

**Vertiv™ Liebert® PSI5 UPS**  
**Guide Specifications**  
**5000\_208V UPS and Transformer Distribution Unit**  
**Single-phase Uninterruptible Power Supply systems**

**1.0 GENERAL**

**1.1 Summary**

This specification defines the electrical and mechanical characteristics and requirements for a continuous-duty single-phase, solid-state, uninterruptible power system. The uninterruptible power system hereafter referred to as the UPS, provides high-quality AC power for sensitive electronic equipment loads. The UPS provides reliable power protection for servers, critical nodes, network workstations, large network peripherals, network routers, bridges, hubs and other electronic equipment.

**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.

**208V Units:**

- UL 1778, c-UL listed (to CSA 22.2 No. 107.1)
- FCC Part 15, Class B
- EN61000-4-5, Level 3, 2064J
- ISTA Procedure 1A
- Energy Star Certified

**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. Off Mode**

The UPS input is plugged into a stable, nominal source, but the outlets are turned off. The internal batteries are charging.

**2. On/Normal Mode**

The UPS input is plugged into a stable, nominal source, and the outlets are turned on. The internal batteries are charging.

**3. 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.

#### 4. 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.

#### 5. On/Battery Mode

The UPS input is not plugged in, or the voltage source has become extremely low or high and unusable. The UPS automatically switches to the internal battery to provide normal, usable voltage to the outlets.

#### 6. Fault Mode

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

#### 7. Battery Self-test Mode

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

- At start-up turning the UPS On.
- Automatically every 8 weeks as a self-check.
- Manually: pressing and holding the ON/Mute button for 3 sec. when the unit is On.

### 1.3.2 Design Requirements

#### 1. Voltage - Input/output voltage specifications of the UPS are:

- **Input:** 208V Units: 0-300 VAC, 60Hz, single-phase (L, L, G)
- **Output:** 208V Units: 200 / 208 / 240 VAC  $\pm$ 1.5% (on battery), 60 Hz, single-phase, programmable

#### 2. Output Load Capacity: Maximum specified output load capacity of the UPS, regardless of load power factor, is: (VA/W)

Input	PSI5-5000RT208
200 V	4250VA / 3825W
208 V	4250VA / 3825W
220 V	5000VA / 4500W
230 V	5000VA / 4500W
240 V	5000VA / 4500W

3. **Internal Battery:** The battery consists of valve regulated, non-spillable, maintenance-free, sealed, lead-acid cells. The battery is user replaceable and hot swappable.
4. **Battery Reserve Time:** 3 minutes minimum at full load with ambient temperature 77°F (25°C).
5. **Battery Recharge:** The UPS contains a battery recharge rate designed to prolong battery life. Recharge time is 6-8 hours typical to 90% capacity at nominal input voltage.

### 1.3.3 Performance Requirements

#### 1. AC Input to UPS

- a. **Voltage Configuration:** The UPS operates at these values without drawing power from the batteries
- **200 VAC setting:** single phase: 150-234 VAC ( $\pm 3$ VAC)
    - Buck compensation: 220VAC ( $\pm 3$ VAC)
    - Boost compensation: 180VAC ( $\pm 3$ VAC)
  - **208 VAC setting:** single phase: 156-243 VAC ( $\pm 3$ VAC)
    - Buck compensation: 229VAC ( $\pm 3$ VAC)
    - Boost compensation: 187VAC ( $\pm 3$ VAC)
  - **240 VAC setting:** single phase: 180-281 VAC ( $\pm 3$ VAC)
    - Buck compensation: 264VAC ( $\pm 3$ VAC)
    - Boost compensation: 216VAC ( $\pm 3$ VAC)
- b. **Frequency:** The UPS automatically senses the input frequency and operates within 55-65 Hz ( $\pm 0.5$  Hz) without drawing power from the batteries.

#### 2. AC Output

- a. **Voltage Configuration:** The UPS configuration shall be selectable via the local HMI and PC Configuration tool and remote SNMP connection. This setting will change the transfer point (Low and High) of the UPS. The factory default setting is 208 VAC for the 208VAC units.
- b. **Voltage Regulation:**  $\pm 5\%$  on battery backup
- c. **Frequency Regulation:**  $+1.0$ Hz on battery
- d. **Load Power Factor Range:** 0.5 lagging to 1.0 (unity)
- e. **Output Voltage Distortion:**
- 2%THD at 100% linear load
  - 5% THD at 100% nonlinear load
  - 12% THD max at overload alarm point
- f. **Inverter Overload Capability:** Overload Warning (visual and audible alarms) occurs between 100%-120% of rated capacity, continuous duty.
- 100% - 110% load: alarm warning
  - 111% - 120% load: alarm warning and shutdown after 10 seconds
  - 121% or greater load: immediate shutdown
- g. **Transfer Time:** user selectable
- 4-6ms typical, 10ms max: Setting 09 ST1 (default)
  - 6-8ms typical, 11ms max: Setting 09 ST2
  - 8-10ms typical, 13ms max: Setting 09 ST3

- h. Efficiency with resistive load:
  - >98.5% (Normal mode)
  - >96.1/95.8% (Buck/Boost mode)
  - >91.8% (Battery mode 50% - 75% load)
  - >89.7% (Battery mode 25% load)

## 1.4 Environmental Conditions

### 1. Ambient Temperature

#### Operating:

- 32°F-104°F (0°C-40°C) for altitude 10,000 ft max (3000 meters) above sea level.
- 77 °F (25°C) for optimum battery performance

#### Storage:

- 5°F to 104 °F (-15°C to 40°C) with batteries 68°F (20°C) for optimum battery storage

### 2. Relative Humidity: 0-90% non-condensing for storage and operation

### 3. Altitude: 10,000 ft. (3,000 m max.), without power derating when operated within the temperature specified in section 1.4.A. Ambient temperature is de-rated 9° F (5°C) for each additional 1640 ft (500m).

### 4. Audible Noise: Noise generated by the UPS during normal operation does not exceed the following values when measured at 1 meter from the surface of the UPS. In normal mode unit measures 45dB max; in battery-mode measure 55dB max

### 5. Input Surge: The 208VAC units can withstand an electrostatic discharge compliant to EN61000-4-5, Level 3, without damage and without affecting the connected load.

## 1.5 User Accessories and Packaging

The specified UPS system is supplied with one (1) Quick installation and User Guide. The guide includes installation drawings and instructions, a functional description of the equipment, safety precautions, illustrations and operating procedures. Full User Manuals are available from manufacturer website. The UPS is also supplied with one (1) USB cable (6-ft; 1.82m), one (1) set of Tower Stands, one (1) pair of Rack mount handles, Mounting Hardware, and one (1) pair of 4 post fixed rails.

## 1.6 Warranty

The manufacturer warrants the UPS against defects in materials and workmanship for two (2) years. The warranty covers all parts. An optional one (1) or three (3) year extended warranty is available.

## 1.7 Quality Assurance

### 1.7.1 Manufacturer Qualifications

Vertiv Corporation provides more than thirty years of experience in the design, manufacturing, and testing of solid-state UPS systems and the company is certified to ISO 9001:2000.

### 1.7.2 Factory Testing

Before shipment, the product is tested to assure compliance with the specification.

## 2.0 PRODUCT

### 2.1 Fabrication

All materials and components making up the UPS are 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 are in accordance with the requirements of the standards listed in section 1.2. All wiring is copper.

#### 2.1.2 Cabinet

The UPS unit comprised of: TVSS & EMI/RFI Filters, Relay, Automatic Voltage Regulator, Battery Charger, Battery consisting of the appropriate number of sealed battery cells.

UNIT	UNIT DIMENSIONS W x D x H, in. (mm)	UNIT WEIGHT, lbs (kg)
5000	17.2 x 24.8 x 3.5 (438 x 630 x 88)	87.7 (39.8)

#### 2.1.3 Cooling

Air intake is through the front of the unit and exhausted out the rear of the unit. The UPS has smart fan speed control which slows the fan down or turns the fan off when the UPS does not require cooling. Fan speeds will be greater at higher loads and when running or charging the batteries.

### 2.2 Components and Operation

#### 2.2.1 Surge Protection:

The 208 VAC units can withstand input surges of up to 2064J without damage per criteria listed in IEEE C62.41, Category A, Level 3. Additionally, the UPS is supplied with one pair of Data Line Protection Connectors to provide phone, fax or modem line surge protection via RJ-45 connectors. These Data Line Ports provide transmission for 10/100 Base-T Ethernet connection.

#### 2.2.2 Input Protection

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

#### 2.2.3 Input Connections

The 120 VAC units have attached input cord 6 feet (1.8 meters) in length, m

Model	120 VAC UNITS
5000	NEMA L6-30P

#### 2.2.4 Bi-Directional Converter

##### 1. General

The Bi-Directional Converter incorporates solid-state devices and control circuitry to convert AC power to regulated DC power to “float charge” the battery during normal mode; and convert DC power from the battery to regulated and conditioned sinewave AC power for supporting the critical load during battery mode. The Bi-Directional Converter is a pulse width modulated (PWM) design. The Bi-Directional Converter operates in the following modes:

In Normal mode of operation, the Bi-Directional Converter maintains the battery at a float charge.

In Battery mode of operation, the Bi-Directional Converter converts DC power from the battery, through the DC-to-DC Converter, to regulated and conditioned sinewave AC power for supporting the critical load.

In the recharge mode of operation, the Bi-Directional Converter converts AC power to regulated DC power to recharge the battery.

## 2. Battery Recharge

The UPS contains a battery recharge rate designed to prolong battery life. The battery is constant voltage charged to recharge and maintain the battery in a fully charged state. Recharge time is 5 hours maximum to 90% rated capacity after discharge into full resistive load.

## 3. Bi-Directional Converter DC Protection

The following DC shutdown levels protect the UPS:

- DC Overvoltage Shutdown
- DC Under-voltage Shutdown (End of Discharge)
- DC Under-voltage Warning (Low Battery Reserve)

## 4. Output Protection

For output faults including short circuits and overloads, the UPS is protected by the input circuit protector during Normal mode and by electronic current limiting during Battery mode. The UPS control logic senses and disconnects the UPS from the critical AC load and clears the protective circuit breaker during Normal mode.

## 5. Overload

The UPS is capable of supplying power for overloads exceeding 100% and up to 110% of full load rating, continuously. A visual indicator and audible alarm indicate overload operation. For greater current demands, the UPS employs circuit protector and electronic current-limiting protection to prevent damage to components. The UPS is self-protecting against any magnitude of connected output overload.

## 6. Output Frequency

An oscillator controls the output frequency of the UPS when on battery. The oscillator maintains the output frequency to  $\pm 1\%$  Hz of nominal.

## 7. Battery Over-Discharge Protection

To prevent battery damage due to excessive discharge levels, the UPS control logic automatically monitors the battery voltage and load level and switches off the output at the predetermined battery shutdown voltage set point.

### 2.2.5 Display and Controls

#### 1. General

The UPS shall include an intuitive LCD display capable of communicating UPS status and operating conditions. Typical UPS performance metrics shall be visible on the screen and include but not limited to Load, Battery Capacity, Event Notification and Local Alarms. The local HMI shall be capable of basic configuration settings by the user.

#### 2. System Indicators

A row of Load Level indicators that display the approximate electrical load placed upon the UPS. A row of Battery Level indicators shall display the approximate battery capacity.

### 3. ON / MUTE

This button controls output power to connected load(s) and has three functions:

- ON - When the UPS is off, pressing the ON/MUTE/Battery Test button for more than 3 seconds will start the UPS, and an audible alarm sounds briefly will continue until user releases ON button. The UPS can start on battery.
- Alarm Silence – Audible alarms via an internal beeper will be used in conjunction with the visual indicators to indicate to the operator a change in UPS operation status. Once the audible alarm is silenced, the audible alarm will not sound, unless a new alarm condition is present. The audible alarm level will be a minimum of 60dBA at one-meter (3ft).

Note: Only ON Battery Alarm can be silenced. Other alarms, warnings, and faults cannot be silenced.

- Manual Self Diagnostic Battery Test - To initiate a manual battery test, press the ON/MUTE button for 3 seconds or more while operating from utility power with no alarm conditions present. The UPS is also provided with an automatic and remote self-diagnostic test feature. The tests ensure the capability of the battery and will detect any internal UPS failures. If the battery/UPS fails the test, the UPS will display a warning to indicate the batteries need replaced. The battery test feature is user accessible via Liebert Multilink software.

### 4. OFF Button

When the UPS is on (in either Normal or Battery mode), pressing the OFF button for more than one (1) second will shut down the UPS. An audible alarm sounds briefly.

#### 2.2.6 Internal Battery

Valve regulated, non-spillable, lead-acid cells are used as a stored-energy source for the specified UPS system. The battery is housed internal to the UPS cabinet and sized to support the inverter at rated load and power factor, with ambient temperature of 77 o F (25 o C) for a minimum of 2 minutes reserve time. The expected life of the battery is 3 - 5 years or 250 complete discharge cycles.

#### 2.2.7 Output Distribution

Output distribution is integral to the UPS and is located on the rear of the unit.

Model	208 VAC UNITS
5000RT208	(4) NEMA L6-30R

##### 1. OPTIONAL Transformer Distribution Units

An optional accessory shall be available to distribute 120VAC power as needed to support critical IT infrastructure. This device shall offer input selection for 240VAC or 208VAC nominal operation.

Transformer distribution units shall offer the available output receptacle configurations:

Model	Input Plug	208V Output Receptacle
TDU-4000RTL630	NEMA L6-30P	(8) NEMA 5-15/20R (2) NEMA L5-20R
TDU-6000RTL630	NEMA L6-30P	(8) NEMA 5-15/20R (2) NEMA L5-30R

UNIT	UNIT DIMENSIONS W x D x H, in (mm)	UNIT WEIGHT, lbs (kg)
4000	(430 x 574 x 88)	47.2 (21.4)
6000	17.2 x 24.8 x 3.5 (430 x 574 x 88)	47.2 (21.4)

## 2.2.8 Communications

### 1. Any Mode Shutdown – EPO Connector

EPO shall be capable of flexible configuration for NO or NC operation via user settings. With EPO active; the UPS output is shut Off regardless of what mode the UPS is operating in. The UPS cannot be started if the signals are active. When the signal is removed, the UPS output can be enabled by pressing the ON/MUTE button.

### 2. USB Interface Port

The UPS will have (1) USB Interface Port. The USB connector a standard 4 pin Type B. The USB interface port will always be active. The UPS will can communicate system status and system shutdown via the USB. Hardware will support and allow operating system communication for Windows 98 and newer. USB port will can communicate via the USBHID standard protocol.

### 3. Data Line Protection Connectors

Data line (in and out) connectors are on the rear of the UPS and provide transient voltage surge suppression (TVSS) for Phone/Fax/DSL/Internet/Modem devices.

### 4. UPS Intelligent Communications

The shall be equipped with the ability to provide advanced communication and monitoring options such as SNMP or other protocol.

The UPS shall be able to monitor environmental sensors such as temperature, humidity and leak detection with optional equipment.