

APC by Schneider Electric

Smart-UPS RT

Uninterruptible Power Supply
5 kVA, 6 kVA, 8 kVA, 10 kVA
230 V Solution

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UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY

- A. **Scope:** This specification describes the operation and functionality of a continuous duty, single-phase, 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 relays).
 - 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 220, 230 or 240 Vac output. The output of the UPS is connected either to the inverter or through a bypass relay 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. The UPS can be restarted immediately after a prolonged power outage without waiting for the battery to be recharged.
 4. The UPS utilizes green mode, a patent-pending operating mode that bypasses unused electrical components in good power conditions to achieve very high operating efficiency (typically 98%) without sacrificing any protection, exceeding ENERGY STAR® qualifications. The UPS provides early-warning fault analysis on batteries and will project battery replacement dates, enabling timely preventive maintenance.
 5. The UPS supports switched outlet groups. A switched outlet group can be operated independently from the main UPS outlets, enabling non-critical load shedding, reboot of hung equipment, and sequenced startup and shutdown.
 6. The UPS has flash memory to facilitate firmware upgrades.
 7. The graphical LCD display with multicolor backlight provides detailed information, with the ability to configure the display locally.

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, external battery packs, 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 and battery packs are available in the following configurations:

TYPE	MODEL Description	SKU
Tower	APC Smart-UPS SRT 5000 VA 230 V	SRT5KXLI
	APC Smart-UPS SRT 6000 VA 230 V	SRT6KXLI
	APC Smart-UPS SRT 5000/6000 VA Battery Pack	SRT192BP
	APC Smart-UPS SRT 8000 VA 230 V	SRT8KXLI
	APC Smart-UPS SRT 10,000 VA 230 V	SRT10KXLI
	APC Smart-UPS SRT 8000/10,000 VA Battery Pack	SRT192BP2
Rack Mount	APC Smart-UPS SRT 5000 VA RM 230 V	SRT5KRMXLI
	APC Smart-UPS SRT 5000 VA RM 230 V HW	SRT5KRMXLW-HW
	APC Smart-UPS SRT 6000 VA RM 230 V	SRT6KRMXLI
	APC Smart-UPS SRT 5000/6000 VA Battery Pack	SRT192RMBP
	APC Smart-UPS SRT 8000 VA RM 230 V	SRT8KRMXLI
	APC Smart-UPS SRT 10,000 VA RM 230 V	SRT10KRMXLI
	APC Smart-UPS SRT 8000/10,000 VA Battery Pack	SRT192RMBP2

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):**
 1. 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):**
 1. ISO 9001, "Quality Management Systems - Requirements."
 2. ISO 14001, "Environmental Management Systems - Requirements with Guidance for Use."

1.3 STANDARDS

A. Regulatory Compliance:

1. By model:

Model Description	SKU	Approvals
APC Smart-UPS SRT 5000 VA 230 V	SRT5KXLI	CE, VDE, C-tick, EAC, EN 50091-1, EN 50091-2, IEC 62040-2 2005 Edition, IEC 60950.
APC Smart-UPS SRT 5000 VA RM 230 V	SRT5KRMXLI	
APC Smart-UPS SRT 6000 VA 230 V	SRT6KXLI	
APC Smart-UPS SRT 6000 VA RM 230 V	SRT6KRMXLI	
APC Smart-UPS SRT 8000 VA 230 V	SRT8KXLI	
APC Smart-UPS SRT 8000 VA RM 230 V	SRT8KRMXLI	
APC Smart-UPS SRT 10,000 VA 230 V	SRT10KXLI	
APC Smart-UPS SRT 10,000 VA RM 230 V	SRT10KRMXLI	
APC Smart-UPS SRT 5000 VA RM 230 V HW	SRT5KRMXLW-HW	CE, VDE, C-tick, EAC, EN 50091-1, EN 50091-2, IEC 62040-2 2005 Edition, IEC 60950, UL-1778, FCC Part 15 Class A, CSA

1.1 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 Model Description	SKU	Height in mm	Width in mm	Depth in mm
APC Smart-UPS RT 5000 VA RM 230 V	SRT5KRMXLI	130	432	719
APC Smart-UPS RT 5000 VA RM 230 V HW	SRT5KRMXLW-HW	130	432	719
APC Smart-UPS RT 5000 VA 230 V	SRT5KXLI	432	130	719
APC Smart-UPS RT 6000 VA RM 230 V	SRT6KRMXLI	174	432	719
APC Smart-UPS RT 6000 VA 230 V	SRT6KXLI	432	174	719
APC Smart-UPS RT 8000 VA RM 230 V	SRT8KRMXLI	263	432	715
APC Smart-UPS RT 8000 VA 230 V	SRT8KXLI	432	263	715
APC Smart-UPS RT 10,000 VA RM 230 V	SRT10KRMXLI	263	432	715
APC Smart-UPS RT 10,000 VA 230 V	SRT10KXLI	432	263	715

3. The UPS cabinet is capable of conversion between Tower and Rack-Mount configurations.
4. The SRT5KRMXLW-HW includes a rail kit and stabilizer brackets.

B. System Characteristics:

1. **System Capacity:** The system is rated to be capable of supporting:
 - a. 5 kVA or 4500 W, whichever limit is reached first (for the 5 kVA models).
 - b. 6 kVA or 6000 W, whichever limit is reached first (for the 6 kVA models).
 - c. 8 kVA or 8000 W, whichever limit is reached first (for the 8 kVA models).

- d. 10 kVA or 10000 W, whichever limit is reached first (for the 10 kVA models).
- 2. **Online Efficiency:** The UPS full-load efficiency stated here is without degradation of output regulation as specified. Efficiency is at least 94% full load and at least 95% at half load for the 5 kVA, 6 kVA, 8 kVA and 10 kVA models.
- 3. **Green Mode Efficiency:** The UPS full-load efficiency stated here is without degradation of output regulation as specified. Efficiency is at least 98% for the 5 kVA, 6 kVA, 8 kVA and 10 kVA models.
- 4. **Input:**
 - a. **AC Input Nominal Voltage:**
 - 1) 220/230/240 Vac, single phase, 3 wire (L + N + G), connected via hardwire (5 kVA and 6 kVA models).
 - 2) 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 and 10 kVA models).
 - b. **AC Input Voltage Range:**
 - 1) For 5 kVA and 6 kVA, 160 – 275 +/-5 Vac (L-N) at full load, while providing nominal charging to the battery system; or 100 – 275 +/-5 Vac (L-N) at 50% load, while providing nominal charging to the battery system.
 - 2) For 8 kVA and 10 kVA models, 160 – 275 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. 100 – 275 Vac (L-N) at 50% load, while providing nominal charging to the battery system.
 - c. **Input Frequency Range:** 40-70 Hz, auto-selecting.
 - d. **Dual Input:** 8 kVA and 10 kVA units offer a second input source to be connected to the UPS bypass.
 - e. **Online Input Power Factor:** 5 kVA and 6 kVA units offer minimum 0.99 for 75% and 100% at 230 Vac. 8 kVA and 10 kVA units offer > 0.95 for 50%, 75% and 100% load at 230 Vac.
 - f. **Green Mode Input Power Factor:** 5 kVA and 6 kVA units offer ≥ 0.9 (for Resistive load $\geq 25\%$) at 230 Vac. 8 kVA units offer ≥ 0.8 (for Resistive load $\geq 25\%$) at 230 Vac. 10 kVA units offer ≥ 0.75 (for Resistive load $\geq 25\%$) at 230 Vac.
 - g. **Input Current Distortion:**
 - 1) 5 kVA and 6 kVA models: <7% for 50% load, <5% for 100% load.
 - 2) 8 kVA and 10 kVA models: <10% for 50% load, <5% for 100% load.
 - h. **Input Circuit Breaker (Recommendation):**
 - 1) 5 kVA: 40 A; 6 kVA: 50 A; 8 kVA: 20 A/63 A (3-Phase/1-Phase); 10 kVA: 25 A/80 A (3-Phase/1-Phase).
 - i. **Input Surge Protection:**
 - 1) 5 kVA, 6 kVA, 8 kVA and 10 kVA: 1610 Joules.
- 5. **UPS Output:**
 - a. **AC Nominal Output Voltage:** Single Phase, 3-wire (Phase + N + G)
 - 1) 220 Vac, 230 Vac or 240 Vac. XLI and "W-HW" models are factory set at 230 Vac.
 - 2) 208 Vac, 220 Vac, 230 Vac or 240 Vac for the SRT5KRMXLW-HW.
 - b. **Output Connectors:**
 - 1) (6) IEC 320 C13, (4) IEC 320 C19, and (2) IEC C14 output power cords for the 5 kVA.
 - 2) (6) IEC 320 C13, (4) IEC 320 C19, and (2) IEC C14 output power cords for the 6 kVA.
 - 3) Hardwire 3 wire (Phase + N + G), (6) IEC 320 C13, (4) IEC 320 C19, and (1) IEC C14 and (2) IEC C20 output power cords for the 8 kVA and 10 kVA.
 - c. **Switched Outlet Groups:** Switched Outlet Groups (SOG); Main Outlet Groups (MOG)
 - 1) 5 kVA: SOG 1: (6) IEC 320 C13; SOG 2: (4) IEC 320 C19.
 - 2) 6 kVA: SOG 1: (6) IEC 320 C13; SOG 2: (2) IEC 320 C19; SOG 3: (2) IEC 320 C19; MOG 1: (3-wire HW, Phase + N + G).
 - 3) 8 kVA and 10 kVA: SOG 1: (2) IEC 320 C19; SOG 2: (2) IEC 320 C19; SOG 3: (6) IEC 320 C13; MOG 1: (3-wire HW, Phase + N + G).

- d. **Output Frequency:** 50/60 +/- 3 Hz (auto-sense) or 50/60 +/- 0.1 Hz (user-selectable).
 - e. **Output Frequency Regulation:** Free Running: Nominal +/- 0.1 Hz
 - f. **AC output voltage distortion (THD):**
 - 1) 5 kVA: 0.5% @ 100% full linear load; 1.5% @ 100% full non-linear load.
 - 2) 6 kVA: 0.5% @ 100% full linear load; 2% @ 100% full non-linear load.
 - 3) 8 kVA and 10 kVA: <2% @ 100% full linear load; <5% @ 100% full non-linear load.
 - g. **AC output static voltage regulation:** +/-1%.
 - h. **AC output dynamic voltage regulation:**
 - 1) 5 kVA and 6 kVA: < ± 1% rms of the initial value. Load Step: 10% to/from 90% resistive load.
 - 2) 8 kVA and 10 kVA: ± 2% rms < 40mSec for 10% to 100% resistive load step.
 - i. **Overload Rating:**
 - 1) **Normal Operation (Online):**
 - a) 150% for 30 seconds.
 - b) 125% for 1 minute.
 - c) 105% continuous.
 - d) >175% 25 line cycles.
 - e) short circuit 500msec.
 - 2) **Bypass Operation:** Overload is limited by the upstream branch protection feeding the UPS.
 - a) Typically a 40 A 2-pole circuit breaker should be fitted at the input of the 5 kVA and a 50 A 2-pole circuit breaker for the 6 kVA model.
 - b) For the 8 kVA models, typically a 63 A 2-pole circuit breaker should be fitted at the input with a single phase supply, and a 20 A 4-pole circuit breaker should be fitted at the input with a three phase supply.
 - c) For the 10 kVA models, typically an 80 A 2-pole circuit breaker should be fitted at the input with a single phase supply, and typically a 25 A 4-pole circuit breaker should be fitted at the input with a three phase supply.
 - j. **Output Load Power Factor Rating:**
 - 1) 0.5 leading to 0.5 lagging.
 - k. **Crest Factor:**
 - 1) 5 kVA and 6 kVA: Unlimited (No limit on applied crest factor, but SRT UPS's regulate it to 2.7 - 3.1 for 208V-240V).
 - 2) 8 kVA and 10 kVA: Unlimited (No limit on applied crest factor, but SRT UPS's regulate it to 2.6 - 3.0 for 208V-240V).
6. **Battery:**
- a. **Battery Type:** Maintenance-free sealed lead-acid battery with suspended electrolyte, leak proof:
 - 1) 5 kVA: 960 VAH.
 - 2) 6 kVA: 960 VAH.
 - 3) 8 kVA and 10 kVA: 1920 VAH.

1.2 SUBMITTALS

- A. **Proposal Submittals:**
 - 1. Product catalog sheets or brochures.
 - 2. Product guide specifications.
 - 3. Product technical specifications.
 - 4. System package submittal drawings including a single-line and mechanical diagrams.
- B. **Delivery Submittals:**
 - 1. Installation manual, which includes instructions for storage, handling, examination, preparation, installation, and start-up of UPS.
 - 2. Operation Manual includes safety information, specifications, UPS features, configuration, UPS settings and troubleshooting information.

1.3 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:** 5°F to 113°F (-15°C to 45°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:** 0 to 50,000 feet (0 to 15,000 meters) above sea level.
 - 2) **Operating Altitude:** 0 to 10,000 feet (0 to 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 60 dBA at 3 feet (1 meter).
 - f. **Protection Class:** IP 20 rating.

1.4 WARRANTY

- A. **Limited Warranty:** Schneider Electric IT Corporation (SEIT) warrants the UPS to be free from defects in materials and workmanship for a period of 3 years (2 years for the battery) from the date of purchase.
1. **Warranty Limitations:**
 - a. The obligation of Schneider Electric IT Corporation (SEIT) 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, Schneider Electric IT Corporation (SEIT) 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 Schneider Electric IT Corporation (SEIT) 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, Schneider Electric IT Corporation (SEIT) 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, 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 replacement battery cartridges (RBCs).
 2. For 5 kVA and 6 kVA models, a minimum of one RBC (two battery modules) must be installed, providing 192 VDC nominal DC bus rail.
 3. For 8 kVA and 10 kVA models, a minimum of two RBCs (four battery modules) must be installed, one providing 192 VDC nominal for the positive DC bus rail, and the other providing 192 VDC nominal for the negative DC bus rail.
 4. Each RBC consists of two 96 VDC battery modules in series.
 5. The batteries of the UPS models in this specification are maintenance-free, leak-proof, valve-regulated lead-acid (VRLA) batteries with suspended electrolyte.
 6. 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.
 7. 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.
 8. 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.
3. The UPS can be restarted immediately after a prolonged power outage without waiting for the battery to be recharged.

- 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 5 kVA and 6 kVA models, and a heavy-duty electromechanical bypass contactor for 8 kVA and 10 kVA models.
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 take 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 by the user display interface.

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 7% at 50% load and 5% at full load for the 5 kVA and 6 kVA models and 10% at 50% load and 5% at full load for the 8 kVA and 10 kVA models 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 contains a temperature compensation circuit, which shall regulate the battery charging to optimize battery life.
 2. The battery charging circuit remains 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 an 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. Controlling the input and output power stage
 6. Remaining runtime calculation.
 7. Self-diagnostics, self-test, and proactive fault detection.
 8. Communication to the host server via a serial port.
 9. Communication to the embedded Network Management Card or another SmartSlot accessory card, if the UPS is equipped with such a card.
- B. **Display Interface:** Located on the front of the UPS is an LCD user display comprised of a graphical, high resolution (3"x3") LCD (256 x 128 Pixels) and 5 pushbutton switches.
 1. **Orientation:** The LCD display 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. The angle of the LCD display can be adjusted out from vertical by 10 degrees for ease in viewing the displayed messages.
 2. **Control Functions:** The following control functions can be accomplished by use of the pushbutton switches.
 - a. POWER ON/OFF button.
 - b. Escape button.
 - c. OK button.
 - d. Up button.
 - e. Down button.
- C. **Data displayed on the Display Interface:** The following indicators are available on the Display Interface Unit:
 1. Load icon and disable/mute audible alarm icon.
 2. The UPS status information (Input and Output Voltage, Output Frequency, Load, and Runtime).
 3. Operation mode icons (On-Line mode, Bypass mode, Green mode, and Battery mode)
 4. Battery status icons.
 5. Controllable outlet group status icons.
 6. Backlight screens: Amber is an indication that requires attention and Red indicates a UPS alarm that requires immediate attention.
- D. **EPO switch:** All UPS models documented in this specification 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. The UPS can accept normally open (NO) or normally closed (NC) contacts.
- E. **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.

- F. **Potential Free (Dry) Contacts:** The following potential free contacts are available on an optional APC SmartSlot Relay I/O Card:
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.
- G. **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 (RJ45), USB (Type B), and a Smart-Slot which can accommodate additional optional communication accessories.
 2. All models also include an embedded Network Management Card 2 with Environmental Monitoring (AP9631) which allows communications over a network via web browser or SNMP or with APC StruxureWare™ management software.

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 by the temperature compensated charger circuitry.
- B. The batteries are of the valve regulated lead acid (VRLA) type.

2.7 Smart Battery Management

- A. Definitions:
1. Battery Module: A string of battery cells arranged to produce a battery assembly with a connector.
 2. Replacement Battery Cartridge (RBC): An APC battery cartridge consisting of two battery modules.
 3. Replacement RBCs can be ordered from the APC web site, www.apc.com.
 4. Smart External Battery Pack (XLBP): An enclosure that contains RBC(s) and battery management electronics.
 5. User Interface (UI): Any interface by which a user can interact with the system. This may include a UPS display interface, a network management interface or PowerChute™ Network Shutdown software.

NOTE: Do not use a battery that is not APC-approved.

The system will not detect the presence of a non-APC-approved battery, and such a battery may adversely affect the operation of the system. Use of a non-APC-approved battery will void the manufacturer warranty.

- B. Features:
1. Monitors and informs the user of the health of each RBC.
 2. Monitors and shows on the UPS Display Interface screen the date for the end of useful life for each RBC.
 3. Emits an alarm and shows a message on the UPS Display Interface screen to indicate the estimated battery end of life. On the UPS Display Interface screen the user can set the number of days before the alarm is heard and the message appears on the UPS Display Interface screen.
 4. Automatically detects the addition or removal of XLBPs and RBCs.
 5. Monitors the internal temperature of each XLBP and automatically adjusts the battery charging.
- C. Maintenance:
1. RBC maintenance: The APC RBC uses sealed lead acid battery cells and does not require maintenance.
 2. Runtime Test (Calibration): This should be performed anytime the steady state load is changed significantly, for example when a new server is added to or removed from the UPS load.

3. Battery health monitoring: The battery energy output and voltage are monitored to assess the health of the installed batteries when the UPS is operating on battery.
 4. Battery health monitoring is done during a UPS Self Test, during a Runtime Calibration Test, and when the UPS is operating on battery power. The UPS can be configured to perform periodic, automatic Self Tests.
- D. End of useful life
1. Near end of life notification: A warning message will appear on the UPS display interface screen when each RBC is approaching the end of its useful life. For configuration details refer to Replacement Notification Time and Replacement Battery Alarm Time. The estimated replacement date for each RBC is available through the UI.
 2. Needs replacement notification: The UPS display interface screen shows when RBC replacement is required. The RBC must be replaced as soon as possible. When an RBC requires replacement, the UPS display interface may recommend that additional RBCs be replaced if they will soon reach the end of their useful life.
- CAUTION: Continued operation after end of useful life notification may cause damage to the batteries.
3. Recycling: Remove the RBC from the XLBP. Recycle the RBC. Do not disassemble an RBC.

2.8 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. All models are equipped with an embedded Network Management Card 2 with Environmental Monitoring (AP9631) as standard equipment.
 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. PowerChute Network Shutdown software is provided with all models for use with the embedded 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.
- D. **Software Compatibility:** Please refer to the APC web site for latest software compatibility listings.
1. **PowerChute Network Shutdown:** This software is provided with the embedded Network Management Card 2 with Environmental Monitoring (AP9631) for all models. It is compatible with the following operating systems.
 - a. IBM® AIX
 - b. HP/UX
 - c. Linux
 - d. Mac OS X
 - e. Solaris
 - f. Windows® 2003
 - g. Windows® 2008
 - h. Windows® 2008 Server Core x32
 - i. Windows® 2008 Server Core x64
 - j. Windows® 7
 - k. Windows® 8
 - l. Windows Server 2011
 - m. Windows Server 2012

- n. Windows Storage Server 2008
- o. Windows® Vista
- p. Microsoft Hyper-V Server Core x64
- q. NETGEAR ReadyNAS
- r. VMware ESX
- s. VMware ESXi

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 User Display Interface, Menu overview, 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 start-up, 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.

3.3 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

Revision 1: April, 2015