1. INTRODUCTION

1.1. General Product Description and Overview
Industrial/utility class battery charger/power supply, specially hardened for use in harsh industrial environments.

2. AGENCY STANDARDS AND CERTIFICATIONS

2.1. Safety Agency Standards
2.1.1. UL Listed for the United States (UL_{US}) and Canada ($_{C}UL$) to UL 1012 and CSA 22.2 No. 107.2
2.1.2. CE-Marked
2.1.3. NEMA PE-5
2.1.4. NFPA 70

2.2. FCC Standards Emissions
2.2.1. 47-CFR-15 (FCC Part 15) Class A

2.3. Electrical Transient
2.3.1. ANSI/IEEE C62.41, EN 61000-4-12 on power terminals, IEC 61000-6-5 and ANSI/IEEE C37.90

2.4. Vibration and Shock
2.4.1. EN60068-2-6, EN-60068-2-64 and EN-60068-2-27

2.5. PIP Compliance shall be available

3. AC MAINS SUPPLY

3.1. The AC input voltage range shall be 400-480VAC.
3.2. The AC input shall be three phase line to line connected.
3.3. The AC input frequency range shall be 47-63Hz.
3.4. Charger shall operate at 50% power limit from 188-357VAC.
3.5. The AC input voltage tolerance shall be $\pm$10%.

4. EFFICIENCY AND POWER FACTOR

4.1. Charging system efficiency shall be up to 95%.
4.2. The charger shall provide active power factor correction. The power factor shall be 0.98 or greater at maximum rated load current and boost voltage.
4.3. The total harmonic distortion shall be less than 3%.

5. OUTPUT

5.1. Output Voltage and Adjustment Range
5.1.1. For 120VDC nominal output models the adjustment range shall be 8-150V.
5.1.2. For 240VDC nominal output models the adjustment range shall be 16-315V.

5.2. Output Current
5.2.1. The output current of the charging system shall be up to 400A for each 120VDC system and up to 200A for each 240VDC system.
5.2.2. Redundancy options shall be optional for all current levels other than the maximum 400A at 120VDC and 200A at 240VDC.
5.2.3. Dual System configurations shall be available. A Dual System provides two independent, isolated charging systems with distinct AC input breakers, DC output breakers and controls in a single cabinet.
5.2.4. Dual AC configurations shall be available. A Dual AC system allows for two independent, isolated AC inputs to be connected converting power to the DC bus.

5.3. The charger shall support connection in parallel with two or more systems.
5.4. The charger shall support the following battery types:
  5.4.1.1. Flooded Lead Acid
  5.4.1.2. AGM (Absorbed glass mat)
  5.4.1.3. Nicad (nickel-cadmium)
  5.4.1.4. VRLA (valve regulated lead acid)
5.5. Battery Temperature Compensation
  5.5.1. Battery temperature compensation shall be standard using the charger internal ambient sensor. The nominal voltage-temperature (V-T) curve changes output voltage when the temperature of the sensor is between 0°C and +40°C at the rate of – 0.18% per degree C.
  5.5.2. The slope for user-programmed battery settings shall be programmable from 0.00% per degree C to -0.30% per degree C.
  5.5.3. The factory voltage setting shall correspond with +25°C.
  5.5.4. A remote battery temperature sensor shall be optional for placement at the battery location.
5.6. Line and load voltage regulation shall be better than ±0.5% of the set value at 25°C.
5.7. Output Ripple
  5.7.1. The output ripple shall be less than 30mV on-battery, less than 100mV off-battery for 120VDC systems.
  5.7.2. The output ripple shall be less than 30mV on-battery, less than 200mV off-battery for 240VDC systems.
5.8. The step response shall be 8ms typical, to recover within 1% of rated output voltage from load step change of 50% of the rated output current.
5.9. The charging system shall operate in a stable fashion with or without a battery connected.
5.10. The system shall charge a fully discharged battery from zero volts.

6. ENVIRONMENTAL

6.1. The charger shall operate from -40°C to 70°C, full specification from -40°C to 50°C.
6.2. The charger shall be able to be stored in temperatures from -40°C to 80°C.
6.3. The charger shall be capable of cold starts down to -40°C.
6.4. Ingress Protection
  6.4.1. The ingress protection shall be IP 20, NEMA 1 minimum
  6.4.2. Charger shall have internal ingress protection such that no falling foreign objects in ventilation openings can cause electrical safety hazards or equipment damage.
6.5. The charger shall operate in humidity levels ranging from 5% to 95%, non-condensing.
6.6. The charger shall operate at full specification from 0 to 6,500 ft, or 0 to 2000m above sea level. Above this altitude, the output shall be derated 0.012% per additional meter at rated ambient temperature.
6.7. Cooling
  6.7.1. Charger thermal components shall be conduction cooled.
  6.7.2. The cooling method shall keep the high efficiency rectifiers free of dust and dirt, making the charger well-suited for operation in industrial, utility, power plant, and other harsh environments.
  6.7.3. Two variable speed, premium ball-bearing fans shall cool each rectifier.
  6.7.4. Rectifiers shall maintain nearly full output capability even if one fan fails.

6.7.5. A fan failure alarm system with local and remote indication shall enable service dispatch while the second fan continues to run.

6.7.6. The fan module shall be able to be easily replaced in the field with common tools.

7. PROTECTION

7.1. The AC input to the system shall be protected by a UL489 3-pole AC input breaker with a minimum interrupt rating of 10KAIC.

7.2. Charging System Protection

7.2.1. Soft start shall gradually increase current with a maximum of 5 seconds to full-required output.

7.2.2. Reverse Polarity Protection

7.2.2.1. Charging system shall not start into a reverse connected battery.

7.2.2.2. The charging system shall recover automatically after removal of a fault condition.

7.2.3. Charger-battery voltage mismatch shall shut down the charger after 5 minutes. Indication via LED and LCD.

7.2.4. Output Blocking Protection

7.2.4.1. The charger shall prevent sparking during battery connection or during hot-swap.

7.2.4.2. Charger shall have an “ORing” function to isolate a non-functioning charging system from others in a redundant charging system configuration.

7.3. The output of the charging system shall be protected by a UL489 listed 2-pole DC output breaker with a minimum interrupt rating of 10KAIC.

8. OPTIONAL SYSTEM ITEMS

8.1. High interrupt AC breakers shall be available with interrupt ratings up to 65KAIC.

8.2. High interrupt DC breakers shall be available with interrupt ratings up to 100KAIC.

8.3. Supplemental Surge Protection

8.3.1. Supplemental surge protection provides additional surge protection for the system from damage due to lightning, transients, and power surges.

8.3.1.1. The AC protective device shall be UL 1449 Listed, the maximum discharge current shall be 75kA 8/20 µs and the protection level shall be 1500V.

8.3.1.2. The DC protective device shall be UL 1449 Listed, the maximum discharge current shall be 75kA 8/20 µs and the protection level shall be 620V.

8.4. Up to (2) 120VAC, 5A relays shall be optional.

8.5. Up to (4) 150VDC, 3A or 240VAC, 10A relays shall be optional.

8.6. AC Breaker shall be available with shunt trip on certain models. This feature will automatically turn off the AC power to the charger when the AC voltage exceeds 550VAC for greater than 3 seconds. This will prevent any internal damage to the charger should any overvoltage condition occur.

9. USER INTERFACE

9.1. The user interface shall include a backlit LCD displaying plain language text, a multicolor LED panel showing system status, and a user control panel.

9.2. Remote Interface

9.2.1. System status and limited control shall be available via optional Modbus RS-485 and TCP/IP communications

9.2.2. System status and limited control shall be available via optional DNP3 communications.

9.2.3. Connection to the charger shall be available via ethernet connection. A software utility shall be available that provides status, control, and configuration options for remote status and control of the charger.

9.3. System shall be equipped with a 1% accuracy meter for indicating AC input and DC output voltage and 1% accuracy meter for indicating AC input and DC output current.

9.4. Security levels shall be selectable via the User Interface Mode menu using the front panel keypad.

9.4.1. This prevents an unauthorized user from changing settings that would affect charger operation, while still allowing full configurability for the authorized users.

9.4.2. Control software prevents conflicts between operating voltage setpoints, temperature compensation system and alarm setpoints.

9.5. Battery Check

9.5.1. A battery check feature shall be provided.

9.5.2. The user shall be able to initiate a test of the battery system from the charger and remotely.

9.5.3. Battery checks shall be able to be scheduled at regular automatic intervals.

9.5.4. Battery check result shall be displayed via communications and alarms.

10. INDICATIONS AND ALARMS

10.1. Any alarm indication shall cause plain language text to appear on the LCD and change appropriate LEDs. Normal LED indication shall be green. Alarm LEDs shall be red. Warning LEDs shall be amber. Multiple alarms result in the relevant LEDs changing color and multiple alarm message screens on the LCD. Alarm status shall also be available via communication interfaces.

10.2. Nine alarm Form C relays shall be provided: Alarm assignment may be changed with the control software. The following alarms shall be provided, and shall be made assignable to any relay:

10.2.1. AC Line Failure
10.2.2. High DC Voltage
10.2.3. Battery on Discharge
10.2.4. Low DC Voltage
10.2.5. Battery End of Discharge
10.2.6. Module Failure
10.2.7. Over Voltage Shutdown
10.2.8. Reverse Polarity
10.2.9. Incompatible Battery
10.2.10. Invalid Settings
10.2.11. Fan Fail
10.2.12. Thermal Foldback
10.2.13. Temperature Probe Fault
10.2.14. Current Limiting
10.2.15. Ground Fault Positive
10.2.16. Ground Fault Negative
10.2.17. Low Current
10.2.18. Load Share Fail
10.2.19. DC Below Startup Voltage

10.2.20. Battery Check
10.2.21. Check Filter
10.2.22. Thermal Fault
10.2.23. High Battery Temperature
10.2.24. High Battery Temperature Shutdown
10.2.25. AC Phase Missing
10.2.26. AC Voltage Over Maximum
10.2.27. AC Voltage Low
10.2.28. AC Frequency Out of Range
10.2.29. AC Voltage High
10.2.30. AC Surge Protector Fault with optional hardware
10.2.31. DC Surge Protector Fault with optional hardware
10.2.32. AC Breaker OFF with optional hardware
10.2.33. DC Breaker OFF with optional hardware

11. COMMUNICATIONS

11.1. Configuration and Firmware Updates

11.1.1. A Setup Utility shall be available providing a custom configuration and diagnostics software utility that runs on a Windows PC via an ethernet port.

12. MECHANICAL

12.1. Enclosure Material and Finish

12.1.1. Cabinet construction shall be 1/8” 5052 aluminum.

12.1.2. Cabinet finish shall be powder-coated ANSI 61 gray.

12.2. Intended for permanent installation using hard-wired electrical conduit

12.3. Charger enclosure shall accommodate top, bottom, or side cable conductor entry.

12.4. Accommodation shall be provided for routing field conductors in a safe and orderly manner.

12.5. Unit weight shall not exceed 500lbs (227kg).

13. CHANGES TO SPECIFICATION

13.1. In order to meet evolving customer requirements, changes to the product and to this specification may be made without notice from time to time.

END OF SPECIFICATION

