

Short specification

Single UPS, three-phase, 160 to 1000 kVA

1. UPS definition

The purpose of this specification is to define the design, manufacture and testing characteristics required in view of supplying, putting into operation and maintaining an Uninterruptible Power Supply (referred to as a UPS hereinafter).

UPS type and composition	Simplified diagram
<p>The UPS shall operate in double-conversion mode, category VFI as per standard IEC 62040-2.</p> <p>Components</p> <ul style="list-style-type: none">♦ (1) rectifier♦ (2) inverter♦ (3) battery charger♦ (4) battery♦ (5) automatic bypass (via a static switch)♦ (6) manual bypass (for maintenance)♦ user and communications interface♦ battery management system♦ any and all other devices required for safe operation and maintenance, including circuit breakers, switches, etc.	

2. AC sources

2.1. Normal AC source (tolerances at rectifier input)

- ♦ Rated voltage: _____ volts, 3-phase input, a neutral is not required
- ♦ Input voltage range: 250 V (at 30% load) to 470 V
- ♦ Frequency: _____ Hz \pm 10%

2.2. Bypass AC source (tolerances at input of automatic-bypass line)

- ♦ Voltage: _____ / _____ volts, \pm 10%
- ♦ Number of phases: 3 ph + N + earth (a non-distributed neutral is possible)
- ♦ Frequency: _____ Hz \pm 8% (adjustable up to \pm 2 Hz)

Outside these tolerances, it shall be possible to supply the load, but in downgraded mode.

3. Electrical characteristics

3.1. Rectifier and charger

3.1.1. The PFC input rectifier using sinusoidal-current IGBTs shall have the following performance levels:

- ♦ total harmonic current distortion (THDI) upstream of the rectifier not exceeding 5%,
 - ♦ input power factor (PF) greater than 0.99 from 50% load upwards.
- 3.1.2. A walk-in device shall eliminate rectifier inrush currents, thus facilitating start-up of an upstream genset.
- 3.1.3. A device shall check the phase sequence (correct connection).

3.1.4. For long battery life, an electronic device shall automatically limit the charging current to the maximum value specified by the battery supplier.

3.1.5. The standard charger shall be sufficient to charge the battery rapidly. For a backup time of ...[5 / 10 / 15 / 20 / 30] ... minutes, battery recharging shall take less than ...[4 / 6 / 7 / 8 / 9 hours]... (values after discharge to Pn/2 and recovery of 90% of total battery charge for a recent battery).

3.1.7. The rectifier/charger voltage shall be regulated as a function of the **ambient temperature in the battery room**.

3.2. Battery

3.2.1. The UPS shall be equipped with a battery of the ...[sealed lead-acid type, mounted and wired in a cabinet identical in aspect to that of the UPS]...[sealed lead-acid type, mounted on shelves] ...[vented lead-acid type mounted on racks]... and shall have a service life of ...[10 / 12]... years.

3.2.2. The battery shall be sized to ensure a continuous supply to the inverter for at least ...[5 / 10 / 15 / 20 / 30...]... minutes, in the event the normal AC source fails, given that the inverter is at full rated load, i.e. _____ kVA for a power factor PF = 0.9.

3.3. Inverter

The inverter shall be sized to supply a rated load of ...[160 / 200 / 250 / 300 / 400 / 500/1000]... kVA at 0.9 PF and shall satisfy the specifications listed below.

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3.3.1. The output voltage shall be ...[380 / 400 / 415 / 440]... volts rms, three-phase + neutral + earth. The voltage shall be adjustable to $\pm 3\%$ to take into account voltage drops in the cables. Output voltage transients shall not exceed $\pm 1\%$ of the rated value for load step changes from 0 to 100% or 100 to 0%, with return to within steady-state tolerances within 100 ms.

For a load unbalance between phases, the variation in the output voltage shall be less than 1%.

3.3.2. Output frequency: 50 or 60 Hz ± 0.5 Hz.

3.3.3. To enable transfer to bypass power, the inverter output voltage shall be synchronised with the bypass source voltage whenever possible (see conditions in section 2.2).

3.3.4. The UPS shall be capable of supplying a 135% P_n load for one minute and a 150% P_n load for 30 seconds. The inverter shall be capable of current limiting to a peak capacity of 230% to 290% (depending on the rating) for 150 ms to allow highly disturbed transient operating states without transferring the load to the bypass.

3.3.6. It shall be possible to increase the power rating when the temperature is less than or equal to 20°C. The increase in the power rating shall be at least 7%. It shall be possible to use a UPS rated P_n (kVA) at 1.07 P_n.

3.3.7. The rated active power shall not be derated for loads at a power factor (PF) up to 0.9 leading.

3.4. Automatic bypass

3.4.1. The UPS shall be equipped with an automatic bypass comprising a static switch. Instantaneous transfer of the load from the inverter to bypass power and back shall take place without a break or disturbance in the supply of power to the load, on the condition that the bypass source voltage and frequency are within the tolerances specified in section 2.2 and that the inverter is synchronised.

3.4.2. The static switch shall be equipped with an RC filter for protection against switching overvoltages and lightning strikes.

3.4.3. For the specified power rating of ...[1000 / 500 / 400 / 300 / 250 / 200 / 160]... kVA, the static switch shall be capable of handling an overcurrent of ...[21 / 16 / 21 / 25 / 18 / 23]... times the rated current of the UPS to facilitate discrimination within the electrical installation.

3.5. Discrimination and short-circuit capacity

If the bypass power is within the tolerances specified in section 2.2, the presence of the static switch shall make it possible to use the short-circuit power of the bypass source to trip the downstream protection devices of the inverter.

To ensure tripping in a selective manner, the available power shall be sufficient to trip protection devices with high ratings (circuit breaker rated I_n/2 or UR fuses rated I_n/4, where I_n is the rated inverter current).

If the bypass source is outside the specified tolerances, the inverter on its own shall, for the same discrimination requirements, trip the circuit breakers rated I_n/2 or UR fuses rated I_n/4, irrespective of the type of short-circuit.

4. Mechanical characteristics

4.1. Mechanical structure

The UPS and batteries shall be installed in cabinet(s) with an [IP 20 / IP 32] degree of protection (standard IEC 60529). Access to the subassemblies making up the system shall be exclusively through the front.

4.2. Dimensions

The UPS shall require as little floor space as possible. To gain space, it shall be possible to install the UPS with the back to the wall or back to back with another UPS unit.

4.3. Connections

To facilitate connections, all terminal blocks shall be easily accessible from the front when the UPS is installed with the back to the wall.

4.4. Ventilation

System cooling shall be by forced-air ventilation. To facilitate layout of cabinets (particularly when installed back to the wall), air input shall be through the front and bottom, exit through the top.

All power electronics shall be equipped with a redundant ventilation system including individual fault detection for each fan.

4.5. Safety

For the safety of maintenance personnel, the cabinet shall be provided with a manually operated mechanical bypass designed to isolate the rectifier, charger, inverter and static switch while continuing to supply the load from the bypass AC source. The switches upstream of the normal and bypass AC lines and downstream of the UPS shall also be built into the system.

5. Environment conditions

5.1. UPS operation (not including battery)

The UPS, not including the battery, shall be capable of operating under the following environmental conditions without loss of performance:

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- ♦ temperature range during continuous operation: 0°C to 35°C
- ♦ maximum temperature: 40°C for eight hours
- ♦ maximum relative humidity: 95% at 25°C
- ♦ maximum altitude without derating: 1.000 m.
- ♦ noise level: <75 dBA for 160 , 200 , 250, 300, 400 , 500 , 1000 kVA

5.2. UPS storage (not including battery)

The UPS, not including the battery, shall be designed for storage under the following conditions:

- ♦ ambient temperature range: - 10°C to + 45°C.

6. Battery protection

6.1. Protection against deep discharge

The UPS shall comprise a device designed to protect the battery against deep discharges, taking into account the characteristics of the discharge cycles, with isolation of the battery by a circuit breaker.

6.2. Voltage/current regulation and monitoring

A regulation system shall regulate the battery voltage and the charge current. A second system, independent of the regulation, shall monitor the battery voltage and the charge current.

6.3. Ambient temperature

A temperature sensor adapts the charge voltage to the ambient temperature.

7. Battery management

7.1. Self-test

The battery shall be equipped with a self-test that can be run manually or automatically according to user-set time intervals.

7.2. Digital battery monitoring with calculation of backup time and remaining battery life

The UPS shall be equipped with a system for battery digital management. Based on a number of parameters (percent load, temperature, battery type and age), the system shall continuously calculate:

- ♦ the true available backup time
- ♦ the remaining service life.

8. User interface and communication

8.1. User interface

UPS operation shall be facilitated by a user interface comprising the elements presented below.

8.1.1. The B&W graphical screen shall enable display of installation parameters, configuration, operating status and alarms and indication of operator instructions for switching operations (e.g. bypass). It shall be capable of supervising a single UPS or a parallel system of up to eight UPS units with their SSC (static-switch cabinet). It shall be possible to display the following indications:

- ♦ measurements (power, voltage, current, frequency, power factor, battery temperature and more)
- ♦ operating indications (operating mode, alarms, faults)
- ♦ the last 2500 events with time-stamping data
- ♦ statistics on the number of overloads, number of transfers to battery power, cumulative time on battery power, maximum power levels, demand-power levels.

8.1.2. The following controls:

- ♦ two ON and OFF buttons located on the front panel of the UPS to turn the UPS-unit on or off
- ♦ EPO terminal block for complete system shutdown on reception of an external signal
- ♦ alarm reset button. If a new alarm is detected after clearing the first, the buzzer sounds again.

8.1.3. Status indications with mimic panel. Indication of status conditions shall be distinct of the graphic display. Three LEDs on the control panel and a mimic panel shall indicate the operating status and the energy flows.

8.2. Communication

8.2.1. It shall be possible to remote all controls, indications and measurements (standard function) via a communications card with programmable relays (four inputs and six outputs).

8.2.2. The UPS shall be designed to enable, on option, the extension of communications, without system shutdown, via the following cards:

- ♦ multi-standard communications card with two outputs:
 - RS485 serial-link implementing the JBus/ModBus protocol and Ethernet 10/100 Mbps with the XML protocol
- ♦ multi-standard communications card with three outputs:
 - the same two outputs plus a modem output for communication with a tele-maintenance system
- ♦ The UPS shall be detectable by supervision software for large UPS systems.
- ♦ Shutdown and administration software shall be available in addition to the communication cards.

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9. Maintainability

A manual bypass shall be available to completely isolate the UPS.

The UPS shall be equipped with a self-test system to check operation of the system as a whole each time it is started.

10. Standards, certification and tests

10.1. Standards and certification

All equipment shall be designed and built in accordance with accepted engineering practice and applicable international standards.

- ♦ IEC 60140-4: UPS - Performance.
- ♦ IEC 62040-1 and EN 62040-1: UPS - Safety.
- ♦ IEC 62040-2 and EN 62040-2: UPS - Electromagnetic compatibility (EMC), level B.
- ♦ IEC 62040-3 and EN 62040-3: UPS - Performance.
- ♦ IEC 60950 / EN 60950: Safety of IT equipment, including electrical business equipment.
- ♦ IEC 61000-2-2: EMC, levels of compatibility.
- ♦ IEC 61000-3-4: Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A.
- ♦ IEC 61000-4: EMC, immunity tests.
- ♦ IEC 439: Low-voltage switchgear and controlgear assemblies.
- ♦ IEC 60529: Degrees of protection provided by enclosures (IP Code).
- ♦ ISO 3746: Sound power levels.
- ♦ CE marking.
- ♦ ISO 9001 or 9002 certification of the industrial site.

What is more, the equipment shall comply with eco-design and eco-manufacturing criteria in view of sustainable development and to that end, the manufacturer shall be able to demonstrate:

- ♦ R&D and production on an ISO 14001 certified site
- ♦ manufacture with over 90% recyclable materials
- ♦ capacity to recover products at the end of their service life and provide proof of destruction by a certified organisation
- ♦ the environmental profile of the product, which shall be supplied with the sales offer.

10.2. Certification of conformity

The manufacturer shall provide, on request, a complete qualification file demonstrating compliance with the above standards. What is more, the indicated levels of performance shall be confirmed by certification from independent laboratories (e.g. TÜV or Veritas).

11. Services

11.1. Functional components - organisation of supplier services

- ♦ Sufficient geographical proximity of the supplier or an authorised agent shall ensure reasonable access times to the customer site in view of reducing the mean time to repair (MTTR). The supplier shall be in a position to offer a contract limiting the response time to four hours.
- ♦ The supplier's logistics system and the availability 24 hours a day of original replacement parts shall similarly contribute to reducing to the greatest extent possible the mean time to repair (MTTR).

11.2. System start-up

System start-up on site, carried out by the supplier or its certified representative, shall include checks on the characteristics of the upstream and downstream protection devices and on the UPS installation parameters.

11.3. Replacement parts

The supplier shall undertake to provide certified original replacement parts for at least ten years following the date of delivery.

11.4. Recycling and renovation/substitution

At the end of the UPS service life, the supplier shall guarantee the continuity of service of the customer's installations if necessary, including dismantling of equipment and replacement of equipment, in compliance with applicable standards on environmental protection.

12. Warranty

The rectifier/charger and inverter subassemblies shall be guaranteed (parts and labour on site) for one year following the start-up date. The sealed lead-acid battery shall be covered by the same warranty as the UPS.

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Appendix. Check list

Type of UPS

Total rated power (kVA) at PF 0.9	<input type="text"/>	kVA	<input type="text"/>	kW	
Manufacturer	<input type="text"/>				
Range of products	<input type="text"/>				
Operating mode (IEC 62040-2)	Double conversion	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Operation as frequency converter		yes	<input type="checkbox"/>	no	<input type="checkbox"/>

Rectifier

Input voltage range	250 V to 470 V	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
3-phase input	Without neutral	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Phase sequence	Check on phase sequence	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Sinusoidal input current	THDI upstream $\leq 5\%$ with PFC rectifier	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Input power factor	PF > 0.99 with IGBT rectifier (from 50% load upwards)	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
No inrush or start-up current		yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Rapid battery recharging	Typical 10-min. backup time recharged in six hours or less	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Voltage regulation	$\pm 1\%$	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Independent regulation/monitoring systems	for the charger	yes	<input type="checkbox"/>	no	<input type="checkbox"/>

Battery

Type	standard	Sealed lead acid in a cabinet	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
	other	<input type="text"/>	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Service life	<input type="text"/>	years	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Backup time	<input type="text"/>	minutes	yes	<input type="checkbox"/>	no	<input type="checkbox"/>

Battery management and protection

Recharge as a function of the temperature		yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Measurement of actual backup time, depending on load, temperature, age		yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Cold start on battery power		yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Protection against deep discharge	with circuit-breaker opening	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Charge-current limiting	0.05 C10 to 0.1 C10 (depending on battery)	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Self-tests		yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Measurement of real backup time		yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Block by block monitoring		yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Prediction on end of service life		yes	<input type="checkbox"/>	no	<input type="checkbox"/>

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Inverter

Three-phase output voltage	<input type="text"/> Volts	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Adjustable within limits	± 3%	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Steady-state conditions	± 1%	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Voltage transients	± 5% (load from 0 to 100% or 100 to 0%)	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Output voltage distortion at Pn	THDU < 3%	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Unbalanced conditions	Voltage variation < 1%	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Output frequency	<input type="text"/> Hz	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Variation in output frequency	± 0.5 Hz	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Adjustable from	- 0.25 Hz to + 2 Hz	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Frequency synchronisation with an external source	± 0.5% to ± 8% of rated frequency	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Overload capacity	125% In for 10 minutes	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
	150% In for 30 seconds	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Current limiting	230% to 290% In for 150 milliseconds (e.g. 290% for 160 kVA and 200% for 300 kVA)	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Crest factor	up to 3:1	yes	<input type="checkbox"/>	no	<input type="checkbox"/>

Bypass functions

Automatic bypass	With static switch	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Short-circuit withstand of static switch	16 to 25 In for 20 ms, depending on rating (e.g. 25 In at 250 kVA / 16 In at 1000 kVA)	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Built-in manual bypass	Mechanical (for maintenance)	yes	<input type="checkbox"/>	no	<input type="checkbox"/>

Efficiency

Normal mode	93% (160 kVA) to >94.5% from 75% load	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
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User interface

Graphical display	Selection of operating language from 19	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
personalisation menu	with password	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
display	measurements, status, events, graphs	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
event log	2500 time-stamped events	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
bargraphs	power levels, backup time	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
statistics	% time on battery power, number of transfers to battery power, average percent load, etc.	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Controls	ON, OFF, EPO terminal block	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Status indications with mimic panel	Audio alarm, LEDs	yes	<input type="checkbox"/>	no	<input type="checkbox"/>

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Communication

Programmable relay card		yes	<input type="checkbox"/>	no	<input type="checkbox"/>	
EPO terminal block		yes	<input type="checkbox"/>	no	<input type="checkbox"/>	
Options	Card with two outputs	JBus/ModBus RS485 + Ethernet 10/100	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
	Card with three outputs	Same as 2-output card + modem + NMTC	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
	Supervision software		yes	<input type="checkbox"/>	no	<input type="checkbox"/>
	Administration software	with shutdown management	yes	<input type="checkbox"/>	no	<input type="checkbox"/>

Certification

Certified standards and tests	See list in section 12.1	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Performance certification	TÜV	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Quality certification	ISO 9001 / 9002	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Eco-design and manufacturing	ISO 14001 site	yes	<input type="checkbox"/>	no	<input type="checkbox"/>

Services

Technical competency of supplier	level 4 NFX 060-010	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Diagnostics and monitoring	Remote	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Technical support	International	yes	<input type="checkbox"/>	no	<input type="checkbox"/>

Operation, Maintainability

Access to power components through front		yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Access to communication through front	hot-swap cards	yes	<input type="checkbox"/>	no	<input type="checkbox"/>

Availability

Availability of original replacement parts	Around the world	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Response time of Service teams		t < 4h	4<t<8	8<t<24	t>24 h
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintenance programmes	Preventive	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
	Predictive	yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Emergency services		yes	<input type="checkbox"/>	no	<input type="checkbox"/>
Renovation / substitution programmes		yes	<input type="checkbox"/>	no	<input type="checkbox"/>