Vertiv™ PowerUPS 9000

GUIDE SPECIFICATIONS
for a 1250 kW 480 VAC 50 Hz
Single-Module or Multi-Module (Distributed Static Switch)
Uninterruptible Power System

1.0 GENERAL

1.1 Summary

The specifications mentioned in this document describe the requirements for a Modular, Scalable, and Digital Uninterruptible Power Supply (UPS) consisting of one or more single power module units connected in parallel inside a standard frame without the need for either a centralized system controller or an external centralized maintenance bypass switch. The UPS shall automatically maintain AC power within specified tolerances to the critical load, without interruption (for specified duration as per battery run time), during failure or deterioration of the mains power supply. The UPS system shall be expandable by inserting additional modules of the same rating, to provide for module redundancy or load growth requirements. The manufacturer shall design and furnish all materials and equipment to be fully compatible with electrical, environmental and space conditions at the site. The UPS includes all equipment to properly interface the AC power source to the intended load and will be designed for unattended operation.

1.2 Standards

The Modular UPS system along with the associated equipment and components will be manufactured in accordance with the following applicable standards:

General safety requirements for UPS	IEC 62040-1
EMC requirements for UPS	IEC 62040-2 (Category C2)
Method of specifying the performance and test requirements of UPS	VFI-SS-111
US Standard for Uninterruptible Power Systems	UL-1778

- The UPS is CE marked in accordance with the requirements set out in Directive 2014/35/EU Directive 2014/30/EU, Directive 2011/65/EU (with amendment Directive (EU)2015/863).
- The Quality System for the engineering and manufacturing facility certificated to conform to Quality System Standard ISO9001:2015 for CE and ISO22301:2019 for US for the design and manufacture of power protection systems for computers and other sensitive electronics.
- The UPS shall be provided with a Short Circuit Withstand Rating label denoting the maximum source fault short circuit current that is applicable to the unit. The withstand rating shall be independently verified by a nationally recognized third-party lab. Self-certification shall not be acceptable.
- The UPS shall withstand input surges to both the rectifier and bypass, when configured as a dual-input unit, without damage per the criteria listed in standard EN62040-2 (6 kV). The manufacturer shall provide evidence of compliance and test data upon request.
- The UPS shall be provided with electrostatic discharge (ESD) immunity per IEC 61000-4-2 Level 2 (4 kV) contact, Level 3 (8 kV) air.

1.3 System Description

1.3.1 Design Requirements

- For non-redundant operation (applicable, not applicable), the complete integrated UPS system shall be sized to provide a maximum of kVA kW quality power output at °F (°C) ambient in N.
- For non-redundant operation (applicable, not applicable), the complete integrated UPS system shall be sized to provide a maximum of ___ kVA ___ kW quality power output at ___ °F (°C) ambient in N+_ (1,2,3).

Load voltage and bypass line voltage shall be 480 VAC, three-phase, four-wire plus ground. Input voltage shall be 480 VAC, three-phase, four-wire plus ground. The AC input source and bypass input source shall each be a solidly grounded wye service. It will be able to supply all required power to full rated output kVA loads with power factor from 0.6 lagging to 0.7 leading without any deration.

The battery will support the UPS a capacity of ___ kW load for at least ___ minutes at 77 °F (25 °C) at startup.

1.3.2 Modes of Operation

The UPS shall operate as an on-line reverse transfer system in the following modes:

1. Normal (VFI Mode)

The UPS inverter continuously supplies the critical AC load. The rectifier draws power from the commercial AC source and converts it into DC power for the inverter and the battery charger. The battery charger maintains the battery in a fully charged and optimum operational condition. The inverter converts the DC power into clean and regulated AC power which is supplied to the critical load (conditioned line).

2. (Optional) ECO Mode (VFD Mode)

The critical AC load shall be continuously powered by the bypass with the inverter available to power the load if the bypass source voltage or frequency exceeds adjustable parameters of power quality. This feature shall also be available in parallel operation.

3. (Optional) Dynamic Online Mode (VI Mode)

If this mode is selected, all power switches (configured internally or externally) and the battery switches are closed except for the maintenance bypass switch, and the system prefers to put the load on the bypass, to achieve the aim of energy-saving. When the load power is fed by bypass supply, the inverter is in the mode of power quality compensation for the bypass voltage. When the voltage of the bypass supply is beyond the pre-defined and adjustable limits, the system will transfer to the inverter output. In this mode, the system can normally charge the battery. This feature shall also be available in parallel operation.

4. Paralleling Operation

The UPS shall have the vertical and horizontal scalability option for redundancy or capacity expansion.

1. **Vertical Scalability:** UPS shall be capable to accommodate additional power modules within the same rack (limited to its maximum frame capacity) online without dropping the connected load. It shall be designed based on discrete control logic platform i.e. each power and static switch module shall have its own intelligent DSP controller to avoid single point of failure. The power delivered to the load will be equally shared between number of UPS power modules installed in the frame with a tolerance of ±5%.

2. **Horizontal Scalability:** UPS shall have option to connect up to four UPSs in parallel configuration for redundancy or capacity expansion. Under normal operating conditions, the power delivered to the load will be equally shared between number of UPS power modules connected to the parallel bus with a tolerance of ±5%. In the event of an overload, the system will transfer to the bypass source.

5. Recharge

Upon restoration of the utility AC source, the rectifier shall supply power to the output inverter and to the DC- DC converter, which shall simultaneously recharge the batteries. This shall be an automatic function and shall cause no interruption to the critical load. Recharge current is same as charge current (Imax = 550A).

6. Bypass

If the UPS must be taken out of service, the static transfer switch shall transfer the load to the bypass source. The transfer process shall cause no interruption in power to the critical load. An optional external wrap-around maintenance bypass shall be used to ensure full isolation of the unit for the service of internal components while providing safety from arc flash.

7. Battery

Upon failure of utility AC power, the critical load shall be powered by the inverter, which, without any switching, shall obtain its power from the battery plant via the DC-DC converter. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.

8. Off-Battery

If the battery is taken out of service, it shall be disconnected from the DC-DC converter by means of an external disconnect circuit breaker. The UPS shall continue to function and meet all the specified steady-state performance criteria, except for the power outage backup time capability. If multiple battery strings are used, each string shall be capable of being electrically isolated for safety during maintenance.

9. Online Maintenance

If the UPS needs to be maintained or repaired, all UPS modules and static switch module in the system should be replaceable online without shutting the system down. Additionally, the UPS should have an external maintenance bypass for full system maintenance.

10. Regen Mode

The UPS rack system shall have the ability to perform self-test for full rated capacity without using any external load banks. In this mode, UPS rectifier, inverter and static bypass shall be tested up to full load capacity without any failure. Power consumption in this mode shall only be full load losses of UPS. This mode shall also be available in parallel UPS configuration.

1.3.3 Performance Requirements

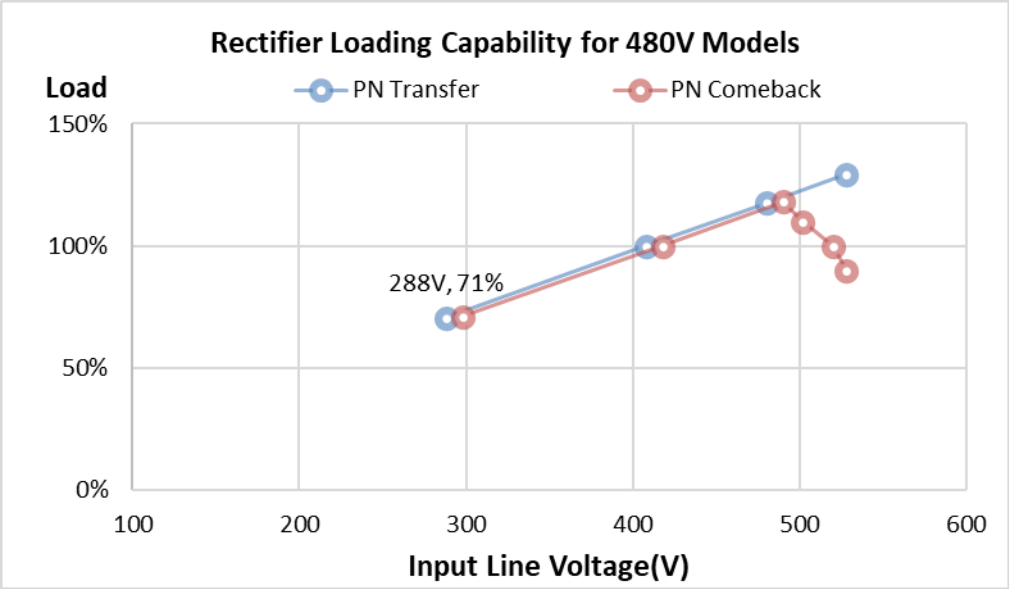
The solid-state power components, magnetics, electronic devices, and overcurrent protection devices shall operate within the manufacturer's recommended temperature when the UPS is operating at 100% critical load and maintain battery charging under either of the following conditions:

- Any altitude, within the specified operating range up to an elevation of 9843 ft. (3000 m). A de-rating factor is applied according to IEC 62040-3 when the unit is installed above 1500 m.
- Any ambient temperature, within the specified operating range of 32 °F to 104 °F (0 °C to 40 °C). The unit can operate up to 50°C with a de-rating factor of 0.9 between 104 °F to 113 °F (40 °C to 45 °C) and 0.8 between 113 °F to 122 °F (45 C° to 50°C).
- Any input voltage within the specified range: 408 VAC to 528 VAC.
- Noise within 1 m (in the front) according to ISO7779 is not more than 79 dB at 100% load.

1.3.4 Input

1. Voltage:
   - Rectifier AC Input: 480 V, three-phase. The bypass and rectifier can share same neutral cable only in case upstream transformers has common neutral and grounding connections. In all the other installations the rectifier and bypass will need their own neutral connections from the upstream source.
   - Bypass AC Input: 480 V, three-phase. The bypass and rectifier can share same neutral cable only in case upstream transformers has common neutral and grounding connections. In all the other installations the rectifier and bypass will need their own neutral connections from the upstream source.
2. **Voltage Range:** Line 408 to 528 at 100% load, 288 to 528 V with linear derating.

   Refer to below table for rectifier loading capability.



3. **Frequency:** 40 Hz to 70 Hz.
4. **Power Factor:** From 50% to 100 % load, input power factor minimum is 0.99.
5. **Total Current Harmonic Distortion:** The Total Harmonic Distortion of input current introduced by the rectifier will be less than or equal to 10% for 25% linear load, 3% for 100% linear load and 5% for 100% nonlinear load. The results are obtained with an input THDi line ≤1%.
6. **Fixed Time Rectifier Walk-In:** Support power walk-in function, one by one power module step in, 0.5 to 5 seconds (settable, 2S default) interval time between modules.
7. **Rectifier Hold Off:** Programmable from 4 seconds to 120 seconds before walk-in begins (adjustable) per module (default 4 seconds), one by one power module step in.
8. **Maximum Inrush Current:** The UPS has soft start feature that exclude inrush current.
9. **Rectifier and Bypass Surge Protection:** Sustains input surges without damage per criteria listed in EN62040-2 (6 kV).
10. **Withstand Rating:** Units shall carry a 150 kA standard short circuit withstand rating with fuses. All withstand ratings shall be UL and TUV tested and certified, and a label shall be applied to the unit clearly identifying this rating as required by the National Electric Code.

11. **Overload Capacity:** With nominal input voltage and without the battery connected, the rectifier shall be capable of supplying the inverter up to 120% of its nominal capacity over the inverter overload range. The extra energy required to fulfill the overload capability of the inverter may be partially shared with the batteries depending on voltage and output power conditions.

1.3.5 AC Output

1. **AC Output Voltage:**
   - 480 V, three-phase.
2. **Load Rating:**
   - 100% continuous load rating at 104 °F (40 °C) for any load from 0.7 leading to 0.6 lagging.
3. **Voltage Stability:**
   - < 1% RMS average for 100% balanced three-phase load.
   - < 3% RMS average for 100% unbalanced load for line-to-line imbalances.
4. **Voltage Adjustment Range:**
   - ±5% for line drop compensation adjustable by factory service personnel.
5. **Frequency Stability:**
   - Synchronized with internal clock: ±0.05%.
   - Synchronized with bypass: ±0.25%.
6. **System Efficiency in Normal Mode:**
   - Defined as output kW/input kW at 1.0 power factor load, measured at 25%, 50%, 75%, and 100% of nominal load, with energy storage disconnected or at float, DC-DC converter running.

     Efficiency—Top Ventilation

For 125k Load (%)	480 V	
	Efficiency (%)	Heat Dissipation (kW)
10	95.62	5.5
25	97.15	8.9
30	97.40	9.8
40	97.58	12.1
50	97.72	14.3
60	97.56	18.3
75	97.44	24.0
90	97.34	29.9
100	97.25	34.4

7. **Phase Imbalance:**
   - Balanced loads: 120° ±1°.
   - 100% unbalanced loads: 120° ±1.5°.
8. **Voltage Transients (Average of All Three Phases):**

Voltage transients shall be limited to a maximum deviation from nominal system output volts as specified below, with recovery to within 2.5% of output voltage within four (4) electrical cycles for each of the below conditions. Limits shall apply to any UPS load within the UPS rating, and frequency shall be maintained at 50/60 Hz ±0.1 Hz. The system shall not transfer to bypass under these conditions.

- 0 to 100% or 100% to 0%.

  Response Meets IEC 62040-3: 2021 annex E.
- 10% to 100% or 100% to 10%.

  Transient Voltage Deviation, RMS <6% after 10 milliseconds and <3% after 20 milliseconds.

9. **Voltage Harmonic Distortion:**
   - Maximum 1% RMS total (linear load).
   - Maximum 3% RMS total for up to 100 kVA non-linear load, per Annex E IEC 62040-3:2011.
10. **Overload at Nominal Output Voltage with ±1% Voltage Regulation:**
    - Not more than 105% of full load continuously at 104 °F (40 °C) ambient.
    - 105% to 125% of full load for a minimum of 10 minutes at 104 °F (40 °C) ambient.
    - 125% to 150% of full load for minimum of 10 minutes to 1 minute at 104 °F (40 °C) ambient.
    - 150% to 200% of full load for a minimum of 200 milliseconds.
11. **Fault Clearing:**
    - Inverter Only: 200% of normal full load current for 200 milliseconds.
    - Bypass Available: UPS will transfer to bypass in 10 milliseconds, bypass can stand 500% rated current for (10) cycles.

1.3.6 Grounding

Input of the UPS must be fed from a solidly grounded wye source or grounded through an HRG.

1.3.7 Cooling Air Volumes

The air flow rate of the VFI and VFD mode for the Vertiv™ PowerUPS 9000 1250 kW are described in the table below.

Mode	% Load	m^3/Hr
VFI	0 to 20	2147
	20 to 50	2576
	50 to 100	5935
	>100	7701
VFD	0 to 30	590
	30 to 70	885
	>70	1770

1.4 Environmental Conditions

The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

1. **Operating Ambient Temperature**
   - UPS: 32 °F to 104 °F (0 °C to 40 °C) full performance, 104 °F to 122 °F (40 °C to 50 °C) with automatic derating.
   - Lead-Acid Battery: 68 °F to 77 °F (20 °C to 25 °C).
   - Vertiv™ EnergyCore Lithium 5 Battery: 59 °F to 77 °F (15 °C to 25 °C).
2. **Storage Ambient Temperature for UPS (contain batteries)**
   - -4 °F to 86 °F (-20 °C to 30 °C).
3. **Transport Ambient Temperature for UPS (without battery)**
   - -40 °F to 158 °F (-40 °C to 70 °C).
4. **Relative Humidity**
   - 0 to 95%, non-condensing.
5. **Altitude**
   - Operating: The maximum operation altitude will be 3000 m (10,000 ft max.) at 77 °F (40 °C). 1% maximum kW de-rating per 328 ft. rise between 4921 ft. (1500 m) and 9843 ft. (100 m rise between 1500 m and 3000 m).
6. **Audible Noise Level**
   - 58 dBA measured at 50% load.
   - 79 dBA measured at 100% load.

1.5 Parallel Systems

The UPS shall have the vertical and horizontal scalability option for redundancy or capacity expansion.

1. Vertical Scalability

The UPS shall be capable to accommodate additional power modules within the same rack (limited to its maximum frame capacity) online without dropping the connected load. It shall be designed based on discrete control logic platform such as each power and static switch module shall have its own intelligent DSP controller to avoid single point of failure. The power delivered to the load will be equally shared between number of UPS power modules installed in the frame with a tolerance of ±5%.

2. Horizontal Scalability

The UPS shall have option to connect up to four UPSs in parallel configuration for redundancy or capacity expansion. Under normal operating conditions, the power delivered to the load will be equally shared between number of UPS power modules connected to the parallel bus with a tolerance of ±5%. In the event of an overload, the system will transfer to the bypass source.

3. Parallel Configurations

Up to four (4) UPS module outputs may be connected in parallel to provide up to 4X maximum output for capacity and 3X maximum output with redundancy. Differences of 20% are allowed for power cables length of up to 20 m. For larger distances, cable lengths may not vary by more than 10%.

4. Inter-Module Communications

The UPS module shall communicate via a redundant cable system based on a bi-directional loop such that any single break or disconnection of the cable system shall generate an alarm but shall not interfere with the parallel operation of the system.

5. Paralleling Switchgear

The outputs of the UPS modules shall be connected to an output switchboard containing a common output bus. The switchboard shall be provided with Module Output Breakers (MOB) for each module to permit isolating any module from the output bus. Each MOB shall be equipped with 1A/1B auxiliary contacts to communicate breaker status. The MOB shall be selected to work with current levels that may occur when switching a module onto the active bus. Breakers with adjustable instantaneous settings shall be adequate to achieve this. As an option, paralleling switchgear may be integrated with UPS modules at the factory for system testing.

6. Individual UPS Module Startup in a Parallel System

When multiple UPS modules are connected in parallel to support a common load the system startup may be performed by starting a single UPS module inverter while the remaining UPS module inverters remain off.

7. Individual UPS Module Shutdown in a Parallel System

When multiple UPS modules are connected in parallel to support a common load, a single UPS module inverter may be shut down while the remaining parallel system UPS module inverters supply the load if the load does not exceed the combined power capacity of the remaining parallel system UPS modules.

8. Load Sharing on Inverter

When multiple UPS modules are connected in parallel and powering a common load, load sharing shall not differ by more than 5% for each UPS module.

1.6 Submittals

1.6.1 Proposal Submittals

Submittals with the proposal shall include:

- Descriptions of equipment to be furnished, including deviations from these specifications.
- Document stating listing to UL, including edition used for listing.

- Document showing compliance with required short circuit withstand rating and labeling.
- System configuration with single-line diagrams.
- Detailed layouts of customer power and control connections.
- Functional relationship of equipment, including weights, dimensions, and heat dissipation.
- Information to allow distribution system coordination, including any overcurrent device in the bypass, and the manufacturer's part number or trip curve.
- Size and weight of shipping units to be handled by contractor.

1.6.2 Order Submittals

Submittals produced for the order shall include:

- All the documentation presented with the proposal, per Section 1.6.1 above.
- Detailed installation drawings including all terminal locations.
- Interconnect wiring diagrams showing terminal numbers for each wire.

1.6.3 UPS Delivery Documents

Submittals upon UPS delivery shall include:

- A complete set of submittal drawings.
- The latest installation manual is available via the Vertiv.com product Web page. Each UPS module serial label includes a QR code and instructions for accessing the product Web page. Manuals shall include receiving and handling instructions.
- The latest instruction manual is available via the Vertiv.com product Web page. Each UPS module serial label includes a label with technical specifications and unique serial number. Manuals shall include a functional description of the equipment, safety precautions, instructions, step-by-step operating procedures, and routine maintenance guidelines, including illustrations.

1.7 Warranty

1.7.1 UPS Warranty

The UPS manufacturer shall warrant the unit against defects in workmanship and materials for 12 months after initial startup or 18 months after the shipping date, whichever comes first.

1.7.2 Warranty - End User

Warranties associated with items not manufactured by the UPS supplier, but included as part of the system, such as switchgear and batteries, shall be passed through to the end user.

1.8 Quality Assurance

1.8.1 Manufacturer's Qualifications

The manufacturer shall have a minimum of 20 years of experience in the design, manufacture and testing of solid-state UPS systems.

The quality system for the engineering and manufacturing facility shall be certified to conform to Quality System Standard ISO 9001 for the design and manufacture of power protection systems for computers and other sensitive electronics.

1.8.2 Factory Testing

Before shipment, the manufacturer shall test the UPS fully and completely to ensure compliance with the specification.

The UPS unit shall be tested at the system-specified capacity. Testing shall be done using load banks at both part-load and the full kW rating of the unit.

Operational discharge and recharge tests shall be performed to ensure guaranteed rated performance.

System operations such as startup, shutdown and transfers shall be demonstrated.

Additional optional factory testing for single module and distributed bypass UPS systems shall include the following:

- Switchgear integration testing with single module and distributed bypass UPS systems.
- Factory witness testing (multiple levels of testing available depending on needs).
- Custom factory witness testing.
- Factory heat run testing.
- Factory burn-in testing (with or without data logging).

A certified copy of test results shall be available for each system as indicated on the order.

2.0 PRODUCT

2.1 Fabrication

2.1.1 Materials

All materials of the UPS shall be new, of current manufacture, high grade and shall not have been in prior service except as required during factory testing. All active electronic devices shall be solid-state. All power semiconductors shall be sealed. Control logic and fuses shall be physically isolated from power train components to ensure operational safety and to protect from heat. Minimum estimated life of the major components used in the UPS (includes fan and bus capacitors) shall not be less than 7 years.

2.1.2 Capacitor Assemblies

All power modules shall be replaceable singularly. All AC and DC capacitors shall have a 15 years design life.

2.1.3 UPS Internal Wiring

Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code and applicable local codes and standards. All bolted connections of bus bars, lugs and cables shall be in accordance with requirements of the National Electric Code and other applicable standards. All electrical power connections shall be torqued to the required value and marked with a visual indicator.

2.1.4 Field Wiring

Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code, OSHA and applicable local codes and standards. All bolted connections of busbars, lugs and cables shall be in accordance with requirements of the National Electric Code and other applicable standards.

All field wiring power connections shall be to tin-plated copper bus bars for connection integrity. Bus bars shall have adequate space to allow two-hole, long-barrel, and compression type lugs forming a permanent connection between field wiring and field- installed lugs.

Provisions shall be made in the cabinets to permit installation of input, output and external control cabling using raceway or conduit. Provision shall be made for top and bottom access to input, output, bypass, and DC connections as per the technical specifications. In conformance with the NEC, connection cabinets shall provide for adequate wire bend radius.

2.1.5 Construction and Mounting

The UPS shall be housed in an IP20 enclosure, designed for floor mounting. The UPS shall be structurally adequate and have provisions for forklift handling. Maximum cabinet height shall be 2 meters for all UPS range.

2.1.6 Cooling

Forced air cooling shall be provided to ensure that all the components are operated within temperature ratings. Airflow shall be controlled according to load demand. If one of the cooling fans experiences a fault, the UPS shall be immediately notified of the condition via the user interface and through remote monitoring services.

2.1.7 Long-Life Components

The UPS shall incorporate long life components to streamline maintenance, maximize uptime and minimize total cost of ownership.

2.2 Equipment

2.2.1 UPS System

The UPS system shall consist of an active power factor-corrected rectifier, DC-DC converter and three-phase, transformer-free T-type inverter, bypass static transfer switch, bypass synchronizing circuitry, protective devices, and accessories as specified. The specified system shall also include a battery disconnect breaker and battery system.

2.2.2 Surge Protection

The UPS shall have built-in protection against surges, sags, and overcurrent from the AC source. The protection shall meet the requirements specified in standards EN 62040-2:2006 and IEC/EN 61000-4-5:2006.

2.2.3 Output Protection

The UPS shall be protected against sudden changes in output load and short circuits at the output terminals. The UPS shall have built-in protection against permanent damage to itself and the connected load for all predictable types of malfunctions. Fast-acting, current-limiting devices shall be used to protect against cascading failure of solid-state devices. Internal UPS malfunctions shall cause the module to trip off-line with minimum damage to the module and provide maximum information to maintenance personnel regarding the reason for tripping off-line. The load shall be automatically transferred to the bypass line uninterrupted for an internal power modules malfunction. The status of protective devices shall be indicated on a graphic display screen on the front of the unit.

2.2.4 AC Ground Fault Detection

The UPS is a three-wire system and shall have the capability to detect and annunciate AC phase-to-ground faults when the UPS is powering the load from the battery or other DC source. If an AC ground fault occurs between a phase and ground, a message shall be displayed on the operator screen indicating that the fault condition exists. The UPS shall also have as standard the ability to indicate this condition via a programmable contact to actuate a third-party device, such as a warning light or audible alarm system.

2.2.5 (Optional) DC Battery Ground Fault Detection and Backfeed Detection

The UPS shall provide a method to detect and annunciate battery DC ground faults, to facilitate proactive resolution of such ground faults. The UPS can be configured to allow the circuit breaker to open or remain closed upon detection of a ground fault.

2.3 Components

2.3.1 Rectifier

The term *rectifier* shall denote the solid-state equipment and controls necessary to convert alternating current to regulated direct current to supply the inverter and charge the battery. The DC output of the rectifier shall meet the input requirements of the inverter without the battery being connected.

1. Input Current Harmonic Distortion

The power module rectifier shall actively control and reduce input current distortion over the full operating range of the UPS without the need for an additional passive input filter. Input current THDi shall be less than 3% at rated linear loads and nominal voltage in double-conversion mode.

2. AC Input Current Limit Reduction

The rectifier, in conjunction with the other UPS controls and circuitry, shall adjust the current demanded for battery charging as a function of UPS wattage load and input voltage level.

3. Fixed Time Input Current Walk-In Control

The power modules rectifier shall provide a feature that limits the total initial power requirement at the input terminals to 0% of rated load and gradually increases power to 100% of full rating over the 0.5 second to 5 second (adjustable) interval.

4. Minimum Frequency Input Current Walk-In Control

The minimum frequency input current walk-in control is an alternative to a fixed time walk-in control. The rectifier shall provide a feature that limits the total initial power requirement at the input terminals to 0% of rated load and gradually increases power to 100% of full rating in the minimum time possible while maintaining a minimum generator frequency of 40 Hz to 60 Hz (adjustable).

5. Step Loads Following Completion of Walk-In with Minimum Frequency Input Current Walk-In Control Enabled

Step (up) loads shall not require a full walk-in as would be required by a fixed time walk-in control. The minimum frequency input current walk-in control algorithm shall initiate an incremental walk-in, beginning at the current load level, to reach the new load level while ensuring the generator frequency does not fall below the minimum frequency setpoint of 59 Hz (adjustable). This method shall ensure walk-in occurs in the minimum time possible and minimize energy consumption from the batteries. The amount of time required for the walk-in solely depends on the setpoint frequency and the relative power rating of the generator as compared to the UPS load.

6. Rectifier Fuse Protection

Each rectifier AC phase shall be individually fused with fast-acting fuses so that loss of any semiconductor shall minimize cascading failures. Fuses shall be bolted to busbars at both ends to ensure mechanical and electrical integrity. The display panel on the front of the unit shall indicate a blown fuse occurring on any phase of the rectifier.

2.3.2 DC-DC Converter

The term DC-DC converter shall denote the equipment and controls to regulate the output of the rectifier to the levels appropriate for charging the battery and to boost the battery voltage to the level required to operate the inverter. The DC-DC converter shall be solid-state, capable of providing rated output power and, for increased performance, shall be a pulse width- modulated design and shall utilize insulated gate bipolar transistors (IGBTs). The DC-DC converter shall control charging of the battery. The AC ripple voltage of the charger DC shall not exceed 1.414% RMS of battery voltage.

1. Battery Recharge

The rectifier/charger shall be capable of supplying an additional 15% power for recharging a fully discharged DC stored energy source for charging current with UPS at full load and input voltage at nominal. After the stored energy source is recharged, the rectifier/charger shall maintain the source at full charge until the next emergency operation.

2. Battery Equalize Charge

A manually initiated equalize charge feature shall be provided to apply an equalize voltage to the battery. The duration of equalize charge time shall be adjustable from 8 to 30 hours. A method shall be available to deactivate this feature for valve regulated battery systems.

3. Stop Battery Charging Function

Battery charging may be stopped by a shunt trip of the battery cabinet breaker when over temperature is sensed in the battery cabinet, on generator or when environmental contact is closed.

4. Overvoltage Protection

There shall be DC overvoltage protection so that if the DC voltage rises to the pre-set limit, the UPS shall shut down automatically and initiate an uninterrupted load transfer to bypass or shall disconnect the battery via the DC breaker(s) in the battery string.

5. Temperature-Compensated Charging

The UPS shall adjust the battery charging voltage based on the battery temperature reported from external battery temperature sensors. When multiple sensors are used, the voltage shall be based on the average temperature measured. Excessive difference in the temperature measurements shall be reported and the charging voltage adjusted to protect the batteries from excessive current.

6. Battery Load Testing

The UPS shall be capable of performing battery load testing under operator supervision. The UPS shall be capable of testing the battery without risk of disrupting power to the critical load. The UPS shall display and log the result of the test with appropriate alarms if reduced battery capacity or battery failure is detected.

2.3.3 Inverter

The term inverter shall denote the equipment and controls to convert direct current from the rectifier or battery via the DC-DC converter to precise alternating current to power the load. The inverter shall be solid-state, capable of providing rated output power and, for increased performance, the inverter shall be a pulse-width-modulated design and shall utilize insulated gate bipolar transistors (IGBTs).

1. Overload Capability

The inverter shall be able to sustain an overload across its output terminals while supplying full rated voltage of up to 150% for 60 seconds. The inverter shall be capable of at least 150% current for short-circuit conditions including phase-to-phase, phase-to-ground, and three-phase faults. After the fault is removed, the UPS shall return to normal operation without damage. If the short circuit is sustained, the load shall be transferred to the bypass source and the inverter shall disconnect automatically from the critical load bus.

2. Output Frequency

The inverter shall track the bypass continuously, providing the bypass source maintains a frequency of Nominal ±5% Hz.

3. Phase-to-Phase Balance

The inverter shall provide a phase-to-phase voltage displacement of no worse than ±1.5 degrees with a 100% unbalanced load.

4. Inverter Fault Sensing and Isolation

The UPS shall be provided with a means to detect a malfunctioning inverter and isolate it from the critical load bus to prevent disturbance of the critical load voltage beyond the specified limits.

5. Battery Protection

The inverter shall be provided with monitoring and control circuits to protect the battery system from damage due to excessive discharge. Inverter shutdown shall be initiated when the battery voltage has reached the end of discharge voltage. The battery end-of-discharge voltage shall be calculated and automatically adjusted for partial load conditions to allow extended operation without damaging the battery. Automatic shutdown based on discharge time shall not be acceptable.

2.3.4 Inverter Bypass Operation (Bypass Static Switch)

When maintenance is required or when the inverter cannot maintain voltage to the load due to sustained overload or malfunction, a bypass circuit shall be provided to isolate the inverter output from the load

and provide a path for power directly from an alternate AC (bypass) source. The UPS control system shall constantly monitor the availability of the inverter bypass circuit to perform a transfer. The inverter bypass circuit shall consist of a continuous duty bypass static switch and an overcurrent protection device to isolate the static bypass switch from the bypass utility source. The bypass static switch shall denote the solid-state device incorporating SCRs (silicon-controlled rectifiers) that can automatically and instantaneously connect the alternate AC source to the load.

1. Static Bypass Switch Rating

   The static bypass switch shall be rated for continuous duty operation at full rated load for highest reliability without the use of mechanical devices as used with a momentary rated device.

2. Manual Load Transfers

   A manual load transfer between the inverter output and the alternate AC source shall be initiated from the control panel. Manually initiated transfers shall be make-before-break, utilizing the inverter and the bypass static switch.

3. Automatic Load Transfers

   An automatic load transfer between the inverter output and the alternate AC source shall be initiated if an overload condition is sustained for a period more than the inverter output capability or due to a malfunction that would affect the output voltage. Transfers caused by overloads shall initiate an automatic retransfer of the load to the inverter only after the load has returned to a level within the rating of the inverter source and the alarm has been acknowledged.

4. Momentary Overloads

   In the event of a load current inrush or branch load circuit fault more than the inverter rating, the bypass static switch shall connect the alternate AC source to the load for at least 100 milliseconds, allowing up to >400% of the normal rated output current to flow. Output voltage shall be sustained to the extent the alternate AC source capacity permits. If the overload condition is removed before the end of the 100 milliseconds period, the bypass static switch shall turn Off and the load shall remain on inverter power. If the overload remains, then a transfer to the alternate AC source is to be completed.

5. Back-Feed Protection

   As required by IEC/EN 62040-1, the static transfer switch shall not back-feed UPS power to the bypass distribution system while the UPS is operating on battery during a bypass power outage. The purpose of this requirement is to prevent the risk of electrical shock on the distribution system when the normal source of power is disconnected or has failed. If a shorted SCR is detected, the static transfer switch shall be isolated by an external contactor-based circuit breaker and an alarm message shall be annunciate at the UPS control panel. The load shall remain on conditioned and protected power after detection of a shorted SCR and isolation of the bypass static switch.

6. ECO-Mode

   When selected, this mode of operation shall transfer the load to the bypass source and maintain it there if the bypass source frequency, slew rate, and voltage are within the adjusted operating parameters. While in this mode, the inverter shall remain operating to demonstrate the ability to instantaneously assume the load without interrupting the output voltage. Should the bypass source go outside the adjusted limits, the bypass static switch shall turn Off, isolating the load from the bypass while the inverter assumes the full critical load. The load shall be transferred from the bypass source to the inverter while maintaining the output voltage within the ITIC and CBEMA curves. There is provision to activate this function via touch screen display.

2.3.5 Dynamic Online Mode

This functioning mode allows significant energy savings by operating with a typical efficiency above 98.8% while providing power conditioning to the load.

1. Normal (VI)

   The operating mode will depend on the quality of the mains supply in the short-term past and on the electrical characteristic of the load. If the line quality remains within permitted tolerance parameters and the load needs power conditioning, (THDi, THDv, PF) the power interface will provide continuous supply to the critical AC load while the inverter operates as series and parallel active filter. The IGBT inverter will be able to compensate the power factor of the load and the current harmonic distortion guaranteeing optimum power conditioning to the load while maintaining the highest level of efficiency.

2. Fast Transfer to VFI

   Emergency (due to mains supply failure or variance beyond tolerance limits) if the bypass mains supply varies beyond tolerance levels (adjustable using the software) that cannot be compensated through the active filter, the load will be transferred from the direct line to the conditioned line, with Class 1* output performance. The load is powered from the mains via the rectifier and inverter, (provided the input mains remains within the tolerances stated in technical specifications). If the input mains fall below the lowest limit, the batteries will be used to power the load via the inverter.

   *Condition apply.

3. Return to VI

   When the mains supply returns within tolerance limits, the UPS will continue to supply the load via the conditioned line for a period dependent on the direct line failure rate (the conditioned line draws power from the mains not the battery). When the direct line has stabilized, the UPS returns to normal VI operation. The battery charger automatically begins to recharge the battery so that maximum autonomy is guaranteed in the shortest possible time.

2.3.6 Display and Controls

1. UPS Control Panel

   Each UPS module shall be equipped with a 9 in. (229 mm) touch screen, graphical LCD display. That will automatically provide all information relating to the status of current of the UPS as well as display metered values. The display shall be menu-driven, permitting the user to easily navigate through operator screens. The flexibility shall also be provided to change the display arrangement and information displayed as per the user requirement.

2. Logic

   UPS system logic and control programming shall reside in a microprocessor-based control system with non-volatile flash memory. Rectifier, inverter, and system control logic shall utilize high-speed digital signal processors (DSPs). CAN bus shall be used to communicate between the logic and the User Interface as well as the options. Switches, contacts, and relays shall be used only to signal the logic system as to the status of mechanical devices or to signal user control inputs. Customer external signals shall be isolated from the UPS logic by relays or optical isolation.

3. Metered Values

   A microprocessor shall control the display and memory functions of the monitoring system. All three phases of three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accuracy to ±2% of AC voltage, ±5% AC current, ±0.2% AC frequency, ±5% battery voltage, and ±5% battery current. The following parameters shall be displayed:

   - Input voltage, line-to-line.
   - Input current per phase.
   - Input frequency.

- Input power factor.
- Battery voltage.
- Battery charging/discharging current.
- Output voltage, line-to-line.
- Output frequency.
- Bypass input voltage, line-to-line.
- Bypass input frequency.
- Load current.
- Load real power (kW), total and percentage.
- Load apparent power (kVA), total and percentage.
- Load percentage of capacity.
- Battery temperature, each battery string.
- Battery state of charge.

4. Power Flow Indications

   A power flow diagram shall graphically depict whether the load is being supplied from the inverter, bypass or battery and shall provide, on the same screen, the status of the following components:

   - AC Input Circuit Breaker (optional).
   - Battery Circuit Breaker, each breaker connection of complete battery complement, complete disconnection, and partial connection (one or more, but not all breakers open).
   - Maintenance Bypass Status.

5. Main Display Screen

   The following UPS status messages shall be displayed:

   - Rectifier (Off/Soft Start/Main Input On/Battery Input On).
   - Input Supply (Normal Mode/Battery Mode/All Off).
   - Battery Self-Test (True/False).
   - Input Disconnect (Open/Closed).
   - EPO (True/False).
   - Charger (On/Off).
   - Output Disconnect (Open/Closed).
   - Maint. Disconnect (Open/Closed).
   - Bypass Disconnect (Open/Closed).
   - Inverter (Off/Soft Start/On).
   - Bypass (Normal/Unable to Trace/Abnormal).
   - Output Supply (All Off/Bypass Mode/Inverter Mode/Output Disable).

- Inverter On (Enable/Disable).

6. HMI Control Buttons

   Buttons shall be provided to start and stop the inverter. A pop-up message requesting confirmation shall be displayed whenever a command is initiated that would change the status of the UPS. Other buttons shall be provided to reset faults and silence the alarm buzzer.

7. Event Log

   This menu item displays the list of events that have occurred recently while the UPS was in operation. The Event Log stores min of 1000 events, with the oldest events being overwritten first if the log's capacity is reached.

Alarm	Explanation
Input Phase Reversed	The AC input phase rotation is reversed
Input Voltage Abnormal	The mains voltage is outside specifications and results in rectifier shutdown
Input Freq. Abnormal	The mains frequency is outside specifications and results in rectifier shutdown
Input Undervoltage	At least one phase main input voltage is within 132V ~ 176V, thus the load should be derated
Input Fuse Fail	The main circuit input fuse of the module is disconnected
Input Backfeed	Battery voltage fed back to rectifier input
Input Current Abnormal	Battery load sharing imbalance or rectifier input current abnormal
Input Current Limit	Input current over limit
Input Neutral Missing	AC rectifier input neutral line not detected
Rectifier Fault	Rectifier failure (bus voltage is too high or too low, or battery discharge SCR short circuit)
Rec. Soft Start Fail	Owing to low DC bus voltage, the rectifier will report this alarm
Rectifier in Setting	The rectifier starts up and is in synchronization
Inverter Fault	The inverter starts up and is in synchronization
DC Bus Abnor. Shutdown	The DC bus voltage is abnormal and results in inverter shutdown. The load transfers to bypass
DC Bus Overvoltage	The rectifier, inverter and battery converter shut down because the DC bus voltage is too high. The load transfers to bypass
Load Impact Transfer	A transfer to bypass occurred due to a large step load. The UPS can recover automatically. Turn on the load equipment in stages to reduce the load impact on the inverter
Excess Auto Rexfers	The load remains on bypass power owing to excessive number of transfers that occurred within the one hour
Excess ECO Auto Xfers	The load remains on bypass power owing to excessive number of transfers that occurred within the one hour
Other Module Xfer	All UPSs in the parallel system transfer to bypass at the same time when one of them needs to transfer to bypass. This message appears on the TOUCHSCREEN of the UPS with passive transfer to bypass
Load Sharing Abnormal	The UPSs in a parallel system are not sharing the load current correctly
Byp. Abnormal Shutdown	Both the bypass and inverter voltages are abnormal, and the output is off
Inverter in Setting	The inverter parameters of this machine are being monitored and synchronized
Inverter Asynchronous	The output voltage and bypass voltage are misaligned in phase. This alarm resets automatically once the condition is no longer true
Inverter Relay Fail	At least one of the inverter relays is opened or shorted. This fault is locked until mains power-off
Overvoltage N-GND	The neutral ground voltage is too high. Check whether the output wiring is shorted to the chassis
Bypass Abnormal	The amplitude or frequency of the bypass voltage exceeds the limit. This alarm automatically resets once the bypass voltage returns to normal
Bypass Phase Reversed	The phase rotation of the bypass voltage is reversed
Bypass Out of Sync	The bypass voltage and frequency are not within the set tracking range
Bypass overcurrent	The bypass current is outside the rated current
Bypass STS Fail	At least one of the STSs at the bypass side is open or shorted. This fault is locked until power-off

Alarm	Explanation
Other Bypass STS Fail	The adjacent bypass STS open circuit fault or short-circuit fault
Bypass backfeed	The bypass backfeed is faulty
Bypass Overtemperature	The bypass has overtemperature
Bypass in Charge	The bypass detects an inverter signal when the system runs normally. When the output voltage is abnormal, the system will transfer to bypass mode for power supply
Bypass in Setting	The bypass module is initialized and synchronized
Bypass Not Available	In generator mode, the bypass output is disabled
Bypass Overcurrent Timeout	When the bypass overload delay time expires, the bypass is closed
Bypass Fuse Fail	Bypass Fuse Fail
Charger Fault	Battery charger has failure
Battery Reversed	Reconnect battery and check battery wiring
No battery	The battery is not connected, check the battery insurance, check the battery and battery wiring
Battery Overtemp.	The battery temperature is over limit
Battery Maintain	The battery maintenance is required
Low Battery	Before the EOD, battery low pre-warning will occur. After this pre-warning, the battery will have the capacity for 3min discharging with full load. The time is user-settable from 3min to 6min
Batt. End of Discharge	Inverter turned off due to battery EOD
Battery Ground Fault	Battery has ground fault
Batt. Room Temp. Abn.	Battery room has overtemperature (option included)
BCB Open	Battery BCB is opened
BCB Closed	Battery BCB is closed
BCB Status Abnormal	Logic conflict between BCB drive signal and backfeed signal
Battery Reset	The battery-related aging coefficient capacity information is reset, which occurs when changing battery-related configuration information or manually resetting the battery
Battery Terminal Abnormal	There are signs of short circuit on the positive and negative terminals of the battery. Check the battery wiring, battery, and machine ports, check the battery insurance, and see if there is any trace of short circuit and arcing
Discharger Curr. Limit	Discharge current is over limit, close the discharger
Internal Battery Switch Open	The auxiliary contact of the internal battery air switch is disconnected
Discharger Fault	Bus voltage abnormal
Balance Circuit Fault	The balance circuit cannot stabilize the positive and negative bus voltage difference
Balance Circuit Overcurrent	Balance circuit current exceeds wave-by-wave current limit
Charger Shutdown	Dry contact signal, the dry contact gives the charger shutdown command, and the charger will shut down
Battery Voltage High	When the battery is connected, it is detected that the battery voltage exceeds the high voltage range. Check if the battery terminal voltage is out of the normal range
Battery Deep Discharge Alarm	In CPSS applications, the battery discharge reaches the termination voltage, the battery stops discharging, and the inverter shuts down
Battery Voltage Low	The battery voltage is too low, which is caused by the wrong configuration of the number of battery cells or a problem with the battery
Batt. Temp Sensor Abnor.	The difference of the battery temperature detection point is too large, or the temperature detection is out of range, or the temperature detection communication is abnormal
Discharger Shutdown	The arrester needs to be turned off in the case of non-arrestor failure, and the arrester needs to be turned off if the joint power supply state is not required
Output Overload	This alarm appears when the load arises above 105% of the nominal rating. The alarm automatically resets once the overload condition is removed
Out. Overload Timeout	The UPS overload status continues and the overload times out. When the time has expired, the load automatically transfers to the bypass

Alarm	Explanation
Output Fuse Fail	At least one of the inverter output fuses is blown
Output Volt. Abnormal	At least one phase of the output voltages is abnormal
Output Fuse Fail	At least one phase module inverter relay or open fuse fault
Output Voltage Abnormal	Abnormal output voltage of at least one phase
Fault Clear	Operator Control Panel Fault Clear Command Options
Silence Active	Operator control panel alarm mute command options
Silence Inactive	SILENCE ON/OFF key on the operator control and display panel pressed in alarm silence state
Inverter Manual On	INVERTER ON key on the operator control and display panel pressed to turn on the inverter
Inverter Manual Off	INVERTER OFF key on the operator control and display panel pressed to turn off the inverter
Autostart	After UPS shutdown at EOD, the inverter automatically starts upon mains restoration
EPO	EPO button on operator control and display panel pressed or external EPO command received
Load on Bypass	UPS is in bypass mode
Load on Inverter	The UPS is in normal mode, that is, the input is in the main power supply mode, and the output is in the inverter power supply mode
Load on Battery	The UPS is in battery power supply mode, that is, the input is in battery discharge mode, and the output is in inverter power supply mode
Load Off	The UPS shuts down, and the bypass and inverter have no output
Output Disabled	EOD event happened. Check the battery voltage
Automatic Battery Test	Regular automatic battery maintenance discharge test in progress (20% capacity discharge)
Calibrated Battery Test	The user starts the battery capacity discharge test (100% capacity discharge)
Manual Battery Test	User initiates battery maintenance discharge test (20% capacity discharge)
Rectifier DSP Update	Upgrading rectifier DSP software
Inverter DSP Update	Inverter DSP software is being upgraded
Inverter FPGA Update	Upgrading inverter FPGA software
Bypass DSP Update	Upgrading bypass DSP software
Bypass FPGA Update	Upgrading bypass FPGA software
HMI Update	Upgrading monitoring software
Remote Turn On	Turn on the inverter through the service command
Remote Turn Off	Turn off the inverter through the service command
Batt. Equalize Charge	The battery is forced to be in boost charge state
Equalize Chg. Timeout	The actual float charging time exceeds the time set by the setting software
Battery Test Fail	Battery test failed
Battery Test Stopped	Battery test stopped
Load on Maintenance Bypass	The maintenance bypass is closed and the load is supplied
Inverter On Cancel	Inverter on cancel
Inverter On Fail	Power-on failure, possibly due to invalid operation (eg service switch closed), DC bus or rectifier not ready
MonCAN Comms. Abnormal	Communication failure between internal supervisory board and inverter, rectifier, bypass
ParaMonCAN Comms. Abnormal	Communication failure between internal inverter, rectifier, bypass
PowerCAN Comms. Abnormal	ParaPowerCAN communication between bypass and bypass fails
Discrete Bus Comms. Abnormal	The discrete bus communication in the rack is abnormal, it is recommended to check whether the communication cable connection on the back of the rack is reliable
ParaDiscrete Bus Comms. Abn.	The discrete CAN communication between the bypass and the bypass fails, it is recommended to check the parallel cable and the bypass board
Batt. System Comms. Abnor.	The MODBUS communication between UPS and BMS is abnormal

Alarm	Explanation
Ambient Overtemperature	Ambient temperature over-temperature detection, can be set
Control Power Fail	Auxiliary power failure or brownout
Fan Abnormal	At least one power module fan has failed
Bypass SCR Fan Abnormal	At least one bypass module fan has failed
Operation Invalid	User operation error (for example, the maintenance switch is closed when the inverter is outputting in parallel, the output switch and the maintenance switch are closed after the inverter is turned on, etc.)
On Generator	Dry contact signal, indicating that the generator is connected
Input Switch Open	Input circuit breaker is disconnected
Maint. Switch Open	Maintenance switch disconnected
QBP Open	External maintenance circuit breaker disconnected
QOP Open	External maintenance isolation circuit breaker disconnected
Maint. Switch Closed	Maintenance switch closed
QBP Closed	External maintenance circuit breaker closed
Output Switch Open	Output switch open
QE Open	The external output circuit breaker is disconnected
Bypass Switch Open	Bypass switch open
System Interrupt Transfer	Intermittent switching is performed when the bypass is super-tracking and the inverter is not phase-locked
Parallel Cable Abnormal	Parallel cable connection is abnormal
LBS Cable Abnormal	Abnormal LBS cable connection
Loss of Redundancy	Loss of redundant capacity
MMS Capacity Exceeded	When the output load of the N+X parallel system is greater than N, the alarm prompts that the input and output switches and cables are bearing more than the designed rated power
LBS Active	LBS is enabled
LBS Abnormal	LBS is abnormal
Rectifier DSP SW Error	There is an error in the DSP program of the rectifier control board. It may be that other programs such as inverter or bypass DSP have been recorded
Inverter DSP SW Error	There is an error in the DSP program of the inverter control board. It may be that other programs such as rectification or bypass DSP have been recorded
Inverter FPGA SW Error	There is an error in the FPGA program of the inverter control board. It may be that other programs such as the bypass FPGA have been recorded
Bypass DSP SW Error	There is an error in the DSP program of the bypass control board. It may be that other programs such as rectification or inverter DSP have been recorded
Bypass FPGA SW Error	There is an error in the FPGA program of the bypass control board. It may be that other programs such as the inverter FPGA have been recorded
Power Hardware Mismatch	The model information set in the background is inconsistent with the actual
Parameter Config. Fail	DSP configuration EEPROM operation failed, or MON failed to deliver DSP parameters
Input Transf. Overtemp	Input Transformer Overtemperature
Module Overtemperature	The rectification and inverter power tubes in the module are overheated
Charger Overtemperature	The power tube of the charger in the module is overheated
Balance Circuit Overtemp	Balance circuit power tube radiator over temperature
Module in Sleeping	When the module is in sleep mode, the inverter does not work. Only the machines with smart parallel mode or smart parallel demonstration mode have this state
Module Comms. Normal	Monitor and module communication is normal

Alarm	Explanation
ECO Mode Enabled	The machine is configured in ECO mode
ECO Mode Active	The machine works in ECO mode
Intell. ECO Mode Enabled	The machine is configured in smart ECO mode
Intell. ECO Mode Active	The machine works in intelligent ECO mode
Intell. ECO Mode Demo Enabled	The machine is configured in smart ECO demo mode
Intell. ECO Mode Demo Active	The machine works in the smart ECO demo mode
Freq. Converter Mode Enabled	The machine is configured in frequency converter mode
Freq. Converter Mode Active	The machine works in inverter mode
IP Mode Enabled	The machine is configured in intelligent parallel mode, that is, sleep mode
IP Mode Active	The machine works in intelligent parallel mode, that is, sleep mode
IP Mode Demo Enabled	The machine is configured as an intelligent parallel demonstration mode, that is, a sleep demonstration mode
IP Mode Demo Active	The machine works in the intelligent parallel demonstration mode, that is, the sleep demonstration mode
Regen. Mode Enabled	The machine is configured in self-aging mode
Regen. Mode Active	The machine works in self-aging mode
Testing Mode Enabled	The machine is configured in commissioning mode
Testing Mode Active	The machine is working in commissioning mode
Pwr. Conditioner Mode Enabled	The machine is configured in power regulator mode
Pwr. Conditioner Mode Active	The machine works in power regulator mode
MMS Inv. Manual Off	There is a machine that presses the manual shutdown button, and chooses to shut down the parallel system uniformly
MMS Inv. Manual On	There is a machine that presses the manual start button, and selects the parallel system to start at the same time
Byp. Mod. Unauthorized	The bypass module is not authorized, and the bypass cannot work. Please contact the manufacturer's customer service to obtain relevant authorization
Pwr. Mod. Unauthorized	The power module is not authorized, the module cannot work, please contact the manufacturer's customer service to obtain the relevant authorization
HMI Unauthorized	The monitoring is not authorized, the machine cannot work, please contact the manufacturer's customer service to obtain the relevant authorization
Mod. Unauthorized	Power module ready lock not ready
Suspend ECO Mode	It is forbidden to work in ECO mode, UPS gives priority to inverter power supply, and comes from configurable input dry contact control commands
Out of Warranty	When the equipment is out of warranty, it will prompt according to the expiration time set on the UPS panel
Time for Service	The service time is up, according to the service time reminder set by the UPS panel
DC Cap Life Pre-warning	The bus capacitor life is about to expire, according to the bus life reminder set on the UPS panel
DC Cap Life Warning	The bus capacitor life has expired, according to the bus life reminder set on the UPS panel
Fan Life Pre-warning	The fan life of the power module is about to expire, according to the bus life prompt set on the UPS panel
Fan Life Warning	The service life of the fan of the power module has expired, according to the bus service life prompt set on the UPS panel

Alarm	Explanation
Bypass Fan Life Pre-warning	The bypass fan life is about to expire, according to the bus life reminder set on the UPS panel
Bypass Fan Life Warning	The life of the bypass fan has expired, according to the bus life prompt set on the UPS panel
Batt. System Abnormal	There is an alarm, or an alarm event is detected in the BMS
Batt. System Fault	There is a fault, or a fault event is detected in the BMS

8. Battery Status Indicator

   A battery status indicator displays DC alarm conditions, temperature, battery state of charge, the present battery voltage, total discharge time, status of last battery test, and battery time remaining during discharge.

   The UPS provides the operator with controls to perform the following functions:

   - Configure and manage manual battery test.
   - Modify test duration and minimum voltage.
   - Start battery test.
   - Monitor test status and progression.
   - Stop battery test.
   - Battery test status.

9. Controls

   System-level control functions are:

   - Start Inverter (and transfer to inverter).
   - Stop Inverter (after transferring to bypass).
   - Startup Screen.
   - Battery Test Set Point Adjustment.
   - Configure Manual Battery Test.
   - Initiate Manual Battery Test.
   - System Settings (Time, Date, Language, LCD Brightness, Password, Audio Level).
   - Alarm Silence Command.
   - Fault Reset Command.
   - Energy Saving Modes.
   - Warning and Critical Thresholds of Load and Battery.

10. Manual Procedures

    - Load Transfers: HMI buttons (START INVERTER, STOP INVERTER) provides the means for the user to transfer the load to bypass and back on UPS.

11. Self-Diagnostics

    - Event Log File - The control system shall maintain a log of the event conditions that have occurred during system operation. Each log contains the event name, event time/date stamp and a set/clear indicator.

- Fault waveform capturing- Records 3 cycles data of voltage/current of rectifier/inverter/bypass when fault triggers, In 3 cycles of recorded data, 2 cycle of data shall be captured before trigger point, 1 cycle of data shall be captured after fault trigger point.

2.3.7 Remote Monitoring and Integration Capabilities

24 X 7 remote monitoring services: The UPS manufacturer shall provide as an optional service, which provides 24x7 continuous monitoring of events and parametric data, event and data analysis reports, and dispatch of factory trained field service personnel. The UPS can initiate periodic and critical event-driven communication with a remote service center to transfer event and parametric data for analysis and action. The remote service centers are staffed with factory-trained service personnel who can receive, analyzing, and interpreting the communicated events and data. In case of any anomalies, the remote service center personnel will dispatch factory-trained field service personnel with necessary tools and accessories to the location of the UPS to fix the problem.

1. **Communication Cards:** The UPS can be equipped with following communication card(s) including:

   - **Optional Communication card:** This card provides Web access, environmental sensor data, and third-party customer protocols for the UPS and manage a wide range of operating parameters, sending data over ethernet networks via secure HTTPS protocol and alarms and notifications via SNMP traps or Modbus protocol. It is also capable to integrate with any existing building management system.
   - **Optional Software:** Provided to support the monitoring of multiple no of UPS systems at single console platform.
   - **Relay card:** Dry contact outputs are provided for Summary Alarm, Bypass Active, Low Battery, and AC Input Failure.

2. **Customer Input Contacts:** The UPS shall have four discrete input contacts available for the input and display of customer-provided alarm points or to initiate a pre-assigned UPS operation. Each input can be signaled by an isolated, external, normally open contact.

   When an assembly is selected as a pre-assigned UPS operation, the following actions should be initiated:

   - **On Generator:** Provides selectable choices to enable or disable battery charging and enable or disable ECO Mode operation while on generator.
   - **Transfer to Bypass:** Manual command to transfer from inverter operation to static bypass operation.
   - **Fast Power Off:** Emergency Module Off (EPO) command to stop UPS operation.
   - **Acknowledge Fault:** Acknowledge a UPS alarm condition and present faults will be reset.
   - **Bypass/Inverter Off:** Emergency Power Off (EPO) command to stop UPS operation.
   - External Maintenance Bypass Breaker (MBB) status (open or closed).

2.3.8 Battery Disconnect Breaker

The battery cabinet shall have a properly rated circuit breaker to isolate it from the UPS. This breaker will be in a separate enclosure or in a matching UPS/battery cabinet. When this breaker is open, there shall be no battery voltage in the UPS enclosure. The UPS will be automatically disconnected from the battery by a shunt trip of the battery cabinet breaker when signalled by other control functions.

2.3.9 Optional Accessories and Features

1. Load Bus Sync

   The Load Bus Sync (LBS) enables two independent single-module UPS units to stay in sync when operating on battery or unsynchronized input sources. The LBS determines the master and slave relationship between UPS units. The LBS will be installed within each single-module UPS.

2. Seismic Anchorage Kits

   Seismic anchorage kits will be provided with the UPS unit, and if included the optional matching battery cabinet, for use in seismic restraint as required for GR-63-CORE or OSHPD certification.

3. FCC Compliance Filter Compatibility

   The ups shall comply with FCC part 15, class 2.

4. Temperature sensor

   Vertiv battery cabinets have built-in temperature sensors. The temperature sensor option includes a remote sensor in the US market that must be field installed.

3.0 STORED ENERGY SYSTEMS

The UPS system shall be provided with a stored energy system that shall comply with the specifications of:

- Flooded-Cell Battery System.
- Valve-Regulated, Lead-Acid Battery System.
- Lithium-Ion Battery System.
- Nickel-Zinc Battery System.

Specifications describing the requirements for the customer-specified stored energy system are contained in SL-25418GS, available at the Vertiv Web site.

4.0 EXECUTION

4.1 Field Quality Control

The following inspections and test procedures shall be performed by factory-trained field service personnel during the UPS startup.

1. **Visual Inspection**

- Inspect equipment for signs of damage.
- Verify installation per drawings supplied with installation manuals or submittal package.
- Inspect cabinets for foreign objects.
- Verify that neutral and ground conductors are properly sized and configured per OEM requirements as noted in OEM drawings supplied with installation manuals or submittal package.
- Inspect each battery jar for proper polarity.
- Verify that all printed circuit boards are configured properly.

2. **Mechanical Inspection**

- Check all control wiring connections for tightness.
- Check all power wiring connections for tightness.
- Check all terminal screws, nuts, and/or spade lugs for tightness.

3. **Electrical Inspection**

- Check all fuses for continuity.
- Confirm input and bypass voltage and phase rotation are correct.
- Verify control transformer connections are correct for voltages being used.
- Verify connection and voltage of the battery string(s).

4. **Unit Startup**

- Energize control power.
- Perform control/logic checks and adjust to meet the manufacturer’s specification.
- Verify DC float and equalize voltage levels.
- Verify DC voltage clamp and overvoltage shutdown levels.
- Verify battery discharge, low battery warning, and low battery shutdown levels.
- Verify fuse monitor alarms and system shutdown.
- Verify inverter voltages and regulation circuits.
- Verify inverter/bypass sync circuits and set overlap time.
- Perform manual transfers and returns.
- Simulate utility outage at no load.
- Verify proper recharge.

4.2 Manufacturer's Field Service

1. Service Personnel

The UPS manufacturer shall directly employ a nationwide service organization, consisting of factory-trained field service personnel dedicated to the startup and maintenance of UPS and power equipment.

The manufacturer shall provide a national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7 days/week, and 365 days/year. If emergency service is required, on-site response time shall be four hours or less within 150 miles of a Vertiv Services center.

Two local customer engineers shall be assigned to the site with a regional office as a backup. Escalation procedures shall be in place to notify Power Technical Support if a site is not functioning within 24 hours.

2. Vertiv™ LIFE™ Services

The UPS manufacturer shall provide LIFE™ services, which provides 24x7 continuous monitoring of events and parametric data, event and data analysis reports, and dispatch of factory-trained field service personnel. The UPS shall be able to initiate periodic and critical event driven communication with a remote service center to transfer event and parametric data for analysis and action. The remote service center shall be staffed with factory-trained service personnel who can receive, analyzing and interpreting the communicated events and data. The remote service center personnel shall also be capable of dispatching factory-trained field service personnel to the location of the UPS.

3. Replacement Parts Stocking

Parts shall be available through an extensive network to ensure round-the-clock parts availability throughout the continental United States and across main regions where Vertiv has presence.

Spare parts shall be stocked by local field service personnel with backup available from regional parts centers and the manufacturing location. A national parts center Customer Support Parts Coordinator shall be on call 24 hours a day, 7 days a week, 365 days a year for immediate parts availability.

4. Maintenance Contracts

A complete offering of preventive and full-service maintenance contracts for both the UPS system and battery system shall be available.

5.0 UNINTERRUPTIBLE POWER SYSTEM TECHNICAL DATA

	Make			
	Model			
A	General Characteristics			Suppliers Data
1	Continuous duty three phase double conversion uninterruptible power system (UPS), The UPS shall utilize a standard 3U size rack mountable power module and scalable array architecture.			
2	Hot swappable power module should have its own controller and contains a full rated rectifier, full rated inverter, and battery charging circuit.			
3	UPS comprises a user replaceable centralized continuous duty hot swappable bypass static switch module.			
4	Standard configuration of UPS footprint shall not exceed.			
5	All the conformal coated PCBs shall be used in the modules.			
6	External battery circuit breaker with necessary shunt tripping shall be provided for external battery banks.			
B	System Characteristics			
	Item	Unit	Specifications	
	Dimensions, W × D × H	in	Power Module Cabinet – 51.1 x 39.3 x 78.7 in. I/O Cabinet – 31.4 x 39.3 x 78.7 in.	
	Weight	lb	UPS Cabinet – 3911 (without switches)	
	Noise within 1m	dBA	Not more than 60 dB at 50% load	
	Operating temperature	°C	32 °F to 104 °F (0 °C to 40 °C) full performance, 104 °F to 122 °F (40 °C to 50 °C) with automatic derating	
	Relative humidity	%RH	0 to 95%, non-condensing	
	Efficiency at Double conversion mode at 480 VAC	%	Up to 97.6% ± 0.2%	
	Efficiency at Eco mode	%	Up to 99% ± 0.1%	
	Efficiency at dynamic online mode	%	Up to 98.9 (±0.2%)	

	Protection degree, IEC (60529)	N/A	IP20	
C	Input Characteristics			
	Rated AC input voltage	VAC	480 V (3-phase 4-wire (+PE) TN/TT/IT power distribution system)	
	Input voltage tolerance	VAC	384 to 528 VAC at full at full load, between 288 up to 384 the UPS has a linear de-rating factor. The maximum de-rating is 75% at 228 VAC without battery discharge	
	Frequency	Hz	50/60 (tolerance: 40 to 70)	
	Power factor	kW/kVA	0.99 (50-100% Load)	
	Maximum Input current	A rated (maximum)	1823 A at lowest input voltage at 100% load connected	
	Harmonic current distortion	THDI%	≤3 with linear load at full load operation	
	Power walk-in duration	s	0.5 to 5 seconds (Default 2 seconds)	
D	Intermediate DC Circuit			
	Battery bus voltage	Vdc	288 V to 690 V without de-rating. 288 V to 384 V with de-rating.	
	Total Battery Capacity (as per above backup time)	AH		
	Maximum battery charging current	A	550	
	Charging Mode		Constant current and constant voltage	
	Float voltage	V/cell (VRLA)	2.27 V/cell (selectable from 2.2 V/cell to 2.3 V/cell)	
	Temperature compensation	mV/°C/cl	-3.0 (selectable from 0 to -5.0 around 77 °F (25°C)). It can be inhibited.	
	Ripple voltage	% V float	≤1.414	
	Ripple current	% C10	≤5	
E	UPS Output characteristics			

	Rated AC voltage	Vac	480 V	
	Frequency	Hz	50/60	
	Overload	%	<105% Continuous	
			105% to 125% for 10 minutes	
			125% to 150% from 10 minutes to 60 seconds	
			150% to 200% for Minimum 200 milliseconds	
	Non-linear load capability	kVA	According to IEC 62040-3	
	Steady state voltage stability	%	±1 (balanced load), ±3 (100% unbalanced load)	
	Transient voltage response	%	<6 for 10 milliseconds <3 after 20 milliseconds	
	Total harmonic voltage	%	≤1 % (100% linear load), ≤3% (100% non-linear load)	
	Synchronization window	Hz	Upper limit: 0.5 Hz, 1 Hz, 2 Hz, 3 Hz, +10%, Default: +10%. Lower limit: -0.5 Hz, -1 Hz, -2 Hz, -3 Hz, -10%, Default: -10%	
	Slew rate (max change rate of synchronization frequency)	Hz/s	For singe module, Setting range: 0.1 to 3 Hz/s (UPS module), default: 0.6 Hz/S For parallel system: 0.1 to 2Hz/s, default: 0.6 Hz/s	
	Transfer time	milliseconds	Frequency converter mode: transfer without interruption 0ms, transfer with interruption < =16 milliseconds ECO mode: 4 milliseconds, Dynamic online mode: 0 milliseconds*. *Condition apply.	
F	Bypass Input Characteristics			
	Rated AC voltage	VAC	480 V, three-phase four-wire, sharing neutral with the rectifier input and providing neutral reference to the output	
	Overload	%	≤110% for continuous	
			110% to 130% for 10 minutes	
			130% to 140% from 10 minutes to 1 minutes	

			140% to 160% for 1 minutes	
			>160% for 200 milliseconds	
	Frequency	Hz	50/60	
	Bypass voltage tolerance	%VAC	Upper limit: +10% VAC	
			Lower limit: -10% VAC, -15% VAC, Default: -10% VAC	
	Bypass frequency tolerance	%	±10	
G	Conformity and Standards			
	General and safety requirements for UPS used in operator access areas		IEC 62040-1	
	Electromagnetic compatibility (EMC) requirements for UPS		IEC 62040-2 (Class C3)	
	Method of specifying the performance and test requirements of UPS		IEC 62040-3 (VFI SS 111)	
	General and safety requirements for UPS used in operator access areas		UL 1778	

BOQ				
Sr. No.	Description	Quantity	Unit Price	Total Amount
1	Rack Based 1250 kVA/kW modular UPS, Suitable to accommodate Maximum of 10 power modules			
2	125 kVA/ kW Intelligent hot swappable power module with DSP controller			
3	Communication Options			
	SNMP and MODBUS			
	Relay Card			
	Software to monitor multiple UPSs at single console			

4	24 X 7 Remote monitoring services (including required hardwire)			
5	Battery and its accessories			
6	UPS to Battery Cable			
7	Installation and Commissioning Charges			