

## Technical Specifications

# Master MHT

300/600 kVA THREEPHASE/THREEPHASE  
On Line Double Conversion Technology (VFI)





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## 1. PURPOSE

The present specification defines the technical characteristics of the UPS **Master HP 300 – 400 – 500 – 600 kVA**, a device which supplies clean energy to the connected load, without any interruption due to disturbances in the mains power supply, including a total power failure.

**Master HP** is a series of UPSs designed entirely by Riello UPS a leading manufacturer of uninterruptible power supplies from 350 VA to 800 kVA, with over 25 years of experience in the sector.

To find out about other products available, as for example Static Transfer Switch (STS), please visit the website: [www.riello-ups.com](http://www.riello-ups.com)

## 2. SYSTEM DESCRIPTION

The **Master HP** series is available in three phase models **100 – 120 – 160 – 200 – 250 – 300 – 400 – 500 – 600 kVA** with On Line double conversion technology in accordance with VFI-SS-111 classification – as defined by standard IEC EN 62040-3 - with transformer in output to the inverter.

**Master HP** is compatible with the most critical, industrial and Information Technology (IT), services thanks to its many features including:

- a) Easy Source
  - Low input current distortion below 3% and power factor up to the unit, from 10% to 100% of the load. This is possible thanks to the rectifier realized with IGBT three phase bridge and controlled by DSP technology;
  - Compatibility with motor generators thanks functions as *Power Walk-In*, that guarantees a progressive start-up of the rectifier, *Power Walk-In* delay timer and battery inhibition.
- b) Battery Care System
  - Battery recharge with two voltage levels as per characteristics IU1 U2;
  - Voltage Recharge with temperature compensation;
  - Compatibility to recharge battery with long autonomy;
  - Battery test to check a battery decay.
- c) Isolation transformer on the inverter that protects the load from network disturbances in all the working conditions without altering the overall efficiency that remains around 94%.
- d) Double load protection towards the battery: one furnished with intrinsic electronic protection in the control circuits and galvanic furnished with output transformer from the inverter.
- e) Thermal overrating of the inverter to guarantee an overload (kVA) at 110% for 60 minutes.
- f) The nominal output power rating of the UPS is given with a power factor of 0,9.
- g) Backfeed protection.
- h) System expandability up to 8 units, Dual BUS and Dynamic Dual Bus systems.
- i) “Energy Management System” function for systems in parallel configurations.

## 3. REFERENCE STANDARDS

Our company quality system is certified ISO 9001/2000 (Certificate No CERT-04674-99-AQ-VEN- SINCERT) and covers all procedures, operating methods and monitoring of all stages from design to production and sales activities.

This certification is a guarantee for the customer with regard to the following aspects:

- Use of quality materials;
- meticulousness in the production and testing phases;
- Constant customer support.

Besides company certification, the product is classified VFI-SS-111 in conformity with standard IEC EN 62040-3 and satisfies the following UPS specific standards:

- **IEC EN 62040-1:** Static uninterruptible power supplies (UPS): general and safety provisions;
- **IEC EN 62040-2:** Electromagnetic compatibility (EMC) requirements category C3;
- **IEC EN 62040-3:** Methods of specification of performances and test provisions;

The **Master HP** series also makes reference to the following general standards, where applicable:

- **IEC 60529:** Degree of protection provided by enclosures;
- **IEC 60664:** Insulation for low-voltage equipment;
- **IEC 60755:** General Requirements for Residual Current Operated Protective Devices;
- **IEC 60950:** General safety provisions for "Information Technology" equipment;
- **IEC 61000-2-2:** Electromagnetic compatibility immunity;
- **IEC 61000-4-2:** Electrostatic discharge immunity test;
- **IEC 61000-4-3:** Radio frequencies, electromagnetic immunity test;
- **IEC 61000-4-4:** Transitory overvoltage immunity test;
- **IEC 61000-4-5:** Overvoltage immunity test;
- **IEC 61000-4-11:** Voltage dips, short interruptions and voltage variations immunity test;
- **IEC 61000-3-12:** Harmonic current emissions (for equipment with rated current  $> 16 \text{ A} \leq 75$ ).

#### **European Directives:**

##### **LVD directive 2014/35/EU**

The LVD covers all health and safety risks of electrical equipment operating with a voltage between 50 and 1000 V for alternating current and between 75 and 1500 V for direct current.

##### **EMC directive 2014/30/EU**

The EMC Directive **limits electromagnetic emissions from equipment**; The Directive **also governs the immunity of such equipment to interferences**.

## 4. APPLICATIONS

The UPSs of the **Master HP** series are suitable for all applications requiring protection of the critical load, from simple installations to more complex systems where a higher level of reliability and maintainability is required.

**Data Centres and Telecommunication:** the uninterruptible power system can grow together with your business since the basic system can be expanded with up to eight units connected in parallel without compromising the initial investment. Furthermore, greater levels of reliability and maintainability can be achieved with the more advanced configurations such as the "Dual Bus" and "Dynamic System Expansion".

**Industrial processes and electro-medical systems:** the UPS is particularly suitable for application with industrial processes and the power supply to electro-medical systems, thanks to its design principles and technical features, such as for example:

- inverter with output transformer guaranteeing isolation of the load from mains interference in all conditions;
- high short circuit and overload capacity;
- high battery recharging capacity, enabling applications with different kinds of batteries (sealed, vented or Nickel Cadmium) with long back-up time.

**Emergency systems:** the STAND-BY OFF mode of operation can be selected to activate the emergency back-up function, as defined by standard EN 50171 (Central Power Supply Systems).

## 5. CONFIGURATIONS

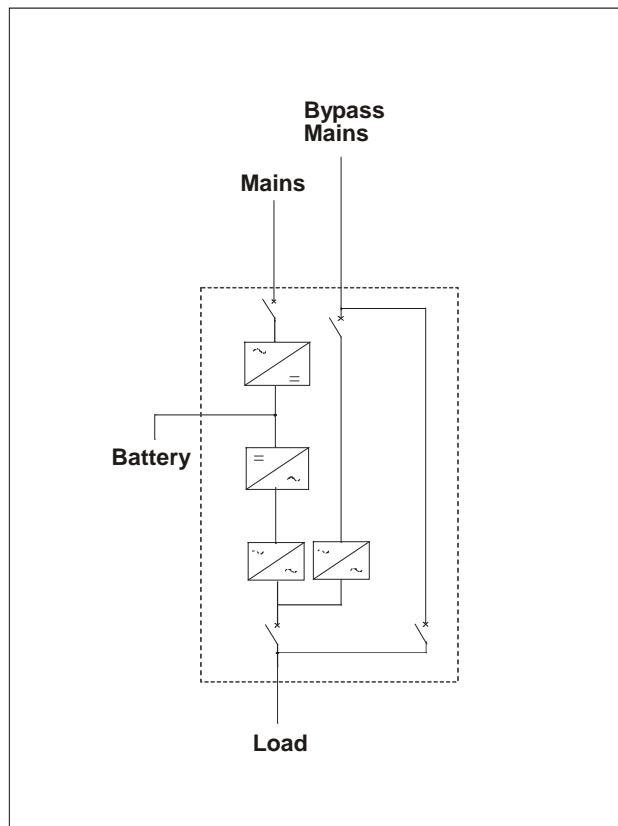
The following configurations are available:

### **Single UPS**

The single version of the system, normally used for simple installations, can be extended to up to 8 units to satisfy increases in load power or to introduce a level of redundancy.

The same group can function as a frequency converter of 50/60 Hz and vice versa with or without battery by a simple arrangement that can be done in site.

With such configuration the UPS can be used without input neutral cable.



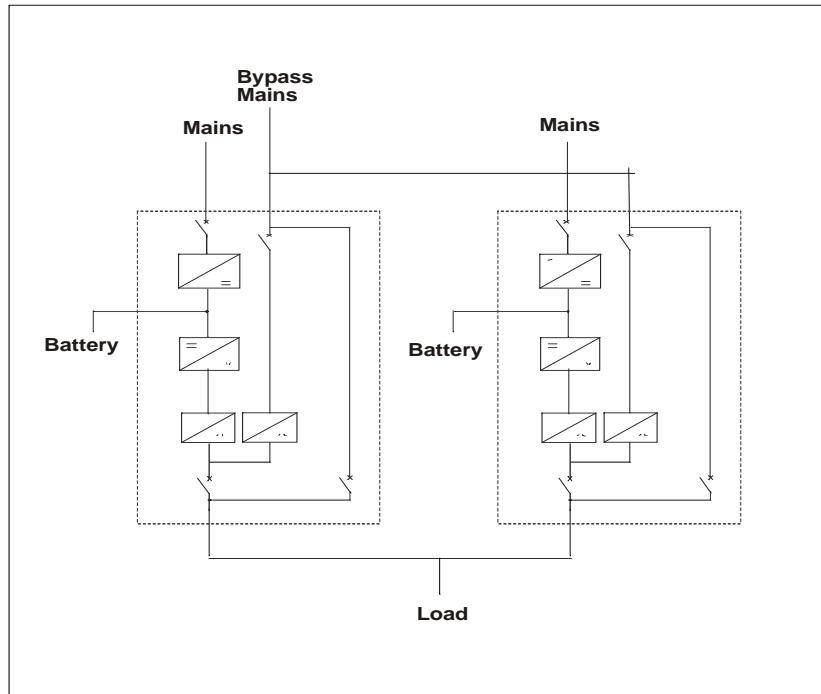
UPS single module

### Parallel configuration

Up to 8 UPSs can be connected in parallel to increase the power of the uninterruptible power system (power parallel) or to enhance its reliability (redundant parallel).

The system is defined as "redundant parallel" when the block of one or several UPSs does not determine the loss of the power supply.

All the UPSs feed the load simultaneously with automatic sharing of the current.



UPS in 1+1 redundant configuration

The units exchange information on the operating status and the sync signals by the connections in loop with dual redundancy. This means that even in the event of the accidental interruption of both connections, only the UPS affected by this interruption cuts itself off, while the other one continues to operate without any interference.

The **"Hot System Expansion" (HSE)** feature means that a new UPS can be added to the system while the other units are on-line and powering the load from the inverter.

The integrated UPS will configure itself automatically with the system data without any disturbance to the load.

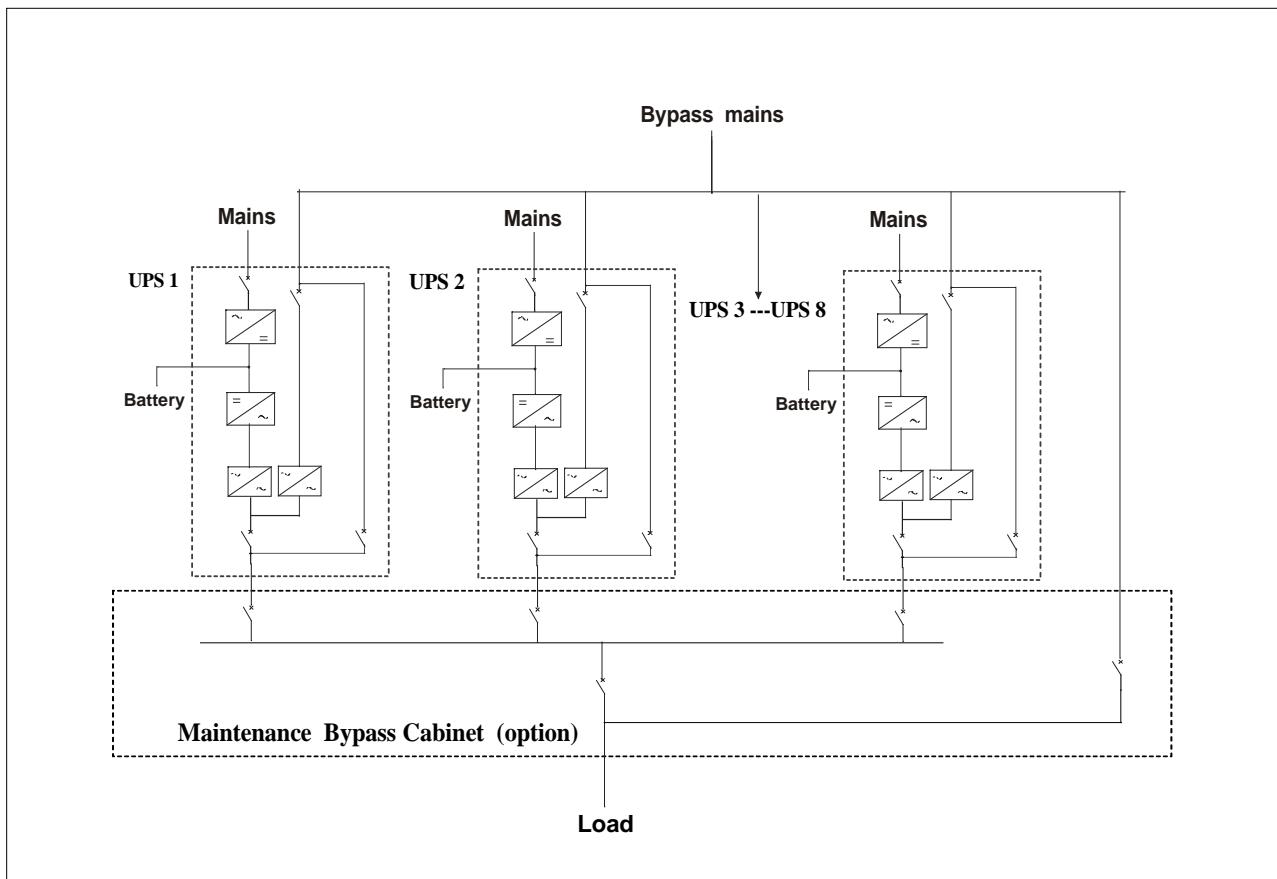
In configurations with more than two units, to improve the normal and extraordinary maintenance operations, it is advisable to install an external maintenance by-pass and to inhibit the UPS's internal one.

The UPS will be equipped with terminal to connect the following auxiliary contacts:

- External Maintenance Switch
- External Load Output Switch

The parallel system may function with a **separate battery** or a **single battery**, that is, one battery shared by several UPSs.

In the case of loss of redundancy the system has an alarm message.



Parallel configuration up to 8 units

In parallel systems, the “**Efficiency Control System**” (ECS) function enables the UPS to be switched on and off automatically according to load variations, while retaining the level of redundancy defined by the operator. This significantly reduces the total energy dissipated by the system since only those UPSs required to power the connected load remain switched on (for example during the night or at weekends).

### Centralized By-pass: Master Static Bypass (MSB)

The configuration with centralised By-pass comprises up to 7 UPS modules (MHT NBP type) having not embedded static switch connected in parallel and a separated By-pass section. The By-pass unit is equipped with a static switch which automatically switches the power supplied to the load by the whole system directly to the mains power supply and vice versa. Switching is needed during system maintenance operations, or when the whole system is unable to support the load due to overloads or output short circuits over the current limits.

This configuration assumes the selection of n UPS modules having the same power rating.

The following site prescriptions should be taken into account for the site planning:

- Distance between UPS module and central by-pass shall not exceed 40 meters.
- Communication bus cable between units shall not exceed 50 meters.
- Total communication ring (UPS units and by-pass) shall not exceed 150 meters.
- Battery can be arranged as common or separate (same as distributed parallel system).
- Maintenance bypass is part of the system either embedded in Riello UPS solution (Fig. 1) or supplied by the customer together with all Input/Output/distribution switches (Fig. 2).

This manually control switch will enable the load feeding directly from the mains insulating the UPS whenever there is an intervention on its critical parts.

According with site arrangement and UPS modules pairing layout, it will be possible to arrange for MSB having switches inside (Fig 1) or MSB without any breaker, leaving the coupling arrangement to the customer which shall ensure handy and safe operations during maintenance (Fig 2).

These two different layouts modify the system current reading but it won't affect the system operation.

Below we resume the two different scenarios according with system operations either on Inverter or bypass mode:

	Display MHT NBP	Display MHT MSB
<b>Riello UPS will provide the system as for Fig. 1</b>		
<b>System on inverter</b>	Unit current in: kW, kVA, peak, rms and % refers to single unit capacity	System current in: kW, kVA, peak, rms, and % refers to MSB capacity
<b>System on static bypass</b>	No info	System current in: kW, kVA, peak, rms and % referred to MSB capacity with inverters locked (fault) or % referred to unit modules with inverters ready to supply load.
<b>Riello UPS will provide the system as for Fig. 2</b>		
<b>System on inverter</b>	Unit current in: kW, kVA, peak, rms and % refers to single unit capacity	System current in % referred to unit module (master one will pass the data) and not MSB capacity
<b>System on static bypass</b>	No info	System current in: kW, kVA, peak, rms and % referred to MSB capacity with inverters locked (fault) or % referred to unit modules with inverters ready to supply load.

Fig 1. System configuration with centralized bypass and switches:

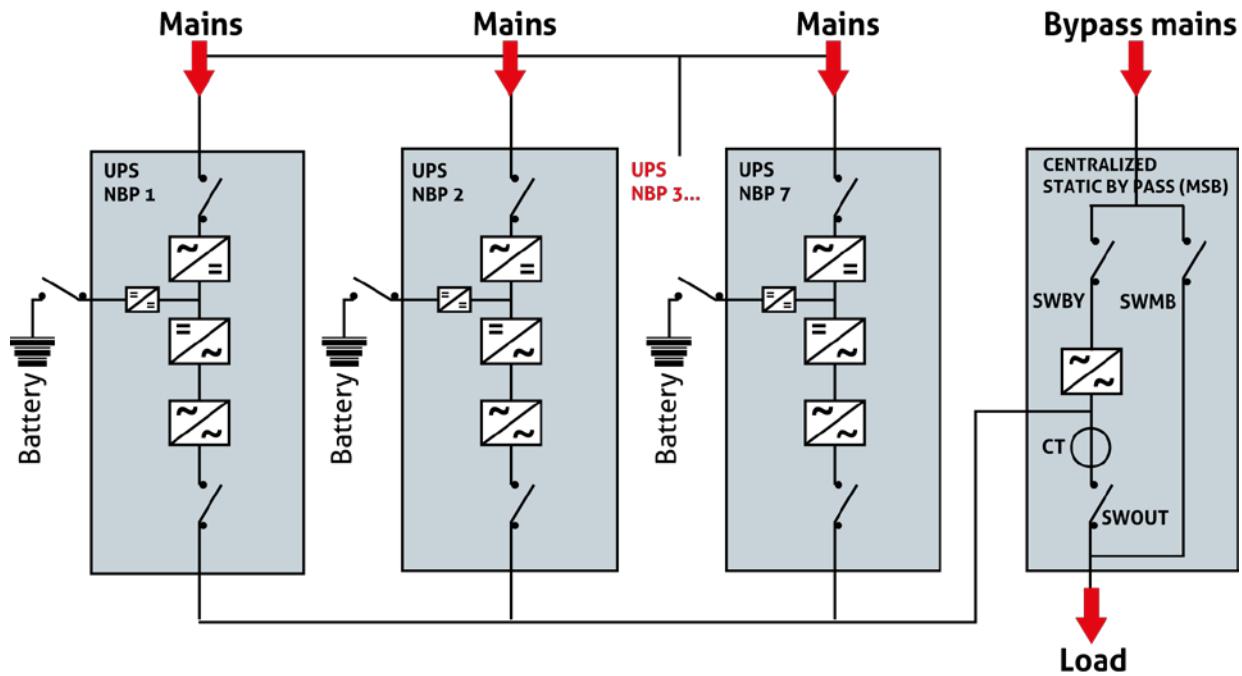
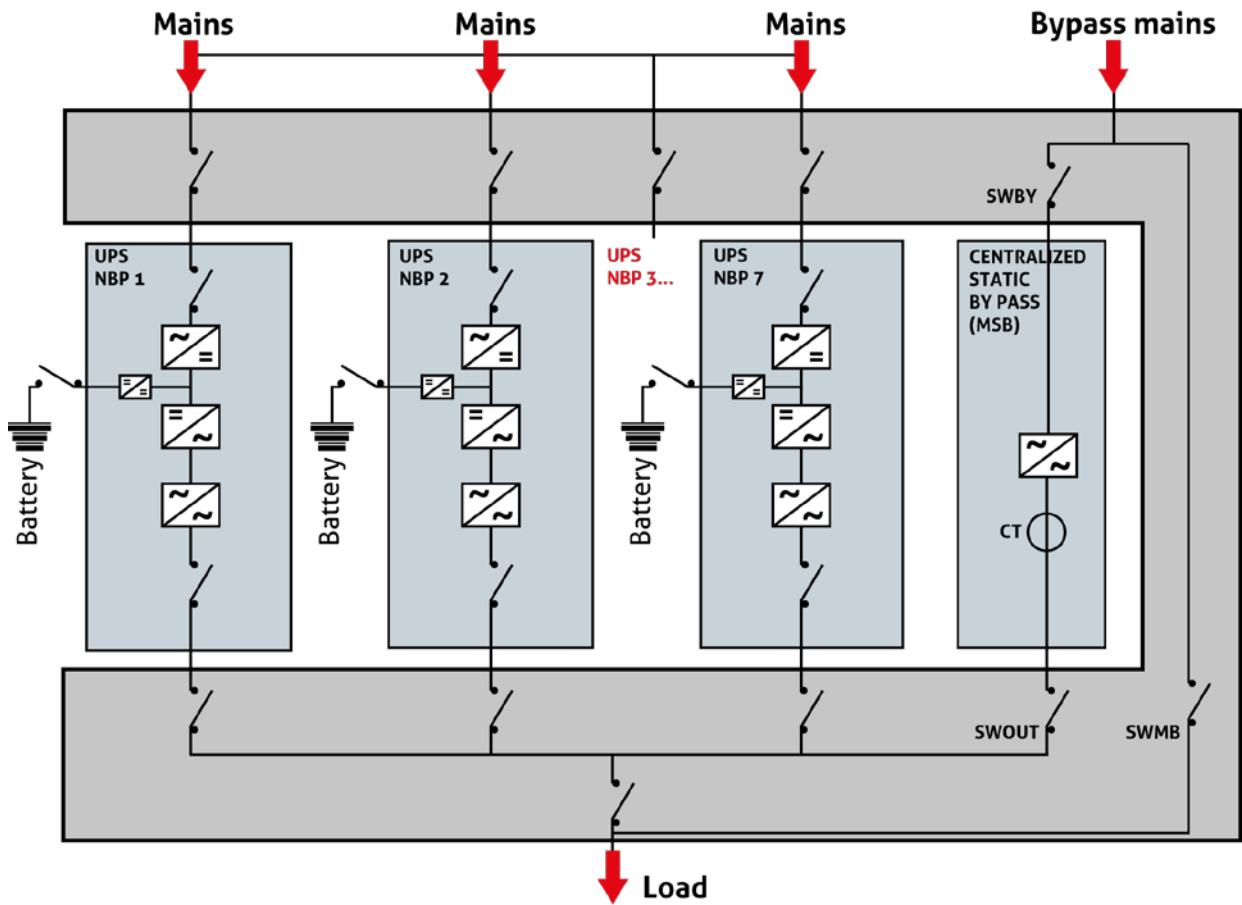


Fig 2. System configuration with centralized bypass without:



NOTE: It is warmly suggested to arrange a proper on site procedure (written or via castell key mechanical interlock) so that SWOUT can be open just after SWBY opening manoeuvre.

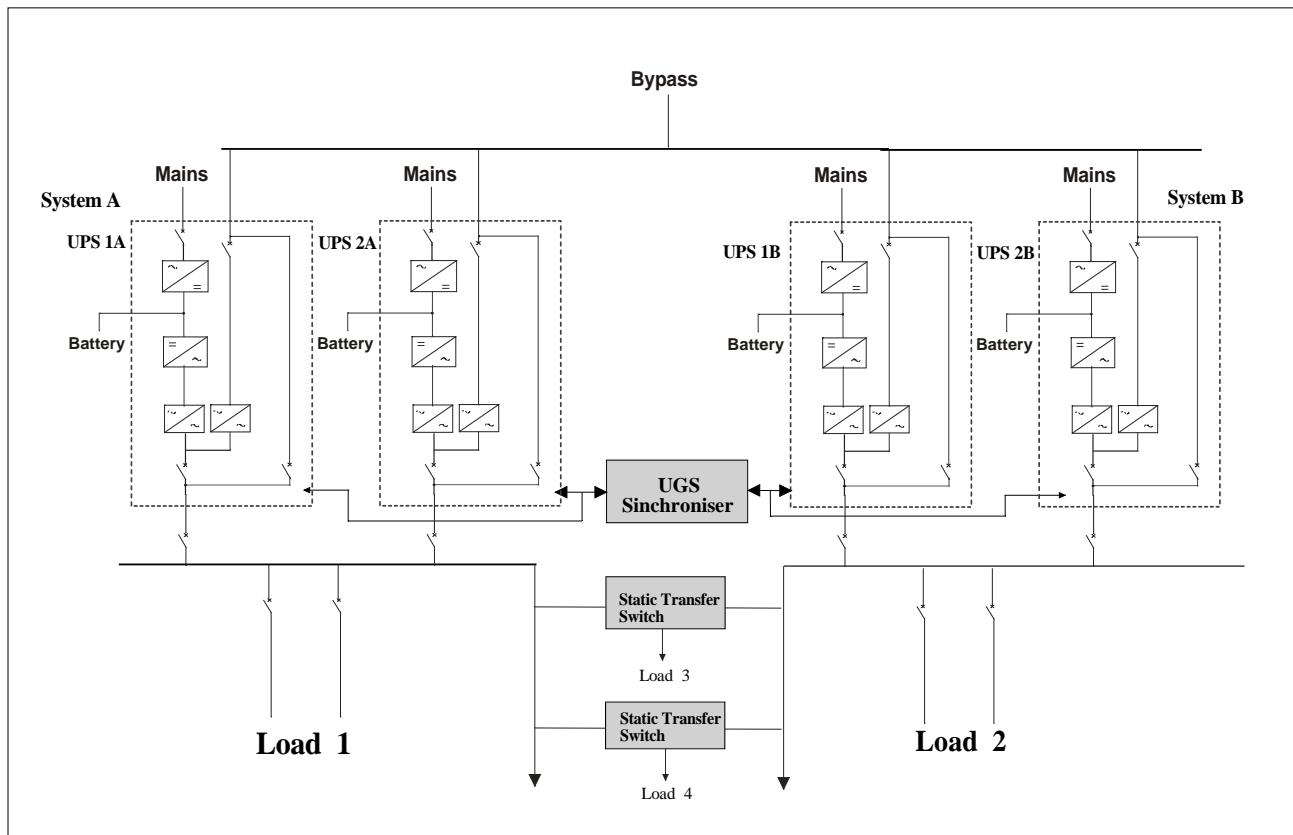
### Dual Bus System (UGS)

Two independent systems can be configured in Dual Bus with a single or separate power source.

The synchronisation option (UGS) keeps the outputs of the two systems constantly synchronised, regardless of the input variations and when the system is powered by the battery.

Each system comprises up to a maximum of 4 parallel UPSs.

This system has been designed for configurations that use the STS (Static Transfer Switch) since it guarantees switching from one continuous source to the other without disturbances to the loads.

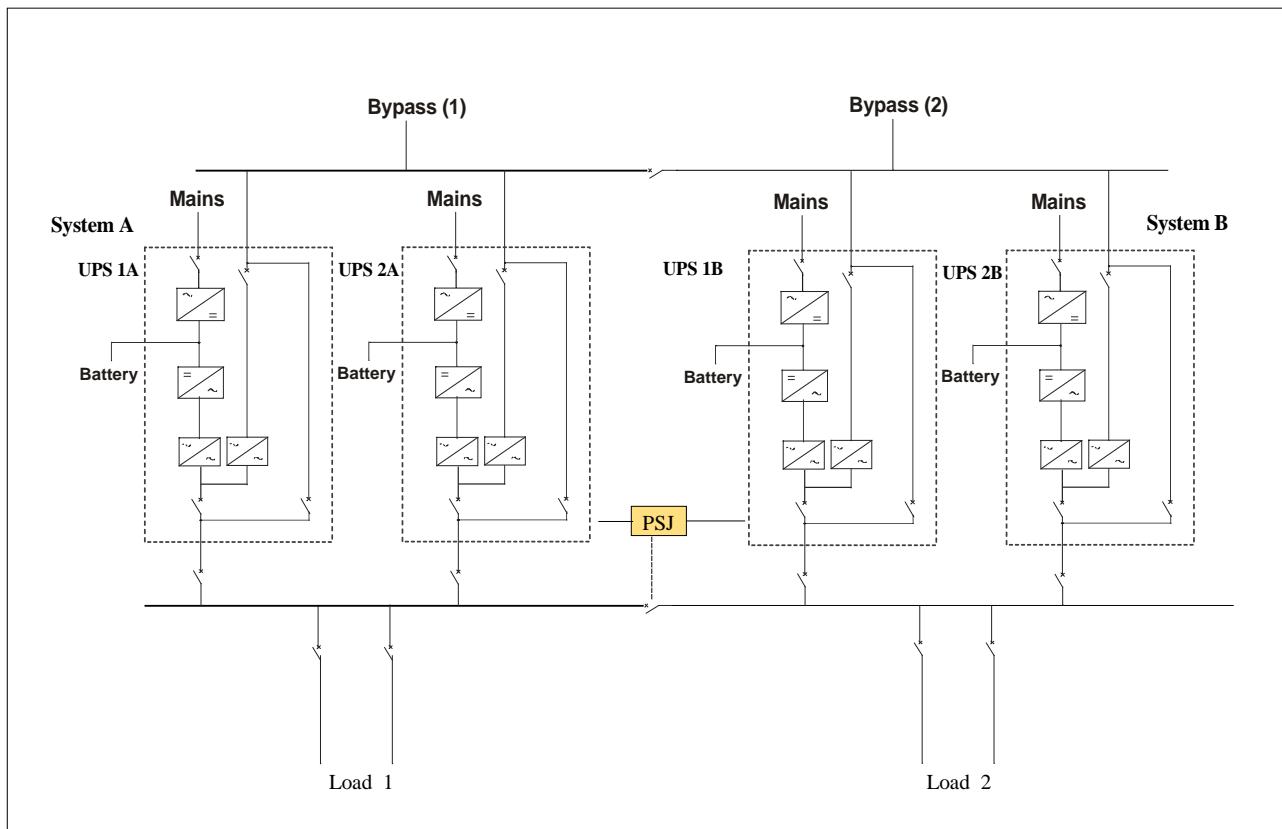


### Dynamic Dual Bus System (PSJ)

Two independent systems (up to 4 units each) can be connected in a "Dynamic Dual Bus" configuration by means of the PSJ (Parallel System Joiner) option.

This enables the two systems to be joined to form a single system when, for example, part of one system is undergoing maintenance and it is felt appropriate to use the redundant UPS for both bars of the load. The synchronization and the equal distribution of power is guaranteed by the PSJ.

This characteristic provides an extreme flexibility of the systems in case of maintenance or when is necessary to modify the redundancy level between the two bus.



### Frequency Converter

Units in standard configuration at 400 V can operate as frequency converters (50/60 Hz and vice versa), whether or not batteries are present. This feature can be set at the commissioning. The bypass is inhibited in this configuration and frequency converters with operating voltages other than 400 V, such as 440 V, 460 V, etc. can be supplied on request (please contact your sales representative).

## 6. UPS DESCRIPTION

The uninterruptible power supply can be set to operate in four operating modes: ON-LINE, STAND-BY ON, SMART ACTIVE and STAND-BY OFF.

### Mode: ON-LINE

- **Normal Operation:** The rectifier draws energy from the mains to power the inverter and keep the batteries charged; the inverter powers the load with voltage and frequency stabilized and in sync with the by-pass mains, if appropriate.
- **Emergency operation:** when the mains power supply goes out of the pre-set limits, the rectifier switches off and the inverter is powered from the battery for the envisaged back-up time without any disturbance to the load. When the mains power supply is restored, the rectifier starts to operate gradually (*Power Walk-In*), powering the batteries again and charging the inverter.
- **By-pass operation:** in the event of an inverter overload beyond the envisaged limits, or a manual shutdown, the load is automatically transferred onto the by-pass mains by means of the Static switch without any disturbance to the load.

### Mode: STAND-BY ON

The load is normally powered from the by-pass mains, the rectifier keeps the batteries charged. When the mains goes outside the preset range, the load is transferred automatically onto the inverter until the mains returns to a suitable level. This mode is suitable for powering loads that are not sensitive to mains interference, thus allowing increased system efficiency of up to 98%.

### Mode: SMART ACTIVE

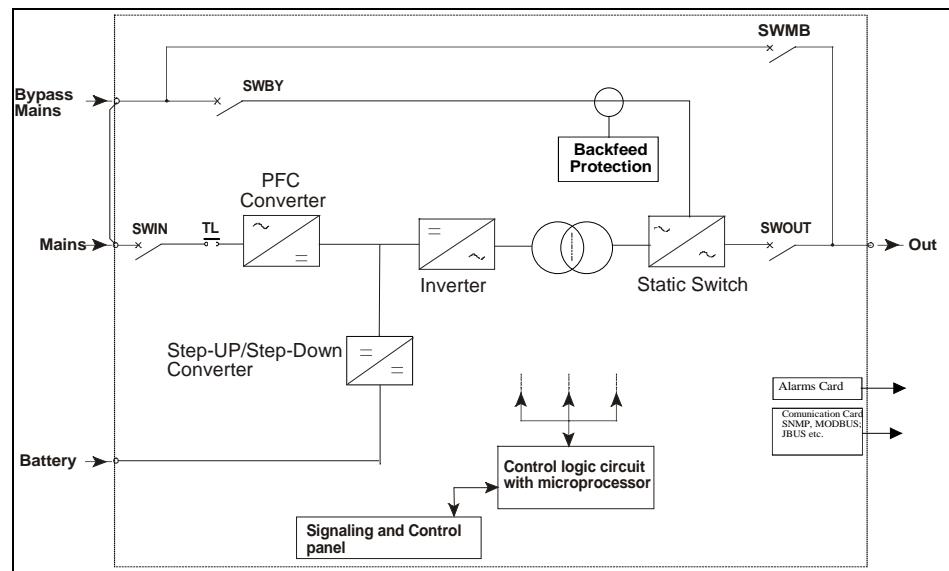
When the **Master HP** is configured in SMART ACTIVE mode, it automatically defines whether to operate in ON-LINE or STAND-BY OFF mode.

This is done by monitoring the by-pass mains: if this remains suitable for a defined period, the system sets itself to STAND-BY ON mode; otherwise it remains in ON-LINE mode.

### Mode: STAND-BY OFF

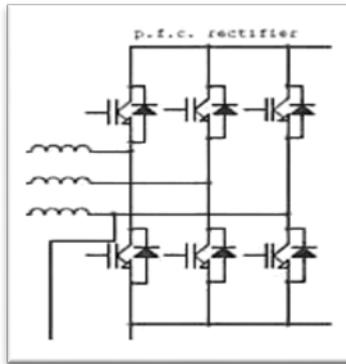
When the mains power supply is present, the rectifier keeps the batteries charged and the inverter is switched off. When the mains fails, the rectifier switches off and the inverter is activated in approx. 200 ms, using the battery energy. This application is suitable for the power supply of emergency lighting, as defined by standard EN 50171.

The block diagram of the **Master HP** system is shown below:



## 6.1. AC/DC Converter

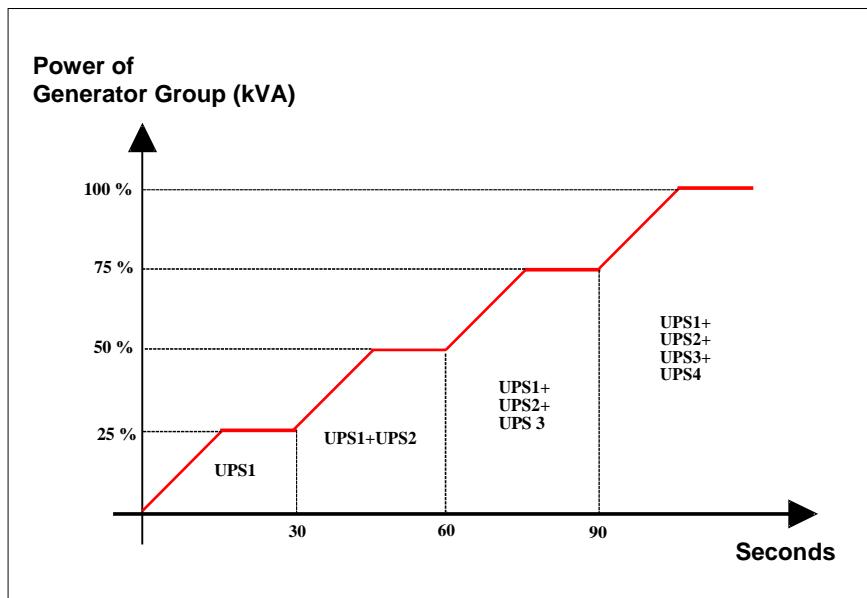
The AC/DC Converter converts the alternate voltage into direct voltage to power the inverter at nominal load and to charge the batteries. The input stage of **Master HP UPS** is realized with a technology such as to reduce the harmonics of current rejected into the mains by up to 3% and increase the power factor up to the unit from 10 to 100% of the load (see the tables with the Technical Data at the end of the present specifications).



### 6.1.1 Easy Source

**Master HP** is designed in order to reduce at minimum the impact on the mains source or on the upstream Generator Set. In detail the features are as follow:

- **Input Harmonics:** thanks to a low input harmonics content of the input and the high power factor, the installation costs are reduced as well as the sizing of a possible generator set upstream.
- **Power Walk-In duration:** when the input voltage is applied to the rectifier, as per example after a mains power failure, this reaches the nominal power progressively in a programmable time from 0 to 30 seconds.
- **Power Walk-in start delay:** in parallel configurations the start-up of the rectifiers can be delayed to reduce the impact to any generator located upstream. The delayed start-up is programmable up to 120 seconds.



Example of calibration from the rectifiers in a parallel system

- **Inhibition of the battery charge current:** while the UPS is operating with a generator set, battery recharging can be excluded and all the available power can be used to feed the load.

- **Inhibition of bypass synchronism:** in case of the generator set with a very unstable output frequency, the Inverter synchronization with bypass can be inhibited. In such as case the inverter generates an output voltage in the free running mode by using the internal oscillator. Consequently, the transfer of the load on the bypass is not allowed.

The “battery recharge current” and “Inverter Synchro with bypass” inhibitions are activated by a remote contact of the generator set connected to the optional Rely Card.

## 6.2. DC/DC Converter

The DC/DC converter takes the output direct current from PFC converter to allow the battery recharge. Such a system closes inside it a STEP-UP/STEP-DOWN converter that takes care of the charging and discharging of the battery, reducing drastically the current ripple in the battery.

The DC/DC converter is also characterised by the following fundamental function:

### 6.1.2 Battery Care System

The “Battery Care System” is a set of functions to control, manage and preserve the battery as long as possible.

- a) **Battery Recharging:** This UPS is suitable for hermetic lead batteries (VRLA), AGM, open vase and Ni-Cd. Depending on the battery type, two recharge methods are available:
  - **Cyclical recharging (factory set):** the state of the battery charge is kept constantly under control and when the charge level drops below the established level, a recharge cycle starts up automatically following the IU characteristic (EN 50272-2). In any case the UPS automatically runs a top-up charge cycle every 24 hours.
  - **Two level recharging (configurable):** this recharge is carried out with two levels of current at two voltage levels following the IU<sub>1</sub> U<sub>2</sub> characteristic (EN 50272-2). During the first phase the charging takes place at the rapid charge voltage (U<sub>1</sub>), followed by a second phase at the floating charge level (U<sub>2</sub>). Both these recharge values are ensured with **temperature compensation of the recharge current** as required by the battery manufacturers so that battery life is not jeopardized. This type of recharge can be configured on-site and is mainly used with open vase or Ni-Cd batteries.
- b) **Battery test:** in normal operating conditions the battery is checked automatically at regular intervals or on manual command. The test takes place without appreciably discharging the battery, in complete safety for the load and without compromising the battery service life. If the test has a negative outcome, a report signal will appear on the UPS panel and remotely.
- c) **Protection against slow discharge:** in the event of discharges of long duration and low load, the end of discharge voltage is raised to approx. 1,8 V/el. as prescribed by the battery manufacturers so as to avoid damaging the batteries.
- d) **Current Ripple:** Thanks to the STEP-UP/STEP-DOWN converter, that provides to recharge and discharge the battery, the current ripple in the battery is extremely reduced. This feature eliminates one of the main causes of reduced battery reliability.

## 6.3. DC/AC Converter

The DC/AC converter converts direct voltage in to stabilized, alternate sinusoidal current to supply the load.

With the UPS in ON-LINE mode, the load is always powered from the inverter.

This comprises a three phase inverter with IGBT (Insulated Gate Bipolar Transistor), a transistor that allows high switching frequencies (>20 kHz) and consequently low consumption and low noise.

The inverter output is connected to the transformer, thus ensuring galvanic isolation between output and battery.

### Voltage regulation

Output voltage is regulated by using the independent phase control, a characteristic that allows a better static and dynamic response. In detail:

- a) **Static condition:** the output voltage from the inverter remains within  $\pm 1\%$  for all the input tension variations within the permissible limits;
- b) **Dynamic condition:** for load variations from 0 to 100%, the output voltage remains within  $\pm 5\%$  below the values defined by class 1 of standard EN 62040-3.

## Frequency regulation

The inverter output frequency is generated autonomously by an internal oscillator in sync with that of the by-pass mains; the frequency stability towards the load therefore depends on the operating conditions:

### a) Frequency stability

- With mains available: the internal oscillator follows the variations in frequency of the by-pass mains, according to the set value, which is normally  $\pm 2\%$  (can be calibrated from  $\pm 1\%$  al  $\pm 6\%$ ).
- With mains not available: the inverter generates the output current frequency autonomously with a stability of  $\pm 0,05\%$ .

### b) Speed of frequency variation

The maximum output frequency variation of the inverter to reach onto that of the backup by-pass mains is 2 Hz/s for the single UPS and 1 Hz/s for the parallel version.

## Output voltage distortion

The regulation of the inverter guarantees the output voltage distortion with linear loads within 1% (maximum 2% with battery nearly discharged). With non-linear loads, as defined by standard EN 62040-3, the output voltage distortion does not exceed 3%.

## Output power

The Inverter is sized to supply output power (kVA) with power factor of 0,9 inductive.

## Overload

The inverter is sized to supply a power overload (kVA) of 110% for 1 hour, 125% for 10 minutes and 150% for 1 minute, on the three phases. On two phases, the limit is 200% for 6 s.

If the time or power limits are exceeded, the load is transferred onto the by-pass mains.

## Short circuit capacity

In the event of a short circuit on the load and with power supply from the battery, the inverter can supply a current limited to 180% for 1 s in the event of a short circuit on the three phases, and 300% for 1 s in the presence of a short circuit between phase and neutral.

## Symmetry of output voltage

In all conditions, the symmetry output voltage is guaranteed within  $\pm 1\%$ , for balanced loads and  $\pm 2\%$  for 100% unbalanced loads (e.g. one phase at nominal load, the other two without load).

## Phase displacement

The inverter three phase output voltages are guaranteed with a phase shift angle of  $120^\circ \pm 1^\circ$  for 100% balanced and unbalanced loads.

### 6.4. Static switch

The Static Switch is an electronic device that transfers the load onto the by-pass mains without any break in power in the following circumstances:

- manual shutdown of the inverter;
- exceeding of the inverter overload limits;
- exceeding of the internal over temperature limits;
- inverter fault;
- DC voltage outside the admitted range.

If at the time of switching the inverter voltage is not in sync with that of the by-pass mains, the transfer takes place with a delay of approx. 20 ms to avoid possible damage to the load. However this value can be set from 10 to 100 ms to cover all the requirements of the various types of load.

### By-pass mains voltage

Transfer onto the by-pass mains only takes place if the voltage and frequency are considered "suitable" to power the load. The limits of acceptability are defined by the user in relation to the connected load:

- Voltage range:  $\pm 10\%$  (can be calibrated from  $\pm 5\%$  to  $\pm 25\%$ );
- Frequency range:  $\pm 1$  Hz (can be calibrated  $\pm 1$  Hz to  $\pm 6$  Hz).

### Overload

In order to guarantee the maximum of service continuity, the static switch does not have protection for overload. This allows the compatibility with any type of system, commissioning to protection devices, externally installed, the selectivity ensuring.

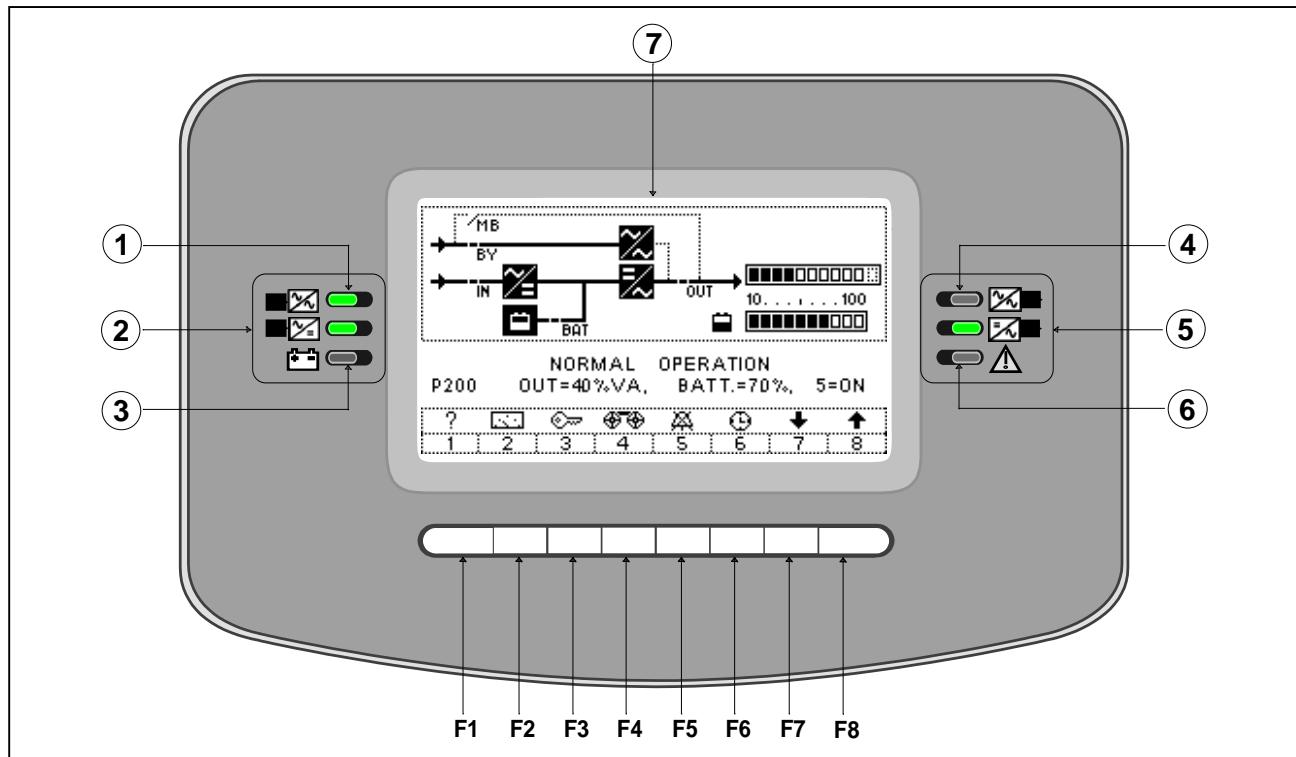
The UPS Static Switch is sized to support the following overloads:

- 110% for 60 minutes
- 125% for 10 minutes
- 150% for 1 minute

The short-circuit capacity may also vary according to the load (see table in the Technical Data section).

## 7. CONTROL PANEL

The control panel located at the front of the equipment may be used to monitor and control all the parameters of the UPS and the batteries connected to it. The operating status of the UPS is shown on a liquid crystal display (LCD), with two rows of 40 characters and four LEDs with three operating states: On (steady), On (flashing), and Off.



**①** LED Bypass input line indicator

**②** LED Mains input line indicator

**③** LED Battery indicator

**④** LED Bypass output

**⑤** LED Normal output

**⑥** LED Alarm for internal

**⑦** Graphic display

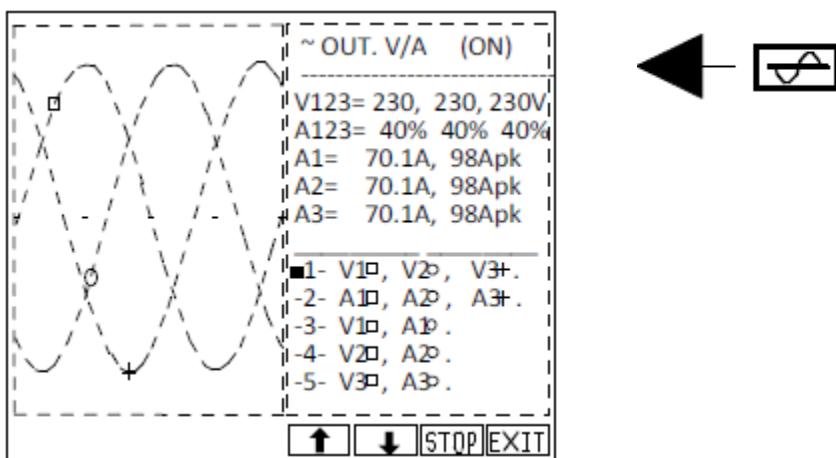
### F1, F2, F3, F4, F5, F6, F7, F8: FUNCTION KEYS

The function of each key is shown at the bottom of the display screen and varies according to the menu displayed.

The display shows the event history log up to 120; the measurements and associated alarms are recorded for each event. The messages are available in the following languages: Italian, English, French, German, Spanish, Portuguese, Dutch, Swedish, Polish, Hungarian, Turkish, Czech, Romanian and Russian (as options).

## Measurements

- Input voltage and frequency
- By-pass voltage and frequency
- Input power
- Output voltage and frequency
- Output power
- Output power peak
- Battery voltage
- Battery recharge/discharge current
- Inverter input voltage
- Internal temperature (logic control, rectifier, Inverter, static switch and magnetic components)
- Sinewave view of the following signals:
  - Input Current /Output Current
  - Input Voltage/ Output Voltage



- Hours of operation on inverter
- Hours of operation on by-pass
- Hours of operation on battery
- Battery attenuation time
- Number of complete battery discharges

## Messages

The alarm messages are the following:

<b>DISTURBANCES ON BY-PASS LINE</b>	Presence of disturbances on the by-pass line.
<b>MANUAL BY-PASS SWITCH CLOSED</b>	The manual maintenance by-pass switch is closed.
<b>INCORRECT BY-PASS VOLTAGE OR SWBY, FSCR OFF</b>	The line voltage or frequency is outside the limits or the switch is open.
<b>INCORRECT VOLTAGE SUPPLY OR SWIN OFF</b>	The rectifier power supply voltage is outside the limits or the rectifier is faulty.
<b>PREALARM FOR MINIMAL BATTERY LIFE</b>	The battery is discharging and has reached the minimum back-up time value (can be calibrated).
<b>BATTERY TEST FAILED OR BATTERY SWITCH OPEN</b>	The battery test has failed or the battery switch is open.
<b>SUPPLY VOLTAGE LOW</b>	The battery voltage is below the preset limit.

<b>OUTPUT OVERLOAD</b>	The load connected to the inverter has exceeded the nominal value in kVA.
<b>LOAD SUPPLIED BY BY-PASS PER MINIMUM LOAD</b>	When the load is less than the value set by the operator, it is transferred onto the bypass line.
<b>INTERNAL DAMAGE Number</b>	Internal fault, details of the alarm are provided by a code.
<b>LOAD TEMPORARILY ON BY-PASS</b>	The load is temporarily on the bypass due to inrush current or inverter start-up.
<b>LOAD ON BY-PASS DUE TO OUTPUT OVERLOAD</b>	Load on bypass due to exceeding of the inverter overload limits.
<b>ACTIVE BY-PASS COMMAND</b>	Load forced onto bypass.
<b>REMOTE COMMAND FOR BY-PASS: ACTIVE</b>	Load forced onto by-pass by a remote command.
<b>OVERLOAD TEMPERATURE OR VENTILATION DAMAGED</b>	The temperature inside the cabinet has exceeded the maximum limit due to too high ambient temperature or ventilation fault.
<b>INPUT PHASE SEQUENCE INCORRECT</b>	Indicates that the sequence of the input phase is incorrect.
<b>MISSING OUTPUT VOLTAGE</b>	Alarm when the output voltage is not present because the SWOUT and SWMB are open at the same time.
<b>AUTO-OFF Timer: Toff= 0: 0', Ton= 0: 0'</b>	Setting of the date and time of automatic UPS start-up and shutdown.

## 8. DISCONNECTING SWITCHES

The UPS is equipped with four switches under load located on the front of the cabinet that can be accessed by the opening of the door:

- Rectifier input;
- By-pass mains input;
- Output load;
- Maintenance by-pass.

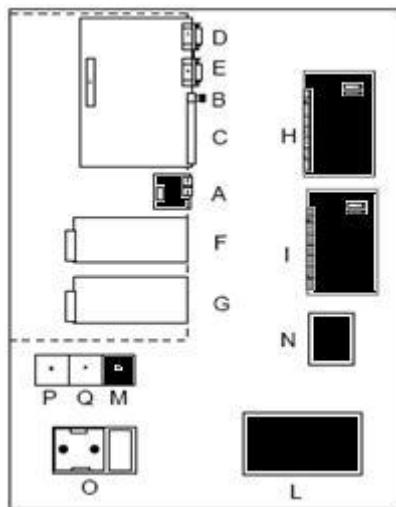
The battery switch is located in the battery cabinet or in a wall panel.

## 9. COMMUNICATION

The alarms, commands and the communication software supplied together with the UPS to interface the unit with the system are listed below.

If these are not sufficient, please see the Options chapter.

Two DB9 connectors are available for RS232 connection; these outputs can be connect to a remote computer or to a Modem.



Interface card with connectors for signals and remote commands

A-PARALLEL (optional)  
 B- EPO (emergency power off)  
 C- REMOTE  
 D- RS232-1  
 E- RS232-2  
 F- SLOT 1 (main)  
 G- SLOT 2 (aux)

H- REMOTE ALARMS (optional)  
 I- REMOTE ALARMS (optional)  
 L- MODEM (optional)  
 M-battery temperature sensor (optional)  
 N- UGS (optional)  
 O- 230 V-auxiliary outlet  
 P- SWOUT aux  
 Q- SWMB aux

### 9.1. Report Signals

These are provided by means of voltage-free relay contacts, the maximum capacity of the contacts is: 1 A – 42 V:

- Battery low;
- Battery discharged;
- Load on by-pass or UPS fault.

### 9.2. Commands

The following commands in the UPS can be activated by means of an external voltage at +12 V 80 mA (max):

- ON/OFF Inverter (Such alarm can be modified as listed on pages 27-28).
- Complete shutdown of the UPS.

This signals reporting can be set.

### 9.3. Emergency Power Off (E.P.O.)

In the event of an emergency the UPS can be completely shut down by an external command.

#### 9.4. Monitoring and control software

The system is provided with **Powershield<sup>3</sup>** monitoring and control software with the following features:

- Event chronology;
- Total events management;
- E-mail, modem, SNMP Agent support;
- Sequential shutdown of all the PCs in the network, saving the active work of the most varied applications.

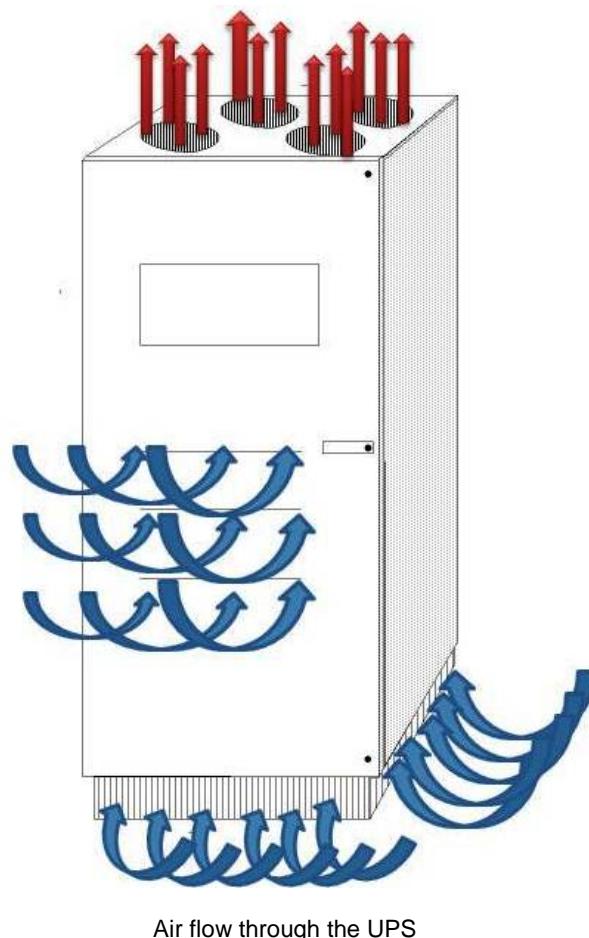
#### 10. UPS CABINET

The cabinet is made in galvanized steel with degree of protection IP20 even with the front door open.

In addition, on request, different versions with higher protection degrees are available.

The forced ventilation is ensured by means of fans at the top; air intake is from the front, and output is from the top.

The parts with greater dissipation, such as the power modules and magnetic parts, are monitored by temperature sensors.



#### 11. INSTALLATION

The UPS are designed to allow all the regular and extraordinary maintenance operations from the front, thus making back or side access superfluous. The cables input is from the bottom, and optionally can be possible require the cable entrance from the top (please refer to the description in the section of options).

Pallet lifters may be used to move the systems.

## 12. OPTIONS

### 12.1. Communication

The software **PowerNETGuard** is a centralized management program used by the UPS that operates through the SNMP communication protocol. It is an ideal instrument for EDP manager in medium and large scale Data Centre.

The main features are the following:

- Display at various levels of geographical areas, building plans, maps.
- Multi-user accesses with several levels of safety.
- Compatible with standard RFC 1628 SNMP agents.
- Creation of graphics and saving on file for physical input and output values.
- Alarm notification via e-mail and SMS.
- Integrated Web Server for the display of the alarms.
- Suitable for operation with Windows operating systems: (98, ME, NT, 2000, 2003, Xp and Vista), Linux, Mac OS X, Solaris 8 and 9.

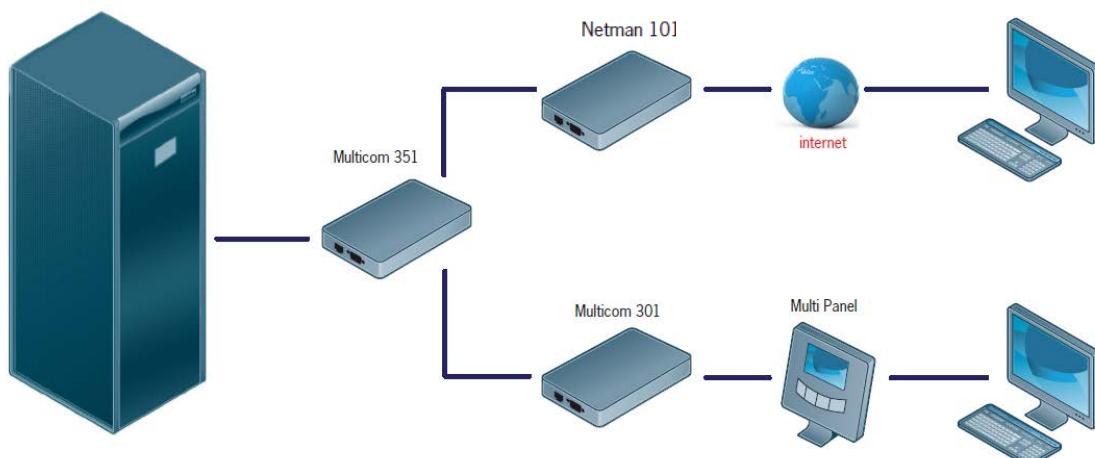
**Note:** the complete and updated list of options is available on the website: [www.riello-ups.com](http://www.riello-ups.com)

#### Hardware

Two slots are available inside the device, at the bottom, to house two of the following communication options:

- a) **NetMan 204:** the NetMan network agent allows UPS management across a LAN using any of the main network communication protocols TCP/IP, HTTP, HTTPS and network interface SNMP v1 and v3. NetMan enabled UPS integrate easily into medium and large sized networks and provide reliable communications between the UPS and management systems employed.
- b) **MultiCom 302:** Modbus/Jbus protocol converter by means of RS232 or RS485 output for the monitoring of UPSs in BMS (Build Management System). It also manages a second independent RS232 serial line that can be used to connect other devices such as NetMan or a PC.
- c) **MultiCom 352:** a device that makes it possible to connect two devices to a single UPS serial port. It can be used in all cases where several serial connections are required for multiple interrogation of the UPS.
- d) **MultiCom 401 (Profibus Converter):** is an accessory, external to the UPS, which makes it possible to integrate the UPS in a network which uses the Profibus DP communication protocol.

The communication cards can be used simultaneously in various combinations to achieve greater flexibility and therefore enhanced services, as can be seen in the following example:



In addition to the cards above mentioned the following communication options are available:

e) **Contact card with programmable power relay** (5 A - 250 V) for connecting a remote control device. The following default alarm signals are available:

- a. Load on inverter;
- b. Load on mains power;
- c. Low battery;
- d. Overload;
- e. Over-temperature;
- f. Load on maintenance by-pass.

There are also two programmable inputs (24 Vca) for: "battery charge inhibition" and "by-pass inhibition" that can be used when is connected a generator-set.

The UPS is predisposed to house two alarm cards, having so up to 12 programmable alarms and 4 inputs. The settable alarms are listed in the following table:

ALARM	DESCRIPTION
<b>INTERFERENCE ON BYPASS LINE</b>	Disturbance on the bypass line (e.g. voltage peaks, harmonic distortion etc.) while the voltage and frequency values remain within acceptable limits. The inverter is not synchronised with the mains power supply.
<b>MANUAL BY-PASS, SWMB-ON</b>	SWMB Manual by-pass switch is closed.
<b>FAULTY BY-PASS VOLTAGE or SWBY, FSCR OFF</b>	This alarm is present if the input voltage of the bypass line is not correct, or the SWBY switch is open.
<b>FAULTY MAINS SUPPLY VOLTAGE or SWIN OFF</b>	The voltage supplied to the rectifier is incorrect or the SWIN switch is open. The battery is in discharge mode.
<b>PRE-ALARM FOR LOW BATTERY VOLTAGE</b>	The battery voltage is below the calculated value to furnish about 5 minutes of autonomy; the pre-alarm value is settable.
<b>DISCHARGED BATTERY OR BATTERY SWITCH (SWB) OPEN</b>	The battery is discharged or the switch is open.
<b>LOW POWER VOLTAGE or OVERLOAD</b>	The power voltage is lower than the nominal value or there is an output overload.
<b>OUTPUT OVERLOAD</b>	The inverter is overload status.
<b>BY-PASS FOR OUTPUT VA &lt; AUTO_OFF VALUE</b>	This alarm is present when the power expressed in % VA, absorbed by the load is lower than the "AUTO OFF" value. (function to be activated when the system is powered up).
<b>INTERNAL FAULT: number</b>	An internal anomaly is present.
<b>TRANSITORY BY-PASS</b>	The load is powered temporarily by the bypass line (e.g. for transitory current peaks).
<b>BY-PASS FOR OVERLOAD ON OUTPUT</b>	The load is powered by the bypass line for overloads on the inverter in excess of the set limits.
<b>BY-PASS COMMAND ACTIVE; DISABLED</b>	This alarm indicates when the load is forced over to the bypass line using a command on the front panel. The inverter is switched off.
<b>REMOTE COMMAND FOR BY-PASS: ACTIVE/ DISABLED</b>	This alarm indicates when the load is forced over to the bypass line via a remote command. The inverter is switched off.
<b>OVERTEMPERATURE or FAULT ON FANS</b>	This alarm indicates an internal over temperature caused by an increase in environment temperature outside the set limits or due to malfunctioning of the fans.
<b>FAULTY INPUT PHASE SEQUENCE</b>	The input sequence phase for the by-pass line is incorrect.
<b>OUTPUT SWITCH AND MANUAL BY-PASS SWITCH OPEN</b>	This alarm indicates when there is no output voltage due to the simultaneous opening of the SWOUT output switch and the SWMB manual bypass switch.

ALARM	DESCRIPTION
<b>ACTIVE/DISABLED SHUTDOWN COMMAND</b>	This alarm indicates when the shutdown command (Rectifier + Inverter + By-pass) has been activated on the front panel or through the connection of the RS232 interface (Powershield <sup>3</sup> ).
<b>REMOTE SHUTDOWN COMMAND: ACTIVATED/DISABLED</b>	This alarm indicates when the shutdown command (Rectifier + Inverter + By-pass) has been activated via remote contact.
<b>CHANGED MEMORY: CODE = NUMBER</b>	Indicates that the system settings have been changed.
<b>BATTERY OVERTEMPERATURE</b>	The temperature in the battery cabinet has exceeded the set limits.
<b>BATTERY TEST FAILED</b>	The battery test has encountered a battery fault
<b>FAULTY FAN ALARM</b>	This alarm indicates a faulty fan inside the system (optional function - on request).
<b>FAULT FUSE</b>	This alarm indicates one or more faulty fuses inside the system (optional function - on request).
<b>FAULT ON PARALLEL CONNECTION</b>	The parallel connection has been interrupted or is disconnected.
<b>AUTO-OFF Timer: Toff= 0: 0', Ton= 0: 0'</b>	This alarm indicates when the daily timer comes in function set for the automatic UPS start-up and shutdown. If required this function is enabled at start-up.

f) **Multi I/O:** Multi I/O has configurable input and output signal contacts to allow UPS integration with control systems. It can be used to connect two devices to a single UPS serial communication port. It can also communicate using the MODBUS/JBUS protocol on RS485 lines.

### 12.2. LED Remote mimic panel

It can be connected up to a distance of 200 m from the UPS for remote supervising. The panel provides information about UPS functions:

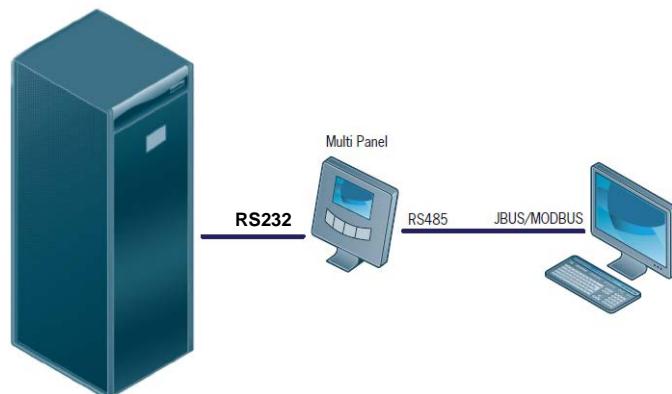
- Green LED: normal operation;
- Yellow LED: not critical alarm;
- Red LED: alarm.

UPS start-up and shutdown commands can also be sent from the mimic panel.

### 12.3. Remote graphic panel

Graphic remote panel gets available remotely on the Graphic Display the information on the UPS status, the measurements and the alarms. In addition it is fitted a RS485 port which gets available the same information in JBUS/MODBUS protocol for the BMS.

The maximum distance between the UPS and remote panel is approx. 300 mt.



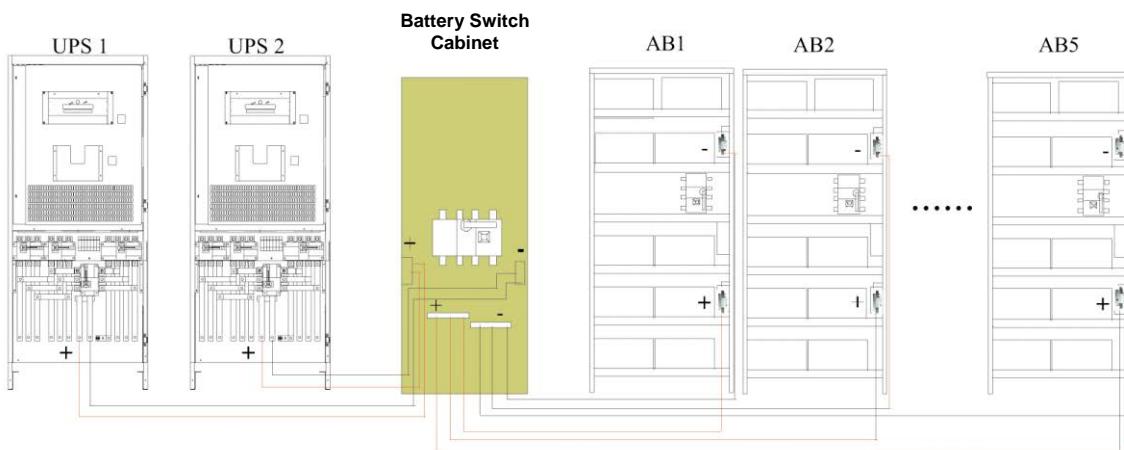
#### 12.4. Battery cabinet

The battery cabinets are available with the following characteristics:

- Protection fuse and switching disconnectors;
- Protection degree IP20 with front door open;
- Complete with batteries or empty with connection cables between the compartments (cells).

The size is (W x D x H): 860 x 800 x 1900 mm, weight 200 kg (empty).

Such battery cabinets can be connected in parallel to reach the required autonomy; for more than 2 in parallel it is advisable to add a single module cabinet where the paralleling of the cables can be connected. Below an installation example is provided:



#### 12.5. Starting up from battery (Cold Start)

This device makes it possible to switch on the UPS even in the event of a mains failure using only the battery energy.

#### 12.6. UGS - UPS Group Synchroniser

This allows 2 systems connected in a "DUAL BUS" configuration to keep synchronised with each other for any variation in the mains voltage, including total failure. The UGS also allows an RIELLO UPS to be synchronised with another power source or to an independent non RIELLO UPS system, even one of a different power rating.  
The UGS box is designed to be wall-mounted:

- Dimensions (W x D x H): 150 x 70 x 110 mm
- Weight: 2 kg

#### 12.7. PSJ - Parallel Systems Joiner

This allows two UPS units to be connected in parallel, with the system on (without interrupting output) by means of a power coupling switch in accordance with the system indicated in Chapter 4 (**Dynamic Dual Bus System**).  
The PSJ box is designed to be wall-mounted:

- Dimensions (W x D x H): 300 x 220 x 120 mm
- Weight: 2 kg

#### 12.8. Isolating transformers

Cabinets with a delta/star bypass isolation transformer are available. Such transformers can also be used to recreate the power supply neutral where this is not present.

*In the case of installations with external maintenance bypass, contact the commercial office.*

### 12.9. Voltage adaptation

On request, the UPS can have different input and output voltages according to requirements.  
For more information, please contact the sales office.

### 12.10. Kit for UPS without input and output neutral

The UPS requires input neutral to work correctly. In applications where the neutral is not available in input and is not required in output, a dummy neutral can be created using this kit.  
 This device is used **only for reference to the internal logic** and not for the supply of power.

### 12.11. Protection levels

The UPSs can be provided with levels of cabinet protection over IP20 in accordance with standard EN 60529.

### 12.12. Environmental sensors

The environmental sensors are devices to be connected to the communication card NetMan, in order to monitor the temperature and humidity of the environment and they have equipped with digital inputs and outputs opportunely settable.

The available sensors are:

- Temperature: detects ambient temperature
- Humidity & temperature: detects percent of relative humidity and ambient temperature in °C.
- Digital I/O & Temperature: detects the environment temperature in degrees °C and is equipped with a digital input and output.

### 12.13. Top cable entry

In order to facilitate cable entry from the top, a special cabinet is placed next to the UPS.



*Example of Installation with cable entry from the top*

There is the availability of two kinds of cabinets:

- Empty Cabinet: size (W x D x H): 400 x 1000 x 1900 mm
- Cabinet with terminals: size (W x D x H): 800 x 1000 x 1900 mm

### 12.14. Fan Failure monitoring

In addition to the standard internal temperature control, the Master HP series can also be fitted with a device for monitoring the operation of each individual fan. In the event of a fault, an alarm shows on the front panel of the system via relay contacts and software.

## 13. ENVIRONMENTAL REQUIREMENTS

<b>Ambient temperature for the UPS</b>	0 ÷ 40° C
<b>Maximum temperature for 8 hours a day</b>	40° C
<b>Average temperature for 24 hours</b>	35° C
<b>Recommended battery temperature</b>	20 ÷ 30° C
<b>Humidity</b>	<95% (without condensing)
<b>Maximum Operating Altitude</b>	Up to 1000 m o.s.l. (derating of 1% each 100 m between 1000 and 4000 m)
<b>Storage Temperature</b>	From -20°C up to 70°C (UPS) -20, +30 °C (for battery)

## 14. TECHNICAL DATA

<b>Mechanical Data</b>	<b>UPS Size (kVA)</b>			
	<b>300</b>	<b>400</b>	<b>500</b>	<b>600</b>
<b>Width (mm)</b>	1500		2100	
<b>Depth (mm)</b>		1000		
<b>Height (mm)</b>		1900		
<b>Weight (kg)</b>	1550	1720	2500	2700
<b>Cooling</b>	Forced by internal fans			
<b>Level of cabinet protection</b>	IP20			
<b>Input cables</b>	From the bottom			
<b>Colour</b>	RAL 7016			

Electrical Data	UPS Size (kVA)			
	300	400	500	600
<b>INPUT</b>				
<b>Rated Voltage</b>	400 Vac 3Phase Without Neutral			
<b>Rated Voltage tolerance (%) with battery recharge, depending on the load percentage</b>	+20%, -10% (100% load) +20%, -20% (85% load) +20%, -30% (75% load) +20%, -40% (65% load)			
<b>Rated Frequency (Hz)</b>	50/60 Hz			
<b>Input frequency tolerance</b>	From 45 to 65 Hz			
<b>Rated current absorbed (A) (at nominal voltage)</b>	423	564	702	842
<b>Rated power absorbed (kVA) at nominal voltage</b>	293	391	486	583
<b>Max current absorbed (A) at full load and battery in recharge</b>	476	635	794	953
<b>Input Power Factor at rated voltage with battery in recharge (from 25% to 100% load)</b>	>0.99			
<b>Current Harmonic distortion (THDi) with main THDv &lt; 1%:</b>				
• Load 100%	≤3%			
• Load 75%	≤3%			
• Load 50%	≤5%			
• Load 25%	≤8%			
<b>Progressive start of rectifier (Power Walk-in Duration)</b>	From 0 to 120 second (Configurable)			
<b>Delay of Progressive start of rectifier (Power Walk-in Start Delay)</b>	From 0 to 120 second (Configurable)			

Electrical Data	UPS Size (kVA)			
	300	400	500	600
D.C. INTERMEDIATE CIRCUIT				
Monoblocks/Number of Pb elements (see note 1)	240 (40 batteries)			
Rated battery voltage (Vdc)	480			
Ripple current with recharged battery (%)	Approx. 0			
Float voltage (Vdc) (2,26 V/el. , can be calibrated)	542			
Recharge Voltage (Vdc) (2,34 V/el. , can be calibrated)	562			
Maximum output voltage (Vcc)	600			
End of discharge voltage (Vcc) (1,6 V/el, can be calibrated)	384			
Voltage Compensation with reference to the battery cabinet temperature (V per °C)	-0.11%			
Maximum current to charge battery with 240 elements (A)-(mains voltage 400 V)				
• Load 100%	65	90	110	135
• Load 90%	120	160	200	240
• Load 80%	170	220	280	340
• Load ≤70%	200	260	330	390

Electrical Data	UPS Size (kVA)			
	300	400	500	600
INVERTER				
Rated Power Pf 0,9 inductive	300 kVA	400 kVA	500 kVA	600 kVA
Active Power with Pf 1 (kW)	270 kW	360 kW	450 kW	540 kW
Nominal Current (A)	433 A	577 A	722 A	866 A
Rated Voltage	400 V 3Phase + N (configurable from 360 V to 420 V)			
Rated Frequency	50 o 60 Hz (configurable on site)			
Output Rated voltage regulation	From 360 to 420 V			
Static variation	±1%			
Dynamic variation	±5%			
Recovery time within ±1%	20 ms in compliance to the standard EN 62040-3, class 1			
Crest current factor (Ipeak/Irms as per EN 62040-3)	3:1			
Voltage distortion with linear load	≤2%			
Voltage distortion with no linear load	≤3%			
Frequency stability with inverter synchronized to the by-pass mains	±2% (configurable from panel display from ±1% to ±6%)			
Frequency stability with inverter not synchronized to the by-pass mains	±0.05%			
Speed of frequency variation	1 Hz/sec (Note 2)			
Dissymmetry of the phases voltage with balanced or unbalanced load	≤1%			
Voltage phase shift with balanced and unbalanced load	120 ± 1°el			
Overload referred to the rated power				
<ul style="list-style-type: none"> <li>Three phase</li> <li>Single phase</li> </ul>	110% for 60 minutes, 125% for 10 minutes, 150% for 1 minute 200% for 6 seconds			
Short circuit current				
<ul style="list-style-type: none"> <li>Phase / Phase</li> <li>Phase / Neutral</li> </ul>	180% for 1 second 300% for 1 second			
Battery mode efficiency (%)	94%			

Electrical Data	UPS Size (kVA)					
	300	400	500	600		
<b>BYPASS</b>						
<b>Rated Voltage</b>	400 Vac 3Phase + N (configurable from 360 V to 420 V)					
<b>Rated voltage tolerance</b>	$\pm 20\%$ (configurable from $\pm 5\%$ $\pm 25\%$ from Control Panel)					
<b>Rated frequency</b>	50 or 60 Hz (auto sensing)					
<b>Rated frequency tolerance</b>	$\pm 2\%$ default (settable from $\pm 1\%$ up to $\pm 6\%$ from Control Panel)					
<b>Switching onto by-pass with Inverter synchronized (UPS in "Normal Mode")</b>	<1 ms					
<b>Switching onto by-pass with non-synchronized Inverter (UPS in "Normal Mode")</b>	~100 ms (see note 3)		~100 ms (see note 3)			
<b>Switching from by-pass to Inverter (UPS in "Stand-by On mode")</b>	4 ms					
<b>Delay in transferring to Inverter after the switching onto by-pass</b>	4 sec					
<b><math>I^2t</math> SCR bypass (25°C, 8-10 ms) [A<sup>2</sup>S]</b>	1805 k			1805 k		
<b>Overload capacity in the power of by-pass line (kVA)</b>	110% for 60 minutes, 125% for 10 minutes, 150% for 1 minute					
<b>Short circuit capacity on the by-pass line (x nominal current)</b>						
• 1 second	12	9	7	12		
• 500 ms	13	10	8	14		
• 200 ms	15	11	9	16		
• 100 ms	17	13	10	18		
• 10 ms	25	18	15	25		

Electrical Data	UPS Size (kVA)			
	300	400	500	600
<b>SYSTEM</b>				
<b>Efficiency AC/AC (On line)</b>				
• Load 100%	93		93.7	
• Load 75%	94		94.3	
• Load 50 %	94		94.3	
• Load 25 %	93		93	
<b>Efficiency system in STAND-BY mode</b>				
• Charge 100%		98%		
• Charge 50%		97.5%		
<b>Neutral size (I/I<sub>rated</sub>)</b>	1.45	1.09	1.38	1.15
<b>Dissipated power without load</b>				
• [kW]	3.7	4.5	6.2	7.0
• [kcal/h]	3181	3869	5331	6019
• [BTU/h] (see note 4)	12625	15355	21155	23885
<b>Dissipated power with 50% of load</b>				
• [kW]	8.6	11.5	14.4	16.3
• [kcal/h]	7395	9888	11694	14015
• [BTU/h] (see note 4)	29344	39240	46405	55618
<b>Dissipated power with 100% of load</b>				
• [kW]	20.3	27.1	30.3	36.3
• [kcal/h]	17455	23302	26053	31212
• [BTU/h] (see note 4)	69266	92469	103388	123861
<b>Maximum current dispersion</b>	300 mA max			
<b>Acoustic noise level at 1 m from the front (from 0 to full load ) [dbA]</b>	72 [dbA]			

**Notes:**

- (1) The number of Pb elements can vary from 222 to 258.
- (2) The parallel version can be calibrated from 0,1 to 1 Hz/s.
- (3) Configurable up to 200 ms (for MHT 300-400 kVA) or up to 100 ms (for MHT 500-600 kVA) or with inhibition of transfer onto bypass.
- (4) 3,97 BTU = 1 kcal.

Electrical Data	Bypass Size (kVA)		
	800 kVA	1200 kVA	2000 kVA
CENTRALIZED STATIC BYPASS (if applicable)			
Technology	Solid Static switch on by-pass path three pole cutting Contactor on inverter module path (MHT NBP 100-400 kVA) Static switch on inverter module path (MHT NBP 500-600 kVA)		
Power Range <sup>(1)</sup>	800 kVA	1200 kVA	2000 kVA
Rated Power/Current [kVA]/ [Amp]	800/1156 Amp	1200/1734 Amp	2000/2887 Amp
Dimensions (W x D x H)	1000 x 1000 x 1900 (SW included)	1400 x 1000 x 1900 (SW NOT included) W= 1800 x 1000 x 1900 (SW included)	2200 x 1000 x 1900 (SW NOT included)
Weight [kg]	570	800/1000 (With/without SW)	1200
Operating temperature	0-35°C ; 40°C (8 hours continuously)		
Cooling	Redundant Forced ventilation (fan failure monitoring as option)		
Cabling	From the bottom (top/side entry cabinet standard from 1200 kVA and higher power rating; optional for 800 kVA)		
Rated voltage: [V]	400 (380-415) 3 phase + N - 50/60 Hz		
Input voltage limits:	±15% (configurable ±10%, ±25% from the control panel)		
Frequency limits:	±2% (configurable ±1 ÷ ±6 % from the control panel)		
Cooling	Redundant Forced ventilation (fan failure monitoring as option)		
Transfer type <sup>(2)</sup>	<ul style="list-style-type: none"> <li>“Standard”</li> <li>“Asynchronous”</li> </ul> Inverter<->bypass with no break Calibrated cut off selectable for asynchronous transfer on bypass side up to 200 ms		
Back feed	Standard: inverter OFF; UPS locked on by-pass Optional: dry contact available to open external contactor for bypass line		
Acoustic noise [dBA]	<65		
Admissible overload (@30°C for 2 MVA)	9 for 1 sec, 10 for 500 msec 12 for 100 msec 15 for 20 msec 18 for 10 msec	3 for 1 sec 4 for 500 msec 12 for 100 msec 16 for 20 msec 20 for 10 msec	2 for 1 sec 2.5 for 500 msec 8 for 100 msec 10 for 20 msec 12 for 10 msec

**Notes:**

(1) For higher power range please contact the factory

(2) Configurable on UPS side up to 200 ms (for MHT 100-250 kVA 100÷200 ms; for MHT 300-600 kVA 20÷200 ms) or with transfer onto bypass inhibited.





[www.riello-ups.com](http://www.riello-ups.com)