



Product Specifications

**Guide Specification for FirstLine® P
65kVA, 80kVA, 100kVA, 125kVA,
160kVA, 200kVA & 250kVA**

**Three-Phase, On-Line
Uninterruptible Power Supply**

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SECTION 1.0 SCOPE

1.1 Summary

- A. This Specification defines the electrical and mechanical characteristics and requirements for the FirstLine P Series UPS as manufactured by Staco Energy Products Co. located in Dayton/Miamisburg, OH.
- B. The UPS shall a continuous duty; three-phase, uninterruptible power system, hereafter referred to as the UPS designed to operate with the building supply to provide conditioned power as well as power back up for the critical loads.

1.2 Qualifications

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

1.3 Standards

- A. The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where conflict arises between these documents and statements made herein, the statements in this specification shall prevail.
 - 1. UL Standard 1778
 - 2. CSA 22.2, No. 107.3
 - 3. NEMA PE-1
 - 4. FCC PT 15, Subpart J, Class A
 - 5. National Electric Code
 - 6. OSHA
 - 7. IEEE C62.41-1991
 - 8. ISO 9001
 - 9. Seismic Withstand Certification (IBC Site Specific A – F)

1.4 System Description

- A. The UPS shall be a true double conversion, "On-Line" system consisting of the following major components:
 - 1. Rectifier complete with power factor correction
 - 2. Battery charger
 - 3. PWM Inverter utilizing IGBT's (Insulated Gate Bipolar Transistor)
 - 4. Continuous duty rated Static Switch
 - 5. Input Isolation switch (SWIN)
 - 6. Output Isolation switch (SWOUT)
 - 7. Maintenance Isolation switch (SWMB)
 - 8. Bypass Isolation switch (SWBY)
 - 9. Internal Maintenance Bypass
 - 10. DSP Control and Monitoring Panel with Graphic display
 - 11. Line up and Match Battery Cabinets with varying back up times and integral DC Circuit Breaker.

1.5 Warranty

A. UPS Warranty

The UPS warranty shall be in effect for 24 months after initial start-up but no more than 30 months after shipment, whichever occurs first. The warranty shall cover all parts and labor for units commissioned by manufacturer's approved service representative.

B. Battery Limited Warranty

Three (3) Year full limited warranty passed through from the battery manufacturer, controlled environment required @ 77°F (25°C).

SECTION 2.0 PRODUCT

2.1 Modes of Operation

- A. The UPS shall always starts on Bypass and transfers to inverter after the rectifier and inverter have started. This means that the bypass source must be qualified (voltage, frequency, phase sequence) in order to start the UPS. The rectifier input must be qualified (voltage, frequency, phase sequence) in order to start the rectifier.
- B. The UPS shall be designed to operate as an on-line, reverse transfer system in the following modes:
1. **On-Line (Normal)**
The load shall always powered by the inverter, with stabilized voltage and frequency, using the energy from the mains power supply (INPUT). If there is a fault in the INPUT, the UPS shall switch to the batteries in zero time and the batteries shall supply energy to the inverter to keep the load powered (for the backup time of the batteries). When the INPUT is restored the batteries shall be automatically recharged by the rectifier.
 2. **Stand-By or Smart Active**
The load shall be powered from the by-pass line (if the power supply line is within the specified limits); if there is a fault on the power supply line, the load shall switch automatically onto the inverter, powered by the battery.

In Stand-By- On mode, the rectifier remains powered and keeps the batteries charged. If the by-pass line voltage or the frequency moves out of the specified limit, the load shall be automatically switched onto the inverter output. With Stand-By On operation, the energy dissipated by the system shall be reduced, leading to considerable savings.

In Smart-Active mode, the UPS autonomously activates On-Line or Stand-By-On operation according to the quality of the power supply. When in Smart-Active mode, the switch from inverter to by-pass line shall be immediate. For the switch to take place, the by-pass line is required to remain within the specified limits for the time set. When Smart-Active mode is activated, the power supply shall be monitored, after which, if the voltage has remained within the pre-set values, the output shall be then switched onto the by-pass line; otherwise the load remains powered by the inverter. After this time, provided there has been no interference, the load shall switch onto the by-pass line; otherwise the logic starts monitoring again, providing for improved efficiency, which is greater than 98%.
 3. **Stand-By Off**
Standby-Off the load shall not be powered. In the event of an input mains failure the UPS shall be powered from the inverter using the energy stored in the batteries.
 4. **Battery System**
Configurations with one (1) battery system for each UPS
Each unit shall draw the energy from its own battery. At the end of its backup time each UPS shall shutdown. The load shall then remain unpowered if the duration of the power source outage is greater than the backup time of the connected battery system. When the power source is restored the system shall restart automatically. Each UPS shall recharge its own battery system.

Configurations with one (1) battery system for multiple UPS units
Each unit shall draw the energy from the common battery system. At the end of the backup time, the UPS systems shall shutdown. The load shall remain unpowered if the duration of the power source outage is greater than the backup time of the connected battery system. When the power source is restored the system shall restart automatically. Each UPS shall recharge the common battery.
 5. **Overload**
If the load condition to the system is not reduced, the UPS system shall switch onto the by-pass line. When the overload is removed, the UPS shall automatically return to normal operation. If the overload is continuous, this shall trigger the external protection devices located at the UPS input on the by-pass line. In this case the load shall remain unpowered.
- C. **Paralleling** - The UPS shall have expansion capabilities for up to 8 modules paralleled for capacity or redundancy in single module and group module configurations as required to support future growth. The UPS units shall be connected in parallel and shall share the connected load. (See Section 6.0)

2.2 Components

A. Rectifier

The IGBT rectifier shall be capable of receiving utility input and rectifying it to produce Direct Current (DC) power at levels sufficient enough to supply the load via the inverter and charge the batteries.

1. Input Protection

The rectifier shall include protection against primary power surges, (except for lightning transients) and under or over voltage conditions. This protection is provided via fuses, Circuit Breakers, and Microprocessor Control of the rectifier.

2. Filtering

Sufficient filtering of the rectifier/charger output shall be provided to prevent damage to the battery. Ripple voltage shall not exceed $\leq 1\%$ RMS.

3. In-Rush Limiting

When the primary power is applied to the rectifier, the current surge shall be limited to no more than nominal input current when the UPS is operating at 480VAC input.

4. Power Walk-In

When the utility power is applied to the rectifier, the current shall be $< 25\%$ of the full load current and shall gradually increase to full load rating within 10 seconds (adjustable 0-30 sec.).

5. Automatic Restart

Upon restoration of utility AC power after a power outage, the rectifier shall automatically restart and assume the inverter and battery recharge loads.

6. Charger

An integral charging circuit shall be capable of recharging the batteries during normal operation to ensure maximum life from the battery system.

7. Charger Capacity

The charger shall have sufficient capacity to recharge a fully discharged battery to 90% capacity within ten times discharge time.

8. Battery Test

The UPS shall periodically check the battery system for an open cell. If the UPS detects an open cell, an alarm condition shall be displayed and an audible alarm shall sound.

B. Inverter

The inverter section of the power converter module shall utilize Insulated Gate Bipolar Transistors (IGBT's). This solid-state device that incorporates digital signal processing (DSP) pulse width modulation (PWM) technology capable of accepting the output of the rectifier or the battery system voltage and delivering AC power within specified limits to the critical load bus. The inverter shall be microprocessor controlled and include all necessary timing logic and control circuits.

C. Inverter Start-Up

The inverter shall automatically startup when a start command is generated and shall be stable and ready to deliver power to the load.

1. Inverter Protection

Inverter IGBT's shall be protected by current limiting circuits. The inverter shall be capable of running indefinitely with the batteries disconnected. For rapid removal of the inverter from the critical load, the inverter's control electronics shall instantaneously turn off the inverter when the inverter's capacity is exceeded. Simultaneously, the static transfer switch shall transfer the load to utility power without interruption to maintain continuous power to the critical load.

2. Inverter Oscillator

The inverter shall contain an oscillator capable of operating and maintaining the output frequency of the inverter within specified limits. The inverter oscillator shall be capable of frequency synchronization and phase locking to the bypass utility power source frequency. When operating as a slave to the utility power and a failure occurs in the slaving signal, the inverter oscillator shall automatically revert to a free running state and maintain the specified limits. The oscillator shall not drift more than 0.05% while operating at maximum rated operating temperature.

3. Phase Balance

Electronic controls shall be provided to regulate each phase so that an unbalanced load will not cause the output voltage to go outside of the specified voltage unbalance or phase displacement limits.

D. Static Transfer Switch – 100% Rated, Continuous Duty

A internally mounted static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be naturally commutated high speed devices rated to conduct full load current continuously while on bypass power. The static switch shall be designed to avoid back-feed into the utility supply. Failure of one device shall not affect the operation of the UPS and the failure shall be shown on the LCD display.

1. Bypass Transfer

The static switch shall automatically and successfully transfer the critical load from the inverter to the bypass source under the following conditions:

- DC voltage out-of-limits
- Inverter failure
- Critical load current exceeds inverter overload rating
- Over-temperature develops within the inverter
- Manual command is given

Transfer shall be automatically inhibited whenever bypass source parameters are outside predetermined (adjustable) limits, or UPS output and bypass are not synchronized and phase locked.

2. Retransfer

The static switch shall automatically and successfully retransfer the critical load from the bypass source to the inverter under the following conditions:

- Inverter output voltage returns to within specified limits.
- Critical load current reduces to within inverter limits.

E. Battery

1. General

The UPS module shall use a valve-regulated sealed lead acid (VRLA) heavy duty industrial battery, designed for auxiliary power service in an UPS application. The primary battery shall be housed in a line up and match cabinet(s) installed both adjacent to or standalone versions.

2. Protection against Deep Discharge and Self-Discharge

The UPS shall be equipped with a device designed to protect the battery against deep discharge, depending on discharge conditions, with isolation of the battery by a circuit breaker. In particular, a monitoring device shall adjust the battery shutdown voltage as a function of a discharge coefficient to avoid excessive discharge at less than the rated output. A second device shall avoid self-discharge of the battery into the UPS control circuits during an extended shutdown of the UPS (over two hours).

3. Battery Self-Tests

1. The battery monitoring system shall be able to perform the following automatic functions:

- Battery circuit checks every 12 hours.
- Open circuit battery test once a month.
- Partial discharge test every three months.

2. This self-test system shall signal faults via LEDs on the front panel or a message to remote supervision systems.

4. Battery Cycle Monitor

1. The system shall be capable of monitoring and retrieving Battery Cycle information from the Front Display Panel.

The information provided shall be:

- a. Hours of normal operation
- b. Hours of operation from bypass
- c. Time spent operating on battery
- d. Number of discharges
- e. Number of full discharges

F. Manual Maintenance Bypass

Bypass switching shall allow the critical load to be fed from the bypass power source, while providing isolation of the static switch during maintenance.

2.3 Electrical Specifications

A. Ratings

1. The UPS shall be available in power ratings of (kVA/kW):

65kVA/58.5kw 80kVA/72kw 100kVA/90kw 125kVA/112.5kw
160kVA/144kw 200kVA/180kw 250kVA/225kw

2. A wide range of battery backup time(s) shall be available with Extended Battery Cabinet(s).

3. AC Input Characteristics

The UPS shall be capable of accepting power from two (2) sources as standard (Dual Input).

- a. **Nominal Voltage:** 480Y/277 VAC, 3 Phase, 60Hz, 3* or 4-wire + ground (Standard Voltage)
*3-wire without using the neutral and systems without an external bypass.

or

208Y/120 VAC, 60Hz, 3 Phase, 4-wire + ground - with external line up and match transformer cabinet (Optional)

or

208V VAC, 60Hz, 3 Phase, 3-wire + ground - with external line up and match transformer cabinet (Optional)

- b. **Nominal Voltage Range:** +15/-10% from nominal voltage during battery recharge.
- c. **Voltage Range on battery:** +15% / -40%
- c. **Frequency Range:** 45 - 65 Hz)
- d. **Power Factor:** > 0.99 at full load, nominal conditions.
- e. **Current Harmonic Distortion (THDi):** < 3%
- f. **Inrush current:** Less than nominal input current for less than one cycle
- g. **Input Surge Protection:** UPS shall be equipped to withstand surges per ANSI/IEEE C62.41.
- h. **Rectifier Walk-in:** Progressive from 0 to 30 seconds (adjustable)
- i. **Rectifier Walk-in Delay Timer:** Progressive start of rectifier from 0 to 120 seconds (adjustable).

4. AC Output Characteristics

- a. **Voltage:** 480Y/277 VAC, $\pm 1\%$ steady state variation phase-to-phase voltage volts AC, 3 Phase, 60Hz, 4 wire plus ground (Standard Voltage).

or

208Y/120 VAC, 3 Phase, 60Hz, 4-wire + ground - with external line up and match transformer cabinet (Optional)

or

400V to 415V, 3 Phase, 50Hz (Voltage adjusted in 1 volt increments), Programmable from the front Panel.

- b. **Frequency:** 60Hz, + 2%, 60Hz, + .05% when free running.
- c. **Voltage regulation:** $\pm 1\%$ for balanced load, $\pm 3\%$ for 100% unbalanced load.
- d. **Voltage Distortion:** Maximum 2% total (THD).
- e. **Voltage Transient (Step Load) Response:** + 5% for 100% step load change.

- f. **Voltage Recovery Time:** Return to within 1% of nominal value within 20 milliseconds.
- g. **Phase Angle Displacement:** 120 degrees + 1° for balanced load; 120°, + 1° for 100% unbalanced load.
- h. **Non-Linear Load Capability:** Output voltage total harmonic distortion shall be less than 2% when connected to a 100% non-linear load with a crest factor not to exceed 3%.
- i. **Slew Rate:** 1 hertz/second maximum.
- j. **Power Factor:** 0.9 at the rated volt amperes (VA).
- k. **Inverter Overload Capability:** 110% of rated load for 60 minutes, 150% of rated load for 1 minute.
- l. **Bypass Overload Capability:** 110% for 60 minutes, 125% for 10 minutes, 150% for 1 minute.
- m. **Output Waveform:** Sinusoidal
- n. **Efficiency:** (DC-AC): Minimum - 95% at Full Load, (AC-AC): Minimum – 93% at Full Load

5. Battery

- a. **Battery Voltage:** 420 volts DC minimum before cutoff, 540 volts float.
- b. **Maximum DC Current:** Maximum DC current at cutoff voltage shall be:
 65kVA 159.5 Amps 80kVA -196 Amps 100kVA – 236 Amps 125kVA – 296 Amps
 160kva – 383 Amps 200kVA – 478.7 Amps 250kVA – 598.4 Amps

2.4 Mechanical Design and Ventilation

- A. Enclosure: The UPS shall be housed in a freestanding NEMA 1 enclosure with dead front construction. The mechanical structure of the UPS shall be sufficiently strong and rigid to withstand handling and installation operations without risk and have provisions for forklift handling. The sheet metal elements in the structure shall be protected against corrosion by a suitable treatment, primed and powder coat painted black with a textured finish.
- B. Combined Convection and Redundant, forced air-cooling shall be provided to ensure that all components are operated within specification with air entry at the front with 36" clearance, lower sides. At least one of the three side walls, right, left or back, shall be free with 24" top clearance for air exit.
- C. Cable Access: The standard UPS available shall accommodate bottom entry cables (top or side cable entry shall be optional).
- D. Cabinet Dimensions: The width of the UPS shall be:
 - 1. 65kva to 125kva: 31.5" (800 mm) Wide x 33.5" Deep (850 mm) x 75" High (1,900 mm).
 - 2. 160kva to 250kva: 39" (1000 mm) Wide x 55" Deep (850 mm) x 75" High (1900 mm).
- E. Cabinet Weights: The UPS shall have a maximum weight of 1,500 lbs. at 65kva and 80kVA, 1,610 lbs. at 100kVA, 1,750 lbs. at 125kVA, 2,330 lbs. at 160kva, 2,550 lbs. at 200kva and 2,770 lbs. at 250kva.
- F. Ventilation and Heat Rejection: The UPS shall be designed for forced air cooling. Air inlets shall be provided from the front and bottom of the UPS enclosure. Air exhaust shall be from the top portion of the unit. Full load heat rejection shall be 15,033 BTU/hr. at 65kVA, 18,500 BTU/hr. at 80kVA, 23,120 BTU/hr. at 100kVA, 28,900 BTU/hr. at 125kVA, 36,980 BTU/hr. 160kva, 46,230 BTU/hr. at 200kva and 57,780 BTU/hr. at 250kva.

2.5 Environmental Requirements

- A. The System shall withstand any combination of the following external environmental conditions without operational degradation.
 - 1. Operating Temperature Range: 32°F (0°C) to 104°F (40°C) for the electronics, however the batteries should not be exposed to prolonged periods of temperature above 77°F (25°C). For every 15°F (8°C) above 77°F battery life is cut in half, and may void the battery warranty.
 - 2. Storage Temperature Range: -25°F (-32°C) to 122°F (50°C) however batteries should not be exposed to temperatures above 77°F (25°C). For every 15°F (9.5°C) above 77°F battery life is cut in half, and may void the battery warranty.
 - 3. Relative Humidity: Continuous operation with a relative humidity up to 90% non-condensing at 77°F (25°C).
 - 4. Altitude: Normal operation without de-rating is 3,281 feet.
 - 5. Audible Noise: Audible noise generated by the UPS shall not exceed 65 dBA when measured at 1 meter in front of the power converter using scale "A" of a standard ASA sound level-measuring device.

2.6 System Controls and indicators

The UPS unit shall incorporate the necessary controls, instruments and indicators to allow the operator to monitor the system status and performance, as well as take any appropriate action. The UPS shall meet, at a minimum the following requirements:

A. Panel Functions

1. LED Control Panel Functions

- Menu Selections
- Mimic Screen
- Function Indicator LED's
- Function Selection Keys
- EPO Button

2. Graphic Display

A graphic display shall be on the UPS door, which provides the user to have a close-up, detailed overview in real time of the status of the UPS. The user shall be able to switch the UPS on and off, consult electrical mains, output, battery measurements and perform the main UPS settings. The display shall be divided into four main areas, each with its own specific role.

- a. **General Information:** Area of the display where the set date and time and, according to the screen, UPS model or title of the menu which is active at that moment is displayed permanently.
- b. **Data Display/Menu Navigation:** Main display area designed for displaying the UPS measurements (constantly updated in real time) and for consulting the various menus which the user shall select using the designated function keys.
- c. **UPS Status/Errors-Faults:** Area where the UPS operating status is displayed. The first line shall always be active and constantly display the status of the UPS at that moment. The second only becomes active in the presence of an error and/or fault with the UPS and shall display the type of error/fault encountered.
- d. **Key Function:** Area divided into four boxes, each relative to the function key below its area. According to the menu which is active at that moment, the display shall indicate the function belonging to the corresponding key in the appropriate box, access main menu, go back to previous menu or display, scroll, confirm selection and silence function keys.

3. Menu Display

- System Diagram
- Measures
- Waveforms
- Commands
 - Battery Test
 - Command
 - Bypass
 - System
 - Stand-By Mode ON
 - Smart Mode ON
- Customizing
 - Date/Time
 - Normal Output Voltage
 - Battery Capacity
- History
- Firmware
- Language

4. LED Status Indication

- Bypass Line
- Main Power
- On Battery
- Load on Bypass
- Normal Output
- Alarm for Internal Fault

5. Alarm Messages/Events

The Display Panel shall provide the following alarm and event messages.

| | | |
|---|------------------------------------|--|
| Normal Operation | Battery test ON | Power |
| Disturbances on Bypass Line | Parallel Cable Fault | Parallel Redundant Lost: Unit OFF |
| Manual Bypass (SWMB) On | Fuse Fault | Break Circuit Fail |
| Bypass Line Volt, Failure | Battery Discharge Fail | Break Circuit Overload |
| Main Line Voltage Failure | High Battery Temperature | Rectifier Switched Off by Remote Command |
| Pre-alarm, Low Battery Voltage | Slave UPS OFF | UPS Service Required |
| Low Battery Charge or Closed Disconnect | Fan Fault | Battery Service Required |
| Low Input Voltage | Parallel Redundant Lost: High Unit | Input Switch Off |
| Output Overload | Input Voltage Sequence not OK | Insulation Loss-AC |
| Internal Fault | Output Off | Insulation Loss-DC |
| Temporary Bypass, Wait | System Off Command ON or OFF | Over-temperature On Bypass Line Transfer |
| Bypass for Output Overload | Remote System Command ON or OFF | Inverters Off |
| Bypass Command ON or OFF | Auto-shutdown Timer ON | |
| Remote Bypass Command | System Off | |
| Active | | |
| Over-temperature or Fan Failure | | |

B. Control Functions

1. Configurable Alarms

The UPS shall have the following user configurable control functions accessible from the Display Panel.

A. Basic Functions

- Output Voltage – Selects the rated output voltage
- Operating Mode – Selects the operating Mode: On-Line, Stand-By ON, Smart Active
- Auto Off – If bypass line is present and the load is < of the set value than the load will be supplied from the bypass line. If the bypass line is not present and the load is < of the set value than the load will not be supply (configurable 0 to 99%).
- Battery Low Warning – Estimated battery time remaining for low battery warning (configurable).
- Battery Capacity – Sets the Amp Hour Battery installed.
- Audible Alarm – Audible alarm operating mode: Enable/Disable
- Language – Selects area Language – English, Italian, German, French, Spanish, Polish or Turkish.

B. Advanced Functions

- Input Frequency Tolerance Range – Selects the acceptable range for the input frequency for switching to the bypass and for the synchronization of the output: +/- 1 to +/- 6 in 1% stages.
- Bypass Voltage Thresholds – Selects the acceptable voltage range for switching to the bypass: +/- 5 to +/- 25 in 1% stages.
- Bypass Voltage Threshold for ECO – Selects the acceptable voltage range for operation in ECO Mode: +/- 5 to +/- 25 in 1% stages.
- Switch-On Delay – Waiting time for automatic power-on after the return of power source voltage: Disable or configurable 1 to 255 in 1 second stages.
- Power Walk-In – Activates the gradual return to power source mode: Activated or Deactivate.
- Power walk-In Duration – Sets the duration of the gradual return to power source voltage (only if Power Walk-In is activated: Minimum 0 seconds to maximum 125 seconds in 1 second stages.
- Inverter Synchronization Speed to Bypass Line – Selects the synchronization speed of the inverter to the bypass line: 0.1 to 1 Hz/sec (parallel units), 0.1 to 3 Hz/sec (single units).

C. Remote Emergency Power Off (EPO)

The UPS shall be equipped with provisions for local and remote emergency power off and Dry Contact input that shall be used to command UPS shutdown remotely.

D. DB-9 Connector: One DB-9 connector with serial output shall be provided for field diagnostics.

- E. **Dry Contacts:** The UPS shall be provided standard with a programmable input/output Relay board. This board shall have 5 dry contacts (i.e., 3 for input signals and 2 for output signals).
1. Contacts shall be programmed as:
 - a. Bypass
 - b. Battery Discharging
 - c. End of battery Discharge
 - d. Inverter Off (input).
 - e. EPO (input).
 2. The contacts shall capable of switching up to 30 V AC or DC at UP 1 Amp.
 3. In place of the three standard ALARM functions above, the unit shall have the capability to be reprogrammed to any (3) of the customized alarms below:

| | |
|---|---|
| <ol style="list-style-type: none"> a. Disturbances on Bypass Line b. Manual Bypass ON c. Bypass Line Voltage Fail d. Main Line Voltage Fail e. Pre-alarm , Low Battery Voltage | <ol style="list-style-type: none"> f. Output Overload g. Internal Fault h. Bypass for Output Overload i. Over Temperature or Fan Failure j. Input Voltage Sequence OK k. Output OFF |
|---|---|

2.7 Parallel Configuration

- A. The UPS shall have expansion capabilities for up to 8 modules (same rating) in a parallel configuration for capacity or redundancy as required to support future growth and to increase both the reliability of the to the load. The UPS units shall be connected in parallel and shall share the connected load.

Having a redundant unit means having one more UPS than the minimum number of elements required to power the load, so that if a faulty unit is automatically excluded, power is still supplied correctly. The UPSs connected in parallel are coordinated by a card which ensures the interchange of information. The information shall be exchanged between the UPSs via a cable connecting them in a loop. The loop connection provides redundancy in the connection cable (communication in the cables between the individual units). This is the most reliable means of connecting the UPS and also allows the hot insertion or disconnection of a UPS. Each UPS has its own controller that continuously communicates with the whole system so as to guarantee the operation of the system. The cable transmits the signals from a "Master" UPS to the other "Slaves" using an opto-isolated system in order to keep the control systems electrically isolated from each other. The operating logic envisages that the first unit that is activated becomes the "Master" and takes control of the other "Slaves". In the event of a fault in the "Master" unit, control is immediately switched to a "Slave" which then becomes the "Master". The current system provides basic operation, each unit having its own battery. The system may be personalized (by means of a code inserted on the display panel) with all the units connected to a single battery.

In a system with several UPS units connected in parallel, there shall be a single MASTER unit and the remaining units shall be SLAVE units. The UPS units shall all be the same rating and the MASTER is chosen on start-up. The MASTER and SLAVE units shall be capable of exchanging roles. If a unit is being serviced, e.g. due to an inverter fault, it will automatically be excluded. The load at this point shall be shared between the units that are still active; if the power in the output is excessive for the remaining UPSs, the system logic shall switch all the units, including the UPS that was excluded, onto the by-pass line.

1. Single Module Paralleling

A Parallel Systems Joiner shall be installed in each UPS Module enabling the connection of the outputs from separate UPS Modules in a parallel configuration into a dynamic dual bus for system expansion, fault tolerance and ease of maintenance.

2. Group Module Paralleling

A UPS Group Synchronizer (UGS) shall be included and shall synchronize the outputs from two separate groups of parallel UPS Modules which may be supplied from separate AC sources. It shall enable the outputs from the groups to be configured into a dual bus format.

The UPS maintains synchronization between the outputs of the parallel groups, regardless of input supply variations. For example, one group may be on battery power or standby power and the other powered by the mains power supply. The device can be generally used with up to eight UPS modules between two separate groups.

If one of the UPS modules within the two parallel systems fails, or has to be switched off for maintenance or emergency service work, the two outputs of the parallel UPS systems are merged by the PSJ (which acts as an output coupling switch) to allow power sharing.

3. Parallel System Static Transfer Switch (STS)

When UPS Modules are connected in Group Paralleling configuration a STS devices shall be used to provide a source of power from one of two primary input sources. This can include either two separately derived power sources, the outputs from two uninterruptible power supplies or a combination of the two. The (STS) on the output shall enable the protected load to be supplied from either of the parallel groups. In this configuration, if one of the UPS groups fails, the STS can transfer the load to the second group - providing there is spare capacity. The STS shall free standing and include a Master Switch. This configuration is designed for sites that have large three phase loads.

4. Hot Insertion/Removal

The system shall have the capability to insert or remove additional UPS modules without disconnecting the load. The hot insertion and removal of the UPS shall make technical support easier and improves the reliability of the system.

B. Battery System

The parallel configuration shall be capable of using (1) battery system per UPS or (1) battery system for multiple UPSs.

1. Configurations with one (1) battery system for each UPS
Each unit shall draw the energy from its own battery. At the end of its backup time each UPS shall shutdown. The load shall then remain unpowered if the duration of the power source outage is greater than the backup time of the connected battery system. When the power source is restored the system shall restart automatically. Each UPS shall recharge its own battery system.
2. Configurations with one (1) battery system for multiple UPS units
Each unit shall draw the energy from the common battery system. At the end of the backup time, the UPS systems shall shutdown. The load shall remain unpowered if the duration of the power source outage is greater than the backup time of the connected battery system. When the power source is restored the system shall restart automatically. Each UPS shall recharge the common battery.

2.8 Options

A. UPS Options

1. **Top or Side Cable Entry**
Standard cable entry shall be from the bottom with provisions for top or side entry using a matching side car cabinet not to exceed 75" high x 15.75" wide x 33.35" deep.
2. **Input / Output Transformer Cabinet with Maintenance Bypass (Make-Before-Break)**
The UPS shall have provisions to accept an input power source of 208 VAC and /or output of 208/120V. An input Auto or Isolation transformer 208 VAC to 480 VAC and/or 480V to 208/120V output transformer shall be housed in a single cabinet. As an integral part of the cabinet, it shall also accept a three (3) Breaker Maintenance Bypass with electronic interlocks and top cable entry capability. The cabinet shall match the UPS cabinet.
3. **Output Distribution Unit (PDU)**
The UPS shall have provisions to provide a 208Y/120 VAC transformerless output distribution unit (PDU) to distribute power to the load. The PDU shall contain two (2) branch circuit distribution panel boards accepting any combination of 1, 2 or 3 pole branch circuit breakers housed in a matching cabinet not to exceed 75" high x 22" wide x 33.35" deep. Branch circuit breakers shall be provided by others. UPS output must be 208Y/120VAC.
4. **Output Sub-Feed Distribution Unit (Sub-Feed PDU)**
The UPS shall have provisions to provide a 208V output distribution unit to distribute power to existing distribution panels. The Sub-Feed PDU shall contain three (3) 125 Amp sub-feed distribution circuit breakers housed in a matching cabinet not to exceed 75" high x 22" wide x 33.35" deep. UPS output must be 208Y/120VAC.
5. **Output Parallel Cabinet**
An Output Parallel Cabinet shall be available for connection of all UPS System connected in parallel.

B. Battery System Options

1. External Battery Cabinet System

Line up and match extended run time battery cabinet(s) shall be furnished in both adjacent or standalone versions. The battery cabinet shall be capable of accepting a minimum of (40) each of VRLA Maintenance Free Cell type batteries, wired and installed. Interconnecting cables and lugs shall be provided by others.

2. Open Rack Battery System

The UPS shall be capable of utilizing Wet Cell or NiCad batteries installed in an open type seismic qualified rack construction.

3. String and Cell Level Battery Monitoring

A Battery Monitoring System (BMS) shall have provisions to accept a wireless battery system that monitors each battery or string. It shall also be capable of monitoring the battery cabinet internal temperature and provide cycle data and other reports and graphs.

C. External Maintenance Bypass

1. Wrap-Around System Maintenance Bypass Switch

An External Maintenance Bypass (MBPS), (make-before-break) shall be available: The MBPS shall provide a means to isolate the load for removal of the UPS. For 480V x 480V power requirements, the maintenance bypass option shall provide for three (3) circuit breakers mounted in a matching cabinet with electronic interlocks.

For 480V input and 208/120V output or 208V input and 208/120V output, see 2.8.2 above.

The total enclosure shall provide a wrap-around bypass configuration for total UPS isolation during maintenance or removal of the UPS. Maintenance bypass transfers shall be without interruption and shall have electronic interlocks to protect the UPS from damage in the event of out-of-sequence transfers.

D. Communications

A. Communication Cards

Open slots shall be available to accept any (2) of the following:

FLU-Netman: Internal SNMP Card with UPSMON Monitoring & Control Software allows management of a single Firstline P UPS across a LAN using any of the main network communication protocols - TCP/IP, HTTP and network interface (SNMP). NetMan enabled UPS's to integrate easily into medium and large sized networks and provide reliable communications between the UPS and management systems employed.

FLU-MultiCOM1: Internal MODBUS/JBUS Card (external model shall be available), Protocol converter shall be used to monitor the UPS using the MODBUS/JBUS protocol on RS232 or RS485 serial lines. It can also manage a second independent RS232 serial line that can be used to connect to other devices such as the Netman SNMP Card with a PC using UPSMON or PowerShield software.

FLU-I/O Expansion: Internal Card shall provide addition remote alarm functions as identified below. The card shall contain 6 outputs: potential-free contacts for alarms (programmable from the display panel) and capable of switching up to 30 V AC or DC at UP 1 Amp, 2 inputs (programmable from the panel) and 1 12V DC maximum 100mA auxiliary input. 2 additional slots shall be available for a total of 12 additional contacts.

- Disturbances on Bypass Line
- Manual Bypass ON
- Bypass Line Voltage Fail
- Main Line Voltage Fail
- Pre-alarm , Low Battery Voltage
- Low Input Voltage
- Output Overload
- Internal Fault
- Bypass for Output Overload
- Over Temperature or Fan Failure
- Input Voltage Sequence OK
- Output OFF

B. Monitoring and Shutdown Software

The UPS shall have Monitoring and Shutdown Software available to provide communication across a LAN networks:

FLU-Powershield: Communication Software shall provide efficient, user-friendly management of multiple Firstline P UPS's using bar chart displays to show major operational information such as the input voltage, UPS load percent and batteries charge percent. The software also provides detailed information on fault conditions and UPS operating characteristics. PowerShield has been developed with a client/server architecture that makes it flexible and easy to use, and provides multi-lingual and on-line support.

Operating systems supported include Windows 2000, 2003Server, XP, Vista, 2008 Server, 7, Linux, Novell Netware, Mac OS X and most common UNIX operating systems such as: IBM AIX, HP, SUN Solaris INTEL and SPARC, SCO Uniware and Open Server, Silcon Graphics IRIX, Compaq Tru64 UNIX and DEC UNIX, Open BSD UNIX and FreeBSD UNIX, NCR UMIX, HP Open VMS VMWare ESX and VSPHERE.

FLU-PowerNETGuard Supervision software shall centralize UPS management using network interface (SNMP) communications. It is ideal for Data Centre managers and medium to large sized networks. PowerNETGuard uses the RFC1628 standard Management Information Base (MIB) and ensures standardized UPS management wherever they are located.

Operating systems supported include Windows (98, ME, NT, 2000, 2003, XP and Vista), Kinux, MacOSX, Solaris 8, 9 and 10 and Silcon Grapics IRIX.

C. Battery Sensor Module

FLU-Sensor: The Battery Sensor Module shall monitor the battery internal cabinet environmental conditions of one (1) Battery Cabinet connected to the UPS and displayed on the UPS front mimic panel. For units with multiple battery cabinets, only the first cabinet will be monitored.

D. Remote Monitor Alarm Panel (RMP)

FLU-MultiPanel: Remote Monitoring Panel device shall provide remote monitoring and control, same functions as the UPS main mimic panel. The RMP shall provide detailed UPS status overview in real time. It shall display values for UPS specific input and output supplies, and battery set measurements. The RMP shall have a high-definition graphical display and can report in 7 languages: English, Italian, German, French, Spanish, Russian and Chinese. It shall have (3) independent serial ports, one of which allows for UPS monitoring via the MODBUS/JBUS protocol (on either an RS485 or RS232 serial line). The others can be used with devices such as the Netman SNMP Card and a PC running UPSMON or PowerShield software.

E. IBC Seismic Withstand Certification

Site specific Seismic Withstand Certification per IBC (International Building Code) Areas A through F. Bracing hardware with drawings shall be available. All unit shall have bolt down capability without the use of external brackets.

F. Harsh Environment Enclosure

The UPS and any accessory cabinet(s) shall have the capability to be mounted and completely wired internal to, include AC cooling, inside any NEMA type enclosure (NEMA 12, 3R, 4X) by the manufacturer.

G. Spare Parts

Shall be available in three levels, Level 1. Minor, Level 2. Medium and Level 3. Major.

H. Service Agreements

Multi-level service and maintenance agreements shall be available.

Section 3.0 Execution

3.1 Factory Testing

Before shipment, the manufacturer shall fully and completely test the system to factory standards to assure compliance with the specification. Each subassembly shall undergo thorough testing prior to installation in the system. The total system shall be exposed to a functional load test and shall be subjected to a minimum of 24 hours "burn-in" test prior to shipment.

A complete test report shall be available for each unit and kept on file for future reference.

3.2 Site Start-Up

Site start-up and testing shall be provided by the manufacturer's field service representative during normal working hours (M/F- 8/5). Individual scheduling requirements shall be met with ten working days advance notice.

Site testing shall consist of a complete test of the UPS and accessories by the UPS manufacturer in accordance with manufacturer's standards. Commissioning must be performed by manufacturer's approved service representative for warranty to apply.

3.3 Field Engineering Support

The UPS manufacturer shall have available a nationwide field service organization staffed by factory trained Field Service Engineers dedicated to the start-up, maintenance and repair of UPS equipment. The manufacturer shall have a toll free service telephone number answered 24 hours a day / 365 days a year.

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