

APC by Schneider Electric

Smart-UPS RT

Uninterruptible Power Supply

Guide Specifications

**1 kVA, 2 kVA, 2.2 kVA, 3 kVA, 5 kVA, 6 kVA, 8 kVA, 10 kVA, 15 kVA, and 20 kVA,
230 V Solution**

THIS GUIDE SPECIFICATION IS WRITTEN IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATIONS INSTITUTE (CSI) MASTERFORMAT. THIS SECTION MUST BE CAREFULLY REVIEWED AND EDITED BY THE ARCHITECT OR THE ENGINEER TO MEET THE REQUIREMENTS OF THE PROJECT. COORDINATE THIS SECTION WITH OTHER SPECIFICATION SECTIONS IN THE PROJECT MANUAL AND WITH THE DRAWINGS. WHERE REFERENCE IS MADE THROUGHOUT THIS SECTION TO "PROVIDE", "INSTALL", "SUBMIT", ETC., IT SHALL MEAN THAT THE CONTRACTOR, SUBCONTRACTOR, OR CONTRACTOR OF LOWER TIER SHALL "PROVIDE", "INSTALL", "SUBMIT", ETC., UNLESS OTHERWISE INDICATED.

SOLID STATE UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY

- A. **Scope:** This specification describes the operation and functionality of a continuous duty, single-phase, solid-state, static Uninterruptible Power Supply (UPS) hereafter referred to as the UPS.
- B. **Included Features of the UPS:**
1. The UPS utilizes double conversion online topology designed to protect electronic equipment by supplying reliable, network-grade power featuring extremely tight voltage and frequency regulation.
 2. The UPS features internal bypass and input power factor correction.
 3. The primary sections of the UPS are: input disconnect and filter stage, input PFC power stage, energy storage stage (DC bus capacitor bank), output power (inverter) stage, bypass, and a battery charger. The control of power module and fault detection logic is microcontroller-based.
 - a. The input disconnect and filter stage contains an input back-feed relay, input filter, transient suppression, and battery select switches (mechanical relay or solid-state).
 - b. The Input PFC power stage contains non-isolated power-factor-correcting AC/DC converters. These converters are capable of full power operation in a very wide input voltage range or from a nominal DC battery voltage.
 - c. The energy storage stage is a split DC bus capacitor handling seamless transitions from battery to online and vice versa as well as the low and high frequency power stages ripple.
 - d. The output power (inverter) stage operates directly from the DC bus and produces a configurable AC output voltage of 200, 208, 220, 230 or 240 Vac output, 1 kVA and 2 kVA models produce 220, 225, 230 or 240 Vac, 15 kVA and 20 kVA models produce 220, 230, 240 Vac (single phase) or 380, 400, 415 Vac (three phase). The output of the UPS is connected either to the inverter or through a bypass relay or static switch to the filtered input line.
 - e. The UPS contains a battery charger, which operates from the DC bus. The UPS batteries are modular, hot-swappable, and user-replaceable.
- C. **Performance, Design, and Configurations:** The UPS and associated equipment operates in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for a mission-critical, electronic equipment load.
1. This specification describes the performance, functionality, and design of the UPS Service Bypass Panel, hereafter referred to as the SBP, the external Battery Systems, and connectivity solutions.
 2. All programming and miscellaneous components for a fully operational system as described in this specification are available as part of the UPS.

3. The UPS is available in the following configurations:

TYPE	MODEL	SKU
Tower	APC Smart-UPS RT 1000 VA RM 230 V	SURT1000XLI
	APC Smart-UPS RT 2000 VA 230 V	SURT2000XLI
	APC Smart-UPS RT 3000 VA 230 V with Pre-installed Input/Output Hardwire Kit	SURT3000XLI-ET
	APC Smart-UPS RT 3000 VA 230 V	SURTD3000XLI
	APC Smart-UPS RT 5000 VA 230 V	SURTD5000XLI
	APC Smart-UPS RT 5000 VA 230 V with Pre-installed Input/Output Hardwire Kit	SURTD5000XLI-ET
	APC Smart-UPS RT 6000 VA 230 V	SURT6000XLI
	APC Smart-UPS RT 6000 VA 230 V with Pre-installed Input/Output Hardwire Kit	SURT6000XLI-ET
	APC Smart-UPS RT 8000 VA 230 V	SURT8000XLI
	APC Smart-UPS RT 10,000 VA 230 V	SURT10000XLI
Rack Mount	APC Smart-UPS RT 1000 VA RM 230 V	SURT1000RMXLI
	APC Smart-UPS RT 1000 VA 230 V – Marine	SURT1000XLIM
	APC Smart-UPS RT 2000 VA RM 230 V	SURT2000RMXLI
	APC Smart-UPS RT 2200 VA 230 V – Marine	SURTD2200XLIM
	APC Smart-UPS RT 3000 VA RM 230 V	SURTD3000RMXLI
	APC Smart-UPS RT 3000 VA 230 V – Marine	SURTD3000XLIM
	APC Smart-UPS RT 5000 VA RM 230 V	SURTD5000RMXLI
	APC Smart-UPS RT 6000 VA RM 230 V	SURT6000RMXLI
	APC Smart-UPS RT 6000 VA 230 V – Marine	SURT6000XLIM
	APC Smart-UPS RT 8000 VA RM 230 V	SURT8000RMXLI
	APC Smart-UPS RT 10,000 VA RM 230 V	SURT10000RMXLI
	APC Smart-UPS RT 15 kVA RM 230 V	SURT15KRMXLI
	APC Smart-UPS RT 20 kVA RM 230 V	SURT20KRMXLI

1.2 REFERENCES

- A. **General:** The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications is the latest date as of the date of the Contract Documents, unless otherwise specified.
- B. **Institute of Electrical and Electronics Engineers, Inc. (IEEE):**
- ANSI/IEEE 519, "Guide for Harmonic Control and Reactive Compensation of Static Power Converters" (copyrighted by IEEE, ANSI-approved).
- C. **International Organization for Standardization (ISO):**
- ISO 9001, "Quality Management Systems - Requirements."
 - ISO 14001, "Environmental Management Systems - Requirements with Guidance for Use."

1.3 STANDARDS

A. Regulatory Compliance:

1. By model:

Model	SKU	Approvals
APC Smart-UPS RT 1000 VA RM 230 V	SURT1000RMXLI	C-tick, CE, EN 50091-1, EN 50091-2, EN 55022 Class A, EN 60950, EN 61000-3-2, GOST, VDE
APC Smart-UPS RT 1000 VA 230 V	SURT1000XLI	
APC Smart-UPS RT 2000 VA RM 230 V	SURT2000RMXLI	
APC Smart-UPS RT 2000 VA 230 V	SURT2000XLI	
APC Smart-UPS RT 8000 VA RM 230 V	SURT8000RMXLI	
APC Smart-UPS RT 8000 VA 230 V	SURT8000XLI	
APC Smart-UPS RT 10,000 VA 230 V	SURT10000XLI	
APC Smart-UPS RT 1000 VA 230 V – Marine	SURT1000XLIM	CE, DNV ¹ , EN 50091-1, EN 50091-2, EN 55022 Class A, EN 60950, EN 61000-3-2
APC Smart-UPS RT 2200 VA 230 V – Marine	SURTD2200XLIM	
APC Smart-UPS RT 3000 VA 230 V – Marine	SURTD3000XLIM	
APC Smart-UPS RT 3000 VA 230 V with Pre-installed Input/Output Hardwire Kit	SURT3000XLI-ET	BSMI, C-tick, CE, CSA, EN 50091-1, EN 50091-2, EN 55022 Class A, EN 60950, EN 61000-3-2, GOST, JEON, UL 1778, VCCI, VDE
APC Smart-UPS RT 3000 VA 230 V	SURTD3000XLI	
APC Smart-UPS RT 3000 VA RM 230 V	SURTD3000RMXLI	
APC Smart-UPS RT 5000 VA RM 230 V	SURTD5000RMXLI	C-tick, CE, EN 50091-1, EN 50091-2, EN 55022 Class A, EN 60950, EN 61000-3-2, GOST, UL 1778, VDE
APC Smart-UPS RT 5000 VA 230 V	SURTD5000XLI	
APC Smart-UPS RT 5000 VA 230 V with Pre-installed Input/Output Hardwire Kit	SURTD5000XLI-ET	C-tick, CE, EN 50091-1, EN 50091-2, EN 55022 Class A, EN 60950, EN 61000-3-2, GOST, VDE
APC Smart-UPS RT 6000 VA RM 230 V	SURT6000RMXLI	
APC Smart-UPS RT 6000 VA 230 V	SURT6000XLI	C-tick, CE, CSA, EN 50091-1, EN 50091-2, EN 55022 Class A, EN 60950, EN 61000-3-2, GOST, UL Listed, VDE
APC Smart-UPS RT 6000 VA, 230 V with Pre-installed Input/Output Hardwire Kit	SURT6000XLI-ET	
APC Smart-UPS RT 6000 VA 230 V – Marine	SURT6000XLIM	CE, DNV ² , EN 50091-1, EN 50091-2, EN 55022 Class A, EN 60950, EN 61000-3-2
APC Smart-UPS RT 10,000 VA RM 230 V	SURT10000RMXLI	C-tick, CE, EN 50091-1, EN 50091-3
APC Smart-UPS RT 15 kVA RM 230 V	SURT15KRMXLI	EN/IEC 62040-2, EN/IEC 62040-1-1, VDE
APC Smart-UPS RT 20 kVA RM 230 V	SURT20KRMXLI	BSMI, EN/IEC 62040-2, EN/IEC 62040-1-1, VDE
<p>¹ For compliance with DNV certification, the Smart-UPS On-Line marine models SURT1000XLIM, SURTD2200XLIM, and SURTD3000XLIM must be used with the APC 3000 VA Filter – Marine (SURT023M).</p> <p>² For compliance with DNV certification, the Smart-UPS On-Line marine model SURTD6000XLIM must be used with the APC 6000 VA Filter – Marine (SURT024M).</p>		

2. **OSHPD Pre-approval:** In addition to the preceding regulatory approvals, the APC Smart-UPS RT 3 kVA RM 230 V model (SURTD3000RMXLI) and the APC Smart-UPS RT 5 kVA RM 230 V model (SURTD5000RMXLI) have OSHPD pre-approval (pre-approval by California Office of Statewide Health Planning and Development) when used in any of three APC NetShelter™ enclosures:
 - a. APC NetShelter SX 42 U Enclosure (Commercial), AR3100SP1
 - b. APC NetShelter VX Seismic 42 U Enclosure (Seismic), AR3100SP1
 - c. APC NetShelter 2-Post Rack 45 U (Commercial), AR201

1.4 SYSTEM DESCRIPTION

A. Mechanical Design

1. The UPS is contained in a rugged steel cabinet with plastic front bezels:
2. The UPS dimensions are:

UPS Cabinet	SKU	Height in mm	Width in mm	Depth in mm
APC Smart-UPS RT 1000 VA RM 230 V	SURT1000RMXLI	85	432	483
APC Smart-UPS RT 1000 VA 230 V	SURT1000XLI	432	85	483
APC Smart-UPS RT 1000 VA 230 V – Marine	SURT1000XLIM	85	432	483
APC Smart-UPS RT 2000 VA RM 230 V	SURT2000RMXLI	85	432	483
APC Smart-UPS RT 2000 VA 230 V	SURT2000XLI	432	85	483
APC Smart-UPS RT 2200 VA 230 V – Marine	SURTD2200XLIM	130	432	660
APC Smart-UPS RT 3000 VA 230 V with Pre-installed Input/Output Hardwire Kit	SURT3000XLI-ET	432	130	660
APC Smart-UPS RT 3000 VA RM 230 V	SURTD3000RMXLI	130	432	660
APC Smart-UPS RT 3000 VA 230 V	SURTD3000XLI	432	130	660
APC Smart-UPS RT 3000 VA 230 V – Marine	SURTD3000XLIM	130	432	660
APC Smart-UPS RT 5000 VA RM 230 V	SURTD5000RMXLI	130	432	660
APC Smart-UPS RT 5000 VA 230 V	SURTD5000XLI	432	130	660
APC Smart-UPS RT 5000 VA 230 V with Pre-installed Input/Output Hardwire Kit	SURTD5000XLI-ET	432	130	660
APC Smart-UPS RT 6000 VA RM 230 V	SURT6000RMXLI	130	432	660
APC Smart-UPS RT 6000 VA 230 V	SURT6000XLI	432	130	660
APC Smart-UPS RT 6000 VA, 230 V with Pre-installed Input/Output Hardwire Kit	SURT6000XLI-ET	432	130	660
APC Smart-UPS RT 6000 VA 230 V – Marine	SURT6000XLIM	130	432	660
APC Smart-UPS RT 8000 VA RM 230 V	SURT8000RMXLI	263	432	736
APC Smart-UPS RT 8000 VA 230 V	SURT8000XLI	432	263	736
APC Smart-UPS RT 10,000 VA RM 230 V	SURT10000RMXLI	263	432	736
APC Smart-UPS RT 10,000 VA 230 V	SURT10000XLI	432	263	736
APC Smart-UPS RT 15 kVA RM 230 V	SURT15KRMXLI	553	432	773
APC Smart-UPS RT 20 kVA RM 230 V	SURT20KRMXLI	553	432	773

3. The UPS cabinet is capable of conversion between Tower and Rack-Mount configurations.

B. System Characteristics:

1. **System Capacity:** The system is rated to be capable of supporting:
 - a. 1 kVA or 700 W, whichever limit is reached first (for the 1 kVA models).
 - b. 2 kVA or 1400 W, whichever limit is reached first (for the 2 kVA models).

- c. 2.2 kVA or 1540 W, whichever limit is reached first (for the 2.2 kVA model).
 - d. 3 kVA or 2100 W, whichever limit is reached first (for the 3 kVA models).
 - e. 5 kVA or 3500 W, whichever limit is reached first for the 5 kVA models).
 - f. 6 kVA or 4200 W, whichever limit is reached first (for the 6 kVA models).
 - g. 8 kVA or 6400 W, whichever limit is reached first (for the 8 kVA models).
 - h. 10 kVA or 8000 W, whichever limit is reached first (for the 10 kVA models).
 - i. 15 kVA or 12000 W, whichever limit is reached first (for the 15 kVA model).
 - j. 20 kVA or 16000 W, whichever limit is reached first (for the 20 kVA model).
2. **Efficiency:** The UPS full-load efficiency stated here is without degradation of output regulation as specified:
- a. Efficiency is at least 88% for the 1 kVA models.
 - b. Efficiency is at least 90% for the 2 kVA models.
 - c. Efficiency is at least 92% for the 2.2 kVA, 3 kVA, 5 kVA, 6 kVA, 8 kVA and 10 kVA models.
 - d. Efficiency is at least 94% for the 15 kVA and 20 kVA models.
3. **Input:**
- a. **AC Input Nominal Voltage:**
 - 1) 220/230/240 Vac, single phase, 3 wire (L + N + G), connected via IEC-320 C14 connector (1 kVA models)
 - 2) 220/230/240 Vac, single phase, 3 wire (L + N + G), connected via IEC-320 C20 connector (2 kVA models)
 - 3) 220/230/240 Vac, single phase, 3 wire (L + N + G), connected via IEC-320 C20 connector (3 kVA models).
 - 4) 220/230/240 Vac, single phase, 3 wire (L + N + G), connected via hardwire (5 kVA and 6 kVA models)
 - 5) 220/230/240 Vac, single phase, 3 wire (L + N + G) or 380/400/415 Vac, three phase, 5 wire (L1+L2+L3+N+G) (8 kVA, 10 kVA, 15 kVA and 20 kVA models)
 - b. **AC Input Voltage Window:**
 - 1) For 1 kVA to 6 kVA non-marine models, 160 – 280 Vac (L-N) at full load, while providing nominal charging to the battery system; or 100 – 280 Vac (L-N) at 50% load, while providing nominal charging to the battery system.
 - 2) For 8 kVA to 20 kVA non-marine models, 160 – 280 Vac (L-N) for single phase input or 277 – 485 Vac for three phase input at full load while providing nominal charging to the battery system.
 - 3) For the 1 kVA and 2.2 kVA marine models, 180 V to 280 V.
 - 4) For the 3 kVA and 6 kVA marine models, 180 V to 270 V.
 - c. **Input Frequency Range:** 45-65 Hz, auto-selecting.
 - d. **Input Power Factor:** Minimum 0.95 at 100% load at 230 Vac.
 - e. **Input Current Distortion:**
 - 1) Maximum 6% at 100% load at 230 Vac (1 kVA, 2 kVA, 8 kVA, 10 kVA, 15 kVA, and 20 kVA models)
 - 2) Maximum 8% at 100% load at 230 Vac (2.2 kVA 3 kVA, 5 kVA, and 6 kVA models)
4. **UPS Output:**
- a. **AC Nominal Output Voltage:** Single Phase, 3-wire (Phase + N + G)
 - 1) 220 Vac, 225 Vac, 230 Vac, or 240 Vac, user-selectable - 1 kVA and 2 kVA models
 - 2) 200 Vac, 208 Vac, 220 Vac, 230 Vac or 240 Vac, user-selectable - 3 kVA to 10 kVA models
 - 3) 220 Vac, 230 Vac or 240 Vac, user-selectable, Single Phase -15 kVA and 20 kVA models
 - b. **Output Connectors:**
 - 1) (6) IEC 320 C13 (1 kVA and 2 kVA models)
 - 2) (8) IEC 320 C13 and (2) IEC 320 C19 (2.2 kVA model and 3 kVA to 6 kVA models)
 - 3) Hardwire 3 wire (Phase + N + G), (4) IEC 320 C13 and (4) IEC 320 C19 (8 kVA and 10 kVA)
 - 4) Hardwire 3 wire (Phase + N + G), (8) IEC 320 C19 or Hardwire 5 wire (3 Phase + N + G), (15 kVA and 20 kVA models)
 - c. **Output Frequency:** 50/60 +/- 3 Hz tracking or 50/60 +/- 0.1 Hz tracking (user-selectable).

- d. **AC output voltage distortion:**
 - 1) Maximum 3% @ 100% linear load; maximum 8% @ 100% non-linear (1 kVA and 2 kVA models)
 - 2) Maximum 2% @ 100% linear load; Maximum 5% @ 100% non-linear load (3 kVA to 20 kVA models)
- e. **AC output static voltage regulation:** +/-1%.
- f. **AC output dynamic voltage regulation:** +/- 8% maximum for 100% load step at less than 10 ms recovery time
- g. **Overload Rating:**
 - 1) **Normal Operation (Online):**
 - a) 150% for 30 seconds
 - b) 125% for 1 minute
 - c) 105% continuous
 - 2) **Bypass Operation:** Overload is limited by the upstream branch protection feeding the UPS.
 - a) Typically a 10 A 2-pole circuit breaker should be fitted at the input of the 1 kVA models.
 - b) Typically a 16 A 2-pole circuit breaker should be fitted at the input of the 2 kVA, 2.2 kVA, and 3 kVA models.
 - c) Typically a 32 A 2-pole circuit breaker should be fitted at the input of the 5 kVA and 6 kVA models.
 - d) For the 8k VA models, typically a 50 A 2-pole circuit breaker should be fitted at the input with a single phase supply, and a 50 A 4-pole circuit breaker should be fitted at the input with a three phase supply.
 - e) For the 10 kVA models, typically a 63 A 2-pole circuit breaker should be fitted at the input with a single phase supply, and typically a 63 A 4-pole circuit breaker should be fitted at the input with a three phase supply.
 - f) For the 15 kVA model, typically a 100 A circuit breaker should be fitted at the input for each Phase plus Neutral with single phase input and output or with three phase input and single phase output. Typically a 35 A or 40 A circuit breaker should be fitted at the input for each Phase and Neutral with three phase input and three phase output.
 - g) For the 20 kVA model, typically a 125 A circuit breaker should be fitted at the input for each Phase plus Neutral with single phase input and output or with three phase input and single phase output. Typically a 50 A circuit breaker should be fitted at the input for each Phase plus Neutral with three phase input and three phase output.
- h. **Output Power Factor Rating:**
 - 1) 0.2 –1.0 lagging
 - 2) Nominal: 0.7 lagging.
- i. **Crest Factor:** 3:1.

1.5 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.
- 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.

1.6 PROJECT CONDITIONS

- A. **Environmental Requirements:** Do not install the solid state UPS until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above

ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1. The UPS is capable of withstanding any combination of the following environmental conditions in which it must operate without mechanical or electrical damage or degradation of operating characteristics.
 - a. **Storage Ambient Temperature:** -4°F to 140°F (-20°C to 60°C)..
 - b. **Operating Ambient Temperature:** 0°C to 40°C (32°F to 104°F). 25°C (77°F) is ideal for most battery types.
 - c. **Relative Humidity:** 0% to 95% non-condensing.
 - d. **Altitude:**
 - 1) **Storage Altitude:** 50,000 feet (15000 meters) above sea level
 - 2) **Operating Altitude:** 10,000 feet (3000 meters) above sea level. At altitude of 10,000 feet the UPS must be loaded only up to 90% of its nominal capacity.
 - e. **Audible Noise:** Less than 55 dBA at 3 feet (1 meter)

1.7 WARRANTY

- A. **Limited Warranty:** American Power Conversion (APC) warrants the UPS to be free from defects in materials and workmanship for a period of two years from the date of purchase,
 1. **Warranty Limitations:**
 - a. The obligation of APC under this warranty is limited to repairing or replacing, at its own sole option, any defective product.
 - b. This warranty does not apply to equipment that has been damaged by accident, negligence, or misapplication or has been altered or modified in any way.
 - c. This warranty applies only to the original purchaser who must have properly registered the product within 10 days of purchase.
 - d. EXCEPT AS PROVIDED HEREIN, AMERICAN POWER CONVERSION MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Some states do not permit limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser.
 - e. EXCEPT AS PROVIDED ABOVE, IN NO EVENT WILL APC BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF THIS PRODUCT, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. Specifically, APC is not liable for any costs, such as lost profits or revenue, loss of equipment, loss of use of equipment, loss of software, loss of data, costs of substitutes, claims by third parties, or otherwise.
 - f. This warranty gives you specific legal rights and you may have other rights that vary from state to state.
 2. **Warranty Procedures:**
 - a. To obtain service under warranty the purchaser must obtain a Returned Material Authorization (RMA) number from customer support.
 - b. Products must be returned with transportation charges prepaid and must be accompanied by a brief description of the problem encountered and proof of date and place of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis of Design:** Products specified are Smart-UPS On-Line Uninterruptible Power Supplies as manufactured by APC by Schneider Electric and as listed on page 2 of this specification. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Architect/Engineer will be the sole judge of the basis of what is equivalent.

2.2 MODES OF OPERATION

- A. **Normal:** The UPS output power stage (inverter) constantly recreates the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT switches. In both online operation and battery operation, the output power stage (inverter) creates an output voltage waveform independent of the mains input voltage waveform. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages do not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter). The input PFC power stage and the output power stage (inverter) shall operate in an on-line manner to continuously regulate power to the critical load. The input PFC stage 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.
1. **Overload Capability:** The output power stage (inverter) is capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for an indefinite length of time.
 2. **Output Contactor:** The output power stage (inverter) is equipped with an output mechanical relay to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter will be removed from the critical bus.
 3. **Battery Protection:** The inverter is provided with monitoring and control circuits to limit the level of discharge on the battery system.
- B. **Battery:** Upon failure of the AC input source, the critical load continues being supplied by the output inverter, which derives its power from the battery system. There is no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.
1. The UPS battery system is comprised of battery modules. Replacement batteries are user-replaceable, hot-swappable battery cartridges. For 8 kVA, 10 kVA, 15 kVA, and 20 kVA models, a minimum of two battery cartridges must be installed, one providing 192 VDC nominal for the positive DC bus rail, the other providing 192 VDC nominal for the negative DC bus rail. Each cartridge consists of two 96 VDC battery modules in series.
 2. The batteries of the UPS models in this specification are maintenance-free, leak-proof, valve-regulated lead-acid (VRLA) batteries with suspended electrolyte.
 3. The UPS incorporates the Intelligent Battery Management system to continuously monitor the health of each removable battery module as well as external battery packs installed in extended run battery cabinets. This system notifies the user in the event that a failed or weak battery module is found.
 4. Additional battery packs may be added to increase runtime. The battery packs and the battery modules within them are hot-pluggable, allowing for easy and quick installation or replacement without the need for electrical wiring, electrician services or powering down of the UPS. The maximum number of external battery packs that may be connected to the UPS is 10 for all units except the 15 kVA and 20kVA units which are limited to 9.
 5. The UPS is shipped with battery modules preinstalled but disconnected.
- C. **Charging:** Upon restoration of the AC input source, the UPS simultaneously recharges the battery and provides regulated power to the critical load.
1. The intelligent battery management system contains a temperature monitoring circuit and compensation algorithm that regulates the battery charging current and voltage so as to optimize battery life.
 2. The battery charging circuit remains active when in bypass and online states.
- D. **Bypass:** The system automatic bypass provides a transfer of the critical load from the Inverter output to the automatic bypass input source during times when the inverter cannot support the load. Such times may be due to prolonged or severe overloads or to UPS failure. The UPS constantly monitors the output current as well as the bypass source voltage and inhibits potentially unsuccessful transfers to automatic bypass from taking place. The design of the automatic bypass switch power path consists of a bypass relay for 1 kVA to 6 kVA models, a heavy-duty electromechanical bypass contactor for 8 kVA and 10 kVA models, and a static switch for 15 kVA and 20 kVA models. For models of 2.2 kVA through 10 kVA, a system bypass switch is provided on the rear of the UPS.

1. **Automatic Transfers:** An automatic transfer of load to bypass takes place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from bypass back to normal operation takes place when the overload condition is removed from the critical bus output of the system. Automatic transfers of load to bypass also take place if for any reason the UPS cannot support the critical bus.
2. **Manual Transfers:** Manually initiated transfers to and from bypass may be initiated for models 2.2 kVA through 10 kVA by engaging the bypass switch on the rear panel of the unit, or for the 15 kVA and 20 kVA models via the front panel user display.

2.3 INPUT PFC POWER STAGE

- A. **General:** The input PFC power stage of the UPS constantly rectifies the power imported from the mains input of the system, converting input mains AC power to DC power for precise regulation of the DC bus voltage, battery charging, and output power stage (inverter) regulated output power.
- B. **Input Current Total Harmonic Distortion:** The input current THD_i will be held to 8% or less for 1 kVA and 2 kVA models and 6% or less for all other models at full system load, while providing conditioned power to the critical load bus and charging the batteries under steady-state operating conditions. This is true while the UPS is supporting loads of either a linear or non-linear type. This will be accomplished with no additional filters, magnetic devices, or other components.
- C. **Input Current Limit:**
 1. The input converter controls and limits the input current draw from utility to 150% of the UPS output. During conditions where input current limit is active, the UPS is able to support 100% load, charge batteries at 10% of the UPS output rating, and provide voltage regulation with mains deviation of up to +/-20% of the nominal input voltage.
 2. 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 will not exceed 130% of UPS output current, while providing full battery recharge power and importing necessary power for system losses.
- D. **Charging:**
 1. The battery charging circuit shall contain a temperature compensation circuit, which shall regulate the battery charging to optimize battery life.
 2. The battery charging circuit shall remain active when in bypass and in normal operation.

2.4 OUTPUT POWER STAGE (INVERTER)

- A. **General:** The UPS output power stage (inverter) constantly recreates the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT driven power converters. In both normal operation and battery operation, the output power stage (inverter) creates 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 power stage (inverter).
- B. **Overload Capability:** The output power stage (inverter) is capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for indefinite length of time.
- C. **Output Contactor:** The output power stage (inverter) is equipped with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter will be removed from the critical bus.
- D. **Battery Protection:** The inverter is provided with monitoring and control circuits to limit the level of discharge on the battery system.

2.5 DISPLAY AND CONTROLS

- A. **Control Logic:** The UPS is controlled by an embedded microcontroller which performs the following functions:
1. Monitoring the quality of the output voltage
 2. Monitoring vital parameters of the UPS
 3. Executing the state machine
 4. Intelligent battery management
 5. Remaining runtime calculation
 6. Self-diagnostics, self-test, and proactive fault detection
 7. Communication to the host server via a serial port
 8. Communication to the Network Management Card or another SmartSlot accessory card, if the UPS is equipped with such a card
- B. **Display/Control Unit:** Located on the front of the UPS is a display/control unit comprised of 16 LEDs and 2 pushbutton switches (for 1 kVA to 10 kVA models) or an LCD display (for 15 kVA and 20 kVA models).
1. **Orientation:** The display/control unit may be turned 90 degrees clockwise or counterclockwise to accommodate the mounting orientation of the UPS as a tower UPS or as a rack-mounted UPS.
 2. **Control Functions:** The following controls functions can be accomplished by use of the pushbutton switches or LCD display.
 - a. Turn the UPS on
 - b. Turn the UPS off
 - c. Initiate a self-test to test the battery condition
 - d. Silence an audible alarm
 - e. Cold-start the UPS.
 - f. Display the input RMS voltage.
- C. **Data displayed on the Display/Control Unit:** The following indicators are available on the Display/Control Unit (1000 VA to 10,000 VA models):
1. The UPS load LED bar
 2. The UPS is online
 3. The UPS is on battery
 4. The UPS is in bypass
 5. The UPS is overloaded
 6. The UPS is in fault state
 7. The battery needs to be replaced
 8. The battery capacity/utility voltage LED bar
- D. **Bypass switch:** On the rear panel of the UPS (models rated 2.2 kVA to 10 kVA) there is a switch that, when engaged, forces the UPS into bypass state if the input voltage and frequency are within acceptable limits. For the 15 kVA and 20 kVA units the bypass can be engaged through the user interface display at the front of the unit. All units, 1 kVA to 20 kVA, can be put into manual bypass via software control.
- E. **EPO switch:** All UPS models documented in this specification, except the 1 kVA and 2 kVA models, are equipped with an Emergency Power Off (EPO) terminal that can be wired so as to provide the means to instantaneously de-energize the UPS and its load from a remote location in case of emergency.
- F. **Audible Alarms:** Using audio signal, the UPS will notify the user about important events. The following is the list of distinct audio alarms:
1. The UPS is on battery
 2. The UPS is on battery and the remaining battery capacity is low
 3. The UPS has shut down due to low battery capacity
 4. The battery needs to be replaced
 5. The UPS is overloaded
 6. The UPS is in fault state

- G. **Potential Free (Dry) Contacts:** The following potential free contacts are available on an optional APC SmartSlot Relay I/O Card (Not available on 2.2 kVA, 3 kVA ,and 5 kVA units):
1. The UPS is on battery
 2. The UPS is on battery and the remaining battery capacity is low
 3. The UPS is off
 4. The battery needs to be replaced
 5. The UPS is in bypass
 6. The UPS is overloaded;
 7. The UPS is in fault state.
- H. **Communication Interface:** For purposes of remote communications with the UPS the following are available and contained within the UPS:
1. All models have a serial port to allow communications with a host computer to gracefully shut down one or more operating systems. All models can also accommodate a Network Management Card, which allows communications over a network via web browser or SNMP or with APC StruxureWare™ management software.
 2. All models 5 kVA and higher have a pre-installed Network Management Card 2 with Environmental Monitoring (AP9631)

2.6 BATTERY

- A. The UPS battery is of modular construction made up of owner-replaceable, hot swappable, fused, battery modules. Each battery module is monitored to determine the highest battery unit temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.
- B. The batteries are of the valve regulated lead acid (VRLA) type.

2.7 ACCESSORIES

- A. **Service Bypass Panel (SBP):** The service bypass panel provides power to the critical load from the bypass source, during times where maintenance or service of the UPS is required. The SBP provides a mechanical means of complete isolation of the UPS from the electrical wiring of the installation. The SBP is constructed in a free-standing, rack mounted or wall-mounted enclosure unless otherwise stated in this specification.
- B. **Software and Connectivity:**
1. **Network Management Card:** The Network Management Card allows one or more network management systems (NMSs) to monitor and manage the UPS in TCP/IP network environments. Models of 5 kVA and higher are equipped with a SmartSlot Network Management Card 2 with Environmental Monitoring (AP9631) as standard (pre-installed), which is available as an option on the 1 kVA to 3 kVA units.
 2. **Unattended Shutdown:** The UPS, in conjunction with a network interface card, is capable of gracefully shutting down one or more operating systems during the time when the UPS is in on-battery mode. The UPS is also capable of using an RS-232 port to communicate with the host computer by means of serial communications to gracefully shut down one or more operating systems during an on-battery situation. The PowerChute™ Business Edition software is provided with 1 kVA to 3 kVA models, and PowerChute™ Network Shutdown software is provided with 5 kVA to 20 kVA models for use with the Network Management Card.
- C. **Remote UPS Monitoring:** The following three methods of remote UPS monitoring are available:
1. **Web Monitoring:** Remote monitoring is available via a web browser such as Internet Explorer.
 2. **Dry Contact Monitoring and Control:** The UPS must be equipped with the APC SmartSlot Relay I/O Card to implement this type of monitoring. This card is **not** compatible with following models (all SURTD models):
 - a. Tower models: APC Smart-UPS RT 3000 VA 230 V (SURTD3000XLI), APC Smart-UPS RT 5000 VA 230 V (SURTD5000XLI), and APC Smart-UPS RT 5000 VA 230 V with Pre-installed Input/Output Hardwire Kit (SURTD5000XLI-ET)

- b. Rack-Mount models: APC Smart-UPS RT 2200 VA 230 V – Marine (SURTD2200XLIM), APC Smart-UPS RT 3000 VA RM 230 V (SURTD3000RMXLI), APC Smart-UPS RT 3000 VA 230 V – Marine (SURTD3000XLIM), and APC Smart-UPS RT 5000 VA RM 230 V (SURTD5000RMXLI)

D. Software Compatibility:

1. **PowerChute™ Business Edition Basic (5-node) Software (PCBE):** This software is included with the 1 kVA to 3 kVA models. It supports graceful shutdown and remote monitoring for the following systems. (For more detailed information on Operating System compatibility, see http://www.apcmedia.com/salestools/ASTE-6Z5QEV_R32_EN.pdf.)
 - a. Microsoft Windows® Server 2011
 - b. Microsoft Windows® Server 2008
 - c. Microsoft Windows® Server 2003
 - d. Microsoft Windows® Storage Server 2008
 - e. Microsoft Windows HPC Server 2008
 - f. Microsoft Windows® 7
 - g. Microsoft Windows® Vista
 - h. Microsoft Windows® XP
 - i. Red Hat® Enterprise Linux®
 - j. SuSE® Linux®.Enterprise Server 11
 - k. Solaris™ 10
2. **PowerChute Network Shutdown:** This software is provided with the pre-installed Network Management Card 2 with Environmental Monitoring (AP9631) for models of 5 kVA and higher. It is compatible with the following operating systems.
 - a. IBM® AIX
 - b. HP/UX
 - c. Linux
 - d. Mac OS X
 - e. Novell NetWare
 - f. Solaris
 - g. Windows® 2003
 - h. Windows® 2008
 - i. Windows® 7
 - j. Windows® Vista
 - k. Windows® XP

PART 3 - EXECUTION

3.1 FACTORY-ASSISTED STARTUP

If a factory-assisted UPS start-up is requested, factory-trained service personnel will 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 battery modules.

B. Mechanical Inspection:

1. Check all UPS and external service bypass panel internal power wiring connections.
2. Check all UPS and external service bypass panel terminal screws, nuts, and/or spade lugs for tightness.

C. Electrical Inspection:

1. Verify correct input and bypass voltage.
2. Verify correct UPS control wiring and terminations.
3. Verify voltage of all battery modules.
4. Verify that neutral and ground conductors are properly landed.
5. Inspect external service bypass panel for proper terminations.

D. Site Testing:

1. Ensure proper system start-up.
2. Verify proper firmware control functions.

3. Verify proper firmware bypass operation.
4. Verify proper bypass switch operation (where applicable).
5. Verify proper inverter operation and regulation circuits.
6. Simulate utility power failure.
7. Verify proper charger operation.
8. Document, sign, and date all test results.

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

3.2 FIELD QUALITY CONTROL

A. **Manufacturer Field Service:**

1. **Worldwide Service:** The UPS manufacturer has a worldwide service organization available, consisting of factory-trained field service personnel to perform startup, preventive maintenance, and service of the UPS system and power equipment. The service organization offers service support 24 hours a day, 7 days a week, 365 days a year.
2. **Replacement Parts:** Parts are available through the worldwide service organization 24 hours a day, 7 days a week, 365 days a year. The worldwide service organization is capable of shipping parts within four working hours or on the next available flight, so that the parts may be delivered to the customer site within 24 hours.

3.6 MAINTENANCE

- A. A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system are available from APC by Schneider Electric. Contract work is performed by Schneider Electric factory-trained service personnel.

END OF GUIDE SPECIFICATION

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