1. Monitoring System Description

This specification defines the minimum requirements for a predictive on-line Universal Battery Diagnostic System with test, analysis, and remote monitoring control capabilities. The system shall be capable of automatically monitoring, displaying, and recording all battery parameters described in this specification. Communications shall be capable of supporting multiple protocols by optional plug in modules. Communication protocols, such as MODBUS, SNMP, SMTP, SMS, HTTP and others will be required. Shall be equipped with USB interfaces for PC use and USB memory sticks for performing data archiving and field firmware upgrades.

1. System Specifications

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| String Capacity | Supports strings with 40-50 12V monoblocs per string. There should not be any limitation to the amount of strings to be monitored. |
| Input Power | 115VAC ±10%, 1 Phase 50 to 60Hz, 3.6 Amps 230VAC ±10%, 1 Phase 50 to 60Hz, 1.8 Amps |
| Operating Temperature Range | 5°C to 40°C  41°F to 104°F |
| Altitude | 0 to 2000 meters above sea level |
| Humidity | 0% to 80% RH (non condensing) at 5°C to 31°C 0% to 50% RH (non condensing) at 32°C to 40°C |
| Environment | Indoor use only |
| Category | Installation Category II |
| Jar voltage: | 12V range 0 to 18V, 0.1% ±12mV  16V range 0 to 24V, 0.1% ±16mV |
| Jar resistance: | 0 to 32,000µΩ, ±5% of reading ±2μΩ |
| String voltage: | 0 to 700.0V, ±0.2% of reading ±0.5V |
| Intertier resistance: | 0 to 5mΩ, ±5% of reading ±5μΩ. |
| Temperature: | 0°C to 80°C (32°F to 176°F), ±1°C. |
| Discharge current: | ±4000A ±1% full scale |
| Float current: | 0 to 5000mA ±50mA. |
|  | Current Sensors - One per battery string. Optional current transducer required.  Temperature Sensors (optional) - Two ambient sensors per string can be defined. |

1. Measurement Capability
   1. Individual jar voltage.
   2. Individual jar DC resistance accomplished by applying a momentary load at user defined intervals.
   3. Individual intertier and disconnect switch resistance measurements performed at user defined intervals. The measurements should not be combined with the internal resistance of the adjacent jars.
   4. Total overall battery voltage per string (Calculated).
   5. Two temperatures per string for temperature trending.
   6. Real time system discharge logging of the overall voltage, individual jar voltage, discharge current, and temperatures.
   7. Float current per string (optional).
   8. Ripple current per string.
   9. Thermal runaway detection (optional).
2. System Hardware and Software Requirements
   1. LEDs indicating alarms, communications, and processor status.
   2. Four communication ports: A USB port for either a local PC connected at all times or for temporary viewing with a notebook computer. A Ethernet port configurable for use on a network using TCP/IP/Modbus, SNMP, SMTP, SMS or HTTP. An RS-485 port for Modbus interface. Viewing of data is to be performed from any one of these ports.
   3. Nonvolatile memory for storage of embedded database for entire history of battery data.
   4. Prefabricated and labeled wiring harnesses with a fast on connection for easy field installation.
   5. Individual resistor terminated leads must have a 10KΩ1W flame proof resistor to limit current for the safety of the technician.
   6. Two voltage-free, form C, alarm contacts for annunciating a common alarm to the alarm reporting system. Each contact can be programmed for either a critical or maintenance event.
   7. Windows® 2000, XP, Windows 7 (32 or 64 bit) or higher compatible software for data analysis, display, archiving, and trending.
   8. One form C contact per string to be triggered in the event of a thermal runaway condition.
3. System Performance
   1. The battery monitoring system shall monitor, display, and record the battery bank voltage, battery discharge current, individual jar voltages, ambient temperature, individual jar resistance, intertier resistances, and thermal runaway conditions. All these parameters shall be continuously monitored in real time during normal operation and during all battery discharges, except for resistance test, which is a user programmable event.
   2. The system shall automatically detect, display, record, and alert all alarm conditions, as they occur. This reporting shall include the following parameters.
      1. Individual jar voltage high and low alarm. Shall support an individual alarm threshold for each jar.
      2. Individual internal resistance high and low alarm. Shall support an individual alarm threshold for each jar.
      3. Intertier resistance high alarm. Shall support an individual alarm threshold for each intertier.
      4. Overall voltage high and low alarm.
      5. Ambient temperature high and low.
      6. Individual jar voltage low alarm during discharge.
      7. Discharge string current high alarm.
      8. Maximum discharge time alarm.
      9. Float current high and low alarm.
      10. String current high alarm.
      11. Thermal Runaway
   3. Each alarm record shall include defined limits, alarming parameter, show the time and date of the event, and the peak value reached during the violation.
   4. Each alarm event shall permit acknowledging.
   5. Each parameter alarm shall be configurable for a latching or nonlatching alarm contact function.
   6. As user defined, the system shall automatically e-mail a report to responsible personnel when any alarm thresholds are exceeded.
   7. The system shall provide and maintain a complete, real-time discharge event log and a dynamic on-line display of battery voltage, individual cell voltages, battery string current, and ambient temperature whenever the battery is in a discharge mode. In addition to the numerical display, the system shall provide a graphical display of the battery voltage and cell voltages versus time that allows playback of the discharge event.
   8. Store historical record of the internal and intertier resistances, voltages of each jar, temperatures, overall voltages, string, float and ripple currents for trending analysis.
4. Software

The software shall operate on the Windows 2000, XP, Windows 7 or 8 (32 or 64 bit) or higher operating systems. Software will allow service technicians to view real time analysis from any accessible network connection.

1. Reports
   1. Alarm condition reporting – tabular, fax or email.
   2. Jar out-of-limits summary report – tabular.
   3. Individual jar voltages over time – graph or tabular.
   4. Individual jar resistance values over time – graph or tabular.
   5. Total battery voltage over time – graph or tabular.
   6. Battery temperature / room temperature over time – graph or tabular.
   7. Discharge report: total battery voltage decay vs. time – graph or tabular.
   8. Discharge report: jar voltage decay vs. time – graph or tabular.
   9. Discharge hit summary report – tabular.
   10. Discharge hit interval summary report – tabular.
   11. General summary report of battery and monitor status of all systems to the battery or string level based on user set thresholds.
   12. Detail summary reports of battery and monitor status of all systems with a line graph trend of any parameter that violated a threshold.
   13. Executive report showing over all system health.
2. Communication I/O
   1. Modbus and SNMP protocols for third party interface.
   2. Local port, USB connector.
   3. LAN port, RJ-45.
   4. Fiber optic for system module interconnect communications. Wireless devices not accepted.