

Schneider Electric
Symmetra PX
Uninterruptible Power Supply
Guide Specifications
96/160 kW
Uninterruptible Power System

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SECTION [26 33 63] [16611]

SOLID STATE UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification describes the operation and functionality of a continuous duty, three-phase, solid-state, static Uninterruptible Power System (UPS) hereafter referred to as the UPS. The UPS shall utilize a rack-mounted redundant, scalable array architecture. The system power train shall be comprised of swappable/trained-user replaceable 16 kVA/16 kW power modules, which shall operate in parallel. Each 16 kVA/16 kW power module contains a full rated input rectifier/boost converter (hereafter referred to as Input Converter), full rated output inverter, and battery charging circuit. The system shall also comprise of a user-replaceable continuous duty swappable bypass static switch module, swappable/trained-user replaceable battery modules, redundant control modules, redundant logic power supplies, and LCD interface display. All of the above system components are housed in a standard, 600 mm wide, 1070 mm deep, and 2000 mm high equipment rack.
- B. In addition, this specification describes the performance, functionality, and design of the Maintenance Bypass, Power Distribution and extended Runtime cabinet, hereafter referred to as the PDU-XR, the Battery System, and connectivity solutions.
- C. The UPS and associated equipment shall operate in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for mission critical, electronic equipment load.
- D. All programming and miscellaneous components for a fully operational system as described in this specification shall be available as part of the UPS.

1.2 SUBMITTALS

- A. **Proposal Submittals:**
 - 1. As bid system bill of materials.
 - 2. Product catalog sheets or equipment brochures.
 - 3. Product guide specifications.
 - 4. System single-line operation diagram.
 - 5. Installation information, including weights and dimensions.
 - 6. Information about terminal locations for power and control connections.
 - 7. Drawings for requested optional accessories.

B. **Delivery Submittals:**

1. Installation manual, which includes instructions for storage, handling, examination, preparation, installation, and start-up of UPS.
2. User manual, which includes operating instructions.

PART 2 – PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. The UPS shall be sized for _____ kVA and _____ kW load.
- B. The UPS battery shall be sized for _____ at a Power Factor of _____ for _____ minutes.

2.2 SYSTEM CHARACTERISTICS

- A. **System Capacity:** The system shall be rated for full kW output in the following frame sizes:
1. 160 kVA/kW - Can be configured with up to (10), 16 kW power modules for N+0
- B. **Input:**
1. **AC Input Nominal Voltage:** 380 V, 400 V or 415 V with 3 Phase 4 wire, with ground 50/60 Hz
 2. **AC Input Voltage Window:** 200 V - 477 V
(If 100% load: 340 V-477 V providing charging to the battery system, depending on load - - system can be recharged from as low as 200 V)
 3. **Short Circuit Withstand Rating:** 30,000 Symmetrical Amperes with gG fuse in front of system
 4. **Maximum Frequency Range:** 40-70 Hz
 5. **Input Power Factor:** > .99 at greater than 25% load
 6. **Input Current Distortion with no additional filters:** < 5% at 100% load
 7. **Soft-Start:** Shall be linear from 0-100% input current and shall not exhibit inrush. This shall take place over a 15 second time period
- C. **UPS Output:**
1. **AC Output Nominal Output:** 380V/400V/415V, 3 Phase 4 wire with ground, 50/60 Hz.
 2. **AC Output Voltage Regulation:**
 - a. +/- 1% For 100 % linear load
 - b. +/- 3% for 100% non-linear load
 3. **Voltage Transient Response:** +/- .5% maximum for 100% load step
 4. Voltage Transient Recovery within <50 milliseconds
 5. **Output Voltage Harmonic Distortion according to IEC/EN62040-3:**
 - a.<2% THD maximum for a 100% linear load
 - b.<6% THD maximum for a 100% non-linear load
 6. **Overload Rating:**
 - a. **Normal Operation:**
 - 1) 150% for 60 seconds in normal operation
 - 2) 125% for 10 minutes in normal operation
 - 3) 150% for 60 seconds in battery operation
 - b. **Bypass Operation:**
 - 1) 110% continuous (with PDU-XR)
 - 2) 1000% for 100 milliseconds
 7. **System AC-AC Efficiency:** >95% at 35 - 100% load
 8. **Output Power Factor Rating:** For loads exhibiting a power factor of .5 leading to .5 lagging no derating of the UPS shall be required.

2.3 OPERATING PRINCIPLES

- A. **Normal operation:** The input converter and output inverter shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

- B. **Battery:** Upon failure of the AC input source, the critical load shall continue being supplied by the output inverter, which shall derive its power from the battery system. There shall be no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.
- C. **Recharge:** Upon restoration of the AC input source, the input converter and output inverter shall simultaneously recharge the battery and provide regulated power to the critical load.
- D. **Static Bypass:** The static bypass shall be used to provide transfer of critical load from the Inverter output to the bypass source. This transfer, along with its retransfer, shall take place with no power interruption to the critical load. In the event of an emergency, this transfer shall be an automatic function.
- E. **Maintenance Bypass:** The system shall be equipped with an external make-before-break Maintenance Bypass Cabinet (MBC) to electrically isolate the UPS during routine maintenance and service of the UPS. The MBC shall completely isolate both the UPS input and output connections.

2.4 ELECTRICAL CHARACTERISTICS

- A. **Input power converter:**
 1. The input power converters of the system are housed within the parallel connected, removable power modules, and shall constantly control the power imported from the mains input of the system, to provide the necessary UPS power for precise regulation of the DC bus voltage, battery charging, and Main Inverter regulated output power.
 2. **Input Current Total Harmonic Distortion:** The input current THD shall be held to 5% or less at full system, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting loads of both a linear or non-linear type. This shall be accomplished with no additional filters, magnetic devices, or other components
 3. **Soft-Start Operation:** As a standard feature, the UPS shall contain soft-start functionality, capable of limiting the input current from 0-100% of the nominal input over a default 15 second period, when returning to the AC utility source from battery operation. The change in current over the change in time shall take place in a linear manner throughout the entire operation. ($di/dt = \text{constant}$).
 4. **Magnetization Inrush Current:** The UPS shall exhibit 0 inrush current as a standard product. If provided with an optional isolation transformer, inrush shall be limited to 6 times the nominal input current of the transformer.
 5. **Input Current Limit:**
 - a. The input converter shall control and limit the input current draw from utility to 150% of the UPS output. During conditions where input current limit is active, the UPS shall be able to support 100% load, charge batteries, and provide voltage regulation.
 - b. In cases where the source voltage to the UPS is nominal and the applied UPS load is equal to or less than 100% of UPS capacity, input current shall not exceed 125% of UPS output current, while importing necessary power for system losses.
 6. **Charging:**
 - a. The battery charging shall keep the DC bus float voltage of +/- 218v, +/-1%.
 - b. The battery charging circuit shall contain a temperature compensation circuit, which will regulate the battery charging to optimize battery life.
 - c. The battery charging circuit shall remain active when in requested Static Bypass and in Normal Operation.
 7. **Back-feed Protection:** The above-mentioned logic controlled contactor also provides the back-feed protection.
- B. **Output inverter:**
 1. The UPS output inverter shall constantly recreate the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT driven bi-directional power converters. In both normal operation and battery operation, the output inverters shall create an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output inverters.
 2. **Overload Capability:** The output power converters shall be capable of 1000% for short-circuit clearing. Steady-state overload conditions, of up to 150% of system capacity, shall be sustained by the inverter for 60 seconds in normal and battery operation. Should overloads persist past the outlined time limitation, the critical load will be switched to the auto-

- matic static bypass output of the UPS.
- 3. **Output Contactor:** The output inverter shall be provided with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter shall be removed from the critical bus.
- 4. **Battery Protection:** The inverter shall be provided with monitoring and control circuits to limit the level of discharge on the battery system.
- 5. **Redundancy:** The UPS shall be configured with redundant output inverters, each with semiconductor fusing, and logic controlled contactors to remove a failed component from the critical bus.

C. **Static Bypass:**

- 1. As part of the UPS, a system static bypass switch shall be provided. The system static bypass shall provide no break transfer of the critical load from the Inverter output to the static bypass input source during times where maintenance is required, or the inverter cannot support the critical bus. Such times may be due to prolonged or severe overloads, or UPS failure. The UPS and static bypass switch shall constantly monitor the auxiliary contacts of their respective circuit breakers, as well as the bypass source voltage, and inhibit potentially unsuccessful transfers to static bypass from taking place. a. Rated voltage: ...[380/400/415]... volts rms, adjustable via the user interface (see section 10), within tolerances of +/- 3% in order to take into account voltage drops in the cables.
- 2. As design of the static switch power path shall consist of Silicon Controlled Rectifiers (SCR) with a continuous duty rating of 125% of the UPS output rating.
- 3. **Automatic Transfers:** An automatic transfer of load to static bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from static bypass back to normal operation shall take place when the overload condition is removed from the critical bus output of the system. Automatic transfers of load to static bypass shall also take place if for any reason the UPS cannot support the critical bus.
- 4. **Manual Transfers:** Manually initiated transfers to and from static bypass shall be initiated through the UPS display interface.
- 5. **Overloads:** The static bypass shall be rated and capable of handling overloads equal to or less than 125% of the rated system output continuously. For instantaneous overloads caused by inrush current from magnetic devices, or short circuit conditions, the static bypass shall be capable of sustaining overloads of 1000% of system capacity for periods of up to 100 milliseconds.
- 6. **Modular:** The static bypass switch shall be of a modular design.
- 7. **System Protection:** As a requirement, back-feed protection in the static bypass circuit shall also be incorporated in the system design. To achieve back-feed protection, a mechanical contactor in series with the bypass SCR(s) shall be controlled by the UPS/static switch, to open immediately upon sensing a condition where back-feeding of the static switch by any source connected to the critical output bus of the system is occurring. One such condition could be a result of a shorted SCR.

2.5 **ENVIRONMENT CONDITIONS**

- A. **Storage Ambient Temperature:** -15 °C to +40 °C.
- B. **Operating Ambient Temperature:** 0 °C to +40 °C (+25 °C is ideal for most battery types).
- C. **Relative humidity:** 0 to 95% non-condensing.
- D. **Altitude:** Maximum installation with no derating of the UPS output shall be 1000 meters above sea level:
 - 1. 1000 m: 100% load
 - 2. 1500 m: 95% load
 - 2. 2000 m: 91% load
 - 3. 2500 m: 86% load
 - 4. 3000 m: 82% load

2.6 **BATTERY**

- A. The UPS battery shall be of modular construction made up of trained-user replaceable, swappable, fused, battery modules. Each battery module shall be monitored for voltage and

temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.

- B. The battery jars housed within each removable battery module shall be of the Valve Regulated Lead Acid (VRLA) type.
- C. The UPS shall incorporate a battery management system to continuously monitor the health of each removable battery module. This system shall notify the user in the event that a failed or weak battery module is found.
- D. The batteries shall have design life of 5 to 8 years and a battery service life of 3 to 5 years. The battery casing shall be flame retardant type.

2.7 DISPLAY AND CONTROLS

- A. **Control Logic:** The UPS shall be controlled by two fully redundant, user-replaceable/swappable control modules. These modules shall have separate, optically isolated, communication paths to the power and static switch modules. Logic power for the control modules shall be derived from redundant power supplies, each having a separate AC and DC input and output. The communication of the control modules shall be of Controller Area Network (CAN Bus).
- B. **Display Unit:** A microprocessor controlled display unit shall be located on a hinged door in the front of the system. The display shall consist of an alphanumeric display with backlight, four LEDs for quick status overview, and a keypad consisting of pushbutton switches.
- C. **Metered Data:** The following metered data, shall be available on the alphanumeric display:
 - 1. Year, Month, Day, Hour, Minute, Second of occurring events
 - 2. Source Input Voltage
 - 3. Output AC voltage
 - 4. Output AC current
 - 5. Input Frequency
 - 6. Battery voltage
- D. **Event log:** The display unit shall allow the user to display a time and date stamped log of the most recent status and alarm events.
- E. **Alarms:** The display unit shall allow the user to display a log of all active alarms. The following minimum set of alarm conditions shall be available:
 - 1. Input Frequency outside configured range
 - 2. AC adequate for UPS but not for Bypass
 - 3. Low/No AC input, startup on battery
 - 4. Intelligence Module inserted
 - 5. Intelligence Module removed
 - 6. Redundant Intelligence Module inserted
 - 7. Redundant Intelligence Module removed
 - 8. Number of Batteries changed since last ON
 - 9. Number of Power Modules changed since last ON
 - 10. Number of Batteries increased
 - 11. Number of Batteries decreased
 - 12. Number of Power Modules increased
 - 13. Number of Power Modules decreased
 - 14. Number of External Battery Cabinets increased
 - 15. Number of External Battery Cabinets decreased
 - 16. Redundancy Restored
 - 17. Need Battery Replacement
 - 18. The Redundant Intelligence Module is in control
 - 19. On Battery
 - 20. Shutdown or unable to transfer to battery due to overload
 - 21. Load Shutdown from Bypass. Input Frequency Volts outside limits
 - 22. Fault, Internal Temp exceeded system normal limits
 - 23. Input Circuit Breaker Open
 - 24. System level fan failed
 - 25. Bad Battery Module

26. Bad Power Module
27. Intelligence Module is installed and failed
28. Redundant Intelligence Module is installed and failed
29. Redundancy has been lost
30. Redundancy is below alarm threshold
31. Runtime is below alarm threshold
32. Load is above alarm threshold
33. Load is no longer above alarm Threshold
34. Minimum Runtime restored
35. Bypass is not in range (either frequency or voltage)
36. Backfeed contactor stuck in OFF position
37. Backfeed contactor stuck in ON position
38. UPS in Bypass due to Internal Fault
39. UPS in Bypass due to overload
40. System in Forced Bypass
41. Fault, Bypass Relay Malfunction
42. High DC Warning
43. High DC Shutdown
44. Low Battery Shutdown
45. Low Battery Warning

F. **Controls:** The following controls or programming functions shall be accomplished by use of the display unit. Pushbutton membrane switches shall facilitate these operations.

1. Silence audible Alarm.
2. Display or set the date and time.
3. Enable or disable the automatic restart feature.
4. Transfer critical load to and from static bypass.
5. Test battery condition on demand.
6. Set intervals for automatic battery tests.
7. Adjust set points for different alarms.
8. Program the parameters for remote shutdown.

G. **Potential Free (Dry) Contacts:** The following potential free contacts shall be available on an optional relay interface board:

1. Normal Operation.
2. Battery Operation.
3. Bypass Operation.
4. Common Fault.
5. Low Battery.
6. UPS Off.

H. **Communication Interface Board:** A communication interface board shall provide the following communication ports which can be used simultaneously:

1. RS232 Serial Port #1.

2.8 SOFTWARE AND CONNECTIVITY

A. **Network Adaptor:** The Ethernet Web/SNMP Adaptor shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments. The management information base (MIB) shall be provided in DOS and UNIX "tar" formats.

B. **Unattended Shutdown:**

1. The UPS, in conjunction with the network adaptor, shall be capable of gracefully shutting down one or more operating systems.
2. The UPS shall also be capable of using an RS232 port to communicate by means of serial communications to gracefully shut down one or more operating systems during an on battery situation.

2.9 ACCESSORIES

A. **Battery Disconnect Breaker:** Each UPS system shall have a 320 A 500 V DC rated, thermal magnetic trip molded case circuit breaker. Each circuit breaker shall be equipped shunt trip

mechanisms and 1A/1B auxiliary contacts. The circuit breakers are to be located within the UPS enclosure or as part of a line-up-and-match type battery cabinet.

- B. **PDU-XR:** The maintenance bypass cabinet shall provide power to the critical load bus from the bypass source, during times where maintenance or service of the UPS is required. 315A GL fuse must be in front of the mains input and if dual mains a 250 A gL fuse on the bypass input must be installed.
- C. **Wall-mount Maintenance Bypass Panel:** The wall-mount maintenance bypass panel provides maintenance bypass without modular power distribution or batteries.

PART 3 – EXECUTION

3.1 REMOTE UPS MONITORING

The following three methods of remote UPS monitoring shall be available:

- A. **Web Monitoring:** Remote monitoring shall be available via a web browser such as Internet Explorer.
- B. **RS232 Monitoring:** Remote UPS monitoring shall be possible via either RS232 or contact closure signals from the UPS.
- C. **Simple Network Management Protocol (SNMP):** Remote UPS Monitoring shall be possible through a standard MIB II compliant platform.

3.2 Software Compatibility:

The UPS manufacturer shall have available software to support graceful shutdown and remote monitoring with PowerChute Network Shutdown (PCNS) for the following operating system families:

1. Microsoft Windows
2. MAC OS X
3. Hyper-V
4. VMware
5. Linux
6. Unix

The full and updated supported OS compatibility chart can be found here: <http://www.apc.com/whitepaper/?um=200>

3.3 STANDARD AND TESTS

- A. **Standards:** All equipment shall be designed and built in accordance with accepted engineering practice and applicable international standards, in particular the standards listed below.
 1. 89/336/EEC
 2. 73/23EEC
 3. EN/IEC62040-1-1, EN/IEC/UL60950-1
 4. EN50091-2/IEC62040-2 (class A), FCC15A
 5. IEC EN/IEC62040-3
 6. VFI-SS-111
 7. IEC62040-2/EN/IEC 61000-4-2 level 3, performance criteria A
 8. IEC62040-2/EN/IEC 61000-4-4 level 2, performance criteria A
 9. IEC62040-2/EN/IEC 61000-4-3 level 2, performance criteria A
 10. IEC62040-2/EN/IEC 61000-4-5 Level 3, performance criteria A

3.4 FACTORY ASSISTED START-UP

If a factory assisted UPS start-up is requested, factory trained service personnel shall perform the following inspections, test procedures, and on-site training:

- A. **Visual Inspection:**
 1. Inspect equipment for signs of damage.
 2. Verify installation per manufacturer s instructions.

3. Inspect cabinets for foreign objects.
4. Inspect Battery Units.
5. Inspect Power Modules.

B. Mechanical Inspection:

1. Check all UPS and external maintenance bypass cabinet internal control wiring connections.
2. Check all UPS and external maintenance bypass cabinet internal power wiring connections.
3. Check all UPS and external maintenance bypass cabinet terminal screws, nuts, and/or spade lugs for tightness.

C. Electrical Inspection:

1. Verify correct input and bypass voltage.
2. Verify correct phase rotation of all mains connections.
3. Verify correct UPS control wiring and terminations.
4. Verify voltage of all battery modules.
5. Verify neutral and ground conductors are properly landed.
6. Inspect external maintenance bypass switch for proper terminations and phasing.

D. Site Testing:

1. Ensure proper system start-up.
2. Verify proper firmware control functions.
3. Verify proper firmware bypass operation.
4. Verify proper maintenance bypass switch operation.
5. Verify system set points.
6. Verify proper inverter operation and regulation circuits.
7. Simulate utility power failure.
8. Verify proper charger operation.
9. Document, sign, and date all test results.

- E. On-Site Operational Training:** During the factory assisted start-up, operational training for site personnel shall include key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

3.5 MANUFACTURER FIELD SERVICE

- A. Worldwide service:** The UPS manufacturer shall have a worldwide service organization Available, consisting of factory trained field service personnel to perform start-up, preventative maintenance, and service of the UPS system and power equipment. The service organization shall offer 24 hours a day, 7 days a week, 365 days a year service support.
- B. Replacement parts:** Parts shall be available through the worldwide service organization 24 hours a day, 7 days a week, and 365 days a year. The worldwide service organization shall be capable of shipping parts within 4 working hours or on the next available flight, so that the parts may be delivered to the customer site within 24 hours.
- B. Maintenance contracts:** A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available. All contract work shall be performed by Schneider Electric factory trained service personnel.

3.6 TRAINING

- A. UPS service training workshop:** A UPS service training workshop shall be available from the UPS manufacturer. The service training workshop shall include a combination of lecture and practical instruction with hands-on laboratory sessions. The service training workshop shall include instruction about safety procedures, UPS operational theory, sub-assembly identification and operation, system controls and adjustment, preventative maintenance, and troubleshooting.

END OF SECTION