

APC Smart-UPS RT

GUIDE SPECIFICATIONS FOR 15kVA and 20kVA Smart-UPS RT 230VAC Uninterruptible Power Supply

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification describes the operation and functionality of a continuous duty, dual input feed with configurable single-phase or three-phase input and output power (1:1, 3:1 or 3:3), solid-state, static Uninterruptible Power System (UPS) hereafter referred to as the UPS.
- B. The UPS shall utilize double conversion online topology designed to protect electronic equipment by supplying reliable, network-grade power with extremely tight voltage and frequency regulation. The UPS shall feature an internal static bypass and input power factor correction.
- C. Configuration Specifics:

- 1. The UPS shall be available in the following configurations:

MODEL	SKU #
UPS	
APC Smart-UPS RT 15,000VA RM 230V	SURT15KRMXLI
APC Smart-UPS RT 20,000VA RM 230V	SURT20KRMXLI
BATTERY PACK	
APC Smart-UPS RT192V RM Battery Pack 2 Rows	SURT192RMXLBP2

- 2. The system power train shall comprise of, input disconnect and filter stage, input PFC power stage, energy storage stage (DC bus capacitor bank), output power stage (inverters), static bypass switch for connecting bypass line to the output, and battery charger.
- 3. The system shall also include field-replaceable output power distribution panels (when battery module is utilized), field-replaceable fan module, field-replaceable battery modules, removable input/output wiring trays, battery disconnects, an LCD interface display, EPO, and an integrated UPS network management card with temperature monitoring.
- D. 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.

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

1.2 STANDARDS

- A. EN50091-1/ EN/IEC62040-1-1
- B. EN50091-2 / IEC62040-2
- C. EN55022 Class A
- D. EN61000-3-2
- E. EN60950
- F. IEC 60950
- G. GOST
- H. CE
- I. VDE
- J. C-tick
- K. ISO 9001
- L. ISO 14001

1.3 MODES OF OPERATION

- A. Normal: The input Power Factor Corrector (PFC) stage and output inverter stage shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.
- B. Battery: Upon failure of the AC input source, the critical load shall continue being supplied by the output inverters, which shall derive their power from the battery system. There shall be no interruption in power to the critical load during either transfer to or from battery operation back to normal operation.
- C. During the re transfer from battery to on-line operation, the load shall be softly transferred from battery back on-line within 10 seconds, to avoid step load changes on the mains supply.

- D. Recharge: Upon restoration of the AC input source, the input converters and output inverters shall simultaneously provide regulated power to the critical load and recharge the battery.
- E. Bypass operation: Bypass mode shall be reached either as a user selection or automatically.
 - 1. Bypass mode can be selected through the Control menu screen on the PowerView display
 - 2. The UPS will automatically switch into bypass mode if:
 - a. Both normal and battery operation modes are unavailable
 - b. An output overload condition occurs
 - c. The UPS has an internal fault

During bypass operation the utility power is connected to the load, bypassing the internal converters. If the bypass mode becomes unavailable the UPS will automatically switch to mains power. In the event that mains power is unavailable the system will switch to battery power.

With the UPS supplied from dual feeds and operating on battery, due to a mains failure, it shall be possible to request the unit to go to bypass, in addition to automatically transfer to bypass when the batteries are depleted. In this bypass mode the inverter shall become a PFC and back-feed the DC busses. This allows the charger to continue charging the batteries.

- F. External Service Bypass Panel (SBP): A maintenance service bypass cabinet shall provide power to the critical load bus from the bypass source, during times where maintenance or service of the UPS frame is required or when removal of the whole unit 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 enclosure unless otherwise stated in this specification. It shall be designed for either three phase input and output or single phase input and output 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 shall be contained in two rugged steel cabinets one containing the power electronics and the other containing the batteries and single phase distribution outlets;
- B. The UPS and battery cabinets shall be capable of conversion between Tower / Stack and Rack-Mount configurations;
- C. The power electronics cabinet dimensions including terminations shall be
- Rack or stack configuration 263 x 432 x 773mm (10.35 x 17 x 30.43 in.) (Height x Width x Depth), requires 6U of rack space and the side rack mounting brackets shall increase the overall width to 482mm (19 in);
- D. The battery cabinet dimensions including terminations shall be
- Rack or stack configuration 263 x 432 x 739 mm (10.35 x 17 x 29.1 in.) (Height x Width x Depth), requiring 6U of rack space and the side rack mounting brackets shall increase the overall width to 482mm (19 in);

2.2 SYSTEM CHARACTERISTICS

- A. System Capacity:
1. The system shall be rated for .8 Pf output:
 - a. 15,000VA or 12,000W whichever limit is reached first (15kVA model).
 - b. 20,000VA or 16,000W whichever limit is reached first (20kVA model).
- B. Input:
1. AC input nominal voltage:

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- a. 220/230/240VAC, single phase, 3 wire (L + N + G) or
 - b. 380/400/415VAC, three phase, 5 wire (L1+L2+L3+N+G);
2. AC input voltage window:
 - a. Full Load, 160 -275V (Line-Neutral) for single phase input or 277 -476V (Line-Line) for three phase input;
 - b. Half Load, 100 -275V (Line-Neutral) for single phase input or 173 -476V (Line-Line) for three phase input;
 3. Input frequency range: 40-70Hz;
 4. Input Power Factor; > 0.98 at 100% load
 5. Input Current Distortion: < 4% at 100% load, 230VAC (<7% for 3 phase output)
 6. Crest factor: 3:1.
- C. UPS Output:
1. AC Output Nominal Output: (Customer configurable)
 - a. 220VAC, 230VAC or 240VAC, Single Phase three wire, 50/60Hz;
 - b. 380VAC, 400VAC or 415VAC, Three phase five wire, 50/60Hz;
 2. AC output voltage distortion: Max. 2% @ 100% linear load; Max. 5% @ 100% non-linear Load;
 3. AC output voltage regulation (Static): +/-1%;
 4. Voltage Transient Response : +/- 8% maximum for 100% load step
 5. Voltage Transient Recovery within < 10ms recovery time;
 6. Output Voltage Harmonic Distortion:
 - a. <2% THD maximum for a 100% linear load
 - b. <5% THD maximum for a 100% non-linear load
 7. Overload Rating:
 - a. Online: 105% - infinite; 125% - 1 minute; 150% - 30 seconds;
 - b. In bypass: Overload is limited by the external input circuit breaker feeding the UPS.
 8. System AC-AC Efficiency: >94% at >50% load
 9. Output Power Factor Rating: 0.2 –1.0 lagging, nominal: 0.8 lagging.
 10. Output frequency: 50/60 +/- 3Hz tracking or 50/60 +/- 0.1Hz tracking (user selectable);

11. Output connectors:
 - a. Single phase: Hardwire 3-wire (Phase + N + G), 8 IEC 320 C19 (when battery module is utilized);
 - b. Three phase: Hardwire 5-wire (3 Phase + N + G)
12. Output frequency Slew rate : 1.0Hz/Sec, 0.5Hz/Sec 0.25Hz/Sec

2.3 ENVIRONMENTAL

1. Storage Ambient Temperature:
 - a. -15° to $+45^{\circ}$ C ($+5^{\circ}$ to $+113^{\circ}$ F) charge the UPS battery every 6 months.
 - b. $+30^{\circ}$ to $+70^{\circ}$ C ($+86^{\circ}$ to $+158^{\circ}$ F) charge the UPS battery every 3 months.
2. Operating Ambient Temperature: 0° C to $+40^{\circ}$ C ($+32^{\circ}$ F to $+104^{\circ}$ F). ($+25^{\circ}$ C ($+77^{\circ}$ F) is ideal for most battery types).
3. Relative Humidity: 0 to 95% non-condensing
4. Storage altitude: 15,240m (50,000 feet) above sea level
5. Operating altitude: 3,000m (10,000 feet) above sea level. At an altitude of 3,000 m the UPS shall be capable of supporting a load of up to 90% of its nominal capacity.
6. Audible noise:
 - a. For 15kVA: <50 dBa at 100 % load at 1m
 - b. For 20kVA: <50 dBa at <70 % load at 1m, <60 dBa at >75 % load at 1m

2.4 INPUT PFC POWER STAGE

- A. The input PFC power stage of the UPS shall constantly rectify the power imported from the mains input of the system, converting the 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 load, 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:

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1. The input converter shall control and limit the input current drawn from the utility supply to:
 - a. 15kVA unit – 95A (single phase), 31.6A per phase (three phase)
 - b. 20kVA unit – 121A (single phase), 40.3A per phase (three phase)
2. Overloads at low line input voltages shall draw power from the battery, (battery assist mode) in order to support the load and maintain the input current below the set current limit points.

D. Charging:

1. The battery charging shall maintain the DC bus float voltage of +/-219V, +/-1% at the nominal temperature of 20°C (68°F)
2. The battery charging circuit shall contain a temperature monitoring circuit, which will regulate the battery charging current to optimize battery life.
3. The battery charging circuit shall remain active when in automatic Bypass and in Normal Operation.
4. The battery charging system shall adjust the charging current by automatically sensing the number of battery modules and by monitoring the individual battery current. Maximum charger power shall be 3kW.

2.5 OUTPUT POWER STAGE (INVERTER)

- A. The UPS output power stage (inverter) shall constantly recreate 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) shall create an output voltage waveform independent of the mains input voltage waveform. 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) shall be capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for an indefinite length of time. The system shall transfer to bypass if the overload persists and then return back on-line when the overload is removed.
- C. Battery Protection: The UPS shall have 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 shall be 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 shall constantly monitor the output current, as well as the bypass source voltage, and inhibit potentially unsuccessful transfers to automatic bypass from taking place.

- B. The design of the automatic bypass switch power path shall consist of an electromechanical bypass contactor and series SCR's.
- C. Automatic Transfers: An automatic transfer of load to bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from 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 shall also take place if for any reason the UPS cannot support the critical bus.
- D. Manual Transfers: Manually initiated transfers to and from bypass shall be initiated through the UPS interface display or via the serial communications port.

2.7 DISPLAY AND CONTROLS

- A. Control Logic: The UPS shall be controlled by an embedded microcontroller which performs the following functions:
 - 1. Monitoring quality of input, bypass and output voltages;
 - 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 Unit: A microprocessor controlled display unit shall be located at the front of the system. The display shall consist of an alphanumeric display with backlight, providing system status, LED alarm indicators and a keypad consisting of pushbutton switches for control and status reading selection.
- C. Metered Data: The following metered data, shall be available on the alphanumeric display:
 - 1. Year, Month, Day, Hour, Minute, Second of occurring events

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2. Source and Bypass Input Voltages
 3. Output AC voltage
 4. Input, Bypass and Output AC currents
 5. Input, Bypass and Output Frequency
 6. Battery voltages and currents
 7. Internal and battery pack temperature
- D. Event log: The display unit shall allow the user to display a time and date stamped log of the 100 most recent status and alarm events.
- E. Alarms: The display unit shall allow the user to display a log of all active alarms. The following minimum set of alarm conditions shall be available:
1. Input Frequency outside configured range
 2. AC adequate for UPS but not for Bypass
 3. Low/No AC input, startup on battery
 4. Number of Batteries changed since last ON
 5. Number of Batteries increased
 6. Number of Batteries decreased
 7. Need Battery Replacement
 8. UPS Fault
 9. On Battery
 10. Shutdown or unable to transfer to battery due to overload
 11. Load Shutdown from Bypass. Input Frequency Volts outside limits
 12. Fault, Internal Temp exceeded system normal limits
 13. System level fan failed
 14. Bad Battery Module
 15. Runtime is below alarm threshold
 16. Load is above alarm threshold

17. Load is no longer above alarm Threshold
 18. Minimum Runtime restored
 19. Bypass is not in range (either frequency or voltage)
 20. UPS in Bypass due to Internal Fault
 21. UPS in Bypass due to overload
 22. Low Battery Shutdown
 23. Low Battery Warning
- F. Controls: The following controls or programming functions shall be accomplished by use of the display unit. Pushbutton switches shall facilitate these operations.
1. Silence audible Alarm
 2. Display or set the date and time
 3. Transfer critical load to and from bypass
 4. Test battery condition on demand
 5. Set intervals for automatic battery tests
 6. Adjust set points for different alarms
- G. Communication Interface Board: A communication interface shall provide the following communication ports which can be used simultaneously:
1. RS232 Serial Port #1
 2. RJ-45 Interface port for PowerView Display
 3. RJ-45 Ethernet connection, on installed Network Management Card

2.8 BATTERY

- A. The UPS battery system shall comprise of user replaceable, hot swappable, battery modules. Minimum four battery module pairs must be installed, two sets providing 192VDC nominal for the positive DC bus rail, two sets providing 192VDC nominal for the negative DC bus rail.
- B. The battery blocks housed within each removable battery module shall be of the Valve Regulated Lead Acid (VRLA) type.

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- C. The UPS shall incorporate an Intelligent Battery Management system to continuously monitor the health of the battery system and notify the user if that system is weak or needs replacing.
- D. It shall be possible to add additional battery modules to increase runtime. These modules shall be 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, XLBP2, that may be connected to the UPS shall be limited to 10.
- E. Battery modules shall have an embedded intelligent Microcontroller that will retain the modules serial number as well as diagnostic information.
- F. Each UPS Battery Module shall have a means of DC disconnect for transportation and to disconnect the battery module completely from the internal bus while installed in the UPS system.
- G. Charging:
 - 1. The intelligent battery management system shall contain a temperature monitoring circuit and compensation algorithm that regulates the battery charging current so as to optimize battery life. The UPS shall monitor the temperature of all battery packs and use the highest one as a reference to adjust the battery float voltage.
 - 2. The battery charging circuit shall remain active when in bypass or on-line.
 - 3. Charging system shall automatically adjust the maximum charger power, up to 3kW, based on the installed battery capacity and current through each battery string to avoid excessive charging that could result in blotted batteries. Each battery pack shall report its battery currents and temperature to UPS through CAN communication
- H. The UPS shall be shipped with battery modules preinstalled but disconnected.

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 shall be constructed in a free-standing, rack mounted or wall-mounted enclosure unless otherwise stated in this specification.

3.2 REMOVABLE INPUT/OUTPUT ELECTRICAL TERMINAL

- A. The input and output terminal connections shall be designed to be removable trays for easy electrical connection and unit removal.
- B. The removable input and output trays shall contain a means of configuring the system for 1 or 3 phase input and output as well as for single or dual feed input.

3.3 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 when the UPS is operating in the battery mode. APC PowerChute Network Shutdown software shall be available with the UPS.
 - 2. The UPS shall also be capable of using an RS232 port to communicate with the host computer by means of serial communications so as to gracefully shut down one or more operating systems during an on battery situation. APC PowerChute Business Edition software shall be available separately.

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

3.5 SOFTWARE COMPATIBILITY

- A. The UPS manufacturer shall have available software to support graceful shutdown and remote monitoring for the systems detailed on the following web link:

[Operating System and Processor Compatibility Chart](#)

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 cabinets for foreign objects.
4. Inspect battery chassis and modules.
5. Inspect power chassis

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 control functions.
3. Verify proper bypass operation.

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4. Verify system set points.
 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 shall have a worldwide service organization available, consisting of factory trained field service personnel to perform start-up, preventative maintenance, and service of the UPS system and power equipment. The service organization shall offer 24 hours a day, 7 days a week, 365 days a year service support.
- B. Replacement parts: Parts shall be available through the worldwide service organization 24 hours a day, 7 days a week, 365 days a year. The worldwide service organization shall be capable of shipping parts within 4 working hours or on the next available flight, so that the parts may be 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 shall be available from APC. All contract work shall be performed by APC factory trained service personnel.

4.4 TRAINING

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

End of Section 16611