



## Standard Specification

# EPIC Intelligent DC Switchboard

*A switchboard shall be furnished in accordance with the following specification.*

### 1. **Rating:**

1.1. The boards are rated 260V, 125V and 48V DC.

1.1.1. Continuous current duty of 260V, 125V and 48V DC load boards are 400A.

### 2. **Standard Product Offering:**

#### 2.1. **260VDC**

- 2.1.1. 260V EPIC INTELLIGENT DC SWITCHBOARDS Complete with BRUNO DC SYSTEM WATCHDOG and 1 Distribution Panel, 1 side, 16 positions
- 2.1.2. 260V EPIC INTELLIGENT DC SWITCHBOARDS Complete with BRUNO DC SYSTEM WATCHDOG and 1 Distribution Panel, 1 side and 1 distribution panel on the rear side, 32 positions.
- 2.1.3. 260V EPIC INTELLIGENT DC SWITCHBOARDS Complete with BRUNO DC SYSTEM WATCHDOG and 1 Distribution Panel, 1 side and 2 distribution panels on the rear side, 48 positions.
- 2.1.4. 260V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 1 Distribution Panels, 1 side, 16 positions
- 2.1.5. 260V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 2 Distribution Panels, 1 side, 32 positions
- 2.1.6. 260V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 3 Distribution Panels, 2 sides, 48 positions
- 2.1.7. 260V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 4 Distribution Panels, 2 sides, 64 positions

#### 2.2. **130VDC:**

- 2.2.1. 130V EPIC INTELLIGENT DC SWITCHBOARDS Complete with BRUNO DC SYSTEM WATCHDOG and 1 Distribution Panel, 1 side, 16 positions
- 2.2.2. 130V EPIC INTELLIGENT DC SWITCHBOARDS Complete with BRUNO DC SYSTEM WATCHDOG and 1 Distribution Panel, 1 side and 1 distribution panel on the rear side, 32 positions.
- 2.2.3. 130V EPIC INTELLIGENT DC SWITCHBOARDS Complete with BRUNO DC SYSTEM WATCHDOG and 1 Distribution Panel, 1 side and 2 distribution panels on the rear side, 48 positions.
- 2.2.4. 130V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 1 Distribution Panels, 1 side, 16 positions
- 2.2.5. 130V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 2 Distribution Panels, 1 side, 32 positions
- 2.2.6. 130V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 3 Distribution Panels, 2 sides, 48 positions



- 2.2.7. 130V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 4 Distribution Panels, 2 sides, 64 positions

### 2.3. 48VDC:

- 2.3.1. 48VDC
  - 2.3.2. 48V EPIC INTELLIGENT DC SWITCHBOARDS Complete with BRUNO DC SYSTEM WATCHDOG and 1 Distribution Panel, 1 side, 16 positions
  - 2.3.3. 48V EPIC INTELLIGENT DC SWITCHBOARDS Complete with BRUNO DC SYSTEM WATCHDOG and 1 Distribution Panel, 1 side and 1 distribution panel on the rear side, 32 positions.
  - 2.3.4. 48V EPIC INTELLIGENT DC SWITCHBOARDS Complete with BRUNO DC SYSTEM WATCHDOG and 1 Distribution Panel, 1 side and 2 distribution panels on the rear side, 48 positions.
  - 2.3.5. 48V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 1 Distribution Panels, 1 side, 16 positions
  - 2.3.6. 48V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 2 Distribution Panels, 1 side, 32 positions
  - 2.3.7. 48V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 3 Distribution Panels, 2 sides, 48 positions
  - 2.3.8. 48V EPIC INTELLIGENT DC SWITCHBOARDS Complete with 4 Distribution Panels, 2 sides, 64 positions
- 2.4. All EPIC INTELLIGENT DC SWITCHBOARDS will each have the following characteristics:
- 2.4.1. Each Distribution Panel will have at least 16 positions, each 2 pole
  - 2.4.2. Branch breakers will be DC rated for at least 10KAIC
  - 2.4.3. A group of 3 copper buses will be located in the base of each Distribution Panel so as to provide access to the main DC input bus with one for + and another for -, plus a third for ground connections.
  - 2.4.4. Main Lugs only.

### 3. System supervision shall be included as part of these EPIC INTELLIGENT DC SWITCHBOARDS as described below:

- 3.1. The DC System supervisory system featuring the BRUNO DC SYSTEM WATCHDOG shall can monitor the entire DC system and providing a central connection for the battery, battery charger and facility loads.
- 3.2. Monitors: battery voltage, battery current, DC system bus voltage, charger current, float current, battery temperature, ambient temperature, system ground fault imbalance and facility demand. By sequentially opening the battery and battery charger switches (SW1 and SW2) the monitor can intelligently isolate the ground fault location within the DC system. Using an internal load, the BRUNO DC SYSTEM WATCHDOG may perform a continuity test on the battery and with an appropriate optional load bank to be used to perform a battery discharge capacity test. Other optional inspections and measurements such as cell electrolyte levels and visual rack and battery inspections may be logged using the monitor's HMI to document and aid in maintenance processes.



- 3.3. The monitor records, time stamps and trends all monitored information per operator specified intervals. Data is viewable on the HMI (Human-Machine Interface) screen as a summary graph or by a CSV file in excel format on a PC. The monitor records the data to a USB flash drive and allows for download of the data to a standard USB drive for analysis or display on a personal computer without the use of proprietary software.
- 3.4. Any monitored data or test result that falls outside customer defined parameters triggers an alarm which is accessible via remote communication protocols or supplied form C contacts.

#### **4. Applicable Codes:**

- 4.1. The monitor portion must meet the requirements of the latest versions of the following industry and agency standards:
  - 4.1.1. IEEE 946 DC System Design
  - 4.1.2. Applicable Safety Standards: UL61010-1/ ANSI61010-1/ CSA C22.2 no 61010-1-12
  - 4.1.3. NERC PRC 005, Table 1-4
  - 4.1.4. FCC Part 15 Subpart J Class A
  - 4.1.5. Seismic requirements: IBC2015, CBC2013, IEEE 693

#### **5. Standard Features:**

- 5.1. Standard Monitor Operating Voltages include: 48, 130, and 260Vdc.
- 5.2. Designed to work with most stationary battery types with Ampere-hour capacities of 50 through 500.
- 5.3. A DC battery disconnect switch (SW1) and a DC charger disconnect switch (SW2) is included to allow isolation of the battery or battery charger from the DC system. These switches will have a 20KAIC rating. Circuit breakers and/or fuses with specific ratings may be provided as an option and may require a separate enclosure depending on size and rating.
- 5.4. The BRUNO DC SYSTEM WATCHDOG monitor provides appropriately sized terminals and is designed to function as a central hub for all DC system component connections (battery, battery charger, DC system loads, etc.).
- 5.5. EPIC INTELLIGENT DC SWITCHBOARD with the BRUNO DC SYSTEM WATCHDOG meets the monitoring requirements for NERC PRC-005 Table 1-4 parts a thru c for the following measurements:
  - 5.5.1. Float current measurement and trending
  - 5.5.2. Float voltage measurement and trending
  - 5.5.3. IEEE 450/1106 Performance capacity discharge testing and data storage (with optional and separate constant resistance load box)
  - 5.5.4. Ground Fault Monitoring
  - 5.5.5. (Optional) Intelligent ground fault analysis of the DC system
  - 5.5.6. Verify battery continuity
  - 5.5.7. (Optional) Measure electrolyte levels in all cells
- 5.6. Operating environment shall be 0 – 50°C, storage at -40 to 70°C, relative humidity 5 – 95% non-condensing, no de-rating in elevation to 3300 meters above sea level.



## 6. Operation:

- 6.1. The BRUNO DC SYSTEM WATCHDOG monitor shall be programmable “controlled” or “operated” via the HMI touch screen. The touch screen that is designed around a Homepage and its simple associated functional pages, as follows:
- 6.2. Homepage: The Homepage will indicate the overall DC system health status and present alarm status.
- 6.3. Dashboard Page: displays overall DC system health status as well as any active alarms. It will also show basic system parameters such as: Battery voltage, Battery current, Charger current, Battery and Ambient temperature. Feature buttons are also displayed on this page. These buttons provide access to individual pages for trended data or functional tests such as battery continuity or battery capacity tests.
- 6.4. Alarm Page: displays the status of any “active” alarms as well as a historical log of “recent” alarm events. Date and time stamp of the alarm and which alarm conditions are reported. All Alarm conditions are displayed with a time and date stamp. Historical data is stored back to time of installation of the BRUNO DC SYSTEM WATCHDOG and can be downloaded for review.
- 6.5. Reports Page: reports files for each logged, recorded or trended parameter can be generated automatically in PDF format. and the raw data can be downloaded in a CSV file in excel format for custom reporting. The raw data is stored in a CSV file which can be imported into an Excel spreadsheet for creating custom reports. Both the standard PDF Report files and raw data CSV files are available for download.
- 6.6. Settings Page: all parameter settings are input entered or modified on the Settings page. The Settings Page will provide links to individual pages for specific settings such as:
  - 6.6.1. General settings
  - 6.6.2. Time and Date
  - 6.6.3. Temperature display in degrees °C or °F
  - 6.6.4. Alarm contacts settings
  - 6.6.5. Latching or self-clearing
  - 6.6.6. Delay time
  - 6.6.7. Alarm set points
  - 6.6.8. Alarm set points
  - 6.6.9. Alert common alarm
  - 6.6.10. Alarm relay assignment
- 6.7. Battery type
  - 6.7.1. Manufacturer data
  - 6.7.2. Manufacturer
  - 6.7.3. Model
  - 6.7.4. Type (VLA, VRLA, NiCad, etc.)
  - 6.7.5. Ah rating
  - 6.7.6. System voltage
  - 6.7.7. Battery set points
  - 6.7.8. Number of cells
  - 6.7.9. Specific gravity



- 6.7.10. High float voltage
  - 6.7.11. Low float voltage
  - 6.7.12. Discharge data
  - 6.8. Communications settings:
    - 6.8.1. Serial MODBUS RTU port settings
    - 6.8.2. Ethernet MODBUS RTU port settings
    - 6.8.3. Network settings
  - 6.9. Data Logging settings:
    - 6.9.1. Logging on/off for each parameter
    - 6.9.2. Set trigger parameters for facility demand (active load profile)
    - 6.9.3. Set logging rate for each parameter
  - 6.10. Input alarm settings
    - 6.10.1. Set custom alarm name
    - 6.10.2. Set contact type (NO or NC)
    - 6.10.3. Alarm relay assignment
    - 6.10.4. Alert common alarm
  - 6.11. Schedule of NERC PRC-005 maintenance requirements
    - 6.11.1. Scheduled intervals and next test activity required
  - 6.12. Support Page: contact information is provided for Sales and Service.
  - 6.13. HindleHealth Page: This page provides access to two (2) pages. One for testing and inspection input and a Setup Wizard to assist in making changes to parameters during initial setup.
  - 6.14. The testing button provides access to additional pages for input manual entry of inter-cell connection resistance, electrolyte levels of individual cells and visual inspection records of racks and batteries.
  - 6.15. The Startup Wizard button, guides the user thru through the set up of key parameters:
    - 6.15.1. Maintenance schedule requirements
    - 6.15.2. System alarm settings
    - 6.15.3. Battery setup
    - 6.15.4. Third party alarm settings
  - 6.16. The HindleHealth System operates in the background. If all operating conditions are within customer pre-set specifications the health system display on the Homepage will be green and to indicate all is operating well. If any alarm condition is raised occurs the display will turn red and to indicate that there is an active alarm condition. Opening the alarm page will indicate the type of alarm and the location of the trouble.
- 7. Features and Functions:**
- 7.1. Features and functions are accessed by on the Dashboard Page., which The Dashboard Page provides detailed trending data for various parameters and can be used to initiate specific test functions.
  - 7.2. Features: The following features are accessed via the Dashboard Page. These parameters feature continually collect and trend data for visual review, report and data download and analysis.
    - 7.2.1. Float voltage trending
    - 7.2.2. Ground fault detection



- 7.2.3. Float current trending
- 7.2.4. Temperature trending:
- 7.2.5. Individual trending of ambient temperature, battery temperature and the difference between these two values (battery temperature rise above ambient).
- 7.2.6. Facility demand (active load profile) data logging
- 7.2.7. This function, when activated, logs any activity that puts creates a demand on the facilities DC system.
- 7.2.8. Logging is automatically activated during any outage incident at the site that affects the DC system and continues logging until the end of the incident or the site is restored to normal operation. Facility demand logging is initiated under the following minimum conditions:
  - 7.2.8.1. Any discharge of the battery
  - 7.2.8.2. Loss of charger output
  - 7.2.8.3. The duration of sampling and sampling rates to be used during the incident logging can are determined by configuration settings accessed on be adjusted in the Settings Page.

7.3. Functions: The following functions are available from the Dashboard Page. These controls can be used to schedule a test, start or stop a test and set up optional test or alarm functions. The following standard tests are available.

- 7.3.1. Battery continuity testing and verification
- 7.3.2. This test will be performed by loading the battery with connecting the battery to a separate load located inside the unit. Size of the load resistors will vary based on the battery size. With the charger removed from the battery, the battery will pick up the load for a 3- minute period. If the battery voltage remains above a pre-set alarm limit it will demonstrate functionality and continuity.

7.4. Battery capacity testing and data analysis

7.5. With an optional external test load an IEEE 450/1106 capacity test can be performed on the battery. The discharge is displayed in real time and the data can be downloaded as is stored in a CSV file in excel format for analysis. The discharge data can be downloaded as a PDF Report File or as a CSV file and imported into Excel for analysis. The BRUNO DC SYSTEM WATCHDOG will store and trend any new multiple capacity test results.

## **8. Alarms, Communications and Data Collection Scheduling:**

- 8.1. All individual alarm contacts are programmable for alarm set points. All adjustments are made thru by changing configuration parameters available on the Settings Page.
- 8.2. Standard, 3 assignable form C alarm contacts for all alarm functions, contact. Contact rating 120VAC/VDC @ 0.50A. Each contact is assignable for any of the alarms available or as a group or common alarm.
- 8.3. Optional high current rated programmable Form C alarm contacts. Contact rating 120VAC/VDC @ 5.0A., Each contact is assignable for any of the alarms available or as a group or common alarm.

**8.4. Available Standard Alarms:**

- 8.4.1. DC System high voltage alarm
- 8.4.2. DC System low voltage alarm
- 8.4.3. DC System ground fault alarm
- 8.4.4. Battery high float current alarm
- 8.4.5. Battery high temperature alarm
- 8.4.6. Battery low temperature alarm
- 8.4.7. High battery temperature above ambient alarm
- 8.4.8. Loss of battery continuity alarm
- 8.4.9. Four (4) assignable auxiliary equipment input alarms (inputs assignable for aux. relays)

**9. Communication modes:**

- 9.1. MODBUS/DNP3 communications for all functions and alarms.
- 9.2. Ethernet Communications of all functions and alarms.
- 9.3. Direct PC connection via a local network for remote viewing and control via secure USB port.

**10. Test and data Collection Scheduler:**

- 10.1. Adjust settings for sampling rates and times for all parameters and tests:
- 10.2. Float current measurements
- 10.3. battery continuity test
- 10.4. routine pdf reports

**11. Optional Test and alarm functions:**

- 11.1. Load bank for capacity test
- 11.2. Hydrogen level detector
- 11.3. Intelligent ground fault by circuit

**12. Protective Devices:**

- 12.1. Standard disconnect switches are used for the DC battery disconnect and battery charger disconnect. DC circuit breakers with specific trip ratings may be provided as options if required.
- 12.2. Contactor K1 is rated for the system loads and during normal operation is Normally Closed (NC). The primary function of SCR-1 and SCR-2 are to maintain connection of the system if K1 should fail. During a battery discharge test, continuity test and float current measurement K1 is open. During these times, the battery charger is feeding suppling the system loads. If during these tests, the facility loses AC power, or the battery charger fails, the BRUNO DC SYSTEM WATCHDOG reacts to insure the battery remains connected to the facility load. If K1 should fail open, for any reason, SCR-2 will connect the battery charger to the battery and SCR-1 will connect the battery to the facility load. This assures the battery is always connected to the load and the battery charger is always connected to charge the battery.





- 12.3. When K1 is open for float current measurement there is a diode or resettable fuse in line with the float current measurement shunt as protection against battery discharge current damaging the shunt.
- 12.4. The protection fuse for the float current shunt is designed to protect the shunt from high battery discharge currents.

### 13. Touch Screen (HMI, Human-Machine Interface):

- 13.1. All HMI interaction is provided through a rugged “true glass” capacitive touch HMI with High resolution graphics, with a modern vector 10.1” display, and 1280 x 800-pixel resolution.
- 13.2. The HMI includes a built in control PLC controller incorporating using the stable **CODESYS** platform (an acronym for **controller development system**, previously stylized **CoDeSys**) a development environment for programming controller applications.
- 13.3. Security passcodes may be set to access the HMI or this can be administratively overridden to allow open access. The Settings Page may be set to be accessed only configured to only permit access via an administrative password if required. A passcode may also be set to be required for performing a be configured and required to perform a battery capacity test.
- 13.4. Standard menu is provided for operation, alarms and settings of the DC System Monitor 1000 as indicated in Section 4.
- 13.5. Graphical display and review of current and past results.
- 13.6. Event logging of alarm conditions
- 13.7. All network and communication settings are configured thru the HMI display.
- 13.8. Data downloads to USB flash drive.

### 14. Data Recording Event Log and Trending Data Graphical Reports

- 14.1. Depending on the user defined recording interval the system can record all data and events in one file. Once the data buffer of the file is full and if there is sufficient memory available in the flash drive, the DC System Monitor 1000 will start a new file to ensure continuous recording.
- 14.2. There are maximum available recorded data points of 1,200,000. One recorded data point equals approximately 4kb of information.
- 14.3. Based on the following default data recording values, the data storage per file is indicated below:
  - 14.3.1. Baseline parameters will have a default measurement rate of one hour resulting in a total of 350,400 data points recorded over a period of 10 years in a single file:
  - 14.3.2. Float voltage; 87,600 data points
  - 14.3.3. Ambient temperature; 87,600 data points
  - 14.3.4. Battery temperature; 87,600 data points
  - 14.3.5. Ground fault (impedance values); 87,600 data points

15. **Facility demand (active load profile)** will record an event once more than 1A has been discharged from the battery. The default sample rate for the data recorded for the parameters





during an event will be 1.0 second. There will be a total of 800,000 data points available to record over a total of 48 hours in a single file. The available data points per parameter will be broken down as follows:

- 15.1. System voltage; 200,000 data points
- 15.2. Charger amperage; 200,000 data points
- 15.3. Battery amperage; 200,000 data points
- 15.4. Battery temperature; 200,000 data points

16. **Float current** will be recorded at a default rate of a maximum of once a day resulting in a total of 21,900 data points available to record over a period of 15 years in a single file. Available data points per parameter will be broken down as follows:

- 16.1. Float current; 5,475 data points
- 16.2. Battery temperature; 5,475 data points
- 16.3. Battery voltage; 5,475 data points

17. **During the capacity test** the parameters will be recorded at a default rate of once every minute resulting in a total of 27,700 data points available over a total of 230 hours in a single file. Available data points per parameter will be broken down as follows:

- 17.1. Battery voltage; 13,850 data points
- 17.2. Battery amperage; 13850 data points
- 17.3. Temperature will be recorded at the beginning of the capacity test.
- 17.4. System shall be certifiable so as to prove reliability of the data received and stored.

18. **Requirements for the Submittals and Instruction Manuals (shall include):**

- 18.1. Equipment Description
- 18.2. Bill of Material
- 18.3. One-line diagrams
- 18.4. Elementary diagrams
- 18.5. Connection diagrams
- 18.6. All production tests performed on the equipment in the factory shall be submitted as part of the submittals.
- 18.7. Technical specifications of all auxiliary equipment/devices installed as part of this purchase shall be included in the equipment Instruction Manual and all shall comply with CE-ES-4008-13.
- 18.8. The manufacturer shall submit complete equipment Instruction and/or Operation Manual sets for review and formal written acceptance. The review will be completed within three weeks by responding with the approval/comments.
- 18.9. Following written approval by the Company representative, the manufacturer shall submit the final documentation.
- 18.10. The final instruction manual shall be delivered not later than one month after the equipment delivery.

**19. Color:**



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- 19.1. The finish will be baked powder epoxy method and shall be ANSI 61 gray. Custom colors are available by special request.

## **20. Documentation**

- 20.1. Each system will be supplied with the following documentation in print and via Pdf format;
  - 20.1.1. System outline
  - 20.1.2. System one line
  - 20.1.3. Installation and wiring diagram
  - 20.1.4. User Manual