Liebert® ITA2 UPS

Compact, Efficient & Robust UPS for Critical Applications 5-20kW/kVA

Contents

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5-20kW/kVA

GUIDE SPECIFICATIONS

1.0 GENERAL

1.1 Summary

The specifications mentioned in this document describe the operation and functional requirements of a tower or rack mounted transformer-free Uninterruptible Power Supply (UPS) performing round-the-clock, classified as VFI-SS-111 in accordance with IEC/EN 62040-3 industry standards. The UPS will automatically maintain AC power within specified tolerances to the critical load, without any interruption (depending on the duration pertaining to the battery run time) during failure or deterioration of the mains power supply. The UPS system will be expandable to provide redundancy or load growth requirements.

The manufacturer will design and furnish all materials and equipment that are fully compatible with electrical, environmental, and space conditions at the site. The UPS will include all the equipment to properly interface the AC power source to the intended load and will also be designed for unattended operation.

1.2 STANDARDS

The UPS along with the associated equipment and components will be manufactured in accordance with the following applicable standards:

General safety requirements for the UPS	EN62040-1/IEC62040-1
EMC requirements for the UPS	EN62040-2/IEC62040-2 (Class C2)
Method of specifying the performance and test requirements of the UPS	EN62040-3/IEC62040-3(VFI SS 111)
safety of information technology equipment, including electrical business equipment	EN60950
Electromagnetic compatibility (EMC)	IEC 61000-3-4, IEC 61000-4-2,4,5,6,8,11
Moisture and dust test	Factory certified. (Or) GB/T 2423.21-2008 Environmental testing for electrical and electronic products- Part 2: Test methods- Test M: low air pressure
High Altitude test	
Energy star certified	2011/65/EU uninterruptible power supplies version 1.0 program requirements/ENERGY STAR UPS version 1.0 test method guidance
Vehicle-carrying test	GB/T21563-2008 Railway applications-Rolling stock equipment-shock and vibration test GB/T 4798.5-2007 Environmental conditions existing in the application of electric and electronic product- section 5: ground vehicle installations

The UPS is CE marked in accordance with EEC directives 73/23 “low voltage” and 89/336 “electromagnetic compatibility”. The Quality management grade pertaining to the engineering and manufacturing facility is certificated to conform to the ISO 9001 international standards, specifically catering to the design and production of power protection systems for computers and other sensitive electronic devices.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

A. For non-redundant operation (applicable, not applicable), the UPS system will be sized to provide a minimum of ____ kVA / kW output.

UPS Num in parallel system	1	2	3
Output KVA	5/6/10/16/20	10/12/20/32/40	15/18/30/48/60

B. For redundant operation (applicable, not applicable), the UPS system will be sized to provide a minimum of ____ kVA / kW output with ___ redundant UPS module(s) out of service.

UPS Num in parallel system	2	3		4		
redundant number	1	1	2	1	2	3
Output KVA	5/6/10/16/20	10/12/20/32/40	5/6/10/16/20	15/18/30/48/60		

The UPS will be able to supply all required power to full-rated output kVA loads with power factor ranging from 0.5 lagging to Unity. The UPS will also work from 0.9 to 0.5 leading power factors subject to de-rating.

The battery modules (which match the UPS dimensions) will support the UPS with a capacity of ____ kW load for at least _____ minutes at 25°C at startup.

Note: Select the appropriate number of battery modules to deliver the required battery autonomy period. The below details are considering 9AH/12V, 16No of batteries. (The autonomy times are approximate and are based on fully charged batteries and can vary +/-5% because of battery manufacturing variances.)

Model	Module number	Backup time									
		5kVA	4.5kVA	4kVA	3.5kVA	3kVA	2.5kVA	2kVA	1.5kVA	1kVA	0.5kVA
5kVA	1	6.8	7.8	9.2	11.2	13.9	17.9	24.3	35.6	58.0	122.4
	2	18.0	20.9	24.6	29.7	36.5	46.0	59.7	81.7	126.4	278.8
	3	31.9	36.6	42.6	50.2	60.2	74.1	94.5	128.3	207.0	435.7
	4	46.3	52.6	60.3	70.2	83.5	102.2	130.3	182.7	287.6	592.5
	5	60.4	68.1	77.8	90.3	107.0	131.4	171.6	237.1	368.2	749.3
	6	74.4	83.7	95.4	110.4	131.5	164.6	212.9	291.5	448.8	906.1

Model	Module number	Backup time									
		6 kVA	5.4 kVA	4.8 kVA	4.2 kVA	3.6 kVA	3 kVA	2.4 kVA	1.8 kVA	1.2 kVA	0.6 kVA
6kVA	1	5.1	6.1	7.1	8.6	10.8	13.9	19.0	28.0	46.9	101.0
	2	14.0	16.1	19.1	23.0	28.6	36.5	48.4	67.0	103.9	228.2
	3	24.7	28.7	33.6	40.0	48.5	60.2	77.6	105.6	167.6	359.7
	4	36.7	42.0	48.7	57.0	68.0	83.5	106.9	147.8	235.1	491.2
	5	48.8	55.3	63.3	73.6	87.5	107.0	138.3	193.5	302.6	622.8
	6	60.5	68.2	77.9	90.4	107.1	131.5	172.9	239.1	370.1	754.3

Model	Module number	Backup time									
		10 kVA	9 kVA	8 kVA	7 kVA	6 kVA	5 kVA	4 kVA	3 kVA	2 kVA	1 kVA
10kVA	2	4.8	5.5	7.4	10.2	14.0	18.0	24.6	36.5	59.7	126.4
	3	8.8	10.2	13.6	18.5	24.7	31.9	42.6	60.2	94.5	207.0
	4	13.7	15.9	21.1	28.4	36.7	46.3	60.3	83.5	130.3	287.6
	5	19.4	22.4	29.7	39.3	48.8	60.4	77.8	107.0	171.6	368.2
	6	25.8	29.6	38.6	50.6	60.5	74.4	95.4	131.5	212.9	448.8

To guarantee the backup time, it is recommended to configure at least two groups of battery modules for the 10kVA model.

Model	Module number	Backup time									
		16 kVA	14.4 kVA	12.8 kVA	11.2 kVA	9.6 kVA	8 kVA	6.4 kVA	4.8 kVA	3.2 kVA	1.6 kVA
16kVA	4	9.5	11.0	13.0	15.6	19.4	24.8	33.8	48.7	77.7	169.6
	6	16.8	19.6	23.1	27.8	34.0	42.9	56.2	77.9	121.7	271.9
	8	25.3	29.3	34.4	40.8	49.2	60.7	78.1	107.3	173.2	374.1
	10	34.4	39.5	45.9	53.8	63.9	78.4	100.3	138.9	225.2	476.3
	12	43.6	49.7	57.2	66.5	78.7	96.1	122.4	173.7	277.2	578.6

Model	Module number	Backup time									
		20 kVA	18 kVA	16 kVA	14 kVA	12 kVA	10 kVA	8 kVA	6 kVA	4 kVA	2 kVA
20kVA	4	6.9	8.0	9.5	11.5	14.3	18.3	24.8	36.7	60.3	130.3
	6	12.3	14.3	16.8	20.4	25.3	32.3	42.9	60.5	95.4	212.9
	8	18.5	21.5	25.3	30.5	37.5	46.8	60.7	84.0	131.8	295.5
	10	25.3	29.3	34.4	41.0	49.7	61.1	78.4	107.6	173.4	378.1
	12	32.6	37.5	43.6	51.4	61.6	75.2	96.1	132.3	215.1	460.7

To guarantee the backup time, it is recommended to configure at least four groups of battery modules for the 20kVA model.

1.3.2 Modes of Operation

The UPS will operate in the following modes:

A. Normal: The UPS inverter continuously supplies the critical AC load. The rectifier draws power from the commercial AC source and converts it into DC power for the inverter and the battery charger. The battery charger maintains the battery in a fully-charged and optimum operational condition. The inverter converts the DC power into clean and regulated AC power which is supplied to the critical load (conditioned line).

B. ECO Mode: The critical AC load will be continuously powered by the bypass with the inverter available to power the load if the bypass source voltage or frequency exceeds adjustable parameters of power quality.

C. Battery: Upon failure or degradation of the primary AC source, the load will be supplied through the inverter drawing power from the battery. Visible and audible signals will alert the user during this operating state. The remaining autonomy time will be calculated by a diagnostic algorithm. Once the end of discharge (EoD) voltage is reached, the UPS will automatically disconnect the battery (internal or external) without the need for external devices.

D. Recharge: If the primary AC source returns within tolerance limits prior to a UPS automatic end of discharge shutdown, the rectifier will recommence powering the inverter and simultaneously recharging the battery through the battery converter. When the inverter has synchronized with the bypass, the UPS will recommence operating in double conversion mode without any break (0 ms) in the supply to the load.

   If the primary AC source does not return within tolerance limits and the UPS performs an automatic end of discharge shutdown, the UPS will recommence operating in bypass mode until it is manually transferred to the inverter. Alternatively, it can be set to start in static bypass mode and automatically transfer to double conversion mode after a time delay, from the moment the rectifier start is complete and the bypass source is back within the synchronization windows. The time delay is selectable between 1 and 999 seconds (default: 10 seconds). During the selected delay, the UPS will charge the battery and phase-lock the inverter with bypass. If the inverter is unable to phase-lock the bypass at the end of the selected window, the load will remain fed by the bypass and the user will be prompted to confirm or cancel an interrupted transfer.

E. Bypass: If the UPS must be taken out of service, the static transfer switch will transfer the load to the bypass source. The transfer process will cause no interruption in power to the critical load. An optional external wrap-around maintenance bypass will be used to ensure full isolation of the unit for the service of internal components while providing safety from arc flash.

F. Off-Battery: If the battery only is taken out of service, it will be disconnected from the DC-DC converter by means of an external disconnect circuit breaker. The UPS will continue to function and meet all of the specified steady-state performance criteria, except for the power outage backup time capability. If multiple battery strings are used, each string will be capable of being electrically isolated for safety during maintenance.

G. Parallel: Inherent scalability features should be available to meet higher capacity and higher reliability requirements. Under normal operating conditions, the power delivered to the load will be equally shared between number of UPS units connected to the parallel bus with a tolerance of 5%. In the event of a unit failure or overload, the system will transfer to the bypass source.

H. Common Battery (for external battery bank): The UPS should be able to support the common battery function when multiple UPS systems are connected in parallel. In this mode, each UPS can use the same battery to feed the required load.

1.3.3 Performance Requirements

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

- Any altitude within the specified operating range ≤3000m elevation.
- Any ambient temperature within the specified operating range of 0°C to 50°C

1.3.4 Input

A. Voltage: Input/output voltage specifications of the UPS will be

- Rectifier AC Input: 220/230/240Vac, single-phase, two-wire-plus-ground for 5/6kVA
  380/400/415Vac, three-phase, four-wire-plus-ground for 16/20KVA
  Single-Phase or Three-phase supply for 10kVA

- Bypass AC Input: 220/230/240Vac, single-phase, two-wire-plus-ground for 5/6kVA
  380/400/415Vac, three-phase, four-wire-plus-ground or Single Phase for 16/20KVA
  Single-Phase or Three-phase supply for 10kVA
- AC Output: 220/230/240Vac, single-phase, two-wire-plus-ground for 5/6/10kVA
  380/400/415Vac, three-phase, four-wire-plus-ground or Single-Phase for 16/20kVA

B. Voltage Range: 305-498Vac at full load; 173-498Vac at 50% derated load conditions without battery discharge

C. Frequency Range: 40 - 70Hz

D. Maximum Inrush Current: UPS inrush current not to exceed 1.5 times rated input current

E. Power Factor: Minimum 0.99 at full load & 0.98 at half load with nominal input voltage
Minimum 0.95 at full load for 3phase in/1 phase out for 10kVA

F. Current Distortion: Less than 5% THD at full load input current in double-conversion mode

G. Surge Protection: Sustains input surges of 4kV (Line to ground) without damage as per criteria listed in EN 61000-4-5: 1995

1.3.5 AC Output

A. Load Rating: 100% of load rating @ 30˚C, 80% of load rating @ 40˚C, 70% load rating @ 50˚C
for any load from 0.5 lagging to unity

B. Load power factor: Unity

C. Voltage Tolerance
- ±1% RMS average for a balanced, three-phase load
- ±2% for 100% unbalanced three phase load
- +/- 3% for parallel UPS

D. Voltage Adjustment Range: ±5% for line drop compensation adjustable by factory service personnel

E. Voltage Distortion:
- <2% for 0-100% linear loads
- <5% for 0-100% Non-linear loads

F. Frequency Regulation:
   - Synchronized with internal clock: +/-0.25%
   - Synchronized with bypass: +/-0.25%

G. Frequency synchronization window: Synchronized to bypass: Nominal ±5% Hz

H. System Efficiency: defined as output kW/input kW at rated lagging load power factor; and not less than the values listed below

   In Online double conversion mode: (depending on load)

   For 5/6kVA – up to 95.5%

   For 10kVA- up to 95.8%

   For 16/20kVA- up to 96.2%

   In Eco mode: up to 99%

I. Phase Imbalance:
   - Balanced loads 120° ±1°
   - 100% unbalanced loads 120° ±1°

J. Voltage Transients (average of all three phases):
   - 0-100% or 100-0%

     Response Meets IEC 62040-3: 2010 Figure 2 Curve 1, Class 1
     Meets ITIC and CBEMA Curve Requirements

K. Overload Capacity:

   105% - 125% of full load for 5minutes

   125% - 150% of full load for 1minute

   >150% of full load for a minimum of 200 milliseconds

1.3.6 Grounding

The UPS chassis will have an equipment ground terminal.

1.4 ENVIRONMENTAL CONDITIONS

The UPS will be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

A. Operating Ambient Temperature
   - UPS: 0 to 50 ˚C
   - Battery: 25°C ± 3°C (depends on battery mfg. recommendations)

B. Storage temperature

   -40°C ~ +70°C (battery excluded); -25°C ~ +55°C (battery included)

C. Relative Humidity
   - 0 to 95%, non-condensing

D. Altitude
   - ≤ 3000m; above sea level derate power by 1% per each 100m increase

E. Audible Noise Level (measured 1m from the surface of the unit)
   - <55 dBA for 5/6/10kVA
   - <58 dBA for 16/20kVA

1.5 SUBMITTALS

1.5.1 Proposal Submittals

Submittals with the proposal will include:

- Descriptions of equipment to be furnished, including deviations from these specifications.
- Document showing the efficiency certification by certified agency.
- System configuration with single-line diagrams.
- Detailed layouts of customer power and control connections.
- Functional relationship of equipment, including weights, dimensions and heat dissipation.
- Information to allow distribution system coordination.
- Size and weight of shipping units to be handled by contractor.

1.5.2 Order Submittals

Submittals supplied at time of order will include:

- All of the documentation presented with the proposal, per Section 1.5.1 above.
- Detailed installation drawings including all terminal locations.
- Interconnect wiring diagrams showing conduit wiring with terminal numbers for each wire.

1.5.3 UPS Delivery Submittals

Submittals upon UPS delivery will include:

- A complete set of submittal drawings.
- Two (2) sets of instruction manuals. The manuals will include a functional description of the equipment, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

1.6 WARRANTY

1.6.1 UPS Warranty

The UPS manufacturer will warrant the unit against defects in workmanship and materials for 12 months after initial startup or 18 months after the shipping date, whichever comes first.

1.6.2 Warranty – End User

Warranties associated with items not manufactured by the UPS supplier but included as part of the system will be passed through to the end user.

1.7 QUALITY ASSURANCE

1.7.1 Manufacturer's Qualifications

A minimum of 20 years' experience in the design, manufacture and testing of solid-state UPS systems will be required. The Quality Management grade pertaining to the engineering and manufacturing facility is certified to conform to the ISO 9001 international standards, specifically catering to design and manufacture of power protection systems for computers and other sensitive electronic devices.

1.7.2 Factory Testing

Prior to the shipment, the manufacturer will fully test the UPS unit comprehensively to ensure compliance with the required specifications. The UPS unit will be tested at the system-specified capacity. Testing will be performed using load banks at partial load as well as the full kW rating of the unit. Operational discharge and recharge tests will be implemented to confirm the rated performance as defined in the specifications. System operations like start-up, shutdown and transfers will be demonstrated to ensure compliance with the mentioned characteristics. A certified copy of the test results will be available for each system as indicated & declared in the order.

2.0 PRODUCT

2.1 FABRICATION

2.1.1 Materials

All materials of the UPS will be new and produced currently by the manufacturer, and of high-grade quality; moreover, it should be never used in service except as required during the factory testing and quality checks. All active electronic devices will be solid-state. All power semiconductors will be sealed. Control logic and fuses will be physically isolated from power train components to ensure operator safety and prevent damage due to heat.

2.1.2 UPS Internal Wiring

Wiring practices, materials and coding will comply with the requirements of the National Electrical Code as well as applicable local regulations and standards. All bolted connections of bus bars, lugs and cables will comply with requirements of the National Electric Code and other applicable standards. All electrical power connections will be torqued to the required value and marked with a visual indicator.

2.1.3 Field Wiring

All field wiring power connections will be to tin-plated copper bus bars for connection integrity. Bus bars will have adequate space to accommodate two-hole, long-barrel, compression type lugs forming a permanent connection between field wiring and field-installed lugs.

Provisions will be made in the cabinets to permit installation of the input, output and external control cabling using raceway or conduit. Provision will be made for top and bottom access to input, output, bypass and DC connections.

2.1.4 Construction and Mounting

The UPS will be housed in an IP20 enclosure, designed for floor and rack mounting. The UPS will be structurally adequate and have provisions for forklift handling. Maximum cabinet height will be less than 0.5 meters for all UPS range.

2.1.5 Cooling

Forced air cooling will be provided to ensure that all components are operating and functioning well within defined temperature ratings. Airflow will be controlled based on the load demand. If one of the cooling fans experiences a fault, the UPS will be immediately notified of the condition via the user interface as well as the remote monitoring services. The cooling air entry will be from the front and air exit will be at the back of the unit.

2.2 Equipment

2.2.1 UPS System

The UPS system will consist of an IGBT power factor-corrected rectifier, DC-DC converter and a three-phase, transformer-free T-type inverter, bypass static transfer switch, bypass synchronizing circuitry, protective devices, and accessories as specified and declared in this document. The specified system will also include a battery disconnect breaker and battery system.

2.2.2 Surge Protection

The UPS will have built-in protection against surges, sags and over current from the AC source. The protection will meet the requirements of IEC/EN 61000-4-5 including:

Level 4 (4kV) (Line to Earth), Level 3 (2kV) (Line to Line) Based on B

2.2.3 Output Protection

The UPS will be protected against sudden changes in the output load and short circuits at the output terminals. The UPS will have built-in protection against permanent damage to itself and the connected load for all predictable types of malfunctions. Fast-acting, current-limiting devices will be used to protect against cascading failure of solid-state devices. Internal UPS malfunctions will cause the module to trip off-line with minimum damage to the module and provide maximum information to maintenance personnel pertaining to the reason for tripping off-line. The load will be automatically transferred to the bypass line

without any interruption in case of an internal UPS malfunction. The status of protective devices will be indicated on a graphic display screen positioned at the front of the unit.

2.3 Components

2.3.1 Rectifier

The term rectifier will denote the solid-state equipment and controls necessary to convert alternating current to regulated direct current to supply the inverter and charge the battery. The DC output of the rectifier will meet the input requirements of the inverter without the battery being connected.

A. Input Current Harmonic Distortion

The rectifier will actively control and reduce input current distortion over the full operating range of the UPS, eliminating the need for an additional passive input filter. Input current THD will be less than 5% (for 3 phase input/3 phase output & 1 phase input/1 phase output) at rated load and nominal voltage in double-conversion mode.

B. Dynamic Current Input Limit Reduction

The rectifier, in conjunction with the other UPS controls and circuitry, will adjust the current demanded for battery charging as a function of the UPS wattage load and input voltage level.

2.3.2 DC-DC Converter

The term DC-DC converter will denote the equipment and controls to regulate the output of the rectifier to the levels required for charging the battery as well as boost the battery voltage to the level required to operate the inverter. The DC-DC converter will be solid-state, capable of providing rated output power and, for increased performance, will be based on a pulse width-modulated design and will utilize insulated gate bipolar transistors (IGBTs). The DC-DC converter will control the charging of the battery. The AC ripple voltage of the charger during float charging mode will not exceed 3% RMS of the float voltage.

A. Battery Recharge

In addition to supplying power for the load, the rectifier/charger will be capable of supplying a minimum of 5% of the module full load power rating for recharging the battery. The battery recharge rate capability will be sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time while running at 95% of full load at nominal voltage, provided that the battery can accept recharge at that rate. After the battery is recharged, the rectifier/charger will maintain the battery at full charge until the next emergency operation.

B. Battery Equalize Charge

A manually initiated equalize charge feature will be provided to apply an equalize voltage to the battery. A method will be available to deactivate this feature for valve regulated battery systems.

C. Stop Battery Charging Function

Battery charging/discharging will be suspended when over temperature is sensed in the battery cabinet or when environmental contact is closed.

D. Overvoltage Protection

There will be DC overvoltage protection because if the DC voltage rises to the pre-set limit, the microprocessor will automatically switch off the battery charger and initiate an uninterrupted load transfer to the static bypass line.

E. Temperature-Compensated Charging

The UPS will adjust the battery-charging voltage, based on the battery temperature reported from the external battery temperature sensors. Excessive difference in the temperature measurements will be reported following which the charging voltage will be adjusted to protect the batteries from excessive current.

F. Battery Load Testing

The UPS will be capable of performing the battery load testing under the supervision of the operator. To accomplish this, the rectifier will reduce charging voltage to force the batteries to carry the load for a short time span. If the curve of battery voltage drop indicates diminished battery capacity, the UPS will display an alarm message. If the voltage drop indicates battery failure, the UPS will annunciate the appropriate alarms.

2.3.3 Inverter

The term inverter will denote the equipment and controls to convert direct current from the rectifier or battery via the DC-DC converter to precise alternating current to power the load. The inverter will be solid-state, capable of providing the rated output power and, for increased performance; the inverter will be a pulse-width-modulated design and will utilize insulated gate bipolar transistors (IGBTs). The inverter will not require an inverter output series static switch/isolator in the case of an overload or fault isolation or transfer to the bypass thereby streamlining the reliable performance and efficiency. No isolation transformer will be considered for the inverter to produce the necessary voltage.

A. Voltage regulation

The advanced space vector control algorithm enables the real-time control of the individual phases with consequent improvement of transient responses, short circuit behavior and synchronism between UPS output and bypass supply in the case of distorted mains voltage.

B. Overload Capability

The inverter will be capable of supplying an overload current as specified in section 1.3.5. For greater currents or longer time duration, the inverter will be self-protecting by means of electronic current-limitation, subsequently preventing the damage of the components.

The control logic will disconnect the inverter from AC load, eliminating the need to clear protective devices while the critical load will be transferred to the static bypass supply automatically.

C. Output Frequency

The inverter will track the bypass continuously, providing the bypass source maintains a frequency of 50Hz ±0.25%.

D. Phase-to-Phase Balance

The inverter will provide a phase-to-phase voltage displacement of no worse than ±1˚ with a 100% unbalanced load.

E. Inverter Fault Sensing and Isolation

The UPS will be provided with the means to detect a malfunctioning inverter and isolate it from the critical load bus to prevent disturbance of the critical load voltage beyond the specified limits.

F. Battery Protection

The inverter will be provided with monitoring and control circuits to protect the battery system from damage due to excessive discharge. Inverter shutdown will be initiated when the battery voltage has reached the end of discharge voltage. The battery end-of-discharge voltage will be calculated and automatically adjusted for partial load conditions to allow extended operation without damaging the battery. Automatic shutdown based on discharge time will not be acceptable.

2.3.4 Inverter Bypass Operation

When maintenance is required or when the inverter cannot maintain voltage to the load due to sustained overload or malfunction, a bypass circuit will be provided to isolate the inverter output from the load and provide a path for power directly from an alternate AC (bypass) source. The UPS control system will constantly monitor the availability of the inverter bypass circuit to perform a transfer. The inverter bypass circuit will consist of a continuous-duty bypass static switch to isolate the static bypass switch from the bypass utility source. The bypass static switch will denote the solid-state device incorporating SCRs (silicon controlled rectifiers) that can automatically and instantaneously connect the alternate AC source to the load.

A. Static Bypass Switch Rating

The static bypass switch will be rated for continuous duty operation at the full rated load to ensure ultimate reliability.

B. Manual Load Transfers

A manual load transfer between the inverter output and the alternate AC source will be initiated from the control panel. Manually initiated transfers will be adhering to make-before-break methodology, utilizing the inverter and the bypass static switch.

C. Automatic Load Transfers

An automatic load transfer between the inverter output and the alternate AC source will be initiated if an overload condition is sustained for a period in excess of the inverter output capability or due to a malfunction that would affect the output voltage. Transfers caused by overloads will initiate an automatic retransfer of the load to the inverter only after the load has returned to a level within the rating of the inverter source and the alarm has been acknowledged.

D. Momentary Overloads

In the event of a load current inrush or branch load circuit fault in excess of the inverter rating, the bypass static switch will connect the alternate AC source to the load for at least 200 milliseconds, allowing >150% of the normal rated output current to flow. Output voltage will be sustained depending on the extent that the alternate AC source capacity permits. If the overload condition is removed before the end of the 200-millisecond period, the bypass static switch will turn off and the load will remain on inverter power. If the overload remains, then a transfer to the alternate AC source is to be completed.

E. Back-Feed Protection

In the event of back feeding during battery mode, UPS will be turned off. And UPS should comply with all UL/TUV safety standards.

F. Active ECO-Mode (Applicable for single UPS only)

When selected, this mode of operation will transfer the load to the bypass source and maintain it there as long as the bypass source frequency, slew rate and voltage are within the adjusted operating parameters. In this mode, the inverter will remain in the operating mode to demonstrate the ability to instantaneously assume the load without interrupting the output voltage. If the bypass source goes outside the adjusted limits, the bypass static switch will turn off, isolating the load from the bypass while the inverter assumes the full critical load. The load will be transferred from the bypass source to the inverter while maintaining the output voltage within the ITIC and CBEMA curves.

2.3.5 Display and Controls

A. UPS Control Panel

The operator control and display panel will be located on the front of the UPS. The control panel includes a min 320 x 240-pixel multi-lingual, graphic liquid crystal display, allowing the user to operate and control the UPS checking parameters, as well as UPS and battery status and retrieve up to 2000 events/alarm logs for reference and diagnosis. Complete access to all LCD menu is possible through four software- assigned buttons will be located below the display. LCD display will adjust its screen (i.e. vertical or horizontal) automatically depending on the UPS orientation (i.e. Tower or Rack). No physical adjustment to the LCD will be carried out.

B. Logic

UPS system logic and control programming will reside in a microprocessor-based control system with nonvolatile flash memory. Rectifier, inverter and system control logic will utilize high-speed digital signal processors (DSPs). SCI bus will be used to communicate between the logic and the User Interface as well as the options. Switches, contacts and relays will be used only to signal the logic system as to the status of mechanical devices or to signal user control inputs. Customer external signals will be isolated from the UPS logic by relays or optical isolation.

C. Metered Values

The LCD displays the system real-time running data of the system. The following parameters should be displayed on the LCD. All the displayed values are effective value and should be refreshed in less than 10s and the accuracy of the displayed voltage effective value is at least ±2%.

- **Input:** voltage (L-N) & (L-L), frequency, power factor, and energy (kWh)
- **Battery:** battery status, battery voltage, battery current, battery backup time, remaining capacity
- **Bypass:** bypass voltage, frequency
- **Output:** kVA, KW, load PF, load percent
- **Efficiency curve**

D. Power Flow Indications

A power flow diagram will graphically depict whether the load is being supplied from the inverter, bypass or battery and will provide, on the same screen.

Main Display Screen

The following UPS status messages will be displayed:

- Rectifier (Off / Main Input On / Battery Input On)
- Input Supply (Normal Mode / Battery Mode / All Off)
- Battery Self Test (True / False)
- EPO (True / False)
- Charger (On / Off)
- Inverter (Off / Soft Start / On)
- Bypass (Normal / Abnormal)
- Output Supply (All Off / Bypass Mode / Inverter Mode / Output Disable)
- Inverter On (Enable / Disable)

E. HMI Control Buttons

Buttons will be provided to start and stop the inverter. A pop-up message requesting confirmation will be displayed whenever a command is initiated that would change the status of the UPS.

Other buttons will be provided for the navigation.

F. Event Log

This menu item will display the list of events that have occurred recently while the UPS was in operation. The Event Log will store up to 2000 events, with the oldest events being overwritten first the log's capacity has reached the maximum value.

G. Alarms

The following alarm messages will be displayed:

- Input abnormal
- Input phase reversed
- Rectifier fault
- Charger Fault
- Battery Reversed

- No Battery
- Fan fault
- Parallel Comm. Fail
- Bypass Abnormal
- Control Power Fail
- Unit Over Load
- System Over Load
- Bypass Phase Reversed
- Load Sharing Fault
- Bypass over Current.

H. Controls

System-level control functions will be accessed via control display screen:

- Turn on/off/to bypass
- Mute/unmute audible alarms
- Start/stop manual battery test
- Clear faults

2.3.6 Self-Diagnostics

- Event Log File - The control system will maintain a log of the event conditions that have occurred during system operation. Each log will contain the event name and event date & time stamp.

2.3.7 Remote Monitoring and Integration Capabilities

A. Communication Cards:

The UPS can be equipped with following communication card(s) including:

- Built-in RJ 45 port for webpage
- Built-in Multi-function port that can be configured as Modbus or to connect to environmental sensors
- Optional Communication card- will provide Web access, environmental sensor data, and third-party customer protocols for the UPS and manage a wide range of operating parameters, sending data over ethernet networks via secure HTTPS protocol and alarms and notifications via SNMP traps. It will also have the capability to integrate with any existing building management system. It will also compatible with shutdown software (used for safe shutdown of severs in the event of battery drained).
- Optional Software- will be provided to support the monitoring of multiple no of UPS systems at single platform.

B. Output Alarm Contacts:

At least two programmable output dry contacts should be available to understand the UPS status such as Low battery, UPS fail.

C. Customer Input Contacts:

At least two programmable input dry contacts should be available to activate battery mode shutdown or any mode shutdown or maintenance mode.

D. Programmable outlets: (default feature)

UPS system should have programmable output outlets for the load shedding of semi-critical loads when the unpleasant event occurs including overloaded condition, Battery Discharge time out, Battery Backup time out, Battery Capacity time out, and restart time after mains recovery time out. These conditions will be defined and activated/deactivated via UPS LCD display.

E. EPO port: The EPO port will be provided to switch off the UPS in emergency conditions. The system will turn off the rectifier, inverter and stop powering the load immediately (inverter and bypass output included), and the battery stops charging or discharging.

2.3.8 Battery Plant

The battery plant will comply with the following specifications

Multiple no of battery modules will be considered to meet the specified autonomy period mentioned in section 1.3.1. Each battery module will esthetically match the UPS cabinet and should be capable enough to place in any orientation (i.e. tower or rack mounted). Consider min. 16 nos of 9AH/12V VRLA SMF batteries in each battery module. Each battery module should be equipped with output switch for disconnection when maintenance needed and communication port to communicate status with UPS system. Accessories that are required to connect with the UPS system should be consider under the scope of supply.

VRLA SMF Battery specification: -

Batteries will be suitable for high efficient discharge applications. It supports at least for more than 260cycles at 100% discharge in cycle service up to 5years in standby service. Batteries & its internal material should also comply with the latest UL standards.

2.3.9 Optional Accessories and Features

A. Load Bus Sync

The Load Bus Sync (LBS) will enable two independent single-module UPS units to stay in sync when operating on battery or unsynchronized input sources. The LBS will determine the master and slave relationship between UPS units. The LBS ports will be integral part of the UPS system and only necessary cables will be considered (if mentioned in the scope of supply) to configure this function.

B. Communication Card

A communication card will facilitate Web-based UPS monitoring and management capabilities and deliver using one or two remote monitoring protocols including SNMP (v1, v2, and v3) and Modbus.

C. Power Distribution Cabinet (POD)

POD will be provided additionally to enable safe and reliable power distribution function.

3.0 EXECUTION

3.1 FIELD QUALITY CONTROL

The following inspections and test procedures will be performed by factory-trained field service personnel during the UPS startup.

A. Visual Inspection

- Inspect the equipment for signs of damage.
- Verify the installation per drawings supplied with the installation manuals or submittal package.
- Inspect cabinets for foreign objects.
- Verify that neutral and ground conductors are properly sized and configured per the supplier's requirements as noted in the suppliers drawings supplied with the installation manuals or submittal package.
- Inspect each battery jar for proper & accurate polarity.
- Verify that all the printed circuit boards are configured properly.

B. Mechanical Inspection

- Check all the control wiring connections for tightness.
- Check all the power wiring connections for tightness.
- Check all the terminal screws, nuts and/or spade lugs for tightness.

C. Electrical Inspection

- Check all the fuses for continuity.
- Confirm whether the input and bypass voltage and phase rotation are correct.
- Verify if the control transformer connections are correct for voltages being used.
- Ensure the connection and voltage of the battery string(s).

3.2 UNIT STARTUP

1. Energize the control power.
2. Perform the control/logic checks and adjust to meet specification.
3. Verify the DC float and equalize voltage levels.
4. Verify the DC voltage clamp and overvoltage shutdown levels.
5. Verify the battery discharge, low battery warning and low battery shutdown levels.
6. Verify the fuse monitor alarms and the system shutdown.
7. Verify the inverter voltages and regulation circuits.
8. Verify the inverter/bypass sync circuits and set overlap time.
9. Perform the manual transfers and returns.
10. Simulate the utility outage at no load.
11. Verify if the recharge is done properly.

3.3 MANUFACTURER'S FIELD SERVICE

A. Service Personnel

The UPS manufacturer will directly employ a nationwide service organization, consisting of factory-trained field service personnel dedicated to the startup and maintenance of UPS and power equipment.

The manufacturer will provide a national dispatch center to coordinate the schedules of the field service personnel. One toll-free number will be provided where a qualified support person can be reached round-the-clock- 24 hours a day, 7 days a week and 365 days a year. If an emergency service is required, the on-site response time will be 4 hours or less within 150 miles of a supplier's service center.

Two local customer engineers will be assigned to the site with a regional office as a backup. Escalation procedures will be in place to notify Power Technical Support if a site is not functioning within 24 hour time-line.

B. Replacement Parts Stocking

Parts will be available through an extensive network; the various channels and partners to ensure round-the-clock parts availability throughout the country.

Spare parts will be stocked by local field service personnel with backup available from national parts centers and the manufacturing location. A Customer Support Parts Coordinator will be on call 24 hours a day, 7 days a week, and 365 days a year for ensuring immediate parts availability.

C. Maintenance Contracts

A complete offering of preventive and full-service maintenance contracts for both the UPS system and battery system will be available.

UNINTERRUPTIBLE POWER SUPPLIES TECHNICAL DATA:

Parameters	Specification data	Suppliers Data
Rating	5/6/10/16/20KVA	
Mounting Type	Rack / Tower	
Battery Autonomy time	Specify (....min@....kW)	
Remote monitoring	Integrated ports for RJ45 & Modbus, optional SNMP card	
Programmable output outlets	Required	
Input Characteristics		
Nominal Voltage	220/230/240VAC, single-phase, two-wire-plus-ground for 5/6kVA; 380/400/415VAC, three-phase, four-wire-plus-ground for 16/20KVA; Single-Phase or Three-phase supply for 10kVA	
Tolerance on voltage	305-498VAC at full load; 173-498VAC at 50% derated load conditions without battery discharge	
Nominal frequency(60Hz selectable)	50Hz	
Tolerance on frequency	40-70 Hz	
Input Power factor @nominal voltage	Minimum 0.99 at full load & 0.98 at half load ;Minimum 0.95 at full load for 3phase in/1 phase out for 10kVA	
Total harmonic distortion (THDi) @ full load	<5%	
Battery Parameters		
Supports variable number of battery blocks	Yes	
Type of Batteries	SMF	
Battery circuit breaker	Required	
DC bus voltage range	144-240VDC for 5/6/10kVA; 288-488VDC for 16/20kVA	
charging current	10% AH capacity	
Ripple voltage	<5% (RMS Value) Vfloat	
End cell voltage	1.6-1.85V/cell selectable	
Float charge voltage	2.27V/cell	
INVERTER OUTPUT CHARACTERISTICS		
Nominal voltage	220/230/240VAC, single-phase, two-wire-plus-ground for 5/6/10kVA; 380/400/415VAC, three-phase, four-wire-plus-ground for 16/20kVA	
Nominal frequency(60Hz selectable)	50Hz	
Output power factor	Unity	
Nominal Power @ 50 Deg C (kW)	3.5, 4.2, 7, 11.2, 14	
Output Voltage Stability in steady state condition	+/-1%	

Parameters	Specification data	Suppliers Data
Stability in dynamic conditions for 100% load step variations	Complies IEC 62040-3, Class-1 Stds.	
Load crest factor without derating	3:1	
Output voltage distortion with 100% linear load	<2%	
Output voltage distortion with 100% non-linear load as specified by IEC/EN 62040-3	<5%	
Output frequency stability in synchronization with mains	Nominal ± 5%	
Output frequency stability with internal clock	± 0.25%	
Frequency slew rate (Hz/s)	For single UPS – 0.2/0.5/1 selectable; For parallel system – 0.2	
Permitted overload: . For 5 Minutes . For 60 seconds . For >200msec	 105-125% 125-150% >150%	
Characteristics of electronic static changeover switch		
Nominal voltage	220/230/240VAC, single-phase, two-wire-plus-ground for 5/6/10kVA; 380/400/415VAC, three-phase, four-wire-plus-ground for 16/20kVA	
Tolerance on voltage	Upper limit: +10%, +15%, or +20% default: +20%; Lower limit: -10%, -20%, -30% or -40% default: -40%	
Nominal frequency (60 Hz selectable)	50Hz	
Frequency range	+/- 5Hz or +/- 10Hz default: +/- 10Hz	
Permitted overload: . For 10 Minutes . For 60 seconds . For >200msec	 105-125% 125-150% >150%	
UPS characteristics		
Maximum UPS cabinet dimensions WxHxD in mm (rack mounted arrangement) , DxWxH in mm (tower mounted arrangement)	430 X 85 X 450 for 5/6kVA; 430 X85 X 560 for 10kVA; 430 X 130 X 570 for 16/20kVA	
Noise level measured @ 1 meter and @ 100% load according to ISO 3746	55dB for 5/6/10kVA; 58dB for 16/20kVA	
Performance in double conversion mode	Up to 95.5% for 5/6kVA Up to 95.8% for 10kVA Up to 96.2% for 16/20kVA	
Degree of protection	IP 20	
UPS Operating temperature	0-50˚C	

Parameters	Specification data	Suppliers Data
Altitude	<=3000 above sea level	
Color of cubicles	Black ZP7021	