APC Smart-UPS RT

GUIDE SPECIFICATIONS FOR
2400VA and 3000VA Smart-UPS RT 100 and 120VAC
Uninterruptible Power Supply

PART 1 - GENERAL

1.1 SUMMARY

A. This specification describes the operation and functionality of a continuous duty, single-phase, solid-state, static Uninterruptible Power System (UPS) hereafter referred to as the UPS.

B. 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. The UPS also features internal bypass and input power factor correction.

C. 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 stage (inverter), bypass and a battery charger. The control of power module and fault detection logic is microcontroller based. Input disconnect and filter stage contains input backfeed relay (in models with an input wire plug), input filter, transient suppression, battery select transfer relays. Input PFC power stage contains non-isolated power factor correcting AC/DC converters. This converter is capable of full power operation in very wide input voltage range or from a nominal DC battery voltage. The energy storage stage is a split DC bus capacitor handling seamless transitions from battery to line and vice versa as well as the low and high frequency power stages ripple. The inverter stage operates directly from the DC bus and produces an AC output voltage of 100VAC (100VAC models) or 120VAC (120VAC models). The output of UPS is either connected through a bypass relay to the inverter or to the input filtered line. UPS contains a battery charger, which operates from the DC bus.

D. The UPS batteries are modular, hot-swappable, user-replaceable.

E. In addition, 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.

F. 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.

G. All programming and miscellaneous components for a fully operational system as described in this specification shall be available as part of the UPS.

H. Configuration Specifics:

The UPS is available in one of the following configurations:

MODEL	SKU #
TOWER	
APC Smart-UPS RT 2400VA 100V	SURTA2400XLJ
APC Smart-UPS RT 3000VA 120V	SURTA3000XL
RACK MOUNT	
APC Smart-UPS RT 3000VA RM 120V	SURTA3000RMXL3U
BATTERY PACK	
APC Smart-UPS RT 192V Battery Pack	SURT192XLBP
APC Smart-UPS RT 192V RM Battery Pack	SURT192RMXLBP3U

1.2 STANDARDS

A. UL 1778 Uninterruptible Power Supply Equipment

B. CSA

C. FCC Class A

D. VCCI

E. ISO 9001

F. ISO 14001

1.3 MODES OF OPERATION

A. Online: 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.

B. On Battery: Upon failure of the AC input source, the critical load shall continue being supplied by the output power stage (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 online operation.

C. Bypass: The bypass mode shall be used to provide transfer of critical load from the inverter output to the primary power 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.

D. External Service Bypass Panel (SBP): The maintenance service bypass panel shall provide power to the critical load from the bypass power source during times where maintenance or service of the UPS is required so that removal of the UPS is desired. The SBP shall provide a mechanical means of complete isolation of the UPS from the

electrical wiring of the installation. The SBP shall be constructed in a free-standing, rack mounted or wall-mounted NEMA 1 enclosure unless otherwise stated in this specification. It shall be designed for single phase input with a " no break" transfer between bypass and UPS power.

1.4 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.

PART 2 - PRODUCT

2.1 MECHANICAL DESIGN

A. The UPS is contained in a rugged steel cabinet with two plastic front bezels;

B. The UPS dimensions are 13 x 43.2 x 66.0 cm (5.10 x 17 x 26 in.);

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

2.2 SYSTEM CHARACTERISTICS

A. System Capacity:
1. The system is rated to be capable of supporting:
   a. 2400VA or 1680W whichever limit is reached first (for the 2400VA model).
   b. 3000VA or 2100W whichever limit is reached first (for the 3000VA model).

B. The UPS efficiency is at least 91%, without degradation of output regulation as specified.

C. Input:

1. AC input nominal voltage: 120VAC (120VAC models) or 100VAC (100VAC models), single phase, 3 wire (L + N + G), connected via NEMA 5-30P connector;

2. AC input voltage window:

a. 75 – 125VAC (L-N) for 2400VA models, or 90 – 150VAC for 3000VA models, at full load, while providing nominal charging to the battery system;
b. 50 – 150VAC (L-N) for both models at 50% load, while providing nominal charging to the battery system;

3. Input frequency range: 45-65Hz;

4. Input Power Factor: Minimum 0.95 lagging at 100% load at nominal voltage;

5. Input Current Distortion: Maximum 6% at 100% load at nominal voltage;

6. Crest factor: 3:1.

D. UPS Output:

1. AC output nominal voltage: 120VAC (120VAC models) or 100VAC (100VAC models), single phase, 3 wire (L + N + G);

2. Output connectors: 3 NEMA 5-15R; 2 NEMA 5-20R; 1 NEMA L5-20R (2400VA models); 6 NEMA 5-15R; 2 NEMA 5-20R (3000VA models);

3. Output frequency: 50/60 +/- 3Hz tracking (user selectable);

4. AC output voltage distortion: Max. 2% @ 100% linear load; Max. 5% @ 100% non-linear Load;

5. AC output static voltage regulation: +/-1%;

6. AC output dynamic voltage regulation: +/- 8% maximum for 100% load step at less than 10ms recovery time;

7. Overload Rating:

a. Online: 105% - infinite; 125% - 1 minute; 150% - 30 seconds;

b. In bypass: Overload is limited by the UPS input circuit breaker which is rated 30A for both models;

8. Output Power Factor Rating: 0.2 –1.0 lagging, nominal: 0.7 lagging.

2.3 ENVIRONMENTAL

1. Storage Ambient Temperature: -4°F to 140°F (-20°C to 60°C).

2. Operating Ambient Temperature: +32°F to 104°F (0°C to 40°C). (77°F (25°C) is ideal for most battery types).

3. Relative Humidity: 0 to 95% non-condensing

4. Storage altitude: 50,000 feet (15000m) above sea level

5. Operating altitude: 10,000 feet (3000m) above sea level. At altitude of 10, 000 feet the UPS must be loaded up to 90% of its nominal capacity only.

6. Audible noise: less than 55dBA at 3 feet (1 m).

2.4 INPUT PFC POWER STAGE

A. 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 shall be held to 6% 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.

C. Input Current Limit:

1. 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 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 shall not exceed 130% of UPS output current, while providing full battery recharge power and importing necessary power for system losses.

2.5 OUTPUT POWER STAGE (INVERTER)

A. 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).

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 relay to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter shall 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.

2.6 AUTOMATIC BYPASS

A. As part of the UPS, a system automatic bypass switch is provided. The system automatic bypass shall provide 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 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.

B. The design of the automatic bypass switch power path consists of a heavy-duty electromechanical bypass contactor.

C. 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.

D. Manual Transfers: Manually initiated transfers to and from bypass may be initiated through the UPS computer interface (via serial or USB communications) or by engaging the bypass switch on the rear panel of the unit.

2.7 BATTERY

A. The UPS battery system is comprised of user replaceable, hot swappable, battery modules.

B. The battery jars housed within each removable battery module are of the Valve Regulated Lead Acid (VRLA) type.

C. The UPS incorporates the Intelligent Battery Management system to continuously monitor the health of each removable battery module as well as external battery modules installed in extended run battery cabinets. This system shall notify the user in the event that a failed or weak battery module is found.

D. Charging:

1. The intelligent battery management system contains a temperature monitoring circuit and compensation algorithm that regulates the battery charging current so as to optimize battery life.

2. The battery charging circuit remains active when in bypass and online states.

E. Additional battery modules may be added to increase runtime. These modules 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 number of external battery modules that may be connected to the UPS is unlimited.

F. The UPS is shipped with battery modules preinstalled but disconnected.

2.8 DISPLAY AND CONTROLS

A. Control Logic: The UPS is controlled by an embedded microcontroller which performs functions:

1. Monitoring quality of 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 serial port;

8. Communication to the Network Interface Card or another SmartSlot accessory card if equipped.

B. Display/Control Unit: A display/control comprised of 16 LEDs and 2 pushbutton switches is located on the front side of the UPS. The display/control unit may be turned 90 degrees clockwise or counterclockwise to accommodate for the way the UPS is mounted: as a tower UPS or as a rack-mounted UPS.

C. The pushbutton switches located at the Display/Control Unit: The following controls functions can be accomplished by use of the pushbutton switches located at the Display/Control Unit:

1. Turn the UPS on;

2. Turn the UPS off;

3. Initiate self-test in order to test battery condition;

4. Silence audible alarm;

5. Cold start.

6. Displaying input RMS voltage on the battery capacity LED bar graph.

D. Bypass switch: On the rear panel of the UPS (models rated 5000VA and higher) there's a switch that when engaged forces the UPS into bypass state provided the input voltage and frequency are within acceptable limits.

E. EPO switch: The UPS is equipped with Emergency Power Off (EPO) terminal which can be wired so as to provide means to instantaneously de-energize the UPS and its load from a remote location in case of emergency.

F. Data displayed on the Display/Control Unit: The following indicators are available on the Display/Control Unit:

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

G. 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 shutdown due to low battery capacity;

4. The battery needs to be replaced;

5. The UPS is overloaded;

6. The UPS is in fault state;

H. Potential Free (Dry) Contacts: The following potential free contacts may be 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.

PART 3 - PART 3 – ACCESSORIES

3.1 SERVICE BYPASS PANEL (SBP)

A. The service bypass panel shall provide power to the critical load from the bypass source, during times where maintenance or service of the UPS is required. The SBP shall provide 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.

3.2 SOFTWARE AND CONNECTIVITY

A. Network Adaptor: APC SmartSlot Network Management Card shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments.

B. Unattended Shutdown

1. The UPS, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems during when the UPS is on battery mode.

2. The UPS is also capable of using an RS232 port to communicate to the host computer by means of serial communications so as to gracefully shut down one or more operating systems during an on battery situation. The PowerChute Business Edition software is available from APC and must be purchased separately.

3.3 REMOTE UPS MONITORING, CONFIGURATION AND CONTROL

A. The following three methods of remote UPS control, configuration and monitoring are available:

1. Web Monitoring: Remote monitoring, configuration and control is available via a web browser such as Internet Explorer provided the UPS is equipped with

2. Monitoring, configuration and control via PowerView Remote Display, four line multilingual intelligent alphanumeric LCD (up to 15 feet/5meters away);

3. Dry contact monitoring and control provided the UPS is equipped with APC SmartSlot Relay I/O Card.

3.4 SOFTWARE COMPATIBILITY

A. A: Included with the UPS is PowerChute Business Edition Basic (5-node) software. The software supports graceful shutdown and remote monitoring for the following systems:

1. Windows 2003

2. Windows NT 4.0 with Service Pack 6

3. Windows 2000 with Service Pack 3

4. Windows XP

5. Red Hat Linux v.7.3, 8.0 and 9.0

6. SuSE v.8.0 and 8.1

7. TurboLinux v.7.0 and 8.0

8. Novell Netware 6.0 with Support Pack 1

9. Novell Netware 6.5

10. Novell Netware 5.1 with Support Pack 3 or above (using PowerChute Business Edition v6.2.2 agent)

11. Sun Solaris 8 and 9

PART 4 - Part 4 - EXECUTION

4.1 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 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 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 shall include key pad operation, LED indicators, start-up and

shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

4.2 MANUFACTURER FIELD SERVICE

A. Worldwide service: The UPS manufacturer has 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 offers 24 hours a day, 7 days a week, 365 days a year service support.

B. 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 4 working hours or on the next available flight, so that the parts may be shipped to the customer site within 24 hours.

4.3 MAINTENANCE CONTRACTS

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

4.4 TRAINING

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

End of Section 16611