

APC by Schneider Electric

MGE GALAXY 5000

Data Center Grade Three Phase Uninterruptible Power Supply Single Module - Guide Specifications 40-130 kVA UPS

THIS GUIDE SPECIFICATION IS WRITTEN IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATIONS INSTITUTE (CSI) MASTERFORMAT. THIS SECTION MUST BE CAREFULLY REVIEWED AND EDITED BY THE ARCHITECT OR THE ENGINEER TO MEET THE REQUIREMENTS OF THE PROJECT. COORDINATE THIS SECTION WITH OTHER SPECIFICATION SECTIONS IN THE PROJECT MANUAL AND WITH THE DRAWINGS.

WHERE REFERENCE IS MADE THROUGHOUT THIS SECTION TO "PROVIDE", "INSTALL", "SUBMIT", ETC., IT SHALL MEAN THAT THE CONTRACTOR, SUBCONTRACTOR, OR CONTRACTOR OF LOWER TIER SHALL "PROVIDE", "INSTALL", "SUBMIT", ETC., UNLESS OTHERWISE INDICATED.

THIS SECTION IS WRITTEN TO INCLUDE THE 2004 MASTERFORMAT AND THE 1995 MASTERFORMAT VERSIONS. WHERE APPLICABLE, THESE ITEMS ARE BRACKETED AND, IN EACH CASE, UNLESS OTHERWISE INDICATED, THE FIRST CHOICE APPLIES TO THE 2004 MASTERFORMAT AND THE SECOND CHOICE APPLIES TO THE 1995 MASTERFORMAT.

SECTION [26 33 63] [16611]

SOLID STATE UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, [Division 01 - GENERAL REQUIREMENTS] [Division 1 - GENERAL REQUIREMENTS], and other applicable specification sections in the Project Manual apply to the work specified in this Section.

1.2 SUMMARY

- A. **Scope:** Provide design and engineering, labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for a solid state uninterruptible power supply (UPS) as required for the complete performance of the work, and as shown on the Drawings and as herein specified.
- B. **Section Includes:** The work specified in this Section includes, but shall not be limited to, a three-phase, on-line, double conversion, solid state UPS. The UPS shall operate in conjunction with the existing building electrical system to provide high quality power conditioning, back-up power protection, and distribution for electronic equipment loads. The system shall consist of a solid state IGBT rectifier/inverter, power factor corrected rectifier, a 100 percent rated for continuous duty static switch, battery plant, graphical status/control panel, and synchronizing circuitry as described herein.

1.3 REFERENCES

- A. **General:** The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
- B. **Institute of Electrical and Electronics Engineers, Inc. (IEEE):**
 - 1. ANSI/IEEE C62.41, "Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits" (copyrighted by IEEE, ANSI approved).
- C. **International Organization for Standardization (ISO):**
 - 1. ISO 9001, "Quality Management Systems - Requirements."

- D. **National Electrical Manufacturers Association (NEMA):**
 1. NEMA PE 1, "Uninterruptible Power Systems (UPS) - Specification and Performance Verification."
- E. **National Fire Protection Association (NFPA):**
 1. NFPA 70, "National Electrical Code" (copyrighted by NFPA, ANSI approved) - hereinafter referred to as NEC.
- F. **Underwriters Laboratories, Inc. (UL):**
 1. UL 1778, "Standard for Uninterruptible Power Supply Equipment" (copyrighted by UL, ANSI approved). "
 2. UL 924, "Emergency Lighting and Power Equipment"

1.4 SYSTEM DESCRIPTION

A. UPS Design Requirements:

INSERT KVA BELOW.

1. **Output Power Continuous Rating:** The continuous output power rating of the UPS shall be [____] kVA at a 0.9 lagging power factor.
2. **Field-Powered Upgrade:** The following power ratings may be upgraded in the field to provide more output power with no increase in footprint:
 - a. 40 kVA/36 kW UPS modules shall upgrade to 50 kVA/45 kW.
 - b. 60 kVA/54 kW UPS modules shall upgrade to 80 kVA/72 kW.
 - c. 100 kVA/90 kW UPS modules shall upgrade to 130 kVA/117 kW.

INSERT VOLTS BELOW.

3. **Input Voltage:** [____] volts AC, -15 percent +10 percent, three-phase, 3 wires, grounded wye, configuration plus ground.
 - a. 480 volts standard.
 - b. 208 volts, 220 volts, 600 volts with optional transformer.

INSERT VOLTS BELOW.

4. **Output Voltage:** [____] volts AC, three-phase, 3 wires plus ground.
 - a. 480 volts standard.
 - b. 208 volts, 220 volts, 600 volts with optional transformer.
 - c. 4 wire output shall be derived within the UPS system and provided as needed at 480/277 or 208/120 with optional transformer.

INSERT AMPS BELOW.

5. **Input Current:** [____] amps @ 480 volts AC maximum charging
6. **Output Current:** [____] amps @ 480 volts AC

INSERT MINUTES BELOW.

7. **Battery Autonomy:** UPS shall be capable of operating at full load for [____] minutes at 0.9 PF output at a temperature of 77 °F (25 °C) on battery power.
8. **Battery Type:** Valve regulated sealed lead acid (VRLA).

B. AC Input Characteristics:

INSERT VOLTS BELOW.

1. **Voltage:** [____] volts AC, -15 percent +10 percent, three-phase, 3 wires, grounded wye, configuration plus ground.
2. **Frequency:** 60 hertz, ±5 percent.
3. **Power Factor:** Greater than 0.98 lagging.
4. **Total Harmonic Distortion:** Less than 5 percent at full load.
5. **Inrush Current:** Less than nominal input current for less than one cycle.

6. **Input Surge Protection:** UPS shall be equipped to withstand surges per ANSI/IEEE C62.41.

C. **AC Output Characteristics:**

INSERT VOLTS BELOW.

1. **Voltage:** [____] volts AC, ± 1 percent steady state variation phase-to-phase voltage volts AC, three-phase, 3 wires plus ground. 4 wire output shall be available through optional transformer.
2. **Frequency:** 60 hertz, ± 1.0 percent (or selectable up to 4 percent); 60 hertz, ± 0.1 percent when free running.
3. **Voltage Regulation:** ± 1.0 percent for balanced load, ± 1.75 percent for 50 percent unbalanced load, ± 2.5 percent for 100 percent unbalanced load.
4. **Voltage Distortion:** Maximum 2 percent total (THD) and 1 percent any single harmonic on 100 percent linear loads.
5. **Voltage Transient (Step Load) Response:** ± 2 percent for load step changes from 100 percent to 0 and from 0 to 100 percent. The system returns to the ± 1 percent range in rms value in less than 100 ms.
6. **Voltage Recovery Time:** Return to within 1 percent of nominal value within 16.67 milliseconds (one cycle).
7. **Phase Angle Displacement:** 120 degrees, +1 degree for balanced load; 120 degrees, +3 degrees for 100 percent unbalanced load.
8. **Non-Linear Load Capability:** Output voltage total harmonic distortion shall be less than 3 percent when connected to a 100 percent non-linear load with a crest factor not to exceed 3 percent.
9. **Slew Rate:** 1.0 hertz/second maximum (or selectable up to 2.0 hertz/second).
10. **Power Factor:** 0.9 at the rated volt amperes (VA).
11. **Inverter Overload Capability:** 125 percent of rated load for 10 minutes, 150 percent of rated load for 1 minute.
12. **Bypass Overload Capability:** Greater than 212 percent for one cycle; greater than 150 percent for 1 minute.

D. **Battery:**

1. **Battery Voltage:** 356 volts DC minimum before cutoff; 432 volts DC nominal; 490 volts DC equalization voltage.

INSERT AMPERES BELOW.

2. **Maximum DC Current:** Maximum DC current at cutoff voltage shall be [____] amperes.
3. The battery charger is equipped with a temperature probe to enable temperature compensated charging.

1.5 **SUBMITTALS**

- A. **General:** See [Section 01 33 00 - SUBMITTAL PROCEDURES] [Section 01300 - SUBMITTALS].
- B. **Product Data:** Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Product data shall include, but shall not be limited to, the following:
 1. Catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.
 2. Manufacturer's installation instructions indicating application conditions and limitations of use stipulated by product inspecting and testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of the product. Include equipment installation outline, connection diagram for external cabling, internal wiring diagram, and written instruction for installation.
- C. **Shop Drawings:** Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data, including, but not limited to, complete electrical characteristics and connection requirements. Provide detailed equipment

outlines with cabinet dimensions and spacing requirements; location of conduit entry/exit paths; location of floor/seismic mounting; available battery types/sizes; cabinet weights; heat rejection and air flow requirements; single-line diagram; and control and external wiring.

- D. **Wiring Diagrams:** Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.
- E. **Contract Closeout Submittals:**
 - 1. **Project Record Documents:** Submit a complete set of installation drawings showing all the information specified elsewhere in this Section.
 - 2. **Operation and Maintenance Data:** Submit operation and maintenance data to include in operation and maintenance manuals specified in [Division 01 - GENERAL REQUIREMENTS] [Division 1 - GENERAL REQUIREMENTS], including, but not limited to, safe and correct operation of UPS functions.

1.6 QUALITY ASSURANCE

- A. **Qualifications:**
 - 1. **Manufacturer Qualifications:** Manufacturer shall be a firm engaged in the manufacture of solid state UPS of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 20 years.
 - a. The manufacturer shall be ISO 9001 certified and shall be designed to internationally accepted standards.
 - 2. **Installer Qualifications:** Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing solid state UPS similar in type and scope to that required for this Project.
- B. **Regulatory Requirements:** Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.
 - 1. The UPS shall meet the requirements of the following standards:
 - a. UL-listed under UL 1778.
 - b. UL Canada (cUL).
 - c. FCC rules and regulations of Part 15, Subpart J, Class A.
 - d. ANSI/IEEE C62.41.
 - e. ISO 9001.
 - 2. The UPS shall be designed in accordance with the applicable sections of the documents published by:
 - a. National Fire Protection Association (NFPA); NEC.
 - b. National Electrical Manufacturers Association (NEMA); NEMA PE 1.
 - c. Occupational Safety and Health Administration (OSHA).
- C. **Factory Testing:** Prior to shipment the manufacturer shall complete a documented test procedure to test functions of the UPS module and batteries (via a discharge test), when supplied by the UPS manufacturer, and warrant compliance with this Section. The factory test shall be performed in the presence of the Owner providing the manufacturer receives adequate prior notice. The manufacturer shall provide a copy of the test report upon request.
- D. **Pre-Installation Conference:** Conduct pre-installation conference in accordance with [Section 01 31 19 - PROJECT MEETINGS] [Section 01200 - PROJECT MEETINGS]. Prior to commencing the installation, meet at the Project site to review the material selections, installation procedures, and coordination with other trades. Pre-installation conference shall include, but shall not be limited to, the Contractor, the Installer, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Architect/Engineer.
- E. **Source Responsibility:** Materials and parts comprising the UPS shall be new, of current manufacture, and shall not have been in prior service, except as required during factory testing. Active electronic devices shall be solid state and shall not exceed the manufacturer's recommended tolerances for temperature or current to ensure maximum reliability. Semiconductor devices shall be sealed. Relays shall be provided with dust covers. The

manufacturer shall conduct inspections on incoming parts, modular assemblies, and final products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
- C. Products shall be packaged in a manner to prevent penetration by debris and to allow safe delivery by modes of ground transportation and air transportation where specified.
- D. Prior to shipping, products shall be inspected at the factory for damage.
- E. Equipment shall be protected against extreme temperature and humidity and shall be stored in a conditioned or protected environment.
- F. Equipment containing batteries shall not be stored for a period exceeding three months without powering up the equipment for a period of eight hours to recharge the batteries.

1.8 PROJECT CONDITIONS

- A. **Environmental Requirements:** Do not install solid state UPS until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.
 - 1. The UPS shall operate under the following environmental conditions:
 - a. **Temperature:**
 - 1) **UPS Module Operating:** 32 °F (0 °C) to 104 °F (40 °C).
 - 2) **Non-Operating:** -4 °F (-20 °C) to 113 °F (45 °C).
 - b. **Relative Humidity (Operating and Storage):** 0 percent to 95 percent non-condensing.
 - c. **Barometric Pressure:** Up to 3281 feet (1000 meters) above sea level (up to 6562 feet [2000 meters] with ambient temperature less than 82 °F [28 °C]) / up to 39,370 feet (12,000 meters) above sea level non-operating.
 - d. **Audible Noise:** 69 dBA at 3 feet (914 mm).

1.9 WARRANTY

- A. **General:** See [Section 01 77 00 - CLOSEOUT PROCEDURES] [Section 01770 - CLOSEOUT PROCEDURES].
- B. **Special Warranty:** The Contractor shall warrant the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for period indicated below. This special warranty shall extend the one year period of limitations contained in the General Conditions. The special warranty shall be countersigned by the Installer and the manufacturer.
 - 1. **UPS Module:** The UPS shall be covered by a full parts and labor warranty from the manufacturer for a period of 12 months from date of installation or acceptance by the Owner or 18 months from date of shipment from the manufacturer, whichever occurs first.
 - 2. **Battery:** The battery manufacturer's warranty shall be passed through to the final Owner and shall have a minimum period of one year.
- C. **Additional Owner Rights:** The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

1.10 MAINTENANCE

- A. The manufacturer shall, upon request, provide spare parts kits for the UPS module in a timely manner as well as provide access to qualified factory-trained first party service personnel to provide preventative maintenance and service on the UPS module when required.
- B. UPS subassemblies, as well as the battery, shall be accessible from the front. UPS design shall provide maximum reliability and minimum MTTR (mean time to repair). To that end, the UPS shall be equipped with a self-test function to verify correct system operation. The self-test function shall identify the subassembly requiring repair in the event of a fault. The electronic UPS control and monitoring assembly shall therefore be fully microprocessor-based, thus doing away with potentiometer settings. This shall allow:
 - 1. Auto-compensation of component drift.
 - 2. Self-adjustment of replaced subassemblies.
 - 3. Extensive acquisition of information vital for computer-aided diagnostics (local or remote).
 - 4. Socket connection to interface with computer-aided diagnostics system.
- C. The UPS shall be repairable by replacing standard subassemblies requiring no adjustments. Communication via a modem with a remote maintenance system shall be possible.
- D. The manufacturer shall offer additional preventative maintenance and service contracts covering both the UPS and the battery bank. Accredited professional service engineers employed exclusively in the field of critical power systems service shall perform maintenance and service. The manufacturer shall also offer extended warranty contracts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis of Design:** Product specified is "MGE Galaxy 5000" as manufactured by APC by Schneider Electric. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Architect/Engineer will be the sole judge of the basis of what is equivalent.

2.2 MODES OF OPERATION

- A. UPS module shall be designed to operate as a double conversion, on-line reverse transfer system in the following modes.
 - 1. **Normal:** The inverter shall continuously supply power to the critical load. The PFC rectifier shall derive power from the utility AC source and supply DC power to the inverter while simultaneously float charging the battery.
 - 2. **Emergency:** Upon failure of the utility AC power source, the critical load shall be supplied by the inverter, which, without any interruption, shall obtain its power from the battery.
 - 3. **Recharge:** Upon restoration of the utility AC power source (prior to complete battery discharge), the PFC rectifier shall power the inverter and simultaneously recharge the battery.
 - 4. **Bypass Mode:** The static bypass transfer switch shall be used to transfer the load to the bypass without interruption to the critical power load. This shall be accomplished by turning the inverter off. Automatic re-transfer or forward transfer of the load shall be accomplished by turning the inverter on.

2.3 COMPONENT DESCRIPTION

- A. **PFC Rectifier and Battery Charger:** Incoming AC power shall be converted to a regulated DC output voltage by an IGBT (insulated gate bipolar transistor) power factor correction (PFC) rectifier. The PFC rectifier shall provide high quality DC power to charge the batteries and power the inverter and shall have the following characteristics:
 - 1. **Input Power Factor Correction (PFC):** The PFC rectifier shall be power factor corrected so as to maintain an input power factor of 0.98 lagging to unity at 75 percent or above load levels to ensure generator compatibility and avoid reflected harmonics from disturbing loads sharing the utility power.

2. **Input Harmonic Current Suppression:** The PFC rectifier shall produce a sinusoidal input AC current on each phase with low harmonic content, limiting THD on the UPS input to below 5 percent.
 3. **Battery Charger Current Limiting:** The UPS shall be equipped with a system designed to limit the battery recharge current (from 0.05 C10 to 0.1 C10).
 4. **Charging Levels:** The battery charging circuitry shall be capable of being set for automatic battery recharge operation, float service, manual battery charge service, and equalizing or commissioning operation.
 5. **Intermittent Charging:** The battery charge level shall be maintained by an intermittent charging technique between two values V_{fmin} and V_{fmax} very close to the floating voltage. This technique shall be based on a cycle made up of a short charge period (a few seconds) from V_{fmin} to V_{fmax} followed automatically by a slow discharge period (a few minutes) from V_{fmax} to V_{fmin} . This cycle shall be repeated continuously to maintain the battery charge level. In this way the battery shall actually be charging only for a small part of the time, which shall considerably increase its service life.
 6. **Temperature Compensated Charging:** The battery charger shall be equipped with a temperature probe to enable temperature compensated charging and shall adjust the battery float voltage to compensate for the ambient temperature using a negative temperature coefficient of 3 mV per cell per degree Celsius at a nominal temperature of 25 °C.
 7. **Battery Capacity:** The battery charger shall have sufficient capacity to support a fully loaded inverter and shall fully recharge the battery to 95 percent of its full capacity within 6 to 8 hours up to four battery cabinets.
- B. **Inverter:** The UPS output shall be derived from a variable frequency Pulse Width Modulated (PWM) IGBT inverter design. The inverter shall be capable of providing the specified precise output power characteristics while operating over the battery voltage range.
- C. **Static Bypass - 100 Percent Rated, Continuous Duty:** The static bypass transfer switch shall be solid state, rated for 100 percent continuous duty without mechanical contactor device in parallel for higher reliability and consistent response time and shall operate under the following conditions:
1. **Uninterrupted Transfer:** The static bypass transfer switch shall automatically cause the bypass source to assume the critical load without interruption after the logic senses one of the following conditions:
 - a. Inverter overload exceeds unit's rating.
 - b. Battery protection period expired and bypass current is available.
 - c. Inverter failure.
 2. **Interrupted Transfer:** If the bypass source is beyond the conditions stated below, the UPS shall make an interrupted transfer (not less than 100 milliseconds in duration).
 - a. Bypass voltage greater than +10 percent, -10 percent from the UPS rated output voltage.
 - b. Bypass frequency greater than ± 2 hertz from the UPS rated output frequency.
 3. **Automatic Uninterrupted Forward Transfer:** The static bypass transfer switch shall automatically forward transfer power, without interruption, after the UPS inverter is turned on after an instantaneous overload-induced reverse transfer has occurred and the load current returns the UPS's nominal rating or less.
 4. **Manual Transfer:** A manual static transfer shall be initiated from the UPS control panel by turning the UPS inverter off.
 5. **Overload Ratings:** The static bypass transfer switch shall have the following overload characteristics:
 - a. 100 percent of UPS output rating for 0.016 seconds (one cycle).
 - b. 150 percent for 1 second.
 - c. 125 percent of UPS for 1 minute.
- D. **Output Static Switch - 100 percent Rated, Continuous Duty:** UPS output shall be equipped with a 100 percent rated output static switch without mechanical contactor device in parallel for higher reliability and consistent response time of 16.66 milliseconds.

2.4 SYSTEM CONTROLS AND INDICATORS

- A. **Microprocessor-Controlled Logic:**

1. The full UPS operation shall be provided through the use of microprocessor-controlled logic. Operation and parameters shall be firmware-controlled, thus eliminating the need for manual adjustments or potentiometers. The logic shall include, but shall not be limited to, a self-test and diagnostic circuitry such that a fault shall be isolated down to the printed circuit assembly or plug-in power assembly level. Every printed circuit assembly or plug-in power assembly shall be monitored. Diagnostics shall be performed via a PC through the local diagnostics port on the UPS. UPS shall be microprocessor-controlled.
 2. The UPS shall include, but shall not be limited to, a standard easy-to-use control and indicator panel. Included shall be a backlit, color graphic animated LCD display and LED indicators. The UPS panel shall include, but shall not be limited to, UPS on and UPS off pushbuttons that shall permit the Owner to safely command the UPS on or off without risk of load loss.
 3. Display shall facilitate operation by offering the functions listed below:
 - a. Operating information supplied on the screens.
 - b. The graphic display shall assist the Owner by providing step-by-step help in the Owner's language.
 - c. LED mimic diagram. The mimic diagram shall enable display of installation parameters, configuration, operating status and alarms and indication of operator instructions for switching operations (i.e., bypass).
 - d. It shall be possible to display the following measurements:
 - 1) Inverter output phase-to-phase voltages.
 - 2) Inverter output currents.
 - 3) Inverter output frequency.
 - 4) Voltage across battery bank.
 - 5) Battery charge or discharge current.
 - 6) Rectifier/charger input phase-to-phase voltages.
 - 7) Rectifier/charger input currents.
 - 8) Active and apparent power.
 - 9) Power factor of the load.
 - 10) Battery temperature.
 - 11) Display of status conditions and events.
 - e. It shall be possible to display the following indications:
 - 1) Load on battery power.
 - 2) Load on UPS.
 - 3) Load on automatic bypass.
 - 4) General alarm.
 - 5) Battery fault.
 - 6) Remaining battery backup time.
 - 7) Low battery warning.
 - 8) Bypass AC source outside tolerances.
 - f. Additional information shall be provided in view of accelerating servicing of the system.
 - g. Log of time-stamped events. This function shall store in memory and make available, for automatic or manually initiated recall, time-stamped logs of important status changes, faults, and malfunctions, complete with an analysis and display of troubleshooting procedures. It shall be possible to time stamp and store at least 2000 events.
- B. **Front Panel LCD Display:** The UPS control panel shall provide a backlit, color graphic display with choice of over 15 operating languages for indication of UPS status, metering, battery status, alarm/event log, and advanced operational features.
1. **Access:** The display shall provide access to:
 - a. Mimic diagram indicating UPS power flow.
 - b. Measurements, status indications, and events.
 - c. Personalization menu protected by a password, used to make specific settings.
 - d. Event log with time stamping.
 - e. Access to measurements.
 2. **System Parameters Monitored:** The visual display shall display the following system parameters based on true RMS metering:
 - a. **Measurements:**
 - 1) Input voltage (Ph-Ph).
 - 2) Input current per phase.
 - 3) Bypass voltage.

- 4) Bypass input frequency.
 - 5) UPS output voltage (Ph-Ph and Ph-N).
 - 6) UPS output current per phase.
 - 7) UPS output frequency.
 - 8) UPS output percent load.
 - 9) UPS output kVA.
 - 10) UPS output power factor.
 - 11) Battery voltage.
 - 12) Crest factor.
 - 13) Battery current.
 - 14) Battery backup time and remaining service life.
- b. **Status Indications and Events:**
- 1) Load on battery.
 - 2) Load on UPS.
 - 3) Load on automatic bypass.
 - 4) Low battery warning.
 - 5) General alarm.
 - 6) Battery fault.
 - 7) Remaining back-up time during operation on battery power.
 - 8) Bypass source outside tolerances.
 - 9) Additional indications shall provide maintenance assistance.
3. **Time-Stamped Historical Events:** This function shall time stamp and store important status changes, anomalies, and faults and make this information available for automatic or Owner-requested consultation.
- C. **LED Status Indicators:** The UPS control panel shall provide three LEDs that shall signal the following status conditions:
1. **Green LED:** Load protected.
 2. **Yellow LED:** Minor fault.
 3. **Red LED:** Major fault, load not protected.
- D. **On/Off Switch:** The UPS shall provide the on and off buttons to start and stop the inverter. The switch shall provide a built-in time delay to eliminate the risk of inadvertent operation (additional confirmation shall be requested). It shall be possible to remotely activate the off function via an isolated dry contact to create an emergency power off function, resulting in:
1. Inverter shutdown.
 2. Opening of the automatic bypass.
 3. Opening of the input, bypass, output, and battery switches/circuit breakers.
 4. Opening of the isolated dry contact on the programmable relay card.
- E. **Audible Alarm Reset:** The UPS shall provide an audible alarm that can be stopped using the user interface. If a new alarm is sensed after the original alarm has been silenced, it shall reactivate the audible alarm.
- F. **Remote Emergency Power Off (REPO):** The UPS shall be equipped with provisions for remote emergency power off and dry contact input that shall be used to command UPS shutdown remotely. Activation of this command shall lead to the following actions:
1. Inverter shutdown.
 2. Opening of the static bypass switch and the battery circuit breaker.
 3. Opening of an isolated dry contact on the programmable relay board.
- G. **DB-9 Connector:** One DB-9 connector with serial output shall be provided for field diagnostics.
- H. **Dry Contacts:** The UPS shall be provided standard with a programmable input/output relay board. This board shall have eight dry contacts (i.e., six for input signals and two for output signals).
1. Contacts shall be programmed as:
 - a. UPS on-line.
 - b. Load on bypass.
 - c. UPS on battery.
 - d. UPS battery low.
 - e. General alarm.

- f. Battery fault.
 - g. Remote UPS on (input).
 - h. Remote UPS off (input).
2. The contacts shall be normally open and shall change state to indicate the operating status. The contacts shall be rated at 2.0 amperes (250 volts AC/30 volts DC).

2.5 MECHANICAL DESIGN AND VENTILATION

- A. **Enclosure:** The UPS shall be housed in a freestanding enclosure with dead front construction. The mechanical structure of the UPS shall be sufficiently strong and rigid to withstand handling and installation operations without risk. The sheet metal elements in the structure shall be protected against corrosion by a suitable treatment, such as zinc electroplating, bi-chromating, epoxy paint, or an equivalent.
- B. **Cable Access:** The standard UPS available shall accommodate bottom entry cables (top entry shall be optional).
- C. **Cabinet Weights and Dimensions:** The width of the UPS shall be [_____] inches ([_____] mm) and shall have a maximum weight of [_____] pounds ([_____] kg).

INSERT WIDTH AND WEIGHT IN PARAGRAPH ABOVE. INSERT BTUs PER HOUR IN PARAGRAPH BELOW.

- D. **Ventilation and Heat Rejection:** The UPS shall be designed for forced air cooling. Air inlets shall be provided from the front bottom of the UPS enclosure. Air exhaust shall be from the top portion of the unit. Full load heat rejection shall be [_____] BTUs per hour.

2.6 BATTERY

- A. **General:** The UPS module shall use a valve-regulated sealed lead acid heavy duty industrial battery, designed for auxiliary power service in an UPS application. The primary battery shall be furnished with impact-resistant plastic cases and housed in a matching cabinet(s) next to the UPS module.
- B. **Protection Against Deep Discharge and Self-Discharge:** The UPS shall be equipped with a device designed to protect the battery against deep discharge, depending on discharge conditions, with isolation of the battery by a circuit breaker. In particular, a monitoring device shall adjust the battery shutdown voltage as a function of a discharge coefficient to avoid excessive discharge at less than the rated output. A second device shall avoid self-discharge of the battery into the UPS control circuits during an extended shutdown of the UPS (over two hours).
- C. **Battery Self-Tests:**
1. The battery monitoring system shall be able to perform the following automatic functions:
 - a. Battery circuit checks every 12 hours.
 - b. Open circuit battery test once a month.
 - c. Partial discharge test every three months.
 2. This self-test system shall signal faults via LEDs on the front panel or a message to remote supervision systems.

2.7 OPTIONAL ACCESSORIES

- A. **StruxureWare Data Center Expert:** A centralized infrastructure management platform hereafter referred to as Data Center Expert shall be available for purposes of complete system monitoring and management of all components outlined in this specification used as a single solution for small IT or part of the StruxureWare software stack providing data to systems such as Data Center Operation.
1. **Monitoring** - Data Center Expert shall be capable of monitoring a PDU through a network of Cat 5 cable and a switch supplied by the user. This switch shall relay information to Data Center Expert, which in turn shall allow access to this information via the user's public network via a single IP address.
 2. **Monitored Values:** Data Center Expert shall be capable of monitoring alarms, general status parameters, voltage and current of the PDU.

3. **Thresholds:** For individualized customer needs, Data Center Expert shall allow for user configurable thresholds for alarm notification. With this feature, Data Center Expert can notify clients of reaching thresholds for PDU capacity, or branch circuit breaker capacity. Other custom programmable alarm points for non- APC products shall also be available via dry contact input signal.
 4. **Public Network Monitoring:** Data Center Expert shall also be capable of monitoring other APC devices that are connected to the client's public network.
- B. **Extended Battery Cabinet:** Matching battery cabinets shall be furnished in both adjacent or stand alone versions. The cabinet shall match the height and depth of the UPS module and shall have a width of 26 inches (660 mm), 36 inches (914 mm), or 48 inches (1219 mm) per battery cabinet. Power wiring and control cables shall be included for adjacent models (remote cabinet cables will be provided by the Owner).
- C. **External Control and Communications Devices:** Up to three of the following control and communications devices may be installed in the UPS module:
1. **RS-232/U-Talk or Dry Contacts Card (66060):** The U-Talk protocol shall be used with Solution-Pac 2 for remote monitoring or graceful shutdown for most popular file servers. The dry contacts shall close on predefined conditions to monitor UPS operations. This shall require one communication slot and optional cables.
 - a. The dry contacts shall close on the conditions listed below, but shall be Owner-programmable to close on preset thresholds of other Owner UPS parameters:
 - 1) UPS on-line.
 - 2) Load on bypass.
 - 3) UPS on battery.
 - 4) Low battery warning.
 - 5) Battery fault.
 - 6) General alarm.
 - b. Two dry contact inputs shall also be provided to turn the UPS inverter on and off remotely upon closure of the contacts. This feature may also be disabled if required.
 2. **RS-232 or RS-485 JBus/Modbus Card (66061):** The U-Talk protocol shall be used with Solution-Pac 2 for remote monitoring or graceful shutdown for most popular file servers. The JBus protocol shall be used with third party Building Management Systems (BMS) to monitor detailed three-phase information. This shall require one communication slot and optional cables.
 3. **High Voltage 6 Alarm Relays Card (66069):** A second set (one set shall be provided standard with the UPS module) of six normally open dry contact outputs rated at 2.0 A (250 volts DC/30 volts DC) shall be available to monitor UPS operation.
 - a. The dry contacts shall close on the conditions listed below, but shall be Owner-programmable to close on preset thresholds of other Owner UPS parameters:
 - 1) UPS on-line.
 - 2) Load on bypass.
 - 3) UPS on battery.
 - 4) Low battery warning.
 - 5) Battery fault.
 - 6) General alarm.
 - b. Two dry contact inputs shall also be provided to turn the UPS inverter on and off remotely upon closure of the contacts. This feature may also be disabled if required.
 4. **Network Management Card (66074):** The Network Management Card (NMC) shall provide a web interface, SNMP (Simple Network Management Protocol), logging, and email capabilities. The NMC shall be used for remote monitoring or graceful shutdown for most popular file servers.
 5. **IBM AS/400 Volt-Free Contact/Remote Power Off Card (66068):** The UPS shall interface with an IBM AS400-UPS signal interface providing the following signals via dry contacts:
 - a. Load on battery.
 - b. Load on bypass.
 - c. Low battery shutdown warning.
 - d. Load powered by UPS.
 6. **Multi-Slot Communications Card Expander (66071):** The Multi-Slot shall provide three additional communication slots. The U-Talk Acquisition Card (66063) shall be included.

- D. **Distribution 208 Volt Panelboard:** Single or dual, 42 pole front-facing distribution panelboard shall be provided with the UPS in a matching adjacent wide cabinet. The panelboard shall be a Square D, NQO Panel accommodating 10 to 100 ampere breakers. The panelboard shall accommodate any combination or one, two, or three pole breakers and shall have a submain circuit breaker (optional) feeding the panelboard.
- E. **Two or Three Circuit Breaker External Maintenance Bypass:** The maintenance bypass option shall provide for two or three circuit breakers mounted inside either freestanding adjacent or remote or wall-mounted enclosure to provide a wrap-around bypass configuration for total UPS isolation during maintenance. Maintenance bypass transfers shall be without interruption and shall have mechanical keyed interlocks to protect the UPS from damage in the event of out-of-sequence transfers. Electrically based solenoid-activated key release shall be available to control the removal of the keys from the key interlock.
- F. **Remote Alarm Status Panel (RASP):** A wall-mounted panel, 17.5 inches (445 mm) high by 12 inches (305 mm) wide by 4 inches (102 mm) deep, with eight indicating LED's shall display UPS status and any active alarms. The alarms shall be a latching type, such that if an alarm is triggered, the LED shall stay on (latch) even if the alarm is corrected. This feature shall provide the operator the chance to verify the occurrence of the alarm.
 - 1. The parameters monitored and controls provided on the RASP shall include, but shall not be limited to, the following:
 - a. UPS on-line (green LED).
 - b. UPS on battery (yellow LED).
 - c. Load on bypass (yellow LED).
 - d. UPS summary alarm (red LED).
 - e. Low battery shutdown.
 - 2. The RASP shall also be equipped with:
 - a. Alarm test/reset pushbutton (white LED) to reset the latching alarm.
 - b. Audible alarm for alarm annunciation.
 - c. Audible alarm reset pushbutton (white LED) to silence the audible alarm.
 - 3. The RASP door shall be equipped with a key lock. The recommended maximum distance from the UPS module shall be 500 feet (152 m).
- G. **Seismic Anchors:** Seismic Zone 4 anchors shall be available for system cabinets.
- H. **Dual Input:** Provide dual input to accommodate a separate input source.
- I. **Bypass Input Fuses:** Bypass input fuses shall be optionally provided on the bypass for current limiting of 65 kAIC.
- J. **Top Entry Cabinet:** 16 inch (406 mm) cabinet shall allow cable entry to UPS unit when MBC or transformer cabinets are not selected.
- K. **Transformer Cabinet:** Provide single or dual K20 transformer, 208 volts, 220 volts, 480 volts, and 600 volts are available. Top entry power cables to the UPS can be achieved via these cabinets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. **Verification of Conditions:** Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Architect/Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
 - 1. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 INSTALLATION

- A. Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings.

3.3 FIELD QUALITY CONTROL

- A. **General:** See [Section 01 45 23 - INSPECTING AND TESTING SERVICES] [Section 01410 - INSPECTING AND TESTING SERVICES].
- B. **Field Service Engineer Qualifications:** The manufacturer shall employ a 7 x 24 nationwide (international where applicable) field service organization with rapid access to all regions of the nation. The responding service professionals shall be factory-trained engineers with an accredited and proven competence to service three-phase UPS.
- C. **Spare Parts:** Field Engineers shall have immediate access to recommended spare parts with additional parts storage located in regional depots. Additional spare parts shall be accessible on a 7 x 24 basis from the national depot and shall be expedited on a next available flight basis or via direct courier (whichever mode is quickest).

3.4 DEMONSTRATION

- A. Provide the services of a factory-authorized service representative of the manufacturer to provide start-up service and to demonstrate and train the Owner's personnel.
 - 1. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
 - 2. Train the Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 3. Review data in operation and maintenance manuals with the Owner's personnel.
 - 4. Schedule training with the Owner, through the Architect/Engineer, with at least seven day's advanced notice.

3.5 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to the Installer, that shall ensure that the solid state UPS shall be without damage at time of Substantial Completion.

3.6 UL 924 OPTION - EMERGENCY LIGHTING

- A. Offered for 40KVA, 50KVA, 80KVA and 100KVA models only. UPS and battery systems.
- B. 90 minutes back-up time.
- C. Shielded test switch.
- D. Manually operated test switch. (Input switch Q1)
- E. All other features and characteristics are the same as the Galaxy 5000 UL 1778.

Rated power (KVA)	40 kVA	50 kVA	80 kVA	100 kVA
UPS system adjacent	SUG540A90UL	SUG550A90UL	SUG580A90UL	SUG5100A90UL
UPS system stand-Alone	SUG540S90UL	SUG550S90UL	SUG580S90UL	SUG5100S90UL
Number of battery cabinets included	2 cabinets	2 cabinets	3 cabinets	4 cabinets
Battery Runtime meet or exceed (min)	90	90	90	90

END OF SECTION

GALAXY 5000 AVAILABLE IN 40 kVA, 50 kVA, 60 kVA, 80 kVA, 100 kVA, OR 130 kVA (APPLIES TO PARAGRAPH 1.4A1).

SINGLE MODULES ARE FIELD UPGRADEABLE TO PARALLEL MODULES (APPLIES TO PARAGRAPH 1.4A2).

INVERTER OUTPUT IS TRANSFORMERLESS AND DOES NOT PROVIDE A NEUTRAL SINGLE-PHASE LOADS, A ΔY VOLTAGE MATCHING TRANSFORMER IS REQUIRED (APPLIES TO PARAGRAPH 1.4A4).

CHOOSE 208 VOLT AC, 220 VOLT AC, 480 VOLT AC, 600 VOLT AC (APPLIES TO PARAGRAPH 1.4B1).

OUTPUT POWER RATINGS (APPLIES TO PARAGRAPH 1.4A1).

- 40 kVA / 36 kW
- 50 kVA / 45 kW
- 60 kVA / 54 kW
- 80 kVA / 72 kW
- 100 kVA / 90kW
- 130 kVA / 117kW

480 VOLT CORE VOLTAGE (208 VOLT, 200 VOLT, 600 VOLT WITH INPUT TRANSFORMER) (APPLIES TO PARAGRAPH 1.4A2 AND PARAGRAPH 1.4A3).

INPUT CURRENTS (APPLIES TO PARAGRAPH 1.4A5)

	40 kVA	50 kVA	60 kVA	80 kVA	100 kVA	130 kVA
A @ 480 volts AC Max – Charging Battery	59	70	88	111	150	182

OUTPUT CURRENTS (APPLIES TO PARAGRAPH 1.4A6)

	40 kVA	50 kVA	60 kVA	80 kVA	100 kVA	130 kVA
A @ 480 volts AC	48	60	72	96	120	156

BATTERY BACK-UP TIME (APPLIES TO PARAGRAPH 1.4A7)

Configuration	Battery	(minutes)					
		40 kVA	50 kVA	60 kVA	80 kVA	100 kVA	130 kVA
1 x Level 3	NPX-150	11	9	X	x	X	X
1 x Level 4	300 WPC	28	22	16	10	x	x
1 x Level 5	400 WPC	41	31	24	16	11	7
1 x Level 6	500 WPC	59	46	36	25	17	11
2 x Level 5	400 WPC	90	72	57	41	31	22
2 x Level 6	500 WPC	X	X	81	58	47	33
3 x Level 6	500 WPC	X	X	127	94	71	54

ADDITIONAL CONFIGURATION AND RUN TIMES ARE AVAILABLE

BATTERY DC CURRENT (APPLIES TO PARAGRAPH 1.4D2)

	40 kVA	50 kVA	60 kVA	80 kVA	100 kVA	130 kVA
ADC At Max End voltage	109	137	164	219	273	355

WEIGHTS AND DIMENSIONS (APPLIES TO PARAGRAPH 2.5C)
DIMENSIONS/WEIGHT

kVA	UPS 40 to 80kVA	MBC 100 to 130kVA	MBC	TOP	DIST	BATTERY
Height	75.0 inches (1905 mm)	75.0 inches (1905 mm)	75.0 inches (1905 mm)	75.0 inches (1905 mm)	75.0 inches (1905 mm)	75.0 inches (1905 mm)
Width	28.0 inches (711 mm)	28.0 inches (711 mm)	28.0 inches (711 mm)	16.0 inches (406 mm)	42.0 inches (1067 mm)	28/36/48 inches (711/914/1219 mm)
Depth	33.4 inches (848 mm)	33.4 inches (848 mm)	33.4 inches (848 mm)	33.4 inches (848 mm)	33.4 inches (848 mm)	33.4 inches (848 mm)
Weight	904 pounds (410 kg)	1168 pounds (530 kg)	Consult drawing	Consult drawing	Consult drawing	Consult drawing

(STAND-ALONE DIMENSIONS)

UPS MODULE HEAT REJECTION (APPLIES TO PARAGRAPH 2.5D ABOVE)

	BTU/HR
40 kVA	9250
50 kVA	11560
60 kVA	13870
80 kVA	18500
100 kVA	19610
130 kVA	25490