the load between the UPS's is linked to the length of the cables, and the rules on the length of the connections indicated in the section "connections" must be followed. In the event of a mains power failure, the load is supported by all of the parallel-connected UPS's.

STAND-BY OFF OPERATION

In this mode, if there is a mains power outage, the UPS's share the load equally; the load is not powered with the mains present.

STABILIZER WITHOUT BATTERY OPERATION

In this mode, the units share the load equally. Without a battery each unit is only a power conditioner, not a UPS.

BATTERY OPERATION

One battery for each UPS

Each unit draws the energy from its own battery. At the end of its backup time each UPS excludes itself. The load remains unpowered if the duration of the mains outage is greater than the backup time of the whole system. When the mains power is restored the system will restart automatically. Each UPS recharges its own battery.

One battery for all the UPS's.

Each unit draws the energy from the common battery. At the end of the backup time, the whole system excludes itself. The load remains unpowered if the duration of the mains outage is greater than the backup time of the whole system. When the mains power is restored the system will restart automatically. Each UPS recharges the common battery.

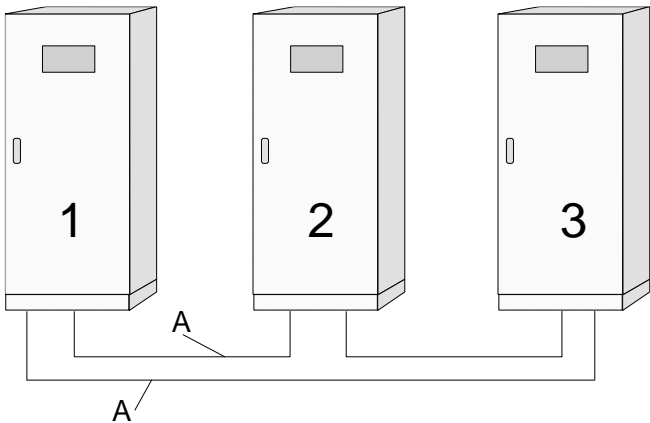
OVERLOAD

Also in this mode, the devices share the overload equally.

If the load applied to the system is not reduced, the whole system will switch onto the bypass line. When the overload is removed, all the units will automatically return to normal operation. If the overload persists, however, it triggers the external protection devices located at the UPS input on the bypass line. In this case the load would remain unpowered.

Example of parallel operation

The instructions shown below refer to a system with three UPS's, but are valid for more complex systems.
Let us assume the UPS's are in the following state:

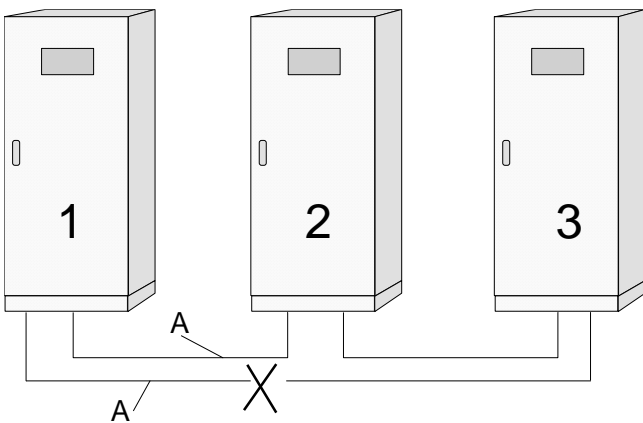


UPS STATUS

- 1) Normal operation, Master unit
- 2) Normal operation, Slave unit
- 3) Normal operation, Slave unit

A - UPS PARALLEL CABLE type RJ45
1, 2, 3 - Parallel-connected UPS's

If the signal cable between UPS's 1 and 3 is open (UPS PARALLEL CABLE type RJ45).



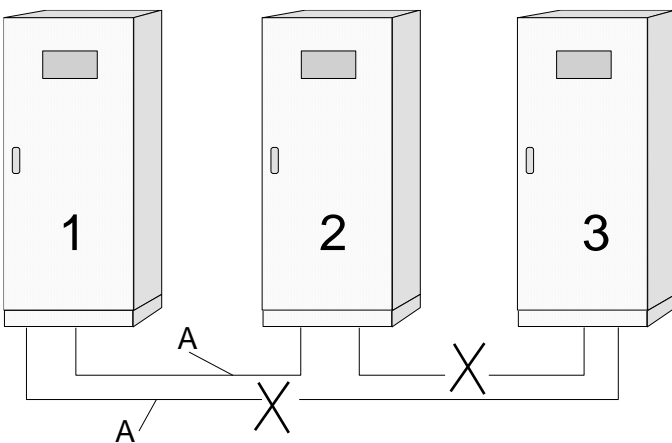
UPS STATUS

- 1) Normal operation, Master unit with message "Parallel signal cable fault" appears on the panel
- 2) Normal operation, Slave units with message "Parallel signal cable fault" on the panel
- 3) Normal operation, Slave units with message "Parallel signal cable fault" on the panel

Note: in this situation the load is powered correctly.

All the UPS's supply power to the load.

Let us assume that the signal cables between UPS's 1,3 and 2,3 are opened.



UPS STATUS

- 1) Normal operation, Master unit with message "Parallel signal cable fault" on the panel
 - 2) Normal operation, Slave units with message "Parallel signal cable fault" on the panel
 - 3) Disconnected (TLI open, SCRs off), Slave units with message "INTERNAL FAULT 10" on the panel
- NOTE: In this situation the load is only powered correctly by UPS's 1 and 2.

To restore the broken signal cable, first the UPS with the message "INTERNAL FAULT 10" on the panel has to be shut down.

8 Maintenance



The uninterruptible power system is designed and produced to last a long time, even in the most severe service conditions. It should be remembered however that this is electronic power equipment, which requires routine maintenance. 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 capacitors. It is therefore recommended to implement a programmed maintenance performed by specialized service personnel authorized by the manufacturer. Our Technical Support Team will be pleased to recommend different options for routine maintenance.

routine maintenance (to be carried out by trained service 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 UPS 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 via the display panel.

Maintenance inside the UPS (trained service personnel only)



Maintenance inside the UPS may only be carried out by trained service personnel. The UPS is designed to power the load when it is disconnected from the mains power supply.
High voltage is present inside the UPS even when the mains power supply and the battery have been disconnected

After disconnecting the mains power supply and the battery cabinet, trained service personnel must wait at least ten minutes for the capacitors to discharge before servicing inside of the equipment.

routine 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 (See page 51).

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

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 range of 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 circuit breaker/disconnect does not eliminate the voltage inside the battery cabinet. **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 RPS technical support.



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”.

UPS models	300kVA	400kVA	500kVA
INTERMEDIATE D.C. CIRCUIT			
N. cells (Lead acid batteries) [N]	240 (40 x 12Vdc battery)		
Rated battery voltage [V]	480		
9.1.1.1.1.1.1.1.1 Float charge (20°C) with cyclical charge not active **			
Battery type 1 or 2 [V]	542 (2,26V/cells-default)		
3 [V]	528 (2,2 V/cells-default)		
0 [V]	2÷2,5 V/cells programmable		
9.1.1.1.1.1.1.1.2 Boost charge **			
Battery type 1 or 2 [V]	562 (2,34 V/cells - default)		
3 [V]	576 (2,40 V/cells - default)		
0 [V]	2÷2,5 V/cells programmable		
9.1.1.1.1.1.1.1.3 End of discharge (20°C) **			
Battery type 1- 2-3 [V]	For Ibatt = 0÷Ah rated value 432÷395		
0 [V]	For Ibatt>Ah rated value 384		
	375÷456 programmable		
Max Vdc [V]	600		
Ripple voltage with recharged battery [%]	Approx. 0		
Max recharge current [A]			
Full load	60	150	100
Load 90%	115	225	190
Load 80%	165	300	285
Load ≤ 70%	210	360	360

** See 1.7 and 1.14.5

UPS models	300kVA	400kVA	500kVA
INVERTER			
Rated power Pf 0.9 (kVA) inductive	300	400	500
Active power Pf 1 (kW)	300	400	450
Rated power reduction factor (kVA/kW) for Pf =0.8/0.9 capacitive	0,95/1		0,85/0,89
Rated voltage	480Vac 3-phase + N		
Rated frequency	60Hz		
Rated voltage adjustment field	+5% -10%		
Static variation	± 1%		
Dynamic variation	± 5%		
Recovery time within ± 1%	20ms		
Non- linear load capability	Conforms to standard IEC 62040-3, class 1		
Voltage distortion with linear load	Conform to standard IEC 62040-3 annex E		
Voltage distortion with non- linear load	1% (typical), 2% (max)		
Stability of frequency with Inverter synchronized with the bypass mains	< 3%		
Stability of frequency with Inverter not synchronized with the bypass mains	± 2% (adjustable from ± 1% to ± 6% from control panel)		
Speed of frequency variation	± 0.05%		
Dissymmetry of the phase voltages with balanced and unbalanced load	1Hz/sec		
Voltage phase shift with balanced and unbalanced load	≤ 1%		
Overload with reference to the rated power three phase	120 ± 1 °el		
single phase	110% for 60min , 125% for 10min , 150% for 1min		
Short circuit current	200% for 7 second		
Phase / Phase	180% for 1 second with current limiting		
Phase / Neutral	300% for 1 second with current limiting		
Inverter efficiency (%)	95%		
Normal mode heat rejection (BTU/Hr)	58,800	78,410	98,000

UPS models	300kVA	400kVA	500kVA
BYPASS			
Rated voltage	480Vac 3-phase + N		
Rated voltage tolerance	± 15% (adjustable from ± 10% to ± 25% from control panel)		
Rated frequency	60Hz		
Frequency tolerance	± 2% (adjustable up to ± 6% from control panel)		
Switching onto bypass with synchronized Inverter (UPS in "Normal Mode")	Approx 0ms		
Switching onto bypass with Inverter out of sync (UPS in "Normal Mode")	20ms		
Switching from bypass to Inverter (UPS in "Stand-by On mode")	from 2 to 5ms		
Delay in transfer onto Inverter after switching onto bypass	4 sec		
Power overload capacity of the bypass line (kVA)	110 % for 60 minutes, 125 % for 10 minutes, 150 % for 1 minute		
Short circuit capacity of the bypass line (x rated current)			
1 second	12	10	7
500 ms	14	11	8
200 ms	16	12	9
100 ms	18	14	10
10 ms	25	20	15

UPS models	300kVA	400kVA	500kVA
Short circuit withstand rating *			
50 kArms @ 480Vac			

*Note: Maximum short-circuit current level at the UPS input terminals

10 Appendix A Alarm messages

Below is a list of the alarm messages that are shown on the first line of the display panel, the “A=” column shows the number that is also displayed on the right in the lower row .

ALARMS		
A=	EVENT MESSAGE	DESCRIPTION
0	NORMAL OPERATION	No Alarms are present
1	INTERFERENCES ON BYPASS LINE	Alarm present when there is interference on the bypass line, such as voltage peaks or harmonic distortion, while the voltage and frequency are correct. WARNING: in this case the inverter is OUT OF SYNC with the bypass line; if the bypass is forced with SWMB, with the remote commands or from the panel, the load may undergo a sudden variation in voltage.
2	MANUAL BYPASS, SWMB ON	The mechanical bypass switch SWMB is closed, thus preventing the UPS from returning to normal operation. The load is powered directly from the input and will remain unpowered if there is a mains failure.
3	BYPASS LINE VOLT. FAIL or SWBY,FSCR OFF	The UPS does not recognize the bypass line because it is out of range or because SWBY is open,
4	MAIN LINE VOLTAGE FAIL or SWIN OFF	The power supply voltage is not correct, the load is powered with the energy stored by the battery. This alarm is present if one of the following conditions occurs: - the supply voltage or frequency of the rectifier power supply line is out of range (see characteristics) - SWIN is open, - rectifier fault
5	PREALARM, LOW BATTERY VOLTAGE	Alarm present if the residual backup time is lower than the time set for the pre-alarm (the factory-set value is 5 minutes).
6	LOW BATTERY CHARGE or CLOSE SWB	A BATTERY TEST performed by the UPS logic with the mains power supply present detected a battery voltage lower than the value calculated (see BATTERY TEST menu page 51).
7	LOW INPUT VOLTAGE or OUTPUT OVERLOAD [W]	Alarm present if one of the following conditions occurs: - the power supply voltage in input is insufficient to power the load (see general characteristics); - the active power [W] of the output load is greater than the rated value.
8	OUTPUT OVERLOAD	This indicates that the required load power, which is supplied by the inverter, is greater than the allowed rated power, thus the value indicated, expressed as a percentage % VA, exceeds the value of 100%. The same alarm is also activated when the peak load current exceeds the maximum value allowed. When this alarm is present the load must be reduced, otherwise the system will automatically transfer to the bypass line within a time that is inversely proportional to the value of the overload.
9	BYPASS FOR OUTPUT VA < AUTO-OFF VALUE	This message is present when the load power in % VA is lower than the "AUTO-OFF" value set (see page 56). The % VA value for AUTO-OFF is factory-set at zero (thus the alarm condition cannot be checked).
10	INTERNAL FAULT :	Alarm codes used by customer service.
11	TEMPORARY BYPASS, WAIT	This indicates that the load is powered from the bypass line and the system is in the condition prior to the automatic return to normal operation with power supplied from the inverter. This temporary operation may take place, as an example, during the start-up phase or while waiting for the return to inverter after a bypass due to overload.
12	BYPASS FOR OUTPUT OVERLOAD	This indicates that the load is powered from the bypass line and is greater than the rated value; the value indicated on the panel, expressed as a percentage % VA, exceeds the value of 100%. The load must be reduced to prevent damage to the UPS. The load must be reduced in order to return to NORMAL OPERATION. Wait a few minutes to allow cooling (e.g. the time for the return to NORMAL OPERATION is 60s if the load goes down to 50%, and 8 minutes if it goes

down to 75%).

13	BYPASS COMMAND ACTIVE; 8=COMMAND OFF	Alarm present when the system has been deactivated and switched onto the bypass, by means of a specific command inserted via the keyboard. The command remains stored also during shutdown due to a mains power supply failure. The system does not return to normal operation when the mains power supply is restored if the block has been set intentionally and not deactivated.
14	REMOTE BYPASS COMMAND: ACTIVE	Alarm present when the system has been deactivated and switched onto the bypass, by the command applied with the "signals and remote commands" connector. The command is not stored, and the system returns to normal operation when the command is cancelled, provided there is a power supply voltage.
15	OVERTEMPERATURE or FAN FAILURE	Alarm when one of the internal temperatures on the system card, the inverter power modules, the rectifier power modules or the transformers has exceeded the maximum value allowed. This may be caused by: - operation in an environment where the temperature is too high; - a fault in the fans.
16	INSULATION LOSS	Indicates that a signal of "insulation loss" has been received from an external device
17	INPUT VOLTAGE SEQUENCE NOT OK	Indicates that the sequence of the phases at the bypass line input is not correct. It is normally sufficient to switch any two phases over in order to obtain normal operation.
18	OUTPUT OFF, CLOSE SWOUT OR SWMB	Alarm when there is no output voltage because SWOUT and SWMB are both open at the same time.
19	SYSTEM OFF COMMAND ACTIVE; 8=COMMAND OFF	Alarm present when the command for total shutdown from the panel or through the RS232 connection, COMMAND STORED, has been initiated. The system executes the shutdown command with a few seconds' delay to allow for cancellation. The command remains stored even during shutdown due to a power outage. When the power supply is restored, the system does not return to normal operation if the block that has been intentionally set is not deactivated; to deactivate it close SWBY or, if required, press 8.
20	REMOTE SYSTEM OFF COMMAND: ACTIVE	Same as the previous alarm, with command present from the "REMOTE" connector.
21	MEMORY CHANGED: CODE =	Code 1 the memory has been changed and the operating parameters have returned to standard values. If non-standard values were previously set, these must be personalized again. Switch the display off and then on again in order to remove the alarm. NOTE: codes other than 1 may be displayed temporarily during variations due to personalization, but this does not affect normal operation.
22	TIMER OFF ACTIVE	Alarm when the daily timer set for the control of the automatic shutdown and restart cycles starts operating (page 56). The values of Toff and Ton are factory-set to zero (thus the timer condition is disabled).
23	SYSTEM OFF	The system is OFF therefore the output load is not feed
24	BATTERY TEST ACTIVE	The battery test is operating
25	Parallel Cable FAULT	There is a fault in the parallel signals cable.
26	Fuse FAULT	Some optional fuses are blown
27	Battery discharge Fail	The optional battery discharging test failed.
28	NOT USED	Alarm number not used.
29	High battery temperature	The battery temperature is over the limit.
30	Slave UPS off by rectifier or SWIN OFF	In a system with common battery the inverter was switched off because the input stage failed or switched off.
31	Fan FAULT	Failure in some fans (available only when installed the fan alarm option)
32	Parallel Redund. lost: High unit power	In a parallel system, the redundancy is has been lost because the output load power is high.

33	Parallel Redund. lost: Redund. unit OFF	In a parallel system, the redundancy is has been lost because the operating units are less than the set number of units.
34	Brake circuit fail	The optional brake circuit has a failure
35	Brake circuit Overload	The optional brake circuit has an overload
36	Rectifier switched OFF by Remote command	The input converter stage is switched off by a remote command.
37	WAIT starting: NOT connect the BATTERY	The input converter is starting, it needs to wait before connecting the battery
38	UPS SERVICE	The unit operation time exceeded the set time to require service.
39	BATTERY SERVICE	The battery operation time exceeded the set time to require service.
40	Battery charge < set level [Ah%]	The system is waiting to start in normal operation, after a complete battery discharging, because the battery is not charged above the requirement.
41	Input switch OFF	The external optional input switch is OFF.
42	INSULATION LOSS A.C.	The external optional ac input insulation checking device, detected the ac. insulation lossing.
43	INSULATION LOSS D.C.	The external optional dc output insulation checking device, detected the ac. insulation lossing.
44	Motor Generator parallel mode (rem.com)"	Optional operation
45	Overtemperature On Bypass line transf.	Optional signal coming from an external transformer insert in the input bypass line
46	Inverters OFF	The inverters are commanded to be OFF from an external command

11 Appendix B - Optional remote commands

Technical support personnel may modify the COMMAND that can be executed from the standard “INV.OFF” remote input or from the optional remote input/output card.

COMMAND		
Name	Description	Typical application
Battery charge inhibition	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 bypass line and the synchronization of the inverter. In the event of an overload or fault, the UPS 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 disconnect contact	Activates the battery discharging or disconnected alarm. To be used to indicate the opening of a battery switch located external to the UPS. <i>A closed contact must be provided when the external switch is opened.</i>	Displays the status of the battery disconnect.
Standby ON	Forces the selection of the UPS Standby-ON operation. <i>This is done with the contact kept closed; if reopened, the command is cancelled.</i>	To be used when the load may support mains interference or frequency variations and it is thus preferred to improve system efficiency. The load is powered if there is a mains power failure.
Battery test	Starts the automatic battery test when the UPS 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. NOTE: 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	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 bypass line. NOTE: The command is only executed if the bypass 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 bypass line). The UPS only switches onto bypass if the bypass 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 blocks 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.