

Vertiv™ PSI5 Lithium-Ion 500VA to 1500VA UPS Short Depth 120V GUIDE SPECIFICATIONS

1.0 GENERAL

1.1 Summary

This specification defines the electrical and mechanical characteristics and requirements for a continuous duty single-phase, line interactive (sinewave), solid-state, uninterruptible power system. The uninterruptible power system hereafter referred to as the UPS, will provide high quality AC power for sensitive electronic equipment loads.

1.2 Standards

The UPS is designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification will govern.

- FCC compliance mark
- UL compliance mark
- c-UL compliance mark
- NOM compliance mark
- IEC62040-3
- EN62040-3
- IEC62040-3:2011
- IEC TR 60721-4-3:2003
- IEC 60068-2-6
- IEC 60068-2-27
- ISO 7779
- EN61000-3-2:2014
- EN61000-3-3:2013
- IEC61000-4-2:2008
- IEC61000-4-3:2006
- IEC61000-4-4:2012
- IEC61000-4-5:2014
- IEC61000-4-6:2013
- IEC61000-4-8:2009
- IEC61000-2-2:2002
- IEC62619:2017
- UN38.3
- ISTA 2A Procedure
- RoHS2, REACH, and WEEE Compliant
- Energy Star 2.

1.3 System Description

1.3.1 Modes of Operation

The UPS is designed to operate as a line interactive system in the following modes:

1. Normal Mode

The UPS input is plugged into a stable, nominal source. The critical AC load is continuously supplied with filtered power. The battery charger maintains a float charge on the battery.

2. Automatic Voltage Regulation (AVR) Boost/Buck Mode

When the input power is in the Buck or Boost range, the UPS transfers to correction mode.

- **On/Automatic Voltage Regulation (AVR)/Boost Mode:** The UPS input is plugged in, but the voltage source is abnormally low (brown-out). The UPS automatically corrects the low voltage and allows the outlets to be on with the normal, expected voltage. The internal batteries are charging.
- **On/Automatic Voltage Regulation (AVR)/Buck Mode:** The UPS input is plugged in, but the voltage source is abnormally high. The UPS automatically corrects the high voltage and allows the outlets to be on with the normal, expected voltage. The internal batteries are charging.

3. Recharge

Upon restoration of utility/mains AC power following an outage and complete or partial battery discharge, the unit automatically restarts and resumes supplying power to the critical AC load. The battery charger also begins recharging the battery. The battery is charged from the utility whether the UPS is *On* or *Off*.

4. Battery Mode

When the input power source exceeds the parameters defined in section 1.3.3, the inverter supplies power to the critical AC load using the battery as its source. The typical detection and transfer time is 4 to 6 ms.

5. Fault Mode

An error or fault condition has occurred. The outlets are shut off.

6. Battery Self-Test Mode

The UPS enters a cycle of approximately 10 seconds which it tests the internal battery. The outlets are still temporarily powered by the internal battery. Self-test mode occurs in the following instances:

- At startup turning the UPS *On*.
- Automatically every 8 weeks as a self-check.
- Select the Start/Stop battery manual test option in the LCD menu.

1.3.2 Design Requirements

- Voltage:** Input/Output Voltage Specifications of the UPS are:
 - Input: 75-150 VAC, 50/60 Hz, single phase, 2 wire plus ground.
 - Output: 120 VAC default (user configurable: 100V, 110V, 115V, 120V, 125V) 50/60Hz, single phase, 2 wire plus ground.
- Output Load Capacity:** The maximum specified output load capacity of the UPS, regardless of load power factor is:

	100 V	110 V	115 V	120 V	125 V	Power Factor
PSi5-500VA	450VA/ 405W	450VA/ 405W	500VA/ 450W	500VA/ 450W	500VA/ 450W	0.9
PSi5-800VA	720VA/ 648W	720VA/ 648W	800VA/ 720W	800VA/ 720W	800VA/ 720W	0.9
PSi5-1100VA	990VA/ 891W	990VA/ 891W	1100VA/ 990W	1100VA/ 990W	1100VA/ 990W	0.9
PSi5-1500VA	1200VA/ 1147W	1275VA/ 1147W	1380VA/ 1350W	1440VA/ 1350W	1500VA/ 1350W	0.9

- Internal Battery:** The internal battery consists of maintenance free, sealed, Lithium-ion (LiFePO₄) cells. The internal battery is user replaceable and hot-swappable.
- Battery Reverse Time:** These times shall be at full load (PF=0.9) with ambient temperature of 25°C (77°F), with resistive loading and internal batteries fully recharged.
 - 500 VA: 3.21 minutes
 - 800 VA: 8.20 minutes
 - 1100 VA: 6.01 minutes
 - 1500 VA: 6.37 minutes
- Battery Recharge:** The UPS contain an internal battery charger designed to prolong battery life. This battery charger will be a high performance 2 stage charger with temperature compensation. Recharge time to 100% capacity is:
 - Internal Batteries: 2 hours (typical, with full load connected)
 - External Battery Cabinet (EBC): 2.30 hours (after complete discharge with full load connected)

1.3.3 Performance Requirements

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

- Operating at any altitude within the specified range (≤ 3000 m elevation).
- Operating at any ambient temperature within the specified range (0 °C to 40 °C)

AC Input to UPS

1. **Voltage Configuration:** The UPS shall incorporate a variable input voltage (line detection) window feature that operates at the nominal output voltage in the following table, without drawing power from the batteries.
 - 100 VAC setting: single phase, 2 wire plus ground: 90 to 110 VAC (± 10 VAC)
 - Boost compensation: 90 VAC ($\pm 3\%$)
 - Buck compensation: 110 VAC ($\pm 3\%$)
 - 110 VAC setting: single phase, 2 wire plus ground: 99 to 121 VAC (± 10 VAC)
 - Boost compensation: 99 VAC ($\pm 3\%$)
 - Buck compensation: 121 VAC ($\pm 3\%$)
 - 115 VAC setting: single phase, 2 wire plus ground: 104 to 127 VAC (± 10 VAC)
 - Boost compensation: 104 VAC ($\pm 3\%$)
 - Buck compensation: 127 VAC ($\pm 3\%$)
 - 120 VAC setting: single phase, 2 wire plus ground: 108 to 132 VAC (± 10 VAC)
 - Boost compensation: 108 VAC ($\pm 3\%$)
 - Buck compensation: 132 VAC ($\pm 3\%$)
 - 125 VAC setting: single phase, 2 wire plus ground: 113 to 138 VAC (± 10 VAC)
 - Boost compensation: 113 VAC ($\pm 3\%$)
 - Buck compensation: 138 VAC ($\pm 3\%$)
2. **Frequency:** The UPS automatically senses the input frequency when first powered up and shall operate within the following frequency specifications. UPS shall be capable of cold start with default frequency of 60Hz, 120V. Once started, the input frequency operating window shall be:

- 50 Hz Applications: 45 to 55 Hz (± 0.2 Hz)
- 60 Hz Applications: 55 to 65 Hz (± 0.2 Hz)

3. **Nominal Input Current Ratings:** The nominal RMS input current will be as follows, assuming internal batteries are fully charged and nominal input voltage.

UPS Rating	Nominal RMS Input Current
500 VA	3.9 A
800 VA	6.1 A
1100 VA	8.4 A
1500 VA	11.5 A

4. **Inrush Current:** The UPS shall have a maximum inrush time of <30 ms, assuming initial startup, a no load, and 120 V nominal input voltage.
5. **Surge Protection:** The UPS shall include MOV ratings at 316 Joules minimum connected L-N, 1056 Joules minimum connected L-G and N-G. The UPS shall comply with ANSI C62.41 Cat. B, Level 3 standard.
6. **Input Power Cord:**

UPS Rating	Input Power Socket
500/800/1100/1500 VA	IEC 320 C14

AC Output

1. **Voltage Configuration:**
 - 120 VAC default, 50/60 Hz, single phase, 2 wire plus ground, selectable through LCD (100V, 110V, 115V, 120V, 125V AC)
2. **Voltage Regulation:** $\pm 1\%$ battery mode operation and steady state.
3. **Frequency Regulation:** Synchronized with input frequency in line mode operation. $\pm 1\%$ for battery mode operation.

4. Voltage Distortion:

- ≤3% Total Harmonic Distortion (THD) typical into a 100% linear load (120 V output) and battery mode
- <5% Total Harmonic Distortion (THD) typical into a 100% non-linear (RCD) load and battery mode

5. Output Power Rating: Output power rating shall be 0.9 lagging power factor as follows:

	100 V	110 V	115 V	120 V	125 V	Power Factor
PSi5-500VA	450VA/ 405W	450VA/ 405W	500VA/ 450W	500VA/ 450W	500VA/ 450W	0.9
PSi5-800VA	720VA/ 648W	720VA/ 648W	800VA/ 720W	800VA/ 720W	800VA/ 720W	0.9
PSi5-1100VA	990VA/ 891W	990VA/ 891W	1100VA/ 990W	1100VA/ 990W	1100VA/ 990W	0.9
PSi5-1500VA	1200VA/ 1147W	1275VA/ 1147W	1380VA/ 1350W	1440VA/ 1350W	1500VA/ 1350W	0.9

6. Inverter Overload Capability:

Nominal Output Voltage	Normal / Buck / Boost Mode	Battery Mode
120 VAC	<p><111% Continuous</p> <p>111% to 120% - 60 seconds</p> <p>121% to 150% - 1.5 seconds</p> <p>>151% - immediate shutdown</p>	<p><111% Continuous</p> <p>111% to 120% - 60 seconds</p> <p>121% to 150% - 10 seconds</p> <p>>151% - immediate shutdown</p>

The time periods described above are for VA or W ratings, in line or battery mode operation

7. AC-AC Efficiency: The UPS will perform with the efficiencies as below, assuming full load, nominal input voltage and batteries fully charged:

- 500 VA: 98.4% AC-AC at full rated linear load (92.0% Boost / 92.0% Buck)
- 800 VA: 98.4% AC-AC at full rated linear load (90.0% Boost / 93.0% Buck)
- 1100 VA: 98.3% AC-AC at full rated linear load (89.0% Boost / 92.0% Buck)
- 1500 VA: 98.3% AC-AC at full rated linear load (89.0% Boost / 92.0% Buck)

8. **Programmable & Controllable Outlets:** The UPS units based on the model shall have up to 4 groups of sockets, one of these groups programmable and controllable. These shall be user customizable to program through LCD display to perform load shedding based selected criteria. The user shall also be able to configure these groups for restart of connected equipment based upon time after input power is restored.

UPS Model	Number of Programable Outlets
500 VA	1
800 VA	1
1100 VA	2
1500 VA	3

1.4 Environmental Conditions

1. Ambient Temperature

Operating: The ambient temperature range, when UPS is operational, shall be from 0 to 40 °C. There shall not be any degradation in the performance when operating in this range. Automatic derating shall occur for operation at higher ambient temperatures.

Storage: The UPS storage temperature range shall be -10 °C to 45 °C with batteries inside the UPS, and -20 °C to 50 °C without batteries inside the UPS.

2. Relative Humidity

Operating: 8% to 90% non-condensing.

Storage: 0% to 90% non-condensing.

3. **Altitude:** 3000 m maximum without power derating. Ambient temperature will require derating of 5 °C for each additional 500 m in altitude.

4. **Audible Noise:** The audible noise of the UPS shall be:

Operating Mode	Load Condition	Audible Noise
Normal & AVR Mode	<70% load	<40 dBA
AVR Mode	>70% load	<45 dBA
Battery Mode	Any load	<55 dBA

NOTE: Assuming batteries are fully charged without alarm.

1.5 User Accessories and Packaging

The specified UPS system shall be supplied with the items described in the chart below. Additionally, a full user manual will be available for download Vertiv's website. The user manual shall include installation instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step-by-step operating procedures and general maintenance guidelines. Additionally, monitoring software shall be available for download on Vertiv's website.

Items Bundled
UPS
Safety Instructions
Quick Installation Guide (QIG) for ease of installation and UPS startup
Plastic feet and screw for mounting in tower form
Rail kit and mounting hardware for 2 post rack mounting
USB type A to B communication cable
IEC 320 C13 to NEMA 5-15P Power Cord

1.6 Warranty

The manufacturer warrants the UPS against defects in materials and workmanship for 5 years. The warranty covers all parts. The no-hassle replacement warranty shall include shipping costs to the customer site for the new replacement.

1.7 Quality Assurance

1.7.1 Manufacturer Qualifications

The manufacturer shall have more than 40 years of experience in the design, manufacture, and testing of solid-state UPS systems and the company shall be certified to ISO 9001:2015 (or applicable).

1.7.2 Factory Testing

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

2.0 PRODUCT

2.1 Fabrication

All materials and components making up the UPS shall be new, of current manufacture, and have not been in prior service except as required during factory testing.

2.1.1 Wiring

Wiring practices, materials, and coding shall be in accordance with the requirements of the standards listed in section 1.2 and other codes and standards. All wiring shall be copper.

2.1.2 Cabinet

The UPS unit shall be comprised of TVSS and EMI/RFI filters, relays, automatic voltage regulator (AVR), battery charger and battery consisting of the appropriate number of sealed battery cells and inverter is housed in a tower, rack, or rack/tower enclosure (depending on the UPS model). The UPS cabinet shall be cleaned, primed, and painted black.

Dimensions and weights shall be:

UPS Rating	Unit Dimensions WxDxH in (mm)	Shipping Dimensions WxDxH in (mm)	Unit Weight lb (kg)	Shipping Weight lb (kg)
500 VA	17.24 x 8.86 x 1.67 (438 x 225 x 42.5)	22.44 x 14.57 x 7.28 (570 x 370 x 185)	12.3 (5.6)	14.77 (6.7)
800 VA	17.24 x 11.81 x 3.39 (438 x 300 x 86.2)	22.44 x 18.5 x 9.45 (570 x 470 x 240)	18.52 (8.4)	22.71 (10.3)
1100 VA	17.24 x 11.81 x 3.39 (438 x 300 x 86.2)	22.44 x 18.5 X 9.45 (570 x 470 x 240)	18.52 (8.4)	22.71 (10.3)
1500 VA	17.24 x 11.81 x 3.39 (438 x 300 x 86.2)	22.44 x 18.5 X 9.45 (570 x 470 x 240)	20.50 (9.3)	24.69 (11.2)
EBC	17.2 x 16.9 x 5.1 (438 x 430 x 130.6)	22.4 x 24.4 x 11.1 (570 x 620 x 282)	67.9 (30.8)	67.9 (30.8)

2.1.3 Cooling

The UPS shall be forced air cooled by an internally mounted, fan with variable speed control depending on load and environmental conditions. Fan power shall be provided from the internal DC supply. Air intake shall be through the front of the unit and exhausted out the rear of the unit.

2.2 Components

2.2.1 UPS Input

Input Protection

The UPS has built-in protection against under voltage, over current, and over voltage conditions including low energy lightning surges introduced on the primary input AC power source. The UPS shall be provided with a resettable input circuit breaker.

2.2.2 Battery Charger

The UPS shall contain an internal battery charger designed to prolong battery life. Recharge time for the internal UPS batteries shall be 2 hours to 100% capacity (full load discharge rate, internal batteries). There shall be DC overvoltage protection so that if the DC voltage exceeds the pre-set limit, the UPS will shut down automatically and the critical load will be transferred to bypass.

2.2.3 Inverter

General

The UPS inverter shall be a pulse width modulated (PWM) design capable of providing the specified AC output. The inverter shall convert DC power from the input converter output or the battery into precise sine wave AC power for supporting the critical AC load.

Overload

The inverter shall be capable of supplying current and voltage for overloads exceeding 100% and up to 120% of full load current. A visual indicator and audible alarm shall indicate overload operation. For greater currents or longer time duration, the inverter shall have electronic current limiting protection to prevent damage to components. The inverter shall be self-protecting against any magnitude of connected output overload. Inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective devices.

Output Protection

The UPS inverter shall employ electronic current limiting circuitry with firmware by load detection.

Battery Deep Discharge Protection

To prevent battery damage from over discharging, the UPS control logic automatically raise the shutdown voltage set point, depending on output load and connected battery system at the onset of battery operation.

2.2.4 Display and Controls

General

The UPS shall be provided with a microprocessor-based unit status display and controls section, designed for convenient and reliable user operation, except for the 500 VA model. The Monitoring functions such as voltages, currents, UPS status, and alarm indicators shall be displayed on an LCD display. The 500 VA model does not have an LCD display, shall indicate alarms and warnings through indicator lights.

Controls

UPS startup and shutdown operations shall be accomplished by using power button on the front panel of the UPS. The LCD display shall use four control buttons for ease of navigation and selection of the configurable parameters.

1. Control Buttons of UPS with LCD

The UPS display control button functionality shall be as follows:

Button	Function
ESC/Mute Button	<ul style="list-style-type: none"> • Mute the alarm: After the UPS is turned on, press and hold this button for at least 2 seconds to mute an active alarm. • Esc key: Press this button to exist from menu or cancel the setting.
Up/Right	<ul style="list-style-type: none"> • Press this button to select the upper or right item in the menu or previous page in the screen or increase the number in the setting.
Down/Left	<ul style="list-style-type: none"> • Press this button to select the lower of left item in the menu or next page in the screen or decrease the number in the setting.
Enter/ 	<ul style="list-style-type: none"> • Turn On/Off the UPS: Press this button for at least 2 seconds to turn on (with confirmation dialog if not a cold start) the UPS when it is off or turn off (with confirmation dialog) the UPS when it is on. • Enter main menu: Press this button to enter main menu from the flow screen. • Enter key: Press this button to confirm the selection.

2. Control Buttons of UPS without LCD

The 500VA has one button and functionality shall be as follows:

Button	Function
Main Button/ 	<ul style="list-style-type: none"> • Turn UPS On (Cold Start): When UPS input power is not available, press and hold the button for 2 seconds to power it on using the battery. • Turn UPS Output On (Line Mode): When UPS is on press and hold for 5 seconds to turn on the UPS output. • Turn UPS Output Off (Line Standby): When UPS is in Line mode (green LED is on) press and hold for 5 seconds to turn off the output of UPS (Line standby). • Mute the Current Event or Alarm: Press and hold for 1 second. • Start Battery test: Press and hold for 3 seconds.

3. Display and System Indicators for UPS with Display

The UPS shall include two LED indicators on the front panel display to indicate operation and alarm status of the UPS:

- Run indicator (green)
- Alarm indicator (red)

In addition, the UPS LCD display shall include company branding and show the relevant UPS status information, including the following menus:

- Status with display of voltages, currents, load, battery information, etc.
- Settings for UPS settings for configuration and adjusting parameters, languages, etc.
- Control for UPS control options.
- Log for listing the current alarms, events and history, etc.
- About for providing the relevant product information (serial number, FW versions, etc.)
- Maintenance to restore factory defaults.
- LCD size will be 28" with 65k true color range and with text in multiple languages.

4. Indicators for UPS without LCD

The UPS shall include four LED indicators on the front panel display to indicate operation and alarm status of the UPS:

LED Color	Status	Meaning
Green (Line Indicator)	Blinking	UPS is on but the output is off (Line standby).
	Solid On	UPS is on but the output is on (Line mode).
	Off	UPS is off or alarm forced to drop the UPS output.
Yellow (Battery Indicator)	Blinking	UPS is operating on battery and UPS output is off.
	Solid On	UPS is operating on battery and UPS output is on.
	Off	UPS operating by input power or UPS is off.
Red (Alarm Indicator)	Blinking	Alarm occurs. (If Alarm indicator and Line indicator blinking together its Site Fault error)
	Solid On	Fault occurs.
	Off	UPS operating normally, or UPS is off.
Red (Battery Status)	Blinking	Battery low.
	Solid On	Battery fault.
	Off	UPS operating normally or UPS is off.

2.3 Internal Battery

Lithium-ion (LiFePO₄) battery cells are used as a stored energy source for the specified UPS system. The batteries are as specified in table below. The battery cells are housed internal to the UPS cabinet and sized to support the inverter at rated load and power factor, with ambient temperature of 77 °F (25 °C) for period of time its mention in below table. The expected life of the battery is 8 to 10 years.

UPS Rating	Batteries Specification	100% Load Runtime
500 VA	LiFe-162500	3 Min and 21 Sec
800 VA	LiFe-246000	8 Min and 12 Sec
1100 VA	LiFe-246000	6 Min and 1 Sec
1500 VA	LiFe-366000	6 Min and 38 Sec

2.3.1 Automatic Battery Test

The UPS shall feature an automatic battery test with the factory default test interval set at every 8 weeks. The battery test shall ensure the capability of the battery to supply power to the inverter while loaded. If the battery fails the test, the UPS shall display a warning message to indicate the internal batteries needs to be replaced. The battery test feature shall be user accessible by the push button on the front of the unit and with communication software.

2.4 Output Distribution

Output distribution is integral to UPS and is located on the rear of the unit according to the following description:

UPS Rating	Output Power Sockets
500 VA	2 non-programmable NEMA 5-15 1 Group with 2 NEMA 5-15R
800 VA	2 non-programmable NEMA 5-15 1 Group with 2 NEMA 5-15R
1100 VA	2 non-programmable NEMA 5-15 2 Groups each with 2 NEMA 5-15R
1500 VA	2 non-programmable NEMA 5-15 3 Groups each with 2 NEMA 5-15R

2.5 Communications Options

2.5.1 Communication Slot

The UPS shall include one Vertiv IntelliSlot™ communication port to allow the user to install an optional IntelliSlot™ communication card. An interface card may be installed during any state of UPS operation (*On, Standby or Off states*). Available optional cards are described below:

- **IntelliSlot™ Communications Card**

The optional IntelliSlot communications card shall deliver SNMP and web management to the UPS when connected to any 10 or 100 Mbit Ethernet network.

- **Dry Contacts (relay) Card**

The optional Vertiv Dry contacts (relay) card shall provide contact closure for remote monitoring of alarm conditions in the UPS, delivering signals for *On Battery, Bypass Active, Low Battery, UPS Fault and On UPS*.

2.5.2 USB Port

The UPS will have one USB port. The USB connector a standard 4 pin Type B. The USB port shall allow connection to a computer to use with a monitoring and shutdown software and for use with the UPS shutdown program.

2.5.3 EPO Port

The UPS shall include in the rear panel an EPO (Emergency Power Off) to allow turning off the output voltage.