

STATIC UNINTERRUPTIBLE POWER SUPPLY

GUIDE SPECIFICATION:

FOR 8-15 kVA, SINGLE PHASE OUTPUT, UNINTERRUPTIBLE POWER SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification defines the electrical and mechanical characteristics and requirements for a continuous-duty split-phase, solid-state, uninterruptible power supply system. The uninterruptible power supply system, hereafter referred to as the UPS, shall provide high-quality AC power for sensitive electronic equipment loads with battery power to maintain uptime. The UPS shall operate in conjunction with the existing building electrical system to protect electronic equipment from power disturbances that may occur with utility power, such as voltage fluctuations, frequency variations, brownouts, power surges and sags.

1.02 SYSTEM DESCRIPTION

Standard UPS System will include a minimum of (1) Rectifier, (1) Inverter, (1) Static bypass and (1) Battery system.

A. Components:

1. Rectifier
2. Inverter
3. Sealed Lead Acid Batteries
4. Battery Charger
5. Automatic Bypass
6. User Interface Panel
7. Serial (RS-232) Communication Interface
8. Communication Card Slots (2)
9. Remote Emergency Power Off Contacts
10. Relay output contact (1)
11. Environmental inputs (2)
12. Hardwired Input, Output
13. (Option) Input Transformer
14. (Option) External Matching Battery Cabinets
15. (Standard/option) Maintenance Bypass Module
16. (Option) Maintenance Bypass with Power Distribution Module
17. (Option) SNMP/Web Adapter
18. (Option) Relay Card
19. (Option) Modbus/JBus card

B. Modes of Operation: The UPS shall operate as a double conversion UPS with the following operations modes:

1. **Normal**
During the Normal or Double Conversion Mode the rectifier shall derive power as needed from the commercial AC utility or generator source and supply filtered and regulated DC power to the on-line inverter. The inverter shall convert the DC power to highly regulated and filtered AC power for the critical loads.
2. **Battery**
Upon failure of the AC input source, the critical load must continue being supplied by the inverter without any switching. The inverter must obtain its power from the battery. There must be no interruption in power to the critical load upon failure or restoration of the AC input source.
3. **Recharge**
Upon restoration of the AC input source, the rectifier/battery charger must recharge the battery. The inverter shall with no interruption in power regulate the power to the critical load.
4. **Bypass**
The static bypass switch has to be used for transferring the critical load to mains supply without interruption. Automatic re-transfer to normal operation must also be accomplished with no interruption in power to the critical load. The static bypass switch has to be capable of manual operation.
5. **External maintenance bypass**
The external maintenance bypass switch is preferred but minimum need is the integral maintenance bypass if no such item in the system. It is used for supplying the load directly from the mains supply, while the UPS is isolated for maintenance.

1.03 APPLICABLE STANDARDS

The UPS shall be 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 shall govern.

Safety

- A. IEC 62040-1-1 or EN 62040-1-1
- B. EN 60950
- C. UL 1778

Emission and Immunity:

- D. EN 50091-2 (Emissions Class A and Harmonics)
- E. EN61000-4-2,-3,-4,-5
 - Slow high energy surges in input/output lines:
1 kV line/earth, 0.5 kV line/line (IEC 61000-4-5)
 - Fast low energy transients in power lines:
2 kV line/earth (IEC 61000-4-4)
 - Fast low energy transients (burst) in control and signal lines:
1 kV line/earth (IEC 61000-4-4)
 - Electrostatic discharge (ESD):
8 kV air discharge, 6 kV contact discharge (IEC 61000-4-2)
 - Electromagnetic field: IEC 61000-4-3 level 3

Markings

- F. CE-Mark (Europe)
- G. UL, cUL (U.S.)

1.04 SUBMITTALS

- A. Submit one copy of a concise operation and maintenance manuals (i.e. User Manual).

1.05 QUALIFICATIONS

- A. The manufacturer of the UPS shall have a minimum of fifty years' experience in the design, manufacture and testing of Uninterruptible Power Supplies.
- B. The manufacturer shall be ISO9001 registered.

Part 2 - PRODUCTS

2.01 GENERAL

A. Manufacturer

1. EATON

B. Model

The UPS system is initially provided as a single module, non-redundant system. The UPS shall be field-upgradable for additional parallel capacity or for redundant operation. The system can be configured with numerous options, including:

1. External Matching Battery Cabinets
2. Several Connectivity Options
3. Maintenance Bypass Cabinets
4. Power distribution module with receptacles
5. Wall Mounted Hot-Tie™ cabinet with bypass
6. Input Transformer

2.02 UNINTERRUPTIBLE POWER SUPPLY

- A. Converter (rectifier): Incoming power shall be filtered and converted to DC by a sine-wave rectifier. The DC power is then processed by a high-frequency converter to supply power to the inverter. The Converter corrects the input power factor to 0.99 and draws sinusoidal current (with less than 5% THD) from the utility. In the event of utility failure, the converter shall be supplied power without interruption from the internal of external batteries.
 - 1. Overload Capacity: The converter shall be capable of supplying up to 150% of rated load for at least 5 seconds if no bypass is available.
- B. Inverter: The inverter converts the DC Power to regulated AC Power for critical loads.
 - 1. Output Voltage: The inverter output voltage is specified in section 2.03.
 - 2. Voltage Regulation: The inverter steady state voltage regulation is +/- 1% phase to neutral, 2% phase to phase. Dynamic regulation meets class 1 performance of IEC62040-3.
 - 3. Frequency Control: The inverter steady state frequency regulation is +/-0.005 Hz free running in steady state. UPS is synchronized to mains in normal operation.
- C. Batteries: The batteries shall be sealed, lead acid, maintenance-free, high-rate discharge cells. They will be kept fully charged by the battery charger. They have a 3-year float service life @ 25° C.
- D. Battery Charger: The battery charger is responsible for charging the battery and maintaining full battery charge when AC is applied to the UPS.

- E. Automatic Bypass (Static bypass): The UPS shall provide an alternate path to the commercial AC or generator source in case of an overload, load fault or internal UPS failure. This input must match the output in voltage, frequency, and grounding in order to properly utilize this feature.
- F. User Interface Panel: The UPS shall provide a user-friendly interface panel, which allows the user to: change operating modes, set system parameters, check alarm logs, etc. This LCD display should have back light and languages consisting of English and the number of optional local languages.
- G. Serial (RS-232) Communication Interface: A 9-pin sub-D connector shall provide capability for communicating with manufacture-supplied software package. The UPS shall also provide signals for indication of UPS general alarm.
- H. (2) Communication card slots: The UPS shall provide (2) Communication card slots in the front of the UPS allowing for additional connectivity options, including SNMP/Web, AS400 relays, and Modus/Jbus capabilities, etc.
- I. Remote Emergency Power Off (EPO) connection: The UPS shall provide a built-in landing for field connection of a Remote Emergency Power Off circuit. Upon initiation of the REPO circuit, the output will be de-energized and battery will be disconnected, preventing power from being delivered to the attached loads.
- J. Disable Bypass Operation connection: If active the automatic transfer to the static bypass is prevented. Synchronization to bypass is not carried out (default).
- K. ABM resting connection: If active the batteries are disconnected from the UPS unit. The discharge of batteries is not prevented but charging will not start.
- L. Remote ON/OFF connection: If active the UPS output turns off regardless of mode of operation. Auxiliary power, communications and rectifier/battery charger shall remain functional.
- M. External Bypass connection: If active the UPS is forced to static bypass operation regardless of the bypass status.
- N. External Battery Breaker Status: If active the UPS knows that the batteries are connected.
- O. Remote Go To Bypass connection: If active the UPS transfers to bypass if bypass voltage, frequency and synchronization are ok.
- P. Remote Go To Normal connection: If active the UPS transfer to inverter operation if not prohibited by EPO or alarm condition.
- Q. (Option) Input Transformer can be ordered to provide a split phase input for installation in locations where only a single phase is available.
- R. (Option) External Matching Battery Cabinets: 64 and 96 block (9 Ah 12V) matching battery cabinets can be ordered for extended runtime requirements.
- S. (Option) Rear Mounted Maintenance Bypass Module: Make Before Break Bypass Module can be ordered as needed for use with the UPS.
- T. (Option) Rear mounted Power Distribution Module with Maintenance bypass can be ordered with a variety of receptacles.

- U. (Option) SNMP/Web Adaptor: Internal communication card providing network communication via SNMP protocol.
- V. (Option) ModBus/Jbus Adaptor: Internal communication card providing network communication via Modbus protocol.
- W. (Option) Relay Card: Internal card providing dry contacts for operation with AS400 systems, etc.

2.03 SYSTEM RATINGS AND OPERATING CHARACTERISTICS

A. System Input

1. Input Voltage Operation Range
 - a. 100/200, 110/220, 120/240 VAC 180 degree phase displacement
 - b. 120/208, 127/220 VAC 120 degree phase displacement
2. Input Frequency
 - a. 45 to 65Hz
 - b. auto sensing
 - c. capable of 50 to 60 Hz or 60 to 50 Hz frequency conversion.
3. Input Power Factor is 0.99
4. Input Current Distortion: 2% THD maximum at full rated linear load.
5. Inrush Current:
 - a. <2x branch rating without input transformer
 - b. <5x branch rating with input transformer
6. Surge Protection:
 - a. Line to Line 180J
 - b. Line to Ground 450J

B. System Output, Normal Mode

1. Nominal Output Voltage
200/100, 220/110, 240/120 VAC, 180-degree phase displacement
208/120, 220/127 VAC, 120-degree phase displacement.
Selectable through front panel or through serial port connection with power management software.
2. Voltage regulation: +/-3% of selected output voltage in steady state
3. Transient Voltage Response:

Meets class 1 performance of IEC62040-3

4. Voltage THD:
 - a. 2% Total Harmonic Distortion (THD) maximum phase to neutral into a maximum rated linear load (5% phase to phase)
 - b. 5% THD maximum phase to neutral into a maximum rated non-linear load (7% phase to phase)
5. Nominal Frequency: 50 or 60 Hz selectable
6. Frequency Regulation:
 - a. 50/60 Hz +/- 0.5 to +/- 3.0 Hz selectable, synchronized to mains, +/- 0.005 Hz free running single units.
 - b. +/- 0.15 Hz parallel units.
 - c. Slew rate selectable to 1.0, 2.0, 3.0 Hz/s for single units, < 0.5 Hz/s parallel units. Generator Mode (6 / 7.5 Hz/s) for single units selectable through software parameters that can be configured via LCD and service PC interface
7. Output Current: Maximum output current (at nominal output voltage) for the UPS shall be:
 - a. 10 kVA system: 42A @ 240V
 - b. 12 kVA system: 50A @ 240V
 - c. 15 kVA system: 63A @ 240V
8. Current Overload Capability without bypass:
 - a. 150% for 5 seconds
 - b. 220% for 300 ms
9. Bypass:
 - a. Automatic bypass shall provide an alternate path to power in the case of overload, inverter failure or other UPS failure.
 - b. External Maintenance Bypass can be utilized with the UPS to all servicing of the UPS.
 - c. Transfer time to and from any internal bypass shall be no-break.
10. Efficiency:
 - a. Typical of >89% while in normal mode.

C. System Output, Battery Mode:

1. Nominal Output Voltage: This shall be the user selected output voltage.
2. Voltage Regulation: +/-1% phase to neutral of selected nominal voltage (+/-2% phase to phase)
3. Transient Voltage Response
 - a. Meets class 1 performance of IEC62040-3

4. Voltage THD:
 - a. 2% Total Harmonic Distortion (THD) maximum into a maximum rated linear load
 - b. 5% THD maximum phase to neutral into a maximum rated non-linear load (7% phase to phase)
5. Frequency Regulation: +/-0.005 Hz of selected nominal frequency
6. Overload Capacity:
 - a. 150% for 5 seconds
 - b. 220% for 300 ms

D. Mechanical Construction:

1. All materials and components making up the UPS shall be new, of current manufacture, and shall not have been in prior service except as required during factory testing. The UPS shall be constructed of replaceable subassemblies. All active electronic devices shall be solid-state.
2. The UPS unit comprised of: input rectifier, battery charger, inverter, bypass, and battery consisting of the appropriate number of sealed battery modules, shall be housed in a single freestanding enclosure. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer's standard color. Casters and leveling feet shall be provided as standard.
3. Matching External Battery cabinets shall be available in different sizes.
4. Dimensions of standard UPS and External Battery Cabinets:

<u>Enclosure</u>	<u>Dimensions (H x W x D)</u>	<u>Weight (inc. bat)</u>
UPS + 1*BAT	817 x 305 x 825 mm	155 kg
UPS + 2*BAT	1214 x 305 x 825 mm	265 kg
Ext. 2*BAT	817 x 305 x 767 mm	214 kg
Ext. 3*BAT	1214 x 305 x 767 mm	321 kg

2.04 BATTERY

- A. Battery Type: Valve Regulated Lead Acid (VRLA), minimum 3-year float service life at 25 degrees C.
- B. UPS Holdover Time (Runtime): Each UPS system, consisting of a minimum of two battery strings (consisting of 32 battery blocks) for each power modules shall have a minimum holdover time of 4.6 minutes, depending on kVA rating. See product manual for detailed information.
- C. Extended Holdover Time (Runtime): Each UPS system shall have capability for addition of extra matching battery cabinets (in two cabinet sizes) to increase the total holdover time. Please refer to datasheet for a list of runtimes. The battery times listed are approximate and may vary depending on load configuration and battery charge.
- D. Battery Recharge Time:

1. Base UPS System consisting of 2 battery strings will have a recharge time of max. 1.45 hours to 95% usable capacity @ nominal line after a full load discharge (15kVA).
- E. Bus Voltage: Nominal bus voltage is 192 VDC. Each string consists of 16 battery blocks in series with 9 Ah capacity.
- F. Battery Protection:
1. Short Circuit Protection: Over-current protection shall protect the batteries from all short circuit fault conditions.
 2. Battery Module Protection: Internal Battery circuit breaker shall be provided.
 3. Under-voltage Protection:
 - a. Inverter cutoff voltage: Battery operation shall be terminated when the battery voltage drops to the 1.7 VPC set point.
 - b. Protective shutdown voltage: Inverter shall shutdown after 1 min when the battery voltage drops below 1.7 VPC volts-per-cell typical.
 4. Over-voltage Protection: If the UPS systems battery bus voltage exceeds the preset set point then the UPS will disable charger and alarm a high battery condition.
- G. Advanced Battery Management:
1. Battery recharge: After recharging batteries to full capacity, the charger will enter the rest mode to increase the battery lifetime according the ABM cycle. Hence, continuous float charging of the battery shall not be allowed.

The active battery charger states are constant-current (charge mode), constant-voltage (float mode) and no-charge (rest mode).
 2. Battery Runtime Monitoring: UPS shall monitor batteries and provide status to end user of battery runtime via front panel, serial communications, or both. Runtime calculations to be based on load demand and analysis of battery health.
 3. Battery Health Monitoring: UPS shall periodically test and monitor battery health and provide warnings visually, audibly and/or serially when battery capacity falls below 80% of original capacity. Battery testing may also be user initiated via front panel or serial communications.

2.05 SYSTEM INPUT & OUTPUT CONNECTIONS

A. AC Input:

1. All UPS units shall be capable of utilizing Hardwired Input.

B. AC Output:

1. All UPS units shall be capable of utilizing Hardwired Output.

All UPS enclosures shall be capable of utilizing optimal Power Distribution Units:

Table A

Option	Receptacle	Breaker	Voltage
A	5-15R2	15A	120V
B	L5-15R2	15A	120V

C	6-15R2	15A	208V
D	L6-15R2	15A	208V
E	5-20R2(UL)	20A	120V
F	5-20R2(CSA)	20A	120V
G	L5-20R	20A	120V
H	6-20R	20A	208V
I	L6-20R	20A	208V
J	L14-20R	20A	120/208V
K	L5-30R	30A	120V
L	L6-30R	30A	208V
M	L14-30R	30A	120/208V

- C. Extended Battery Connector: External battery cabinets include cable to connect each battery cabinet to the UPS or daisy chain external battery cabinets.
- D. Remote Emergency Power Off (REPO) connection: The UPS shall provide a built-in landing for field connection of a Remote Emergency Power Off circuit. Upon initiation of the REPO circuit, the UPS shall open its input relays, and disengage the battery converter, preventing power from being delivered to the attached loads.
- E. Serial (RS-232) Communication Interface: A 9-pin sub-D connector shall provide capability for communicating with manufacture-supplied software package. The UPS shall also provide signals for indication of UPS alarm status.
- F. (2) Communication card slots: The UPS shall provide (2) Communication X-slots in the back of the UPS allowing for additional connectivity options, including SNMP/Web, AS/400 relays, Modbus/Jbus capabilities, etc.
- G. (2) programmable Input connections: The UPS shall provide a built-in input for field connection (environmental input). The inputs shall be parameter programmable to suit the needs of the application. to a generator.

2.06 USER INTERFACE

- A. Front Panel Display: The UPS shall include a front panel display consisting of a graphical LCD display with back light, four status LED's, and a four-key keypad.
 - 1. Graphical LCD display: Basic Language (English and local selectable language), display of unit function and operating parameters. It shall be used to signify the operating state of the UPS, for indicating alarms, for changing operations control parameters and set points.
 - 2. Four status LED's, which indicate:
 - a. Alarms, with a Red LED
 - b. On Battery, with a Yellow LED
 - c. On Bypass, with a Yellow LED
 - d. Power On, with a Green LED
 - 4. Four-Key Multifunction Keypad: UPS shall have keypad to allow user to adjust UPS parameters, view alarm and inverter logs, change UPS operational modes, turn UPS on and off.
- B. Power Management Software Package: The UPS shall include serial communications interface that provides the following communication capabilities:

1. Monitor and graphically display input and output voltage and other operating characteristics.
2. Notify end users in the event of a power anomaly via network, E-mail or page

C. Communication Ports:

1. (2) Communication card slots: The UPS shall provide (2) Communication X-slots in the back of the UPS allowing for additional connectivity options, including SNMP/Web, AS/400 relays, Modbus/Jbus capabilities, etc.
2. Serial communications (via RS-232) with manufacturer-supplied Power Management Software package.

2.07 ENVIRONMENTAL CONDITIONS

A. The UPS shall be certified to the following safety standards:

1. EN 62040-1-1, IEC 62040-1-1, EN 60950

B. The UPS shall meet CISPR22 Class A (EN50091-2) for Emissions and EN50091-2 (IEC610003-2 for 16 amps or less) for Harmonics.

C. Audible Noise: Less than 53 dBA (A weighted) at 1 meter from all sides in all system modes.

D. Ambient Temperature

1. Operating: UPS 0 deg C to +40 deg C
2. Storage: UPS 0 deg C to +25 deg C

E. Relative Humidity

1. Operating: 5 to 95% non-condensing.
2. Storage: 5 to 95% non-condensing.

F. Altitude

1. Operating: To 3000 meters. Derating or reduced operating temperature range may be required for higher altitudes.
2. Transit: To 10,000 meters.

G. Electrostatic Discharge: The UPS shall be able to withstand a minimum 8 kV without damage and shall not affect the critical load.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufactures instructions and associated User and Installation Manual.