DELPHYS XM

TECHNICAL SPECIFICATION

Uninterruptible Power System

RATED POWER: 300-800 kVA/kW – Three-phase

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# TERMS and ABBREVIATIONS

For the purpose of this document, we have used the following terms and standard abbreviations:

UPS Uninterruptible Power System

THDU [Total Harmonic Distortion Voltage](http://www.allacronyms.com/Total_Harmonic_Distortion_Voltage/abbreviated) (Phase/Phase)

THDI [Total Harmonic Distortion](http://www.allacronyms.com/Total_Harmonic_Distortion_Voltage/abbreviated) in Current

VFI Voltage and Frequency Independent (according IEC/EN 62040-3)

AC Alternate Current

DC Direct Current

VRLA Valve Regulated Lead Acid

AGM Absorbed Glass Mat

EMC Electro Magnetic Compatibility

IEC International Electrotechnical Commission

EC European Conformity

EN European Norms

# USER GUIDE

Paragraphs shown in red are referring to options. These parts can be deleted if these options are not relevant to the current project.

Text in grey is to be completed, edited or selected according to the needs of the project.

*Text in purple gives you recommendations or highlight some facts, please read them carefully!*

# PURPOSE OF THE SPECIFICATION DOCUMENT

This specification document describes a double conversion Uninterruptible Power System (hereafter referred to as UPS). This solution is specified to provide high quality power, improve the overall availability and energy efficiency of power systems dedicated to protect sensitive and critical loads.

The system will be composed of …N…. UPS Unit(s). Each UPS Unit shall be designed with internal power conversion modules of 100kW combined with a common static bypass rated for permanent operation at the power of the UPS unit. The power converters and static bypass will be associated with an appropriated mechanical and electrical segregation system, so that any abnormal event will be contained to the related brick and not propagated to the rest of the unit.

This UPS and installation shall allow a high grade of serviceability; such that all UPS maintenance can be carried out in a simple and fast way. The equipment must minimize the Mean Time to Repair (MTTR) thanks to withdrawable power conversion modules and static bypass subassemblies.

The UPS shall be designed to enable service engineers - that are qualified by the manufacturer or by authorised partners, following the procedures outlined in the manual - to extract power conversion modules in online mode without switching to static by-pass. This operation is conditioned by the correlation between remaining power conversion modules capacity and the load rate during the intervention.

The technical reference is SOCOMEC *Delphys XM* UPS or as a similar solution approved by us.

*In case of several UPS units connected in parallel, please make sure you clearly specify the number of Units included in each system.*

*In case of several parallel systems, please make sure you clearly specify the number of systems.*

# 

# DIRECTIVES AND STANDARDS CONFORMITY

The UPS covered by this specification must have the EU marking, in accordance with European directives and standards:

* Low voltage directive (LVD) : 2014/35/EU.
* Electromagnetic compatibility directive (EMC): 2014/30/EU.
* Restriction of the use of certain hazardous substances (RoHS): 2011/65/EU.
* WEEE - Electrical and electronic equipment waste (WEEE): 2012/19/EU.
* Safety UPS standard (LV): EN/IEC 62040-1.
* EMC Emissions UPS standard: EN/IEC 62040-2 class C3.
* EMC Immunity UPS standard: EN/IEC 62040-2 classes C2-C3.
* Test and performances UPS standard: EN/IEC 62040-3.

Relevant documentation and certificates must be made available on request.

Compliance related to the Safety standard shall be certified by independent laboratory.

# GENERAL DESCRIPTION

The UPS architecture shall eliminate all single point of failure associated to traditional UPS to ensure best protection level under real operating conditions. An inherent feature of the UPS is the requirement of provide intrinsic redundancy so that the UPS can remain operating in double conversion mode – until the load is equal or less than the power available through the remaining 100kW double conversion modules.

## UPS architecture

Each UPS will consist of the following parts:

* Input, output and DC energy storage connection area, although capable of accepting top cabling as standard or bottom connection through adding a side cabinet when required.
* A unique and fully rated Static by-pass, designed to sustain high downstream fault current.
* A combination of 100 kVA/kW power conversion modules which are sharing the load to reach the full UPS power.
* Switches in the default configuration to facilitate easy maintenance. The operator must be able to isolate the UPS inputs / output and close the wrap-around maintenance bypass at the unit level. This ensures the critical load remains supplied during all necessary maintenance activities that require switching off the UPS(not applicable to 800KVA top entry version).
* UPS control unit, monitoring and indication incorporating a 10” color touch screen HMI for local interface and communication slots ready for plug-in remote communication interfaces.

## General UPS characteristics

The general following requirements will be evaluated:

|  |  |
| --- | --- |
| Apparent rated power of the UPS unit(s) at 40°C | 300 / 400 / 500 / 600 / 800 kVA |
| Active rated power of the UPS unit(s) at 40°C | 300 / 400 / 500 / 600 / 800 kW |
| Rated output power factor design | PF=1 |
| AC/AC efficiency in double conversion mode (VFI mode) | Up to 97.1% |
| AC/AC efficiency in smart conversion mode (VFI mode) | Up to 99 % |
| UPS classification according EN/IEC 62040-3 (Edition 3.0 - 2021) | VFI - SS - 11 |
| Rated voltage | 380 / 400 / 415 V |
| Rated frequency | 50 / 60 Hz |
| Type of network (input/output) | Three-phase + N |
| Power feeders for rectifier and bypass | Common input / Separate inputs |
| Storage temperature range | -25°C to + 55°C |
| Operating temperature range, without derating | 0°C to + 40°C |
| Maximum relative humidity | ≤ 95 % at room temperature, without condensation |
| Input(s) and Output AC power connection | Top entry as default / Bottom with side cabinet |
| Protection Index according to EN/IEC 60529-2 | IP 20 |

# Power conversion architecture

Each UPS Unit shall be composed of several 100kW withdrawable power conversion modules, each of including the following sub-assemblies.

Each power conversion module unit will be protected by a group of electronic circuits, fuses and contactors to guarantee its disconnection (input and output) in case of internal failure, and composed of following subassemblies:

* Rectifier
* DC/DC converter (battery management)
* Inverter
* Input and output contactors together with fast acting fuses

The number of power conversion modules are multiple of 100kW required to reach the rated power of the UPS unit.

## Inverter

The UPS shall be designed to supply the latest generation of loads with unity output power factor (pf =1), without derating of ambient temperature. It must comply with the following key technical specifications:

|  |  |
| --- | --- |
| Rated power @ 40°C | 300 / 400 / 500 / 600 / 800 kVA |
| Rated Output voltage | 380 / 400 / 415 V, (3Ph+N+PE) |
| Maximum relative humidity | 95 % at room temperature, without condensation |
| Overload capacity (without the help of redundancy) in double conversion mode | ≤110% for 60min  ≤125% for 10min  ≤150% for 60sec |
| Load management without derating within the limits of the rated apparent and active power | Any load with a power factor from 0.7  inductive to 0.7 capacitive |
| Minimum average peak short circuit current limitation (when the auxiliary mains or the bypass line is not available) | At least 200% of UPS rated current (≥2 In) |
| Frequency stability  (in battery mode or while auxiliary mains is absent) | ± 0.1 Hz |
| Line synchronisation range (auxiliary mains present) | ± 0.5 Hz to ± 2 Hz (configurable) |
| Output voltage stability | ± 1 % Vn  in static mode between 0 to 100% load |
| Total output voltage distortion with a linear load at rated power | THDU ≤1% with linear load |
| Total output voltage distortion with a Non-linear load at rated power | THDU ≤3% with non-linear load |

## Rectifier

The rectifier will be protected by a current limitation and shall also operate with reverse input phase rotation.

The rectifier will comply with the following key technical specifications:

|  |  |
| --- | --- |
| Rated input voltage | 380 / 400 / 415 V, (3Ph+N+PE) |
| Voltage tolerance (without derating or use of battery support) | 323~485Vac for 100% Load |
| Frequency operating range | 40 - 70 Hz |
| Input power factor at full load  (without active or passive filters) | ≥ 0.99 |
| Input Harmonic distortion (THDi) at full load  (without active or passive filters) | ≤ 3 % |
| Rectifier power walk-in (current ramping) | Yes |

## 

## DC/DC converter

The system shall have a DC/DC converter that manages the battery according to the battery manufacturer’s recommendations. A sensor to measure the temperature of the battery room shall be provided and connected to the UPS.

To maximize the battery lifetime, its voltage shall be independent from DC bus which is generated by the rectifier and shall have the following performances:

|  |  |
| --- | --- |
| Battery connection | 2 Wires (+ / -) |
| Battery voltage range | Up to 720V |
| Battery charger max current available at 100% output load | 90A (300kVA) / 120A (400kVA)  150A (500kVA) / 180A (600kVA) / 240A (800kVA) |
| Charging current in normal mode | Adjusted according to battery manufacturer recommendation |
| Floating voltage (Lead acid batteries) | Possibility to adjust according to the temperature |
| Voltage dynamic without any output power derating compliance with VRLA batteries | 360 to 690Vdc  From 40 to 50 pcs of 12V blocks |

The following parameters shall be adjustable and configurable to suit with energy storage technology and supplier’s specifications:

* Maximum recharge current limit
* Floating voltage
* End-of-discharge voltage.

## Energy Storage

Energy accumulator will provide a backup time of … minutes at end of life at a load of … kW.

The UPS must be compatible with various battery types, including sealed lead-acid maintenance-free (VRLA) with AGM technology, VRLA gel technology with pure lead, unsealed lead-acid, and Lithium-ion batteries. These batteries should have a rated lifespan of 10-12 years according to EUROBAT standards, or over 12 years at 20°C as per EUROBAT guidelines.

Batteries will be supplied and installed in a separate metallic cabinet / on shelves with an acid container / on shelves without an acid container / open steel racks. The battery calculation sheet will be attached to the offer, specifying the rated output power (kW), the inverter efficiency and the voltage at the end of discharge.

## Static Bypass

The UPS shall be provided with an automatic static bypass ensuring the system switching between the power conversion part and the auxiliary source without any interruption of power. Each UPS Unit shall be designed with:

* A static bypass in the auxiliary source branch sized for a permanent operation at the rated power of the UPS unit – connected in parallel of each power conversion module. Architecture where the static switch for the bypass line is part of the power conversion modules will not be accepted.
* User initiated transfer from double conversion inverter operation to utility via the static bypass must be available through soft commands at the control HMI.
* The static bypass should be easily replaceable to reduce the Mean Time to Repair (MTTR). The entire bypass module must be designed to be easily withdrawable within minutes.
* No protections in series with the static bypass or, if present, fully coordinated with upstream and downstream plant protection in order not to compromise the coordination/selectivity design of the plant; the protection characteristics will need to be submitted for approval.
* Control logic ensuring a no break transfer to static bypass in case of overload, inverter failure or downstream short circuit.

The static bypass of each UPS Unit will comply with the following key technical specifications:

|  |  |  |
| --- | --- | --- |
| Switching with inverter synchronized to the auxiliary source | No interruption | |
| Static bypass overload capability:   * Continuous * 10 minutes | 110 %  125 % | |
| Short circuit capability (without damaging the static switch) | 300 – 400kVA | 1.361.000 A²s |
| 16.500 Apeak |
| 500kVA | 2.205.000 A²s |
| 21.000 Apeak |
| 600kVA | 3.075.000 A²s |
| 24.800 Apeak |
| 800kVA | 4.740.000 A²s |
| 30.600 Apeak |
| Short-circuit withstanding (Icw) | up to 35kArms | |

## Manual Maintenance Bypass

Inputs (rectifier - bypass) and output switches, along with a manual maintenance bypass, should be available at the UPS level (applicable only for 300-600kVA models). This design facilitates maintenance operations, ensuring uninterrupted supply to the critical load. The UPS Unit(s) shall be ready to monitor the position of an external manual maintenance bypass. This information shall be managed by the UPS system for safe operation and maintenance activities. Transfer from the static bypass switch to the manual maintenance bypass switch shall be without power interruption to the load.

# OPERATING CARACHTERISTICS

## UPS System resiliency

To ensure the highest level of reliability, the general following requirements will be evaluated:

* The solution must feature mechanical segregation between each power conversion modules and the static bypass which will be housed in their own frame within the UPS system. This design improves the level of UPS reliability by avoiding any fault propagation between subassemblies.
* The UPS is designed to provide intrinsic double conversion mode redundancy in case of a single power conversion module is no longer available, to grant a minimum of capability to supply the connected load. The UPS shall be capable of configuring N or N+1 modules, including in that case a redundant module to ensure 100% capacity even in degraded mode if one module fails.
* Any potential module fault should be isolated, keeping the critical load protected in double conversion mode through the remaining power conversion modules. This maximizes the Mean Time Between Failures (MTBF)
* For units in parallel, the failure of one power conversion module inside one UPS shall not impact the overall system capacity, reducing the total power available only by the loss of that single power conversion module. During this degraded operation mode, the UPS units in parallel shall be able to operate with a different number of power conversion modules per UPS without affecting the critical load.
* Electronic controls must be designed with internal redundancy to ensure no single point of failure at the UPS level.

## Fast Repair (MTTR)

The UPS shall be designed for risk-free maintenance activities by allowing fast and easy maintenance or repair of each part of the system, while all others continue to protect the critical load.

Compliance with the following requirements will be evaluated:

* Maintenance activities shall be done with a full front access in order to reduce the Mean Time To Repair (MTTR) by easing the access to the parts.
* If required, it shall be possible to do the hot swap of a single power conversion module without any cabling action, by on-site trained people in less than 5 minutes, with all other power conversion modules continuing to support the critical load in on-line mode.
* Each power conversion module, once inserted inside the system, shall carry out a self-test prior to connecting to the running system.

The above requirements shall allow to at least 2 people to ensure a short First Time Fix Rate, having the possibility to swap a power conversion module and to limit the time and operation on wrap-around bypass.

## Energy saver mode (double conversion)

The UPS shall have an energy saving mode to improve the online double conversion efficiency under low load rate condition. Non-required power conversion modules shall be able to automatically switch in hot stand-by while keeping batteries charged and the load protected by the remaining power modules.

The power modules operating in online mode and hot stand-by mode will automatically rotate operation to have a homogenous lifetime of the different power conversion modules.

In case of sudden load increase, all power conversion modules in hot stand-by will immediately come back into normal operation to provide the full double conversion capability without interruption for the critical load.

## Smart Conversion mode

The UPS unit(s) shall allow operating in a Smart Conversion mode to optimize efficiency without compromising the load protection. It will automatically select the most optimized working mode: double conversion or line interactive mode according to the input network conditions. Under line interactive operation, the UPS will work as power factor and harmonics compensator, supplying the load through the bypass line together with the inverter – able to ensure the batteries charge.

The algorithm monitors in real time the network parameters related to the inputs network conditions in order to have the best power protection at any times with the highest level of efficiency up to 99%.

In case of mains out of the tolerances UPS shall transfer to online double conversion respecting the class 1 curve according to IEC 62040-3 standards.

# CONSTRUCTION SPECIFICATION

The manufacturer shall provide the UPS width, depth and height in accordance to here-in specified features and functionalities, including optional cabinet dimensions when required.

* The standard UPS unit shall not exceed a width of 800 mm for common or separated inputs with top cable entry.

If required, the UPS shall be provided with a side cabinet allowing bottom entry cables connection which shall not exceed 400 mm width up to 600kW and 800mm for 800KW).

* The power and control cables must be accessible from the front.
* The cooling will be assured by forced ventilation:
  + the air inlet will be on the front panel
  + the outlet will be on the rear or on the top of the cabinet without any impact on the footprint.
* Maintenance operations will be carried out with front access only to ease and minimize the Mean Time To Repair.

With specific option the unit shall allow back to back or wall installation, without impacting general footprint, operating and servicing, no rear or side clearance needed.

|  |  |
| --- | --- |
| Width of the Standard unit | 800mm |
| Depth of the Standard unit | 1000mm |
| Height of the Standard unit | 2000mm |
| Ventilation | Forced  Front to rear in standard  Front to top kit shall be possible on demand – with no impact on the footprint |
| Colour | RAL 7016 |
| Input / Output / Battery Cabling | Top  Bottom entry connection shall be possible via side cabinet - if required |
| Access for cabling and maintenance | Only front access, without any need of rear or lateral access  for minimum footprint and operator safety |
| Integrated switch | 300-600 kVA and 800kVA bottom version shall integrate input and output switches to isolate the unit from the grid and the load |

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# LOCAL USER INTERFACE, CONTROLS AND ALARMS

The user interface on the UPS Unit must have a touchscreen colour graphic display of at least 10” and must provide the following controls/alerts:

* Display of the following parameters:
  + input and output voltages, currents and frequencies;
  + battery voltage;
  + battery charge / discharge current;
  + apparent and active power;
  + output load rate.
* Three-colour LED status bar giving instantaneous view of the UPS status
* With its dedicated input terminal blocks, the system will be able to manage the following external devices/signals:
  + External Emergency stop in order to activate following functions :
    - UPS stop and separation by opening the inverter downstream contactor
    - Static by-pass stop
    - Battery protection tripping (if equipped with a trigger device)
  + Genset status, with the option to disable the battery recharge
  + Battery protection (open/closed), taking into account the status on the display;
  + Battery temperature, to display on the screen and manage the battery charge;
  + External maintenance bypass breaker (open/closed), to secure manual and automatic operations ;
  + External output breaker status (open/closed), to secure manual and automatic operations ;
  + External bypass breaker status(open/closed), to secure manual and automatic operations ;
  + Report the upstream backfeed isolation device position;
  + Trigger the upstream backfeed isolation device if a fault is detected
* Cold start / Black start
* The system will provide an alarm synthesis of any faults that could appear on the UPS unit (general alarm).
* In/Out programmable card, with at least 3 inputs and 4 outputs (Volt Free Contact) by card; Card programming must allow affecting to each output a state or an alarm available inside the system.

# CONNECTIVITY & SMART COMMUNICATION FUNCTIONALITY

The UPS shall be compliant with the following minimum connectivity requirements to enable smart communication functions and digital services as follows:

## EDGE connectivity for UPS local monitoring and orderly shutdown

**Connection compliance:** the following items shall be available:

* An Ethernet network card with an Ethernet port to connect to the LAN/WAN over TCP/IP (supporting also SNMP and Modbus TCP/IP protocols).
* A Modbus RTU RS485 multi-point interface for monitoring the UPS for example by BMS (Building Management System) and SCADA systems.

To avoid any loss of communication in any operating mode of the UPS, both interfaces shall be permanently powered by a secure supply such as from a UPS.

**Smart communication functionality**: the following shall be available:

* Web server function to Monitor the UPS via a web browser into LAN/WAN.
* Notification via secured email alerts into SMTP/TLS
* NMS monitoring compatibility via Simple Network Management Protocol (SNMP V1-V3) to monitor the UPS remotely through a standard MIB file
* Modbus RTU or Modbus TCP/IP communication protocol to monitor the UPS for alarms, status and metering data for integration into the SCADA system. (The Modbus registers communication table shall be made available and shall be provided for the SCADA system integration)
* Unattended Automatic Shutdown shall be provided to manage the graceful shutdown process for standalone workstations/servers, virtual machines and related hosts, via a Shutdown Agent software.

## Permanent Cloud IOT connectivity

An IoT Network Management card shall be provided as the gateway for Cloud provisioning via LAN/WAN ­– compliant with the OWASP security recommendation / ISO27002:2013 standard. This shall enable the Internet connection for UPS data collection to the secure-proof manufacturer Cloud platform to provide the services listed below.

*in the applicable countries and regions*

**Smart communication functionality - End-user smartphone UPS monitoring app**

The UPS manufacturer shall provide a smartphone app, downloadable from the major App Stores (such as Apple Store and Google Play).

As a minimum, the app shall display:

* The UPS model & serial number, to clearly identify the machine
* An overview of all UPSs installed,
* Real time UPS main information, including :
  + UPS status
  + Global UPS load rate
  + Battery capacity and autonomy
  + UPS internal temperature
* Push notifications in case of alarms and anomaly occurrence.

**24x7 proactive remote service monitoring**

The UPS manufacturer shall be able to provide a UPS remote monitoring and diagnostics service 24/7/365 that includes a permanent and direct connection to the manufacturer’s expert technical service team.

When the operating parameters of the UPS fall outside the allowed range the system shall be able to automatically identify the anomaly and notify the local Service Center. The supervising service engineer of the manufacturer shall then carry out an immediate check of the alarms by accessing the UPS parameters and proactively inform the end-user.

**Health Check reporting**

The UPS manufacturer shall be able to provide the end-user with the following:

* Regular “health check reports” including technical notes, statistics on data and power quality trending of the UPS and recommendations from the manufacturers expert.
* UPS historical data access via an interactive WEB dashboard to consult graphs and performance trends including the possibility to download the data.

## On demand over Mobile Network connectivity

**Connectivity compliance**

A Bluetooth ® Low Energy (BLE) interface shall be available to allow on demand over mobile network service to enable a temporary and real time access for remote service purposes.

**SMART communication functions**

The manufacturer's expert service engineer shall be able to remotely connect direct-to- UPS at the customer's site for real-time diagnosis, an in-depth troubleshooting and perform a full root cause analysis. *in the applicable countries and regions.*

The connection shall be temporary and encrypted to guarantee safety operations (cybersecurity proof ).

The established connection with the Service Center shall be further secured by using an OTP code (One Time Password) between the remote service engineer and the end-user.

In order to ensure maximum data protection during communication, all remote operations shall be based on a telecom mobile connection that is completely independent of the customer’s local area network LAN/WAN.

# EXECUTION

## Factory testing and inspection

The supplier of the equipment must be able to offer factory acceptance tests which may be witnessed by the customer.

All tests will be carried out with appropriate measuring instruments, their accuracy demonstrated by a certificate of calibration.

Following the positive outcome of the test procedure, the manufacturer shall prepare a certificate listing the tests performed and the results obtained.

## Commissioning

After installing the equipment (the complete system and the power modules required at the beginning) and its power supply, commissioning will be carried out by technicians trained and certified by the UPS manufacturer.

The following steps must be performed on the supplied equipment:

* Visual inspection of the equipment,
* Check electrical and mechanical connections,
* Functional and operational tests,
* Install and verify the transfer of data to the supervision station
* Basic training for system users: \* General description of how to use the system

\* Instructions on use and maintenance

At the end of the commissioning procedure, the technician will create a full report on the undertaken work.

## FIELD MAINTENANCE AND REMOTE SERVICES

The UPS manufacturer shall ensure a local or remote service organisation available 24 hours a day, 7 days a week, 365 days a year, in order to perform the maintenance services necessary to preserve the UPS in the best operating conditions during its lifecycle.

All maintenance operations (onsite or remote) shall be performed by service engineers that are qualified by the manufacturer or by authorised partners that have been trained and certified by the UPS manufacturer.

The UPS manufacturer shall ensure the proper asset management maintenance program of the installed UPS equipment, by means of a service contract agreed between the manufacturer and the end-user including a defined SLA (Service Level Agreement).

The service program shall list details of what is included such as the following:

* **preventive maintenance program,** that will ensure the maximum availability of the UPS
* **on field and digital remote services**, to:
  + meet the UPS life expectation as declared
  + minimize the MTTR in case of anomalies
* **List of Replacement Parts** to be readily available for shipment within four (4) working hours from the order confirmation
* **24x7 proactive remote monitoring service**:

The UPS manufacturer shall be able to provide a UPS remote monitoring and diagnostics service 24/7/365 by means of a permanent and direct connection to the manufacturer’s expert remote service engineering team, in the applicable countries and regions.

The system shall be able to automatically identify an anomaly and notify the remote Service Center whenever the UPS’s operating parameters fall outside the predetermined range. In this case the supervising service engineer shall immediately carry out an alarm verification by accessing the UPS parameters and proactively informing and advising the end-user.

The remote diagnostics system shall as a minimum offer the following features:

* Continuous monitoring of the performance of the UPS,
* Ensure communication between the UPS, the authorized Service Centre and the authorized service engineers,
* Automatic call out of service engineers in the event of an abnormal operation of the UPS (24/7/365),

The system shall provide the end-user with the following:

* Regular health check report by Email including technical notes from the expert service engineer, statistical data on power quality and trending of the UPS,
* Access to a WEB interactive dashboard to consult the UPS time-stamped historical data, interactive graphs and key parameters with the possibility to download all available data.
* **Remote real-time diagnostics**:

The manufacturer shall have the possibility to connect the remote service engineer to the UPS at customer site to perform real-time diagnostics, a full root cause analysis and with the possibility to troubleshoot and clear a fault remotely.

To ensure a maximum of data protection during communication, all remote operations shall be based on a connection that is completely independent from the customer local area network LAN/WAN.