

**STATIC UNINTERRUPTIBLE POWER SUPPLY
GUIDE SPECIFICATION
Eaton 93PM 10-200 kW 208V UPS**

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification describes a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up and distribution for critical electrical loads. The UPS shall consist of, as required by the project, the UPS module, batteries, or other DC storage systems, and accessory cabinet(s) for transformers, maintenance bypass, and distribution applications, and other features as described in this specification.

1.02 UPS SYSTEM DESCRIPTION

- A. UPS System Components: The UPS system shall consist of the following main components:
1. UPS module containing Rectifier(s), Inverter(s), Battery Charger(s), Static Bypass, and associated Control and Monitor Panel.
 2. Battery string(s) in Line-and-Match Battery Cabinets.
 3. Line-and-Match and/or sidecar-type accessory cabinets for transformer, maintenance bypass, parallel tie and distribution applications. Specific accessory availability depends on UPS model.
 4. Non-matching wall mounted or floor standing maintenance bypass cabinets or multi-module parallel tie cabinets.
- B. UPS Module Modes of Operation: The UPS Module shall operate as an on-line, fully automatic system in the following modes:
1. Normal: Utilizing commercial AC power, the critical load shall be continuously supplied by the Inverter. The Inverter shall power the load while regulating both voltage and frequency. The Rectifier shall derive power from the commercial AC source and shall supply DC power to the Inverter. Simultaneously, the Battery Charger shall charge the battery.
 2. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source. The 93PM UPS shall be capable of operating with 480VDC battery systems.
 3. Recharge: Upon restoration of the AC source, the Charger shall recharge the batteries and simultaneously the Rectifier shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.
 4. Bypass: If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to

Normal mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually from the front panel.

5. Energy Saver: The UPS shall continuously monitor the voltage and frequency of the bypass source. When the source parameters are within acceptable limits, the UPS will utilize a minimal/optimal combination of its internal subsystems to ensure acceptable power is always delivered to the critical load, at a system efficiency of up to 98.5%. The Energy Saver System shall be enabled by the user, and shall be adjustable. It shall incorporate a "High Alert Mode" to automatically (without user intervention) provide maximum power conditioning any time bypass source variation levels exceed preset, adjustable limits. When Energy Saver System is utilized, the UPS shall attenuate ANSI C62.41-type line transients to within IEC and ITIC limits. The Energy Saver System shall be able to distinguish between upstream (utility) faults and downstream (load) faults, and react appropriately to protect and support the critical load, without interruption.

1.03 REFERENCES

- A. UL 1778 (Underwriters Laboratories) – Standard for Uninterruptible Power Supply Equipment. Product safety requirements for the United States, 5th Edition.
- B. C-ULus CSA C22.2 No 107.3-14(Canadian Standards Association) – Commercial and Industrial Power Supplies. Product safety requirements for Canada.
- C. NEMA PE-1 – (National Electrical Manufacturers Association) – Uninterruptible Power Systems standard.
- D. IEC 62040-2 C2
- E. IEC 62040-3 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements.
- F. IEEE 587 (ANSI C62.41) Category A & B (International Electrical and Electronics Engineers) – Recommended practices on surge voltages in low voltage power circuits.
- G. FCC Rules and Regulations 47, Part 15, Class A (Federal Communications Commission) – Radio Frequency Devices.

1.04 SUBMITTALS

- A. The UPS shall be supplied with sufficient documentation, including the following manuals:
 1. Installation and Operation Manual: One copy of the installation and operation manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians or representatives to install and operate the UPS equipment and accessories. The manual shall include the following major items:
 - a) UPS description
 - b) UPS site planning and unpacking
 - c) UPS installation
 - d) Optional accessory installation
 - e) UPS theory of operation
 - f) Operating procedures
 - g) System events
 - h) UPS maintenance

- i) Performance and technical specifications
- j) Wiring requirements and recommendations
- k) Physical features and requirements
- l) Cabinet dimensions

1.05 QUALIFICATIONS

- A. The UPS manufacturer shall have a minimum of fifty years of experience in the design, manufacture and testing of solid-state UPS systems. A list of installed UPS systems of the same type as the manufacturer proposes to furnish for this application shall be supplied upon request.
- B. The UPS manufacturer shall have ISO 9001 and ISO 14001 certification for engineering/R&D, manufacturing facilities and service organization.
- C. The UPS manufacturer shall maintain a staffed 7x24x365 call center for technical and emergency support.
- D. Field Engineering Support: The UPS manufacturer shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. The organization shall consist of local offices managed from a central location. Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours. A map of the United States showing the location of all field service offices shall be submitted with the proposal. Third-party service or maintenance will not be accepted.
- E. Spare Parts Support: Parts supplies shall be located in the field to provide 80% of all emergency needs. The factory shall serve as the central stocking facility where a dedicated supply of all parts shall be available within 24 hours.
- F. Product Enhancement Program: The UPS manufacturer shall make available feature upgrade service offerings to all users as they are developed. These upgrades shall be available as optional field-installable kits.
- G. Maintenance Contracts: A complete range of preventative and corrective maintenance contracts shall be provided and offered with the proposal. Under these contracts, the manufacturer shall maintain the user's equipment to the latest factory revisions.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. The UPS shall withstand any combination of the following external environmental conditions without operational degradation.
 - 1. Operating Temperature: 5° C to + 40° C (41° F to 104° F) without de-rating (excluding batteries).
 - 2. Storage Temperature: - 25° C to + 55° C (-13° F to 131° F). Prolonged storage above + 40° C (104° F) will cause rapid self-discharge and permanent damage to the battery.
 - 3. Relative Humidity (operating and storage): 5-95% non-condensing.
 - 4. There shall be at least a 1.8°F (1.0°C) difference between the dry bulb temperature and the wet bulb temperature, at all times, to maintain a non-condensing environment
 - 5. The maximum rate of temperature change shall be limited to 3°F over 5 minutes (36°F/hour), based on the ASHRAE Standard 90.1-2013

6. Elevation:
 - a) Operational: 5000 ft. (1500 m) maximum without de-rating. Above this rating, altitude percent load de-rating as per IEC 62040-3
 - b) Transportation: Capable of air transport, up to 15,000m.

1.07 SAFETY

- A. The UPS shall be certified by Underwriters Laboratories in accordance with UL 1778, 5th Edition.
- B. The UPS shall be certified by the Canadian Standards Association in accordance with cULus CSA C22.2 NO.107.3-14.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers: Eaton.

2.02 UPS MODULE STANDARD FEATURES

The UPS module shall consist of the following standard components, housed in a 60 kW, 120kW, 160kW or 200kW frame:

- A. Quantity 1-3, (60 kW), 1-6, (120kW), 1-8 (160kW) or 1-10 (200kW) identical 20kW UPM Uninterruptible Power Modules, each containing:

1. Rectifier/Charger: The rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery. The rectifier/charger shall be a high-frequency PWM design, using Insulated Gate Bipolar Transistors (IGBTs). The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode. The rectifier/charger module shall also provide the following:
 2. The rectifier shall be capable of drawing power from the utility with a power factor of 0.99 under nominal conditions.
 3. The rectifier shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
 4. Inverter: The inverter shall feature an IGBT pulse-width-modulation (PWM) design with high speed switching. The inverter shall also have the following features:
 5. The inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.
 6. The modular design of the UPS shall permit safe and fast removal and replacement of the power module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode.
 7. The inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.

- B. Static Bypass: The bypass shall serve as an alternative source of power for the critical load when an abnormal condition prevents operation in normal mode. Each bypass circuit for 60kW/120kW/160kW/200kW frames shall consist of a fully rated, continuous duty, naturally commutated static switch for high-speed transfers. The bypass shall feature the following transfer and operational characteristics.
1. Transfers to bypass (for stand alone, and parallel capacity systems) shall be automatically initiated for the following conditions:
 - a) Output overload period expired.
 - b) Critical bus voltage out of limits.
 - c) Internal over temperature period expired.
 - d) Total battery discharge.
 - e) UPS failure.
 2. Parallel Redundant UPS systems shall transfer to bypass on conditions (a), (b), and (d) above. Conditions (c) and (e) will result in the affected UPS isolating itself from the parallel bus, allowing the remaining UPS(s) to support the critical load.
 3. Uninterrupted automatic re-transfer shall take place whenever the inverter(s) is capable of assuming the critical load.
 4. Uninterrupted automatic re-transfers shall be inhibited for the following conditions:
 - a) When transfer to bypass is activated manually or remotely.
 - b) In the event of multiple transfers/re-transfer operations the control circuitry shall limit "cycling" to three (3) operations in any ten-minute period. The third transfer shall lock the critical load on the bypass source, for 60 minutes.
 - c) UPS failure.
 5. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to bypass and from bypass shall be possible with the inverter logic. During manual transfers to bypass mode, the inverter must verify proper bypass operations before transferring the critical load to the bypass.
 6. All transfers to bypass shall be inhibited for the following conditions:
 - a) Bypass voltage out of limits (+10%, to -10% of nominal)
 - b) Bypass frequency out of limits (+/- 4 Hz, adjustable, factory set)
 - c) Bypass out of synchronization
 - d) Bypass phase rotation / installation error
 7. Static transfer time: No break, complete in less than 4ms.
 8. The bypass shall be manually energized using the control panel or remotely through a building alarm input.
- C. Monitoring and control components: The following components shall provide monitor and control capability:
1. Control panel: color LCD, touch sensitive, with LED status indicators.
 2. Alarm and metering display.
 3. Building alarm monitoring.
 4. Communication ports: RS-232 and USB.

- D. Battery management system: The UPS shall contain a battery management system which has the following features:
1. The battery management system shall provide battery time remaining while operating in normal mode and battery mode. Upon commissioning, battery runtime information shall be available.
 2. The battery management system shall automatically test the battery system to ensure that the battery is capable of providing greater than 80% of its rated capacity. Testing the batteries shall not jeopardize the operation of the critical load. Upon detection of the battery string(s) not capable of providing 80%, the UPS system will alarm that the battery needs attention/replacement. The battery test shall be able to detect the following:
 - a) Open battery string
 - b) Shorted battery string (current limit)
 - c) Battery capacity (runtime) less than 80% of "new" battery capacity
- E. Wiring Terminals: The UPS 60kW, 120kW, 160kW and 200kW frame modules shall contain through-hole busbar landings (adequately sized to accommodate 75 degree C wiring), for securing user wiring, using compression lugs, to the following locations:
1. Rectifier/charger input connections 3-wire plus ground
 2. Bypass input connections, (for dual source configurations): 4-wire plus ground.
 3. DC connections for battery cabinets (positive and negative plus ground).
 4. AC output connections 3-wire or 4-wire plus ground.

2.03 UPS MODULE OPTIONS AND ACCESSORIES

The UPS system may include the following options and accessories as required:

- A. Integrated Maintenance Bypass, Distribution, and Accessory Cabinet(s): Integrated Line-and-Match cabinet(s) shall be provided that include(s):
1. All hardware and interconnecting cable for connection to UPS module.
 2. SIAC-B (Bypass) Sidecar: Two, three, or four-breaker manual maintenance bypass switch in a sidecar configuration for 60 and 120kW; matching cabinet for 160 and 200kW, to isolate UPS module from commercial AC input and critical load. The bypass may be mounted on either side of the UPS module, and will be sized based on the UPS static switch rating. 160 and 200kW bypass cabinet must be placed adjacent to the UPS (no remote mounting). Switch shall provide complete isolation of UPS for servicing. Switch shall be make-before-break, slide-bar or kirk-key interlocked between UPS and bypass to prohibit improper operation. For all designs, the MBP breaker includes auxiliary contacts for monitoring. For 3 or 4 breaker designs, the BIB breaker also includes auxiliary contacts and a 48VDC shunt trip for backfeed protection.
 3. SIAC-TE (Top Entry) Sidecar, for 60 and 120kW frames: Empty side-car for top entry conduit landing and cabling. The sidecar may be mounted on either side of the UPS module. The 160 and 200kW UPS allows top entry without need for a sidecar.

4. Maintenance Bypass Panelboard: Wall-mount or floor-standing two, three, or four-breaker manual maintenance bypass system to isolate UPS module from commercial AC input and critical load.
5. Parallel Tie Panelboard: Wall-mount or floor-standing design, allows paralleling up to four UPS systems, includes MIS and optional MBP breaker to isolate UPS module from commercial AC input and critical load.
6. IAC-PD (Power Distribution) cabinet (**10-200kW models**): This standalone cabinet may be positioned on either side of the UPS module, or placed remotely from the UPS.

All versions are available in the following output configurations:

- a) (1) 225A Panelboard
- b) (1) 400A Panelboard
- c) (1) 225A Panelboard + (1) 250A Subfeed
- d) (1) 400A Panelboard + (1) 250A Subfeed
- e) (1) 225A Panelboard + (2) 250A Subfeeds
- f) (1) 400A Panelboard + (2) 250A Subfeeds
- g) (1) 225A Panelboard + (3) 250A Subfeeds
- h) (1) 400A Panelboard + (3) 250A Subfeeds
- i) (1) 225A Panelboard + (1) 400A Subfeed
- j) (1) 400A Panelboard + (1) 400A Subfeed
- k) (1) 225A Panelboard + (2) 400A Subfeeds
- l) (1) 400A Panelboard + (2) 400A Subfeeds
- m) (2) 225A Panelboards
- n) (1) 225A Panelboard and (1) 400A Panelboard
- o) (2) 400A Panelboards
- p) (1) 400A Subfeed
- q) (2) 400A Subfeeds
- r) (3) 400A Subfeeds
- s) (4) 400A Subfeeds

- B. Network Adapter and UPS Power Monitoring Software: Optional PX Gateway card adapter shall provide a communications interface between the UPS module and the following network management systems.

1. SNMP v.1, v.3
2. Modbus TCP
3. BACnet/WS or /IP
4. IPv6

This capability shall allow the unit to be monitored remotely over an Ethernet network using a standard web browser.

- C. UPS Power Monitoring Software: This system shall continuously monitor critical power elements associated with the UPS, using the communications port on each module and a customer furnished PC. The system shall automatically alarm if any problems arise and notify local or remote personnel of the alarm condition via email, page, or text message.
- D. Relay Card: Serial dry contact card providing 5 isolated dry output contacts, 1 isolated input. The relays are programmable.

- E. External Battery Cabinet: The battery cabinet shall feature either lithium ion batteries or valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements. The battery cabinet shall have the following features:
1. The battery cabinet shall be the same depth and height as the UPS module. A "Slim" (16.7" width) battery cabinet is optional for 10 to 200 models.
 2. The battery cabinet shall feature a mechanical enclosure of like appearance to the UPS module and shall feature casters for easy installation. Each battery cabinet shall require front access only for installation, service and maintenance.
 3. Power wiring internal to each line and match battery cabinet shall be factory provided. Each battery cabinet shall feature up to 10 battery trays which can be individually disconnected from the battery cabinet power wiring with quick disconnect devices. Each battery tray shall be firmly secured to the battery cabinet frame with fasteners. Each battery tray shall be removable from the front of the battery cabinet.
 4. Up to 4 line-and-match battery cabinets may be connected to a single UPS, see battery runtime charts for more information.
 5. For parallel systems, each UPS frame shall have a discrete battery system. A single battery system may not be shared across multiple UPS frames.
 6. Each battery cabinet shall feature a DC rated circuit breaker. The circuit breaker within the battery cabinet shall only provide protection to the battery string(s) within that battery cabinet. For battery configurations involving multiple battery cabinets, the batteries in one battery cabinet may be isolated from the DC link via its circuit breaker without disconnecting other battery cabinets from the DC link and the UPS module.
 7. The circuit breaker in each battery cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition.
 8. The circuit breaker in each battery cabinet shall feature a 48VDC shunt trip device. The shunt trip shall operate to trip the battery breaker(s) for an emergency power off command or battery disable command.
 9. Power and Control wiring between the co-located battery cabinet and the UPS shall be factory provided. Remote installation is available, with cabling provided by the installer.
 10. The batteries shall be optionally configured with a ¼" spade type connector for attaching sense leads to each jar to facilitate the future addition of a battery monitoring system.
 11. Expected battery life: for VRLA batteries, 200 complete full load discharge cycles when operated and maintained within specifications.
- F. Internal Batteries: The 60kW UPS frame shall feature internal, valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements.
1. The 60kW frame with internal batteries shall be configurable with either 2, 3, or 4 strings of batteries (8, 12, or 16 battery trays, respectively). Each battery tray shall be removable from the front of the UPS cabinet.
 2. The circuit breaker in the 60kW UPS cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition.

3. The circuit breaker in the 60kW UPS cabinet shall feature a 48VDC shunt trip device. The shunt trip shall operate to trip the battery breaker(s) for an emergency power off command or battery disable command.
 4. Expected battery life: 200 complete full load discharge cycles when operated and maintained within specifications.
- G. Parallel Systems (10 to 200kW models): Up to 4 UPS modules (UPS “frames”) may be paralleled for N+X redundancy, and/or for increased capacity. Maximum capacity in a parallel- system is 400kW.
1. UPS frames are not required to be identical in terms of quantity of internal UPMs, however frame sizing must be the same. For example, a 60/120kW UPS may be paralleled with a 120/120kW UPS.
 2. Additional 20kW UPMs may be field-added to available space in any UPS frame in a parallel system.
 3. Each UPS frame must have a dedicated battery system, or DC storage system.
 4. Each UPS will contain a built-in circuit (Control Area Network, or CAN) for communication of metering and status information between UPS frames. This will not require the use of a separate communication card. Interruption of the CAN bus will not cause the parallel system to fail to support the critical load.
 5. Load share balance will be within +/-5% of full load rating.

2.05 UNINTERRUPTIBLE POWER SUPPLY RATINGS AND OPERATING CHARACTERISTICS*

- A. UPS Continuous Ratings. The UPS shall be rated:

Rating	60kW Frame		120kW Frame		160kW Frame		200kW Frame	
	Capacity	N+1	Capacity	N+1	Capacity	N+1	Capacity	N+1
10	X	X	X	X	X	X	X	X
15	X	X	X	X	X	X	X	X
20	X	X	X	X	X	X	X	X
25	X	X	X	X	X	X	X	X
30	X	X	X	X	X	X	X	X
35	X	X	X	X	X	X	X	X
40	X	X	X	X	X	X	X	X
45	X		X	X	X	X	X	X
50	X		X	X	X	X	X	X
55	X		X	X	X	X	X	X
60	X		X	X	X	X	X	X
65			X	X	X	X	X	X
70			X	X	X	X	X	X
75			X	X	X	X	X	X
80			X	X	X	X	X	X
85			X	X	X	X	X	X
90			X	X	X	X	X	X
95			X	X	X	X	X	X
100			X	X	X	X	X	X

105			X		X	X	X	X
110			X		X	X	X	X
115			X		X	X	X	X
120			X		X	X	X	X
125					X	X	X	X
130					X	X	X	X
135					X	X	X	X
140					X	X	X	X
145					X		X	X
150					X		X	X
155					X		X	X
160					X		X	X
165							X	X
170							X	X
175							X	X
180							X	X
185							X	
190							X	
195							X	
200							X	

Units may be upgraded to their maximum UPS frame rating when sufficient UPMs are installed and appropriate firmware settings are implemented.

UPS output power factor rating is unity with the ability to support 0.8 leading to 0.8 lagging without de-rating.

The UPS may be ordered with any of the optional ratings, and later upgraded to its corresponding maximum frame rating (60kW, 120kW, 160kW or 200kW). It is recommended that premises wiring should be sized for the maximum possible rating of the UPS (i.e. to match the UPS frame rating).

B. Acceptable UPS input sources:

1. UPS shall support 4-wire grounded Wye sources. A neutral conductor from the source is required to be terminated on the neutral bus in the UPS, and is then passed through to the load, if 120 or 127 Vac output is required.

- a) Single source, single or dual feed: 4-wire grounded neutral wye
- b) Dual source*, dual feed: 4-wire grounded neutral wye

*TT sources for the UPS must all share the same ground plane.

C. Rectifier/charger input:

1. Nominal three phase input voltage: 208/120 or 220/127Vac three wire plus ground

2. Operating input voltage range: +15%, -15% for 208V, and +10%, -15% for 220V of average nominal input voltage without battery discharge. Note the UPS shall “power share” with the battery to -30% of nominal voltage, at full rated load.
3. Operating input frequency range shall be 40 to 72Hz.
4. Input power factor 0.99 lagging at rated load.
5. Normal input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode:
6. Rectifier/charger input current limit shall be adjustable from 100 to 115% of UPS kW rating.
7. On generator input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode on generator:
8. Rectifier/charger input current limit shall be adjustable from 100% to 115% of UPS full load kW rating.
9. Battery recharge input current limit shall be adjustable from 0 to 7A per 20kW UPM module. This limit may be less, depending on size of input service and UPS input current limit setting
10. Input current total harmonic distortion (THD) shall be less than 3.5% at nominal line voltage and 5% nominal source impedance.
11. Power walk-in: Ramp-up to full utility load adjustable from 14 amps per second to 0.7 amp per second, per each UPM in the system.

D. Bypass input:

1. Synchronizing bypass voltage range shall be +10, -15% of average nominal input voltage.
2. Synchronizing bypass frequency range is +/- 0.5 Hz to +/-4 Hz, user adjustable, and is centered on the nominal frequency. Default setting is +/- 4 Hz.
3. Slew rate: 0.5 Hz per second, maximum.
4. Bypass and rectifier inputs can be supplied from out of phase sources if required.
5. Input surge withstand capability: The UPS shall be in compliance with IEEE 587 (ANSI C62.41), category A & B (6kV).

E. Rectifier/charger output:

1. Nominal DC voltage shall be 480 VDC (open circuit battery voltage).
2. Capacity: The rectifier/charger shall support a fully loaded inverter and recharge the VRLA battery to 90% of its full capacity within 10 times the discharge when input current limit is set at maximum.
3. Low line operation: The rectifier/charger shall be capable of sharing the DC load with the battery when the input voltage falls below the specified operation input voltage range, the “on battery” indicator shall annunciate operation in this mode.
4. DC sensing: DC voltage sensing methods shall be incorporated for providing battery over-voltage protection.
5. Battery charger characteristics: The UPS battery charging system shall have the following characteristics:

- a) The charger shall be capable of being configured for several charge modes including:
 - (1) A charging mode that increases battery life by allowing the battery to rest periodically, reducing positive plate corrosion
 - (2) A charging mode floating the battery at a set level, which can be adjusted via firmware.

- b) UPS module will automatically adjust battery shutdown based upon loading and battery capacity.
 - (1) The UPS module shall automatically adjust the final discharge voltage between 1.67 and 1.75 Volts per cell based on the existing load and the rate and length of discharge.
 - (2) The absolute minimum operational voltage is 1.67 V per cell (adjustable upward).

F. UPS output in normal mode

- 1. Nominal output voltage 208V or 220V, 3-phase, 3-wire or 4-wire plus ground at the UPS output terminals, .
- 2. Steady-state voltage regulation (in inverter) shall be within +/- <1% average from nominal output voltage.
- 3. Transient voltage response shall be per EN62040-3, Class 1, VFI-SS-111.
- 4. Transient voltage recovery shall be compliant to EN62040-3, Class 1, VFI-SS-111.
- 5. Linear load harmonic distortion capability: Output voltage THD of less than 1.6% for 100% linear load.
- 6. Non-linear load harmonic distortion capability: Output voltage THD of less than 2% for 100% non-linear load when tested using the non-linear load described in IEC 62040-3.
- 7. Line synchronization range shall be +/- 4Hz, adjustable to +/-0.5 Hz.
- 8. Frequency regulation shall be +/- 0.1Hz free running.
- 9. Frequency slew rate shall be 0.5 Hz/second maximum.
- 10. Phase angle control:
 - a) Balanced linear load shall be <1 degree from nominal 120 degrees
- 11. Phase voltage control:
 - a) Balanced linear loads shall be +/- 1% from average phase voltage
 - b) Unbalanced linear loads shall be less than <2% (@208V) and <3% (@220V) from average phase voltage for 100% load unbalanced
- 12. Overload current capability (with nominal line and fully charged battery, non-paralleled systems):
 - a) Double Conversion mode: The unit shall maintain voltage regulation for 102% to <110% of resistive/inductive load for 10 minutes, 111% to <125% for 60 seconds, and 126% to 150% for 10 seconds, >151% for 300ms.

- b) Stored energy mode (typically on battery): The unit shall maintain voltage regulation for 102% to <110% of resistive/inductive load for 10 minutes, 111% to <125% for 60 seconds, and >126% for 300ms.
 - c) Energy Saver System operation: Continuous = 110%. Transient = 1000% peak current for 10ms.
 - d) On bypass (single UPS systems): Continuous = 125%. Transient = 1000% peak current for 10ms.
13. Fault clearing current capability: See section 12 above.
 14. Static transfer time, inverter to bypass: No break, completed in less than 4ms.
 15. Static transfer time, Energy Saver to inverter: No break, completed in less than 4ms maximum, typically <2ms.
 16. Common mode noise attenuation:
 - a) -65dB up to 20kHz, -40db up to 100kHz
 - b) > 100dB with isolation transformer
 17. Acoustical noise: Noise generated by the UPS under normal operation shall not exceed levels in table below at one meter from any operator surface, measured at 25 degrees C (77 degrees F) , per ISO 7779 standard.

UPS frame kW	50% load	70% load	100% load	
60				
120				
160				
200				

18. EMI Suppression: The UPS shall meet FCC rules and regulation 47, part 15, for Class A devices, and IEC62040-2 C2 and C3.
19. Electrostatic discharge (ESD): The UPS shall meet IEC61000-4-2 level 3; 4kV contact/8kV air discharge.
20. Efficiency: The UPS incorporate 3-level power converter design for highest possible efficiency. Full load efficiency for non-derated hardware shall be up to 95%, 50% load efficiency shall be 95%, and the UPS shall achieve >94.0% efficiency at 25% load. These numbers are for N+0 configurations only.

G. UPS Output with Energy Saver System option

1. The Energy Saver System acts to optimize the internal components of the UPS power train to maximize system efficiency when the bypass source is within the following (adjustable) limits: Voltage: +/-10%, and Frequency: +/-3Hz.
2. Nominal output voltage 208V or 220V, 3-phase, 4-wire plus ground at UPS output terminals. Steady-state voltage regulation shall be within +/- 10% from nominal output voltage.
3. Line synchronization range shall be +/- 4 Hz, adjustable.

4. Frequency regulation shall be +/-4 Hz when bypass source is within the limits in (1) above, and +/- 0.1Hz free running,
5. Overload current capability (with bypass source within the limits of (1) above)
Continuous: 110%, Transient: 1000% for 10msec.
6. Static transfer time: No break, typically completed in less than 2ms, including detection time.
7. Acoustical noise: Noise generated by the UPS under normal operation shall not exceed 65dbA at one meter from any operator surface, measured at 25 degrees C (77 degrees F) and full load.
8. EMI Suppression: The UPS shall meet FCC rules and regulation 47, part 15, for Class A devices, and IEC62040-2 C2 and C3.
9. Electrostatic discharge (ESD): The UPS shall meet IEC61000-4-2 level 3; 4kV contact/8kV air discharge.
10. Efficiency: The UPS efficiency shall be up to 98.5%, over the range of 25% to 100% load; for N+0 configurations only.

*Unless otherwise specified, performance data in Sec 2.05 above is measured under conditions of 100% resistive load for fully rated UPS sizes, 25 degrees C ambient temperature, nominal rectifier and bypass input voltages, and battery system floating.

2.06 MECHANICAL DESIGN

- A. Enclosures: The UPS shall be housed in free-standing double front enclosures (safety shields behind doors) equipped with casters and leveling feet. The enclosures shall be designed for computer room applications. Front doors shall have locks to prevent unauthorized entry.
- B. Modular construction: The UPS shall be comprised of Universal Power Modules (UPMs), each hardware-rated for 20kW, and each including the rectifier, inverter, and battery converter power and control circuitry. These UPMs shall be draw-out assemblies that can be quickly exchanged or replaced by authorized service personnel, with proper personal protective equipment; [PPE], , without transferring the UPS output load to bypass.
- C. Ventilation: The UPS and shall be designed for forced-air cooling. Air inlets shall be on the front of the unit. Air outlet configuration for the UPS, and its accessory cabinet(s) shall be user selectable at time of order to exhaust warm air at the top of the cabinet (row or wall installations), or exhaust at the rear of the cabinet for "hot aisle" configurations. Eighteen inches of clearance over the UPS outlets shall be required for proper air circulation (top exhaust), or working space (rear exhaust). An air filter shall be mounted in the front door of the UPS module.
- D. No rear or side clearance or access shall be required for the system. The back and side enclosure covers shall be capable of being located directly adjacent to a wall.
- E. Cable entry: Standard cable entry for the 60 or 120kW frame UPS cabinet shall be through the enclosure bottom. Top cable entry shall be facilitated by a sidecar which can be mounted on either side of the UPS. Standard. Cable entry for the 160 and 200kW UPS shall be top or bottom, or both.
- F. Front access: All serviceable subassemblies shall be modular and capable of being replaced from the front of the UPS (front access only required). Side or rear access for installation, service, repair or maintenance of the UPS system shall not be required.
- G. Service area requirements: The system shall require no more than thirty six (36) inches of front service access room and shall not require side or rear access for service or installation.

2.07 CONTROLS AND INDICATORS

- A. Microprocessor controlled circuitry: The UPS controls shall have the following design and operating characteristics:
1. Fully automatic operation of the UPS shall be provided through the use of microprocessor controlled Digital Signal Processing. Start-up and transfers shall be automatic functions, and will not require operator intervention.
- B. Digital Front Panel Display: The UPS control panel shall be a 7" touch sensitive, backlit LCD front panel display that includes LED indicators for basic UPS status. Large, luminous, color coded LED pillars (vertical bars) shall show the UPS status (green, amber, red), and be visible up to 30m from the UPS. The LCD shall display:
1. UPS status (home screen): the LCD screen shall have a color coded border (header) that turns red on alarm, and shows basic UPS status in the header of the display, visible at all times. The header shall alternately show UPS status output voltage and battery time remaining, and be visible constantly in all display screens. The home screen shall show load level, average efficiency, and power consumption in kWh. The home screen shall show a system mimic diagram with a color-highlighted power path, operating mode, and active events.
 2. Controls tab: Shall provide touch sensitive button controls, with a confirm prompt, for turning the UPS on and off, transfer to/from bypass, and enabling or disabling the battery charger, initiating a battery test, and enabling or disabling Energy Saver System (ESS).
 3. Metering tab: The metering screen shall show voltages currents, temperatures, kW, kVA, and power factor (as applicable) for the UPS input, output, bypass source, and battery. Color coded (green, amber, red) bar graph indicators will accompany power and temperature measurements
 4. Logs tab: alarm/event queue, active alarms and alarm history, events, status changes and commands, all timed to the 1/1000th second for tracking and analysis.
 5. Statistics tab: Numerically and graphically displays the estimated savings afforded by ESS operation over time.
 6. Settings tab: shall provide button access to user adjustable settings such as, but not limited to: date/time, building alarm designations, communications parameter setup, UPS name, user passwords, and display language.
- C. Control Panel Lamp Indicators: The UPS control panel shall provide the following monitoring functions with indicator (icon) LED's:
1. NORMAL: This green LED shall indicate that the commercial AC utility or generator source is supplying power to the rectifier and the inverter is supporting the critical load.
 2. BYPASS: This amber LED shall indicate that the UPS has transferred the load to the bypass circuit.
 3. BATTERY: This amber LED shall indicate that the commercial AC utility or generator source has failed and the battery is supplying power to the inverter, which is supporting the load.
 4. ALARM: This red LED and the accompanying audible alarm horn, shall indicate that the UPS detects an alarm condition, outlined in detail in the Logs tab from the home screen and in the operator's manual.

- D. Interface panel: The UPS shall be equipped with an interface panel, located behind a protective cover, which provides the following signals and communication features in a Class 2 environment:
1. Alarm contact: A dry contact for annunciating a summary alarm shall be provided for customer use. This contact shall be Form "C" capable of supplying both N/O and N/C contacts. Contact ratings shall be 5A max at a voltage not to exceed 28VDC or 277VAC.
 2. RS232 (EIA / TIA-232) and USB communications interfaces: Circuitry shall be provided for one "host", and one "device" USB connector, and one RS232 (EIA / TIA-232) communication port for connection to automated service department diagnostic tools. This port may be used with simple ("dumb") terminals to gain remote access to all unit operation information.
 3. Building alarms: Five inputs shall be provided for monitoring the status of external dry contacts. Building alarms shall be set up through the UPS configuration mode function on the UPS front panel display or via the RS232 (EIA / TIA-232) port.
 4. External REPO contacts: Shall be provided to connect an external remote emergency power off switch to shut down the UPS and de-energize the critical load. Normally open or normally closed contacts shall be acceptable.
 5. Battery control contacts: Contacts shall be provided to connect the battery shunt trip and auxiliary contact signals from a battery breaker or battery disconnect switch.
 6. External bypass indicator connection: A connection point shall be provided to acknowledge that an external maintenance bypass has been closed around the UPS, placing the critical load on utility power.
 7. SELV 24V: this provides stable power for communication between the UPS and optional accessories.

2.08 COMMUNICATIONS

- A. Communications Bay: The UPS shall be equipped with field configurable communications bays that will accommodate four (4) plug-in communication devices
- B. Remote Monitoring:
1. Optional WEB/SNMP communication capabilities will be available for all systems.
 2. The UPS shall be able to be monitored remotely via communications devices. UPS manufacturer shall provide optional communications devices capable of communicating via various industry standard protocols such as RS232, SNMP, BACnet and ModBus. Monitoring of UPS status may also be performed through isolated dry contact Form C relays.

The UPS communication capability should be able to integrate into any industry standard Building Management System (BMS) and/or Network Management System (NMS). The UPS must also be able to be monitored via any standard Internet browser.

All optional hardware interfaces shall be "Hot-swappable" (UPS maintains power to critical applications while changing interfaces).

- C. Shutdown:
1. There shall be a mechanism that provides graceful, orderly, unattended, sequential shutdown of one or multiple computers powered by one UPS. This shutdown shall be performed via in-network or out-of-network means. The order

of shutdown shall be user-defined, allowing the maximization of runtime on battery for more critical systems.

2. The UPS shall also be capable of interfacing with an operating system's built-in shutdown routine. This shall be done through a cable connection to the communication interface card.

D. Notification:

1. There shall be a mechanism to send alerts to key personnel via email or SNMP traps. An alarm notification may also be sent by a network message.

2.08 UPS MODULE PROTECTION

- A. Rectifier/Charger and Bypass protection shall be provided through individual fusing of each phase.
- B. Bypass backfeed protection shall be included with sidecar and wall mount maintenance bypass options. The UPS shall provide backfeed detection. If no maintenance bypass is used, backfeed protection shall be provided via a shunt trip (48VDC) signal available to an external bypass input breaker
- C. Battery protection shall be provided by thermal-magnetic molded-case circuit breakers in each battery cabinet (if standard battery pack is provided) or external protective device for an external battery.
- D. Electronic current limiting circuitry and fuses in the Inverter circuit shall provide output protection.
- E. To comply with agency safety requirements, the UPS module shall not rely upon any disconnect devices outside of the UPS module to isolate the battery cabinet from the UPS module.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.02 COMMISSIONING

- A. Factory start-up shall be provided on a 5x8 basis (7 x 24 optional). Start-up service shall be provided at no extra charge and shall include one visit to perform all procedures and tests specified within UPS Installation and Operation manual. UPS manufacturer shall also offer the following optional services:
 1. Pre-energize visit to inspect installation and provide guidance to installers as required.
 2. Post-start-up visit for alarm notification configuration, operator training, generator testing, etc.
- B. The following procedures and tests shall be performed by Field Service personnel during the UPS startup:
 1. Visual Inspection:

- a) Visually inspect all equipment for signs of damage or foreign materials.
 - b) Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.
2. Mechanical Inspection:
- a) Check all the power connections for tightness.
 - b) Check all the control wiring terminations and plugs for tightness or proper seating.
3. Electrical Pre-check:
- a) Check the DC bus for a possible short circuit.
 - b) Check input and Bypass power for proper voltages and phase rotation.
 - c) Check all lamp test functions.
4. Initial UPS Startup:
- a) Verify that all the alarms are in a “go” condition.
 - b) Energize the UPS module and verify the proper DC, walkup, and AC phase on.
 - c) Check the DC link holding voltage, AC output voltages, and output waveforms.
 - d) Check the final DC link voltage and Inverter AC output. Adjust if required.
 - e) Check for the proper synchronization.
 - f) Check for the voltage difference between the Inverter output and the Bypass source.
 - g) Optional on site full-load, step-load, and battery discharge tests using supplier furnished load bank, shall also be offered.
5. Operational Training: Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.

3.03 WARRANTY

All components of the UPS system shall be covered by a standard one-year limited factory warranty and service protection package.

One-year limited factory warranty shall include replacement coverage for the UPS parts for a period of 18 months from shipment or 12 months from start-up, whichever occurs sooner. Labor coverage is for 90 days after product startup.

One-year service protection package shall include 7x24 on-site repair/replacement labor for UPS parts and batteries; 7x24 technical support coverage; and 7x24 PredictPulse predictive analytics and remote monitoring service (with monthly reports for UPS and battery performance). Connectivity kit for PredictPulse is provided upon customer signup. Standard service response time shall be 8 hours from receipt of call. Manufacturer shall also offer, as an option, 7x24 on-site service support with guaranteed response times of 4, or 2 hours in certain major metropolitan areas. Additional preventive maintenance visits shall be available as an option for both UPS and battery components.

Manufacturer shall also include Start-up services consisting of: 7x 24 Start-up service of UPS and batteries. On-site user training, Site Audit, installation and commissioning of monitoring service, and validation of one-year limited factory warranty will be performed during the start-up.

Manufacturer shall also offer an optional service plan to provide 7x24 on-site coverage (preventive and corrective) for UPS and batteries, guaranteed response time, remote monitoring, Web access to service site history, annual Site Audit, UPS and battery preventive maintenance visit, and discounts on upgrade and modification kits. Manufacturer shall also provide an optional battery service plan to provide parts-and-labor coverage for partial and full battery strings, either with preventive maintenance or replacement coverage.

END