

FirstLine P
FirstLine P 924
65-125kVA UPS
USER MANUAL

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

301 Gaddis Boulevard • Dayton, Ohio 45403
U.S. Toll Free 866-261-1191
(937) 253-1191 • Fax: (937) 253-1723
Web site: www.stacoenergy.com
Thank you for choosing our product.

Staco Energy 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:

FLU-65-xx

65 kVA, 480 V input, 480 V output, 60 Hz, configured as wye-wye or delta-delta

FLU-80-xx

80 kVA, 480 V input, 480 V output, 60 Hz, configured as wye-wye or delta-delta

FLU-100-xx

100 kVA, 480 V input, 480 V output, 60 Hz, configured as wye-wye or delta-delta

FLU-125-xx

125 kVA, 480 V input, 480 V output, 60 Hz, configured as wye-wye or delta-delta

WARNING



The wye output configuration that provides an output neutral connection is only permitted when an input neutral is provided; delta-wye configuration is prohibited. The source must have a grounded neutral, even if the neutral is not connected to the UPS; a delta source may not be ungrounded or corner grounded. Please refer to Section **C.3 Mains and Load Connections**. for additional information.

Safety Warnings



IMPORTANT SAFETY INSTRUCTIONS - SAVE THESE INSTRUCTIONS

This manual contains important instructions for Models 65, 80, 100 and 125kVA FIRSTLINE P series UPS that should be followed during installation and maintenance of the UPS. Please read all instructions before operating the UPS 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. Unit 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 UPS 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).

WARNING



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 unit without a proper protective ground.

WARNING



Batteries can present a risk of electrical shock or burn from high short circuit current. Observe 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

Emergency Interventions

The following information is of a general nature.

First aid interventions




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

Firefighting measures

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

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:

	<p>Danger / Risk of Electric Shock <i>This symbol indicates possibility of serious injury or substantial damage to the unit, unless adequate precautions are taken.</i></p>
	<p>Warning <i>This symbol indicates important information which must be understood and any stated precautions taken</i></p>
	<p>Note</p>

Protective Equipment

No maintenance operations shall be carried out on the unit without wearing the Personal Protective Equipment (PPE) described below. Personnel involved in the installation or maintenance of the unit must be properly clothed.

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 unit.

	<p>Accident prevention footwear</p>		<p>Protective eyewear</p>
	<p>Protective clothing</p>		<p>Helmet</p>
	<p>Work gloves</p>		

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 UPS.

This UPS 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.

Table of Contents

Applicability.....	iii
Safety Warnings	iii
Emergency Interventions	iv
First aid interventions	iv
Firefighting measures	iv
Symbols used in the Manual	v
Protective Equipment.....	v
General Precautions	v
1. Layout.....	1
1.1 Views.....	1
1.2 Preliminary Operations	2
1.2.1 Removing the Packaging and Positioning the Device	2
1.2.2 Storage	2
1.2.3 Handling	2
1.2.4 Cooling of the Premises	3
2. Installation.....	4
2.1 Accessing the UPS terminals.....	4
2.2 UPS - Single Module Configuration	5
2.3 Cable Entry.....	6
2.4 Connect of Power Cables	7
2.4.1 Input Line without Neutral	7
2.4.2 Single Input.....	8
2.4.3 Connection of Power Cables for Dual input Unit	10
2.5 Differential (GFI)	12
2.6 Emergency Power off Device (EPO).....	12
2.7 Connection of Signals and Remote Commands.....	13
2.7.1 Remote Commands, Alarms and EPO	13
2.7.2 RS232-1 and RS232-2.....	15
2.7.3 SLOT 1 and SLOT 2	16
2.7.4 Optional Remote Alarm Cards	16
2.7.5 Optional MODEM.....	16
2.7.6 Optional MULTI I / O	16
2.7.7 Optional Battery Temperature Sensor	17
2.7.8 Optional Dual Bus System – UGS.....	17
2.7.9 Multi Panel.....	17
2.7.2	17
2.7.10 SWOUT and SWMB aux.....	17
3. Operation.....	19
3.1 Start up.....	20
3.1.1 Before Start Up	20
3.1.2 Start-Up Procedure Single Module.....	20
3.2 Single UPS and Load Shutdown.....	21
3.3 Transfer to Bypass/Inverter.....	21
3.4 Operating Modes	21
3.4.1 On-line Factory Setting	21
3.4.2 Standby-On / Smart Active.....	21
3.4.3 Standby-Off (with Mains Present the Load is not Powered)	22
3.4.4 Stabilizer (Operation In On-Line Mode Without Battery).....	22
4. Control Panel and Display.....	23

4.1 Signal panel functions.....	23
4.2 Graphic Display	25
4.2.1 Diagram Items Shapes.....	26
4.2.2 Keys Numbers and Icons	26
4.3 Basic menu (text lines area)	27
4.3.1 The First Line of the Basic Menu.....	27
4.3.2 The Second Line of the Basic Menu.....	28
4.4 Language setting menu (keys 1, 1).....	29
4.5 Measurements menus (key 2)	30
4.6 Full page Measurements and output waveforms (key 2, 7).....	32
4.7 Controls Menu (key 3)	33
4.7.1 Battery Test (Keys 3, 2)	33
4.7.2 Customizing	34
4.7.2.1 Entering Customized Code.....	35
4.7.2.2 Rated Output Voltage	35
4.7.2.3 Battery	36
4.7.2.4 Cyclical Battery Recharging.....	36
4.7.2.5 Two-Level Charging	36
4.7.2.6 Pre-Alarm	37
4.7.2.7 Auto-Off "VA".....	39
4.7.2.8 Auto-Off Timer.....	39
4.7.2.9 Bypass Voltage Range Adjustment.....	40
4.7.2.10 Bypass Frequency Range Adjustment.....	40
4.7.2.11 MODEM Set-up	41
4.7.2.12 "Dial /Send" MODEM.....	42
4.7.2.13 RS232	42
4.7.2.14 ECHO.....	42
4.7.2.15 IDENT	43
4.7.2.16 Operation in Standby-On.....	43
4.7.2.17 Smart Active Operation.....	43
4.7.2.18 Inverter-Off/Bypass.....	44
4.7.2.19 Total Block.....	44
4.7.3 "Recorder": Recorded Events (key 4).....	44
4.7.3.1 Recorded Voltages Measurements.....	45
4.7.3.2 Recorded Codes.....	45
4.7.3.3 Recorded Value on Full Page.....	45
4.7.4 Disabling the Audible Alarm (key 5)	46
4.7.5 "Clock": Date/Time (key 6)	47
4.7.6 "Arrow Down": Internal Codes, Firmware Ver.(key 7).....	47
5. UL924 Emergency Lighting Systems	48
6. Maintenance	49
6.1 Periodic Maintenance (to be carried out by trained personnel and with doors closed)	49
6.2 Maintenance Inside the UPS (factory authorized personnel only)	49
6.3 Ordinary Maintenance for Batteries (trained personnel only)	49
6.4 Recommended Replacement Intervals	50
7. Specifications.....	51
7.1 Electrical Specifications	51
7.2 Environmental Requirements.....	52
7.3 Mechanical Specifications	53
7.4 Rated Currents	53
7.4.1 Input (Single Input Module).....	53

7.4.2 Rectifier Input (Dual Input Module).....	53
7.4.3 Bypass Input (Dual Input Module).....	53
7.4.4 Output.....	54
7.4.5 Battery	54
7.5 Torque specifications.....	54
Appendix A – Alarms	55
Appendix B - Optional remote commands.....	58
Appendix C - Parallel Configuration	59
C.1 Introduction	59
C.2 Electrical System Set-Up	60
C.2.1 Input.....	60
C.2.2 Ground Fault	60
C.2.3 Emergency Power Off Device (EPO).....	60
C.2.4 External Maintenance Bypass.	61
C.3 Mains and Load Connections.....	61
C.4 Installing Parallel kit	62
C.4.1 Parallel Card Installation.....	63
C.4.2 Parallel Card Connections.....	64
C.4.3 Parallel Card RJ45 Installation	64
C.4.4 Parallel Card RJ45 Connections.....	65
C.5 Connection of Signals	65
C.5.1 RJ45-flat-adapter signals parallel card.	66
C.5.2 Single UPS Configured in Parallel	66
C.5.3 Two UPS's in Parallel	67
C.5.4 Three UPS's in Parallel	67
C.6 Parallel Start-up procedure	68
C.7 Parallel Communication Troubleshooting	68
C.7.1 Normal Condition.....	69
C.7.2 Single Opened Parallel Cable.....	69
C.7.3 Multiple Opened Parallel Cable	69
C.8 Mechanical Bypass	70
C.8.1 Mechanical bypass on a single unit	70
C.8.2 Mechanical bypass on the whole system.....	70
C.8.2.1 All the UPS are in NORMAL OPERATION.....	70
C.8.2.2 - Whole System with Output Not Synchronized with the Bypass Line.....	71
C.9 Insertion and removal with UPS's operating (hot swap)	71
C.9.1 Example of Hot Insertion	71
C.9.2 Example of Hot Removal.....	72

Figures

Figure 1 - Cabinet front view	1
Figure 2 – Single Input 1-Line	5
Figure 3 – Dual Input 1-Line.....	5
Figure 4 – Bottom Cable Entry Layout	6
Figure 5 - Schematic diagram: Single Input without Source Neutral	7
Figure 6 - Schematic diagram: Dual Input without Source Neutral	7
Figure 7 - UPS 65-80kVA Power Connection Terminals	8
Figure 8 - UPS 100-125kVA Power Connection Terminals	9
Figure 9 - UPS 65-80kVA Power Connection Terminals	10
Figure 10 - UPS 100-125kVA Power Connection Terminals	11
Figure 11 – Emergency Power Off (EPO)	12
Figure 12 – Signals and Remote Command Connections	13
Figure 13 – Remote Alarm Contacts	14
Figure 14 – RS232-2 Female Connection	15
Figure 15 – RS232-1 Male Connection	15
Figure 16 – Wrap-around bypass.....	18
Figure 17 – Single Input 1-Line	19
Figure 18 – Dual Input 1-Line.....	19
Figure 19 – Signal Panel.....	23
Figure 20 – Graphic Display.....	25
Figure 21 – Typical (3) Module Parallel System	59
Figure 22 – Recommended Ground Fault Interrupter Layout	60
Figure 23 – Parallel System EPO.....	60
Figure 24 - Three units connected in parallel (Typical)	61
Figure 25 – Parallel Card Installation	63
Figure 26 – Parallel Card connections	64
Figure 27 – Parallel Card RJ45 Installation	64
Figure 28 – Parallel Card Flat Cable Installation	65
Figure 29 - Parallel Control Routing	65
Figure 30 - RJ45-flat-adapter signals parallel card.....	66
Figure 31 – Parallel Connection – Single Module.....	66
Figure 32 – Parallel Connection – Two Modules	67
Figure 33 – Parallel Connection – Three Modules.....	68

Tables

Table 1 - Torque specifications for terminal blocks on customer interface board.....	13
Table 2 - Interface Remote Command Alarms and EPO	14
Table 3 - Interface Terminal Connector.....	18
Table 4 - Led Status Indicators	24
Table 5 - Diagram Items Shapes.....	26
Table 6 - Keys Numbers and Icons	26
Table 7 – Battery Models approved for UL924	48
Table 8 – UL924 Approved Systems.....	48
Table 9 - Recommended Replacement Intervals	50
Table 10 – Parallel Kit Components.....	62

1. Layout
1.1 Views

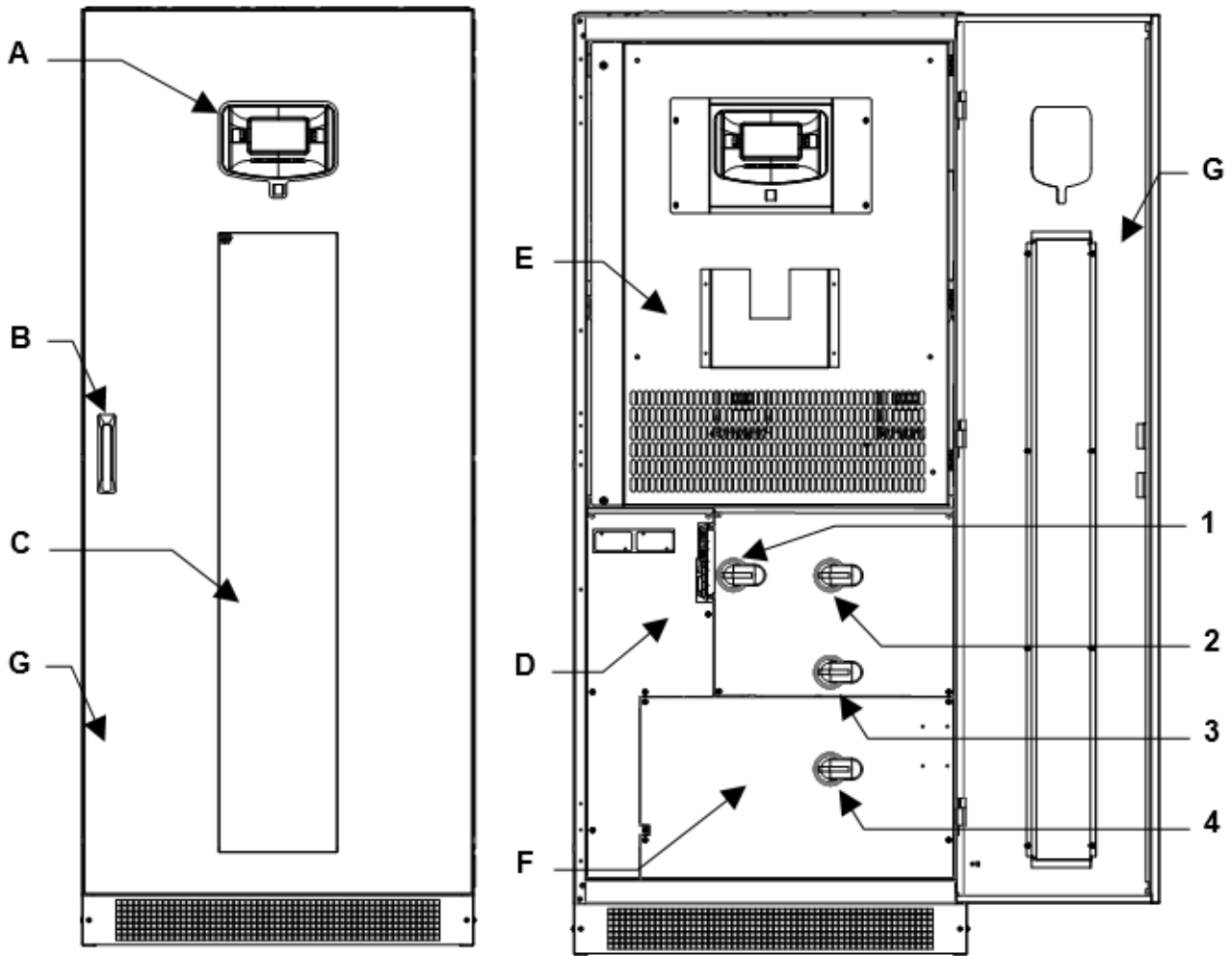


Figure 1 - Cabinet front view

- 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 - SWOUT: Static switch output
- 3 - SWMB: Mechanical bypass switch
- 4 - SWBY: Static switch bypass input

1.2 Preliminary Operations

1.2.1 Removing the Packaging and Positioning the Device

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

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

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

1.2.2 Storage

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

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

WARNING



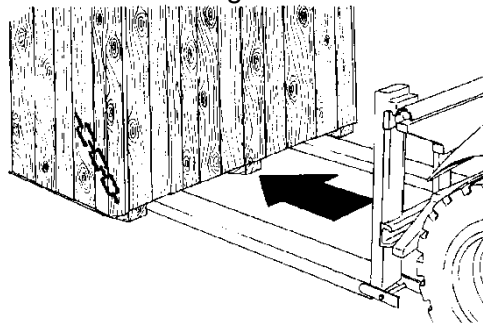
For the installation of a battery cabinet, if provided with the uninterruptible power supply, follow the instructions given in the specific manual.

The list of material provided may vary depending on the order specifications. Most systems include the following: this manual, the installation drawing, the warranty and eventual accessories.

1.2.3 Handling

The equipment must only be handled by adequately trained personnel.

- 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 device to the fork-lift before moving it.



DANGER



In order to avoid the risk of the device overturning, ensure that it 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 device.

The packaging should be removed as follows:

1. Cut the bands
2. Slide away the carton from above.
3. Remove the screws securing the cabinet to the wooden base.

1.2.4 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.

The airflow inside UPS is by the fans located inside the UPS (forced convection) and by the air around the side panels (natural convection).

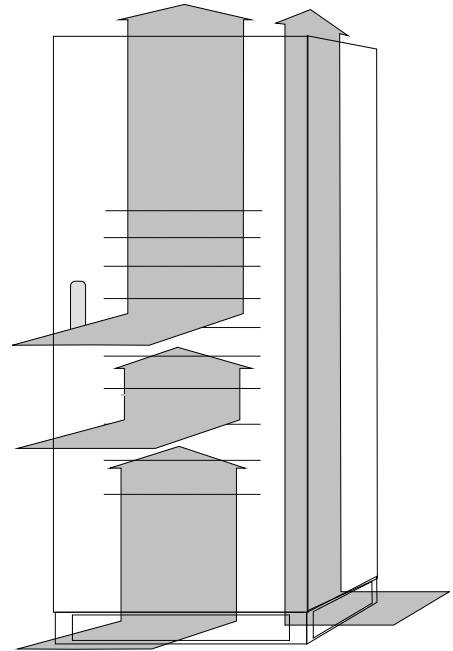
In order to ensure proper air circulation measures must be taken during installation to avoid any obstructions to the free circulation of air. These include the following:

- 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 observed:

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

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



2. Installation

- Check the Safety Instructions.
- Any incorrect connection or handling may cause damage to the UPS and/or the loads connected to it. Read these instructions carefully and follow the steps indicated.
- This UPS must be installed by qualified electrician.
- It is advisable to provide a maintenance bypass switch or an electrical panel with individual protection for input, output, and static bypass, as well as a manual bypass. This allows isolation of unit during preventive maintenance or repair.

2.1 Accessing the UPS terminals

DANGER



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:

- UPS input line is completely isolated;
- Battery circuit breaker/disconnect is open;
- All UPS power and load connection switches (SWIN, SWBY, SWOUT and SWMB) 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 labeled PE. The UPS must operate with the grounding system connected.

WARNING



- Do not connect the output neutral to the input neutral.
- 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.
- 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.
- The UPS cannot feed from a corner ground or mid-point grounded delta supply source.
- Use only lugs or cables with tin-plated eyes for the connections.
- Ensure correct phase rotation at the input and output terminals
- Ensure correct polarity battery connections



The DC input requires a disconnect means which is provided in most Staco supplied battery cabinets.

AC and DC cables and cable lugs are to be provided by others as part of the UPS installation



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 to the Power Connection terminals diagrams later in this section for details concerning configuration of the neutral to ground bond.

2.2 UPS - Single Module Configuration

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

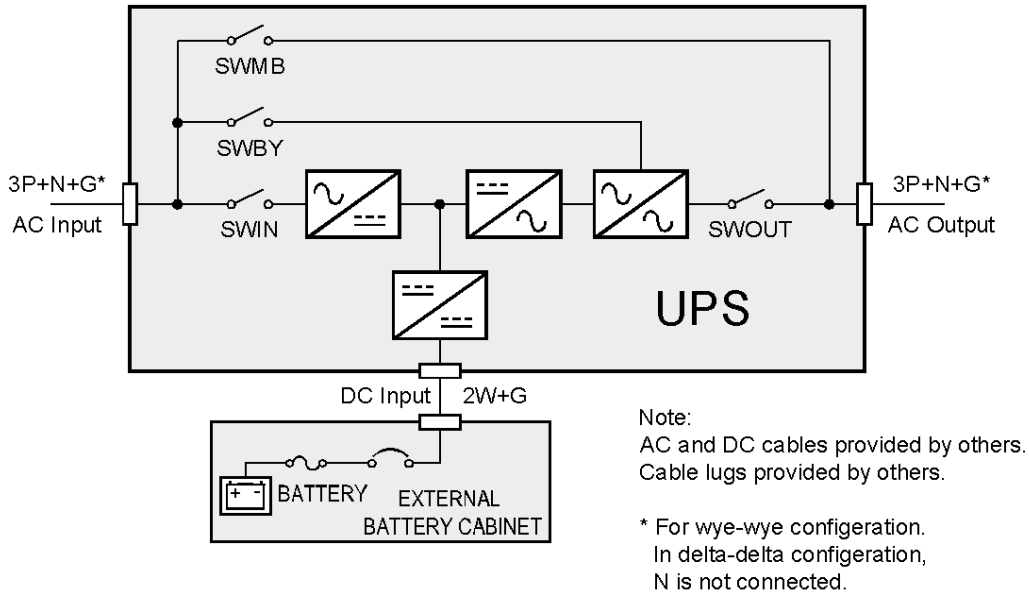


Figure 2 – Single Input 1-Line

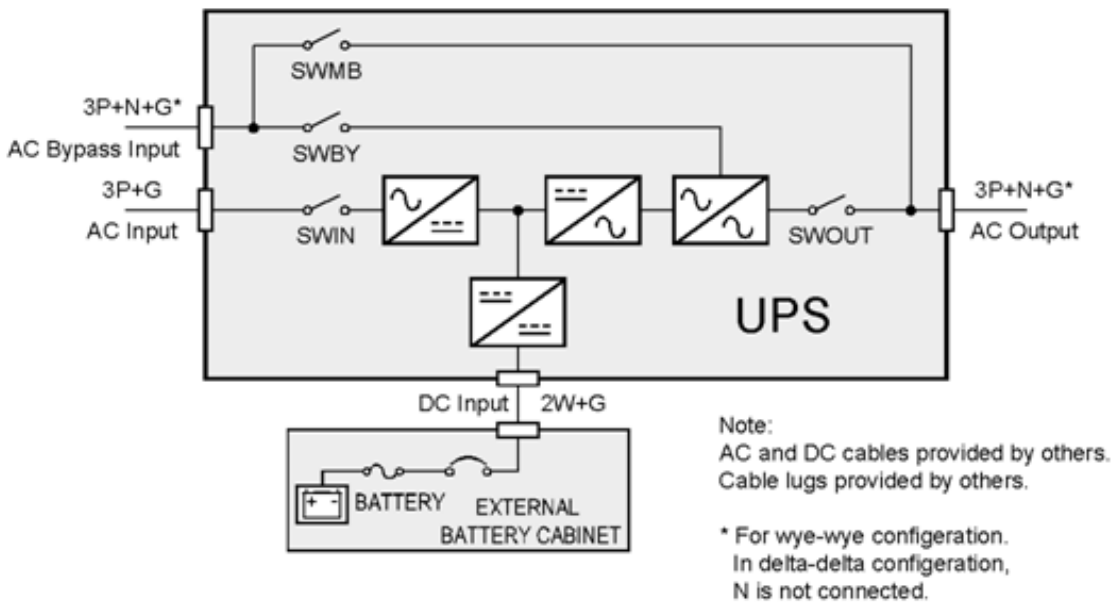


Figure 3 – Dual Input 1-Line

2.3 Cable Entry

The cables can enter in the UPS from the bottom or from the top with the optional (Top Entry Cabinet)

Proceed as follows in order to open the UPS

1. Open the door
2. Remove the switch cover panel
3. Remove the bottom cable entry cover plates
4. Drill or punch conduit holes in the cover plates
5. Route the power cable through the bottom to the UPS terminals in base to your configuration (see **Figure 4**)

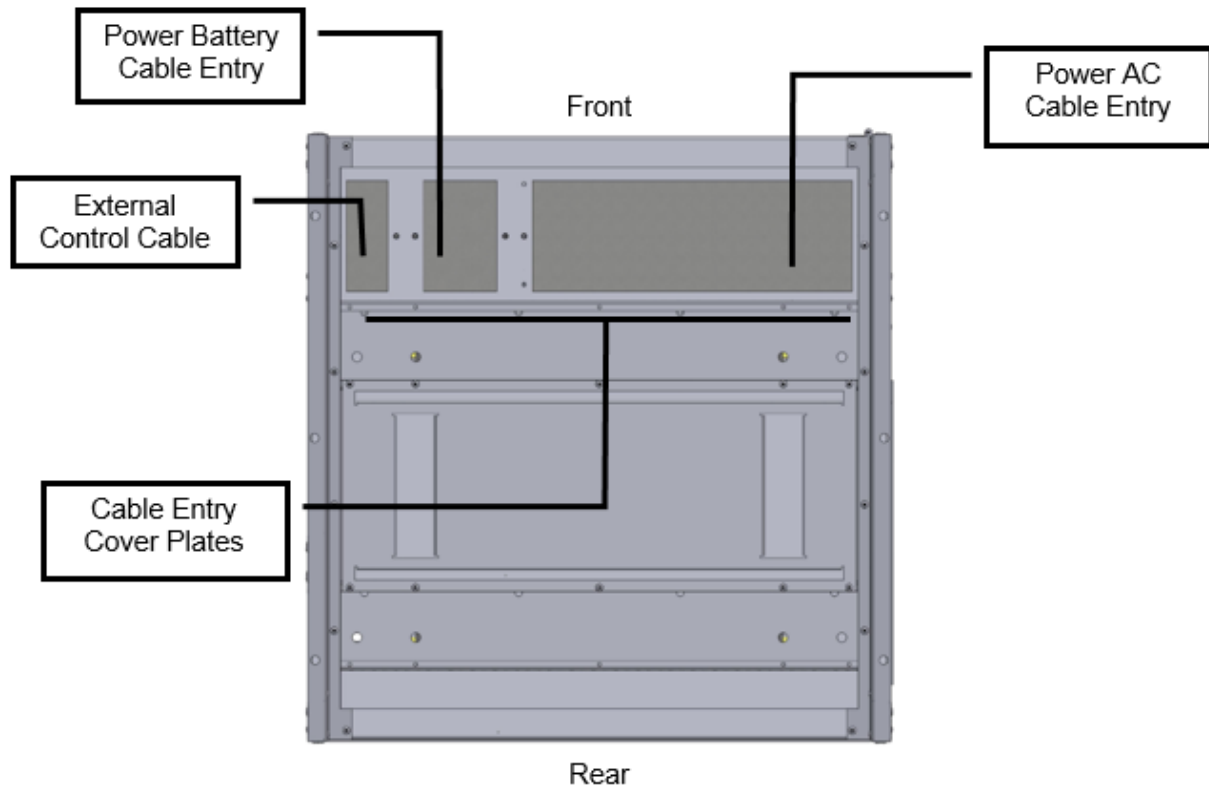


Figure 4 – Bottom Cable Entry Layout

2.4 Connect of Power Cables

2.4.1 Input Line without Neutral

If utility is a 3-wire source and the load requires a neutral, a transformer must be inserted either on the mains supply line or on the bypass line.

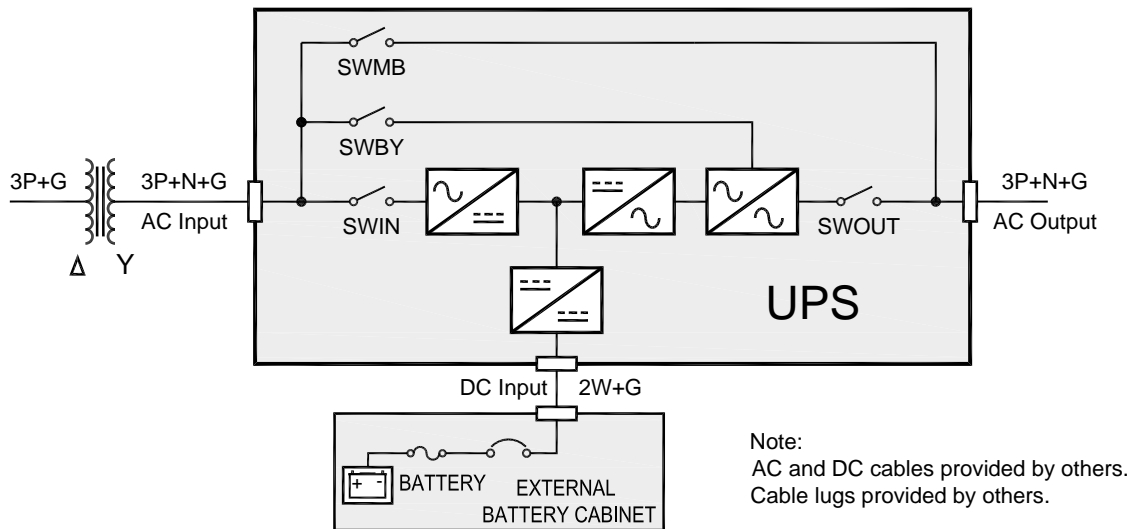


Figure 5 - Schematic diagram: Single Input without Source Neutral

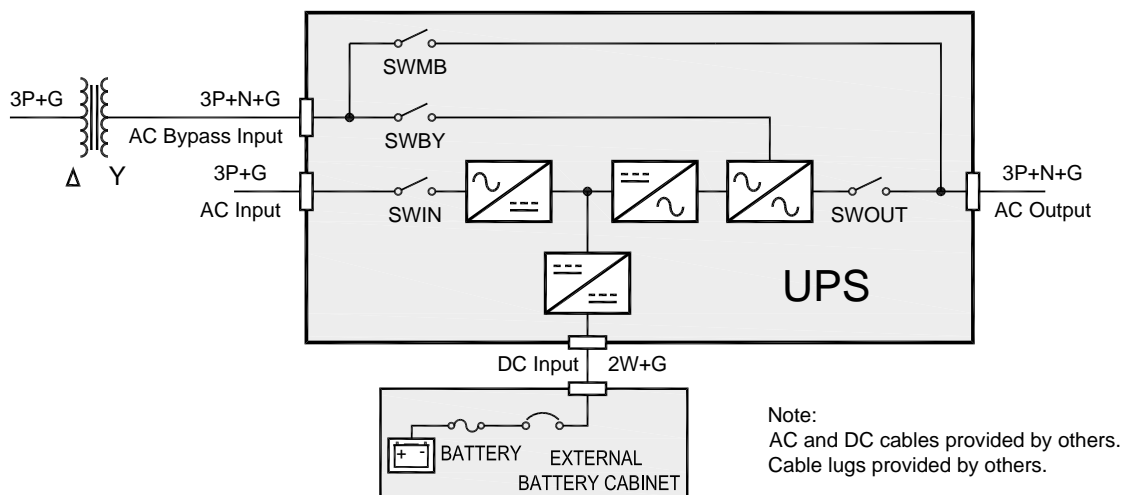


Figure 6 - Schematic diagram: Dual Input without Source Neutral

2.4.2 Single Input

Connect the input, output and battery cables to the terminals as shown in **Figure 7** and **Figure 8**:

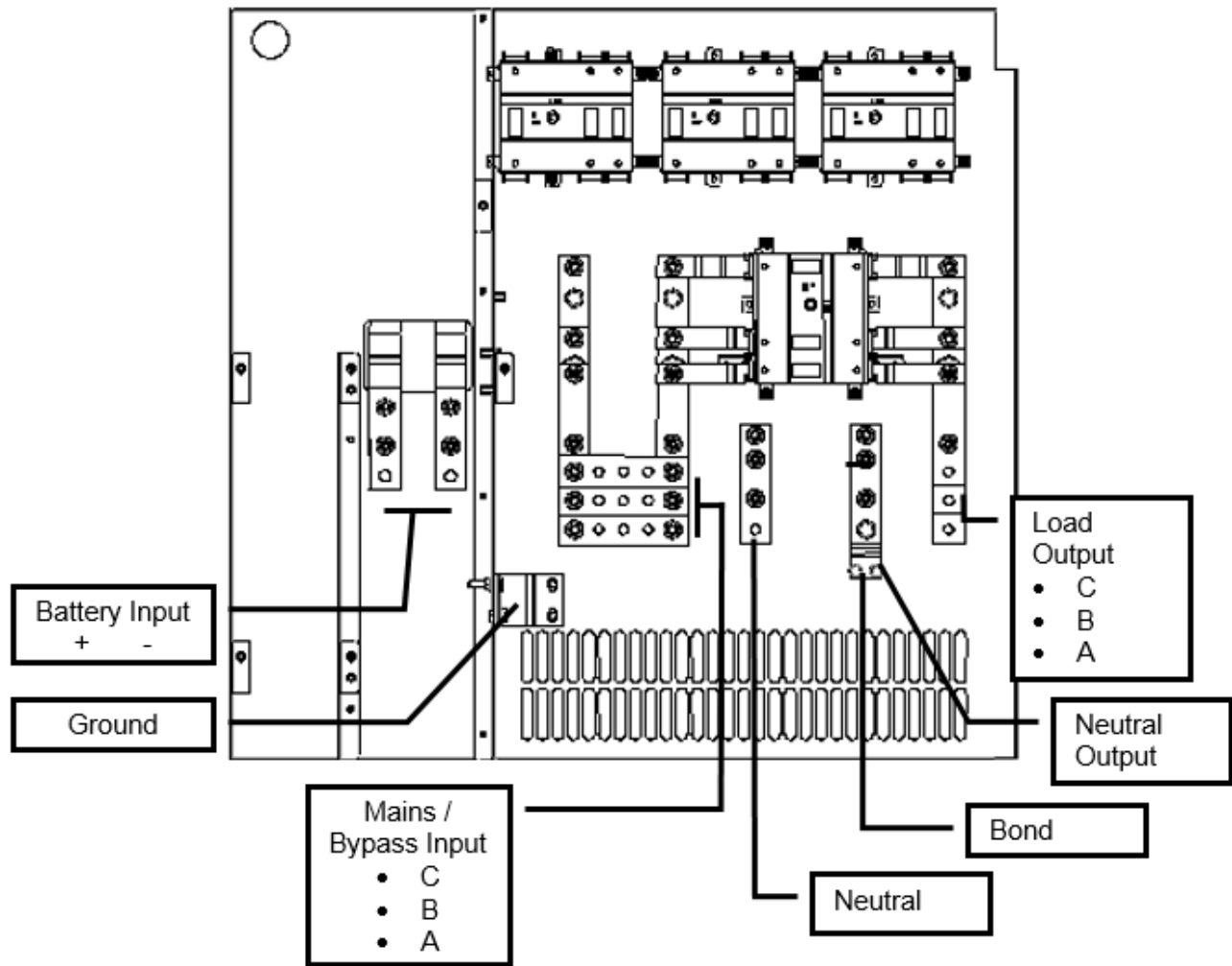


Figure 7 - UPS 65-80kVA Power Connection Terminals



For the Input, Output and Battery connections, follow the order from the top to bottom, or right to left, as described in the boxes. The label marked "N" present on the terminal identifies the neutral terminal.

The single input is a factory default configuration. Do not remove the bypass jumper. The input phase connections are made using bolts to one of the three holes in the busbar. Do not loosen the bolts that attach the busbar.



The UPS is provided with a separate busbar 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 busbar must be removed.

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

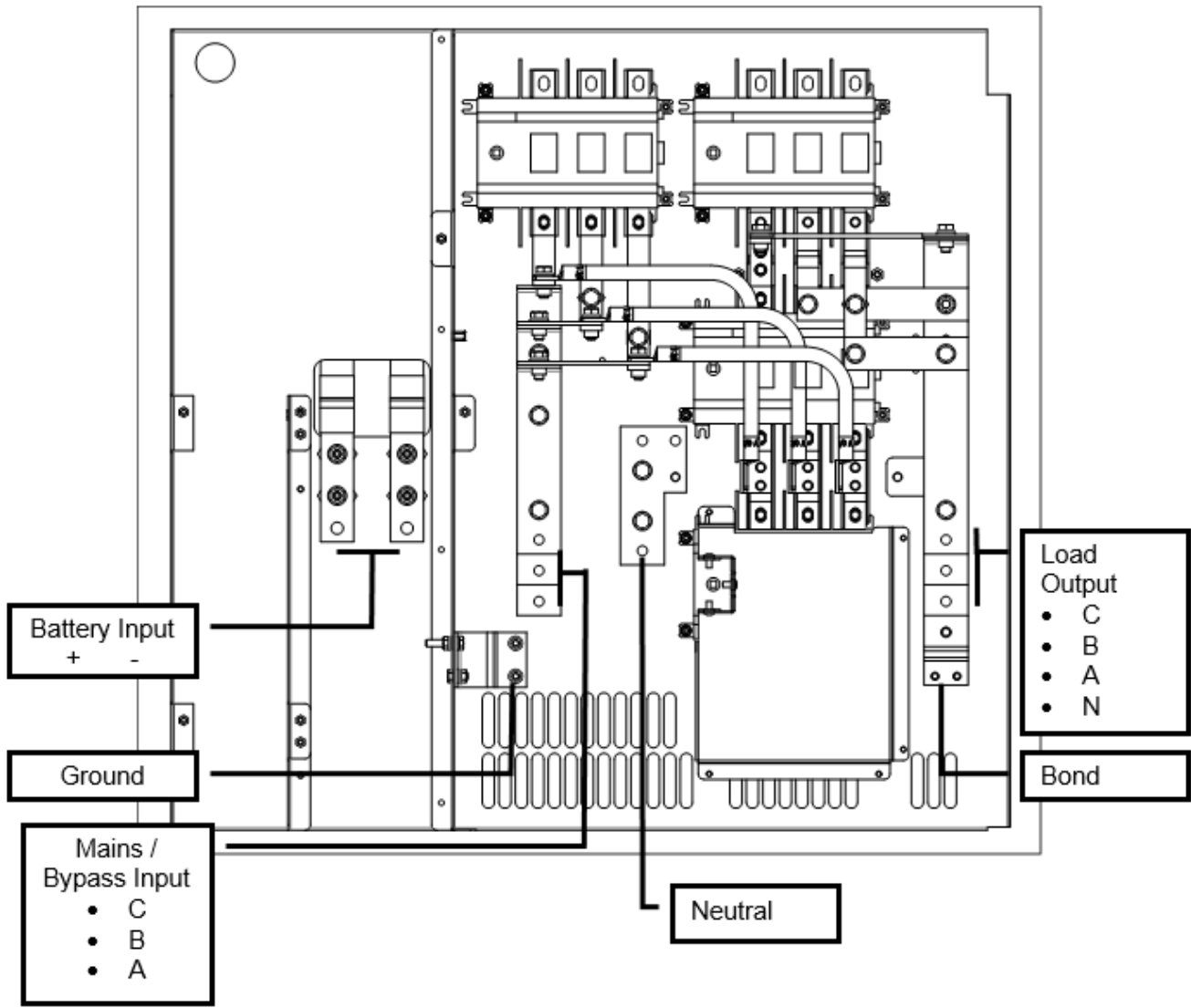


Figure 8 - UPS 100-125kVA Power Connection Terminals



For the Input, Output and Battery connections, follow the order from the top to bottom, or right to left, as described in the boxes. The label marked “N” present on the terminal identifies the neutral terminal.

The single input is a factory default configuration. Do not remove the bypass jumper. The input phase connections are made using bolts to one of the three holes in the busbar. Do not loosen the bolts that attach the busbar.



The UPS is provided with a separate busbar 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 busbar must be removed.

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

2.4.3 Connection of Power Cables for Dual input Unit

Connect the input, bypass, output and battery cables to the terminals as shown in **Figure 9** and **Figure 10**:

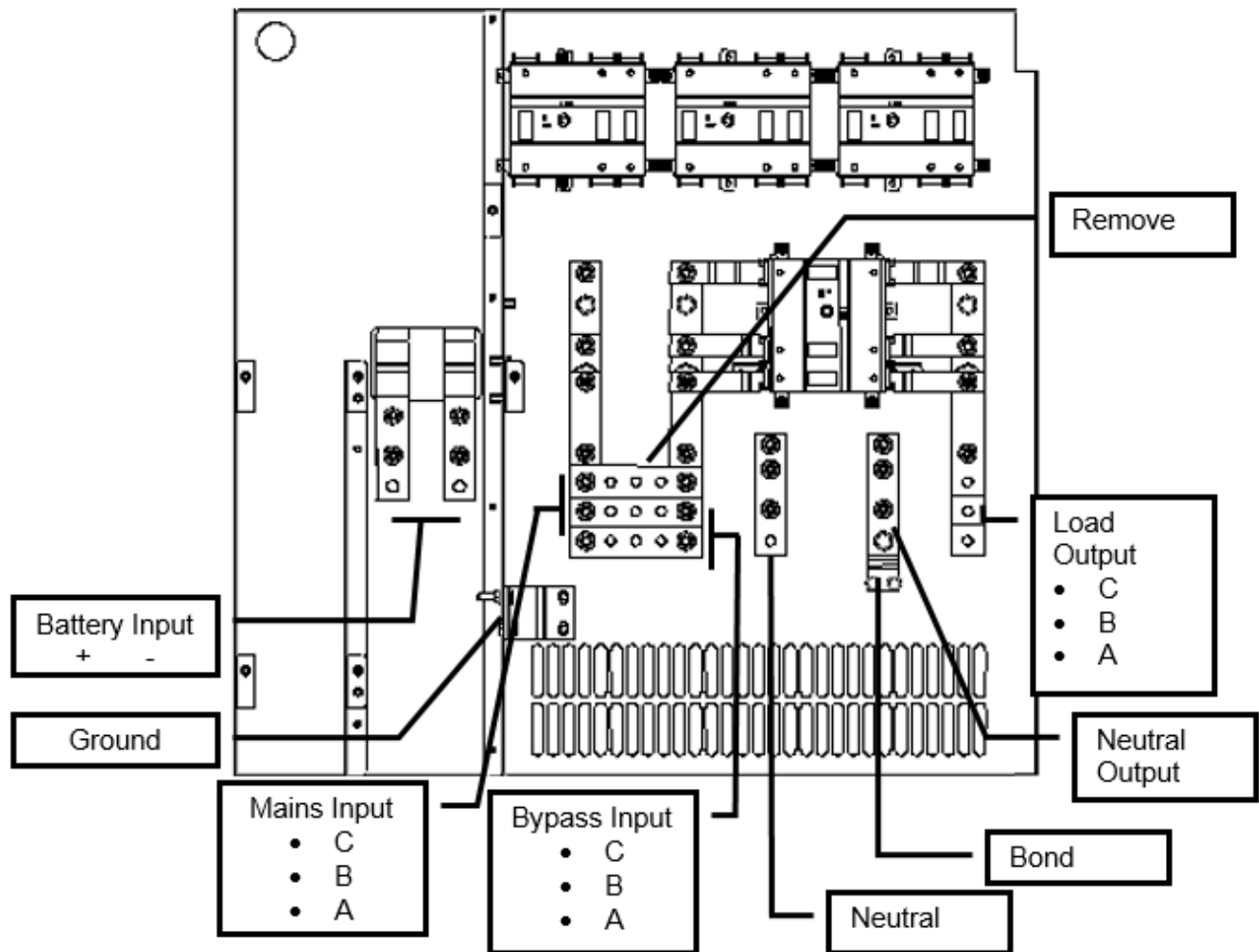


Figure 9 - UPS 65-80kVA Power Connection Terminals

The single input is a factory default configuration. 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 busbars. 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 to the rectifier input source, although the rectifier source must be a grounded wye.



For the Input, Bypass, Output and Battery connections, follow the order from the top to bottom, or right to left, as described in the boxes. The label marked “N” present on the terminal identifies the neutral terminal.



The UPS is provided with a separate busbar 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 busbar must be removed.

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

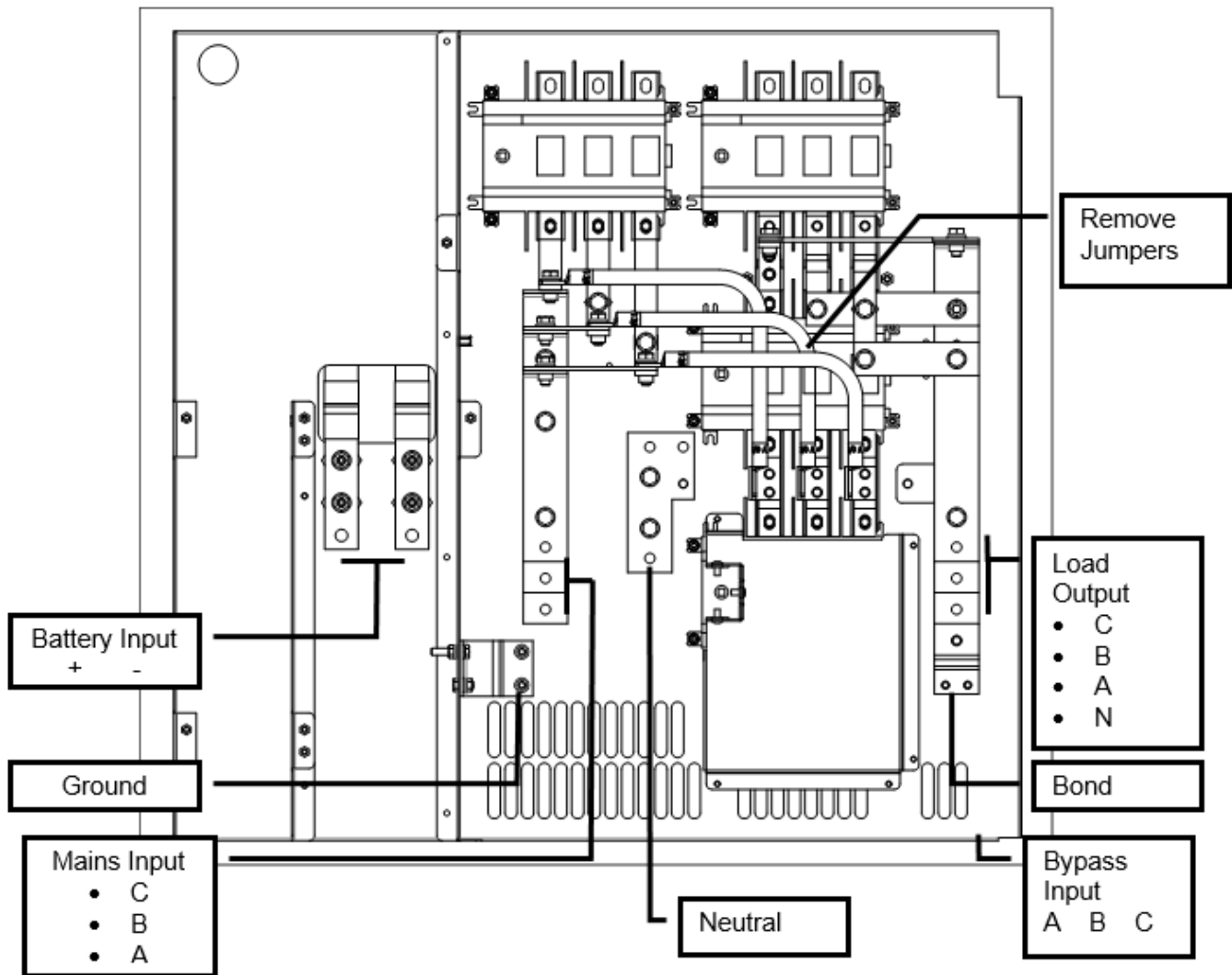


Figure 10 - UPS 100-125kVA Power Connection Terminals

The single input is a factory default configuration. 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 busbars. 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 to the rectifier input source, although the rectifier source must be a grounded wye.



For the Input, Bypass, Output and Battery connections, follow the order from the top to bottom, or right to left, as described in the boxes. The label marked "N" present on the terminal identifies the neutral terminal.



The UPS is provided with a separate busbar 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 busbar must be removed.

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

2.5 Differential (GFI)

If the UPS protection against electric shock uses a differential current device (Ground Fault Interrupter), 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 0.1 s.



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)

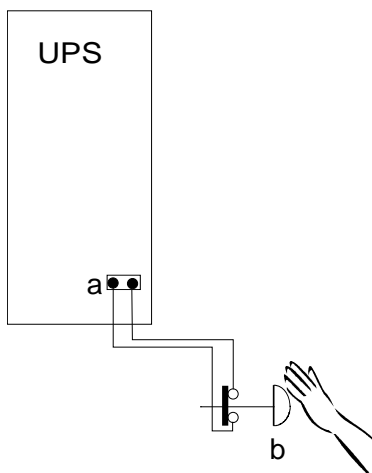
When operating in the presence of mains supply, a differential breaker (GFI) installed on the input will intervene as the output circuit is not isolated from the input circuit.

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

2.6 Emergency Power off Device (EPO)

The UPS has an EPO (Emergency Power Off) function. In the event of an emergency, using this function will cause the UPS to shut down the rectifier, inverter, static switch and completely disconnect 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. 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 closed with the button in the rest position and must open when the button is pressed.



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

Figure 11 – Emergency Power Off (EPO)

2.7 Connection of Signals and Remote Commands

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

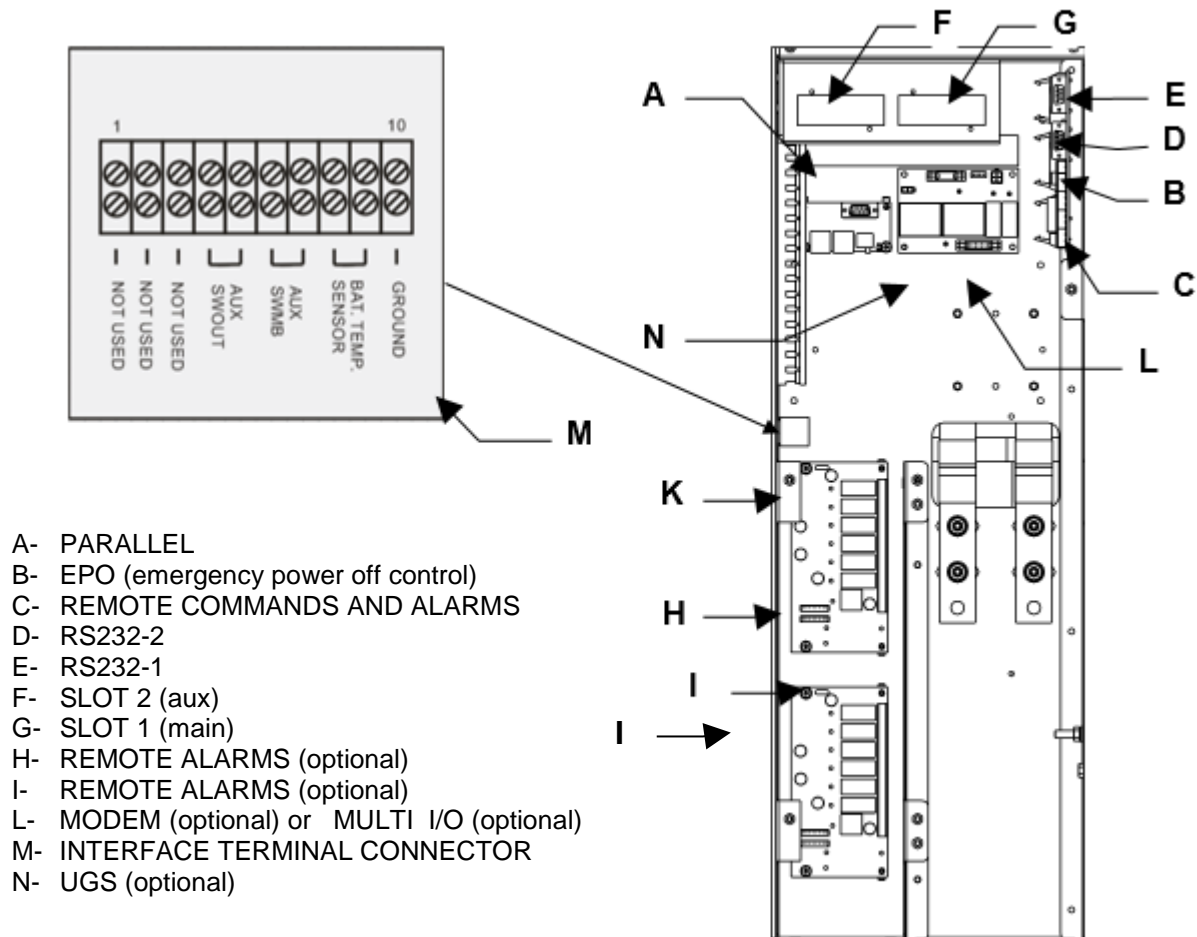


Figure 12 – Signals and Remote Command Connections

Table 1 - Torque specifications for terminal blocks on customer interface board

AWG Wire size range	Torque Load	
	#22 -12AWG	4.4 lbf-ft

2.7.1 Remote Commands, Alarms and EPO

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

Power Supply - 1 power supply 12Vdc 80mA (max.) [Pins 10 and 11];

Alarms - 3 potential-free change-over contacts for alarms (they are capable of switching up to 30 V AC or DC at UP to 1 A);

Command - 1 command programmable from the panel [Pins 11 and 12];

Table 2 - 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 stage. See Note 1
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 should there be a mains outage). - In "EMERGENCY OPERATION", If the STOP INVERTER command is received, the UPS shuts down (load is not powered). See Note 1
13,14	EPO	INPUT EPO	If the jumper on the connector is opened, the voltage on the UPS output will be cut. 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.

Note 1: If the UPS installation includes a Staco Maintenance Bypass Switch (MBS) Cabinet, this connection is required to be connected to the MBS and is not available for other use. An Optional Remote Alarm interface can be installed if a second function is required in this case.

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 reprogrammed via the display panel. The ALARMS and the COMMAND are factory-set. The position of the contacts as shown is without the alarm present. **The contacts can take a maximum current of 1A with 24Vac.**

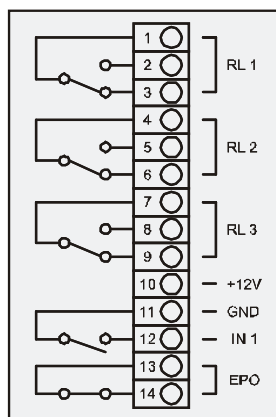


Figure 13 – Remote Alarm Contacts

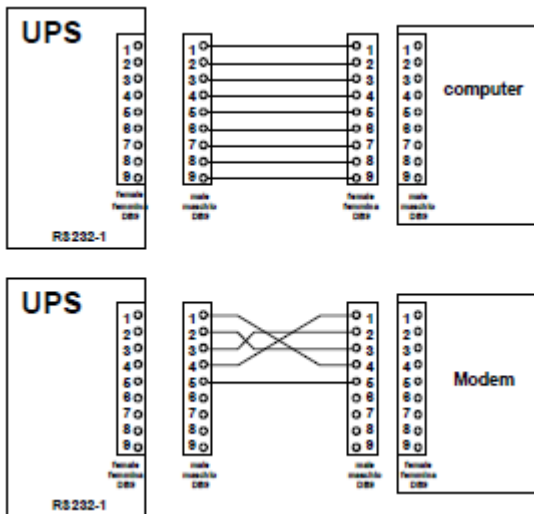
2.7.2 RS232-1 and RS232-2

2 DB9 connectors are available for RS232 connection. The factory-set transmission protocol is: 9600 baud, -no parity, -8 bits, -1 stop bit.

The transmission speed may be varied from 1200 to 9600 baud, using the PERSONALIZATIONS menu on the CONTROL PANEL. Depending on the distance of transmission, the recommended values for the transmission speed are:

- 9600 baud 50m
- 4800 baud 100m
- 2400 baud 200m
- 1200 baud 300m

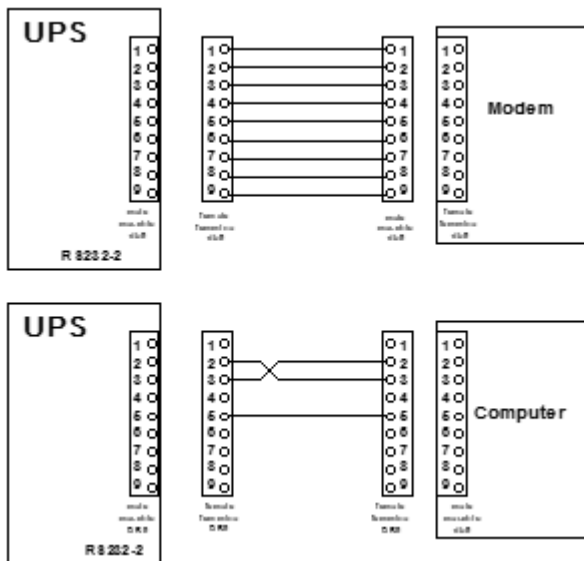
See the diagrams below for the connection procedure.



DB9 female RS232-2

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

Figure 14 – RS232-2 Female Connection



DB9 female RS232-1

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

Figure 15 – RS232-1 Male Connection

2.7.3 SLOT 1 and SLOT 2

Following Cards May be Inserted (Optional):

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

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

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

The main function of this device is to integrate the 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.

MULTICOM card (in SLOT 1 main or SLOT 2 aux)

This device may be used to:

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

Note: each card connected precludes the use of a standard RS232 port, as follows.

- The use of SLOT 1 (main) inhibits the use of RS232-2
- The use of SLOT 2 (aux) inhibits the use of RS232-1



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

2.7.4 Optional Remote Alarm Cards

6 outputs: potential-free contacts for alarms

- Programmable from the display panel;
- Capable of switching up to 30 V AC or DC at UP to 1 A;

(2) Inputs

- Programmable from the panel;
- (1) 12V DC maximum 100mA auxiliary input.

2.7.5 Optional MODEM

Model compatible with the communication standards between the UPS and the software provided.

Note: the modem must be connected to an RS232 port; a standard RS232 port may not therefore be used.

2.7.6 Optional MULTI I / O

The function of this accessory is to convert external signals from the UPS (e.g. temperature of environment, temperature of battery premises, etc.) into signals by means of relay contacts or via serial output RS485 in MODBUS protocol. It has the following characteristics:

- 8 inputs (e.g. humidity, smoke, etc. sensors)
- communication with the UPS via serial port
- 8 relays configurable with 8 events on the UPS
- RS232 output port with configurable messages
- RS485 output port MODBUS /JBUS with configurable messages.

2.7.7 Optional Battery Temperature Sensor

The UPS has a connector for connection of 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 regulate the values of the charge and maintenance voltage according to the working temperature of the battery.

Optional Battery Temperature Alarm

The battery temperature alarm is active only when Battery Temperature Sensor is connected. The temperature value to start the alarm can be changed with the following procedure:

- 1) The following sequence of numbers must be entered into the display to access settings. Press the front panel display buttons 3, 5, 151515, 7
- 2) Press 3, 5, 327171, 7 to access the battery temperature settings
- 3) Press key 5 or 6 as necessary to adjust the minimum battery temperature [default:0 ; range:0-10]
- 4) Press key 7 or 8 as necessary to adjust the maximum battery temperature [default:50 ; range 20-60]
- 5) Press 1 to exit from the battery temperature menu
- 6) The alarm temperature value is now adjusted

2.7.8 Optional Dual Bus System – UGS

Two independent systems may be configured with Dual Bus with a single source or a separate source. The synchronization option (UGS) keeps the outputs of the two systems always synchronized, regardless of the input variations and when the system is running from the battery. Each system may be made up of a maximum of 4 parallel-connected UPS's. This system has been designed for configurations using STS's (Static Transfer Switches) since this guarantees switching from one uninterruptible source to another without affecting the loads.

2.7.9 Multi Panel

The Multi Panel is used to monitor the UPS from a distance and provides a detailed overview of the module operating status. It allows the operator to consult measurements relating to mains power, output load, batteries, etc. and also to identify any malfunctions.

The Multi Panel connects from the UPS Serial port on the Multi Panel to the RS232-1 or RS232-2 port in the UPS. See Section

2.7.2 RS232-1 and RS232-2.

2.7.10 SWOUT and SWMB aux.

Terminals to be used for connection of the auxiliary contacts of switches used for a wrap-around bypass

Note:

- Auxiliary switch of SWMB EXT must open in advance, before closing the power contact
- Auxiliary switch of SWOUT EXT must close in advance, before opening the power contact

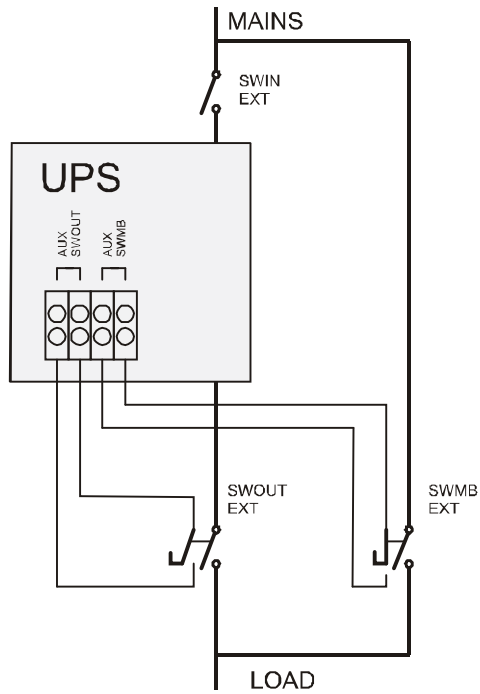


Figure 16 – Wrap-around bypass

Table 3 - Interface Terminal Connector

PIN	NAME	TYPE	FUNCTION
1	Not Used	-	-
2	Not Used	-	-
3	Not Used	-	-
4	Aux Swmb	INPUT	Normally close contact used to indicate when the SWMB EXT is closed
5	Aux Swmb Return	INPUT	
6	Aux Swout	INPUT	Normally open contact used to indicate when the SWOUT EXT is closed
7	Aux Swout Return	INPUT	
8	Bat. Temp. Sensor	INPUT	Battery temperature sensor
9	Bat. Temp. Sensor Return	INPUT	
10	Ground	INPUT	Ground

3. Operation



It is critical that the following procedure be followed in the sequence given.

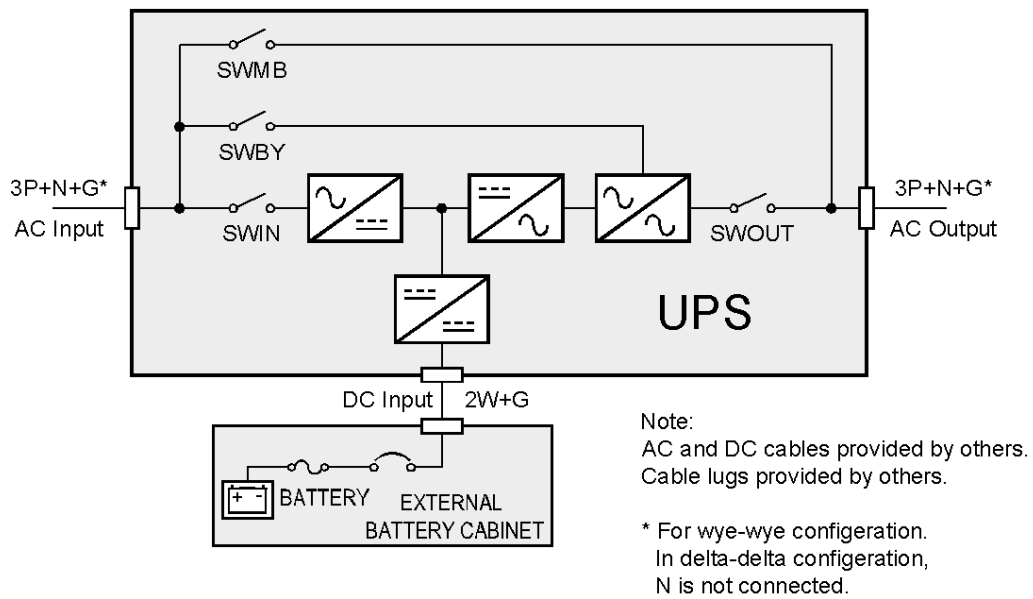


Figure 17 – Single Input 1-Line

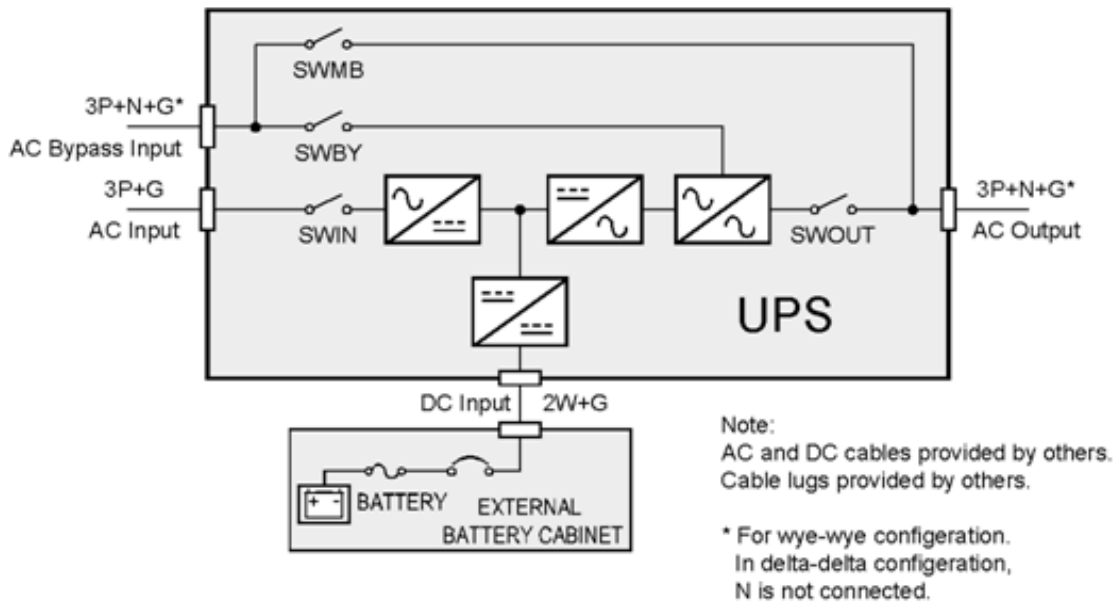


Figure 18 – Dual Input 1-Line

3.1 Start up

3.1.1 Before Start Up

- 1) Verify that all the connections have been made correctly and are properly tighten, following the labeling of the phase rotation sequence.
- 2) Check that the UPS switches and any external battery cabinet or cabinets are in off position.
- 3) Be sure that all the loads are turned off.

3.1.2 Start-Up Procedure Single Module



It is very important to follow the established order during the following instructions. **DO NOT** close battery disconnect until instructed to do so.

- 1) Close input power switch SWIN,
- 2) On front LCD, 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.
- 4) Close the static switch bypass line input switch SWBY,
- 5) Close the static switch output switch SWOUT.
Once these operations have been carried out, the humming of the fans and the sound of the buzzer will be heard.
- 6) Wait to close the external battery circuit breaker/disconnect device.

Single Battery Disconnect



Close the external battery circuit breaker/disconnect only **when the following message is shown** on the first line of the display panel:

BATTERY CHARGE OFF

Multiple Battery Disconnect



If multiple battery cabinets are present, all breakers must be closed within one minute after the **BATTERY CHARGE OFF** message appears. 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 in Section **4.7.2 Customizing**.

After the start-up operations have been completed, perform a manual battery test:

- 1) Press button 3 and then 2 on the control panel.
- 2) 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.

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

3.2 Single UPS and Load Shutdown

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

- 1) Open the load switch;
- 2) Open SWOUT, static switch output switch;
- 3) Open SWIN, input power switch;
- 4) Open SWBY, static switch bypass input;
- 5) Open the battery cabinet circuit breaker/disconnect.



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

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



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 Section 3.1 **Start up**) to restart the UPS.

3.3 Transfer to Bypass/Inverter

Press the following sequence of keys on LCD to access the menu:

1. 3
2. 6
3. 47263

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.

3.4 Operating Modes

The various UPS operating modes are described below



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**.

3.4.1 On-line Factory Setting

The load is always powered by the inverter, with stabilized 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.

3.4.2 Standby-On / Smart Active

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:

See Section **4.7.2.18 Inverter-Off/Bypass** to place the unit in Standby mode. The switch from inverter to bypass line may be immediate (time set = 0) or delayed (up to 180 minutes). For the switch to take place, the bypass line has to remain within acceptable limits for the delay time set. In **Standby On** mode, the rectifier remains powered and keeps the batteries charged. If the bypass line voltage or frequencies go outside of acceptable limits, the load is automatically switched onto the inverter output. With **Standby On** operation, the energy dissipated by the system can be reduced, leading to considerable saving. Before using this function it must be ensured that, in the event of a mains outage, the load powered can tolerate an interruption of the power supply of around 2-5 ms, and that it can tolerate 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:

The UPS autonomously activates **On-Line** or **Standby-On** operation according to the quality of the power supply (see the **4.7.2.17 Smart Active Operation**). 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.

3.4.3 Standby-Off (with Mains Present the Load is not Powered)

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.

3.4.4 Stabilizer (Operation In On-Line Mode Without Battery)

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.

4. Control Panel and Display

4.1 Signal panel functions

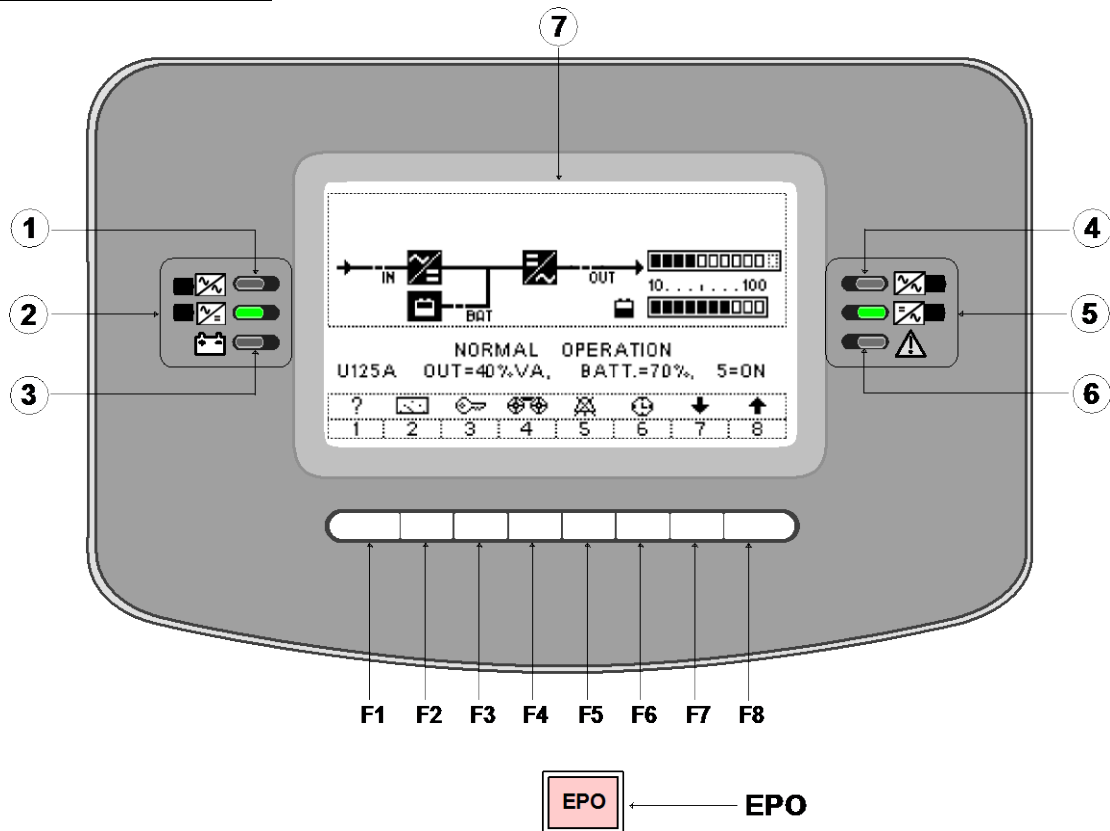


Figure 19 – Signal Panel

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.







<u>Indicator</u>	<u>Symbol</u>	<u>Color</u>	<u>Function</u>	<u>State</u>	<u>Meaning</u>
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
				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 feed 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.

Table 4 - Led Status Indicators

4.2 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. and perform the main unit settings.

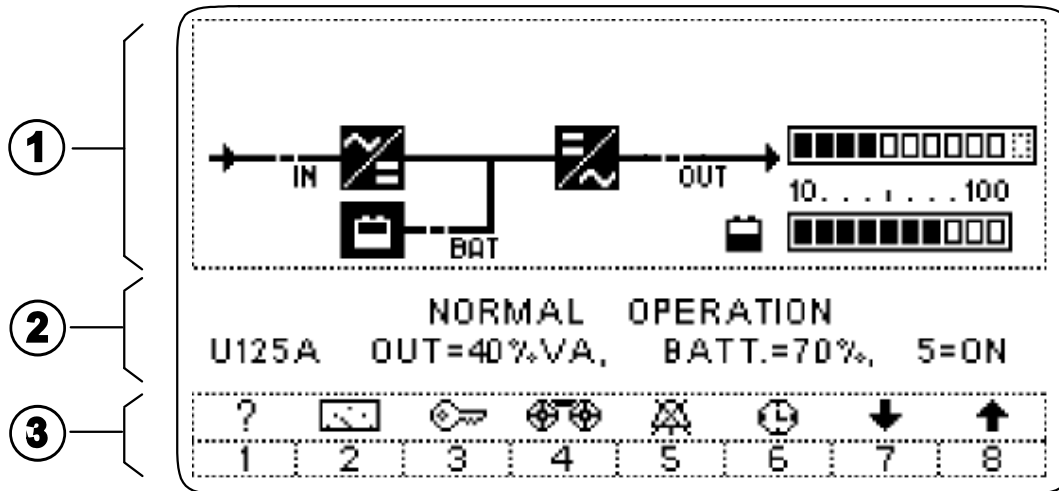


Figure 20 – Graphic Display

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



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

4.2.1 Diagram Items Shapes

Active	Inactive	Meaning
		Input converter
		Output inverter
		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 5 - Diagram Items Shapes

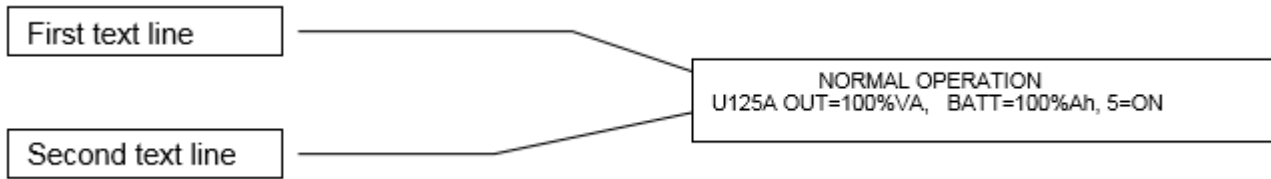
4.2.2 Keys Numbers and Icons

Key Off/ON	Icon	Meaning
		?

Table 6 - Keys Numbers and Icons

4.3 Basic menu (text lines area)

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



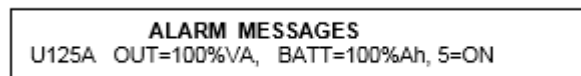
In each operating condition, the display returns to the "basic menu" after two minutes from the last command. The basic menu shows the signal messages relating to the current operating state

4.3.1 The First Line of the Basic Menu

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

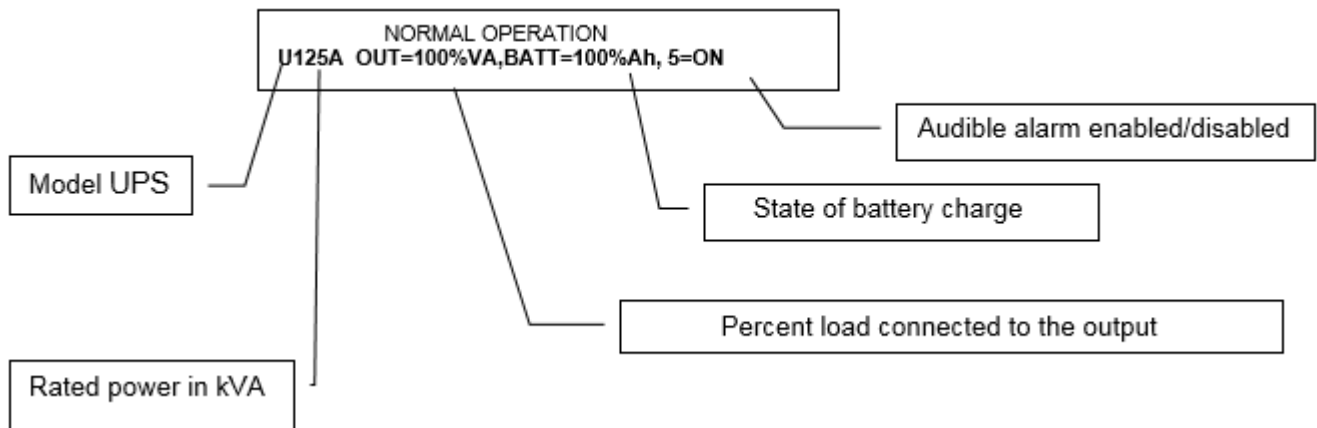


When some alarms are present, the first text line of the main menu shows each active ALARM message, "**ALARM MESSAGES**", one at a time for a few seconds:



4.3.2 The Second Line of the Basic Menu

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



- **U125A** indicates an UPS model with 125kVA rated power, operating with 60Hz output frequency.
 - When the unit is set for the parallel operation the letter "P" is added (U125A P). The letter "P" became lower case "p" when the unit operate as slave.
- **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 effective current and the peak current.
- **BATT= 100%Ah**: example of the current 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.
- **%Ah** changes to "min." (minutes) during operation in the event of a mains failure or when the battery is discharging.
 - 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.
 - 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 not be considered 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.

4.4 Language setting menu (keys 1, 1)

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

The following languages are available:

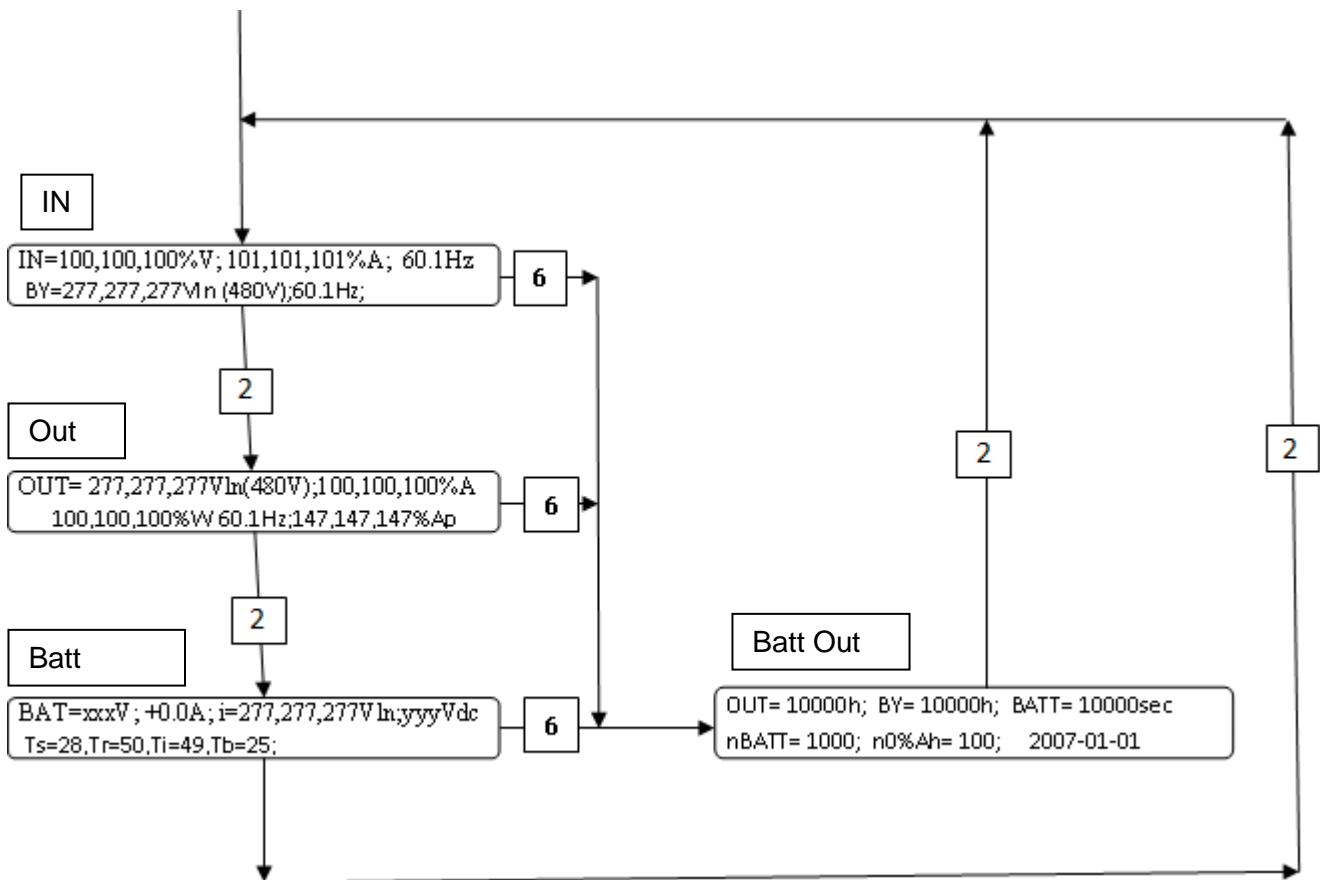
- Italian,
- English,
- French,
- German,
- Spanish,
- Dutch,
- Swedish,
- Polish,
- Hungarian,
- Turkish,
- Czech,
- Russian,
- Romanian and
- Portuguese.

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.

4.5 Measurements menus (key 2)

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



IN

- **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

- **OUT=230,230,230Vln** 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.

Batt

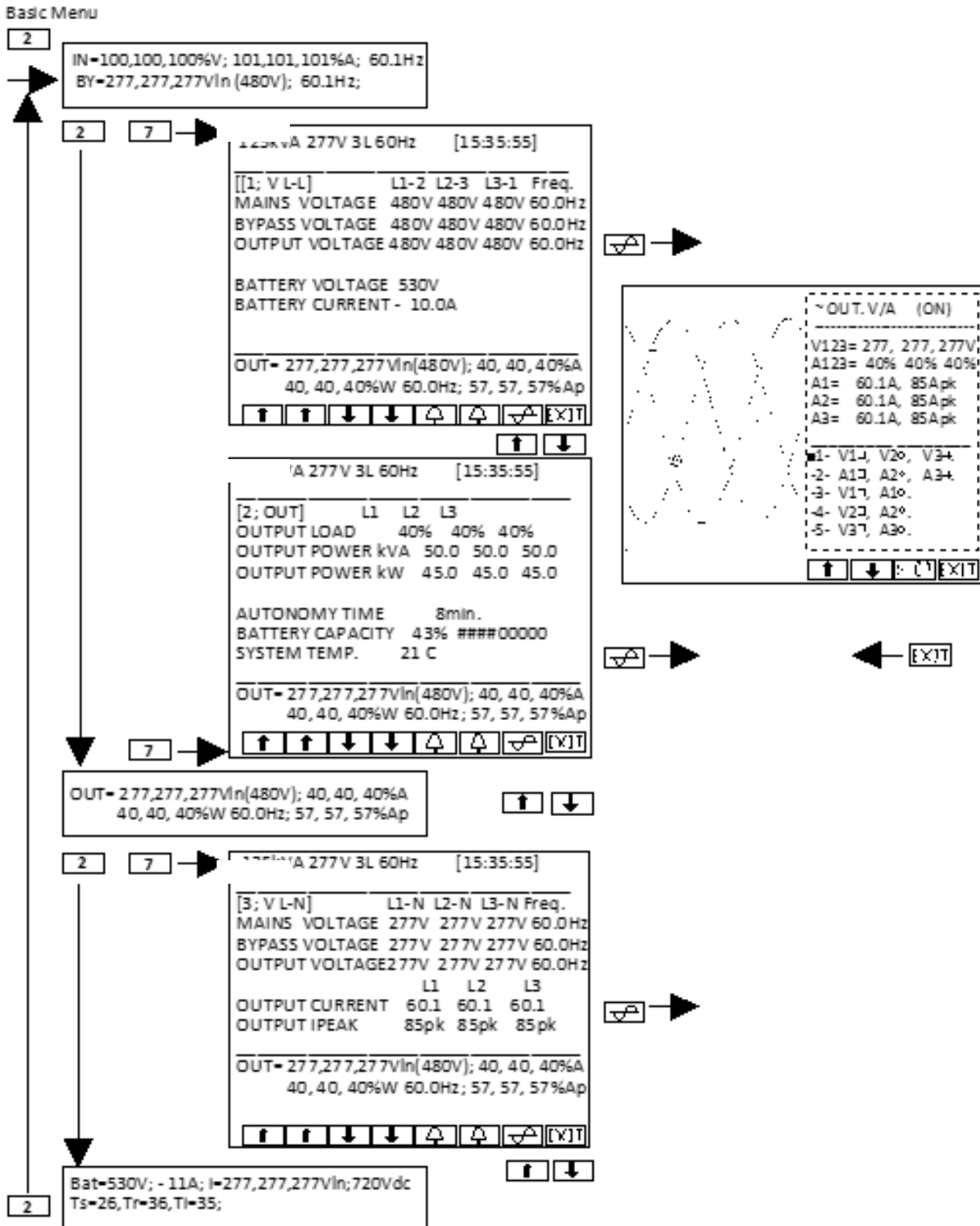
- **BATT=xxxV** Battery voltage value;
- **+0.0A** Battery current, positive with Battery discharging, negative with battery charging;
- **i=230,230,230Vin** Inverter output voltage;
- **yyyVdc** Input inverter DC voltage
- **Ts=28, Tr=50, Ti=49, Tb=25**; Temperature of the system, and of the rectifier and inverter modules, Tb is present only if the external temperature the sensor is installed.

Batt Out

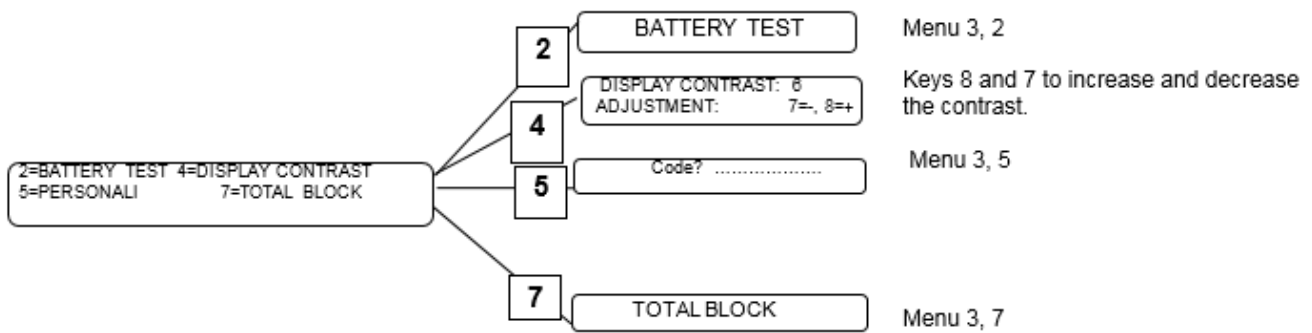
- **OUT=10000h** Hours of normal operation
- **BATT=10000sec** Time spent in operation from battery
- **nBATT = 1000** Number of times the battery has discharged
- **n0%Ah = 100** Number of times the battery has discharged fully
- **2007-01-01** Data stored on first start-up of the UPS. These are HISTORY data, and remain stored even when the device is switched off and may not be reset.

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

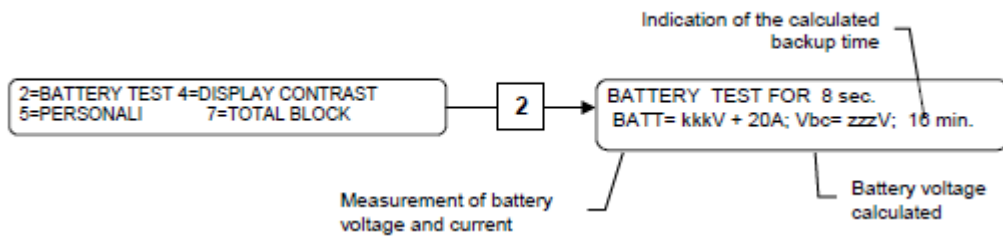
The full page measurements and output voltage and current waveform are selected by pressing key 7 from the two line measurement menu.



4.7 Controls Menu (key 3)



4.7.1 Battery Test (Keys 3, 2)



This activates the cycle to check the state 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 load even when the input 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 can be 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. The 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 capacity is low, the battery circuit is interrupted, the battery disconnect 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 capacity of the battery; the more frequent the alarm, the more serious the problem.

Disabling the BATTERY TEST:

1. Press keys 3, 5: "CUSTOMIZING",
2. Insert code 323232, with battery test disabled the code o=02 will be shown in the basic menu of the display.
3. To reactivate the test, insert code 323232 again.

4.7.2 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.

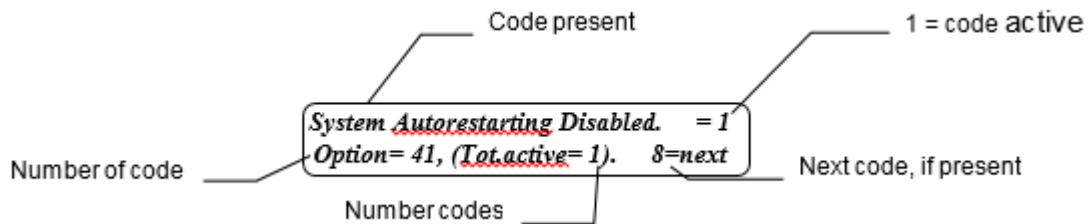


Access by CODE ensures that unauthorized persons cannot modify the operating parameters of the equipment.

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

The activated codes may be displayed (if present) with the following sequence of keys from the basic menu:

1. 7 + 4 then by
2. Scrolling through the alarms with keys 7 and 8.
3. The following message will be displayed

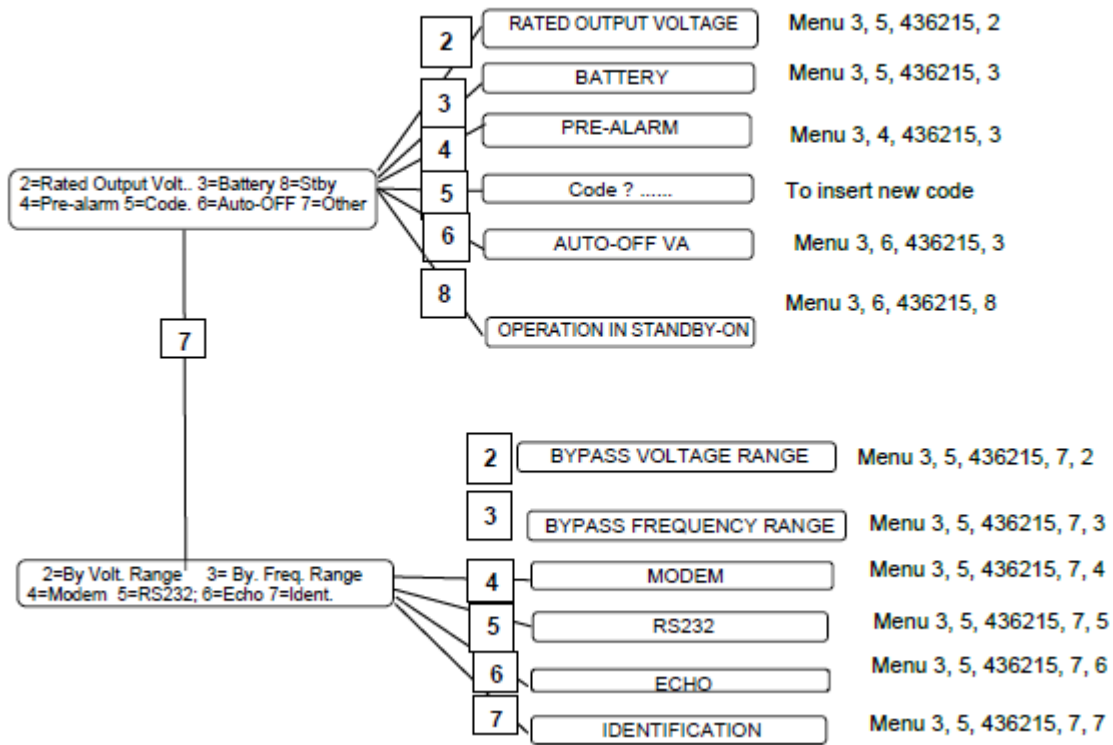


4.7.2.1 Entering Customized Code

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.



4.7.2.2 Rated Output Voltage

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 2

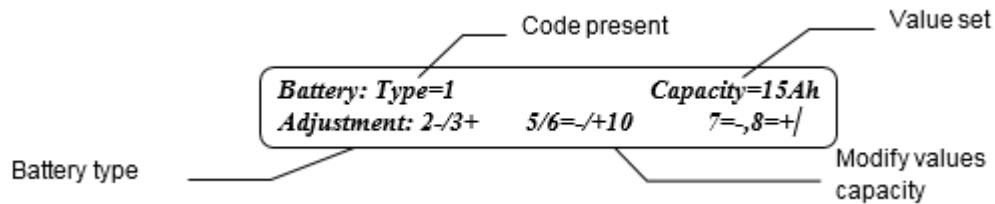
Keys 7 and 8 can be used to decrease or increase the rated output voltage.

The value displayed is the voltage between phase and neutral "V_{in}". 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.

4.7.2.3 Battery

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 3



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



It is important to insert the correct battery capacity value, since this value is used by the system logic to calculate the backup time.

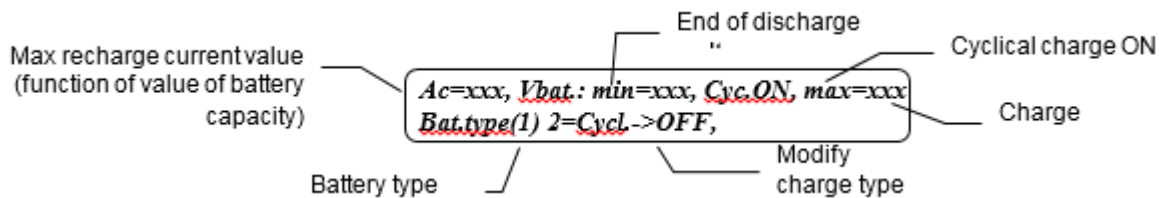
If not set otherwise, this value is assumed to be equal to the UPS power. E.g. at 100kVA the value set by default is 100Ah

Battery type =

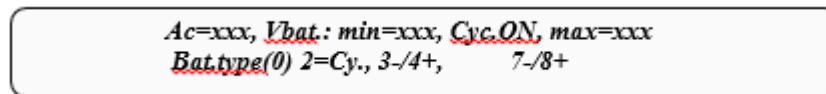
1. Default pre-set for normal batteries;
2. High intensity discharge batteries;
3. Open vase batteries.

4.7.2.4 Cyclical Battery Recharging

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



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



4.7.2.5 Two-Level Charging

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).



This type of recharging may be configured on site and is mainly used for special type batteries such as open vase and NiCd .

- For batteries of type 1, 2 or 3, press key 2 from menu to change from cyclical charge to charging at two levels

Float voltage

Ac= xxx, Vbat: min=xxx, ch xxx, max=xxx
Bat type(1) 2=Cycl->ON,

- For batteries of type 0, press key 2 from menu to change from **cyclical charge to charging at two levels**

Ac= xxx, Vbat: min=xxx, ch xxx, max=xxx
Bat type(0) 2=Cy., 3-/4+, 5-/6+, 7-/8+

- Use keys 3,4; 5,6 and 7,8 to set the values

4.7.2.6 Pre-Alarm

Press the following sequence of keys to access the menu:

- 3
- 5
- 436215
- 4

End of discharge voltage pre-alarm Start discharge voltage

Minimum battery voltage Value set

(420Vmin,480Vp,540Vs) Pre-alarm 5 min.
ADJUSTMENT: 7=, 8=+

Modify values

Press key 1 to exit the menu.

The menu above will appear with batteries of type 1, 2 or 3.

- Voltage values Vmin, Vp and Vs are not fixed values but are a function of the battery discharge current, [Vp= Vmin+5V+10*(battery current [A]/battery capacity [Ah]).
- Keys 7 and 8 can be used to decrease or increase the time to activate the pre-alarm before the system blocks due to end of battery discharge. Variations in the field of 1 minute are possible from 2 to 254 minutes.
- The pre-alarm signal is activated when the remaining calculated time is lower than the pre-alarm value set or when the battery voltage is lower than the pre-alarm voltage value Vp.



A wide safety margin must be provided for the use of the pre-alarm function, since the expected backup time may not provide for increases in the output load power, and may not make allowance for sudden, unexpected battery defects.

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.

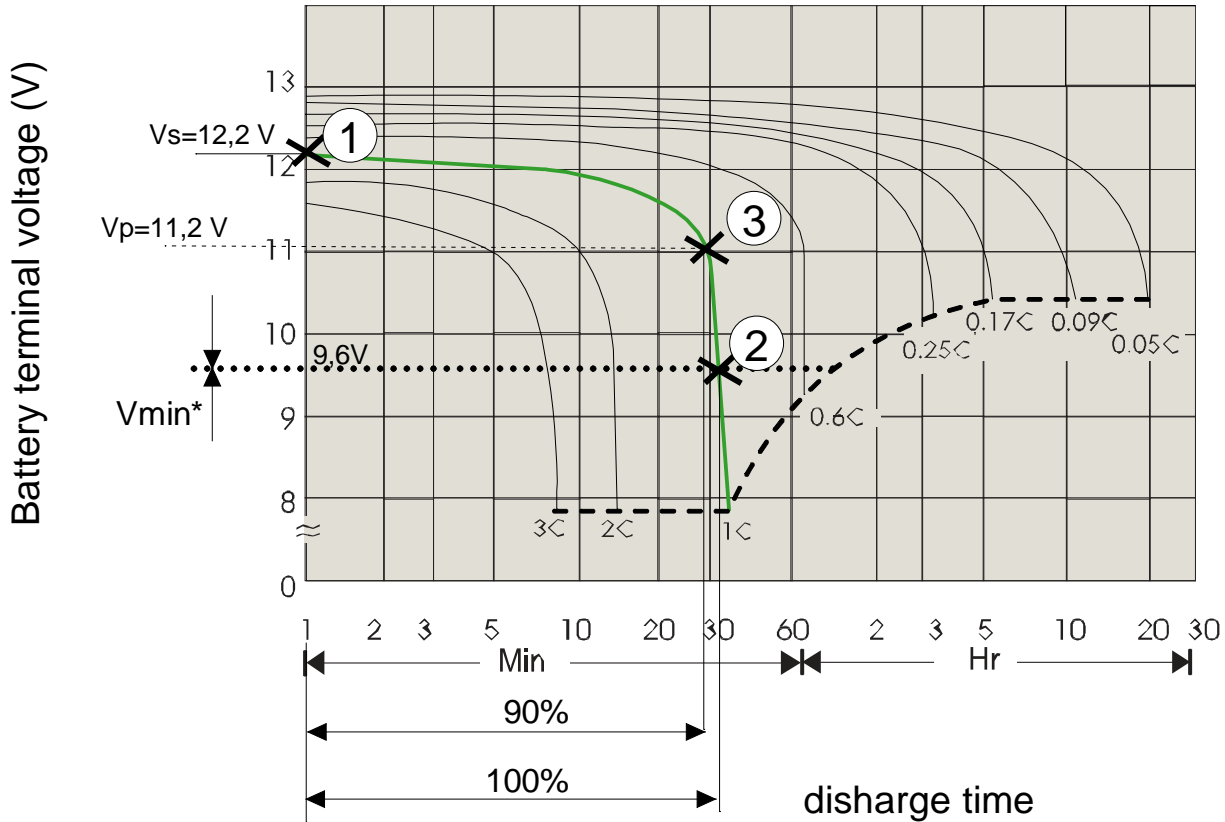
Vbat.test: Vmin., Vp, Vs: 420, 480, 540V
Adjustment: 3-4+, 5-6+, 7-8+



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, V_s , V_{min} and V_p , are obtained from the discharge characteristic curve, supplied from manufacturer, relating to the **battery discharge regime** 1C has been determined:

- **V_s** Start of discharge voltage (1), intersection with the x-axis (battery terminal axis), [the value must be multiply for 40, number of batteries]
- **V_{min}** Minimum voltage value (end discharge battery), point of intersection with the dashed curve (if this value is lower than V_{min}^* set up $V_{min} = V_{min}^*$ (2). [the value must be multiply for 40, number of batteries]
- **V_p** Battery voltage with discharge at 90% of the total time (3).

4.7.2.7 Auto-Off "VA"

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 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.

4.7.2.8 Auto-Off Timer

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 6
5. 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, 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, if the mains voltage is present, the system automatically reactivates and returns to normal operation.

4.7.2.9 Bypass Voltage Range Adjustment

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 7
5. 2

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

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.

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.

4.7.2.10 Bypass Frequency Range Adjustment

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 7
5. 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.

4.7.2.11 MODEM Set-up



Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 7
5. 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** Modem connected to the RS232 port is deactivated. Terminal 20 of the RS232 connector assumes a low level (-12V) (DTR signal deactivated).
-  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 on 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.
-  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.
 - 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** Same as 2 with automatic call when any alarm is verified.
- **4** Same as 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** Same as 4 with automatic call when any alarm is verified.

4.7.2.12 "Dial /Send" MODEM

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 7
5. 4
6. 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.

4.7.2.13 RS232

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 7
5. 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.

- 1200
- 2400
- 4800
- 9600

4.7.2.14 ECHO

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 7
5. 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=.....).

4.7.2.15 IDENT

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 7
5. 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.

4.7.2.16 Operation in Standby-On

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 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. The setting remains stored even during a shutdown due to a power failure. For a description of the operation see the Section **3.3 Operating Modes**

4.7.2.17 Smart Active Operation

Press the following sequence of keys to access the menu:

1. 3
2. 5
3. 436215
4. 8
5. 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 **3.3 Operating Modes**.

When the code is inserted the basic menu becomes:

NORMAL OPERATION SMART A.
P200. M OUT= 99%VA. BATT= 100%Ah. 5=0

4.7.2.18 Inverter-Off/Bypass

Press the following sequence of keys to access the menu:

4. 3
5. 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.

4.7.2.19 Total Block

Press the following sequence of keys to access the menu:

1. 3
2. 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, press button 8.



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.

4.7.3 "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

- Key 1: Return to the basic menu by
- 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.

4.7.3.1 Recorded Voltages Measurements

Press the following sequence of keys to access the menu:

1. 4
2. 2
3. 2
4. 2

*IN=100,100,100%V,60.0Hz; BATT=430V,+100A
BY=400V,60.0Hz;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, n35 (flashing) indicate 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.

4.7.3.2 Recorded Codes

Press the following sequence of keys to access the menu:

1. 4
2. 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.

4.7.3.3 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      2013- 1-24/15:35: 120;
-----
s=8000 c=0000 b=0000 r=0000-00 i=0000-00
=====
IN=100,100,100%V;  45, 45, 45%A;  60.1Hz
-----
OUT= 230,230,230In(400V); 40, 40, 40%A
      40, 40, 40%W 60.0Hz; 57, 57, 57%Ap
-----
Bat=XXXV; - 11A; i=230,230,230VIn;XXXVdc
Ts=26,Tr=36,Ti=35;

```

STOP EXIT

```

NORMAL OPERATION
a=0000-0000      2013- 1-24/15:35: 120;
-----
s=8000 c=0000 b=0000 r=0000-00 i=0000-00
=====
IN=100,100,100%V;  45, 45, 45%A;  60.1Hz
-----
OUT= 230,230,230In(400V); 40, 40, 40%A
      40, 40, 40%W 60.0Hz; 57, 57, 57%Ap
-----
Bat=XXXV; - 11A; i=230,230,230VIn;XXXVdc
Ts=26,Tr=36,Ti=35;

```

STOP EXIT



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
-----
PREALARM, LOW BATTERY VOLTAGE
a=1C00-0000      2011- 1-24/10: 1: 3;n119
-----
MAIN LINE VOLTAGE FAIL or SWIN OFF
a=1800-0000      2011- 1-24/10:05: 1;n118
-----
NORMAL OPERATION
a=0000-0000      2011- 1-24/10:01:18;n117
-----
MAIN LINE VOLTAGE FAIL or SWIN OFF
a=1800-0000      2011- 1-24/09:40: 1;n116

```

6 EXIT

```

s=8000 c=0000 b=0000 r=0000-08 i=0000-00
a=0000-0000      2013- 1-24/13:35: 0;n120
-----
s=8000 c=0000 b=3C20 r=0000-08 i=0000-00
a=0400-0000      2013- 1-24/13: 5: 5;n119
-----
s=8000 c=0000 b=0000 r=F881-00 i=0000-00
a=1C00-0000      2013- 1-24/13: 1: 3;n118
-----
s=8000 c=0000 b=0000 r=F881-00 i=0000-00
a=1800-0000      2013- 1-24/12: 1: 1;n117
-----
s=8000 c=0000 b=0000 r=0000-08 i=0000-00
a=0000-0000      2013- 1-24/11: 4:18;n116

```

6 EXIT



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.

4.7.4 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.

4.7.5 "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

1. 2
2. 3
3. 4
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.

4.7.6 "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.

125kVA 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
U125AA OUT= 40%VA, Batt= 35% 5=0N
EXIT

5. UL924 Emergency Lighting Systems

The Staco FirstLine P can be used as part of an approved UL924 Emergency Lighting system.

Table 7 – Battery Models approved for UL924

CSB	FIAMM	C & D
HRL 12540W	12FLX540	UPS12-540MR

Table 8 – UL924 Approved Systems

Staco UL924 Model #	kW	Staco UPS Model #	# of Strings of 540W batteries
FLU-P-924-58	58.5kW	FLU-065	2
FLU-P-924-72	72kW	FLU-080	3
FLU-P-924-90	90kW	FLU-100	3
FLU-P-924-112	112.5kW	FLU-125	4
FLU-P-924-144	144kW	FLU-160	5
FLU-P-T-924-144	144kW	FLU-160-T	5
FLU-P-924-180	180kW	FLU-200	6
FLU-P-T-924-180	180kW	FLU-200-T	6
FLU-P-924-225	225kW	FLU-250	8
FLU-P-T-924-225	225kW	FLU-250-T	8

6. Maintenance



The Uninterruptible Power Supply is designed and produced to last a long time, even in the most severe service conditions. It should be remembered however that this is electronic power equipment, which requires periodic 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 preventive maintenance program which should be entrusted to specialized personnel authorized by the manufacturer.

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

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

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

- Ensure that the air intake slots (located on the front door and at the back of the cabinet) and the output grilles located on the top of the cabinet are clean;
- Ensure that the 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.

6.2 Maintenance Inside the UPS (factory authorized personnel only)

Danger



Maintenance inside the UPS may only be carried out by trained 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 input utility and the battery source, trained service personnel must wait at least ten minutes for the capacitors to discharge before working on the inside of the UPS.

6.3 Ordinary Maintenance for Batteries (trained personnel only)

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

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

- Keep the operating temperature within the range of 20 - 25°C;
- Perform two or three discharge and charge cycles during the first month of use;
- Repeat this operation every six months after the first month of use.

Danger



Maintenance inside the UPS may only be carried out by trained personnel.

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 FROM THE BATTERIES.** If the batteries are thought to be faulty in any way, please contact Staco technical support.

Warning



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

6.4 Recommended Replacement Intervals

The Staco UPS has a long design life. Due to the characteristics of the part, not the design of the UPS, certain components used in the design have a limited life, even with proper maintenance.



Service and maintenance work must be performed only by factory authorized personnel.

Staco recommends these limited-life components be periodically inspected and replaced before the expected expiration of their life cycle. The recommended replacement schedule is an estimate only. The life of these parts depends on site conditions such as ambient temperature, load profile, cleanliness of environment and other factors. See Section **7.2 Environmental Requirements**.

Staco Recommends a Factory Authorized Preventative Maintenance review is schedule at least once a year.

Component	Recommend Replace in:
Fans	4-6 years
Batteries	4 years
AC Filter Capacitors	4-6 years
DC Filter Capacitors	4-6 years

Table 9 - Recommended Replacement Intervals

The functional lifetime of batteries is significantly affected by the temperature at which they are stored and operated. Ideally, batteries should be used in a 21° C (70° F) environment. For every 8.3° C (15° F) increase in temperature, the life expectancy of a battery will be halved.

Exposure to temperatures in excess of 32° C (90° F) should be limited to no more than 30 days per year. Under no circumstances should the battery be exposed to temperatures over 40° C (104° F) which can lead to thermal runaway, a condition that damages the battery. Thermal runaway can cause batteries to swell. If the battery cases burst, the hazardous contents may be exposed.

Maintaining proper ambient temperature usually requires installing the product in a temperature controlled space. Equipment rooms without cooling systems do not generally maintain the proper conditions for good battery life.

7. Specifications

7.1 Electrical Specifications

UPS Models	65 kVA	80 kVA	100 kVA	125 kVA	
INPUT RECTIFIER					
Rated Voltage	480Vac 3-phase				
Rated Voltage Tolerance w/o Contrib. of Battery @100% Load	-10%, +15%				
Voltage Tolerance In Battery Mode or Load Depending	-40%, + 15%				
Input Frequency Tolerance [Hz]	45 to 65				
Power Factor at Rated Voltage (480 V) and Battery Charge from 25% to 100% of the Load	>0.99				
Current Harmonic Distortion [THDi] (with Mains Distortion <1%)	≤ 3 at 100% Load				
	≤ 5 at 75% Load				
	≤ 8 at 25-50% Load				
Rectifier Power Walk-In	from 0 to 30 seconds (configurable)				
Rectifier Power Walk-In Delay Timer	from 0 to 120 seconds (configurable)				
D.C. CIRCUIT					
Jars /Cells	40 / 240				
Ripple Voltage with Recharged Battery [%]	Approx. 0				
Max Recharge Current [A]					
	Full load	16	20	24	30
	Load 90%	27	33	42	50
	Load 80%	38	47	51	70
	Load ≤ 70%	49	60	76	95
INVERTER					
Rated Power[kVA]	65	80	100	125	
Active Power [kW]	58.5	72	90	112.5	
Rated Power Reduction Factor (kVA/kW) for PF =0.8/0.9 Capacitive	0.85/0.89				
Rated Voltage	480Vac 3-phase + N				
Rated Frequency [Hz]	60				
Rated Voltage Adjustment	-0.05				
Static Variation	± 1%				
Dynamic Variation	± 5%				
Recovery Time within ± 1%	20ms; Conforms to standard EN 62040-3, class 1				
Crest Factor (I _{peak} /I _{rms})	3:1				
Voltage Distortion with Linear Load	1% (typical), 2% (max)				
Voltage Distortion with Non-Linear Load	< 3%				
Frequency Stability (Synchronized with the Bypass Mains)	± 2% (adjustable from ± 1% to ± 6% from control panel)				
Frequency Stability (Not Synchronized with the Bypass Mains)	± 0.05%				
Frequency Slew Rate	1Hz/sec				
Dissymmetry of the Phase Voltages with Balanced & Unbalanced Load	≤ 1%				
Voltage Phase Shift with Balanced & Unbalanced Load	120 ± 1 °el				
Overload					
	Three Phase	110% for 60min , 125% for 10min , 150% for 1min			
	Mono Phase	200% for 7 second			
Short Circuit Current					
	Phase / Phase	180% for 1 second with current limiting			
	Phase / Neutral	300% for 1 second with current limiting			
Inverter Efficiency [%]	95%				

UPS Models	65 kVA	80 kVA	100 kVA	125 kVA	
Normal Mode AC/AC Efficiency	93%				
Normal Mode Heat Rejection [BTU/Hr]	15,033	18,500	23,120	28,900	
Bypass					
Rated Voltage	480Vac 3-phase + N				
Rated Voltage Tolerance	± 15% (adjustable from ± 10% to ± 25%)				
Rated Frequency	60Hz				
Frequency Tolerance	± 2% (adjustable up to ± 6%)				
Switching to Bypass with Synchronized Inverter	Approx 0ms				
Switching to Bypass with Inverter out of Sync	20ms				
Switching from Bypass to Inverter	from 2 to 5ms				
Delay in Transfer to Inverter after Switching to Bypass	4 sec				
Overload	110 % for 60 minutes, 125 % for 10 minutes, 150 % for 1 minute				
Short Circuit Current					
	1 second	20	15	12	10
	500 ms	23	18	15	12
	200 ms	26	21	17	14
	100 ms	30	22	18	15
	10 ms	40	30	25	20

7.2 Environmental Requirements

Rated Ambient Temperature (UPS)	32 - 104°F (0 - 40°C)
Maximum Temperature for 8 hours a day	104°F (40°C)
Average Temperature for 24 hours	95°F (35°C)
Recommended Battery Temperature	68 – 86°F (20 - 30°C)
Humidity	<95% (without condensing)
Maximum Operating Altitude	Up to 3280ft. (1000m) above sea level [derating of 1% each 328ft (100m) between 3280ft. (1000m) and 13,123ft. (4000m)]
Storage Temperature	UPS: -4 to 158°F (-20 to 70°C) Battery: -4 to 86°F (-20 to 30°C)

7.3 Mechanical Specifications

UPS models	65kVA	80 kVA	100 kVA	125 kVA
Width (inches [mm])	31.50 [800]			
Depth (inches [mm])	33.46 [850]			
Height (inches [mm])	75.02 [1905]			
Weight (lbs [kg])	1499 [680]		1742 [790]	
Ventilation	Forced			
Noise at 1m from front (0-100% load)[dBA]	65	65	65	68
Applicable Standards	UL Standard 1778 2nd Edition National Electrical Code (NFPA-70) NEMA PE-1, CUL to CSA C22.2, ASME, ASA-C-39.1-1984, FCC Part 15 Subpart J Class A, NEC, OSHA, IEEE587, ANSI C 62.41-1980, ISO9000			

7.4 Rated Currents

Warning



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.

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.

7.4.1 Input (Single Input Module)

UPS models	Nominal Current	Maximum Current	OCP Current	OCP Device rating ^{1,3}	Bolt Size (in.)	Phase and Neutral Conductor	Ground Wire
65 kVA	78.2A	89A	111.3A	125A	5/8	1	6 AWG
80 kVA	96.3A	109A	136.3A	150A	5/8	1/0	6 AWG
100 kVA	120.3A	136A	170A	175A	5/8	2/0	6 AWG
125 kVA	150.4A	160A	200A	200A	5/8	3/0	4 AWG

7.4.2 Rectifier Input (Dual Input Module)

UPS models	Nominal Current	Maximum Current	OCP Current	OCP Device rating ³	Bolt Size (in)	Phase and Neutral Conductor	Ground Wire
65 kVA	78A	90A	112.5A	125A	5/8	1	6 AWG
80 kVA	94A	109A	136.3A	150A	5/8	1/0	6 AWG
100 kVA	118A	136A	170A	175A	5/8	2/0	6 AWG
125 kVA	147A	160A	200A	200A	5/8	3/0	4 AWG

7.4.3 Bypass Input (Dual Input Module)

UPS models	Nominal Current	OCP Current	OCP Device rating ^{2,3}	Bolt Size (in)	Phase and Neutral Conductor	Ground Wire
65 kVA	78.2A	97.8A	100A	5/8	3	6 AWG
80 kVA	96.3A	120.4A	125A	5/8	1	6 AWG

100 kVA	120A	150A	150A	5/8	1/0	6 AWG
125 kVA	150.4A	188A	200A	5/8	3/0	4 AWG

7.4.4 Output

UPS models	Nominal Current	Bolt Size (in)	Phase and Neutral Conductor	Ground Wire
65 kVA	78.2A	5/8	3	6 AWG
80 kVA	96.3A	5/8	1	6 AWG
100 kVA	120.3A	5/8	1/0	6 AWG
125 kVA	150.4A	5/8	3/0	4 AWG

7.4.5 Battery

UPS models	Nominal Current (@480Vdc)	Maximum Current (@400.8Vdc)	OCP Device rating	Bolt Size (in)	Phase and Neutral Conductor	Ground Wire
65 kVA	127	159.5A	175A	3/8	2/0	6 AWG
80 kVA	156A	196.4A	200A	3/8	3/0	6 AWG
100 kVA	195A	235.8A	250A	3/8	250 kcmil	6 AWG
125 kVA	244A	294.8A	300A	3/8	350 kcmil	4 AWG

Notes:

1. Over Current Protection Device, must be rated for branch circuit protection.
2. 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.
3. Input and output circuit protection must be provided by others as part of the UPS 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 conductor 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.

7.5 Torque specifications

Bolt Size	Torque Load	
5/16	10 lbf-ft	13.5 Nm
3/8	22 lbf-ft	30 Nm
1/2	37 lbf-ft	50 Nm

Appendix A – Alarms

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.

A=	EVENT MESSAGE	DESCRIPTION
0	NORMAL OPERATION	No Alarms are present
1	DISTURBANCES 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 not synchronized 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 outside the acceptable 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: <ul style="list-style-type: none"> - the supply voltage or frequency of the rectifier power supply line is not within an acceptable 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.
7	LOW INPUT VOLTAGE or OUTPUT OVERLOAD [W]	Alarm present if one of the following conditions occurs: <ul style="list-style-type: none"> - 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. 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.

A=	EVENT MESSAGE	DESCRIPTION
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. The values of Toff and Ton are factory-set to zero (thus the timer condition is disabled).

A=	EVENT MESSAGE	DESCRIPTION
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 t he 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 loss.
43	INSULATION LOSS D.C.	The external optional dc output insulation checking device, detected the DC insulation loss.
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

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.

<u>Name</u>	<u>Description</u>	<u>Typical application</u>
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 remain 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 close.</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 close.</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 close.</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 close.</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.

Appendix C - Parallel Configuration

C.1 Introduction

UPS's 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 supported by each individual unit, thanks to automatic load sharing. The reliability is only increased provided that the total power of the system with one unit deactivated remains greater than the required power. This condition can be achieved by always adding a redundant unit (**$N+1$**).

Having a redundant unit means having one more UPS than the minimum number of elements required powering the load, so that if a faulty unit is automatically excluded, adequate power is still supplied. The UPS's connected in parallel are coordinated by a card 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 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 operating logic envisages that the first unit that is activated becomes the "Master" and takes control of the other "Slaves". 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 personalized (by means of a code inserted on the display panel) with all the units connected to a single battery.

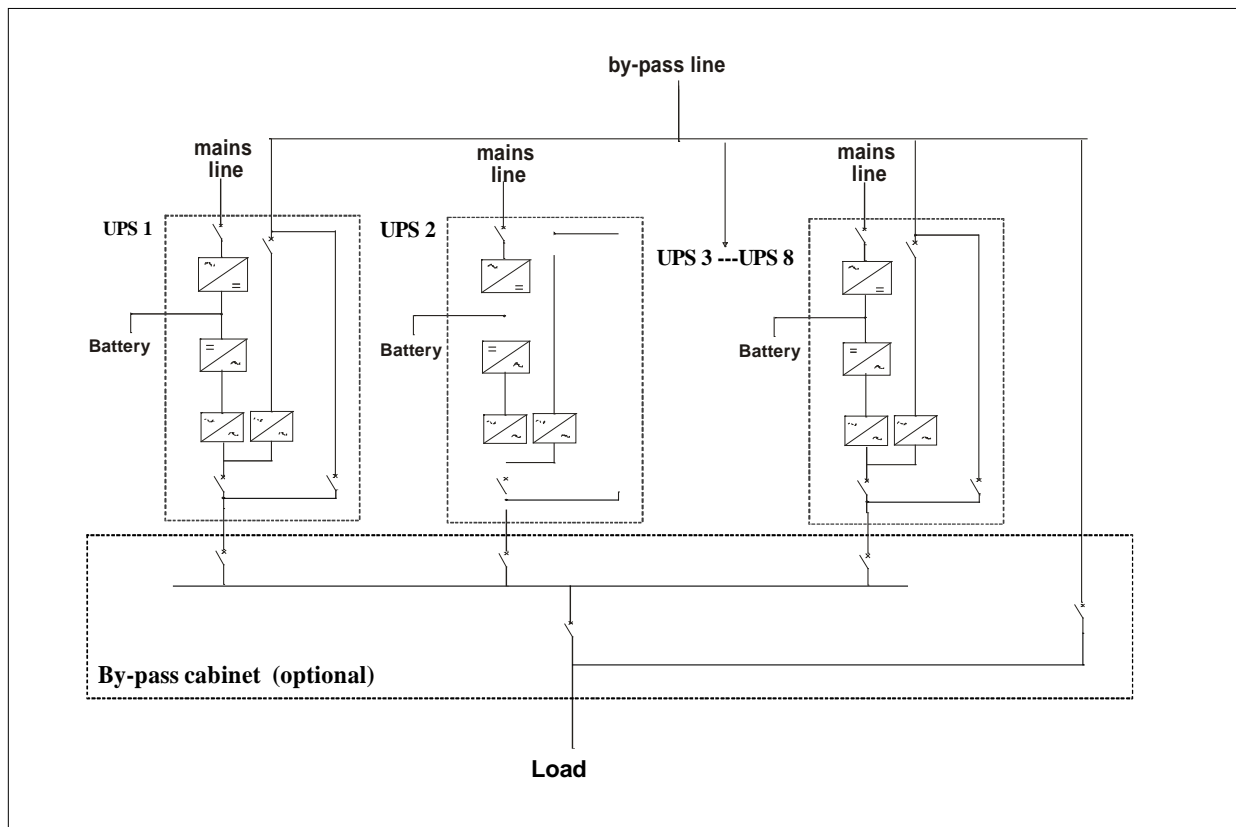


Figure 21 – Typical (3) Module Parallel System

C.2 Electrical System Set-Up

All the information contained in the section on electrical system set-up in relation to the UPS remains valid with the addition of the information set out below.

C.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. (See Section 7.4 Rated Currents)

C.2.2 Ground Fault

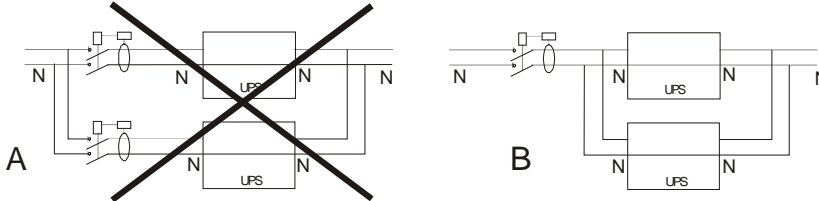


Figure 22 – Recommended Ground Fault Interrupter Layout

It is recommended that a Ground Fault Interrupter (GFI) device is implemented for safety. In order to avoid unnecessary interventions, versions with several parallel-connected devices must have a single GFI inserted at the input of the whole system, as shown in Figure 22.

C.2.3 Emergency Power Off Device (EPO)

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

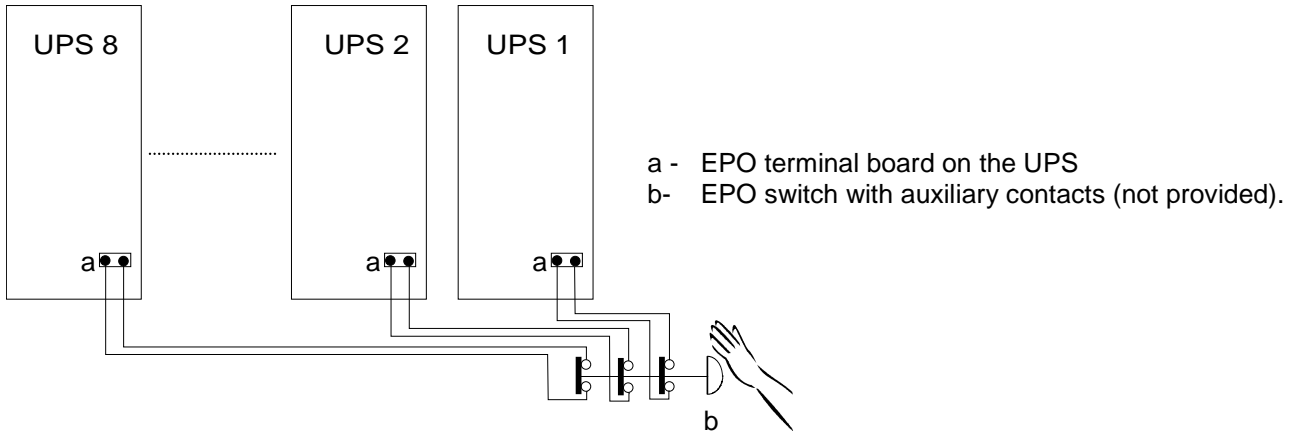


Figure 23 – Parallel System EPO

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.

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.

C.2.4 External Maintenance Bypass.

In some cases, in order to facilitate maintenance operations of the individual units making up the system, it may be advisable to install an external maintenance bypass.

The External Maintenance Bypass should be installed in accordance with the manual for the External Maintenance Bypass Cabinet

C.3 Mains and Load Connections.

All the information contained in the section “Mains, load and battery connections” (see Section 2.4 Connect of Power Cables) in relation to the UPS remains valid with the addition of the information set out below.

Refer to the Electrical Connections (see Section 7.4 **Rated Currents**) of this manual for information on how to size the cables for **each UPS**.



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 observed for phases L2, L3 and for the input and output neutral.

Parallel connect the UPS as follows:

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

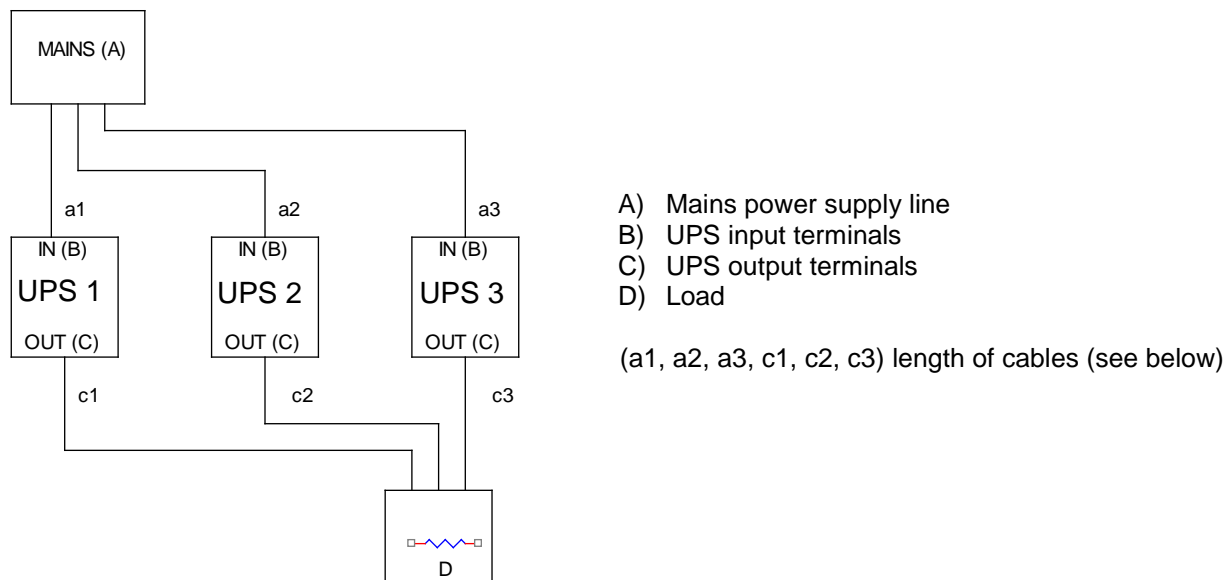


Figure 24 - Three units connected in parallel (Typical)

Length of cables

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 must also be observed 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 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 lead to a deterioration of the components on that line, both internal and external to the UPS.

C.4 Installing Parallel kit

If the modules were ordered from the factory as Parallel units, this skip to section **C.5 Connection of Signals**



Read the instructions carefully before carrying out installation. All maintenance operations inside the UPS must be carried out only by trained personnel.

Switch off all the UPS before carrying out the following procedures

High voltages are present inside the ups when the input and battery switches are open.

After disconnecting the mains line and the DC power, authorized service personnel should wait at least **ten minutes** for capacitor bleed off before attempting internal access to the UPS.

Table 10 – Parallel Kit Components

Picture Position	Description	Qty
01	Nylon support for board h=9.5	5
02	Dist. Supports for board M/F M4.	3
03	Screw M4.	3
04	Flat cable for the connection between parallel card to system card	1
05	Cable for closing connector on parallel card	1
06	Cable for connection between UPS	1
07	SK Parallel signal RJ45.	1
08	Parallel card	1

C.4.1 Parallel Card Installation

1. Open the UPS doors
2. Place and fix the new card (position 8) on the UPS door as shows in the picture.

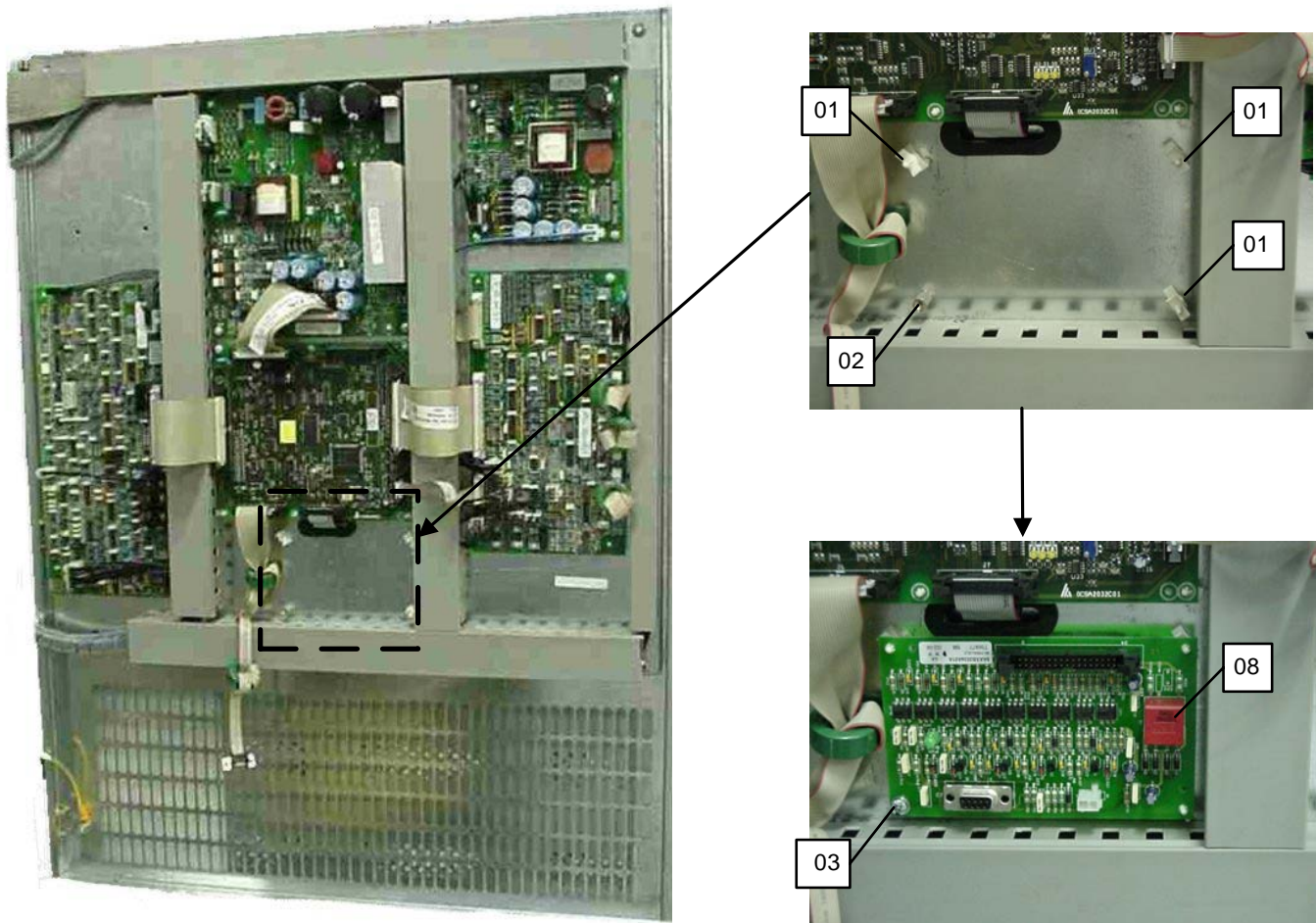


Figure 25 – Parallel Card Installation

C.4.2 Parallel Card Connections

1. Connect the flat cable DB9(present in the UPS) to the connector J2 in the parallel card
2. Insert the supplied connector (05 position) in J1 of the parallel card
3. Connect the flat cable supplied (04 position) from the connector J3 in the parallel card to the connector J2 in the system card

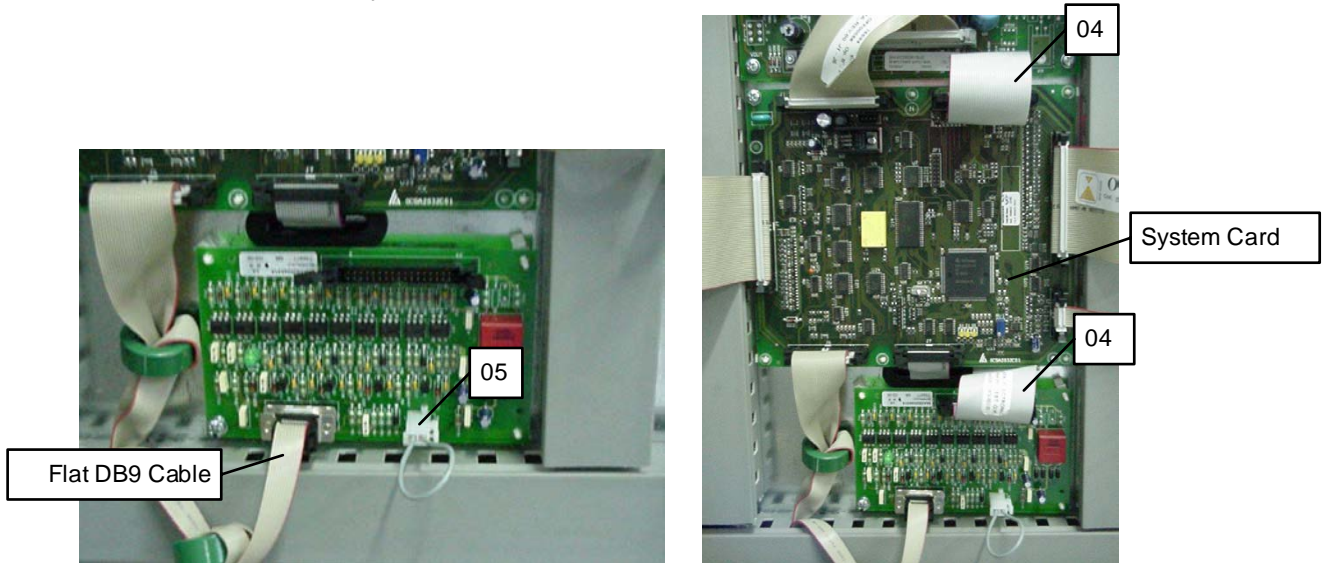


Figure 26 – Parallel Card connections

C.4.3 Parallel Card RJ45 Installation

1. Open the options panel
2. Remove the protection metallic panel
3. Place the SK Parallel signal RJ45 (07 position)

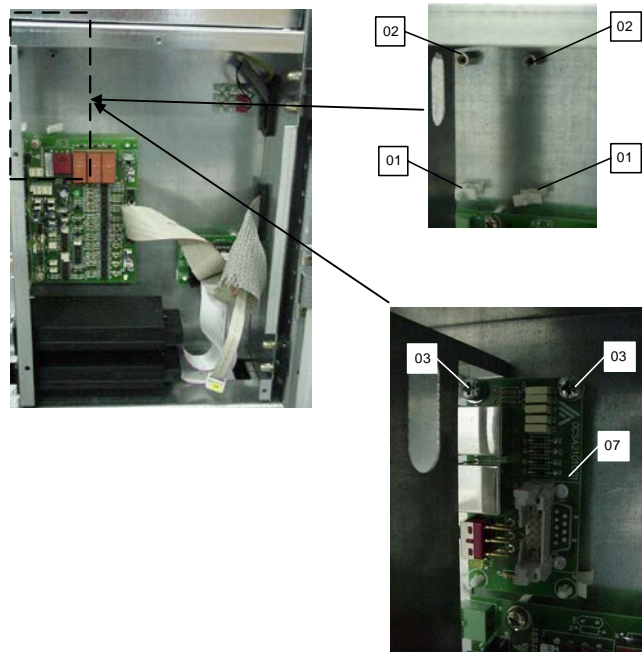


Figure 27 – Parallel Card RJ45 Installation

C.4.4 Parallel Card RJ45 Connections

Connect the flat cable (present in the UPS) to the connector J4 in the parallel card RJ45

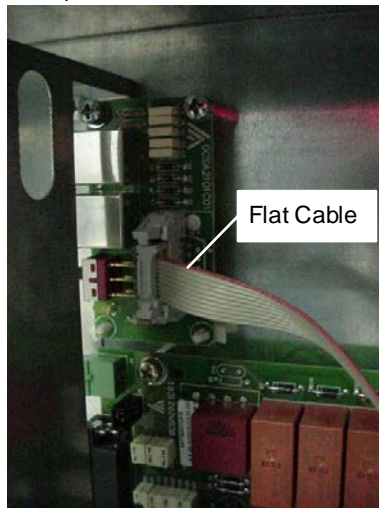


Figure 28 – Parallel Card Flat Cable Installation

C.5 Connection of Signals

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

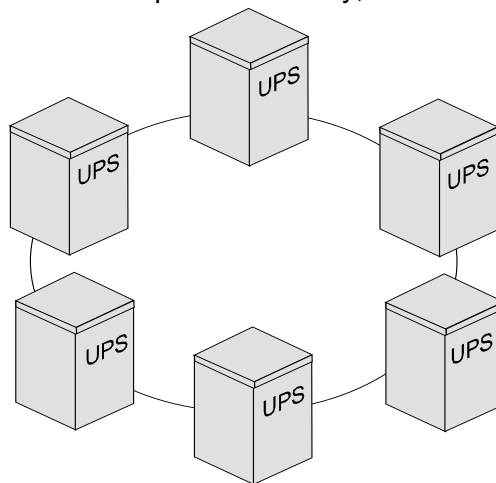


Figure 29 - Parallel Control Routing

The various UPS's are connected through the “signals RJ45-flat-adapter” parallel card, located in the lower part of the UPS.

C.5.1 RJ45-flat-adapter signals parallel card.



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.

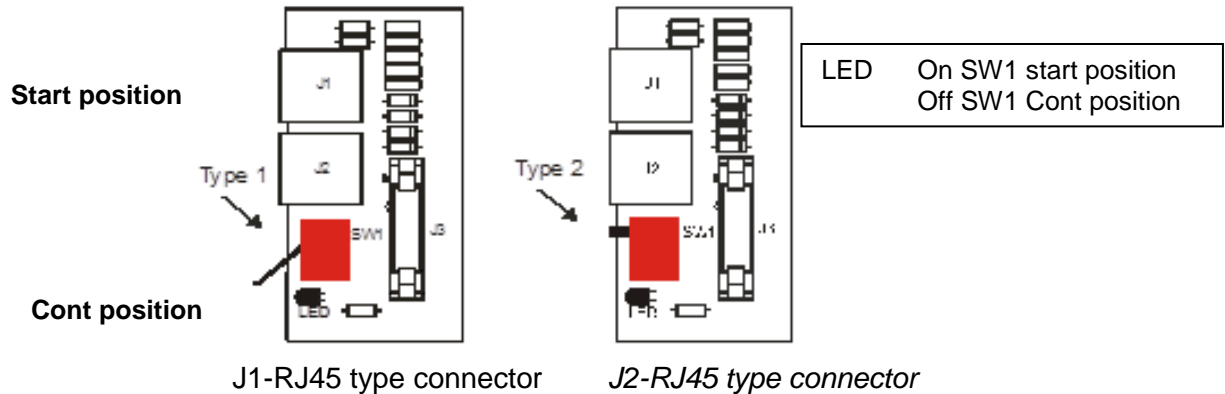


Figure 30 - RJ45-flat-adapter signals parallel card

Warning



All the parallel-connected UPSes 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:

C.5.2 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.

UPS PARALLEL CABLE

- A. RJ45 type connector
- B. RJ45-flat-adapter signal parallel card
- C. LED on
- D. SW1 in start position

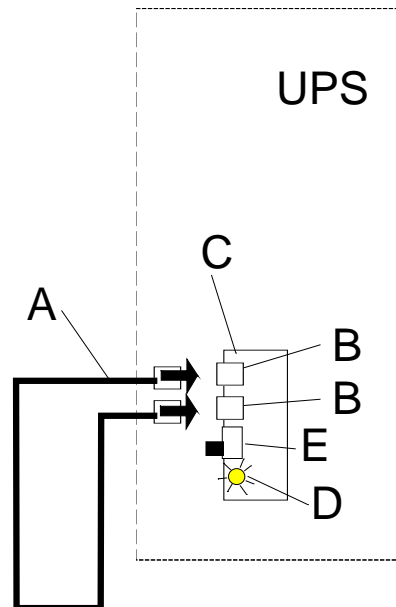


Figure 31 – Parallel Connection – Single Module

C.5.3 Two UPS's in Parallel

- A. UPS PARALLEL CABLE
- B. RJ45 type connector
- C. RJ45-flat-adaptor signal parallel card
- D. UPS1 LED on, UPS2 LED off
- E. SW1 in start position on UPS1, SW1 in cont position on UPS2



Two RJ45 cables are required despite redundancy. System will not start up unless two cables are installed.

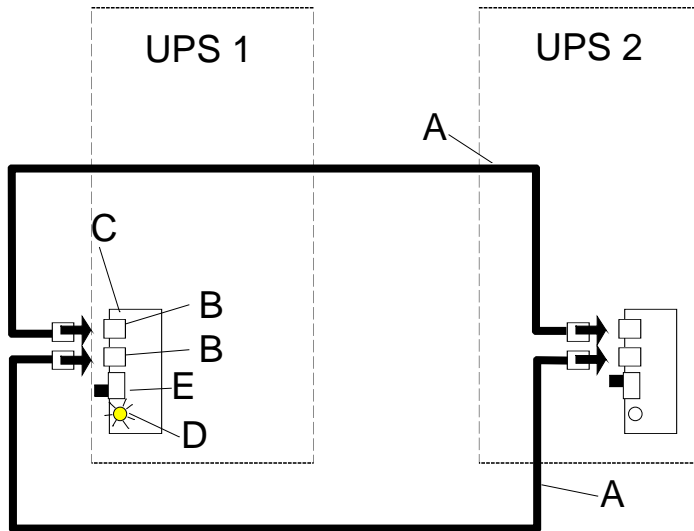


Figure 32 – Parallel Connection – Two Modules

C.5.4 Three UPS's in Parallel

- A. UPS PARALLEL CABLE
- B. RJ45 type connector
- C. RJ45-flat-adaptor signal parallel card
- 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



Three RJ45 cables are required despite redundancy. System will not start up unless three cables are installed.

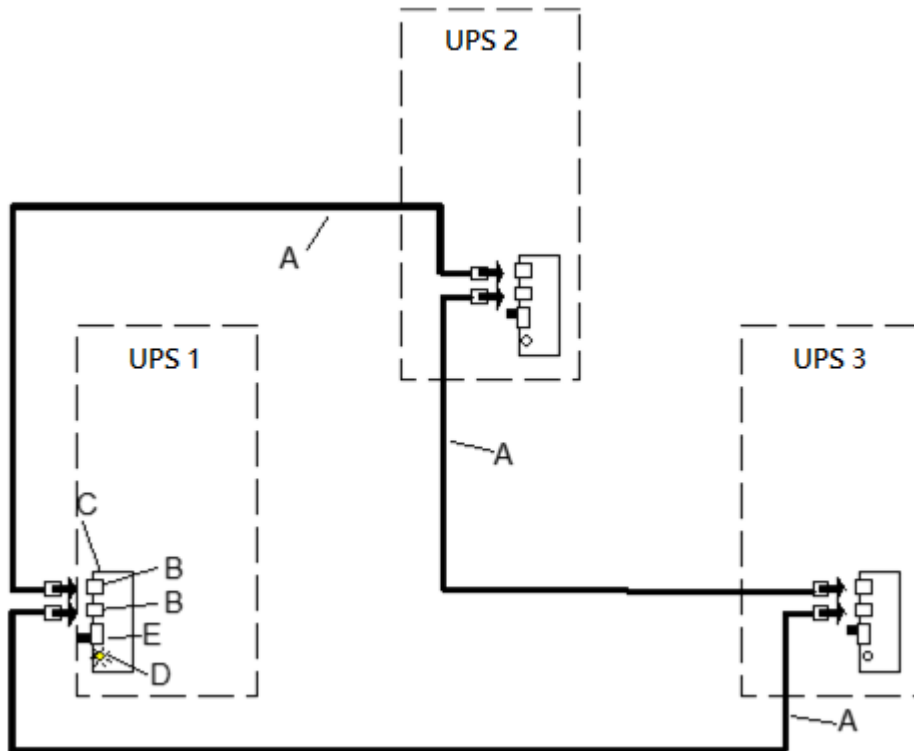


Figure 33 – Parallel Connection – Three Modules

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

Danger



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

C.6 Parallel Start-up procedure

For each UPS, follow the start-up single unit procedure. See Section **3.1.2 Start-Up Procedure Single Module**



It is critical that the following procedure be followed in the sequence given.

Warning

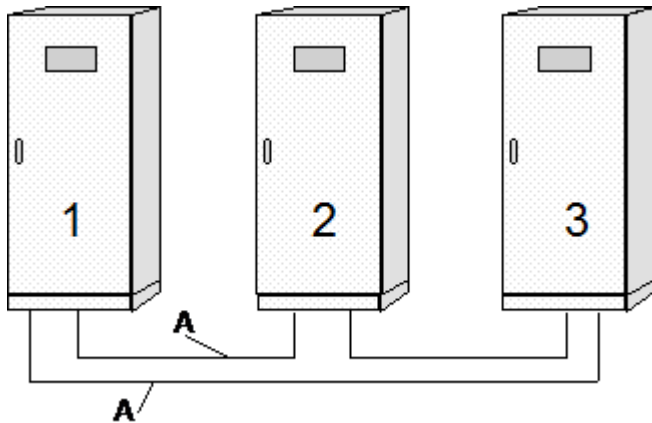


These instructions assumed that the units have been wired properly and the proper installation tests have been performed by factory authorized personnel.

C.7 Parallel Communication Troubleshooting

For the sake of simplicity, the instructions shown below refer to a system with three UPS's, but are equally valid for more complex systems.

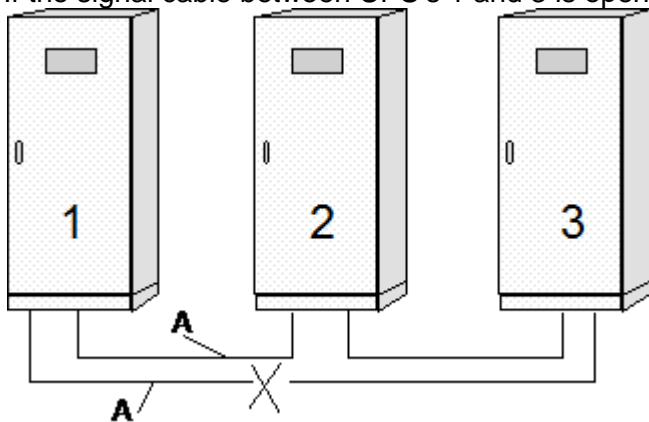
C.7.1 Normal Condition



- 1) Normal operation, Master unit
 - 2) Normal operation, Slave unit
 - 3) Normal operation, Slave unit
- A - UPS Parallel Cable

C.7.2 Single Opened Parallel Cable

If the signal cable between UPS's 1 and 3 is open



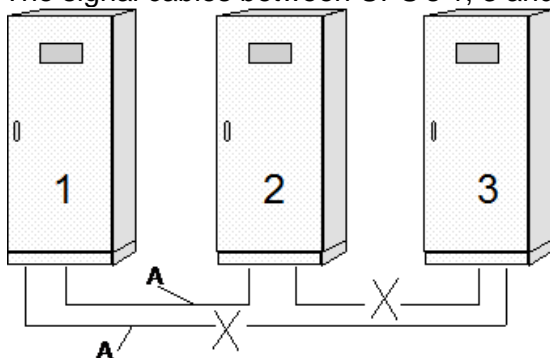
- 1) Normal operation, Master unit with message "Parallel signal cable fault" appears on the panel
 - 2) Normal operation, Slave units with message "Parallel signal cable fault" on the panel
 - 3) Normal operation, Slave units with message "Parallel signal cable fault" on the panel
- A - UPS Parallel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



In this situation the load is powered correctly. All the UPS's are supplying power to the load.

C.7.3 Multiple Opened Parallel Cable

The signal cables between UPS's 1, 3 and 2, 3 are opened.



- 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
- A - UPS Parallel Cable



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.

C.8 Mechanical Bypass

Warning



The 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 UPSes 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”.

Danger



The If SWMB is closed on any unit, the whole system switches to bypass. If all the switches are then opened to allow maintenance operations to be carried out, all the power required by the load will switch onto the mechanical bypass line of the unit in which SWMB has been closed.

WARNING: both the automatic and the mechanical bypass line of each UPS are sized for the rated power of the single unit.

NOTE To mechanically bypass the entire UPS system the switches SWMB of all the units must be closed.

C.8.1 Mechanical bypass on a single unit

This is the procedure to perform a mechanical 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.

Danger



When the mechanical bypass switch SWMB is closed lethal voltages are present inside the UPS. Extreme care must be exercised when performing maintenance on a UPS with mains voltage present and the SWMB closed. Staco recommends only using the mechanical bypass for keeping your load powered if the UPS has failed. For maintenance we recommend the use of a Staco external maintenance bypass switch. Consult the factory for more details.

C.8.2 Mechanical bypass on the whole system

The sequences of operations to be carried out to place the system in mechanical bypass are described below. The procedures vary depending on the initial state:

C.8.2.1 All the UPS are in NORMAL OPERATION

The power supplied to the load is not interrupted in any way;

Warning



The bypass line is present and its frequency and voltage are suitable the UPS display panel indicates Normal Operation.

1. Close all the switches SWMB (the control logic automatically disables the inverter)
2. Open all the switches on the UPS (SWIN, SWOUT, SWBY and the battery cabinet circuit breaker/disconnect) and keep only SWMB (mechanical bypass switch) closed. The control panel remains off.



After carrying out the operations indicated above, personnel must wait at least ten minutes for the capacitors to discharge before working on the inside of the UPS.

Warning



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 deactivated in this state).

C.8.2.2 - Whole System with Output Not Synchronized with the Bypass Line

The power supplied to the load is interrupted; therefore, this operation should be used only if absolutely necessary.

Warning



The bypass line is outside the acceptable limits; the following message is seen 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.



After carrying out the operations indicated above, personnel must wait at least ten minutes for the capacitors to discharge before working on the inside of the UPS.

After the maintenance operations have finished, restart the UPS by following the instructions in the section on Start-Up Procedure (see Section **3.1.2 Start-Up Procedure Single Module**) and then open SWMB (if closed).

The UPS will return to Normal Operation.

C.9 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**.

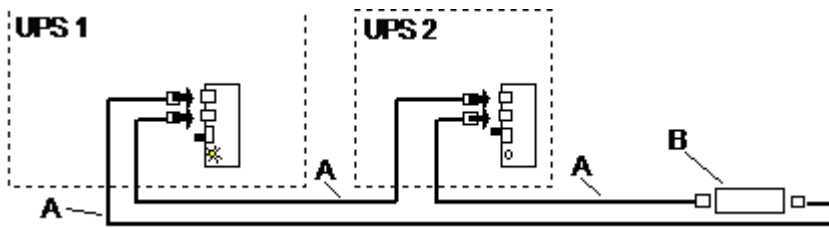
The hot insertion and removal of the UPS makes technical support easier and improves the reliability of the system.

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:

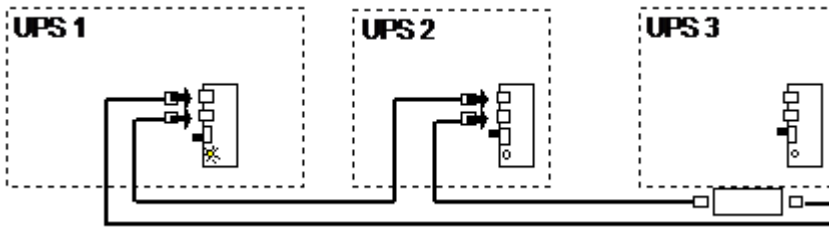
- The UPS system must be prearranged with a distribution panel (for power connections)
- The UPS system must be prearranged with a RJ45 female/RJ45 female shielded adaptor cable (not provided with the UPS).
- All the UPS's in the system must have the same firmware version.

C.9.1 Example of Hot Insertion

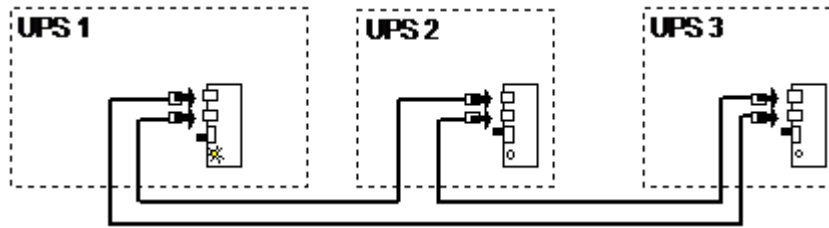


- A) UPS parallel cable type RJ45
- B) RJ45 female/RJ45 female shielded adaptor cable UPS BYPASS CABLE

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



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



- 3) Now switch on UPS 3 (the added UPS).
- 4) 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.

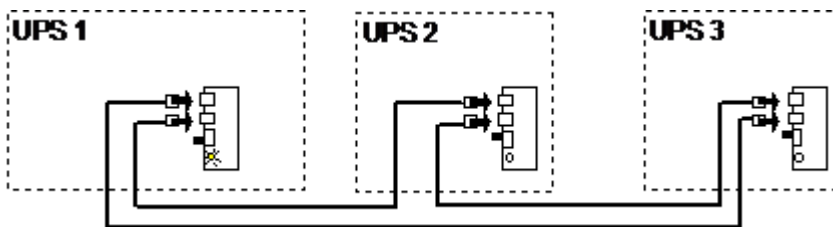
C.9.2 Example of Hot Removal

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



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.**

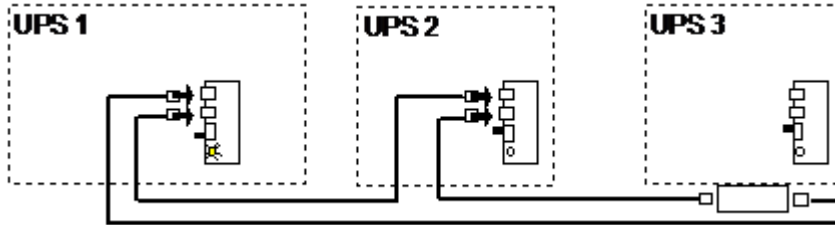
- 1) Shut down the UPS (3) that is to be removed. Remove the signal cables of the UPS to be removed.



- A) UPS parallel cable type RJ45

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

- 2) Connect the RJ45 female/RJ45 female shielded adaptor cable (not provided) between cables A



- 3) Check that all the UPS's are operating normally and that the system is sharing the output power.

