MITSUBISHI ELECTRIC

UNINTERRUPTIBLE POWER SUPPLY

MODEL

9900AEGIS

SINGLE MODULE SYSTEM
SPECIFICATIONS

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SECTION 263353
STATIC UNINTERRUPTIBLE POWER SUPPLY SYSTEM

PART 1 GENERAL

1.1 SUMMARY

This specification describes a three phase continuous duty, online/double conversion, solid-state, uninterruptible power system, hereinafter referred to as the UPS. The UPS shall operate utilizing the existing power distribution system to provide a high quality, reserve source of power to electronic equipment loads. The system shall consist of a converter, system battery, solid-state inverter, and an automatic static bypass transfer circuit.

1.2 STANDARD

The UPS has been designed in accordance and complies with the following standards:

1. UL 1778 (Underwriter Laboratories) Standard for UPS Equipment.
2. CSA 22.2 (Canadian Standards Association – cUL Equipment).
3. IEC (International Electro-Technical Commission) Semiconductor Converter Standards.
4. EMI compatibility: FCC Title 47, Part 15, Subpart B.
5. IEEE 587, ANSI C62.41 1991 Standard for Surge Withstand Ability.
6. ISO 9001 Quality Assurance program.

1.3 SYSTEM DESCRIPTION

1.3.1 Components

The UPS system shall consist of the following major equipment:

A. UPS module
   1. Insulated Gate Bipolar Transistor (IGBT) Converter
   2. Insulated Gate Bipolar Transistor (IGBT) Inverter
   3. Digital Signal Processor (DSP) using Pulse Width Modulation (PWM) for Direct Digital Control (DDC) of all UPS control and monitoring functions
   4. Static bypass switch sized to provide fault clearing
B. Battery system
C. Battery protective and disconnect device
D. MODBUS/TCP Communication
E. ENVIRO – Static Transfer Switch (ESTS) (option)
F. Maintenance bypass cabinet (option)
G. Remote status alarm panel (option)

1.3.2 Mode of Operation

The UPS shall be designed to operate continuously at the rated capacity as an online/double conversion, automatic reverse transfer system in the following modes:

A. Normal - The inverter continuously supplies AC power to the critical load by converting the utility AC power source to a regulated DC power source. The DC power serves as the inverter input and as the battery system’s float charge.

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B. Emergency - In the event of a utility AC power failure, the inverter shall derive its input from the system battery, therefore providing uninterrupted power to the critical load. This transition shall be accomplished without any switching or coupling, and with no interruption of power to the critical load from either a failure or restoration of the utility AC power.

C. Recharge - Subsequent to the restoration of utility AC power, the converter shall automatically reactivate and provide DC power to the inverter while simultaneously recharging the system battery. This occurs automatically and without interruption to the critical load.

D. Bypass - In the event that the UPS must be taken offline due to an overload condition or UPS failure, the critical load shall be transferred to the bypass source via the static switch without interruption of AC power to the critical load. A paralleling, wrap-around contactor shall be used to maintain the bypass source. The static switch shall only be utilized for automatic emergency transfers. A retransfer from bypass to inverter shall be performed automatically in overload conditions. A retransfer shall be inhibited if satisfactory synchronization of the inverter and bypass is not accomplished. The use of the static switch shall not be required during the manual or automatic retransfer process, therefore increasing reliability.

E. ENVIRO Mode (Optional)- The UPS shall be supplied using double conversion technology with an option that allows the user to transfer to a high efficiency (ENVIRO) operating mode. In the ENVIRO mode, the UPS shall supply power to the critical load through the UPS internal bypass. The bypass shall have an integral ENVIRO Static Transfer Switch (ESTS) that provides a smooth transition to inverter operation during emergency mode operation.

1.4 SUBMITTALS

1.4.1 Proposal Submittals

Submittals with the proposal shall include:

A. System configuration with single-line drawings.
B. Functional relationship of equipment, including weights, dimensions, and heat dissipation.
C. Descriptions of equipment to be furnished, including deviations from these specifications.
D. Size and weight of shipping units to be handled by installing contractors.
E. Detailed layout of customer power and control connections.
F. Detailed installation drawings, including all terminal locations

1.4.2 Delivery Submittals

Submittals upon UPS delivery shall include:

A. Shop Drawings.
Submit system configurations with single-line diagrams, detailed layout of power and control connections, dimensional data and detailed installation drawings, including all terminal locations.
B. Product Data.
Provide product data for the UPS and battery, including catalog sheets and technical

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data sheets to indicate electrical performance, UPS type, battery type, detailed equipment outlines, weight, dimensions, control and external wiring requirements, heat rejection and air flow requirements.

C. Owners and technical manual.

D. Test Report.
Submit a copy of factory and field test reports.

1.5 ENVIRONMENTAL CONDITIONS

A. The UPS shall be capable of withstanding any combination of the following external environmental conditions without mechanical damage, electrical failure or degradation of operating characteristics:

1. Operating ambient temperature: +5 degrees C to +35 degrees C (41 degrees F to 95 degrees F) no de-rating required.
2. Recommended operating temperature range: +20 degrees C to +25 degrees C (68 degrees F to 77 degrees F).
3. Non-operating and storage ambient temperature: -20 degrees C to +70 degrees C (-4 degrees. F to 158 degrees F).
4. Operating relative humidity: 5% to 85 %, non-condensing.
5. Recommended operating relative humidity: 30 % to 90%.
6. Operating altitude: will vary with model.
7. There should be no inflammable / explosive gas.
8. Dust in the room where the UPS is installed must not exceed normal atmospheric dust levels. In particular, that dust should not include iron particles, oils or fats, or organic materials.

B. Audible acoustical noise: When operating under full rated load at a distance of one meter from any UPS operator surface, the noise generate by the UPS shall not exceed 70dB, as measured on the A scale of a standard sound level meter at slow response.

C. Input surge withstand capability: The UPS shall be in compliance with IEEE C62.41, Category B.

1.6 WARRANTY

The UPS manufacture shall warrant to the original end user that the Uninterruptible Power Supply System sold by Mitsubishi Electric Power Products, Inc. (the “Product”) shall be free from defects in material and workmanship under normal use and service for a period of twelve (12) months from the date of installation or eighteen (18) months from the date of shipment of the Product, whichever comes first, at the premises of the original end user.

1.7 QUALITY ASSURANCE

1.7.1 Maintainability

MTTR of the UPS shall not exceed 4 hours/failure, including time to replace components.

1.7.2 Factory Test

A. The manufacturer shall fully and completely test the system to assure compliance with the specifications before shipment.

B. All UPS units shall come equipped with one (1) factory test report included in the UPS enclosure. The factory test report shall include the following:

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1. Series / kVA
2. Serial Number
3. Date of test
4. Approved by / Inspected by / Tested by
5. Inspection of construction
6. Checking of wiring (Black/Red marking on each connection point)
7. Grounding Continuity
8. Insulation strength test
9. Control Circuit Operation
10. Measurement of steady state characteristics (Voltage/ current/ efficiencies)
11. Transient characteristics (0-100% step load, AC input failure)
12. Overload Testing
13. Transfer switch operation

PART 2 PRODUCT

2.1 ELECTRIC CHARACTERISTICS

The UPS shall have the following electrical characteristics:

2.1.1 UPS Output Capacity

The 9900 Series UPS Module is available in the following sizes:

kVA	kW
80	72
100	90
150	135
160	144
225	202.5

UPS Module output capacities are in accordance with 0.9 pf lagging.

2.1.2 Battery Capacity

A. Discharge time to end voltage: ___ minutes at full load, 25 degrees C (77 degrees F).

2.1.3 AC Input

A. Nominal input voltage: 480V.
B. Number of phase: 3 phase, 3 wire, plus ground.
C. Voltage range: +15%, -20%.
D. Frequency and range: 60Hz +/-10%.
E. Power walk-in time: 10 seconds (0% to 100% load).
F. Power factor:
    1. 0.99 typical at 100% load.
    2. 0.99 typical at 50% load.
G. Reflected input current total harmonic distortion (THD):
    1. 3% typical at 100% load.
    2. 5% typical at 50% load.

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2.1.4 Bypass Input

A. Nominal input voltage: 480V.
B. Number of phase: 3 phase, 3 wire.
C. Synchronization voltage range: +/-10% of nominal.
D. Frequency tracking range: 60Hz +/-5% maximum.
(Bypass synchronous range shall be selectable from 1% to 5% in 0.1% increment)

2.1.5 AC output

A. Nominal output voltage: 480V.
B. Number of phase: 3 phase, 3 wire, plus ground.
C. Nominal dynamic voltage regulation:
1. +/-1% for balanced load.
2. +/-2% for unbalanced load.
D. Voltage stability: +/-1%
E. Manually adjustable output voltage: +/-5% range.
F. Voltage transient response:
1. 100% step load: +/-2%.
2. Loss or return of AC input: +/-1%.
3. Retransfer from bypass to inverter: +/-5%
(Voltage transient response shall not exceed the above and shall recover to within the nominal voltage regulation tolerance within 20 msec).
G. Frequency (inverter synchronous): 60 Hz (tracks frequency of static bypass source).
H. Free running output frequency (asynchronous): 60 Hz +/-0.01%.
I. Frequency slew rate (inverter synchronized to static bypass): 1Hz to 5Hz/second (selectable).
J. Output voltage harmonic distortion:
1. 2% maximum at 100% linear load.
2. 5% maximum at 100% non-linear load.
(Load power factor range of 0.9 lagging to 1.0 within kW rating of UPS. Crest factor: 2.3)
K. Voltage phase angle displacement:
1. +/-1 degree for 100% balanced load.
2. +/-3 degrees for 100% unbalanced load.
L. Overload capability:
1. 105% to 110% for 1 hour (Voltage regulation maintained).
2. 111% to 125% for 2 minutes (Voltage regulation maintained).
3. 126% to 150% for 1 minute (Voltage regulation maintained).
M. Fault clearing: Typically 1000% for 1 cycle (utilizing bypass source).
N. ENVIRO-mode: Emergency mode (battery backup) transfer time: 4ms

2.1.6 DC input and Battery

1. Voltage: 480V DC nominal, 400V DC minimum.
2. Voltage ripple (normal operation): less than 2% of DC voltage.

A. The Battery System shall be sized to provide the specified backup time to the inverter when the UPS is supplying 100% rated load.
B. The battery system shall be capable of operating in an average ambient temperature of 25°C, with excursions of 16°C to 32°C, and shall be sized as follows:

- Float Voltage: 545V DC (2.25 to 2.27 V/cell)
- Final Voltage: 400V DC (1.67 V/cell)

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2.1.7 Efficiency

- Normal mode:

UPS Module Capacity (kVA)	Battery to AC Efficiency (%)				AC to AC Efficiency (%)			
	25% Load	50% Load	75% Load	100% Load	25% Load	50% Load	75% Load	100% Load
80	96.1	97.0	97.2	97.0	93.4	95.6	96.4	96.6
100	96.1	97.0	97.2	97.0	94.2	96.1	96.5	96.6
150	93.5	95.8	96.5	96.2	94.9	96.3	96.6	96.5
160	94.8	95.2	96.7	96.1	95.1	96.3	96.5	96.4
225	96.5	97.1	96.9	96.7	95.7	96.8	96.9	96.8

- ENVIRO-mode:

UPS Module Capacity (kVA)	AC to AC Efficiency (%)			
	25% Load	50% Load	75% Load	100% Load
80	94.5	97.1	98.0	98.3
100	95.5	97.6	98.2	98.5
150	96.4	97.6	98.3	98.4
160	96.5	97.8	98.3	98.4
225	97.4	98.6	99.0	99.2

2.2 COMPONENTS

UPS module shall be comprised of the following:

2.2.1 Converter Section

AC input, converter input contactor, converter input fuse, input harmonic filter, and converter utilizing:

2.2.1.1 IGBT Converter

A. General

The Converter shall convert the incoming AC power into regulated DC power to supply the inverter input and system battery. The Converter shall utilize the following technologies:

a. Solid state PWM controlled IGBT power transistors switching at 6.0kHz. Switching shall be defined as the IGBT turn on and turn off rate. The doubling of frequency at the inverter output shall not be considered as the true switching frequency.
b. Input Power: Rated kVA at 1:1 ratio.
c. DSP based control logic.

B. Reflected Harmonic Content

The IGBT converter shall typically not introduce more than 3% reflected input current total harmonic distortion (THD) into the utility AC input source at the nominal voltage and rated load. The reflected input current shall typically not exceed 5% THD at 50% load.

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C. Automatic Input Power Walk-In

The converter logic and control circuit power walk-in function enables delayed and timed ramping of the input current. Subsequent to energizing the converter input, initiation of the power walk-in function and current ramping shall be delayed by a maximum of 3600 seconds. Upon initiation of the power walk-in function, the ramping of current shall be timed to gradually increase the load within 10 seconds. This function is included as standard in the converter control circuitry.

D. Input Overcurrent Protection

Converter input contactor, input fuses, and the input current limit control shall provide converter protection against excessive input overload conditions.

E. Step Load Change Operation (0-100%)

In the occurrence of a 100% step load change, the UPS Module inverter shall draw power only from the converter to provide the required load demand. The system batteries will not be cycled at any time during a step load change.

F. Input Current Limit

The Converter logic shall provide input current limiting by limiting the AC input current. Three (3) line-side current transformers shall be employed as a means of sensing the current amplitude. The Converter shall also provide sufficient capacity to provide power to a fully loaded inverter while simultaneously recharging the system battery to 90% of its full capacity within 20 times the discharge time. The AC input current limit values are as follows:

Input current limit setting: 110% of nominal rated current.

The AC input current limit shall be setup so that the converter can provide sufficient capacity to the inverter at the rated load and also have the capability to recharge a discharged battery.

The input current limit protects the converter components from damage due to an excessive input current.

G. Input Power Demand

The converter logic and control shall also be capable of providing auxiliary current limiting when initiated by an external dry contact closure (e.g. in the event power demand is required when the UPS is fed from a generator).

Power Demand: Adjustable, maximum 110% of the nominal rated current.

2.2.1.2 Charger/Booster

A. General

The charger/booster utilizes solid state Pulse Width Modulation (PWM) controlled Insulated Gate Bipolar Transistors (IGBT). The charger switching frequency is 9kHz, and the booster switching frequency 3kHz.

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B. Battery Charge Current Limit

The converter logic and control circuit DC battery current limiting function enables controlled battery charging. The battery charge current limit will control the recharge current by reducing the converter output when the set limit is reached. The following battery current limits shall be provided as a minimum:

1. Battery charge current limit: 10% of battery Ah rate.
2. Maximum charge current: 20% ampere of UPS rated kVA.

C. Equalize Charge Timer

The UPS Module logic and control shall provide an electronic equalize charge timer function (0 to 100 hour selectable - default twenty-four (24) hour). Once activated, the timer circuit shall provide a high-rate equalizing charge voltage to the system battery for the selected time. The function can be manually activated and deactivated via the UPS Module LCD. The level of equalizing voltage shall be equal to that stated by the battery manufacturer (typically .04 to .08 VDC/cell higher than the specified float level). Upon completion of the timer count, the converter output voltage shall return to the specified float voltage (typically 2.25 to 2.27 VDC/cell). An Auto Equalize charge operation is also provided following AC input restoration and subsequent to the power walk-in function. This equalizing charge will occur until the battery target voltage is reached (the equalizing charge ends when this condition is met), at which time the float voltage will be applied.

D. Temperature Control Battery Charging

The UPS shall have, as standard, a battery temperature compensation function. This allows the converter voltage to fold-back to a safe value in the event the battery system temperature reaches a pre-determined (dangerous) level. The initiation will be by dry contact input from a thermocouple sensor (user supplied).

E. DC Input Protection

The DC input circuit shall be protected by a DC circuit breaker. The DC circuit breaker allows complete interruption of DC current, and the isolation of the UPS Module DC input and the battery system.

The DC Circuit breaker shall incorporate UVR and auxiliary contact connections to the UPS Module control to prevent incorrect startup and shutdown sequencing.

The DC Circuit Breaker shall be provided as standard equipment.

F. Ripple voltage

The UPS shall provide for the maximum battery life by limiting the DC (battery) bus RMS ripple voltage to less than 2% of the UPS nominal DC voltage level at 100% load.

G. Battery Self-Test (Diamond-Sense)

For a short duration, a small power discharge from the battery is automatically performed. From this small power discharge, the UPS module evaluates the degradation of the system battery. The following advantages are achieved:

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1. The Diamond-Sense Battery Self-Test function can be performed even when the load is on inverter.
2. Due to the short duration and small power discharge, there is no effect to battery life expectancy.
3. The small power discharge has negligible effect on the overall battery backup time.
4. The small power that is discharged by the battery will be quickly replenished.

The Battery Self-Test will automatically occur at a 720 hour interval. An event alarm will occur and be displayed if battery abnormalities are detected.

2.2.2 Inverter

A. General

The inverter shall generate AC power derived from DC power supplied from the converter or system battery. The inverter shall be capable of providing the rated output as specified while operating from any DC voltage within the battery operating range. The inverter shall utilize the following technology:

1. Solid state PWM controlled IGBT power transistors, switching at 6.0 kHz. Switching shall be defined as IGBT turn on and turn off rate (the apparent doubling of frequency at the inverter output due to simultaneous IGBT device activation shall not be considered as the true switching frequency).
2. UPS Module Full Direct Digital Control (DDC) Adoption:

    a. Field Programmable Gate Array (FPGA) Control.
    b. DSP based Control.

B. Voltage Regulation

The inverter output voltage shall not deviate by more than +/- 1% RMS with the following steady state conditions:

1. 0 to 100% loading.
2. Inverter DC input varies from maximum to minimum.
3. Environmental condition variations within the specifications defined herein.
4. In the ENVIRO mode, voltage regulation is dependent on the utility and not the UPS.

C. Voltage Adjustments

The inverter shall have the ability to manually control and adjust the output voltage to within +/- 5% of the nominal value.

D. Voltage Transient Response

(Normal Mode)
The dynamic regulation and transient response shall not exceed +/- 2% for a 100% step load (applied or removed), +/- 1% for a loss or return of AC input and +/-5% for an inverter to bypass transfer, and vice versa.

E. Transient Recovery

Voltage transient response shall not exceed the above specification, and shall recover to

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within the nominal voltage regulation tolerance within 20 ms.

F. Frequency Control

The Inverter output frequency shall be controlled by an oscillator internal to the UPS module logic. It shall be capable of synchronizing to an external reference (e.g. the bypass source) or operating asynchronously. A message located on the touch screen shall identify the loss of synchronization. Synchronization shall be continuously maintained at 60 Hz +/- 0.01% for the duration of loss of the external reference. The Inverter output frequency shall not vary during steady state or transient operation due to the following conditions:

1. 0 to 100% loading.
2. Inverter DC input varies from maximum to minimum.
3. Environmental condition variations within the specifications defined herein.

G. Output Voltage Harmonic Distortion

The inverter output shall limit the amount of harmonic content to 2% maximum at 100% linear load, and 5% maximum at 100% non-linear load. The need for additional filtering to limit the harmonic content shall not be required. Therefore, high efficiency, reliability and the original equipment footprint are maintained.

H. Output Overload Capability

The inverter output shall be capable of providing an overload current while maintaining the rated output voltage (and voltage regulation) to:

105% to 110% for a 1-hour duration.
111% to 125% for a 2-minute duration.
126% to 150% for a 1-minute duration.

The UPS Module Operation/Display panel LED indication will illuminate to identify an overload condition. If the time limit associated with the overload condition expires, or the overload is in excess of the set current, the load power shall be transferred to the bypass source without interruption.

I. Inverter Current Limit

The inverter output current shall be limited to 230% of the rated load current. Two current transformers in separate locations on the output (which operate separately, offering redundancy) shall be employed as means of current sensing.

The inverter current limit protects inverter components from damage due to excessive over-current conditions (e.g. excessive load, faults and reverse current).

J. Inverter Output Isolate

The inverter output contactor isolates the inverter from the load and bypass source.

2.2.3 UPS Module Control and Monitoring

A. The UPS Module Control and Monitoring operates and controls the converter, inverter and independent automatic bypass static switch circuit.

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B. The UPS Module control circuitry utilizes Digital Signal Processor (DSP) and Application Specified IC (ASIC), which creates advanced controllability and simplifies the control circuit. Direct Digital Control (DDC) utilizing DSP and ASIC ensures high reliability, as well as superior functionality and performance.

C. The UPS Module utilizes unique Major and Minor Feed Forward Current Loop Control, enabling instantaneous control of the UPS Module output. The digitalized UPS Module incorporates Field Programmable Gate Array (FPGA) for Current Minor Loop Control, and DSP based control for Feed Forward Control and Voltage Major Loop Control. DSP Sampling Frequency is 48.0 kHz, therefore the control samples 800 times in 1 cycle of output voltage. Thus, the output voltage can be controlled with high precision.

D. The UPS Module Control power supply employs a redundant design configuration, utilizing the UPS AC input (utility), Bypass input and the UPS Module inverter output, therefore enhancing reliability.

2.2.4 Bypass and Static Switch

The UPS module contains an automatic bypass static switch circuit and associated bypass static switch transfer control circuitry.

A. General

A bypass circuit shall be provided as an alternative source of power other than the inverter. A high-speed Thyristor switch and wrap-around contactor shall be used to assume the critical load during automatic transfers to the bypass circuit. The static switch and wrap-around contactor shall derive power from an upstream bypass feed contactor internal to the UPS module. The wrap-around contactor shall be electrically connected in parallel to the static switch and shall, at the same time as the static switch, be energized and, upon closure, maintain the critical load feed from the bypass source. The static switch shall only be utilized for the time needed to energize the wrap-around contactor, therefore increasing reliability. The bypass circuit shall be capable of supplying the UPS rated load current and also providing fault clearing current capabilities. The UPS system logic shall employ sensing, which shall cause the static switch to energize within 150 microseconds. This provides an uninterrupted transfer to the bypass source when any of the following limitations are exceeded:

1. Inverter output under-voltage or overvoltage.
2. Overloads beyond the capability of the inverter.
3. DC circuit under-voltage or overvoltage.
4. Final voltage of system battery is reached (bypass source present and available).
5. System failure (e.g. logic fail, fuse blown, etc.).

B. Automatic Retransfers

In the event that the critical load must be transferred to the bypass source due to an overload, the UPS system logic shall monitor the overload condition and, upon the overload being cleared, perform an automatic retransfer back to the inverter output. The UPS system logic shall only allow a retransfer to occur three times within a five-minute period. Retransfers shall be inhibited on the fourth transfers due to the likelihood of a reoccurring problem at the UPS load distribution. All retransfers will be inhibited if the inverter and static bypass line are not synchronized.

C. Manual Transfers

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The UPS shall be capable of transferring the critical load to/from the bypass source via the front control panel. If performing manual retransfers to inverter or automatic retransfers, the UPS system logic shall force the inverter output voltage to match the bypass input voltage, and then parallel the inverter and bypass sources. This provides a make-before-break transition, allowing a controlled walk-in of load current to the inverter. Manual transfers will be inhibited if the inverter and static bypass line are not synchronized.

D. Static Switch

The static switch shall be a high speed transfer device comprised of naturally commutated Thyristor's. During manual transfers the static switch is not required. The static switch shall not use fuses for protection.

2.2.5 Operation/Display Panel

The control panel shall employ the use of a touch screen interface, which allows the lock-out of all UPS control functions for security (the Emergency Power Off function shall not be locked out). The operator interface shall provide the following:

1. UPS startup procedure
2. UPS shutdown procedure
3. Emergency Power Off (EPO)
4. Audible alarm silence
5. System status levels

The UPS module shall be provided with a control/indicator panel. The panel shall be on the front of the UPS module. Controls, meters, alarms and indicators for operation of the UPS module shall be on this panel.

2.2.5.1 Graphic Operator Terminal Liquid Crystal Display (LCD):

A. The LCD touch screen interfaces with the UPS Module Control and main processor board to provide menu-driven operator instructions and UPS Module operation details. The LCD indicates system operation, operational guidance, measurement data, setup data and alarm messages and logs. All metering shall be digitally displayed on the LCD with an accuracy of 1% or better.

B. The touch screen area is composed of four MENU sheets: MAIN, MEASUREMENT, OPERATION, and STATUS. Each MENU sheet has a name tab, and the four name tabs form an overlap index at the top of the screen area. Touching the name tab of any of the MENU sheets at this index will make that specific MENU be displayed. Each MENU sheet displays specific information and includes touch icons that perform MENU related functions.

1. MAIN MENU Sheet: The MAIN MENU indicates power flow and measured values. The LCD panel allows the user to verify the status and operation of the UPS Module components by the mimic display. The following information is available on the MEASUREMENT MENU Sheet:
   a. Converter operation
   b. Battery operation
   c. Load on inverter

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d. Load on bypass
e. Typical measurement values of Input, Bypass, Battery and Output
f. Alarm/Fault messages

2. MEASUREMENT MENU Sheet: The MEASUREMENT MENU indicates measured values. The following display information is available on the MEASUREMENT MENU Sheet:

   a. Bypass Voltage and Frequency
   b. Input Voltage and Frequency
   c. Battery Voltage and Charging/Discharging Current
   d. DC link Voltage
   e. Output Voltage, Frequency and Current
   f. Output active power
   g. Output power factor

3. OPERATION MENU Sheet: The OPERATION MENU Sheet prompts the user to select specific performance and UPS setting data (remote or local start & stop operation, date & time adjustment, ENVIRO-mode or MMS operation, etc.).

4. STATUS MENU Sheet: The STATUS MENU Sheet indicates event and alarm/fault information and battery discharge records. A maximum of 50 events can be displayed. The following alarm/status information shall be available as a minimum:

   a. Load on Inverter
   b. Battery Low Voltage
   c. Battery Operation
   d. Output Overload
   e. Converter Operation
   f. Static Bypass Input Out of Range
   g. Minor Fault Data
   h. Major Fault Data

2.2.5.2 LED indication

The Operation/Display Panel contains the following LED indication:

a. Load on Inverter (Green)
b. Battery operation (Orange)
c. Load on Bypass (Orange)
d. Overload (Orange)
e. LCD Fault (Red)
f. UPS Fault (Red)

2.2.5.3 Emergency Power Off (EPO) Button

The UPS shall be provided with a set of terminals, which may connect to a remote EPO contact signal. Remote contact shall be non-powered and normally open. The UPS shall also have a unit-mounted EPO button.

When the UPS Module EPO button is activated, the EPO function shuts down the UPS module. The EPO function can be performed both locally and remotely. When EPO is performed, all system UPS Modules will be shutdown and the critical load is

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dropped.

2.2.6 Microprocessor Interface/Diagnostics

2.2.6.1 Microprocessor Controlled Operator Guidance

The UPS's microprocessor logic shall, as standard equipment, provide menu-driven operator instructions detailing the operation of the UPS system. The instruction menu shall be accessible via an LCD touch screen display located at the control panel. The microprocessor shall monitor each step, thus prompting itself to the next set of instructions. The following instructions shall be available as a minimum:

a. Inverter stop
b. Inverter start
c. Transfer of critical load to static bypass source
d. Equalize charge to system battery

2.2.6.2 Microprocessor Controlled Diagnostics

The UPS shall provide microprocessor-controlled diagnostics capable of retaining fault alarms and metering parameters in the event of a UPS failure. The microprocessor memory data shall be viewed via an LCD display or LED located at the control panel. The following alarm/status information shall be provided as a minimum:

a. Load on Inverter
b. Inverter Operation
c. Battery Operation
d. Battery Low Voltage
e. Output Overload
f. Remote Operation
g. Battery Depleted
h. Battery Temperature Abnormal
i. Converter Operation
j. DC breaker Open
k. Converter Input Out of Range
l. Equalize Charge Activated
m. Inverter Running Asynchronously
n. Load on Bypass
o. Static Bypass Input out of Range
p. Minor Fault
q. Major Fault

2.2.6.3 Integrated UPS Communications Protocols (LookUPS)

The UPS shall have factory-installed integral communications system capable of communicating real-time UPS data to a Building Management Systems (BMS) or other information/analytical systems. These communication protocols shall be user selectable and comprised of MODBUS RTU (RS232/485/422); MODBUS TCP/IP (Ethernet); Simple Network Management Protocol (SNMP) Simple Mail Transfer Protocol (SMTP); and Web Browser.

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2.2.7 UPS Status and Function Interfacing

2.2.7.1 Output Contact

The internal UPS logic shall provide, as standard equipment, a programmable a set of eight (8) normally open, A-type dry contact outputs to allow user interfacing of the UPS operating status. The available parameters are identical to the alarm and status information, which is itemized the following:

a. Total Alarm
b. Minor Fault
c. Alarm
d. AC Input Abnormal
e. Bypass Abnormal
f. Battery Abnormal
g. Battery Low Voltage
h. Battery Depletion
i. Overload
j. Overload Prealarm
k. Fault Group 1
l. Fault Group 2
m. Bypass Synchronous
n. Bypass Asynchronous
o. Remote Operation Enable
p. Load on Inverter
q. Load on Bypass
r. Load on AC
s. Battery Operation
t. Converter Operation
u. Inverter Operation
v. CB1 Close
w. CB2 Close
x. 52S Close
y. Power Demand
z. Equalizing Charge
aa. Another Bus Synch OK

2.2.7.2 RS 232 Communication

External communications are provided using Lookups. Refer to the Lookups technical manual U-ENM00017 for details.
Field installed, and field tested RS 232 additions shall not be accepted.

2.2.7.3 Input Ports

The UPS shall have, as standard equipment, four (4) input ports. The input ports include the following parameters:

a. Remote Start
b. Remote Stop
c. Power Demand 1
d. Power Demand 2
e. Battery Liquid Low

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f. Battery Temperature Abnormal
g. Generator Operation
h. Asynchronous Operation
i. Another Bus Synch
j. Remote Inverter Supply (MMS)
k. Remote Bypass Supply (MMS)
l. Ext Byp dV Str
m. Battery Charger Limit 2
n. Charger Stop
o. External Alarm
p. CB2 Ex
q. Charge Device Error

2.2.8 (Option) Remote Status Alarm Panel

The UPS manufacturer shall offer a Remote Status Alarm Panel, which shall not allow any control over the UPS. The RSAP shall have, as standard equipment, a battery backup feature. This allows it to continue monitoring the UPS status conditions during power outage situations. Ride through shall be for a minimum of 8 hours. The RSAP shall act only as an annunciation panel, providing the following alarms/indications as a minimum:

a. Converter on
b. Load on Inverter
c. Load on Bypass
d. UPS Failure
e. Output Overload
f. UPS in battery backup mode
g. Low battery while in backup mode

2.2.9 (Option) DiamondSync

The UPS manufacture shall offer a Sync circuit, which shall allow any two or more different UPS modules to sync into a master Sync source. The circuit allows both UPS modules to operate into a common output transfer cabinet and allows the load continue to operate without any degradation to the load.

2.3 MECHANICAL DESIGN

2.3.1 Cabinet Structure (Enclosure)

A. The enclosure shall be primed and painted with the Munsell 5Y7/1 (beige) color. The enclosure shall be a free standing floor mount design. The enclosure panels and doors shall consist of minimum 16 gage steel for maximum strength and durability.

B. The UPS shall be installed in cabinets of heavy-duty structure, meeting with NEMA standard for floor mounting. The UPS shall be equipped with standard forklift provisions to allow ease of installation using conventional lifting/moving equipment. The UPS module cabinet shall have hinged and lockable doors on the front only. The operating controls shall be located outside the locked doors. Input, output, and battery cables shall be installed through the bottom or right side of the cabinet.

2.3.2 Serviceability

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The UPS shall have front access for all servicing adjustment and connections for maintenance or service only. Side access or rear access shall not be accepted.

2.3.3 Ventilation

Forced air cooling shall be provided to allow all components to operate within their rated temperature windows. Thermal relay, using a latched contact, which is capable of being reset, shall be used as overload protection for the cooling fan. All air inlets use air filters that shall be removable from the front of the UPS without exposure to any electrical hazards. Air filters shall be door mounted to prevent floor dust from being sucked into the unit. Bottom mount air filters shall not be accepted.

2.3.4 (Option) Eyebolts

Eyebolts shall be installed for lifting the UPS. Four (4) heavy duty eyebolts will be installed on each corner on top of the UPS. The eyebolts are detachable (unscrew manually) once the UPS is set in the installation area.

PART 3 EXECUTION

3.1 SITE PREPARATION

The owner shall prepare the site for the installation of the equipment.

3.2 INSTALLATION

A. The UPS shall be set in place, wired and connected in accordance with the approved installation drawings and owners/technical manual delivered with equipment.

B. The equipment shall be installed in accordance with local codes and the manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

A. The equipment shall be checked out and started by a customer support representative from the equipment manufacturer. Visual and mechanical inspection of electrical installation, initial UPS startup and operational training shall be performed. A signed service report shall be submitted after equipment is operational.

B. The following inspection and test procedures shall be performed by field service personnel during the UPS startup:

1. Visual Inspection
   a. Ensure that shipping members have been removed.
   b. Ensure that interiors are free of foreign materials, tools and dirt.
   c. Check for damage (dents, scratches, frame misalignment, damage to panel devices, etc).
   d. Check doors for proper alignment and operation.
2. Mechanical Inspection
   a. Check all the power wiring connections for tightness.
   b. Check all the control wiring connections for tightness.

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3. Electrical Inspection
   a. Check input and bypass for proper voltage and phase rotation.
   b. Check battery for proper voltage and polarity.

4. Startup
   a. Energize the UPS.
   b. Check the DC output voltage and inverter output voltage.
   c. Check the inverter output voltage on battery operation.
   d. Check for the proper synchronization.
   e. Perform manual transfers and returns.

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