

Sola/Hevi-Duty S2K Series UPS

GUIDE SPECIFICATIONS

350VA to 1000VA

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, 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.

120V Units

UL 1778, c-UL listed (to CSA 22.2 No. 107.1)
FCC Part 15, Subpart B, Class B
ANSI C62.41, Category A, Level 3 (IEEE 587, Category A);
EN61000-4-5, Level 3, Criteria A
EN61000-4-2, Level 3, Criteria A
EN61000-4-3, Level 3, Criteria A
EN61000-4-4, Level 4, Criteria A
EN61000-4-6, Level 3, Criteria A
EN61000-3-2
EN61000-3-3
ISTA Procedure 1A

230V Units

EN50091-1-1, TUV/GS listed, CE compliance mark
EN50091-2, Class B
EN61000-4-2, Level 3, Criteria A
EN61000-4-3, Level 3, Criteria A
EN61000-4-6
EN61000-4-4, Level 4, Criteria A
EN61000-4-5, Level 3, Criteria A
EN61000-3-2
EN61000-3-3
ISTA Procedure 1 A

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:

- A. Normal** - The critical AC load is continuously supplied with filtered power. The battery charger maintains a float-charge on the battery.

- B. Voltage Boost/Buck** - During input power source abnormalities (sags and swells), the AC output power is corrected by means of boost (sag correction) or buck (swell correction) compensation taps. Operation of the compensation taps automatically maintains the proper output voltage for the connected critical equipment. The compensation taps is designed for indefinite operation to their limits. Operation of the compensation taps will not discharge the battery.
- C. Recharge** - Upon restoration of utility / mains AC power, after a utility / mains AC power outage and complete or partial battery discharge, the unit automatically restarts and resumes supplying power to the critical AC load; and the battery charger recharges the battery.
- D. Battery** - When the input power source exceeds the parameters defined in section 1.3.3.1, the critical AC load is supplied power by the inverter, which obtains its power from the battery. Typical detection and transfer time is 4-6 ms.
- E. Battery Start-** The UPS is capable of starting without input power. The unit starts up and operates from the battery, with output frequency the same as the last operating frequency.

1.3.2 Design Requirements

- A. Voltage:** Input/output voltage specifications of the UPS are:

Input:

120V Units: 0-160 VAC, 60/50 Hz auto-sensing, single-phase, 2-wire-plus-ground.

230V Units: 0-300 VAC, 50/60 Hz auto-sensing, single-phase, 2-wire-plus-earth.

Output:

120V Units: 110/120/127 VAC $\pm 10\%$, 60/50 Hz, single-phase, 2-wire-plus-ground.

(DIP Switch selectable)

230V Units: 220/230/240 VAC $\pm 10\%$, 50/60 Hz, single-phase, 2-wire-plus-earth.

(DIP Switch selectable)

- B. Output Load Capacity:** Maximum specified output load capacity of the UPS, regardless of load power factor, is:

350VA / 210W 500VA / 300W

650VA / 390W 1000VA / 600W

- C. Internal Battery:** The battery consists of valve regulated, non-spillable, maintenance-free, sealed, lead-acid cells. The battery is user replaceable and hot swappable.

- D. Battery Reserve Time:** 5 minutes typical at full load with ambient temperature 77°F (25°C).

- E. Battery Recharge:** The UPS contains a battery recharge rate designed to prolong battery life. Recharge time is 6 hours typical to 90% capacity after a complete discharge into full resistive load.

1.3.3 Performance Requirements

1.3.3.1 AC Input to UPS

- A. Voltage Configuration:** The UPS operates at these values without drawing power from the batteries.

110 VAC nominal: single phase, 2-wire-plus-ground: 78 – 138 VAC (± 3 VAC),

Buck compensation: 122VAC (± 3 VAC)

Boost1 compensation: 98VAC (± 3 VAC)

Boost2 compensation: 87VAC (± 3 VAC)

120 VAC nominal: single phase, 2-wire-plus-ground: 85 – 145 VAC (± 3 VAC),

Buck compensation: 133VAC (± 3 VAC)

Boost1 compensation: 107VAC (± 3 VAC)

Boost2 compensation: 95VAC (± 3 VAC)

- 127 VAC nominal: single phase, 2-wire-plus-ground: 90 – 150 VAC (± 3 VAC),
 Buck compensation: 141VAC (± 3 VAC)
 Boost1 compensation: 113VAC (± 3 VAC)
 Boost2 compensation: 100VAC (± 3 VAC)
- 220 VAC nominal: single phase, 2-wire-plus-earth: 155 – 270 VAC (± 6 VAC)
 Buck compensation: 243 VAC (± 6 VAC)
 Boost1 compensation: 197 VAC (± 6 VAC)
 Boost2 compensation: 174 VAC (± 6 VAC)
- 230 VAC nominal: single phase, 2-wire-plus-earth: 163 – 282 VAC (± 6 VAC)
 Buck compensation: 254 VAC (± 6 VAC)
 Boost1 compensation: 207 VAC (± 6 VAC)
 Boost2 compensation: 183 VAC (± 6 VAC)
- 240 VAC nominal: single phase, 2-wire-plus-earth: 171 – 291 VAC (± 6 VAC)
 Buck Compensation: 265 VAC (± 6 VAC)
 Boost1 compensation: 215 VAC (± 6 VAC)
 Boost2 compensation: 191 VAC (± 6 VAC)

B. Frequency: The UPS automatically senses the input frequency and operates within the following frequency specifications without drawing power from the batteries.

- 50 Hz Applications:* 46.5 – 53.5 Hz (± 0.1 Hz)
- 60 Hz Applications:* 56.5 – 63.5 Hz (± 0.1 Hz)

C. Surge Protection: The 120 VAC units can withstand input surges of up to 570J without damage per criteria listed in IEEE C62.41, Category A, Level 3. The 230 VAC units can withstand input surges of up to 660J without damage per criteria listed in EN61000-4-5, Level 3, Criteria A.

D. Input Connections: The 120 VAC units have an attached input cord 6.0 feet (1.8 meters) in length, measured between the inside edges of the connectors. The attached input cord has a NEMA 5-15 plug.

1.3.3.2 AC Output

A. Voltage Configuration:

120 VAC units: 110/120/127 VAC, 60/50 Hz, single-phase, 2-wire-plus-ground.

120VAC $\pm 8\%$ (Battery mode)

230 VAC units: 220/230/240 VAC, 50/60 Hz, single phase, 2-wire-plus-earth.

230 VAC $\pm 8\%$ (Battery mode)

B. Voltage Regulation: $\pm 10\%$ steady state.

C. Frequency Regulation: ± 0.1 Hz synchronized to utility / mains.

± 0.5 Hz free running or on battery operation.

D. Load Power Factor Range: 0.6 lagging to 1.0 (unity).

E. Inverter Overload Capability: Overload Warning (visual and audible alarms) occurs between 100%–109% of rated capacity, continuous duty. Shutdown occurs at the following levels:

>110 – 120%; after 120 seconds (Normal mode)

>120 – 150%; after 15 seconds (Normal mode)

>150% - short-circuit; after 5 seconds (Normal mode)

>110%; after 2 cycles (Battery mode)

F. Voltage Transient Response: $\pm 15\%$ in Normal mode for 0-100-0% loading of the UPS rating, $\pm 5\%$ in Battery mode for 20-100-20% loading of the UPS rating.

G. Transient Recovery Time: To within $\pm 8\%$ of nominal voltage in < 2 cycles.

H. Efficiency: $> 95\%$ (Normal mode)

$> 90\%$ (Buck/Boost mode)

I. Output Power Cords: The 230 VAC units have two (2) detachable IEC-320-C14 output power cords measuring 2m (6.6 ft) in length.

1.4 ENVIRONMENTAL CONDITIONS

A. Ambient Temperature

Operating: $32^{\circ}\text{F} - 104^{\circ}\text{F}$ ($0^{\circ}\text{C} - 40^{\circ}\text{C}$) for altitudes 0 – 5,000 ft. (0 – 1500 meters) above sea level

$32^{\circ}\text{F} - 86^{\circ}\text{F}$ ($0^{\circ}\text{C} - 30^{\circ}\text{C}$) for altitudes 5000 ft – 10,000 ft (1500 – 3000 meters) above sea level.

77°F (25°C) for optimum battery performance

Storage: $5^{\circ}\text{F} - 104^{\circ}\text{F}$ ($-15^{\circ}\text{C} - 40^{\circ}\text{C}$) with batteries

$5^{\circ}\text{F} - 122^{\circ}\text{F}$ ($-15^{\circ}\text{C} - 50^{\circ}\text{C}$) without batteries

68°F (20°C) for optimum battery storage.

B. Relative Humidity

0 – 95% non-condensing.

C. Altitude:

3,000 m (10,000 ft. max.), without power derating when operated within the temperature specified in section 1.4.A.

D. Audible Noise

Noise generated by the UPS during normal operation does not exceed 40dB when measured at 1 meter from the surface of the UPS, “A” weighted.

E. Electrostatic Discharge

The 120 VAC units are able to withstand an electrostatic discharge compliant to EN61000-4-2, level 3, Criteria A without damage and without affecting the connected load. The 230 VAC units are able to withstand an electrostatic discharge compliant to EN61000-4-2, level 3, Criteria A without damage and without affecting the connected load.

1.5 USER ACCESSORIES AND PACKAGING

The specified UPS system is supplied with one (1) user's manual. The manual includes installation drawings and instructions, a functional description of the equipment, safety precautions, illustrations, operating procedures, and general maintenance guidelines. The UPS is also supplied with one (1) one (1) Multilink serial cable (10-ft; 3m), one (1) USB cable (6-ft; 1.8m), one (1) RJ-11 cord (7-ft; 2.1m) and one (1) warranty card (120V models only). The package of the 230 VAC units also includes two (2) output power cords (2m; 6.6 ft). The package meets the requirements of ISTA Procedure 1A.

1.6 WARRANTY

The manufacturer warrants the UPS against defects in materials and workmanship for two (2) years. The warranty covers all parts.

1.7 QUALITY ASSURANCE

1.7.1 Manufacturer Qualifications

Sola/Hevi-Duty provides more than twenty years experience in the design, manufacture, and testing of solid-state UPS systems and the company is certified to ISO 9001.

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. All relays are provided with dust covers.

2.1.2 Wiring

Wiring practices, materials, and coding are in accordance with the requirements of the standards listed in section 1.2. All wiring is copper.

2.1.3 Cabinet

The UPS unit comprised of: TVSS & EMI/RFI Filters, Bi-Directional Converter, Automatic Voltage Regulator and Battery consisting of the appropriate number of sealed battery cells; is housed in a mini-tower NEMA type 1 enclosure. The UPS cabinet is injection-molded standard color. Dimensions and weights are:

UNIT	UNIT DIMENSIONS W x D x H in (mm)	120 VAC UNITS	230 VAC UNITS
		WEIGHT lbs (kg)	WEIGHT kg (lbs)
350VA	4.6 x 7.7 x 8.7 (116 x 196 x 222)	16.8 (7.6)	7 (15.4)
500VA	4.6 x 7.7 x 8.7 (116 x 196 x 222)	17.2 (7.8)	7.4 (16.3)
650VA	4.6 x 14.1 x 8.7 (116 x 358 x 222)	20.7 (9.4)	9.1 (20.1)
1000VA	4.6 x 14.1 x 8.7 (116 x 358 x 222)	29.7 (13.5)	13.2 (19.1)

2.1.4 Cooling

The UPS is convection cooled.

2.2 COMPONENTS AND OPERATION

2.2.1 Input Protection

The UPS has built-in protection against undervoltage, overcurrent, and overvoltage conditions including low-energy lightning surges introduced on the primary input power source. The UPS is provided with an input circuit protector. The 120 VAC UPS models withstand input surges without damage per criteria listed in IEEE C62.41, Category A, Level 3 and the 230 VAC UPS models withstand input surges without damage per criteria listed in EN61000-4-5, Level 3, Criteria A. 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 Protection Connectors provide transmission for 10/100 Base-T Ethernet connections.

2.2.2 Bi-Directional Converter

2.2.2.1 General

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

1. In Normal mode of operation, the Bi-Directional Converter maintains the battery system at a float charge.
2. In Battery mode of operation, the Bi-Directional Converter converts DC power from the battery to regulated and conditioned stepped-sinewave AC power for supporting the critical load.
3. In the recharge mode of operation, the Bi-Directional Converter converts AC power to regulated DC power to recharge the battery.

2.2.2.2 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 6 hours maximum to 90% rated capacity after discharge into full resistive load.

2.2.2.3 Bi-Directional Converter DC Protection

The following DC shutdown levels protect the UPS:

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

2.2.2.4 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.

2.2.2.5 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. The UPS control logic senses and disconnects the UPS from the critical AC load and clears the protective circuit breaker during Normal mode.

2.2.2.6 Output Frequency

An oscillator controls the output frequency of the UPS. The oscillator maintains the output frequency to ± 0.1 Hz of nominal when not synchronized to the utility/mains source.

2.2.2.7 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.

2.2.3 Display and Controls

2.2.3.1 General

The UPS is provided with a microprocessor-based unit status and control display designed for convenient and reliable user operation. The status and alarm indicators are displayed on a status indicator display.

2.2.3.2 System Indicators

There are three (3) status indicators on the front of the UPS (Utility, Battery and Fault) and one (1) on the rear (Site Wiring Fault):

The Utility Indicator illuminates when the UPS is operating and supplying power to connected loads: green indicates Normal mode, amber denotes Buck/Boost mode.

The Battery Indicator illuminates to indicate the UPS is operating on battery (green) or to signify a battery warning (amber).

The Fault Indicator illuminates when the UPS detects a problem: red for an internal UPS fault, green for overload and over-temperature conditions.

The Site Wiring Fault Indicator on the rear panel illuminates red when the UPS detects a line-neutral reversal or a poor neutral-ground bond.

2.2.3.3 On/Off Controls

UPS start-up and shutdown operations are accomplished by the "On/Off/Alarm Silence" push button located on the front panel of the UPS. Depressing the button for more than 0.5 sec will start-up the UPS and to turn the UPS off the button will need to be depressed for more than 2 sec

2.2.3.4 On-Line Battery Test

The UPS is provided with an automatic biweekly battery test feature. The test ensures the capability of the battery to supply power to the inverter while loaded. If the battery fails the test, the UPS will display a warning to indicate the batteries need replaced. The battery test feature is user accessible via Multilink.

2.2.4 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 ° F (25 ° C) for a minimum of 5 minutes reserve time. The expected life of the battery is 3 - 5 years or 250 complete discharge cycles.

2.2.5 Output Distribution

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

UNIT	120 VAC UNITS	230 VAC UNITS
350VA, 500VA, 650VA	(4) NEMA 5-15R (orange) Battery backup + surge protection; (2) NEMA 5-15R (black) surge protection only	(4) IEC-320-C13 (orange) Battery backup + surge protection; (2) IEC-320-C13 (black) Surge protection only
1000VA	(6) NEMA 5-15R (orange) Battery backup + surge protection; (2) NEMA 5-15R (black) surge protection only	(6) IEC-320-C13 (orange) Battery backup + surge protection; (2) IEC-320-C13 (black) Surge protection only

2.2.6 Communications

The UPS has a DB-9 (9 pin female) connector on the rear to allow UPS status communications with a computer system running MultiLink™ software. The DB-9 is capable of supplying serial communication, on battery and low battery signals.

The UPS can signal “on battery” and “low battery” using opto-couplers. When the UPS is operating in Battery mode, it can receive a signal from the host computer system that will shut down the UPS (after gracefully shutting down the operating system on the host computer system) when the remaining battery run time is low. The timing of the signal depends on MultiLink’s configuration settings. This shutdown signal (5-12VDC) must have a duration of at least 1.5 seconds for the UPS to be shut down. The UPS communicates via serial communications using Sola/Hevi-Duty proprietary protocol.

The S2K Series UPS has a USB interface port for communication that will work with the built-in Microsoft Power Manager software on the user’s PC, if the PC is so equipped. It will provide UPS status and manages the automatic orderly shutdown of the computer. The UPS (USB) communications meets HID standard, version 1.11. All USB models are compatible with Microsoft Windows 2000, Windows XP and Mac OS 10.2 or later. All USB models ship with a 6-ft. (1.8m) USB cable.

The pin out configuration of the DB9 connector is:

Pin	Assignment Description
1	Low Battery (open collector)
2	UPS TxD (typical RS-232 levels)
3	UPS RxD (typical RS-232 levels)
4	Battery Mode Shutdown (5-12V)
5	Common
6	Any Mode Shutdown (short to pin 5)
7	Low Battery (open emitter)
8	AC Fail (open emitter)
9	AC Fail (open collector)

Maximum voltage and current on Pins 1, 7, 8, and 9 is 55VDC; 10.0 mA.