Cordex® HP Controller
Software Manual

Read this document carefully.
Learn how to protect your equipment from damage and fully understand its functions.

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1. Safety

Save these instructions: This document contains important safety instructions that must be followed during the installation, servicing, and maintenance of the product. Keep it in a safe place. If there are any questions regarding the safe installation or operation of this product, contact Alpha Technologies Ltd. or the nearest Alpha® power system representative.

Safety wording and symbols

To reduce the risk of injury or death, and to ensure the continued safe operation of this product, the following symbols have been placed throughout this document. Where these symbols appear, use extra care and attention.

> *Attention: The use of attention indicates specific regulatory or code requirements that may affect the placement of equipment or installation procedures. Follow the prescribed procedures to avoid equipment damage or service interruption.*

> *Notice: A notice provides additional information to help complete a specific task or procedure or general information about the product.*

> *CAUTION: Cautions indicate the potential for injury to personnel.*

> *Warning: Risk of serious injury or death. Equipment in operation poses a potential electrical hazard which could result in serious injury or death to personnel. This hazard may continue even when power is disconnected.*

> *CAUTION: Risk of burns. A device in operation can reach temperature levels which could cause burns.*

General warnings and cautions

> *Warning: You must read and understand the following warnings before installing the system and its components. Failure to do so could result in personal injury or death.*

> *Warning: This system is designed to be installed in a restricted access location that is inaccessible to the general public.*
>
> *Ce système est conçu pour être installé dans un endroit à accès restreint inaccessible au grand public.*

⚠️ **Warning:** *This equipment is not suitable for use in locations where children are likely to be present.*

Cet équipement ne convient pas pour une utilisation dans des lieux ou des enfants sont susceptibles d'être présents.

- Read and follow all instructions included in this document.

- Only trained personnel are qualified to install or replace this equipment and its components.

- Use proper lifting techniques whenever handling equipment, parts, or batteries.

Electrical safety

⚠️ **Warning:** *Hazardous voltages are present at the input of power systems. The DC output from some UPS devices and batteries can have high voltage and high short-circuit current capacity that may cause severe burns and electrical arcing.*

⚠️ **Warning:** *Lethal voltages are present within the system. Always assume that an electrical connection or conductor is energized. Check the circuit with a voltmeter with respect to the grounded portion of the enclosure (both AC and DC) before performing any installation or removal procedure.*

Before working with any live battery or power system, follow these precautions:

- Remove all metallic jewelry, such as watches, rings, metal rimmed glasses, or necklaces.

- Wear safety glasses with side shields at all times during the installation.

- Use approved insulated hand tools. Do not rest tools on top of batteries.

- Do not work alone under hazardous conditions.

- A licensed electrician is required to install permanently wired equipment. Input voltages can range up to 240VAC. Ensure that the utility power is disconnected and locked out before performing any installation or removal procedure.

- Ensure that no liquids or wet clothes come into contact with internal components.

- Hazardous electrically live parts inside this unit are energized from the batteries even when the AC input power is disconnected.

- Always assume electrical connections or conductors are live. Turn off all circuit breakers and double-check with a voltmeter before performing installation or maintenance.

- Place a warning label on the utility panel to warn emergency personnel that a reserve battery source is present which will power the loads in a power outage condition or if the AC disconnect breaker is turned off.

- At high ambient temperature conditions, the internal temperature can be hot so use caution when touching the equipment.

Battery safety

Warning: *Follow battery manufacturer's safety recommendations when working around battery systems. Do not smoke or introduce an open flame when batteries (especially vented batteries) are charging. When charging, batteries vent hydrogen gas, which can explode.*

Notice: *Read the material safety data sheet (MSDS) for any batteries used in the system before installation. The MSDS provides important information including hazard identification, first aid measures, handling and storage, and personal protective equipment (PPE).*

- Never transport an enclosure with batteries installed. Batteries must only be installed after the enclosure has been securely set in place at its permanent installation location. Transporting the unit with batteries installed may cause a short circuit, fire, explosion, or damage to the battery pack, enclosure, and installed equipment.

- Servicing and connection of batteries must be performed by, or under the direct supervision of, personnel knowledgeable of batteries and the required safety precautions.

- Batteries contain or emit chemicals known to cause cancer and birth defects or other reproductive harm. Battery post terminals and related accessories contain lead and lead compounds. Wash your hands after handling batteries.

- Batteries are hazardous to the environment and should be disposed at a recycling facility. Consult the battery manufacturer for recommended local authorized recyclers.

2. Software version history

The release history for recent software versions are found in the following sections.

📢 **Notice:** *Downgrading the Cordex® HP system controller or Alpha® FXM HP uninterruptible power supply (UPS) module to earlier versions of the operating system is not advisable, and can cause unpredictable results, including failure to boot.*

2.1. Software version 8.30

Released: December 2024

Contains the following significant changes:

- Added support for EnVision™ energy router 1RU remote controllable distribution panel with smart switch modules.
- Added support for the Alpha® DPX distributed transport system:
  - DPX 5kW 380VDC rectifier module
  - DPX 2kW fault managed power distribution module with EnShield™ technology
  - DPX ground fault monitoring device
- Added support for multiple DC systems. This requires modules that support multi-system compatability. Currently only DPX 5kW 380VDC rectifier modules are supported.
- Reduced performance burden caused by SNMP, alarm processing, and calculations.
- Changed power flow for better support for large numbers of batteries.
- Changed automatic voltage regulation (AVR) lower limit to support the same change in the Alpha® FXM HP uninterruptible power supply (UPS) module.
- Transport Layer Security (TLS) version 1.2 support for email

2.2. Software version 8.21

Released: February 2024

Contains the following significant changes:

- Added a **System Use Notification** feature that can show the user a message before signing in to the system controller.
- Added a feature to support user configurable sign in password strength options.
- Added a feature to support Remote Authentication Dial-In User Service (RADIUS) intended for Intelligent Distribution Products (IDP) including:
  - Alpha® Matrix 300™ series power distribution system
  - Alpha® Matrix C16™ distribution breaker panel
  - Alpha® HDN™ DC distribution center
  - Alpha® PowerBay+™ BDFB distribution bay

- ◦ Alpha® GMT 125 Series™ fuse panel
- ◦ Alpha® v30/30™ distribution panel
- Added a feature to perform a discharge on Polarium® batteries.

> 📢 **Notice:** *Future versions have deprecated dedicated support for Polarium® in favor of generic lithium-ion battery support fom battery models of different vendors, including Polarium®.*

- Added a feature to reset a forgotten password on a system controller that has been pre-configured.
- Added a feature to allow the system controller to send SNMP traps continuously while an alarm is active.
- Added more fields to better describe system properties.
- Changed **Environment Manager** to cycle air conditioner units more evenly.
- Fixed a problem with the web server that could allow for overloading of the system controller CPU that could result in slow responsiveness to browsing the website or serving SNMP requests.
- Fixed a problem with Cordex® HP 3kW hyperboost modules shelf layout.
- Fixed a problem with data rollup for a Polarium® battery system.

> 📢 **Notice:** *Future versions have deprecated dedicated support for Polarium® in favor of generic lithium-ion battery support fom battery models of different vendors, including Polarium®.*

2.3. Software version 8.10

Released: July 2023

Contains the following significant changes:

- Added support for **Environment Manager System**.
- Added a **Battery String Age Estimation** feature to the DC system.
- Added **System Identification** under the **Factory Information** menu.

- The DC system's **Battery on Discharge** alarm logic now additionally activates under the condition of a slowly discharging battery.
- Added a **Custom Data Numeric Capture** variable.
- Simple Network Management Protocol (SNMP) performance improvements.
- Fixed SNMP data type inconsistencies and updated the associated Management Information Base (MIB) as necessary.
- Support for Transport Layer Security (TLS) versions 1.0 and 1.1 security protocols with HTTPS have been deprecated with support ending on June 30, 2023.

2.4. Software version 8.00

Released: January 2023

Contains the following significant changes:

- New user interface look and feel. Improved navigation scheme.

- Added Syslog messaging support (UDP only) for up to 10 destinations.

- Added support for Cordex® CXPS-HSS hyperboost converter system and modules.

- Added support for the Matrix C16™ high density connectorized DC distribution breaker panel.

- Updated Load Shunt Pair comma separated values (CSV) for better readability and configuration input.

- In miller column selection, moved **No Source** configuration field to be right after unknown. Previously, it was situated under the **Controller** menu.

- Changed module locate functionality to continue to flash the module LEDs for up to five minutes (approximately).

- Fixed an issue for Modbus limited dataset where the battery mode was not properly updated.

- Updated drag and drop functionality for manually configured shelf layout systems.

- Added Alpha® FXM HP uninterruptible power supply (UPS) module battery temperature to performance logs.

- Removed **Module Assignment Rule** for systems from the web user interface. The assignment rule is now set to always automatic on new system creation.

- Fixed Alpha® AMPS HP2 inverter system Phase 2 Output Watts calculation.

2.5. Software version 7.40

Released: September 2022

Contains the following significant changes:

- Added a **Maintenance Mode** feature, which inhibits alarm summary relays during maintenance.

- Added a **Custom Data Result as Text** feature, which displays custom data equation results as text, in addition to the already existing result as Numeric and Result as Boolean.

- Added LCD panel dashboard text size and alignment options in the user interface preferences.

- Added an additional authentication attribute for RADIUS authentication.

- Added preliminary Polarium® battery support for the DC system. Initial support monitors the batteries only.

> 📢 *Notice: Future versions have deprecated dedicated support for Polarium® in favor of generic lithium-ion battery support fom battery models of different vendors, including Polarium®.*

◦ Feature compatibility is not guaranteed in future software releases.

◦ Power Flow is not available for the Polarium® battery.

◦ The Cordex® HP protocol bridge peripheral for use with Polarium® batteries will send meaningless values when no battery modules are connected.

2.6. Software version 7.30

Released: July 2022

Contains the following significant changes:

- Improved support for nickel-cadmium batteries.
- Changed the maximum value of the Alpha® FXM HP uninterruptible power supply (UPS) module **Keep Alive Startup Delay** to 3600 seconds.
- Added an option to turn the Alpha® FXM HP UPS module on automatically after programmed **AC Output Shutdown**.
- Added the ability to shutdown the Alpha® FXM HP UPS module AC output voltage via SNMP in the UPS module MIB.
- Changed the way invalid values are indicated in SNMP.
- Fixed a problem with the reporting of **upsEstimatedMinRemaining** value in the UPS module MIB.
- Added missing **ControllerInfo** fields in the resource MIB.
- The **Battery Current Source** field, for a battery system, has had available mapping options reduced. Any load related options and the **Total Output Current** field are no longer available for mapping.

- On upgrade to software version 7.30 from any prior version of system controller software, if a DC system battery string had mapped its **Battery Current Source** to **Total Output Current** then it will be set to "---" on upgrade. Manual intervention is required to update the source to either a battery shunt or a calculation. This fixes a potential problem with unintended battery discharge due to incorrect battery current configuration.

- A suffix has been added to the name exported config files to distinguish between clone, system, ADIO module, and partial.
- **Total Output Current** field for a DC system has been renamed to **Total Rectifier O/P Curren**t.
- On a **Change Relay** action, the **Relay To Change** entry no longer requires an exclusive relay; the chosen relay can now be shared with other alarms.

2.7. Software version 7.20

Released: January 2022

Contains the following significant changes:

- Improved **Export Partial** to allow partial configuration from multiple systems to be exported into one single file.
- Detached SNMPv3 credentials from the admin credentials to allow a unique username and password for SNMPv3.
- Added IPv6 support to Email, Network Time Server, Remote Authentication, Modbus, and Data Sharing.
- Fixed an issue when using an in-shelf system controller (for example, Cordex® CXCM1 HP system controller), where the backup, restore, and software upgrade features via a plugged in USB drive would not succeed.

2.8. Software version 7.10

Released: August 2021

Contains the following significant changes:

- Improved line powering system commissioning with added configuration import.
- New off-grid generator system control.
- Improved event log for threshold alarm entries, showing value when alarm activated.
- Deprecated redundant DC system fields. These deprecated fields can be found in the battery string instead. See the version 7.10 software release notes for more information.

2.9. Software version 7.01

Released: March 2021

Contains the following significant changes:

- Added heating and cooling states for FlexAir® thermal controller module.
- Added support for FlexAir® thermal controller module relay states.
- Added support for Alpha® external maintenance bypass switch (XMBS) hardware revision 2.

2.10. Software version 7.00

Released: December 2020

Contains the following significant changes:

- Support for thermal system.
- Support for battery disconnect with latching contactor.
- Added a feature to export system controller backups from the web interface.
- Improved voltage regulation to reduce small voltage fluctuations on some systems.

2.11. Software version 6.30

Released: August 2020

Contains the following significant changes:

- Added a feature to disable and enable USB ports.
- Added a feature to create custom dashboard views.
- Added a feature to group sets of custom data, timers, counters, and custom actions.
- Improved detection and notification of possible network configuration problems.
- Fixed an issue with voltage regulation and loadsharing that was noticeable on systems with large numbers of rectifier modules.

2.12. Software version 6.20

Released: February 2020

Contains the following significant changes:

- Added support for ending a battery test based on State of Charge.
- Added support for upgrading the operating system via a web browser.
- Added support for setting some system controller configuration from SNMP.
- Added **Configuration Hints** to help identify system states (such as Temperature Compensation) and potential configuration issues (such as missing or incorrectly configured settings).
- Added Power Flow for line power systems. Added the ability to show power flow between a DC system and Alpha® AMPS HP2 inverter systems when those systems are on different system controllers.
- Added configuration restore points to better manage storing and restoring configuration files.
- Added basic support for AC and DC generator system control.
- Added AC current to performance log for Alpha® AMPS HP2 inverter systems.
- Added support for starting timers manually.
- Added support for the Alpha® external maintenance bypass switch (XMBS).
- Added support for system controller redundancy.

2.13. Software version 6.10

Released: October 2019

Contains the following significant changes:

- Added a feature to automatically back up configuration to USB drive on a schedule.
- Added a feature to manually set the bay, shelf, and slot ID of CAN devices that do not automatically provide this information.
- Improved the way time data is displayed and entered as configuration.

- Added basic support for a generic AC input source to allow for mapping rectifier modules to different AC inputs.
- Added a disconnect that can be used for load shedding.
- Added a feature to allow an analog-digital input output (ADIO) module relay to be used to indicate when the ADIO module loses CAN communication. This functionality requires a firmware upgrade on any supported ADIO module.
- Added shunt and transducer to allowable Alpha® FXM HP uninterruptible power supply (UPS) module inventory.
- Added power **Outage Logs Section** under **Working with Logs**.

2.14. Software version 6.00

Released: July 2019

Contains the following significant changes:

- Support for distribution systems in **Power Flow**.
- Added a **Test Alarm** button for each alarm.
- Improved filtering and searching on the web interface.
- Improved **Add Load/Shunt Pairs** wizard and **Map Shunts to ADIO Inputs** wizard to allow naming and manual mapping.
- Support for French language.
- Improved battery configuration based on battery model number.
- Added multiple scrollable screens on the LCD panel dashboard.
- Added an SNMP table to view active module alerts.
- Support for Alpha® FXM HP uninterruptible power supply (UPS) modules.
- Added a system shortcut page to the LCD panel. Accessed with button press on the LCD panel dashboard.
- Support for the Cordex® CT-IPM current transducer interface and power module peripheral.
- Added ability to reset the IP address from the organic light emitting diode (OLED) display panel on in-shelf system controllers.
- Added ability to set up a datalog to capture a sample on a change in value.
- Added a new user role for Restricted Operator. Restricted Operator does not have permission to add or remove items from systems.
- Added more rectifier module information to the rectifier module details screen.
- Added option to include Alpha® T2S inverter controller module configuration and event log to diagnostic export.

2.15. Software version 5.20

Released: March 2019

Contains the following significant changes:

- Added support for Terminal Access Controller Access-Control System Plus (TACACS+) remote authentication.
- Added support for multiple battery strings.
- Added a generic external DC source to properly account for other sources of current on the DC bus, like photovoltaic panels.
- Added support for **Power Flow** display of Alpha® AMPS HP2 inverter systems.
- Added support for Alpha® AMPS HP2 inverter system data over Modbus TCP/IP.
- Improved display of data for loads, shunts, rectifier modules, converter modules in the LCD panel **Inventory Summary** page.
- Improved performance of SNMP.
- Added a feature called **Data Sharing** to share a limited amount of data between system controllers.

2.16. Software version 5.10

Released: November 2018

Contains the following significant changes:

- Added a feature to download inventory to a USB drive or to the PC. This includes most configuration and status values that are displayed on the user interface.
- Add a feature to disable write access through the web browser unless overridden by a local user on the LCD panel.
- Added a new battery conditioning mode for **Boost**.
- Added user configurable termination conditions to **Equalize** and **Elevated Absorption** modes.
- Added a new type of inventory called **General Purpose Transducer**, similar to a current transducer. This inventory can be created in a DC system, converter system and auxiliary system.
- Modified the limitation of 10 distribution systems (Alpha® smart BDFB distribution system, Alpha® smart E2 distribution panel, user defined) to allow more Alpha® smart E2 distribution panel. Up to 40 Alpha® smart E2 distribution panel subsystems can be supported if there are no other Alpha® smart BDFB distribution system or user defined distribution systems created.
- Fixed an issue with the SNMP trap destination port always being set to 162, even if configured as something else.

2.17. Software version 5.01

Released: August 2018

Contains the following significant changes:

- Full Modbus transmission control protocol (TCP) support for the DC system, system controller, custom data, timers, counters, and user alarms.
- Added a wizard to help configure multiple shunts and associated loads in the DC system.

- Fixed an issue with setting the **True If** value for custom data state variable when the variable was a boolean.
- Added a user configurable startup delay for alarm processing to avoid nuisance alarms and traps.
- Fixed an issue with the bus voltage fault status of a disconnect when the Invalid System Voltage alarm was disabled.
- Limit response to SNMP GetRequests to five per second to avoid excessive CPU usage.
- Added additional statistics for total output current performance log of the DC system to keep track of top three hourly average maximums.
- Fixed an issue with display of temperature in Fahrenheit on the Datalogs.

2.18. Software version 5.00

Released: May 2018

To upgrade to this version from version 4.20 and previous, it is necessary to first install version 4.90.

Contains the following significant changes:

- Power Flow view for the DC system to visually show system status and important information.
- Support for HTTPS secure web server protocol.
- Support for Remote Authentication Dial-In User Service (RADIUS) remote authentication protocol.
- Allow user customizable alarm names and the ability to hide default name/ID strings.
- Added ability to set the thresholds used to decide when a battery is charging or discharging for better support of systems with light loads and large batteries.
- Added dropdown navigation links to the menu bar.

2.19. Operating system version 6.30

Released: July 2020

Contains the following significant changes:

- Further improvements to flash disk error handling.
- Corrected flash timing parameters for improved reliability and faster boot times.

2.20. Operating system version 6.20

Released: February 2020

Contains the following significant changes:

- Drastic reduction in the likelihood of random boot failures
- Proper detection and handling of bad flash sectors to improve reliability and longevity of flash

2.21. Operating system version 6.00

Released: July 2019

Contains the following significant change: Improved longevity and operation of non-volatile memory.

2.22. Operating system version 5.20

Released: March 2019

Contains the following significant change: Changed random-access memory (RAM) timings for better compatibility with different RAM chips.

2.23. Operating system version 4.70

Released: February 2019

Contains the following significant changes:

- Improved flash programming reliability
- Added feature to allow software to start a flash refresh for flash used by the operating system
- Support for virtual local area network (VLAN)
- Fix for clock overflow

2.24. Operating system version 2.20

Released: August 2015

Contains the following significant change: Support in-shelf system controllers.

3. Introduction

The purpose of this document is to provide simple and complete information on how to use Cordex® high performance (HP) system controller and software. It contains an overview of the software features, on-site setup, and operation of the system controller, as well as information on creating, configuring and maintaining your system using the system controller.

3.1. Using the system controller software manual

3.1.1. Purpose and audience

The audience of this document are technicians and or facility operators tasked with installing, programming and commissioning, maintaining or troubleshooting the power system. When using the system controller there are a variety of ways to perform most tasks. This document covers using the built-in display, as well as the web interface.

3.1.2. Knowledge and permissions

We assume you have a good working knowledge of, and access to, the following:

- Ethernet cables and TCP/IP settings needed to connect your computer to the system controller

- Current version of Microsoft Edge, Google Chrome, Mozilla Firefox, or Apple Safari

- Power system that the system controller is controlling

- System controller login passwords and the appropriate level of permissions.

3.2. Product overview

This section provides an introduction to the system controller, the system controller software, as well as a brief overview of what the system controller does, how it works, and an image of a typical network configuration. The Cordex® CXC HP system controller (2RU model) has the following features:

- **Front touchscreen:** Full color touchscreen liquid crystal display (LCD) panel to access controls and menu items by using fingertip touch or a stylus.

- **Home button:** Provides the ability to go directly back to the home screen from any menu.

- **Front panel reset:** For emergency use only to restart the system controller if the unit touchscreen or home button are not responding.

- **Front panel LEDs:** For alarms, progress, and status indication.

- **Audio speaker:** Built-in audio speaker tones during active alarms and can be disabled if required.

- **Ethernet:** Dual 10/100BASE-T Ethernet ports for connection on both the front and rear of the system controller for remote or local communication.

- **USB:** Dual ports on both the front and rear of the system controller for upgrades or file management via a standard USB drive.

- **CAN:** Dual independent controller area network (CAN) bus ports for communication with the Cordex®, DPX, and Alpha® AMPS family of products.

- **Real-time clock with field replaceable lithium battery:** Allows timestamps on alarms and events.

- **System fail alarm/relay:** Activates when there is a major internal failure. During such a condition the unit attempts to reset.

Figure 3-1   Cordex® CXC HP system controller (2RU model)

3.2.1. What does the system controller do?

The Cordex® HP system controller family provides centralized setup, control, and monitoring of power systems. This can range from simple monitoring and threshold alarms for temperature, voltage and current, to advanced battery charging and diagnostic features.

The system controller provides Ethernet ports allowing for network, LCD panel, and local laptop access to the controller including both web and SNMP interfaces.

The system controller supports CAN ports to allow up to 254 power and ADIO modules to be controlled and monitored. The system controller uses external analog-digital input output (ADIO) modules to monitor electrical signals (such as temperature, voltage, and temperature) and generate electrical signals through relays.

The most commonly used ADIO module is the Cordex® HP L-ADIO smart peripheral for low voltage systems which includes:

- Eight digital inputs

- Four voltage sensors

- Four temperature sensors

• Four current sensors

• 12 Form C relay outputs

See the *Cordex® HP system controller reference guide* for a full list of power and ADIO modules that are supported by the system controller.

3.2.2. Watchdog alarm

The System Fail Relay activates (de-energized) when there is a major internal failure if the system controller is not running properly. The unit would attempt to reset.

The relay is energized when the system controller software starts up. The relay remains energized during normal operation. If the system controller loses power, or reboots, the relay is de-energized, which can be used to indicate an alarm condition.

When the hardware watchdog timer is not updated by the system controller software for more than 30 seconds, the system controller is determined to be not running normally. After 30 seconds, the relay will be de-energized, and the unit would reset.

3.2.3. Typical system configuration

The system controller is a scalable software platform that allows multiple systems to be created and managed by one system controller. The user interface is organized around system inventory so you only see the systems that you have created and you can manage them independently. Both the web interface and the LCD panel provide a summary of all systems monitored by the system controller as well as system controller and alarm information.

The following figure shows a specific DC power system with the following elements:

- Cordex® HP system controller and ADIO modules with CAN bus connections

- One or more rectifier modules

- A battery string

- A shunt to measure battery current

- A battery low voltage disconnect (LVD) in series with the battery string

Figure 3-2 Typical DC system configuration

3.2.4. How to get help

The system controller has a **Help** icon on the web interface and the LCD panel dashboard, but not on the in-shelf display panel (Cordex® HP in-shelf system controllers have a small OLED display panel). The Help menus provide a description of the product feature, its function and the typical default values. Each of the LCD panel menus has a descriptive Help statement. For example:

From the LCD panel dashboard select **Alarms > Settings > Alarm Cut-Off and Global Alarm Settings** and the screen provides information about the default cut off time.

The **Help** icon displays on a screen such as, **Controller > Settings > Site Information > Description > Name**.

Figure 3-3 Accessing help on the LCD panel interface

Accessing help on the web interface:

Select any of the items on the dashboard area and the **Help** field displays. The help menus provide a description of the item, and in most cases a default value for the field.

Figure 3-4 Accessing help on the web interface

The software manual can uploaded to the system controller for quick access. Follow the steps in the **Uploading the Software Manual** section.

Once uploaded, access the software manual via the web interface by selecting **Accounts** icon on the right of the top bar.

Figure 3-5 Accounts and shortcuts

4. Getting started

This section explains how to navigate the menus and basic connection, monitoring, and control functions using the LCD panel, the in-shelf display, and the web interface of the system controller.

4.1. Apply power

The system controller and most ADIO modules are designed to run on battery or DC bus power for 12, 24, and 48 volt systems. A Cordex$^{®}$ HP redundant input power module (RIPM) (PN: 0180045-001) is available to simplify the connection of power from above and below a battery LVD to both the system controller and ADIO modules.

1. Apply power to the system controller (for example, close battery breaker or rectifier module input and output breakers).
2. The LEDs start cycling, and then after a few seconds the Cordex$^{®}$ HP logo displays.
3. Wait for approximately about 30 seconds. The LEDs will turn off and the system controller software will load.
4. Once the software is loaded, the green LED turns on (it may turn to yellow or red depending on the system controller alarm state).

The front panel display shows the dashboard.

4.2. Connect to the system controller

There are three options for connecting to the system controller web server from a web browser running on your computer:

- Through a local area network (LAN)

- Direct connection with IP auto-configuration

- Direct connection with static IP address

> *Notice: If the **Require Login for Sensitive Information** setting is enabled, a sign in will be required to view the IP settings on the LCD panel.*

Factory default passwords

Obtain the user account information and passwords from the system administrator. The default values are:

- Default User Name: `admin`

- Default Password: `admin`

📢 **Notice:** *When using the in-shelf display, you can view, but not edit the IP settings.*

Connection through a LAN

1. Use the LCD panel to verify that the Ethernet port is configured to acquire an IP address automatically. IP **Address Mode** can be found in the **Configuration** table at **Shortcuts > Ethernet > Ethernet/Rear**.

   📢 **Notice:** *Enable DHCP at* **Controller > Communication > Ethernet**. *Go to the desired Ethernet port and select the* **Change Network Configuration Wizard** *button in the* **Configuration** *table.*

2. Plug an Ethernet cable in to the rear Ethernet port and to your LAN. The computer that you want to connect the system controller to must also be on this same LAN.

3. Use the LCD panel to determine the IP address automatically assigned to the system controller. You can use either the IPv4 or IPv6 addresses. IP address information can be found at **Shortcuts > Ethernet > Ethernet/Rear**.

4. Enter this IP address into the address bar of your web browser and select enter. The web interface **Login** screen displays.

Direct connection with IPv4 auto-configuration

1. If available, use the LCD panel to verify that the rear Ethernet port is configured to acquire an IP address automatically. IP **Address Mode** can be found in the **Configuration** table at: **Shortcuts > Ethernet > Ethernet/Rear**.

   📢 **Notice:** *Enable DHCP at* **Controller > Communication > Ethernet**. *Go to the desired Ethernet port and select the* **Change Network Configuration Wizard** *button in the* **Configuration** *table.*

2. Connect an Ethernet cable to the rear port of the system controller and your computer. Your computer must be configured to obtain an IP address automatically.

3. Use the LCD panel to determine the IP address that has been automatically configured. The IP address should use the dotted-decimal format: 169.254.XXX.YYY.

4. Enter this IP address into the address bar of your web browser and select enter. The **Login** webpage displays.

Direct connection with an IPv6 link-local address

1. Connect an Ethernet cable to the front or rear port of the system controller and your computer. Your computer must also be configured to allow IPv6 addresses to be used.

2. Use the LCD panel to determine the IPv6 address that has been automatically configured. The IP address should use the colon-hexadecimal format: fe80::wwww:xxxx:yyyy:zzzz

3. Enter this IPv6 address into the address bar of your web browser and select enter. The web **Login** screen displays.

Direct connection with default static IPv4 address

Contact your IT department if you are unsure of how to do this.

1. Connect an Ethernet cable to the front port of the system controller and to your computer. Your computer must be configured with a static IP address (for example, 10.10.10.202) and subnet (for example, 255.255.255.0).

2. Use the LCD panel to verify that the IP address for the front port is similar to your computer's IP address (for example, 10.10.10.201).

3. Enter the system controller's IP address (for example, http://10.10.10.201) into the address bar of your web browser and select enter. The **Login** webpage displays.

4.2.1. In-shelf system controller

Some systems may have an in-shelf system controller display. They do not require a sign in. The display enables you to execute a set of commands much like the LCD panel on the 2RU system controller.

From the dashboard, use the **Select** button to enter a menu. When you enter a menu, the top item is highlighted. To go to another menu scroll through using the **Forward** and **Back** buttons. To execute a highlighted menu item, select the **Select** button.

To set a default system or disable USB maintenance actions go to **Controller > Settings > User Interface > In-Shelf Controller Display Preferences** table from the web interface.

4.3. Navigating the system controller user interface

Both the web interface and the LCD panel dashboard provide a summary of system, system controller and alarm information. When you sign in to the web interface or the LCD panel, the dashboard provides an at-a-glance view of the overall systems.

4.3.1. Sign in to the system controller

You can sign in to the system controller via the web interface or LCD panel.

If the IP address has not been configured, see the previous section, *Connect to the system controller*.

1. Enter the default IP address into the web address bar on the computer.
2. Sign in to the web interface:

    a. Enter the default user name: *admin* (or the user name supplied by your administrator).

    b. Enter the default password: *admin* (or the password supplied by your administrator).

> 📢 ***Notice:*** *Once signed in, the session expires after 3 hours, or after 60 minutes with no activity.*

Sign in to the LCD panel:

3. From the main dashboard of the LCD panel, select **Login**.
    a. Enter the default user name: *admin*.
    b. Enter the default password: *admin*.
4. Select the check mark to complete the sign in process.

The main dashboard displays.

4.3.2. System controller menu

The top level system controller menu bar contains eight items: **Dashboard**, **Power Flow**, **Controller**, **Systems**, **Modules**, **Alarms**, **Logs**, and **Shelf Layout**. Similar menu items are available under the **Menu** button on the LCD panel, with the exception of **Dashboard**, **Power Flow**, and **Shelf Layout**. In most cases, these top-level menu items are further subdivided into sub menus. If you select the top-level item, you will see a display of all sub menus under that item, and can then select any level of the menu to jump to that page directly. If there are no sub menus under the menu, you will navigate to that page of the controller immediately by selecting the top-level menu. Menus with sub menus can be identified by the small down-arrow icon beside the menu name.

The following is an overview of the menu structure under the top-level item **Controller**, which is displayed when you select **Controller** on the main menu.

Figure 4-1 Menu structure

4.3.3. Overview of the LCD panel

The LCD panel is a touch-sensitive color panel on the front of the system controller. The display is always on when the system controller is first powered up but after 20 minutes of inactivity the user will be logged out and the display will be turned off. Touching the home button or the LCD panel in any spot reactivates the LCD panel screen.

It is possible to change the inactivity time-out of the LCD panel in the **Controller > Settings > User Interface** menu, in the **LCD Preferences** table. The time-out can be set to 20 minutes, 1 hour, 4 hours, or 8 hours. However, to prevent the LCD panel from prematurely aging, it is strongly recommended to leave this setting at 20 minutes, unless temporarily changing it for commissioning or demonstrations purposes.

The LCD panel is most responsive to touch when firm, substantial pressure is applied. The LCD panel does not usually respond to light, quick taps. A stylus may be used if desired.

The default screen that displays on the system controller when it is powered up and running normally, is called the dashboard. See the following figure.

Figure 4-2 system controller LCD panel dashboard

The upper-left area of the dashboard is the **Alarm** tile. If there are active alarms the LCD panel will show the top three active alarms.

If there are no alarms in the system, the Alarm tile displays **No Alarms** and the display will be green in color. If there are active alarms the color will match the state of the highest priority alarm as follows:

- Green for no alarms present

- Yellow or orange for minor alarms

- Red for major and critical alarms

Selecting the **Alarm** tile takes you to the **Active Alarms** menu to see a list of active alarms, active alerts and hints. From the **Active Alarm** view, you can also activate the alarm cut-off (ALCO) as well as press the individual alarms, alerts, and hints to get detailed information on each.

> *Notice: Alarms, alerts, and hints have specific definitions:*
>
> - *Alarm: Has user configuration and can send email or SNMP notifications.*
> - *Alert: Status from modules like rectifier modules or converter modules.*
> - *Hint: Information about system activity or possible configuration problems; can be dismissed.*

The upper-right area of the dashboard is the **System Status** tile. It displays battery voltage, total load current and the Battery Mode of a DC power system. Selecting the **System Status** tile takes you to the shortcuts pages for that system, if it exists, or the status page for that system.

For support of system controllers that manage multiple power systems, there is a configuration option which allows the dashboard to shrink the alarm tile to show an extra **System Status** tile.

Below the **Alarm** and **System Status** data tiles there are five buttons providing access to the rest of the system controller's functionality.

Maintenance: Provides easy access to frequently-needed maintenance tasks including the alarm cut-off. Selecting the **Maintenance** button takes you to the Maintenance screen. The first page contains general shortcuts, like **Alarm Cut-Off**, **Forget All in Comms Lost** and **Replace ADIO**. Each system defined is also listed on the main page. Selecting the system button provides access to a page of system-related maintenance shortcuts.

Figure 4-3 Maintenance page

Figure 4-4 System maintenance page

Information: Provides contact information for technical support, as well as general information about the system controller such as the serial number, software version, and operating system version.

Menu: Provides access to the system controller menu, which follows almost the same menu structure as the web interface, with some exceptions. Some examples of menus not available on the LCD panel are:

- **Power Flow**

- **Shelf Layout**

Shortcuts: Provides quick access to several key functions that are used often, such as the **Ethernet** settings. The **Shortcuts** menu also provides access to functions only supported via the LCD panel such as:

- USB file browser

- Backup

- Restore

- Display calibration

4.3.3.1. LCD panel menu button

This section provides an overview of all the LCD panel menus on the system controller. The LCD panel has a menu structure that mirrors the web interface. Select the **Menu** button on the LCD panel dashboard to navigate and select menu items. The menu items are as follows:

- Controller

- System

- Modules

- Alarms

- Logs

When a menu item is selected, it is highlighted in blue, and an **arrow** displays on the right side of the screen. Select the arrow to navigate to the next page.

Figure 4-5 LCD panel menus page

For example, select **Menu > Controller > About > General** to view detailed information about the system controller.

Figure 4-6 Controller status page

When selected, some views display a **pencil** or **hand** icon on the right side of the screen which means you can edit settings or perform actions.

For example, from the **Controller > Settings > Time and Date** screen select the **pencil** icon to set the following:

- Current time and date

- Time zone

- Daylight saving time method

- Network time server address

Figure 4-7 Time and date page

To edit the time zone, you can choose from the list of supported time zones.

Figure 4-8 Time zone page

If **Network Time Server Address** is selected, a text field, and on screen keyboard displays.

Figure 4-9 Network time server page

Selecting the **back arrow** cancels an edit, selecting the **check mark** accepts the changes. Selecting the **Help** icon displays a help screen with more information about the item. If the edit is unsuccessful an error displays in red text below the text box. You can either try again, or select the back arrow to abandon the change.

Another screen that displays when selecting items, is the **Execute** screen. For example, **Synchronize Time**. Most edits and executable actions (except **ALCO** and **Restart**) require you to sign in. If you select an editable item or executable action before logging in, the system controller responds providing an opportunity to log in and then continue with the action.

When you select the **back arrow** the action is canceled. If you select **Execute**, the command is executed, and the system controller provides feedback on whether the action was successful.

Figure 4-10 Synchronize time

4.3.3.2. LCD panel shortcuts button

The LCD panel **Shortcuts** menus provide quick access to often-used areas of the system controller menu, as well as additional functionality not available via the standard menus.

Figure 4-11 Shortcuts

Functions available through the **Shortcuts** menu are as follows:

Ethernet: Provides access to the **Controller > Communication > Ethernet** page, and displays information for each Ethernet port. Viewing and editing the Ethernet configuration is one of the most often-used features from the LCD panel. Selecting an Ethernet port from the list allows you to view and edit the detailed information for that port.

Figure 4-12 Ethernet page

Inventory summary: Provides access to a special **Inventory Summary** page, which allows for a quick check of what devices are available. The top-level inventory page shows counts of each device type. Selecting the icon associated with that device displays a list of that type of device. Selecting an individual device from the list displays that particular device's details.

Figure 4-13 Inventory summary page

Dashboard config: Provides a shortcut to the **LCD Preferences** page which provides the opportunity to switch the dashboard configuration between **Automatic** and **Manual** and also to change the LCD panel default between a single-panel view, dual-panel view, or a wide-data panel display. The dual-panel view has a single top alarm, and provides two system status data panels, which allows data points for two different systems (for example, DC and converter) to be shown in the case of a multisystem configuration. The wide data panel view allows you to display six signals from a single system.

In **Automatic** mode, the dashboard shows a single panel view if there is one system, and a dual panel view if there are two systems.

In **Manual** mode a user can select the option to have the LCD panel main dashboard display only a single system, even if there are two installed.

Figure 4-14 Dashboard with multisystem panels

Figure 4-15 Dashboard using wide data panel view

To access the wide data layout, go to **Controller > Shortcuts > Dashboard Config > LCD Dashboard Option > Wide Data Panel**. If there is more than one system on the system controller. Switching to **Wide Data Panel** from **Automatic** is a two-step process. Once **Wide Data Panel** is chosen, a specific system must be selected so that the data values display for that specific system.

Language: Provides access to the **Controller > Settings > User Interface > LCD Preferences > LCD Language** setting, where the language for the LCD panel can be changed to any of the available translations. Switch the language by selecting the desired language from the list then select the check mark. The system controller supports three languages: English (Imperial), English (Metric), and French.

Browse USB: Provides access to an LCD panel only function, which allows you to view the files on any USB drive that may be attached to the system controller. If a file is selected from this view, the LCD panel goes to the available action screen for that file – for example, the LCD panel displays an upgrade screen if an application file is chosen from the USB.

📢 *Notice: When using a USB drive with the system controller, use a version 3.0 (or later) USB drive for best reliability. Once inserted, it can take up to 20 seconds for the system controller to recognize a USB drive.*

Export diagnostic information: Provides an option to export a diagnostic information package containing important logs and a system controller clone to a USB drive. This information is needed for any support requests. For more information on how to download, refer to the **Exporting Diagnostic Information** section of this document.

Figure 4-16 Export diagnostic information

Backup: Selecting this button, allows you to do a back-up of the system. It backs up the application, as well as the config file. These backups are saved on a USB drive.

Notice: For the backup to work properly, only one USB drive should be attached at backup time. If a file named Cordex HP.Backup already exists in the root directory of the USB drive, it is overwritten with the current backup.

Figure 4-17 Backup

Restore: Provides an opportunity to insert a USB drive and restore a previously saved backup file.

Clock: Provides a direct link to the **Time and Date** screen.

Speaker: Provides the ability to enable or disable the speaker.

Display: Provides the ability to re-calibrate the touchscreen.

*Notice: When recalibrating the touchscreen display, the final screen of the wizard will say: **Select the Enter key to accept the new settings. Select the ESC key to keep the old settings.** Select the touchscreen anywhere to accept the new settings. If using a keyboard, you have the option to select the **ESC** key to keep the old settings.*

Reset: Provides a direct link to reset the system controller.

4.3.4. Overview of the web interface

The dashboard is the default view displayed when you sign in to the system controller via the web interface. It provides an up-to-date overview of most critical information of your system. It displays system controller information, a system summary table, and the list of any active alarms.

The upper-left tile of the screen provides a color-coded live status view of these alarm notifications. The upper-right tile provides a system status bar with detailed information about the systems.

If there are active alarms, the **Alarm Notification** tile displays the last active alarm according to alarm priority:

- Red for major or critical alarms

- Amber for minor alarms

- Blue for warnings

Selecting the Alarm tile takes you directly to the **Active Alarms** menu.

If there are no active alarms, a **No Alarms** message will be shown. In some situations, the system controller will provide hints as to certain behaviors of systems, or misconfigurations. If there are no alarms, one hint may be displayed below the **No Alarms** message. Hints are explained in more detail in later sections.

The upper-right tile displays **System Status Bars** which contains summary information for the systems. Selecting the system link at the top of the **System Status Bars** takes you directly to the **Systems** status page.

The upper right-side of the of the web interface also provides the **Shortcuts** and **Language** dropdown menus. The small cog icon is the **Shortcuts** menu which provides a quick link to the user manual, account settings, and a few other often-used items. From the **Language** dropdown menu you can change the language from English to other languages as well as choose imperial or metric measurement units for the display.

Figure 4-18 Dashboard overview on web interface

Under the **Alarm Notification** and the **System Status Bar** are the main menus for the system controller:

- **Dashboard** (Home)
- **Power Flow**
- **Controller**
- **Systems**
- **Modules**
- **Alarms**
- **Logs**
- **Shelf Layout**.

As you enter the menus, the interface provides a context sensitive breadcrumb trail at all levels so that you can see where you are within the system and go back to any previous menu. The lower area of the main dashboard contains system tables with detailed information including:

- Controller status
- Systems
- Active alarms

You can work with the system directly from this area.

4.3.4.1. Global search

Within the web interface, there is a search bar at the top-right of the screen. This search bar allows you to quickly find the following information:

- Configuration
- Alarms
- Buttons

To search, enter terms into the search box. After the search returns a result, you can select the **Go To View** button to go to the view the status of that **Configuration**, **Alarm**, or **Actions**. For **Configuration**, you can select the **Edit** button to directly edit this value.

The following example illustrates the usage of the search bar to find the **Output Voltage Low** alarm for a DC system.

Figure 4-19 Global search example

4.3.4.2. Paging, sorting, and filtering

Within the web interface there are three additional features that help you find information: paging, sorting, and filtering.

Paging: Displays multiple page tabs on tables that have a large quantity of information. If there is too much information for one table the table's lower right corner contains a list of numbers which allows you to scroll through the information.

Sorting: Provides a way to sort the table columns, either ascending or descending similar to any standard spreadsheet program.

Filtering: Provides an easy way to refine the information shown in a particular table.

The search bar on the upper-left side performs a search on each of the space-separated terms in all columns of the table. The **Aa** toggle can be used to make the search case-sensitive, and the **abc** toggle can be used to only match whole words. For example, typing *dc system major* will display all alarms of priority **Major** on the DC system.

The following example shows these features on the **All Alarms** table.

Figure 4-20 Web interface table features

4.3.4.3. Controller menu

This section provides an overview of the **Controller** menu. The system controller menu has a total of six sub-menus: **Status**, **Settings**, **Communication**, **Files & Upgrade**, **User & Security**, and **Programmability**.

About: Provides access to sub-menus providing various status information about the system controller, including:

- **General**: General information and active user sessions. The **General** table includes a button to reset the system controller or export diagnostic information.
- **Storage & Memory**: Application storage, memory, and alarms tables.
- **Factory Information**: Factory information and branding tables.

Settings: Provides access to configuration sub-menus including the following:

- **Site Information**: Description and location tables.
- **Time & Date**: Time and date table for all related settings. You can also synchronize time and data to a network time server or to a web browser with the buttons.
- **Speaker** (if available): View the speaker state, enable or disable it, and edit the external speaker relay.

- **User Interface**: User interface, LCD panel preferences, in-shelf system controller display preferences, file preferences, web interface preferences, custom views, and system dashboard values.

- **Maintenance Mode**: See status, alarms, and relay behavior during maintenance. You can also manually start and stop maintenance mode on this page.

- **Notifications**: Configure a message to be displayed before a user signs in to the system controller.

Communication Provides sub-menus for the many different communication protocols the controller supports, including:

- **Ethernet**: Configure Ethernet, ports, and virtual local area network (VLAN) support.
- **CAN**: Settings for the two Controller Area Network (CAN) ports on the system controller.
- **SNMP**: Configuration, SNMPv3 configuration, read communities, write communities, Simple Network Management Protocol (SNMP) destination, SNMP and component reference.
- **Modbus**: Configuration, system device IDs, and Modbus reference tables.
- **Email**: Simple Mail Transfer Protocol (SMTP) configuration and email destination tables.
- **Web Server**: Webserver ports and secure web server.
- **Data Sharing**: A method for sharing data to another system controller.
    - Published Data and Systems
    - Data Subscriptions.
- **Syslog**: Configuration and syslog destinations tables. Select *SEND TEST MESSAGE TO ALL DESTINATIONS* to test connected systems.
- **Soft Shutdown**: View and edit status and configuration tables.
- **Controller Redundancy**: A method for keeping configuration in sync with a backup system controller.
- **Website Proxies**: Allow the system controller to be used as a gateway to access IDP products.

Files & Upgrades: Provides access to sub-menus related to the various files that can be uploaded and downloaded to the system controller, including configuration files, backup files, upgrade files, license files, and software manual files:

- **Configuration & Software Backup**: Import and export configuration files including clones. Create configuration restore points, export a system controller backup, and view restore point information.
- **Software Upgrade**: Upload new system controller software and operating system to upgrade or download the system controller.
- **Licenses**: Import and export the license key file, enable and disable temporary licenses, and view related alarms.
- **Software Manual**: Upload the HyperText Markup Language (HTML) software manual to the system controller.

Users & Security: This menu provides access to user configuration and other settings related to authentication and permissions, such as:

- **Users**: Configure users, view active user sessions, and machine account status.
- **Remote Authentication**: Configure Remote Authentication Dial-In User Service (RADIUS) and Terminal Access Controller Access-Control System (TACACS+) settings.
- **Remote Configuration Lockout**: View and configure remote configuration lockout including status and related alarms.
- **Password Management**: Configure system controller password strength and reset options.

Programmability: The system controller provides some features to allow users to customize its behavior, for example, custom alarms, a calculation engine, and a scheduler:

- **User Alarms**: Add digital user alarms and threshold user alarms.
- **Custom Data**: Custom data, counters, timers, and change field to variable actions.
- **Scheduler**: Scheduled actions and time spans.

4.3.4.4. Systems menu

This section provides an overview of the **Systems** menu.

Depending on a created system, there can be a variety of sub menus that will vary from system to system. For example, sub menus such as **Status**, **Configure System**, **Inventory**, **System Functions**, and more.

If the system controller is new, and a system hasn't been created yet, then selecting the **Systems** menu on the navigation bar will lead to the **Add or Remove Systems** page. The **Create System** wizard can be selected in the table to launch the process to create a specific system. Follow the wizard step by step to create the desired system.

After the creation of a new system, the **Add or Remove Systems** table will be populated with the newly created system. To go to any created systems sub menus, select the **Systems** menu which will display created systems and their potential sub menus.

> *Notice: Upper level sub menus are displayed in the navigation tree and there can be further lower level sub menus after selecting an upper level sub menu. For example, the **Battery** inventory item in a DC system can have battery strings. In this case, battery strings are not displayed in the upper level menu.*

4.3.4.5. Modules menu

This section provides an overview of the **Modules** menu.

The **Modules** menu has the following tables: **CAN Modules**, **Power-Line Comms Modules**, **Firmware Upgrade**, and **Firmware Files**.

CAN Modules: Provides a table to view or locate all modules.

Power-Line Comms Modules: To view all power line communication modules in this table, their parent CAN module must be part of a system.

Firmware upgrade: Provides a table to start and monitor a firmware upgrade.

Firmware files: Provides a table to view, upload, or delete firmware files.

> 📢 *Notice: Even if a system is configured to auto-assign devices, once a rectifier module has been unassigned from the system, it must be manually reassigned back into the system. This is necessary to avoid unintentional auto-assignment. If a device is unassigned using the **Forget** button, then it will auto-assign when discovered on the CAN bus.*

4.3.4.6. Alarms menu

The alarms sub menus are: **Settings**, **Active Alarms**, **Controller Alarms**, and **All Alarms.**

Figure 4-21 Alarms menu

Settings: Provides alarm cut-off functionality, configuration, and settings for global alarm behavior. This menu also includes the **Alarm Summary Relays** table.

Active Alarms: Provides tables to view and configure active alarms, module alerts, and hints as well as an **Alarm Cut-Off** button.

Controller Alarms: Provides a table to view and configure alarms not belonging to a given system or module.

All Alarms: Provides a table to view and configure all possible alarms. Any alarms can be easily searched for and configured (for example, with a mapped relay) using this table.

4.3.4.7. Logs menu

The logs section has several log-related sub menus: **Events & Alerts**, **Battery**, **Power Outage**, **Datalogs**, and **Performance**. Every log can be exported to comma separated values (CSV) files for further analysis.

Figure 4-22 Logs menu

Events & Alerts: The **Events** table provides a list of system and system controller events that record configuration changes, alarms and general system controller and system operation. The **Module Alerts** table shows the module alert name and module serial number when a module reports an alert condition.

Battery: The battery log records the duration and change in capacity (Ah) for every charge and discharge of a battery. If you have **Battery Runtime & Heath** enabled, the log will also record the change in State of Charge and State of Health.

Power Outage: The power outage log records the start time, end time and duration of each power outage.

Datalogs: The datalog allows users to record measurements at set intervals over a period of time using the system controller sensors and calculated values as inputs.

Performance: The performance log provides daily roll-ups with a minimum, maximum and average value for key usage statistics. For power systems, that usually includes the input voltage and current and the output voltage and current. For the system controller, the central processing unit (CPU), and memory usage are tracked.

4.3.4.8. Shelf layout menu

The **Shelf Layout** page displays a virtual view of your shelf layout system. To display the physical representation of a system, a device must provide the bay ID, shelf ID, and slot ID information.

Figure 4-23 Shelf layout menu

From the **Shelf Layout** you can select any of the devices to be taken to the device details page.

Some modules support the **Shelf Layout** function and can supply shelf and slot information automatically. These include:

- Cordex® HP 12kW 48VDC rectifier system
- Cordex® HP LPS36 line power system
- Cordex® HP eLimiter+ distribution system
- Alpha® inverter module (AIM) 2500
- Cordex® CXPS-HSS hyperboost converter system

If all the devices in a system do not have bay ID, shelf ID, and slot ID information then the view will switch to a simple table with each device on a separate row.

Modules that do not support automatic population of shelf and slot data can be manually configured.

4.3.4.8.1. Configure shelf layout manually

If devices do not provide bay ID, shelf ID, slot ID information then the **Configure Shelf Layout** feature can be used to manually configure a layout. On the **Shelf Layout** page, a **Configure Shelf Layout** link is provided for DC systems and converter systems. If all the modules of your system have bay ID, shelf ID, and slot ID information, the button will appear on top of the system's shelf layout. Otherwise the button will appear on the simple table of modules.

To map your modules to the Shelf Layout:

1. Select **Configure Shelf Layout** to open the **Configure Shelf Layout** page
2. On the module you wish to map, select the **Locate** button. The physical module LED will begin to blink.
3. On your physical layout, locate the flashing module and make a note of the slot position.

4. On the **Shelf Layout** page, drag the module to the appropriate shelf and slot position on the layout grid.

5. To remove a module from the layout grid, select the red "**X**" icon. The module will return to the list of available modules.

6. Repeat the steps above until you have mapped all your modules.

7. After you have mapped all the modules, go to **Shelf Layout** on the main menu and you will see the completed shelf layout grid.

If you select a module in the layout, you will be taken to the details of the module. In the details page, you will see that the bay ID, shelf ID, and slot ID information is set to where you dropped the module.

4.3.5. Overview of the in-shelf system controller display

In-shelf system controllers have a small OLED display panel. This displays shows 30 characters total (six characters wide, five lines high) and the system controller has three navigation buttons and one reset button.

In-shelf system controller display screens

The in-shelf display panel has three main operating modes: dashboard, menu, and screen saver. After 20 minutes with no activity, the in-shelf system controller goes into screen saver mode and the display shuts off. From screen saver mode, select any of the three navigation buttons to re-activate the screen and enter dashboard mode.

In dashboard mode, the in-shelf display panel shows the key operating parameters of a system. For example, output voltage and load current. If more than one system is defined, you can cycle between systems using the **Forward** and **Back** buttons. With multiple systems, you can specify a default system, which is then displayed first.

To set a default system, from the web interface, go to the **Controller > Settings > User Interface** and select a system from the **In-Shelf Controller Display Preferences** table.

In-shelf system controller display menu

From the OLED display panel dashboard, use the **Select** button to enter a menu. From the menu, the OLED display panel lets you execute a set of commands much like the LCD panel screens on the 2RU system controller.

When you enter a menu, the top item is highlighted. To go to another menu scroll through using the **Forward** and **Back** buttons. To execute a highlighted menu item, select the **Select** button.

To exit a menu and return to the main OLED display panel dashboard, scroll to the **Back** command, and then select the **Select** button. The following figure shows an example of the menu screen. The following table provides a full list of menus available via the in-shelf system controller display.

Table 4-1 In-shelf system controller full menu

Menu label	Description
ALCO	Perform the alarm cut-off command.
Rstrt	Perform a restart of the system controller.
IPv4	Display the IPv4 address, subnet, and gateway for this system controller.
IPv6	Display the IPv6 addresses assigned to this system controller.
AutoIP	Set the IP to **Automatic** (obtained from DHCP server).
RstIP	Reset the IP to **Static Default** (IP: 10.10.10.201, subnet: 255.255.255.0).
Port	Displays the port number for the system controller.
Backup	Backup the system controller software and configuration to a file on a USB device.
Resto	Restore the system controller software and configuration from a file on a USB device.
Upgra...	Upgrade the system controller software from a file on a USB device.
OS Upg	Upgrade the system controller's operating system from a file on a USB device.
Info	Display system controller information including serial number, part number, software and hardware version.
Rotate	Rotate the in-shelf system controller display information by 90 degrees.
ExpInv	Export all inventory to USB drive. This is a large file and may take a while to export. The data can be used for analysis in a spreadsheet program.
RemCfg	When **Remote Configuration Lockout** has been enabled, this menu allows the lockout to be temporarily overridden for a preconfigured amount of time.
Back	Exit the menu and return to the OLED display panel dashboard.

In-shelf system controller buttons

The in-shelf system controller can be mounted vertically or horizontally. The contents of the display can be rotated, but the buttons cannot be rotated.

4.4. Factory Information

Under the **Controller > About > Factory Information** menu, there are some values which are intended to be set when the system controller is manufactured and before it is sent to a customer. This includes the serial number, part number, and manufacturing date and time, and any special branding. For the most part, these fields can only be set in the factory, and are not intended to be edited by end users.

The **Factory Information** page includes information about **System Identification**. This table has a set of fields which are intended to help identify the larger systems with which the system controller may have been provisioned. Two sets of fields are provided in case there is a need to include identifying information for more than one system. The fields provided are: **System Serial Number**, **System Model**, and **System Part Number** . The **System Serial Number** can only be set in the factory, and will not be imported or exported with the system controller configuration file, as it would not be logical to transfer this information to another system controller. The other two fields, **System Model** and **System Part Number**, can be edited by users with **administrator** privileges, and will be imported and exported with other system controller configuration. If an imported file is about to overwrite these values, the import wizard will warn the user so that they can make an informed decision about whether to proceed. If overwriting these values is not the desired behavior but the configuration file must be imported, the user should take note of the current values before import and rewrite the fields back to their desired behavior after import.

4.5. Email notification

The system controller can be configured to send alarm summary emails. In this case the system controller is acting as an Simple Mail Transfer Protocol (SMTP) client. This section describes the features of and how to set up the system controller email client.

For email notifications in a different language, go to **Controller > Settings > User Interface** and set the **LCD Language** in the **LCD Preferences** table to a preferred language. Although this setting is called **LCD Language**, it serves as the default language for the system controller, and will affect the language of email notifications.

Figure 4-24 SMTP client and server default ports

A summary of alarm activities in the system controller can be delivered using email. A period of monitoring time is configured, and then all alarms within that period are reported.

This summary is designed to assist decision making when determining the urgency of any action required to resolve issues that may occur in your system.

Table 4-2 Email notification features

Feature	Description
HTML based emails	HTML based emails provide better formatting features such as color coding and table alignment.
Multilevel security	Different security levels are available and automatic detection is executed to support the appropriate level. Direct Secure Sockets Layer (SSL) connection (default port 486) is not currently supported.
Encrypted SMTP server password	The password used for authentication on the Simple Mail Transfer Protocol (SMTP) server is securely encrypted.
Test email capability	A test button is available to send a test email ensuring proper configurations are set for email notifications to reach the appropriate monitors.
Public SMTP server	We currently support the following public server: **Google® Gmail** Google® Gmail requires use of an 'app password' for the SMTP server password. Refer to Google's documentation for more information. Less secure connections via Google® Gmail is no longer supported as of May 30, 2022.
Private SMTP server	The system controller supports private servers with the following security settings: • Transport Layer Security (TLS) version 1.2 • Clear text with authentication • Clear text anonymous

Email content

- Subject line with filterable text and alarm counts.
- Static title for filtering.
- Configurable name of the system controller.
- Configurable location of the system controller which provides a link to open Google® Maps showing the location of the system controller (internet connection required).
- Time and date of the notification.

- List of up to 10 active alarms sorted by priority with an active alarm count indicator showing total active alarms.
- List of up to 10 cleared alarms sorted by priority with a cleared alarm count indicator showing total cleared alarms.

How email notification works

- An alarm activity is the main item that will trigger an email notification. To avoid overwhelming the network, emails are only sent out at the configured interval set in the **Email Destination** table.
- When alarm transitions occur (for example, alarms activating or clearing) a timer starts from the first transition. During this collection period, all alarm transitions are collected for reporting in the email that is sent out at the end of the period. Continued transitions after the email is sent will start another timer for the next email notification.
- Active alarms are reported as a snap shot of all currently active alarms, regardless of when they activated or if they were a part of a previous notification.
- All cleared alarms are collected based on the last occurrence within the collection period. This is to avoid multiple entries of the same alarm in the case the alarm toggled multiple times.

Secured email

Connection to a SMTP server defaults to TLS secured connection on port 587. Checks are done via the system controller and if Transport Layer Security (TLS) is not supported, proper degradation of security features is done in the following sequence:

1. TLS handshake attempt.
2. Clear-text authentication with username and password.
3. Anonymous clear-text transmission with no authentication.

The checks are done by following SMTP protocol for SMTP server commands and responses. Please see SMTP protocol standards for more details.

Table 4-3 Email configuration

Configuration	Description
Enable	Email notification defaults to inactive. Enabling allows email notifications to go out when all configuration information is set correctly.
SMTP Server Address	A Domain Name Server (DNS) name or an IPv4 or IPv6 address will work in providing a target location of the email server.
Port	Default port is 587.
Domain	This is a DNS formatted string (words separated by '.') used for identifying the client to the SMTP server. Required for most public SMTP servers like Google®.

Table 4-3 Email configuration (continued)

Configuration	Description
SMTP User Name	The username used for authentication to the server to access SMTP resources.
SMTP Password	The password used for authentication to the server to access SMTP resources. Set this value by using the **Set SMTP Server Password** button. You can clear the configured password by using the **Clear Server Password** button.
Use TLS encryption	By default, the system controller will attempt to use TLS encryption when the server indicates during the initial handshake that TLS is supported. To force the system controller not to use TLS, set this value to **Never**. This may help with email send errors in the case of some older server types.
From	The From field is used as the source of the email and is usually the same as the Username provided to authenticate the client to the SMTP server. For example, Gmail requires this value to be the email address of the account in use.
To	The To field is for the destination or receiver of the email notification. This field allows multiple email address entries separated by commas.

4.6. Setup SNMP communication

Simple Network Management Protocol (SNMP) is a standard protocol or language that Network Management Systems (NMS) or SNMP manager use to control network devices and report information. A typical SNMP system is often represented as one SNMP manager collecting data from several SNMP agents or devices.

The system controller acts as an agent or device in an SNMP system. This section of the manual describes how to add a new agent (the system controller) to an existing SNMP system. It does not cover how to set up an SNMP manager nor does it explain how to correctly set up an SNMP system. Those topics are specific to the SNMP management software chosen which will have its own documentation.

Figure 4-25 SNMP manager and agent default ports

There are two main steps required to add a new agent to your SNMP system:

- Configure the agent with the IP address of your SNMP manager (tell the agent to send information to the manager).
- Compile the agent's Management Information Bases (MIBs) into the manager (tell the manager how to interpret information sent by the agent).

Configure an IP address to receive notifications

Configuring an IP address for notifications is referred to as *Subscribing to Notification Services*. Up to 10 IP addresses can be configured. SNMP monitoring systems need to compile and install the ALPHA-NOTIFICATION-MIB. Please refer to the user guide of the SNMP manager for this process.

For each of the 10 SNMP notifications addresses, the user can select the address and select the **Go To** button to see more details about that particular monitoring destination, and to edit details.

> *Notice: For detailed information on using SNMP, see the **SNMP Integrator Guide (User Guide ID: 0350099-J0)** on the EnerSys® website, www.enersys.com.*

4.7. Setting up Modbus communication

The system controller can act as a Modbus server (agent) in a Modbus system. This section describes how to enable the Modbus server on the system controller. It does not cover how to set up an Modbus client nor does it explain how to correctly set up a Modbus monitoring system. Those topics are specific to the Modbus client software chosen which will have its own documentation.

Figure 4-26 Default ports: Modbus client (master) and server (agent)

To setup Modbus TCP/IP on the system controller, you need to enable the Modbus server via the web interface:

1. Go to **Controller > Communication > Modbus**.
2. In the **Configuration** table, enable the Modbus Agent.
3. Select the **Edit** button on the **Internet Protocol** line, and then select the internet protocol to be used.
4. Select the **Edit** button on the **Byte Order** line, and then select the byte order.
5. **Limited Data Set Device IDs** are normally left as the default values.

> *Notice: For detailed information on using Modbus, download the **Modbus Integrator Guide (User Guide ID: 0350114-J0)** on the EnerSys® website, www.enersys.com.*

4.8. Setup system logging protocol (Syslog) communication

Syslog overview

System Logging Protocol (Syslog) is a communication protocol which is used to send system log or event messages to a server that supports Syslog. This protocol is a Simplex Communication Protocol meaning information only gets sent in one direction. The system controller, acting as an agent, has the capability to send event log and module log messages to a configured Syslog server.

4.8.1. Syslog agent configuration

To setup the **Syslog Agent** on the system controller:

1. Go to **Controller > Communication > Syslog**.
2. In the **Configuration** table, select the **Edit** button and then select **Enable** from the dropdown menu.
3. If the **Facility Value** is different that Local 0 (default), set the value using the **Edit** button to the expected value for the Syslog server.
4. Follow the Syslog destination configuration section in this manual to configure specific Syslog servers

4.8.2. Syslog destination configuration

On the system controller, a Syslog server is considered a destination. The system controller can be configured for up to 10 receiving destinations meaning 10 different Syslog servers can receive system controller curated Syslog messages. Any messages generated in the **Logs > Events & Alerts** page of the system controller will be sent to a Syslog destination. Be sure to enable the Syslog agent, detailed in Syslog agent configuration section of this manual, prior to starting this section otherwise no messages will be received for any Syslog server.

1. Go to **Controller > Communication > Syslog**.
2. In the **Syslog Destinations** table, select the **Go To** button for one destination.
3. For this single destination, using the **Edit** button for each configuration, configure the Server IP Address, Server Port, and Request for Comments (RFC) Version to start receiving Syslog messages.

4.8.3. Syslog message format

A system controller Syslog message will contain a priority, some header data, and the message.

An example message using Linux rSyslog:

Nov 26 8:58:00, 192.168.0.99, CXCHP[v8.30], ControllerEvent, [Source]: Web User, [Name]: Logon, [Value]: admin

📢 ***Notice:*** *The message presented is not the entire message displayed and the timestamp is formatted via rSyslog on Linux. It is to be used as a reference for the information detailed below.*

Using the Syslog message format, the system controller will curate a message with the following:

1. In Syslog message format, the AppName is the CXCHP[Version].

2. In Syslog message format, the MsgId are the specific types of events generated by the system controller. These events categories are: *ConfigurationEvent*, *ControllerEvent*, *AlarmEvent*, and *ModuleEvent*. To find these generated events on the web interface, go to **Logs > Events & Alerts**.
   a. A *ConfigurationEvent* can be generated when configuration on the system controller changes.
   b. A *ControllerEvent* can be generated when any action, state transitions, or any event that does not fall into the other three categories.
   c. An *AlarmEvent* can be generated when any alarm is activated or deactivated.
   d. A *ModuleEvent* can be generated if transitions occur on a module.

3. All event types will always have a severity level of Information besides *AlarmEvent*.

4. An *AlarmEvent* has a severity level that can change. This change is based on the specific alarms priority configuration on the controller. The alarm priorities on the system controller are mapped to the severity of Syslog. The mappings can be found in the following table.

5. In the Syslog message format, the system controller event message will have the format of "[Source]: Source of the Event, [Name]: Name of the Event, [Value]: Value of the Event".

Table 4-4 System controller alarm priorities to Syslog severity mapping table

System controller priority level	Syslog severity level (name)	Syslog severity level (#)
Critical	Critical	2
Major	Error	3
Minor	Warning	4
Warning	Notice	5

5. DC power systems

This section provides a brief overview of the components and functions within a typical DC power system. A basic power system usually consists of rectifier modules and batteries, but can also include other components.

5.1. Guidelines for commissioning the DC system

The following section contains basic guidelines for commissioning a DC power system. Overall system commissioning consists of four parts: power system inspection, battery inspection, commissioning the system, and testing the system. Commissioning should only be conducted by a qualified technician. For more detailed information refer to the relevant system manual for your specific system.

Perform an inspection of the power system to confirm that the mechanical and electrical requirements and parameters are within specification. Pay special attention to the battery to ensure it is installed safely and correctly, and that the battery terminals are torqued to specification.

1. Make sure all power to the system is off.
   Are all batteries disconnected, rectifier modules are removed, fuses pulled and circuit breakers turned off?
2. Make sure the battery polarity is correct. Use a voltmeter if necessary to confirm.
3. Install one rectifier module.
4. Turn on the AC to the rectifier module and allow it to start up.
   Verify that the system starts up, and the system controller turns on. Did the rectifier module turn on? AC and DC lights on?

   > 📢 **Notice:** *With no load and batteries disconnected, the rectifier module may have a fail alert. This should go away when load is connected.*

5. Confirm the battery settings on the system controller: capacity, charge limit, the Peukert exponent. If there is no means of disconnecting the battery, then the rectifier module output voltage should be reduced by using the system controller to match the rectifier module voltage to the battery voltage to avoid sparks.
6. Check that the battery polarity is correct and turn on the breakers, fuse or circuit breakers for the batteries.
7. Follow the initial battery charge procedure as indicated in the manufacturer's instructions.

The system controller and rectifier modules are operating normally. There may or may not be active alarms depending on system configuration.

Perform commissioning tests to confirm that the system is operating properly. Specific tests to perform will depend on the system configuration but may include:

- Correct AC input voltage and DC output voltage
- Battery test

- Relay test

- Battery disconnect operation

- Alarm test

5.1.1. Battery mode

The **Battery Mode** value, as shown in top section of the web interface or in the system **Status** page, indicates the state of the battery in the system.

In a system with a fully charged battery, the **Battery Mode** will be **Float** which indicates the battery is floating.

In a system that is charging, the **Battery Mode** will be **Charging**. The adjacent value either show **Bulk** (battery is charging at constant current) or **Absorption** (battery is in the absorption phase of charging).

In a system that is discharging the **Battery Mode** will either be **Discharging** (AC mains has failed) or **Test Discharging** (battery test in progress).

The **Battery Mode** may also be **No Battery** (no battery in the system), **Disconnected** (battery appears disconnected) or **Unknown**. When it is **Unknown** then the system controller is busy trying to determine the state of the battery. If this value persists for more then a minute or so, it may indicate that one or more of the following may not be properly configured:

- Load current

- Battery current

- Battery capacity

- System voltage

- Battery voltage (it is recommend that system voltage and battery voltage to be configured to read the same)

5.2. DC system functions

5.2.1. Modules, inventory, and system functions

To set up a system on the system controller, you need to work with modules, inventory, and system functions. This section explains these terms which will help you to navigate the system controller menu and answer questions such as:

- Why are rectifier modules in both the **Modules**, and in the **Inventory** menus, but ADIO modules are only in the **Modules** menu?

- Why is temperature compensation in the **Systems > DC System > System Functions** menu, and not under the **Systems > DC System > Inventory > Battery** menu?

Modules

A module is a device that communicates information. Most modules in a system controller will be CAN devices such as rectifier modules, converter modules, inverter modules, and ADIO modules. Future releases, may have modules such as Ethernet and USB serial connected modules.

Since the system controller can communicate with modules, each module in the system should also have a **Communications Lost** alarm. Most modules are replaceable, because of this there are functions within the system to remove old modules and create new ones. Some modules also have the ability to download reports and diagnostic information via the system controller.

Inventory

An inventory item is an item that is directly involved in the flow of power through the system. For example, a rectifier is an inventory item but a system controller or an ADIO module is not. Other examples of system inventory are: AC source, rectifier module, load, battery, disconnect, shunt, DC current transformers (DCCTs), breaker, and power meter. Setting up the inventory of a system focuses on the monitoring, not the control of the system.

You can set monitoring in one of three ways:

1. If the inventory item is also a module, you can communicate with it directly, such as with rectifier modules.

2. If the inventory can be measured or controlled via an ADIO module, then you can map the inventory to read data through the ADIO module, such as with shunts, batteries, current transducers, and disconnects.

3. If the inventory item's values can be inferred through a calculation, then you can map the inventory to use that calculation such as with AC sources and DC loads.

System functions

System functions are the major features of the system. Some examples are:

- Battery charging
- Battery runtime estimation
- Charge current control
- Voltage regulation
- Temperature compensation

Once the inventory is in place to monitor the system, you can configure and test the system functions to ensure that the system is working as intended.

5.2.2. Mixed rectifier module system

You can add any rectifier module to the DC system that has the appropriate DC bus voltage. Some of the **System Functions** assume that the controlled rectifier modules and managed batteries are the only source of power on the DC bus. Those **System Functions** work best with either a single rectifier module model or models that have been designed to work together such as, the Cordex® 1.8kW and the Cordex® HP 2.0kW rectifier modules, or the Cordex® HP 3.0kW and the Cordex® HP 4.0kW rectifier modules.

Mixing of other rectifier module types is not recommended. If you need to mix other sizes and types of rectifier modules you many need to turn off some of the **System Functions** for the DC system. See your system manual or contact Technical Support if you encounter this situation and do not have instructions on how to set up the **System Functions**.

5.2.3. Battery charging

The system controller applies a typical three-stage charging cycle including *Bulk Charging*, *Absorption Charging*, and *Conditioning* which is sometimes called float charging.

Figure 5-1 Three-stage charging cycle

Bulk charging

After the bulk charging stage, the battery should be in a 70 to 90 percent State of Charge. On the **Systems > DC System > System Functions > Charging** page, in the **Charge Current Control** table, you can enable and disable charge current control and set the charge current limit (C/X) in hours.

> *Notice: If you do not set a charge current limit, the battery may be charged at a much higher rate than is recommended by the battery manufacturer.*

Absorption charging

After the absorption charging stage, the battery should be in a 95 to 98 percent State of Charge. On the **Systems > DC System > System Functions > Charging** page, on the **Elevated Absorption Charging Status** table, you have the option to charge the battery at a voltage higher than the float voltage. The higher voltage is used to speed up the absorption charging stage after a prolonged AC power failure.

Conditioning - float

The conditioning or float charging stage brings the batteries to 100 percent State of Charge and maintains it there. When the system is in the conditioning stage it is usually at the **Float Voltage**. When the system is in conditioning-float, a higher **Equalize Voltage** or **Boost Voltage** can be applied from the **Systems > DC System > System Functions > Equalize & Boost** menu.

Conditioning - equalization

When a string of battery cells or blocks are charged, a single charge current is applied on the group. If the voltages of the cells or blocks begin to differ, the charge imbalance can lead to battery failure. Applying a higher **Equalize Voltage** to a fully charged battery string subjects the stronger cells or blocks to overcharge but this also allows the weaker cells or blocks to regain their full charge. When the voltage is returned to the **Float Voltage**, the stronger cells shed their overcharge and the battery string should be more balanced or equalized.

Applying an equalize voltage (an overcharge) to a fully charged battery can also be used to reverse sulfation.

⚠️ *CAUTION: Applying an overcharge to a battery string also has negative effects on the batteries. See the battery manufacturer's guide to determine whether an equalization voltage should be used at all. If so, what the voltage and the duration should be, and how frequently an equalization charge should be applied.*

Conditioning - boost

The purpose of boost is similar to equalize - to equalize cells or reverse sulfation. Boost voltage is usually a higher voltage than equalize. In fact it can be too high for the load and therefore require the presence of dropping diodes to be switched into the circuit between the rectifier modules and the load to prevent damage to the load. Before boost can be activated, the dropping diodes must be switched into the circuit.

5.2.4. Battery temperature compensation

Temperature compensation (Temp. Comp.) is used to prolong battery life and help prevent thermal runaway. When battery temperature compensation is enabled, the system controller uses the battery temperature to calculate an offset which is applied to the battery voltage.

A typical temperature compensation curve for a 48 volt battery system is shown in the following figure.

Figure 5-2 Temperature compensation voltage graph

Battery performance and life expectancy are directly related to the battery ambient temperature. The optimum operating temperature for battery operation is typically 77°F (25°C). Above this temperature battery life may be reduced and below this temperature battery performance may be reduced.

Thermal runaway occurs if the internal temperature rises due to overcharge, high ambient temperature or internal fault. Temperature compensation automatically adjusts the float voltage as the battery temperature changes to protect the battery from thermal runaway.

The temperature compensation function adjusts the system voltage every two seconds, as the temperature changes, and provides for a maximum voltage change of 0.2 volts over this interval. Temperature compensation occurs at standard rates commonly referred to as slope-compensation settings.

The slope of the temperature compensation curve in either mV/°F/Cell or mV/°C/Cell can be set via the **Systems > DC System > System Functions > Temperature Compensation** menu in the **Configuration** table. The value is set based on the battery manufacturer's information.

Since a battery can have multiple temperature sensors, temperature compensation uses the average of the temperature readings to determine the battery temperature on which to adjust the battery voltage. The average is used as long as all the temperature readings are within 9°F (5°C) of each other. When a temperature reading rises, perhaps due to local heating or thermal runaway, and reaches a point when the highest temperature reading is 9°F (5°C) greater than the lowest temperature reading, then temperature compensation will use the highest temperature reading to determine the compensated battery voltage. This will result in a lower battery voltage and reduce the risk of thermal runaway.

If one or more battery temperature probes appear to be disconnected or broken, then the temperature compensation function calculates the enabled setpoints as if the temperature reached the **Upper Temperature Breakpoint.** This is the safest option in case the failed sensor happened to be the one with the highest temperature reading.

5.2.5. Battery runtime and health estimation

Battery Estimation can be enabled via the **Systems > DC System > System Functions > Battery Runtime & Health** menu in the **Configuration** table. When enabled, the system controller calculates an **Estimated State of Charge (SoC)**, and an **Estimated Battery Runtime (RTR)** remaining at all times. It is not always practical to estimate these values. For example, if the system goes into a charging stage immediately after a restart, there is no way to estimate the State of Charge or Estimated Battery Runtime.

The accuracy of the estimated battery health improves as the battery undergoes more discharge cycles and it also improves with deeper discharges.

If a battery discharge occurs that goes below a State of Charge value of 80 percent, then the **Battery Runtime & Health Estimation** function creates a **Last Battery Discharge Summary**, a **Last Battery Recharge Summary** and recalculates the **Estimated Battery Health**. If estimated battery health is less than 80 percent then that battery is normally due to be replaced.

5.2.6. Low voltage disconnect operation

Whenever the system parameters requires the low voltage disconnect (LVD) to be activated, a 60 second countdown and audible warning begins. When the countdown reaches zero, the LVD is activated.

During the countdown, a command in the disconnect menu can be selected to inhibit LVD activation. When the disconnect first changes to **Pending**, every user logged into the system will receive notification that the disconnect is about to activate, and the option to inhibit it. To release the inhibit, you must activate the release command for each LVD.

There are three types of disconnects: legacy disconnect, general purpose disconnect, and battery disconnect with latching contactor.

Legacy disconnect

The legacy disconnect is the first disconnect available on the system controller. It offers the ability to disconnect based on voltage, time elapsed since AC fail, and the state of charge of the battery.

General purpose disconnect

The general purpose disconnect is best suited for use as a load shedding disconnect. It can be configured to disconnect based on voltage, or up to three customizable disconnect conditions. There are three customizable reconnect conditions in addition to the usual voltage reconnect threshold.

When using the optional disconnect, note the following conditions:

- The voltage must be less than the disconnect threshold **or**
- One or more optional disconnect conditions are true **and**
- All optional reconnects must be unknown or false
- If the option to disallow disconnect during battery test is true and battery test is active, the disconnect will not activate until battery test is no longer active or this option is disabled.

When using the optional reconnect, note the following conditions:

- The voltage must be greater than the connect threshold **or**
- One or more optional reconnect conditions are true **and**
- All optional disconnect conditions must be unknown or false
- If the option to require AC for reconnect is enabled and AC input is not present no reconnect will occur until AC returns or this option is disabled.

To better support use as a load shedding disconnect there are three configuration parameters that may be used to further customize the behavior:

1. **Allow disconnect during battery test:** By default this is set to **No** but may be set to **Yes.** Example: using the battery test to observe and measure the runtime available to critical loads after less important loads are disconnected.
2. **Require AC info for reconnect:** By default this is set to **Yes** but may be set to **No.** Example: if there are additional DC sources (like solar panels or a DC generator system) on the voltage bus that are capable of supporting the loads even when AC is lost.
3. **Required time to stay disconnected:** By default this is set to 0 seconds. It may be set to a non-zero number in to ensure that a load is fully powered off before reconnecting. Some loads may not start up correctly unless they are fully powered off first.

Battery disconnect with latching contactor

A battery disconnect with a latching contactor can be used for disconnecting based on voltage. External to software, this type of contactor requires a latching contactor interface which is used with a traditional ADIO module.

A battery disconnect with latching contactor can be created using the **Create Disconnect** wizard found at **Systems > DC System > Inventory > Disconnects**. After creation, the disconnect will appear in the **Disconnects** table, use the **Go To** button in the table row to configure the battery disconnect with latching contactor.

Operation of the battery disconnect with latching contactor

The battery disconnect with latching contactor operates differently than a standard non-latching contactor. The system controller will energize the associated ADIO module relay (for example, **Relay to Open** or **Relay to Close**, depending on the desired contactor state) for approximately four seconds and then de-energize the ADIO module relay. The brief energization of the ADIO module relay provides a pulse of current to open or close the latching contactor. The latching contactor has an internal magnet to keep it open or closed after the pulse has been applied and does not continuously draw power unlike standard contactors.

Contactor state source

The **Contactor State Source** is used to detect the contactor physical state which could be **Open** or **Closed**. If this is set, the system controller will automatically attempt to fix the contactor state if an

incorrect state is detected. If the state does not automatically adjust after a few retries then the **Contactor State Error Alarm** will trigger indicating the position of the contactor is not in its expected state. If this source is not set, the system controller will not attempt to close or open the contactor as the state is unknown.

Contactor retry countdown

The **Contactor Retry Countdown** is found in the **Status** table. The contactor retry countdown will automatically start counting down after three retries. After the retry countdown reaches 0, the system controller will automatically attempt to retry closing or opening the contactor three times. If the expected state is not reached, the contactor retry countdown will start over.

Test disconnect open button

To test the contactor, there is a **Test Disconnect Open** button located in the **Status** table. A test can only be initiated if the disconnect **State**, found in the **Status** table, is **Inactive** (contactor closed).

The **Test Disconnect Open** button will open the contactor. The contactor will remain open for 60 seconds, then close automatically.

5.2.7. Battery test

A battery test is used to update the **Estimated Battery Health** of a lead acid battery. The settings for this feature can be found in the **Systems > DC System > System Functions > Battery Test** menu. The **Estimated Battery Health** will be updated on the **Systems > DC System > System Functions > Battery Runtime & Health** page.

Definitions

- **Battery test termination voltage:** The voltage threshold at which the test normally ends.

- **Battery test timeout:** The maximum time the test can run before it is stopped.

- **Battery test termination on SoC:** Enable or disable the battery test termination State of Charge threshold to terminate a battery test.

- **Battery test termination SoC:** The State of Charge threshold at which the test normally ends.

- **Battery test alarm:** The battery test is active.

Using the test discharge mode

If the test is started when the battery is fully charged, the results of the battery capacity estimate will be more accurate. Use charge current control to limit the battery recharge current to the battery manufacturer's specified maximum value.

During a test, the **Estimated State of Charge** and **Estimated Battery Runtime** hours can be viewed via the **Systems > DC System > Status** menu in the **Battery** table or the **Systems > DC System > System Functions > Battery Runtime & Health** menu in the **Status** table.

Test discharge initiation

When the test begins, an entry is made in the event log. If the **Battery Test Alarm** has been enabled, it provides a warning to indicate that a battery test is in progress. The output voltage of the rectifiers is set to the battery test termination voltage to allow the battery to discharge. **Battery Mode** changes to **Test Discharge** when a battery test is started.

Test discharge mode runs for the period set as timeout or until the battery test termination voltage is reached or the battery test termination State of Charge is reached (if enabled).

The rectifier modules are periodically scanned to ensure that they do not begin sourcing current. If so then the test is stopped and the battery is recharged.

The rectifier module float voltage is reset to the setting that is stored in the system controller. When the system voltage reaches the end (termination) voltage or a timeout occurs, the system controller will command the rectifier modules to turn on and enter Float mode.

Activity during test discharge mode

Temperature compensation features are suspended during a battery test. When the battery is discharging, the battery test alarm is active. Battery State of Health estimation begins at three percent of Depth of Discharge, but is not displayed unless Depth of Discharge > 20 percent; the point at which reasonable accuracy can be assured.

AC failure during test discharge mode

If the AC fails during a battery test, the test is aborted. This places the rectifier modules into a state that enables them to resume providing power to the load when AC returns. If the runtime is being displayed, it continues to update.

Addition of rectifier modules during test discharge mode

If rectifier modules are added to the system when a battery test is active, they are placed into the same state as the current system rectifier modules. They are either: placed into battery test state or set to the same voltage as rectifier modules already in the system.

Conditions to watch for during test discharge mode

If the voltage drops below 46 volts before or when three percent depth of discharge is reached, the test is aborted and the battery health is set to zero percent (resulting in a *Battery Health Low* alarm). This provides an indication that the battery is very weak. Battery State of Health must be manually reset to 100 percent before the next battery test is started, so that the battery monitor can properly estimate the battery health. If rectifier modules are sourcing current during the test, and the battery ceases discharging, the test is aborted.

Canceling test discharge mode

Test Discharge mode can be canceled by either changing the mode to **Float** or stopping the test manually. To stop the battery test manually go to **Systems > DC System > System Functions > Battery Test** and select the **Stop Manual Battery Test** button in the **Status** table.

Battery discharge test completion

Once the battery begins to charge, the recharge cycle begins. Live battery recharge information is available at **Systems > DC Systems > System Functions > Battery Runtime & Health** menu in the **Status** table. The test is considered complete once the battery begins to charge. This is due to either, the test ending from timeout, the system reaching the termination voltage or from an abort condition.

5.2.8. Power save

When using **Power Save** we recommend the following:

- That the **Power Save** feature only be used on systems with a battery.

- If a system supports 120 to 240VAC input operation and if operating at less than 208VAC - do not use **Power Save**.

- The current and power limit settings in **Systems > DC System > Inventory > Rectifiers > Configuration** menu in the **Configuration** table should be set to 100% when using **Power Save**.

The **Power Save** feature is designed to improve the efficiency of the system, by optimizing the output power of the rectifier modules. Rectifier modules that are either loaded too light or too heavy generally have lower efficiency.

Power Save analyzes the system power requirements, as well as available rectifier module capacity, determining the optimum loading. Based on the system information the system controller then takes rectifier modules into or out of standby to achieve maximum rectifier module efficiency. Rectifier modules in standby do not supply to the load or to battery charging. **Power Save** periodically cycles these rectifier modules to ensure they contribute evenly to supplying the load. This balances rectifier module operation and maximizes rectifier module lifetime.

When active, **Power Save** relies on the battery to briefly take up some of the load current during operation. If there are modules in standby and the load increases, rectifier modules supplying power will momentarily have reduced capacity to supply the load. At that point the battery supplies the extra capacity required. **Power Save** detects this and will bring one or more rectifier modules out of standby so that the load is fully supplied by the rectifier modules.

Power Save has three main tables, **Status**, **Configuration**, and **Modules**. The **Status** table has a **Test Rotation Now** button which can be used to immediately advance the rotation of the rectifier modules. Regular scheduled rotation will still occur according to the **Module Rotates In** time settings.

To view these tables go to **Systems > DC System > System Functions > Power Save**.

Configuration table

The **Configuration** table has the following fields:

- **Power Save**: Enable or disable the power save feature on a system.

- **Module Power for Maximum Efficiency:** Provides a percentage at which the module should be loaded to achieve maximum efficiency. **Power Save** works to get as close to this value as possible. Refer to the module's user documentation to get information for best performance. If you don't have this information, use the default value based on the rectifier modules used.

- **Rotate One Module Every**: A length of time in days. After the configured number of days, the module that has been in standby longest will be turned on, the module that has been on the longest will be turned off. Module rotation occurs at 3:00 am.

Status table

The **Status** table displays which values **Power Save** calculates. These include the following fields:

- **Power Save**: Provides the general status which may be active, disabled, insufficient redundancy or invalid data suspended. **Power Save** cannot operate if in a battery test, if AC has failed or if any required data is unknown.

- **Average Power**: Provides the average module output power computed for the system. **Power Save** will try to get this value as close as possible to the **Module Power for Maximum Efficiency** (set in the **Configuration** table). For example: if the efficiency target is 80 percent, and the average power is 72 percent and turning off a rectifier module would make the average power 83 percent, then **Power Save** will turn off a rectifier module to get closer to the efficiency target.

- **# Modules Supplying Power**: The number of modules presently supplying power (or capable of supplying power). Modules that are failed, communications lost or have derated output for any reason are not included in this count.

- **# Modules in Standby**: The number of modules presently not supplying power but can be turned on to supply more power as needed.

- **Module Rotates In**: Provides how many hours left until the next module rotation (always occurs at 3am).

- **Estimated Time to Rotate All Modules**: Provides the estimated number of days until all modules in the system will be rotated. This value changes depending on number of rectifier modules and rotation period.

- **Estimated Required Capacity**: Provides the capacity required to supply the load and charge the battery. For example, if your load is 100 A and your battery charge current limit is 10A, this value would be 110A.

- **Estimated Available Capacity**: Provides the estimated available capacity of all modules that are **Supplying Power** (modules **In Standby** are not included).

- **Estimated Redundant Capacity**: Provides the estimated extra capacity of all modules that are supplying power in the system. In a system operating in **Float** mode, some modules are **In Standby,** and some are **Supplying Power.** The modules **Supplying Power** may be loaded at

80 percent. The remaining 20 percent is considered redundant capacity. This represents rectifier module capacity that is immediately available should a rectifier module fail. This number can be increased by lowering the **Module Power for Maximum Efficiency** to cause more rectifier modules to turn on – it is up to the user to balance the requirement for redundancy versus operating efficiency.

- **Estimated Standby Capacity**: The estimated amount of capacity for modules that are in standby.

Modules table

The **Modules** table displays the **Power Save** status of all the modules in the system including: serial number, mode, hours supplying power, and hours in standby.

Hours Supplying Power and **Hours In Standby** is the time a rectifier module spent in those modes.

5.2.9. Battery string age estimation

The battery string age estimation feature allows the system controller to estimate the battery age. This feature solely relies on temperature and the battery chemistry must be lead acid. The feature does not apply to discharge cycles a battery has encountered and it is purely based on the temperature changes that the battery string has experienced over the time it has been in the system. This feature only applies to a battery string per string basis.

The age estimation is based on an age factor which is computed using the battery string active temperature. The age factor is always between 1.0 and 8.0. The computation for this feature occurs every hour which updates the estimated age of the battery string. If the battery string does not have a temperature assigned, then a default age factor of 1.0 is used. This means that if a battery string in the last hour aged at a factor of 1.0 then the amount aged is 1 hour.

Table 5-1 Lead acid battery temperature age factor reference table

Temperature range in Celsius	Temperature range in Fahrenheit	Age factor
TC ≤ 25°C	TF ≤ 77°F	1.00 (minimum) to 1.41
25°C < TC ≤ 35°C	77°F < TF ≤ 95°F	1.41 to 2.83
35°C < TC ≤ 45°C	95°F < TF ≤ 113°F	2.83 to 5.66
TC > 45°C	TF > 113°F	5.66 to 8 (maximum)

This feature by default is disabled on new string creation and must be enabled and configured for accurate estimation.

5.2.9.1. Battery string age estimation configuration

The **Battery Age Estimation** table has the following configuration fields that can be modified using the **Configure Battery Age Estimation** wizard:

- **Battery Age Estimation**: Enable or disable the battery age estimation feature. If disabled, the battery age estimation will be paused furthermore if it is enabled it will continue from its pause state.

- **Expected Lifespan**: The expected lifespan (design life) of the battery. If the battery manufacturer specifies a design life it should be entered here (in hours). When the expected lifespan is changed, the alarm thresholds for the **Battery Lifespan Close to Exceeded** alarm and **Battery Lifespan Exceeded** alarm will manually need to be updated.

To setup battery string age estimation via the wizard:

1. Go to **Systems > DC System > System Functions > Battery String Age Estimation**.

2. In the **Battery String Age Estimation Overview** table, select the **Go To** button for the battery string to be configured for this feature.

3. On the **Battery String** page, find the **Battery Age Estimation** table and within it launch the **Configure Battery Age Estimation** wizard.

4. Follow the wizard and configure the required parameters. On completion, the wizard will re-initialize all associated values, enable alarms (if disabled) for the feature based on wizard entries and then begin estimating the battery age.

> *Notice: The initial age of a battery string is only visible and configurable through the **Configure Battery Age Estimation** wizard. The initial age serves as a starting point to start estimation. For example, if the battery to be configured had already been installed for two years then the initial age must be entered in the wizard which will allow the estimated age to start at the initial age and then add time.*

5.2.9.2. Battery string age estimation alarms

The battery string has the following battery string age estimation alarms:

- **Battery Lifespan Exceeded**: This alarm will trigger when the estimated battery age is greater than the configured expected lifespan.

- **Battery Lifespan Close to Exceeded**: This alarm will trigger when the battery is nearing end of life. By default, this is configured to trigger one year prior to the end of the battery lifespan.

The alarm thresholds can be manually configured or when first configuring the battery string feature using the **Configure Battery Age Estimation** wizard.

For manual configuration of these thresholds (limits):

1. Go to **Systems > DC System > System Functions > Battery String Age Estimation**.

2. In the **Battery String Age Estimation Overview** table, select the **Go To** button for the battery string to be configured for this feature.

3. Find the **Alarms** table on the **Battery String** page and within it select the **Go To** button for the alarm to be configured.

4. On the alarm to be configured, set the limit to the desired limit.

> 📢 **Notice:** *If the* ***Configure Battery Age Estimation*** *is run, the alarm threshold limits will be updated to the values specified in the wizard.*

5.2.9.3. Battery string replacement hint

The battery string age estimation feature has a **Battery String Replacement** hint that will trigger if thresholds have been exceeded. This hint is provided in the case that a user may have disabled the battery string alarms and may choose to replace their battery string later.

The battery string age estimation hint will trigger when the **Battery Lifespan Close to Exceeded** alarm limit (threshold) is exceeded. This hint will stay active until the **Configure Battery Age Estimation** wizard is completed again which will reinitialize the feature.

If the hint does become active, it will be displayed in the **Alarms > Active Alarms > Hints** table.

5.2.9.4. Time spent in temperature range

The **Time Spent in Temperature Range** table displays how long the battery string was within a certain temperature range. The time spent range values are displayed at their accelerated time and therefore if a battery age factor was computed to be 4.0 at the hour then the time range would display 4.0 h although only an hour had elapsed in real-time. If the initial age of the battery started at 0, then aggregating all the time within each time range would equal to the estimated age. If the initial age started at a different age other than 0, then only the time that the feature has been enabled will be displayed within any time range.

The **Time Spent in Temperature Range** table can be found at:

Systems > DC System > System Functions > Battery String Age Estimation > Time Spent in Temperature Range.

The same values displayed within the table can be found in the **Battery Age Estimation** table for a battery string.

5.2.10. Battery discharge and recharge

The battery discharge and recharge system function is only available for the lithium-ion battery system only. The battery discharge system function will allow for discharge of the battery.

The battery discharge can be started using the **Start Battery Discharge** button in the user interface.

A battery discharge will occur for as long as any of the termination conditions have not been met. Once a termination condition has been met, the discharge will stop.

User configurable termination conditions are available for the battery discharge system function which are: based on a timeout, termination voltage, or State of Charge. Additionally, a discharge can be manually stopped using the **Stop Battery Discharge** button in the web interface.

A battery discharge can terminate on two additional termination conditions:

1. If the minimum test voltage in rectifier module configuration is lower than any DC system disconnect threshold. To modify the rectifier module minimum test voltage configuration, go to **DC System > Inventory > Rectifiers > Configuration > Minimum Test Voltage**.

2. If the load current is too low that the battery is not discharging appropriately.

Once the battery is discharged, a delay timeout can set before the battery starts to recharge. The system will wait for the timeout period to expire before recharging the battery to System Float Voltage. During this time, some charging or discharging current can occur until the battery and system voltage are equalized. Because the minimum system float voltage for some DC system is 47.5V, the battery will be charged to 47.5V during the delay time.

When the delay recharge is active, its Battery Recharge Delay alarm will be active.

The delay can be manually stoppped using **Start Battery Recharge** button in the web interface.

To use the battery discharge system function for a lithium-ion battery, go to **DC System > System Functions > Battery Discharge.**

5.3. Create a DC system manually

On a system controller, if there is no power system defined, you can create the inventory items needed to monitor and control a DC system. There are four steps to creating a new DC system.

1. Verify that the ADIO module sensors you are using to monitor the system are working correctly, and document the purpose of each sensor and relay used.

2. Create the DC system and other inventory items, and then configure the inventory to use the ADIO module sensors to monitor the system.

3. Configure each of the system functions to correctly control the DC system and manage the battery.

4. Adjust thresholds, enable and disable alarms, and set up any remote alarm reporting using alarm relays or SNMP notifications.

This section provides the first steps of how to set up a 48VDC system. For this example, the system is set up as shown in the following figure.

Figure 5-3 Example of a DC system

5.3.1. Quick reference for configuring a DC system

The following figure shows the key configuration settings for a DC system that should be set or checked so that the system operates correctly.

There are many optional and alarm reporting settings that can also be configured.

Figure 5-4 Quick reference for configuring a DC system

System > Add or Remove Systems
Create DC System

System > DC System > Configure System
[System Voltage Source] Float Voltage = 54V Rectifier Assignment Rule   = Automatic

System > DC System > **Inventory** > Shunts > Shunt
[Shunt Current Source] Range in Amps = 800A Range in Millivolts = 100mV Name = Battery Shunt

System > DC System > **Inventory** > Disconnects > Disconnect
[Relay] Disconnect Threshold = 42V Connect Threshold = 50V Name = Battery Disconnect

System > DC System > **Inventory** > Battery Subsystem > Battery String
[Battery Voltage Source] [Battery Current Source] [Battery Temperature Source] Capacity Rating = 50 A-h Peukert Exponent = 1.15 Name = Alphacell 85GXL-HP Description = Install May 2013

System > DC System > **Inventory** > Loads > Load
[Load Voltage Source] [Load Current Source]

System > DC System > **Inventory** > Rectifiers > Configuration
Note: The defaults are fine for this example

Modules > ADIOs > L-ADIO
V1 > Name = Bus Voltage I1 > Name = Battery Current T1 > Name = Battery Temp K1 > Name = LVBD Relay K10 > Name = Minor Alarm K11 > Name = Major Alarm K12 > Name = Critical Alarm

DC System Calculated Values
Total Rectifier O/P Current Total Rectifier O/P Current - Battery Current Total Rectifier O/P Current - Load Current

System > DC System > **System Functions** > Charging > Bulk Charging
Charge Current Control = Enabled Charge Current Limit (C/X) = 10

System > DC System > **System Functions** > Charging > Absorption Charging
Auto Absorption Charging = Enabled

System > DC System > **System Functions** > Temperature Compensation
Temp Comp in Float = Enabled Temp Comp in Equalize = Enabled Temp Comp in Absorption = Enabled

System > DC System > **System Functions** > Battery Runtime and Health
Battery Estimation = Enabled Load Model = Resistive [Battery LVD]

System > DC System > **System Functions** > Rectifier Control and Monitoring
Regulation = Enabled Loadsharing = Enabled

5.3.2. Create a DC system

There is no DC power system on a new system controller. Creating a DC system is done using the **Create System** wizard. In the current release, multiple creation of DC system is supported.

You can also import a configuration file containing a DC system from another system controller.

A new power system can be created via the **Systems > Add or Remove Systems** menu from either the LCD panel or the web interface. Both have wizard assistance to help step you through the process to create the new system. You can create either a 48 volt system or a 24 volt system. Once the system is created, an associated load, battery, disconnect, and shunt is also created.

The DC system will also be created with a reasonable set of defaults and associated alarms. The only value which is mandatory to configure after system creation, is the **System Voltage Source**, which can be set to any voltage input. It is recommended that this be set to the same input as the **Battery Voltage** input. All other items, such as Name, Description, System Number, and Serial Number are optional and can be used to describe and organize your system.

You can configure the alarms associated with the system. You can enable or disable the alarms, change the priority, map relays to the alarms, and where applicable, modify the thresholds.

To create a DC system:

1. Go to **Systems > Add or Remove Systems**. Select the **Create System** button to launch the wizard.
2. Select **DC System** from the dropdown menu.
3. From the results page, select the **Configure DC System** wizard to be guided through system configuration or follow the instructions that follow.
4. Once configured, the **Results** page will give additional guidance on the next steps. If a battery was added during the wizard, a placeholder will be added for this battery. On the **Results** page, the battery string configuration wizard can be launched which allows for configuration of a single battery string. If additional battery strings are required then they will have to be created by navigating to the newly created DC system battery page.

On the **Results** page the wizard provides information on what else needs to be done to ensure the system functions as expected. Any lines coded blue denote action that must be taken, such as in the above example, the **Configure Shunt** and **Disconnect** buttons. The gray coded lines indicate actions recommended, such as in the above example, the **Confirm Load** and **Battery String** buttons. If the item was configured correctly it will display with the line green, meaning no action is required.

5.3.2.1. Create a system from a configuration file

A system can be created by importing from a configuration file. See the *Importing a system* section for more information.

5.3.3. Configure basic DC system settings

The **Configure System** page has three tables (**Configuration**, **System Properties**, and **Alarms**) with some basic settings that must be configured.

To configure basic DC system settings (from the main dashboard):

1. Go to **Systems > DC System > Configure System**.
2. In the **Configuration** table:
   a. Set the system name, description, number, and serial number.
   b. Set the float voltage setting. This is the desired output voltage of the rectifier modules when the system is in float mode.
   c. Set the system voltage source, which is the voltage used to control the system. This is the input of the ADIO module that measures system output voltage, and is usually the same input as the battery voltage.
3. In the **Alarms** table, configure the related alarms.

5.3.4. Configure dynamic thresholds for output voltage alarms

Both the high and low output voltage alarms can use a dynamically adjusted threshold. This adjusted limit is calculated by adding the difference between the voltage regulation setpoint and the Float voltage to the configured limit. To use dynamically adjusted thresholds for an **Output voltage alarm**:

1. Go to **Systems > DC System > Configure System**.
2. In the **Alarms** table, select the **Go To** button for the **Output Voltage** alarm to configure.
3. Use the dropdown menu to set the **Absolute** or **Adjusted** field to **Adjusted**.

5.3.5. Configure the rectifier modules

These are settings that include start delay, safe mode voltage, or over voltage protection threshold.

> **Notice:** *The safe voltage is the voltage that the rectifier modules default to if they lose communication with the system controller. This feature has a time delay that varies according to rectifier module. Most rectifier modules revert to **Safe Mode** after five minutes.*

Rectifier module output voltage is configured from the **Systems > DC System > Configure System** menu.

To configure the rectifier modules:

1. Go to **Systems > DC System > Inventory > Rectifiers > Configuration**.
2. Set up your rectifier module group configuration settings. These include, start delay, safe mode voltage, or overvoltage protection (OVP) threshold.

You can configure the group settings, using information in the following table.

5.3.5.1. Rectifier module configuration guidelines

The following are guidelines for setting rectifier module configuration. Some or all may apply.

Overvoltage Protection Threshold	Set this value as far above equalize voltage or boost voltage as needed. For a 48 volt system, the usual value is 60 volts. The actual upper limit of this setting depends on the rectifier module model. If the **Rectifier Configuration Error** alarm is active, it usually means the overvoltage protection (OVP) threshold is too high or too close to the equalize, boost or float voltage setting. It is necessary to have at least 1 volt (for 48 volt systems) difference between float, equalize and OVP settings.
System Start Delay	Set this value to delay the start up of all rectifier modules when AC returns to give other AC equipment on site a chance to start up first.
Module Start Delay	Set this value to apply a staggered start delay to individual rectifier modules. This helps limit AC inrush current and gives the system controller time to engage charge current control, if enabled, to prevent a battery breaker or fuse from opening. Each rectifier module is assigned a module start delay that is a multiple of the configuration value. If the value exceeds 250s, the value starts again at the lowest multiple. For example, if the module start delay is 60s and there are eight rectifier modules in the system, the start delays assigned to the rectifier modules will be: 1s, 60s, 120s, 180s, 240s, 1s, 60s, 120s. This means that three rectifier modules will be assigned the same 1s, 60s, and 120s delays.
Current Limit/Power Limit	Set one of these values (not both) to limit the output current of the rectifier module. This is normally only done if the site has undersized AC breakers or is running on an undersized AC generator. These values must only be set while in float mode. Setting them when the battery is bulk charging may result in too much current to the battery.
Fast Soft Start	Set this to enabled if the system has no batteries and the load does not turn on when AC returns.
Rectifier Overload Alert	This is usually disabled when the system has batteries to avoid a current limit or power limit alarm during battery charging.
Ramp Test	This is normally enabled to detect if a rectifier module has been disconnected from the load. When enabled and if the rectifier module is sourcing less than 2.5 percent of it's maximum current, the rectifier module will briefly raise it's output voltage by 0.5 volts (for 48 volt systems) once per minute. If the rectifier module cannot source at least 2.5 percent of it's maximum current, the ramp test will fail and a Rectifier Fail alarm will activate.

5.3.6. Configure the shunts

By default the system has one shunt. You may add or remove shunts as needed.

To configure a shunt you need an ADIO module with current inputs. The shunt will map the current inputs from the ADIO module to the **Load Current Source** field of the **Load Configuration** table or the **Battery Current Source** field of the **Battery Configuration** table.

To configure a shunt:

1. Go to **Systems > DC System > Inventory > Shunts**. You will see a list of shunts in the system. Add or remove shunts from this page.

2. Select the **Go To** button for the shunt you want to configure.

3. In the **Configuration** table, assign the shunt a name and description. We recommend that you assign the shunt a name that represents the actual shunt. For example you might name it **Battery Shunt**.

4. Select the **Shunt Current Source**. This is the current input on an ADIO module that takes a voltage reading across the shunt.

5. Enter the **Range in Amps** for the shunt.

6. Enter the **Range in Millivolts** for the shunt.

7. Enter the **Offset Calibration** for the shunt if the shunt reading error is too high.

5.3.7. Configure the system loads

By default the system has one load. You may add or remove loads as needed.

To configure each load:

1. Go to **Systems > DC System > Inventory > Loads**. You will see a list of loads in the system. Add or remove loads from this screen.

2. Select the **Go To** button for the load you want to configure.

3. In the **Configuration** table, assign the load a name and a description. We recommend that you assign the load a name that represents the actual load.

4. Select the **Load Voltage Source**. This is the voltage input on an ADIO module that takes a voltage reading near the load.

> 📢 *Notice: If you do not have this connected, you can select the input that reads the battery voltage or system voltage.*

5. Select the **Load Current Source**. This is the shunt input that reads the load current. If you have a real shunt reading for the load current, then select the shunt from the dropdown menu. If you don't see the shunt you want, then create it.

   If you do not have a shunt for reading the load current, then select the 'virtual' input that calculates the load current by subtracting the total rectifier module output current minus the battery current.

6. Select the **Edit** button for the **Load Breaker/Fuse Source**. Select the digital input on the ADIO module which is connected to monitor the breaker or the fuse.

   If you need to change the polarity for the **Load Breaker/Fuse Open** alarm, go to the **Modules** menu and select the appropriate ADIO module in the **CAN Modules** table. Then, open the details

of the appropriate digital input from the **Digital Inputs** table and change the **Active When** entry accordingly.

7. Configure the load alarms.

5.3.8. Configure the current transducer module

The system, by default does not contain any current transducer modules. You can add or remove current transducer modules as needed. To configure a current transducer module you need a voltage input on an ADIO module. To configure a current transducer module with a Cordex® HP current transducer interface and power module (CT-IPM), you need a shunt input on an ADIO module.

To configure a current transducer module:

1. Go to the system where you want to add the transducer module and navigate to the inventory page. Go to **Systems > DC System > Inventory > Other Transducers**. In the **Other Transducers** table, there will be a list of current transducer modules in the system. Add or remove them from this page.

   You may be using a current transducer module with **Interface & Power Module (IPM)**. This device takes the voltage reading from a current transducer module and divides the reading by 50. The factored voltage reading is then sent to the Cordex® HP L-ADIO smart peripheral shunt input.

2. Select the **Go To** button for the **Current Transducer** you wish to configure.

3. In the **Configuration** table, select **Configure Current Transducer** to launch the wizard and complete each step to configure the transducer module.

4. Enter the **Measurement Range** in amps.

5. Enter the **Range in Volts**.

6. Select **CT Current Source**. This can be any voltage source.

7. Optional: enter the **Offset** calibration for the **Current Transducer** if the reading error is too low or high.

5.3.9. Configure the general purpose transducer module

The system, by default does not contain any general purpose transducer modules. You can add or remove general purpose transducer modules as needed. To configure a general purpose transducer module you need a voltage input on an ADIO module.

To configure a general purpose transducer module:

1. Go to the system where you want to add the transducer module and navigate to the inventory page. Go to **Systems > DC System > Inventory > Other Transducers**. In the **General Purpose Transducers** table, there will be a list of general purpose transducer modules in the system. Add or remove them from this page.

2. Select the **Go To** button for the **General Purpose Transducer** you want to configure.

3. In the **Configuration** table assign a name and a description.

4. Select **Transducer Input Source**. This can be any voltage source or a custom data.

5. Enter the **Transducer Input Minimum in Volts** and **Transducer Input Maximum in Volts**.

6. Enter the **Transducer Output Minimum** and **Transducer Output Maximum**.

7. Select **Units and Precision**.

8. **Optional**: Enter the **Offset** calibration for the calculated **Value** if the reading error is too low or high.

The **Calculated Slope** and the **Offset** are used to convert the **Input Source Value** to the **Value**. The value is displayed in the selected units and precision.

5.3.10. Configure the system disconnects

By default the system has one disconnect. You can add or remove disconnects as needed.

There are two types of non-latching disconnect: a legacy disconnect, and a general purpose disconnect, but each are configured as follows:

1. Go to **Systems > DC System > Inventory > Disconnects** and select the **Create Disconnect** button to launch the **Create Disconnect** wizard.

2. Both types of disconnects have a name, voltage disconnect, and connect thresholds and a relay to map. The wizard for the general purpose disconnect has three extra configurations that can be used to customize the behavior of the disconnect: **Allow Disconnect During Battery Test**, **Require AC Input For Reconnect**, **Required Time to Stay Disconnected**. These extra configurations are most useful when setting up a load shedding disconnect.

3. When the wizard is complete the disconnect is functional but won't have any customizations required for alarming, or load shedding. If further configuration is required, select the **Go To** button to continue configuration.

4. In the **Digital Inputs for Alarms** configuration table, assign the digital inputs that are used to monitor the state of the physical contactor.

5. In the **Alarms** table, configure the alarms.

6. For the legacy disconnect, it is possible to configure the following additional disconnect options:

   ◦ **Disconnect on Time After AC Fail**: This will open the disconnect after a certain amount of time when AC has failed. This feature is used when configuring a disconnect for load shedding.

   ◦ **Disconnect on Battery State of Charge** table. This feature is used when configuring a disconnect for load shedding.

7. For a general purpose disconnect, it is possible to configure up to three user defined disconnect and reconnect conditions. An optional disconnect condition is configured the way as an optional reconnect condition:

   ◦ **Enable**: If desired, set this to **Enabled**

   ◦ **Value to Test**: Set this to a value that the condition should operate on. It is possible to use a **Custom Data** here for added flexibility.

- **Logic**: Select a logical operation: greater than, less than, is True and is False

- **Limit**: When using greater than or less than, set a number to compare **Value to Test** against.

Ensure that any optional disconnect conditions cannot be true as the same time as any optional reconnect conditions, otherwise the disconnect may get stuck in either the disconnected or reconnected state.

5.3.10.1. Configure a battery disconnect with latching contactor

To configure a battery disconnect with latching contactor:

1. Go to **Systems > DC System > Inventory > Disconnects**.
2. In the **Disconnects** table, select the **Create Disconnect** button to launch the wizard.
3. At the **Select Disconnect Type** step, select **Battery Disconnect with Latching Contactor** and select the **Next** button to exit the wizard.
4. A newly created **Disconnect** will be displayed in the **Disconnects** table.
5. Select the **Go To** button next to the newly created disconnect. In the **Configuration** table, for the disconnect, configure the following:
   a. **Enable**: This will enable the disconnect.
   b. **Relay to Close**: This is the relay that will be used to close the latching contactor. Using the selector, set this relay to the ADIO module relay which corresponds to the relay input of the latching contactor interface which will close the latching contactor.
   c. **Relay to Open**: This is the relay that will be used to open the latching contactor. Using the selector, set the relay to the ADIO module relay which corresponds to the relay input of the latching contactor interface which will open the latching contactor.
   d. **Contactor State Source**: This is the digital input that is wired to sense the contactor state. Using the selector, set the source to the digital input which corresponds to the auxiliary input of the latching contactor interface. For proper operation of a battery disconnect with latching contactor, this source is required to be configured.
6. In the **Disconnect On Voltage** table, configure the following:
   a. **Voltage Disconnect Threshold**: This is the voltage at which the disconnect will activate and open the connection. This threshold cannot be disabled.
   b. **Voltage Connect Threshold**: This is the voltage at which the disconnect will deactivate and reconnect. This threshold cannot be disabled.

5.3.11. Configure lead acid or nickel cadmium battery parameters

The system is only permitted to have a single battery. The battery may consist of multiple battery strings. When the DC system is being created using the DC system creation wizard, the user will be given the option of adding a battery to the system, or not.

If a battery is required, configure battery parameters:

1. Go to **Systems > DC System > Inventory > Battery**. On the **Battery** page, you will see several tables, with **Status**, **Configuration**, **Alarms**, **Battery Strings**, and **Charging/Discharging Threshold**. There is also a table with a list of battery strings, and a button to add more.

2. In the **Configuration** table, assign the battery a name and description if required.

3. Edit the **Battery Voltage Source** and **Battery Current Source** if necessary. Note that it is possible to map the entire battery to an ADIO module input for the voltage and current sources, but is recommended to leave those values at their defaults at this level. The defaults will average the voltages of the battery strings, and sum the currents.

4. In the **Battery Strings** table, select the **Add Battery String** button to launch the wizard which will add more battery strings if necessary.

5.3.11.1. Configure the battery strings

A battery string can be configured by editing the necessary values manually, or by launching the **Add Battery String** wizard (to create and configure a number of new battery strings), or the **Configure Battery String** wizard to set the configuration of an existing battery string.

Configure the battery string configuration values manually:

1. Select the **Go To** button to step into the details for each string. Do the following steps on each of the battery strings in your system.

2. In the **Configuration** table, set a **Name** and **Description** for each string, if desired.

3. In the **Configuration** table, select the **Battery Voltage Source**. This is the voltage input on an ADIO module that takes a voltage reading as near the battery as possible.

4. In the **Configuration** table, select the **Battery Current Source**. This is the shunt input that reads the battery current. If you have a real shunt reading the battery current, then select the shunt from the dropdown menu. If you don't see a shunt, you should create one now.

   If you do not have a shunt for reading the battery current, then select the 'virtual' input that calculates the battery current by subtracting the total rectifier module output current minus the load current

5. Temperature sensors can be added via the **Temperatures** table. See the next section for information on how to do this.

6. In the **Configuration** table, configure the **Capacity Rating**. This value may be available from the battery specification sheet. Use the capacity at the 20-hour rate (C/20).

7. In the **Configuration** table, configure the **Open Circuit Voltage**. This value is may be available from the battery specification sheet. If not, leave at the default value.

8. In the **Configuration** table, launch the **Configure Peukert Exponent** wizard to configure the **Peukert Exponent**. This value may be available from the battery specification sheet.

   If the Peukert exponent *(n)* is not supplied in the battery specification, calculate it by the equation:

$$n = \frac{[\log(T_2) - \log(T_1)]}{[\log(I_1) - \log(I_2)]}$$

where *T* is the discharge time in hours and *I* is the corresponding discharge current in amps. Both *T* and *I* are often available in the battery specification sheet.

9. Under the **Breaker/Fuse Source**, select the digital input on the ADIO module that is connected to monitor the breaker or fuse.

10. Optional: Configure the **Midpoint Voltage Source** if your ADIO module is wired to read the battery midpoint voltage.

11. In the **Alarms** table, configure the related alarms.

5.3.11.2. Configure battery strings wizard

A battery string can be configured by editing the necessary values manually, or by launching the **Add Battery String** wizard.

To add a new battery string:

1. In the **Battery Strings** table, select the **Add Battery String** button to launch the wizard.

2. Under **Battery Parameter Source**, choose the source of battery parameters. You can choose to set the parameters based on the battery model or copy them from an existing battery string. The following steps will assume that you have chosen to set the parameters based on the battery model, as this is the most complex case. Choose **Use Parameters based on Battery Model** and select **Next**.

3. On the **Select Battery Model** page, choose the battery manufacturer and battery model. If yours is in not on the list, choose the most similar battery. Once completed, select **Next**.

4. On the **Verify Battery Parameters** page, review the battery parameters. The values will be pre-populated. The numbers may be edited at this step to make sure that they match your battery string. Select **Next**.

5. On the **Number of New Strings** page, select the number of strings you wish to add, then select **Next**.

6. If you have chosen to add more than one string, you will get be taken to the **Clarify Mappings** page. Clarify the voltage source and shunt information, then select **Next**.

7. On the **Name the String(s)** page, enter a name for each of the new strings, if desired. Select **Next.**

8. On the **Map the String(s)** page you will be able to map a voltage source (either one per string, or an overall voltage reading). You can also map a midpoint voltage for each string and a breaker or fuse source for each string. If you chose to add a current source for each string, that field will also be available to edit here.

9. The **Results** page will show whether the addition of the battery strings was successful. Select **Done** to exit the wizard

5.3.11.3. Update system parameters based on battery parameters

When a system is created, default values are used for battery parameters such as Float Voltage, Equalize Voltage, Temperature Compensation Slope, and Charge Current Control maximum current. Battery strings usually have their own recommended values for these parameters, available in the battery data sheets. For battery models often used with the system controller, these values are pre-populated into the

battery string settings when a user chooses to create a battery string based on a known model. However, the system values are not automatically updated, in order to avoid unexpected results for users who have already set their system settings the way they desire. If the user adds or removes battery strings, or updates the battery parameters within the strings, and then wishes to update the system parameter accordingly, they can do this using the **Update System Parameters** wizard.

To update the system parameters based on recommended values of the battery strings:

1. In the **Battery Strings** table, select the **Update System Parameters** button.
2. A wizard window will open. It will contain a comparison of the current system parameters that are in effect, with the new ones. Note that the new values are calculated based on the recommended values from all battery strings in the system, not just any new or changed battery strings. The values are calculated as follows:
    - **Float Voltage:** The average of all valid recommended float voltages of the battery strings in the system.
    - **Equalize Voltage:** The average of all valid recommended equalize voltages of battery strings in the system.
    - **Temperature Compensation Slope:** Numerical lowest of all the recommended slopes of battery strings in the system. Since the slope is negative, this means the highest slope will be chosen, which is the safest option if strings with different recommended temperature compensation slopes are being used.
    - **Charge Current Max:** The lowest of all the recommended current values of battery strings in the system, but multiplied by the number of strings in the system. For example, if there are two battery strings and one has a recommended charge current maximum of 8 amps and the other has a recommended charge current maximum of 3 amps, the new value will be 3 amps × 2 = 6 amps.
3. To accept these values as the system parameters, select **Next**. To cancel and leave the values as they are, select **Cancel**.
4. The **Results** page will show whether the system parameters were updated successfully.

5.3.12. Configure third-party lithium-ion battery module parameters

The DC system is only permitted to have a single battery, though the battery may consist of multiple third-party lithium-ion battery modules. Battery modules are automatically added to the battery system according to the Cordex® HP protocol bridge peripherals assigned to the system. Each protocol bridge peripheral can communicate with up to 32 third-party lithium-ion battery modules.

Notice: *All third-party lithium-ion battery modules must be the same model. Mixing and matching battery modules from different manufacturers is not supported.*

Notice: *The **Maximum Temperature** and **Minimum Temperature** of all the battery modules are logged as performance logs. To see these logs, first follow the steps below to add battery*

*modules to your system. Then go to **Logs > Performance** to view the appropriate temperature log for the third-party lithium-ion battery.*

To add third-party battery modules to the DC system for the first time:

1. Connect a Cordex® HP protocol bridge peripheral for use with third-party lithium-ion battery module on the CAN bus, and ensure the third-party lithium-ion battery modules are connected to the protocol bridge.

2. Configure the protocol bridge as described in the following section.

3. Remove the default battery system so that a battery system compatible with third-party lithium-ion battery modules can be added. To do this, go to **Systems > DC System > Inventory > Battery**. If a battery already exists, remove it.

4. Launch the **Add Battery** wizard, and select **Add Third-party Li-ion Battery** from the dropdown list. Finish the wizard.

5. In **Systems > DC System > Inventory > Battery**, the third-party lithium-ion battery module connected via the protocol bridges will begin to appear in the **Third-party Li-ion Battery Modules** table. If the battery modules do not appear, the protocol bridges may not be assigned to the battery system or the protocol bridge has not been configured. If this is the case, use the **Configure Third-party Li-ion Battery** wizard to manually assign the appropriate protocol bridges to the battery system. For more information on configfuring the protocol bridge, see the following section.

6. By selecting the **Go To** button for a given battery module, the name and description can be set if desired; this can be helpful to record the battery replacement date, for example.

5.3.12.1. Configure the Cordex HP® Protocol Bridge Peripheral

On the system controller, when connected via CAN bus and acquired, the protocol bridge is seen as a CAN module; **Model:** Cordex HP® protocol bridge for generic lithium-ion batteries. If acquired appropriately, a user can go to the **Modules** page of the user interface to view that module within the **CAN Modules** table. Use the **Go To** button to see the information presented by the module. The protocol bridge can communicate with a variety of third-party lithium-ion batteries that communicate data via the Modbus protocol.

It is necessary to reconfigure a protocol bridge if it is replaced or if it needs to connect to a different battery module than it was previously configured for. To prepare for possibly replacement of a protocol bridge, first export and store the configuration from a fully configured protocol bridge first as described in the following section.

For the protocol bridge to be fully functional, the following entries must be configured:

- ModbusFunctionCode
- DuplexModeSelection
- BaudRate
- StopBits
- Parity

The configuration for the protocol bridge in the **Modbus Configuration** table.

Name	Default Value	Description

Modbus Function Code	ReadInputRegisters	The Modbus function code to be used in fetch data from the battery modules.
		
		    • ReadInputRegisters
		    • ReadHoldingRegisters

Duplex Mode Selection	HalfDuplex	The duplex mode to be used for Modbus connection. The protocol bridge peripheral uses RS-485 serial bus and half duplex is commonly used for Modbus communication.
		
		    • HalfDuplex
		    • FullDuplex

Baud Rate	9600	The baud rate to be used for Modbus connection.
		
		    • 9600
		    • 14400
		    • 19200
		    • 38400
		    • 57600
		    • 115200
		    • 128000
		    • 256000

Stop Bits	Bit1	The stop bit to be used for Modbus connection.
		
		    • Bit1
		    • Bit2

Parity	None	The parity to be used for Modbus connection.
		
		    • None
		    • Odd
		    • Even

Battery Address Range 1 Low	0	The first lowest range of the Modbus address in the network that the protocol bridge peripheral will search for the battery modules.

Name	Default Value	Description
		• 0 to 65535
Battery Address Range 1 High	0	The first highest range of the Modbus address in the network that the protocol bridge peripheral will search for the battery modules. • 0 to 65535
Battery Address Range 2 Low	0	The second lowest range of the Modbus address in the network that the protocol bridge peripheral will search for the battery modules. Set this value in case battery modules are located on a different register address. • 0 to 65535
Battery Address Range 2 High	0	The second highest range of the Modbus address in the network that the protocol bridge peripheral will search for the battery modules. Set this value in case battery modules are located on a different register address. • 0 to 65535
State of Charge Register Address	0	The register address to be used in fetching the State of Charge of the battery modules. • 0 to 65535
State of Charge Value Type	Integer16	The value type to be used in fetching the State of Charge data of the battery modules. • Integer16 • UnsignedInteger16 • Integer32MostSignificantWordFirst • Integer32LeastSignificantWordFirst • UnsignedInteger32MostSignificantWordFirst • UnsignedInteger32LeastSignificantWordFirst • Float32MostSignificantWordFirst • Float32LeastSignificantWordFirst

Name	Default Value	Description

State of Charge Byte Swap	Normal	The byte swap mode to be used in fetching the State of Charge data of the battery modules.
		
		    • Normal
		    • Swap

State of Charge Offset	0	The offset value to be used in fetching the State of Charge data of the battery modules. • –999999999 to 999999999
State of Charge Scale Factor	1	The scale factor to be used in fetching the State of Charge data of the battery modules. • 0 to 10000
State of Health Register Address	0	The register address to be used in fetching the State of Health data of the battery modules. • 0 to 65535

State of Health Value Type	Integer16	The value type to be used in fetching the State of Health data of the battery modules.
		
		    • Integer16
		    • UnsignedInteger16
		    • Integer32MostSignificantWordFirst
		    • Integer32LeastSignificantWordFirst
		    • UnsignedInteger32MostSignificantWordFirst
		    • UnsignedInteger32LeastSignificantWordFirst
		    • Float32MostSignificantWordFirst
		    • Float32LeastSignificantWordFirst

State of Health Byte Swap	Normal	The byte swap mode to be used in fetching the State of Health data of the battery modules.
		
		    • Normal
		    • Swap

State of Health Offset	0	The offset value to be used in fetching the State of Health data of the battery modules.

Name	Default Value	Description
		• –999999999 to 999999999
State of Health Scale Factor	1	The scale factor to be used in fetching the State of Health data of the battery modules. • 0 to 10000
Battery Current Register Address	0	The register address to be used in fetching the current data of the battery modules. • 0 to 65535
Battery Current Value Type	Integer16	The value type to be used in fetching the current data of the battery modules. • Integer16 • UnsignedInteger16 • Integer32MostSignificantWordFirst • Integer32LeastSignificantWordFirst • UnsignedInteger32MostSignificantWordFirst • UnsignedInteger32LeastSignificantWordFirst • Float32MostSignificantWordFirst • Float32LeastSignificantWordFirst
Battery Current Byte Swap	Normal	The byte swap mode to be used in fetching the current data of the battery modules. • Normal • Swap
Battery Current Offset	0	The offset value to be used in fetching the current data of the battery modules. • –999999999 to 999999999
Battery Current Scale Factor	1	The offset value to be used in fetching the current data of the battery modules. • –10000 to 10000

Name	Default Value	Description
Temperature Register Address	0	The register address to be used in fetching the temperature data of the battery modules. • 0 to 65535
Temperature Value Type	Integer16	The value type to be used in fetching the temperature data of the battery modules. • Integer16 • UnsignedInteger16 • Integer32MostSignificantWordFirst • Integer32LeastSignificantWordFirst • UnsignedInteger32MostSignificantWordFirst • UnsignedInteger32LeastSignificantWordFirst • Float32MostSignificantWordFirst • Float32LeastSignificantWordFirst
Temperature Byte Swap	Normal	The byte swap mode to be used in fetching the temperature data of the battery modules. • Normal • Swap
Temperature Offset	0	The offset value to be used in fetching the temperature data of the battery modules. • –999999999 to 999999999
Temperature Scale Factor	1	The scale factor to be used in fetching the temperature data of the battery modules. • 0 to 10000
Cycle Count Register Address	0	The register address to be used in fetching the cycle count data of the battery modules. • 0 to 65535
Cycle Count Value Type	Integer16	The value type to be used in fetching the cycle count data of the battery modules.

Name	Default Value	Description
		• Integer16 • UnsignedInteger16 • Integer32MostSignificantWordFirst • Integer32LeastSignificantWordFirst • UnsignedInteger32MostSignificantWordFirst • UnsignedInteger32LeastSignificantWordFirst • Float32MostSignificantWordFirst • Float32LeastSignificantWordFirst
Cycle Count Byte Swap	Normal	The byte swap mode to be used in fetching the cycle count data of the battery modules. • Normal • Swap
Fully Charged Alerts Register 1 Address	0	Register address for fully charged alert. • 0 to 65535
Fully Charged Alerts Register 1 Mask	0	Register mask to be used for fully charged alert. • 0 to 65535
Charged Blocked Alerts Register 1 Address	0	Register address for charge blocked alert. • 0 to 65535
Charged Blocked Alerts Register 1 Mask	0	Register mask to be used for charge block alert. • 0 to 65535
Charged Blocked Alerts Register 2 Address	0	Register address for the charge blocked alert. Set this value in case that the alerts are split across multiple registers. • 0 to 65535
Charged Blocked Alerts Register 2 Mask	0	Register mask for the charge blocked alert. Set this value in case that the alerts are split across multiple registers.

Name	Default Value	Description
		• 0 to 65535
Failure Alerts Register 1 Address	0	Register address for battery failure alert.
		• 0 to 65535
Failure Alerts Register 1 Mask	0	Register mask for charge blocked alert.
		• 0 to 65535
Failure Alerts Register 2 Address	0	Register address for battery module failure alert. Set this value in case that the alerts are split across multiple registers.
		• 0 to 65535
Failure Alerts Register 2 Mask	0	Register mask for battery module failure alert. Set this value in case that the alerts are split across multiple registers.
		• 0 to 65535

📢 **Notice:** *Refer to the data sheet of the battery module you are configuring to get the correct values.*

5.3.12.1.1. Export the protocol bridge configuration

To export the configuration file of the protocol bridge:

1. Go to **Modules** → **CAN Modules** table, and select the **Go To** button on the appropriate protocol bridge peripheral.
2. In the **Modbus Configuration** table, select **Export Protocol Bridge Configuration**. The configuration file in CSV format will be downloaded to the local device.

5.3.12.1.2. Import the protocol bridge configuration

To import the configuration file of the protocol bridge:

1. Go to **Modules → CAN Modules** table, and select the **Go To** button on the appropriate protocol bridge peripheral.

2. In the **Modbus Configuration** table, select **Import Protocol Bridge Configuration.**

3. Select **Select File** and choose the configuration file to upload.

4. Select **Upload** to import the selected configuration file.

5.3.13. Configure the battery temperature sensors

The battery can have any number of battery temperature sensors. These should be added at the battery string level.

In previous releases, it was possible to add temperature values at the overall battery level. If you upgrade from a release that allowed that and you had temperature sensors at the overall battery level, those will be maintained and can still be used, but no new temperature sensors can be added at that level. You should add new temperature sensors on the individual battery strings.

Adding temperature sensors can be done using the **Add Multiple Temperature Values to Strings** wizard from the overall battery page. Otherwise, they can also be added manually from the individual battery string pages. Depending on your requirements, you can choose to have only a single temperature reading for your battery, or one for each battery string, block, or cell.

5.3.13.1. Add multiple temperature values to strings

To add multiple temperature values use the Add Multiple Temperature Values to Strings wizard:

1. In the first step of the wizard, you can choose whether to add temperature sensors to a single string, or to all of your battery strings. The following description will assume you chose to add to all your strings, but the steps to add to a single string are very similar. Choose **Add the same number of temperature sensors to all your battery strings.** from the dropdown menu on the first page of the wizard. Select **Next**.

2. Choose how many sensors you would like to add to each string. The same number will be added to each of your existing battery strings. Select **Next**.

3. In the third step of the wizard, you will be able to map each of these new temperature sensors to a temperature reading from an ADIO module, Custom Data, or other calculated temperature value. Select **Next**.

4. The temperature readings will be added to your battery strings, and a success or failure message displayed.

5.3.13.2. Add battery temperature values manually

To add and configure battery temperature sensors manually from the battery string pages:

1. Go to **Systems > DC System > Inventory > Battery**. Select on the details of an individual battery string.

2. On the **Temperatures** table, select **Add Temperature Value**. The table will be populated with a new line for temperature value.

3. Select the **Go To** button on the right-side of the line for the new temperature value.

4. A new page displays with information about the new temperature value. In the **Configuration** table you can enter an optional name and description if desired.

5. It is mandatory to select a **Battery Temperature Source** for the temperature value. Select the **Go To** button and select the desired temperature input. The dropdown list displays all temperature inputs present on all ADIO modules.

6. In the **Status** table, verify that the temperature is now reading a temperature value.

7. Repeat these steps for each temperature value required. When finished navigate back to the **Battery** page.

Enable the temperature sensor alarms as needed.

8. Go to **Modules**. Select each ADIO module you are using, and then view the **Alarms** table. For the temperature sensor you are using, verify that the **Temperature Sensor Failure Alarm** is enabled.

In the **Temperatures** table, you should now see a list of temperature values. The battery **Status** table should show the minimum, average and maximum temperature values as determined from the list of temperatures. The battery **Status** table at the overall battery level will also contain the minimum, maximum, average, and active temperatures across all temperatures sensors within the battery, including all temperatures for both the strings and the battery itself. At the DC system level, battery temperature should now show a valid reading on the **Systems > DC System > Status** page.

5.3.14. Configure the charging system function

There is no way to turn off battery charging via the system controller, but you can control the bulk and absorption stages.

You can enable and disable charge current control in the bulk charging stage. For example, in a situation where multiple power systems are connected to the DC bus and a decrease in current on one system would result in an increase in current on the second system you may want to disable charge current control. Charge current control may be suspended for various reasons. If this is the case the **Charge Current Control State** will say **Suspended** and the suspend reason will be shown in **Charge Current Control Suspended Reason**.

You can enable or disable an increased voltage in the absorption charging state. If you disable **Elevated Absorption Charging** or the arming threshold was not reached, then the absorption charging stage will be done at the float voltage. You can configure **Elevated Absorption Charging** to terminate on a timeout and a low current threshold.

Absorption charging, at an increased voltage, is normally done for deep discharges only so there is an **Absorption Arming Threshold**. A battery discharge must reach a voltage below the **Absorption Arming Threshold** for **Elevated Absorption Charging** to be activated on the recharge.

To configure the charging system:

1. Go to **Systems > DC System > System Functions > Charging**. Note that you must have a battery defined in the DC system in order to have this menu item available under **System Functions**.

2. In the **Charge Current Control** table, ensure the **Charge Current Control** setting is **Enabled** (this is the default).

3. Set the **Charge Current (C/X)** limit to an appropriate value (for example,10 hours). See your battery manufacturers' data sheet for charging recommendations.

> 📢 *Notice: The charge current limit in amps cannot be set to an arbitrarily low value. The charge current control feature uses the rectifier module's ability to limit its output current. All rectifier modules have a lower limit to which their current can be adjusted and this value is documented in the rectifier module hardware manual. For example, if you have two Cordex® HP 48V-1.2kW rectifier modules, they have a minimum current limit of 23 percent of maximum current. This means the lowest amount of current they can output is 2 × 25 amps × 0.23 = 11.5 amps. If the load is 5 amps, the lowest charge current limit to the battery will be 11.5 amps – 5 amps = 6.5 amps. A charge current limit of less than 6.5 amps cannot be achieved with this arrangement.*

4. From the **Absorption Charging Configuration** table, enable **Elevated Absorption Charging**.

5. Set the **Elevated Absorption Arming Threshold** to a voltage that indicates a deep enough discharge to warrant absorption charging at a higher voltage.

6. Set the **Elevated Absorption Voltage** to a value recommended by the battery manufacturer.

7. Set the **Elevated Absorption Termination Threshold** in amps.

8. Set the **Elevated Absorption Timeout** in hours.

9. Set the **Terminate/Disallow Elevated Absorption When True** setting to either prevent or terminate elevated absorption based on a custom data condition (if desired).

5.3.15. Configure the temperature compensation system function

Temperature compensation uses the battery temperature to adjust battery voltage. The default value for temperature compensation is –1.5 mV/°F/Cell (–2.5 mV/°C/Cell).

To configure temperature compensation:

1. Go to **Systems > DC System > System Functions > Temperature Compensation**. Note that you must have a battery defined in the DC system in order to have this menu item available under **System Functions**.

2. Enable or disable **Temp Comp in Float**, **Temp Comp in Equalize** and **Temp Comp in Absorption**.

3. Set the **Slope** based on the battery manufacturer's information.

4. Set the **Upper Temperature Breakpoint Voltage** to a value below the float voltage.

5. Set the **Lower Temperature Breakpoint Voltage** to a value above the float voltage.

6. Adjust the values and enable or disable the **Temp Comp Sensor Fail** and **Temp Comp Voltage Warning** alarms.

5.3.16. Configure battery runtime and health estimation

Battery runtime and health estimation is used to calculate **Estimated State of Charge** during charges and discharges, **Estimated Battery Health** for discharges that exceed a 20 percent Depth of Discharge and Estimated Battery Runtime at all times.

To configure battery runtime and health estimation:

1. Go to **Systems > DC System > System Functions > Battery Runtime & Health Estimation**. Note that you must have a battery defined in the DC system in order to have this menu item available under **System Functions**.

2. In the **Configuration** table, select the **Edit** button to enable or disable **Battery Estimation**.

3. Set the **Load Model**. The load model has no affect on calculating **Estimated State of Charge** or **Estimated Battery Health** but it has a significant impact on calculating the **Estimated Battery Runtime**.
   a. With the constant current model, the load current is expected to stay the same as the load voltage decreases.
   b. With the resistive model, the load current is expected to decrease as the load voltage decreases.
   c. With the constant power model, the load current is expected to increase as the load voltage decreases.

4. Set the **Battery LVD**. If there is no battery low voltage disconnect (BLVD), this can be left unknown.

5.3.17. Run a manual battery test

Once your DC system is set up, running a manual battery test may be as simple as selecting the **Start Manual Battery Test** command.

1. Go to **Systems > DC System > System Functions > Battery Test**. Note that you must have a battery defined in the DC system in order to have this menu item available under **System Functions**.

2. From the **Configuration** table, set the **Termination Voltage**, **Timeout** and **Termination State of Charge** values.

   Which ever one of these conditions occurs first will terminate the battery test.

3. From the **Status** table, select the **Start Manual Battery Test** command.

To start a battery test, the **Battery Mode** must be in the **Float** mode. Otherwise the battery test cannot start.

There are a number of reasons why the test might terminate early. Two examples are a weak battery detected where the voltage drops too quickly and AC failure being reported by the rectifier modules.

If **Battery Runtime & Health Estimation** is **Enabled** you should see the battery State of Charge and Estimated Battery Runtime, update during the test. If the test runs long enough, the test results should be stored in the **Battery Log** page.

5.3.18. Configure power save

Power Save works to improve the efficiency of the system by optimizing the output power of the rectifier modules. This section describes how to configure **Power Save**.

Power Save should only be used on systems with a battery. If the system supports 120 to 240VAC input voltage operation and is operating at less the 208VAC - do not use **Power Save**.

1. Go to **Systems > DC System > System Functions > Power Save**.
2. In the **Configuration** table, enable **Power Save**.
3. Set the percentage of **Module Power for Maximum Efficiency**. The default value is 80%.

   For best efficiency performance, refer to the specifications in the module's hardware manual. Ensure this value is below the user configured current or power capacity in the **Rectifiers > Configuration** menu.

4. Set the module rotation period in days. The default is seven days.

   Module rotation occurs at 3:00 AM.

5.4. Connect to other systems

The output of a DC system can be used to power DC loads as well as converter and inverter systems. These power systems act as a load on the DC system and you have to represent them as loads on the DC system to ensure the DC system calculations are accurate.

5.4.1. Represent a converter system as a DC load

A converter system is represented on a DC system like an ordinary DC load.

To configure a converter system as a DC load:

1. Go to **Systems > DC System > Inventory > Loads**. You will see a list of loads in the system. Add or remove loads from this screen.
2. Select the **Go To** button for the load you want to configure.
3. In the **Configuration** table, assign the load a name and a description. We recommend that you assign the load a name that represents the actual load.

4. Select **Load Voltage Source**. This voltage is the DC input to the converter system. This is normally a voltage input on an ADIO module that measures the DC system voltage.

   If you do not have this connected, you can select the input that reads the battery voltage or system voltage.

5. Select **Load Current Source**. This is normally the **Converter System > Total Input Current** value.

6. Configure the related load alarms.

5.4.2. Represent an inverter system as a DC load

An inverter system will normally have an AC input and a DC input. The inverter system may only be using the DC input when the AC input has failed. When the AC input is available, the inverter system may take all of its power from the AC input.

On the system controller, inverter systems can measure the DC current they are using and they can also calculate how much DC current they are expecting to use, should their AC input fail. The DC system uses both of these values to calculate the battery runtime remaining in all situations.

To configure an inverter system as a DC load:

1. Go to **Systems > DC System > Inventory > Loads**. You will see a list of loads in the system.

2. Select the **Add Inverter System Load** button the **Loads** table to add a new load to the list.

3. Select the **Go To** button for the load you want to configure.

4. In the **Configuration** table, assign the load a name and a description. We recommend that you assign the load a name that represents the actual load.

5. Select the **Load Voltage Source**. This voltage is the DC input to the inverter system. This is normally a voltage input on an ADIO module that measures the DC system voltage.

   If you do not have this connected, you can select the input that reads the battery voltage or system voltage.

6. Select the **Load Current Source**. This is normally the **Inverter System > DC Input Current** value which is measuring how much DC current the inverter system is using right now.

7. Select the **DC Input Current In AC Failure Source**. This is normally the **Inverter System > Expected DC Input Current In AC Failure Source** value which is measuring how much DC current the inverter system is expecting to use should the AC input fail.

8. Configure the related load alarms.

5.5. Multiple DC power system support

In version 8.30 and later, multiple DC power systems are supported. You can create a new DC power system even if there is an existing DC power system in the system controller. This feature allows creation of multiple DC power systems that have different voltages but modules assigned to these systems must support this as indicated by the Multi-system compatibility field shown in the module details. They can be the same nominal voltage, but each must operate on its own DC bus.

To create and configure multiple DC system:

See the Create a DC system section.

> 📢 **Notice:** *Multiple DC system supports next generation rectifier modules that support multi-system compatibility. Currently only DPX 5kW 380VDC rectifier modules are supported.*

6. Converter systems

This section provides an overview of converter modules, how they function, and how to configure a converter system.

6.1. Introduction to converter systems

A DC-DC converter system takes a DC input voltage and converts it to a different output voltage. A converter system provides flexibility that allows you to maintain a single voltage battery system. Converter modules provide DC-DC power conversion (for example, from +24 to –48 volts) to produce a consistent voltage source for equipment that is not compatible with the primary plant voltage. Converter modules can be used to create dual voltage capability in new systems **or** upgrades to existing DC plants. They provide tight voltage regulation for sensitive loads as well as galvanic isolation.

Mixed converter system

Different types of converter modules must be used within different converter systems, check your system and rectifier module or converter module manuals for a list of any default parameters or requirements.

Components of a converter system

A converter system consists of a source, converter modules, and a load as shown in the following diagram. Converter modules should have dedicated fuse or circuit breaker positions on the main DC power system for protection and isolation.

Figure 6-1 Example converter system

Quick reference for configuring a converter system

Figure 6-2 Quick reference for configuring a converter system

```
┌──────────────────────────────────┐        ┌──────────────────────────────────┐
│ System > Add or Remove Systems   │        │ Modules > ADIOs > L-ADIO         │
├──────────────────────────────────┤        ├──────────────────────────────────┤
│ Create Converter System          │        │ V1 > Name = 48V Bus Voltage      │
└──────────────────────────────────┘        │ I1 > Name = Battery Current      │
                                             │ T1 > Name = Battery Temp         │
┌──────────────────────────────────┐        │ K1 > Name = LVBD Relay           │
│ `System > Converter              │        │ K10 > Name = Minor Alarm         │
│ System > Configure System        │        │ K11 > Name = Major Alarm         │
├──────────────────────────────────┤        │ K12 > Name = Critical Alarm      │
│ [System Voltage Source]          │        └──────────────────────────────────┘
│ Output Voltage = 27V             │
│ Converter Assignment Rule        │        ┌──────────────────────────────────┐
│              = Automatic         │        │ Converter System Calculated Values│
└──────────────────────────────────┘        ├──────────────────────────────────┤
                                             │ Average Converter Output Voltage │
┌──────────────────────────────────┐        │ Total Output Current             │
│ System > Converter               │        │ Total Input Current              │
│ System > Inventory > Loads >     │        └──────────────────────────────────┘
│ Load                             │
├──────────────────────────────────┤
│ [Load Voltage Source]            │
│ [Load Current Source]            │
└──────────────────────────────────┘

┌──────────────────────────────────┐
│ System > Converter               │
│ System > Inventory >             │
│ Converters > Configuration       │
├──────────────────────────────────┤
│ Note: The defaults are fine for  │
│ this example                     │
└──────────────────────────────────┘
```

6.2. Creating a converter system

There is no converter system on a new system controller. Creating a converter system is done using the **Create System** wizard. In the current release, only a single converter system is supported, so if a system already exists on the system controller, the option to create a new converter system will not be available.

You can also import a configuration file containing a converter system from another system controller.

A new power system can be created from the LCD panel or the web interface, via the **Systems > Add or Remove Systems** menu. Both have wizard assistance to help step you through the process to create the new system. You can create either a 48V-24V system or a 24V-48V system. When the system is created, an associated load is also created.

The converter system created will have a reasonable set of defaults and associated alarms. Optional converter descriptors, such as **Name**, **Description**, **System Number**, and **Serial Number** can be used to describe and organize your system.

You can configure the converter module alarms associated with the system. You can enable or disable the alarms, change the priority, map relays to the alarms, and where applicable, modify the thresholds.

To create a converter system:

1. Go to **Systems > Add or Remove Systems**.

2. Select **Create Converter System**. Name the system if required.

3. In the **Select System Type** dropdown menu.

4. Step through the rest of the wizard instructions.

5. Use the **Configure Converter System** wizard to configure the basic system settings and the system inventory.

6.2.1. Creating a system from a configuration file

A system can be created by importing from a configuration file. See the *Importing a system* section for more information.

6.3. Configure the converter modules

These settings include start delay, output voltage, or overvoltage protection (OVP) threshold.

> 📢 *Notice: The output voltage is also the voltage that the converter modules default to if they lose communication with the system controller. The converter modules will drop any of the adjustments made by the system controller to perform load sharing and just try to meet the configured output voltage.*

This feature has a time delay that varies according to converter modules. Most converter modules revert to output mode after five minutes. Check the converter module manual for a list of default parameters.

To configure the converter modules:

1. Go to **Systems > Converter System > Inventory > Converters > Configuration**.

2. In the **Configuration** table, set up your converter module group configuration settings. These include, **System Start Delay** and **Overvoltage Protection** threshold.

3. Configure the settings for the converter modules. The values for these settings depend on your specific system.

6.4. Configure the shunts

By default the system has no shunts. You may add or remove shunts as needed.

To configure a shunt you need an ADIO module with current inputs. The shunt will map the current inputs from the ADIO module to the **Load Current Source** field of the **Load** configuration table or the **Battery Current Source** field of the **Battery Configuration** table.

To configure the shunts:

1. Go to **Systems > Converter System > Inventory > Shunts**. You will see a list of shunts in the system. Add or remove shunts from this page.

2. Select the **Go To** button for the shunt you want to configure.

3. In the **Configuration** table, assign the shunt a name and description. We recommend that you assign the shunt a name that represents the actual shunt. For example you might name it **Battery Shunt**.

4. Select the **Shunt Current Source**.

    This is the current input on an ADIO module that takes a voltage reading across the shunt.

5. Enter the **Range in Amps** for the shunt.

6. Enter the **Range in Millivolts** for the shunt.

7. Enter the **Offset Calibration** for the shunt if the shunt reading error is too high.

6.5. Configure the loads

By default the system has one load. You may add or remove loads as needed.

To configure the loads:

1. Go to **Systems > Converter System > Inventory > Loads**. You will see a list of loads in the system. Add or remove loads from this screen.

2. Select the **Go To** button for the load you want to configure.

3. In the **Configuration** table, assign the load a name and a description. We recommend that you assign the load a name that represents the actual load.

4. Select the **Load Voltage Source**. This is the voltage input on an ADIO module that takes a voltage reading near the load.

    If you do not have a sensor connected, you may want to select the **Average Converter Output Voltage**.

5. Select the **Load Current Source**. This is the shunt input that reads the load current. If you have a real shunt reading for the load current, then select the shunt from the dropdown menu. If you don't see the shunt you want, then create it.

    If you do not have a shunt for reading the load current, you may want to select the **Total Output Current** for the converter system.

6. Select the **Edit** button for the **Load Breaker/Fuse Source**. Select the digital input on the ADIO module which is connected to monitor the breaker or the fuse.

    If you need to change the polarity for the **Load Breaker/Fuse Open** alarm, go to the **Modules** menu, from the All Modules table, select the ADIO module required, and then select the **Go To** button to access the **Digital Inputs** table.

7. Configure the related load alarms.

6.6. Configure the current transducer module

The system, by default does not contain any current transducer modules. You can add or remove current transducer modules as needed. To configure a current transducer module you need a voltage input on an

ADIO module. To configure a current transducer module with a Cordex® HP current transducer interface and power module (CT-IPM), you need a shunt input on an ADIO module.

To configure a current transducer module:

1. Go to the system where you want to add the transducer module and navigate to the inventory page. Go to **Systems > DC System > Inventory > Other Transducers**. In the **Other Transducers** table, there will be a list of current transducer modules in the system. Add or remove them from this page.

   You may be using a current transducer module with **Interface & Power Module (IPM)**. This device takes the voltage reading from a current transducer module and divides the reading by 50. The factored voltage reading is then sent to the Cordex® HP L-ADIO smart peripheral shunt input.

2. Select the **Go To** button for the **Current Transducer** you wish to configure.

3. In the **Configuration** table, select **Configure Current Transducer** to launch the wizard and complete each step to configure the transducer module.

4. Enter the **Measurement Range** in amps.

5. Enter the **Range in Volts**.

6. Select **CT Current Source**. This can be any voltage source.

7. Optional: enter the **Offset** calibration for the **Current Transducer** if the reading error is too low or high.

6.7. Configure the general purpose transducer module

The system, by default does not contain any general purpose transducer modules. You can add or remove general purpose transducer modules as needed. To configure a general purpose transducer module you need a voltage input on an ADIO module.

To configure a general purpose transducer module:

1. Go to the system where you want to add the transducer module and navigate to the inventory page. Go to **Systems > DC System > Inventory > Other Transducers**. In the **General Purpose Transducers** table, there will be a list of general purpose transducer modules in the system. Add or remove them from this page.

2. Select the **Go To** button for the **General Purpose Transducer** you want to configure.

3. In the **Configuration** table assign a name and a description.

4. Select **Transducer Input Source**. This can be any voltage source or a custom data.

5. Enter the **Transducer Input Minimum in Volts** and **Transducer Input Maximum in Volts**.

6. Enter the **Transducer Output Minimum** and **Transducer Output Maximum**.

7. Select **Units and Precision**.

8. **Optional**: Enter the **Offset** calibration for the calculated **Value** if the reading error is too low or high.

The **Calculated Slope** and the **Offset** are used to convert the **Input Source Value** to the **Value**. The value is displayed in the selected units and precision.

7. Inverter systems

This section provides an overview of inverter modules, how they function, and how to configure an inverter system.

7.1. Introduction to inverter systems

An inverter system takes both AC and 48VDC input and converts it to 120VAC output voltage. The inverter system can operate in one of several modes:

- **Line (AC-AC):** When AC input is present the inverter modules normally take this voltage and convert it to AC at the output.

- **Inverter (DC-AC):** When AC input is lost, the inverter modules take the DC input voltage and convert it to AC at the output.

- **Bypass Mode:** When the maintenance bypass switch has been used to bypass the inverter modules and directly connect the AC input to the output.

To monitor and interact with the inverter system, the system controller communicates with a sub-controller, called an Alpha$^®$ T2S inverter controller module.

7.1.1. Components of an Alpha$^®$ T2S Inverter System

An inverter system typically consists of an AC source, a DC source, inverter modules, an AC load, input breakers, output breakers, and a bypass switch. A very large inverter system may not have a bypass switch and will use breakers to perform the maintenance bypass function.

Figure 7-1 Single Alpha$^®$ T2S inverter system components

7.1.2. Quick reference for configuring an inverter system

Figure 7-2 Quick reference for configuring an inverter system

7.1.3. Phase and group data

The inverter system will aggregate and display data about the output phases, AC input groups, and DC input groups.

The output phase information includes data such as the output voltage, output power (in VA and W), frequency, and loading.

The AC input group information include data such as the input voltage, input power (VA and W), and frequency for each phase (there is a one-to-one correspondence between the phase and AC input group).

The number of DC input groups is the number of redundant DC input sources. An example is a system with separate batteries. The DC input group information includes data such as the DC voltage, current and power (W).

To get information on **Phase and Group Data**, go to **Systems > Inverter System > Phase and Group Data**.

> *Notice: When the AC output is light (10 percent or less) or the phases are unbalanced, some of the data, (percentage of DC input, DC input current or AC output power readings) will tend to be inaccurate and inconsistent. This is normal. Once the AC output is loaded sufficiently the readings will be correct.*

7.1.4. Live alerts

The Alpha® T2S inverter systems in an inverter system report alert status relating to the Alpha® T2S inverter system or its inverter modules via the **Live Alerts** table. Go to **Systems > Inverter System > Live Alerts**. The table shows the **Owner** of the alert, the alert **Type** and the **Alert Name**.

The **Owner** of the alert indicates if the alert belongs to the Alpha® T2S inverter system or to a specific inverter module.

The **Type** of alert indicates if the alert is an individual Alpha® T2S inverter system alert, an inverter module alert or a system alert. A system alert is an alert that is active on all inverter modules. A system alert usually indicates a configuration error or a problem with an input source or an output which is affecting all inverter modules at the same time.

The **Alert Name** displays the name of the alert as well as a numeric code. This numeric code can be used to cross reference the alert in the Alpha® T2S inverter system log file when troubleshooting.

Additional information about a specific alert can be found in **Alerts** table of the **Owner** identified within the **Live Alerts** table.

7.1.5. System functions

The inverter system has three functions available:

• Zero phase shift

• AC input power limit

• Manual DC priority

These are briefly described in the following section. For information on using these functions go the **Inverter & T2S System Maintenance** section.

Zero phase shift

The output of the inverter modules is normally shifted from the input by five degrees for certain regulatory compliance. For some systems running on a generator system, it may be necessary to momentarily reduce this phase shift to zero degrees before any manual bypass operation is performed. A wizard guides you through this operation.

During the wizard, the system controller will check the difference between the input voltage and output voltage (as measured line-neutral). This difference is caused by different levels of loading on input or output or unusual AC mains conditions. If the difference is greater than six volts, a warning indicates that proceeding with the bypass operation may result in momentary interruption of power to the load. If the difference is larger than six volts there is a small chance that inverter modules may shutdown when they detect too much current flowing into the input or output as the bypass switch is turned. If this warning is occurs, wait until input and output are closer together.

AC input power limit

This function can be used to limit the AC input power that the inverter system will take by using some of the energy from a DC bus. If there is only a battery (and no rectifier modules) supplying the DC bus, this function must be manually controlled by an operator to ensure the battery is recharged once it is depleted.

Manual DC priority

This function can be used to take power from the DC bus based an on a user-specified percentage. If there is only a battery (and no rectifier modules) supplying the DC bus, this function must be manually controlled by an operator to ensure the battery is recharged once it is depleted.

7.2. Create an inverter system

There are two options for creating an inverter system:

• Use the **Create System** wizard via the **Systems > Add or Remove Systems** menu, and select **Create Inverter System** from the dropdown menu of systems to create.

• Use a configuration file to import an inverter system.

After an inverter system is created, it must have one Alpha® T2S inverter controller module assigned to it. The module is a CAN device that controls and monitors the inverter modules.

7.2.1. Create a system from a configuration file

A system can be created by importing from a configuration file. See the *Importing a system* section for more information.

7.3. Assign an Alpha® T2S Inverter Controller Module

Each inverter system requires one assigned Alpha® T2S inverter controller module. If the **T2S Assignment Rule** was set to **Automatic** during system creation, then a module is automatically assigned once discovered on the CAN bus.

If the **T2S Assignment Rule** was set to **Manual**, go to **Systems > Inverter System > Inventory > T2S**, and select **Assign** in the **Modules Available for Assignment** table.

> 📢 *Notice: It can take several minutes to discover an Alpha® T2S inverter controller module on the CAN bus, for the first time.*

7.4. Commission an inverter system

Once an inverter system has been created, and an Alpha® T2S inverter controller module has been assigned to the system, it can be commissioned. There are three stages to commissioning:

- Setting the system options
- Commissioning seed inverters
- Adding inverters

Setting system options

This wizard requests the following configuration information:

- Output voltage
- Frequency
- AC phases
- DC input groups
- DC commissioning

Output voltage can be set to 120V or 230V. Refer to the system specifications to determine which voltage setting is correct. The output voltage normally matches the input voltage.

Frequency can be set to 60 Hz or 50 Hz is the same for both input and output. Refer to the system specifications to determine with frequency is correct. DC commissioning can be set to **No** or **Yes**. Normally AC is input is present and this should be set to No.

> 📢 **Notice:** *It is important that these values are correct for the proper operation of system commissioning, and for adding new inverter modules.*

Commission seed inverter modules

The second stage of commissioning involves inserting one seed inverter module for each phase. The seed inverter module provides a reference for all other inverter modules in the same phase so they can learn their power configuration and the phase angle. The commission wizard steps the user through the process. Once this is complete, there will be one inverter module (per phase) in the system.

> 📢 **Notice:** *Follow all wizard instructions: If a mistake is made during commissioning or the wizard encounters an error, commissioning must start over.*

Commissioning may take several minutes to complete. This process is complex due to several factors:

1. The type of AC input source connection is unknown. The AC input source may be connected as single phase, split phase, 2-pole, or three phase. The system controller identifies the correct configuration of the AC input and configures the Alpha® T2S inverter controller module accordingly.

2. For three phase and split phase connection, the AC phase rotation is unknown. This means that if phase 1 is assumed to have a phase angle of 0 degrees, phase 2 may have a phase angle of 120 degrees or 240 degrees. The system controller will identify the correct phase rotation.

3. The inverter modules take time to synchronize to the AC input. As the system controller probes all possible combinations the inverter modules take at least 30 seconds after each combination before determining if they have synchronized to the AC input.

Once the correct AC input connection and the phase angle have been determined, the Alpha® T2S inverter controller module is configured correctly to accept more inverter modules.

Adding inverter modules

The third stage of commissioning involves inserting the rest of the inverter modules. This process takes time. It is recommended that you follow all the instructions within the wizard.

When an inverter module is inserted, it learns its power configuration from the inverter modules already inserted in that phase. The system controller sets the values for the following:

- AC input group
- DC input group
- The location information of bay ID, slot ID, and shelf ID
- The correct phase number and phase shift.

After all inverter modules are inserted into the shelves, the final step is to configure the Alpha® T2S inverter controller module with the parameters for the number of modules per phase, and the number of redundant modules in each phase. This information is important for the correct operation of alarms associated with redundancy, missing inverter modules, or system overload.

> 📢 **Notice:** *After configuring and commissioning is successful, make a backup of the system from the LCD panel via the **Shortcuts > Backup** menu. This allows the system configuration to be restored in the event of a system controller replacement.*

7.5. Configure the Alpha® T2S Inverter Controller Module

The configuration of the Alpha® T2S inverter controller module occurs primarily during the commissioning process. There are two optional settings that an operator may want set after the commissioning is complete: the Alpha® T2S inverter controller module name and description.

Additionally, there are some Alpha® T2S inverter controller module configuration parameters for the number of modules per phase and the amount of inverter redundancy in a phase that are set during the add and remove wizards. This is why it is required to use these wizards when changing the number of inverter modules in a system.

To configure Alpha® T2S inverter controller module:

1. Go to **Systems > Inverter System > Inventory > T2Ss** and select the **Go To** button of the module.
2. In the **Configuration** table, enter the **Name** and **Description**.

7.6. Configure the inverter modules

Inverter modules are normally configured automatically when using the commissioning and add inverter modules wizards. The inverter module parameters that are configured automatically are, AC and DC input group, as well as the bay ID, shelf ID, and slot ID.

To reconfigure an inverter module, remove the inverter module first, using use **Remove Inverters** wizard. Add it back into the system using the **Add Inverters** wizard. This ensures that the system configuration remains correct and consistent.

Alternatively, the number of redundant inverter modules per phase can be changed using the **Configure Inverter Redundancy** wizard. To access the wizard go to **Systems > Inverter System > Configure System**.

For expert users it is possible to change the inverter modules DC Input group and bay ID, shelf ID, and slot ID.

To configure inverter module values manually:

1. Go to **Systems > AMPS HP2 Inverter System > Inventory > Inverters > Status** and select the **Go To** button for the inverter module.

2. In the **Inverter Mapping** table, set the **Bay ID** and **Shelf ID** and **Slot ID** to the desired values.

3. Launch the **Change DC Input Group** wizard and follow the steps.

7.7. Configure the bypass switch

The inverter system can have one or more bypass switches. The bypass switch will raise an alarm when the inverter system goes into bypass mode.

If there is more than one bypass switch, then the inverter system will go into bypass mode when any of the bypass switches are activated. During creation of the inverter system a default bypass switch is created. If a physical bypass switch does not exist, the bypass switch should be removed from the system.

7.7.1. Configure a basic bypass switch

The following describes how to configure a basic bypass switch. If the site is equipped with an Alpha® external maintenance bypass switch (XMBS), see the following section.

To configure the basic bypass switch:

1. Go to **Systems > Inverter System > Inventory > Breakers, Fuses and Bypass Switches**. Select the **Add Bypass Switch** button. If a bypass switch exists, but needs to be removed, select **Remove**.

2. Select the **Go To** button of the bypass switch to configure.

3. In the **Bypass Switch** table, set the **Name**, **Description** and **Input Source** values. When the value of digital input source is **Active**, bypass is in the **Bypass** state. When it is Inactive, the bypass is in the **Inverter** state. Alternatively, select the **Configure Bypass Switch** wizard to be prompted for the essential configuration required for the bypass switch to function.

4. In the **Alarms** table, select the **Go To** button of the **Bypass Active** alarm and configure as required.

7.7.2. Configure an Alpha® External Maintenance Bypass Switch (XMBS)

To configure the Alpha® XMBS bypass switch:

1. Go to **Systems > Inverter System > Inventory > Breakers, Fuses & Bypass Switches**. Select the **Add Bypass Switch with XMBS support** wizard.

2. In the wizard, determine whether signals such as the switch's bypass state will be transmitted via CAN or hardwired I/O. CAN signals is the recommended connection type when available. The CAN signals connection type is not supported on Alpha® XMBS bypass switches (hardware revision 1).

3. After finishing the wizard, select the **Go To** button of the bypass switch to configure.

4. If the Alpha® XMBS bypass switch signals are to be transmitted via hardwired I/O, select the **Configure XMBS Hardwired Signals** wizard if it has not been configured already.

5. In the **Alarms** table, select the **Go To** button of each alarm and configure as required.

6. If the inverter system has an internal bypass switch, go to **Systems > Inverter System > Configure System** and map the **Internal Bypass Switch** entry appropriately. This allows the system controller to inform the Alpha® XMBS bypass switch of the internal bypass switch's position when signals are to be transmitted via CAN; this is important so that the Alpha® XMBS bypass switch can determine if it is interlocked (when the Alpha® XMBS bypass switch is in inverter module state, but the internal bypass switch is in bypass state).

Figure 7-3 A fully configured Alpha® XMBS bypass switch with hardwired I/O signals

Figure 7-4 A fully configured Alpha® XMBS bypass switch with CAN signals

7.8. Configure the breaker or fuse

The inverter system can have one or more breakers and fuses. An alarm condition occurs when a breaker or fuse is open. When first creating an inverter system, two breakers and a fuse are created by default. They should be removed if not needed.

To configure a breaker or fuse:

1. Go to **Systems > Inverter System > Inventory > Breakers, Fuses and Bypass Switches**. Select the **Add Breaker or Fuse** button if needed. If a breaker or fuse switch exists, but needs to be removed, in the **Breakers and Fuses** table, select **Remove**.

2. Select the **Go To** button of the breaker or fuse to configure.

3. In the **Configuration** table, enter the **Name**, **Description** and **Input Source** values. When the value of the input source is **Active**, the breaker or fuse is open. Alternatively, select the **Configure**

Breaker or Fuse wizard to be prompted for the essential configuration required for the breaker or fuse to function.

4. In the **Alarms** table, select the **Go To** button of the **Breaker/Fuse Open** alarm and configure as required.

8. Line power systems

This section provides an overview of line power converter modules, how they function, as well as how to configure a line power system.

8.1. Introduction to line power systems

The line power conversion modules in a line power system take a –48V nominal DC input voltage and converts it to a different output voltage. There are three types of line power modules:

- Cordex® HP LPS36 –48VDC to ±190VDC upconverter module

- Cordex® HP LPS36 ±137V upconverter module

- Cordex® HP eLimiter+ 57V distribution module

All three types have four independent output channels, each with a maximum output power of 100 watts. In a line power system (LPS) the output of the channels from different modules can be combined to supply power to loads at remote locations. Combining channels allows for supplying power to loads that may exceed the 100 watts limit of a single channel.

The two Cordex® HP LPS36 upconverter modules are designed for outdoor power applications that deliver power through existing copper telephone wires. The Cordex® HP eLimiter+ distribution module is designed for indoor power applications that use larger gauge wire for power delivery.

⚠️ **Warning:** *Working with line power modules, especially Cordex® HP LPS36 up converter modules, pose potentially fatal safety concerns. Refer to the appropriate hardware manual before attempting to wire an line power system or to get more detailed information about the electrical performance of these modules.*

8.1.1. Components of a line power system

Systems with Cordex® HP LPS36 up converter modules are different than systems with Cordex® HP eLimiter+ distribution modules.

Cordex® HP LPS36 up converter modules require down converter modules at the remote end to convert the high voltage output to a nominal –48V which is suitable for most loads.

The output of the Cordex® HP eLimiter+ distribution modules is already at –48V, so these systems do not require down converter modules.

Refer to the following diagrams for the typical components of an line power system.

Figure 8-1 Example Cordex® HP LPS36 line power system

Figure 8-2 Example Cordex® HP eLimiter+ class 2 distribution system

Notice: Due to the remote location of down converter modules, they are not monitored by the system controller.

8.1.2. Quick reference for configuring a line power system

Figure 8-3 Quick reference for configuring a line power system

```
┌─────────────────────────────────────┐      ┌─────────────────────────────────────┐
│ System > Add or Remove Systems       │      │ System > Line Power System          │
├─────────────────────────────────────┤      │ > Inventory > Line Power Modules    │
│ Create Line Power System             │      ├─────────────────────────────────────┤
│        System Type = 57V or +/-190V  │      │ Name                                │
└─────────────────────────────────────┘      │ Description                         │
                                              │ Bay, Shelf, Slot IDs                │
┌─────────────────────────────────────┐      │ Module Details & Alerts             │
│ System > Line Power System           │      │ Channel 1, 2, 3 & 4                 │
│ > Configure System                   │      └─────────────────────────────────────┘
├─────────────────────────────────────┤
│ Module Assignment Rule = Automatic   │      ┌─────────────────────────────────────┐
│ Primary Output Display = Watts or Amps│      │ System > Line Power System          │
└─────────────────────────────────────┘      │ > Inventory > Line Power Loads      │
                                              ├─────────────────────────────────────┤
┌─────────────────────────────────────┐      │ Name                                │
│ System > Line Power System           │      │ Description                         │
│ > Status                             │      │ Status                              │
├─────────────────────────────────────┤      │ Alarms                              │
│ Average Input Voltage                │      │ Power On / Power Off                │
│ Total Output Current                 │      └─────────────────────────────────────┘
│ Total Output Power                   │
│ Total Input Current (Est.)           │      ┌─────────────────────────────────────┐
│ Total Input Power (Est.)             │      │ System > Line Power System          │
└─────────────────────────────────────┘      │ > Inventory > Line Power Channels   │
                                              ├─────────────────────────────────────┤
                                              │ Name                                │
                                              │ Description                         │
                                              │ Shelf, Slot, Channel IDs            │
                                              │ [Line Power Load]                   │
                                              └─────────────────────────────────────┘
```

8.2. Create a line power system

There is no line power system on a new system controller. You can create a new system from scratch or import one from a configuration file that contains a system from another system controller. It is possible to create more than one line power system.

A new power system can be created from the LCD panel or the web interface, via the **Systems > Add or Remove Systems** menu. A wizard steps you through the process to create the new system. You can create three types of systems:

- Cordex® HP LPS36 ±190VDC line power system

- Cordex® HP LPS36 ±137V line power system

- Cordex® HP eLimiter+ class 2 distribution system

The new system will have a reasonable set of defaults and associated alarms where possible. Optional configurable descriptors, such as name, description, and system number, can be used to describe and organize your system.

You can configure the alarms associated with the line power system. You can enable or disable the alarms, change the priority, map relays to the alarms, and where applicable, modify the thresholds.

To create a line power system:

1. Go to **Systems > Add or Remove Systems** and select the **Create System** button.

2. Select **Create Line Power System** from the dropdown list. The **Create Line Power System** wizard will launch.

3. Name the system if required.

4. From the **Select System Type** dropdown list, select the value that corresponds to your line power module type. If there are line power modules already connected to the system controller, they are preselected with the correct option.

5. Follow the rest of the wizard instructions.

8.2.1. Create a system from a configuration file

A system can be created by importing from a configuration file. See the *Importing a system* section for more information.

8.3. Configure the line power modules

There are two settings that are applied to all line power modules: **Input Voltage Low Shutdown** and **Input Voltage Low Restart**.

When the input voltage falls below the low shutdown threshold, the line power modules will power off all output channels. Set this threshold to a value that prevents over-discharge of the battery.

When the input voltage rises above the restart threshold, the units turn back on. The restart threshold must be at least two volts above the shutdown threshold or the **LP Module Configuration Error** alarm will activate (Cordex® HP LPS36 up converter module only).

These settings are stored on the line power module itself which means that even if disconnected from the system controller, the line power modules will still perform in this way.

To configure the line power modules:

1. Go to **Systems > Line Power System > Configure System**.

2. In the **Configuration** table, set the **Input Voltage Low Shutdown** threshold to the desired value.

3. In the same table, set the **Input Voltage Low Restart** threshold to the desired value.

8.3.1. Shared alarm configuration

The **Shared Alarm Configuration** feature is a setting which can be used to enable, disable, or change the priority of alarms on all line power modules in a system. When using this feature you can configure both the **Channel Shutdown** and the **Module Failure** alarms on the specific line power system being configured. Configuring **Channel Shutdown** will apply the setting to each of the four channel shutdown alarms on each line power system module.

8.4. Line power module alarms

Line power modules assigned to a system, report active alarms which are displayed on the details page of each specific module, and on the **Active Alarms** page. Line power module alarms function the same as regular alarms with the exceptions of shared configuration, as detailed in the previous section.

Each line power module has four channel alarms and a **Module Failure** alarm.

A **Module Failure** indicates a module-level failure such as, input voltage, high/low, high temperature, or if the module has lost communication.

A **Channel Shutdown** is activated if any channel shutdown alert such as, overvoltage and ground fault, are active.

Both channel and module alarms provide an SNMP notification that identifies the alert or condition which produced the alarm, and the physical location of the module (bay-shelf-slot-channel).

8.5. Configure the line power system channels

Each line power module has four channels that can be given a name, description and assigned to a load. All channels are listed in table that can be sorted and searched. You can also export all channel details to a file.

To configure line power system channels:

1. Go to **Systems > Line Power System > Inventory > Line Power Channels.** You will see a table of channels in the system. There is also a **Export Channel Details** button to export the information to a CSV file.

   Channels cannot be added or removed. It is also possible to configure channels and get detailed channel information from **Systems > Line Power System > Inventory > Line Power Modules** and select the **Go To** button for the module.

2. Select the **Go To** button for the channel you want to configure.

3. In the channel table, assign an optional name and description. This might be a channel address, wire color, or customer name.

4. In the channel table, assign an optional **Line Power Load**. To assign a load it is necessary to first create a load. Refer to **Configure the Line Power Loads**.

8.6. Configure the line power system loads

A line power load represents the remote load that is powered by the line power module channels. Create a load when you want to monitor and alarm separate remote loads. Creating a load allows all channels that have been assigned to the load to be powered on or off as a group. To turn all the channels assigned to a load on or off, use the **Power On** or **Power Off** buttons on the **Configuration** table.

You may add or remove loads as needed. Removing a load does not affect the power delivered.

📢 ***Notice:*** *To assign channels to a load, refer to the section on Line power system layout or Configure line power system channels.*

To configure line power system loads:

1. Go to **Systems > Line Power System > Inventory > Line Power Loads**. You will see a table for loads in the system. This table shows how many channels are assigned to the load and the loads total output current and power. Add or remove loads from this screen.

2. Select the **Go To** button for the load you want to configure.

3. In the **Configuration** table, assign the load a name and a description. We recommend that you assign the load a name that represents the actual load.

4. Configure the load alarms as needed.

8.7. Line power system layout

The line power system **Layout** screen shows a graphical view based on the shelf and slot ID as reported by the line power modules. This view allows a convenient way to view module status and to configure and interact with individual channels.

8.7.1. Use the layout screen to view module status

The line power **Layout** screen provides a convenient way to view:

- Module shelf and slot position

- Output voltage, power, and current for each module

- Module and channel alert status

- Module and channel information (detailed)

- Load information (detailed)

How to use the Layout screen to view module and channel status:

1. Go to **Systems > Line Power System > Layout**. This screen shows a grid of line power modules organized by shelf ID vertically, and slot ID horizontally. Each module is represented by a rectangle showing the output voltage and the output power for each channel. The information in the rectangle is green to indicate that a module is operating normally.

   It is possible to display channel output power or channel output current on this screen. Change the **Primary Output Display** to the desired value in the **System Properties** table at **Systems > Line Power System > Configure System**.

2. Select a channel for detailed information. If a module has an active alert then the green turns to red to indicate an alert with the module or with a channel. If the alert is on a specific channel then the specific channel will be highlighted red. If it is module alert only, then the channels will all show green but there will be red border around the module. To get more detail on the active alert, select the channel that has the alert (if it is a module alert select any channel that belongs to the module).

3. In the **Channel Details** table, select the **Go To** button for the **Line Power Module** to view active alert information.

4. In the **Module Alerts** table sort by **Value** to bring the active alerts to the top of the table.

8.7.2. Use the layout screen to view load status

The following steps describe how to use the **Layout** screen to view load status.

1. Go to **Systems > Line Power System > Layout**.

2. Using the **Line Power Load** dropdown list, select a load. A table displays detailed information about the load. You can modify the name, description, and other information about the load as well as do all load management tasks from this page.

8.7.3. Use the layout screen to assign channels to loads

The line power **Layout** page provides a convenient way to:

- View which channels have been assigned to the line power loads

- Assign channels to a line power load

- Unassign channels from loads

- Add, remove, and rename loads

To use the Layout screen to view and configure channels assigned to line power loads:

1. Go to **Systems > Line Power System > Layout**. At the top of the table use the dropdown list to select a line power load. When **None** is selected, the channels that are not assigned to a load display as highlighted.

2. Select a load from the dropdown list. The channels assigned to this load will be highlighted.

3. To add a new channel to the load, select it. The channel rectangle will turn blue to indicate it is selected.

4. In the layout table, select **Assign Selected Channel(s) to Selected Load**. In the channel details table, the **Line Power Load** field will be populated with the name of the load.

   By default, the **Assign Selected Channel(s) to Selected Load** and **Unassign Selected Channel(s) from Load** buttons are disabled unless a load and channels are selected.

5. To unassign a channel from the load, select a highlighted channel, and then select **Unassign Selected Channel(s) from Load**. In the channel details table, the **Line Power Load** field will be set to "- - -".

6. To assign or unassign multiple channels at once, hold the control **CTRL** key on the keyboard and select the required channels which display as blue when selected.

7. Once all required channels are selected, use the **Assign Selected Channel(s) to Selected Load** or **Unassign Selected Channel(s) from Load** buttons to assign and unassign multiple channels.

8.8. Line power channels import

The line power channel import provides the ability to map line power channels to line power loads which are created on import for a line power system. This is achieved using a comma separated values (CSV) file which is filled in by the user.

The import will automatically remove pre-existing line power loads and channel assignments if the provided import file is valid. After removal, newly created inventory and configuration is added based on the file being imported.

The *Export line power channels* section will describe how to get started.

8.8.1. Export line power channels

Preamble: A line power connection in the system controller is the shelf, slot, and channel together which indicates its physical position in the system. The total connections on a system controller for a line power system is based on the maximum shelves (9) × maximum slots (12) × maximum channels (4), for a grand total of 432 total connections if modules are inserted in all shelves and slots.

How to export: with a line power system created and modules assigned to the system, a user can go to **Systems > Line Power System > Inventory > Line Power Channels** and select the **Export Channel Details** button to export a CSV file with all the currently existing line power connections available. The exported connections are based on the modules acquired for the line power system.

The sections: (1) 'Sort Exported Line Power Channels' will help sort the line power connections in Microsoft Excel as the file rows will be out of order and sorting will make it easier to enter data. (2) 'Enter data into a Line Power Channels File' will help populate the exported CSV file empty cells.

8.8.2. Sort exported line power channels

After export, a user can open the file in a CSV editing program such as Microsoft Excel. In Excel, for better readability, it is always recommended to sort the data presented as the shelf, slot, and channel data columns will be out of order. After sorting the data, a user can start entering the required data in sequential order for what channel belongs to which load.

To sort channel data in Microsoft Excel:

1. Highlight all the available data.
2. Select the **Data** tab.
3. Select **Sort** within the **Data** tab.
4. In the **Sort Window**, add the Shelf column for **Sort By** using the dropdown list. Additionally, verify the **Sort On** value is Cell Values and the **Order** value is A to Z.
5. In the **Sort Window**, select the **Add Level** button.
6. In the **Sort Window**, for the new level, add the Slot column for **Sort By**.
7. Select **OK** in the **Sort Window** to view the data in sequential order.
8. After sorting, follow section Enter data into a Line Power Channels File for details on what to enter into the empty CSV file cells.

8.8.3. Enter data into a line power channels file

When opening the line power channels CSV file, there are multiple columns with headings. Some columns are not to be changed, some are recommended to enter, and some are required to be filled in.

Fill in the empty CSV cells based on the following information.

Figure 8-4 A non-filled sorted line power channels CSV file

1. Column cells that should not be changed in the CSV file

The shelf, slot, and channel columns should not be modified as they are the possible connection values on the system which will be assigned to a line power load. These values are automatically populated when the line power channels template is used or the channels file is exported.

a. The **Shelf** column corresponds to the shelf which the line power module is inserted.

b. The **Slot** column corresponds to the slot on the shelf that the line power module is inserted.

c. The **Channel** column corresponds to the channel in the slot that the line power module is inserted.

d. The **Module** column will be empty if the line power channels template is used and it will be filled in with the module serial number if the channels file was exported from the system controller.

2. Column cells which are recommended to be changed in the CSV file

All recommended entries will be imported if a value is entered in the CSV cell associated with the line power channel but will not affect channel to line power load assignment.

a. The **Channel Name** can be entered with a suitable name.

b. The **Channel Description** can be entered with a suitable description.

c. The **Load Description** can be entered with a suitable description.

d. **Downstream Loads** that are linked to a line power load can be entered. The downstream loads are based on the **Load Name.** If the **Load Name**, is the same for multiple channels the downstream loads entry must be the same as well.

An example of a downstream load is a radio powered by a line power down converter module. The down converter module can be made to be the line power load in the line power system. There can be many radio loads linked to one line power load (down converter module) which provides the flexibility to enter those names into **Downstream Loads** column.

3. Column cells that is required to be modified in the CSV file

To create a load and assign a channel to a load, the **Load Name** must be entered for each channel

To assign multiple channels to the same line power load, a user may enter the same **Load Name** for each respective channel.

4. After the required information has been filled in

After modification of the file and saving it. Follow section *'Import a line power channels file*' for guidance on importing the file.

8.8.4. Import a line power channels file

📢 *Notice: If there are line power loads and channels that already exist on the line power system, then it is always recommended to export those channels as a backup just in case the system configuration needs to be reverted. Go to* **Systems > Line Power System > Inventory > Line Power Channels** *and pressing the* **Export Channel Details** *button. The exported file then can be re-imported later to return to that configuration if required.*

After modifying the line power channels CSV file, go to **Systems > Line Power System > Inventory > Line Power Channels** and select the **Import configuration from CSV** button. Upon successful import, verify that the system configuration is correct based on the imported CSV file.

Follow the following sections: (1) 'Verify a Line Power Channel Import' for tips on validating an imported CSV file and (2) 'Line Power Channels File Import Errors' to troubleshoot errors that may have been encountered on the import process.

8.8.5. Verify a line power channel import

After a successful import, it is always recommended to check against the file imported to what now exists on the system.

Line power channels and loads

In **Systems > Line Power System > Inventory > Line Power Channels** table. The values in this table will be filled based on the imported CSV file with each channel assigned to an expected line power load. This table can be used to verify the values entered in the CSV file match the expected system configuration.

Additionally, the **Systems > Line Power System > Inventory > Line Power Loads** table can be used to check the line power loads created and the number of channels assigned are correct.

Line power layout page

A secondary way to verify an imported CSV file is to go to the **Systems > Line Power System > Layout** page. This page serves as a all-in-one page to display the physical layout of a line power system. Additional information about the **Line Power Layout** page can be found in the section detailed **Line Power System Layout**.

In this table, selecting **Line Power Load** and selecting the **Load Name** in the dropdown list will highlight the channels associated with that load. A user can go through each load one-by-one using the CSV for reference to observe if assignment is correct.

For additional information on for the line power layout, visit the *Line power layout* section of this manual which describes the layout in more detail.

9. Auxiliary systems

This section provides an overview of the auxiliary system and how it is configured.

9.1. Introduction to auxiliary systems

The auxiliary system serves as a standalone system for monitoring the readings on a current or other transducer module. Both AC or DC current transducer modules can be used.

The typical application for this type of system is to monitor current flowing through the AC feeds into a site or a power system.

9.2. Create an auxiliary system

To create an auxiliary system:

1. Go to **Systems > Add or Remove Systems** and select the **Create Auxiliary System** button.
2. Go to **Systems > Auxiliary System > Configure System** and enter a **Name** and **Description** for the system.

9.2.1. Create a system from a configuration file

A system can be created by importing from a configuration file. See the *Importing a system* section for more information.

9.3. Current transducer modules

The physical current transducer module can be of the voltage-output type (0 to 5V or 0 to 10V) or current output type (4 to 20mA) type depending on the accuracy requirements. A 4 to 20mA type is more accurate because losses in the sensor leads are inherently compensated.

A transducer module with a voltage output can be connected directly to a Cordex® HP L-ADIO smart peripheral voltage input. A transducer module with 4 to 20mA output must have a 500R 500 ohm resistor added across the voltage input. For AC, the current transducer module must be of the type which conditions the signal to provide a DC output proportional to the RMS (or average) value. AC waveforms cannot be monitored by the Cordex® HP L-ADIO smart peripheral input circuitry due to noise filtering.

9.4. Configure the current transducer module

The system, by default does not contain any current transducer modules. You can add or remove current transducer modules as needed. To configure a current transducer module you need a voltage input on an ADIO module. To configure a current transducer module with a Cordex® HP current transducer interface and power module (CT-IPM), you need a shunt input on an ADIO module.

To configure a current transducer module:

1. Go to the system where you want to add the transducer module and navigate to the inventory page. Go to **Systems > DC System > Inventory > Other Transducers**. In the **Other Transducers** table, there will be a list of current transducer modules in the system. Add or remove them from this page.

   You may be using a current transducer module with **Interface & Power Module (IPM)**. This device takes the voltage reading from a current transducer module and divides the reading by 50. The factored voltage reading is then sent to the Cordex® HP L-ADIO smart peripheral shunt input.

2. Select the **Go To** button for the **Current Transducer** you wish to configure.

3. In the **Configuration** table, select **Configure Current Transducer** to launch the wizard and complete each step to configure the transducer module.

4. Enter the **Measurement Range** in amps.

5. Enter the **Range in Volts**.

6. Select **CT Current Source**. This can be any voltage source.

7. Optional: enter the **Offset** calibration for the **Current Transducer** if the reading error is too low or high.

9.5. Configure the general purpose transducer module

The system, by default does not contain any general purpose transducer modules. You can add or remove general purpose transducer modules as needed. To configure a general purpose transducer module you need a voltage input on an ADIO module.

To configure a general purpose transducer module:

1. Go to the system where you want to add the transducer module and navigate to the inventory page. Go to **Systems > DC System > Inventory > Other Transducers**. In the **General Purpose Transducers** table, there will be a list of general purpose transducer modules in the system. Add or remove them from this page.

2. Select the **Go To** button for the **General Purpose Transducer** you want to configure.

3. In the **Configuration** table assign a name and a description.

4. Select **Transducer Input Source**. This can be any voltage source or a custom data.

5. Enter the **Transducer Input Minimum in Volts** and **Transducer Input Maximum in Volts**.

6. Enter the **Transducer Output Minimum** and **Transducer Output Maximum**.

7. Select **Units and Precision**.

8. **Optional**: Enter the **Offset** calibration for the calculated **Value** if the reading error is too low or high.

The **Calculated Slope** and the **Offset** are used to convert the **Input Source Value** to the **Value**. The value is displayed in the selected units and precision.

10. Distribution systems

This section provides an overview of the operation and configuration of a distribution system and its subsystems, panels, and breakers.

10.1. Introduction to distribution systems

A distribution system is a way to define and track how the output power of a DC system is distributed. The system may be composed of specialized smart CAN modules built for the purpose of distribution or via general purpose ADIO modules in any configuration. The distribution system itself is just a container for distribution subsystems.

In the case of the specialized CAN modules (a smart subsystem), the subsystem will map one-to-one with the CAN module. For example, a Alpha$^®$ smart BDFBi peripheral will be represented in the distribution system as one subsystem. Manually created subsystems can be mapped to a number of ADIO modules, and contain a user defined number of breaker or fuse panels and breakers themselves.

Within a subsystem there may be a number of panels. A panel is a grouping of breakers and fuses. An exception is the distribution subsystem based on a EnVision™ energy router distribution panel, which does not include a concept of panels. The EnVision™ energy router based distribution subsytem is composed of a set of EnVision™ smart switch modules which are a type of smart breaker.

A panel is considered a downstream load of a subsystem and a breaker or fuse is considered a downstream load of a panel. A breaker can then feed a referenced load. For example, a breaker may feed a DC system or another subsystem. In this way, a user can create primary and secondary distribution layouts. Understanding this relationship helps to visualize how a distribution system, its subsystems, panels, breakers or fuses, and referenced loads are organized.

A manually defined subsystem may contain up to 160 breakers across all panels. This could consist of 160 panels with one breaker each, 10 panels with 16 breakers each, or another combination. The smart subsystems will contain the number of panels and breakers supported by the smart CAN module type to which they correspond.

Figure 10-1 Example of a DC system distribution system

10.2. Create a distribution system

There is no distribution systems on a new system controller. Creating distribution systems is done via the **Create System** button located under the **Systems > Add or Remove Systems** menu. There is no configuration required at the system level.

You can also import a distribution system via a configuration file.

The system controller supports multiple distribution systems. We recommend using multiple distribution systems to separate the distribution of different voltage levels. For example, a user can create a 48-volt distribution system, and a 24-volt distribution system. Multiple systems could also be used in different ways, such as to separate primary and secondary distribution, or even physical layouts such as first floor distribution and second floor distribution.

When first created, a distribution system is empty. Subsystems must be added to give the system meaning. The system-wide voltage and current readings are **Unknown** when the subsystem is first created. These values are mapped to sources via the **Systems > Distribution System > Configure System** page. By default, the **Voltage Source** is set to **Average All External Input Voltages** and the **Current Source** is set to **Sum All External Input Currents**.

External inputs, as mentioned, mean inputs external to the distribution system. Only subsystems that are mapped as a referenced load in another system will be used to create system summary values by default. This provides the opportunity to nest layers of subsystems within the same distribution system, and have the system summary values computed properly. If a different behavior is required, the voltage and current sources can be edited to sum or average all subsystems, or to point to any other voltage and current sources available on the system controller, including custom data. Because the EnVision™ energy router based subsystem does not contain the concept of referenced loads, its reported voltages and currents will be summed into the overall distribution system readings even when **Voltage Source** is set to **Average All External Input Voltages** and the **Current Source** is set to **Sum All External Input Currents**.

To create a distribution system:

1. Go to **Systems > Add or Remove Systems** and select the **Create System** button.
2. Select **Create Distribution System** from the dropdown list of systems.
3. A system is immediately added to the **Inventory** table.
4. Go to **Systems > Distribution System > Configure System** and enter a **Name**, **Description** and any other identifying information required.

10.2.1. Create a system from a configuration file

A system can be created by importing from a configuration file. See the *Importing a system* section to do this.

10.3. Distribution subsystems

Once a distribution system exists, at least one subsystem must be added. This is done via the **Systems > Distribution System > Subsystems** menu on the web interface or LCD panel. There are two types of subsystems: **Smart Distribution Subsystem** or **User Defined Subsystem**. Each type uses a wizard to assist in creating and configuring a subsystem.

Generally a subsystem will correspond to a physical rack on the site. Subsystems that distribute power from the same source should all be contained within the same distribution system. Multiple distribution systems are possible, but should only be used if the representation of multiple distributions systems is required.

For example, distribution equipment such as on different two different floors, may be better represented by two distributions system rather than one.

The following sections describe the different subsystems and information on creating them.

10.4. Create a smart distribution subsystem

A smart distribution subsystem correlates one-to-one with a smart distribution CAN module, such as the Alpha® smart BDFB distribution system, the Alpha® smart E2 remote distribution panel, or the EnVision™ energy router distribution panel. The number of panels and breakers supported by that smart CAN module are created automatically. During the wizard set up, you can map the CAN module for the subsystem. This can also be done later if the CAN module is not available when the system is created. The smart subsystem will not function properly until the correct type of CAN module is assigned.

In the first step of the wizard, there is an option to name the subsystem. The current smart distribution subsystems are the Alpha® smart BDFB distribution system, the Alpha® smart E2 remote distribution panel, or the energy router-based distribution subsystem. From the list of smart CAN modules currently acquired by the system controller, you can choose the CAN module for this subsystem, or it can be done later via the **Systems > Distribution System > Subsystem > Smart CAN Modules** page. Once an CAN module is selected, you can choose to locate the CAN module to ensure it is correct. It is also possible to give a custom name to the CAN module so that it is easily recognized in the **Modules > All Modules** list.

In a smart subsystem, inventory is automatically created based on the system type. For example, a Alpha® smart BDFB distribution subsystem supports eight panels with 20 breakers per panel, and a Alpha® smart E2 remote distribution panel subsystem has two panels with 11 breakers. The energy router distribution subsystem will contain up to 12 smart switch modules.

A smart subsystem gets all available information from its associated CAN module. The current and voltage are measured by the CAN module, as well as any active alarms. On the Alpha® smart BDFB distribution system, one breaker trip signal is available per panel. This means that the subsystem knows, at the panel level, that one or more of the 20 breakers associated with that panel are tripped, but not which particular breakers. On the Alpha® smart E2 remote distribution panel and the energy router distribution panel, the individual breaker trip signals are provided by the CAN module, so they can be displayed at the breaker or smart switch level.

The Alpha® smart BDFB distribution system also has the ability to have its panels set up as "linked" to other panels, or "blank" if unused. This information can be viewed from the **Systems > Distribution System > Subsystem > Panel** page.

Figure 10-2 Example of Alpha® smart BDFB distribution system

To create a smart distribution subsystem:

1. Go to **Systems > Distribution System > Subsystems**, and then select **Create Smart Distribution Subsystem**. Follow the wizard.

You can now view the **Smart Distribution Subsystem** from the **Distribution Subsystems** table. No further configuration is necessary. If you plan to reconfigure the smart CAN module, continue with the following steps.

2. Go to the **Systems > Distribution System > Subsystem > Smart CAN Modules** menu.

3. Select the **Go To** button of the assigned CAN module to view all its details including configuration and I/O. (Ensure there is an CAN module assigned to the system first).

4. Some types of CAN modules support the upload of configuration files. In the **Configuration File** table use the **Upload Configuration file to Controller** and **Get Configuration File from ADIO** buttons to send the configuration to the CAN module.

10.5. Create a user defined subsystem

Any type of distribution that is not a smart subsystem is called a user defined subsystem. The user can specify the number of panels, breakers or fuses, and shunts, and then quickly bulk-map the ADIO module inputs to shunt sources.

The first step of the wizard there is an option to name the subsystem. Next, specify the number of breaker or fuse panels to create. There is a limit of 160 breakers across all the panels. This could consist of 160 panels with one breaker each, 10 panels with 16 breakers each, or some other combination. There is an option to name each panel, specify the number of breakers or fuses, and specify the shunt configuration. When finished you can still add or remove panels, breakers and shunts via their respective pages in the subsystem tree. After panels, breakers and shunts have been added, specify the ranges of all the shunts in the subsystem. These can be changed later via the **Shunts** table.

Figure 10-3 Example of a user defined subsystem

To create a user defined subsystem:

1. Go to **Systems > Distribution System > Subsystems**, select **Create User Defined Subsystem**, and then follow the wizard.

2. In the **Distribution Subsystems** table, select the **Go To** button to view the subsystem.

3. If you need to map the shunt sources, go to **Systems > Distribution System > Subsystems > Subsystem > Shunts**, select **Map Shunts to ADIO Inputs**, and then follow the wizard.

4. Shunts and breakers/fuses can be removed from any of the tables where these are listed in the subsystem. However, because the sSubsystem needs to know the parent panel when adding new shunts or breakers/fuses, they can only be added from the **Systems > Distribution System > Subsystems > Subsystem > Subsystem Details > Downstream Loads > Panel > Shunts** table.

10.6. Configure an EnVision™ Energy Router Distribution Subsystem

📢 *Notice: The system controller recognizes the EnVision™ energy router remote controllable distribution panel as a CAN module.*

EnVision™ energy router distribution subsystems are based on an EnVision™ energy router distribution panel, which consists of a shelf containing up to 12 EnVision™ smart switch modules. The system controller communicates to the shelf over CAN protocol, and the shelf manages the communication to the smart switch modules using its own internal protocol.

The EnVision™ energy router shelf will report its status, including the input voltage and current, maximum current rating, ambient temperature, and alerts based on the overall status of the shelf. Each EnVision™ smart switch module also reports its status including voltage, current, and maximum current rating. The trip current of these smart switch modules are configurable, so you can set them up to the maximum current rating of each smart switch module. Each smart switch module can also be named, and a description added. For example, it might be useful to note in the description of the smart switch modules what kind of equipment it is powering. There is also a field where the wire gauge can be noted.

Both the shelf and each smart switch module have alarms to help notify the user of any conditions on the devices which may be of concern. Under **Subsystem Details > Alarms** are the subsystem or shelf-level alarms. Under **Subsystem Details > Shared Alarm Configuration**, the configuration of the alarms for individual smart switch modules are available. This shared configuration can be for each of the smart switch modules. For example, if you want to disable the **Smart Switch Module Turned Off** alarm, you only have to edit the **Smart Switch Module Turned Off Alarm Processing** field under **Subsystem Details**, and that change will take effect for all smart switch modules in the energy router distribution subsystem. The alarms however, will be raised individually for each smart switch module so that it is easy to tell which device is causing the alarm. The status of each of the smart switch module-related alarms is available on the **Smart Switch Modules** page, and can be accessed from the regular **Active Alarms** views when they are activated.

A performance log is available for smart switch modules in order to allow you to better understand the smart switch module usage over time. This may be accessed from the **Logs > Performance** page.

Smart switch modules can be upgraded just like all CAN modules with which the system controller communicates. A unique feature of the smart switch modules is that they can also be upgraded from the **Modules** page using a similar mechanism. A firmware update for the smart switch modules will be contained in a **ASEC** file provided on the website.

The energy router distribution subsystem does not support the concept of "panels" or user-defined breakers, fuses, or shunts like other distribution subsystems. It also does not have a **Layout** screen. Therefore the remainder of this chapter on distribution subsystems is not relevant to the energy router.

10.7. Configure the panel details

A panel is a grouping of breakers or fuses within a subsystem. A panel is considered a downstream load of a subsystem. On smart subsystems, these are automatically created according to the number of panels that the CAN module supports. For Alpha® smart BDFB distribution systems, the full eight panels are created, even though some may be linked or blank. For Alpha® smart E2 remote distribution panels, two panels are created. On a user defined subsystem, you can add up to 10 panels per subsystem.

To monitor a breaker or fuse trip associated with a panel, the **Breaker/Fuse Source** should be mapped to a digital input as well. Again, for smart subsystems, these values are automatically set based on the assigned CAN module.

There are several text fields associated with a panel, which the user may find useful to further describe the panel, such as **Description**, **Fuse Number**, **Fuse Size**, and **Fuse Maximum Amperage**. These are optional and may be filled in by the user if desired.

There are three alarms provided on each panel: **Breaker Trip**, **Loss of Feed**, and **Overcurrent**. On a user defined subsystem, thresholds for these alarms are set as applicable. The **Breaker Trip** alarm is not a threshold alarm; it is calculated based on the **Breaker/Fuse Source** set for the panel. On a smart subsystem, alarms come directly from the CAN module and thresholds must be set on the CAN module.

A concept specific to the Alpha® smart BDFB distribution system is linking panels. Panels may be linked up to the panel above, or linked down to the panel below, based on the loads. They may also be set blank if unused. When one or more panels are linked, one must still be designated as the shunt, and the others are configured as linked. The voltage and current measurements are taken from the shunt panel only. The breaker trips are still monitored on all linked panels. The configuration of panels as shunt, linked up, linked down, or blank must be done via the Alpha® smart BDFBi CAN module. The system controller only reports the details.

To configure panel details:

1. Go to **Systems > Distribution System > Subsystems**, and select the **Go To** button for the subsystem that contains the panels to configure.
2. Enter the **Subsystem Details** menu.
3. In the **Downstream Loads** table, select the **Go To** button for the panel to configure.

   📢 *Notice: In smart subsystems, the configuration is done automatically via CAN module.*

4. In the **Configuration** table, edit the details of the panel.

10.8. Configure the breaker or fuse details

In a distribution system, a breaker or fuse represents a downstream load of a panel. Breaker or fuse configuration can be accessed directly under the subsystem, or from the panel in which it resides.

Within the breaker/fuse configuration, there are a number of text fields that can be used to better describe and define the breakers. These cannot be obtained from the CAN module in any automatic way. They need to be configured manually. These fields include a **Description**, **Usage**, **Size**, **AWG**, and **Destination** field for each breaker. Manually editing all of these fields is a lot of work for large systems. The most effective way to do this is to download and edit the fields in spreadsheet format. This makes it easy to cut and paste, use macros, or reuse entered text for other purposes (such as printing labels).

📢 *Notice: The input source of the breaker is set automatically because the value is constrained by physical wiring on the panel. Although the field is editable, it will be set back to the correct value if it is manually changed. This is true for Alpha® smart E2 remote distribution panel subsystems only.*

To configure all breakers or fuses in a distribution subsystem:

1. Go to **Systems > Distribution System > Subsystems** and select the **Go To** button for the subsystem that contains the breakers or fuses to configure.
2. Enter the **Breakers and Fuses** menu.
3. Select **Export to CSV** to download a file to the computer. Open this file in a spreadsheet program.

   Alternatively, you can export a CSV file to configure just the breakers or fuses associated with a single panel. Go to **Subsystem > Subsystem Details > Downstream Loads**, and then select the **Go To** button of the **Panel** that contains the breakers/fuses configuration you want to change. In the **Downstream Loads** table, select **Export to CSV**.

4. In the spreadsheet program, enter the breaker or fuse information as needed. Ensure that you do not to change the Owner or Identity column. This is required to import the configuration correctly. Save the file.
5. Select the **Import Configuration from CSV** button and select the edited file.
6. Once uploaded, verify the configuration is correct.

10.9. The subsystem layout

Distribution subsystems contain a **Layout** page to visualize the layout of the panels. This page shows the panels, including a graphical representation of whether the panels are linked (in Alpha® smart BDFB distribution systems).

- In smart subsystems, panels are arranged two panels per row, to best match the LCD panel screens of the smart devices.
- In user defined subsystems, panels are arranged one per row to more closely represent a physical distribution system.
- The Energy Router subsystem does not support a representation of the layout.

Selecting a panel will display the details on the right side of the layout page, as well as a table for breakers, and for shunts (user defined subsystem only). This is available via the web interface only.

To view the **Layout** page, go to **Systems > Distribution System > Subsystems**, then select the **Go To** button of the subsystem required. Select to enter the **Layout** menu.

10.10. Map shunts to ADIO module inputs

The **Map Shunts to ADIO Inputs** wizard assists the process of mapping ADIO module shunt inputs to shunt inventory items. We recommend that your ADIO modules are named before launching this wizard to help identify which ADIO modules to select.

Using the wizard you can select to map in bulk or individually. In bulk mode, the current sources of the shunt inventory in the subsystem are set automatically to the shunt inputs of the ADIO modules selected in the wizard; the ADIO modules will be mapped in the order in which they were selected in the wizard. In individual mode, you can select an ADIO module shunt input for each shunt.

Within the distribution system, this wizard is only available for user defined subsystems. You can launch this wizard from any of the tables in subsystems that show shunts. The following example shows how to configure a subsystem for a Cordex® CXPS-C centralized power system.

To create a Cordex® CXPS-C centralized distribution subsystem:

1. Follow the steps detailed in the **Creating a User Defined Subsystem** section, creating six panels, with four breakers per panel, and one shunt per breaker.
2. Ensure that four Cordex® HP 6i ADIO smart peripherals are acquired and named as per the schematic (#1 to #4).
3. Go to **Systems > Distribution System > Subsystems > Subsystem > Shunts** and select **Map Shunts to ADIO Inputs**.
4. On the **Shunt Mapping Type** step, ensure the mapping type is selected as **Map Shunts in Bulk** and select **Next**.
5. Leave the first panel selected in the **Select Starting Panel** step, and select **Next**.
6. On the **ADIO To Shunt Configuration** step, set the ADIO module configuration as **ADIOs Wired Sequentially** and select **Next**.
7. Select ADIO #1 from the dropdown list, and then select **Add Selected ADIO to List**. You will see the list below update with the ADIO module you just selected.
8. Repeat for ADIO modules #2 to #4, and then select **Next**.
9. The **Review** step details which inputs are mapped to which shunts. Review to ensure it matches the wiring schematic.
10. Select **Next**, and the 24 inputs of the four Cordex® HP 6i-ADIO smart peripherals will now be mapped to the 24 shunts in the user defined subsystem.

11. DC source systems

This section provides a brief overview of the components and functions of a DC source system. In this system, DC sources external to the system controller (photovoltaic cells or DC generator systems), can be created and monitored.

11.1. Create a DC source system

There is no DC source system on a new system controller. Creating a DC source system is done using the **Create System** wizard. There is no configuration required at the system level.

You can also import a DC source system via a configuration file.

The system controller supports multiple DC source systems. We recommend using multiple DC source systems to separate different types of DC sources contributing to the DC bus. For example, a user can create a photovoltaic DC source system, and a generator system DC source system. This is optional, and a users can group DC sources together however makes the most sense for their specific use case.

When first created, a DC source system is empty. DC sources must be added to give the system meaning. The system-wide voltage and current readings are **Unknown** when the system is first created. These values will be the average of all DC source voltages, and the sum of all DC source currents.

To create a DC source system:

1. Go to **Systems > Add or Remove Systems** and select the **Create System** button to launch the **Create System** wizard.
2. From the dropdown list, select **DC Source System**, then select **Done**.
3. A DC system is added to the **Inventory** table.
4. Go to **Systems > DC Source System > Status & Config** and enter a **Name**, **Description** and any other identifying information required.

   The **Linked System** indicates which system will have the DC source in its power flow.

11.2. Create and configure a DC source

A **DC Source** represents one piece of inventory which is external to the system controller, providing DC power to the bus. For example, a DC source could be a photovoltaic array.

A special type of DC source is provided to model a DC generator system. This DC source has additional capabilities for controlling a generator system using a relay to start and stop it, based on a voltage or a set of optional conditions.

To create and configure a DC source:

1. Go to **Systems > DC Source System > DC Sources**.
2. In the **DC Sources** table, select one of three types of DC sources.

- A generic **DC Source**.
- A **DC Generator** is a specialized type of DC source which can automatically control the starting and stopping of a generator system with the use of a relay, based on conditions specified.
- A **Legacy DC Generator** can also automatically control the starting and stopping of a generator system, but has been succeeded by the **DC Generator** system option.

3. After the DC source has been added, select the **Go To** button.

4. In the **Configuration** table, set the **Name** and **Description** to identify the **DC Source**.

5. In the **Configuration** table, set the **Voltage Source** to the ADIO module voltage sensor reading that is monitoring the voltage of this DC source. Do the same for **Breaker/Fuse Source** (if applicable).

6. In the **Configuration** table, set the **Current Source** to the configured **Shunt** that is monitoring the current of this DC source.

> 📢 **Notice:** *A **Shunt** needs to be created and configured before the **Current Source** of this DC source can be configured.*

11.3. DC source system effect on other systems

A DC source system is useful in representing external equipment for inventory purposes. Its strength lies in making DC system calculations more accurate. Many DC systems will use a battery shunt to read the battery current, and the load current is calculated using **= (Total Rectifier O/P Current - Battery Current)**.

In situations where there are DC sources external to the system controller, this calculation is not be sufficient.

When DC source systems are created, two new calculations are available:

- **= (Total Rectifier O/P Current - Battery Current + Total DC Source Current)**
- **= (Total Rectifier O/P Current - Total Load Current + Total DC Source Current)**

These can be used when a DC source is present to ensure the contributions of the DC sources to the system currents will be accurate. In the case that both load and battery use shunts to measure current, custom data can be used to include the contributions from the DC sources.

In addition to the above, DC source systems will appear on the Power Flow in the relevant diagrams, giving a more complete picture of all the power sources flowing through the system.

> 📢 **Notice:** *At present, a DC source only appears on the Power Flow for a DC system and its battery and on the Alpha® FXM HP uninterruptible power supply (UPS) module and its battery.*

12. AC source systems

This section provides a brief overview of the components and functions of an AC source system. AC source systems are intended to be used by customers who need to model multiple AC sources for their system. An example might be a system that has a set of rectifier modules fed from AC mains, and a different set fed from a generator system. For customers with a single AC source, or even multiple sources such as mains and generator system which switch over automatically with a transfer switch, it is usually not necessary to model an AC source system.

12.1. Create an AC source system

There is no AC source system on a new system controller. Creating an AC source system is done using the **Create System** wizard. There is no configuration required at the system level.

You can also import a AC source system via a configuration file.

The system controller supports multiple AC source systems. Multiple AC sources can be modeled within the same AC source system. Users can group AC sources together to best suit their specific use case.

When first created, an AC source system is empty. AC sources must be added to give the system meaning. The system-wide voltage readings are **Unknown** when the system is first created. These values will be the average of all AC source voltages for each phase.

To create an AC source system:

1. Go to **Systems > Add or Remove Systems** and select the **Create System** button to launch the **Create System** wizard.
2. From the dropdown list, select **AC Source System**, then select **Done**.
3. An AC system is added to the **Inventory** table.
4. Go to **Systems > AC Source System > Status & Config** and enter a **Name**, **Description** and any other identifying information required.

12.2. Create an AC source

An **AC Source** will represent one AC input to the system, for example **AC Mains**.

To create and configure an AC source:

1. Go to **Systems > AC Source System > Inventory**.
2. In the **AC Sources** table, select **Add AC Source**. The **Add AC Source** wizard will launch.
3. Set the **Name** to identify the **AC Source**.
4. Select one of three types of AC sources.

- ◦ A **Simple AC Source** can be used to model an AC source with voltage readings for each phase. This source includes **AC Fail** and **Urgent AC Fail** alarms.
- ◦ A **Generator** is a specialized type of AC source which can automatically control the starting and stopping of a generator system with the use of a relay, based on conditions specified.
- ◦ A **Legacy Generator** can also automatically control the starting and stopping of a generator system, but has been succeeded by the **Generator** option.

5. Select the **Phase** for your **AC Source**.

6. On the **Alarms** page, select whether the **AC Input Fail** alarm should be enabled for this source. Select **Yes** or **No**.

7. On the **Voltage Readings** page, select the system from which the AC source will obtain its readings.

8. If a DC system was chosen for the **Voltage Readings** source in step 7, there will be an option to launch the **Map Rectifiers to AC Source** wizard on the **Results** page.

*Notice: If the **Voltage Reading Source System** has been set to a DC system, the phase voltage sources will be automatically set to the mapped rectifier modules. If the **Voltage Reading Source System** has been set to an inverter system, these phase voltage sources will be set to read from the inverter system. If the **Voltage Reading Source System** is left unknown, these phase voltage sources should be set to read from transducer modules or any other voltage sources as desired.*

*Notice: If the **Voltage Reading Source System** has been set to a DC system, and the AC fail alarms are enabled, the AC input fail alarm will be calculated in the same manner as the DC system's AC fail alarm. If 90 percent of the rectifier modules mapped to this AC source have failed, then the AC input is assumed to be failed. Otherwise, if the **Voltage Reading Source System** is set to an inverter system, or left unset, the AC input fail alarm will be activated if any one of the phase voltages falls below 10 volts.*

12.2.1. Map rectifier modules to an AC source

An **AC Source** can get its data from either a DC system, an inverter system, or from transducer modules.

To map rectifier modules from a DC system to an AC source:

1. Launch the **Map Rectifiers to AC Source** wizard. This can either be run directly from the results page of the **Add AC Source** wizard, or launched from **Systems > AC Source System > Inventory > AC Source** page.

2. Choose rectifier modules to map from the **Selected** column. If rectifier modules have previously been mapped to this source, they will show as selected. Select **Next**.

3. The **Review** step will show the changes requested. Selecting **Cancel** at this time will discard your changes. Select **Next** to accept your changes.

The chosen rectifier modules will be mapped to this AC source.

Notice: *The rectifier module mapping can also be changed one-by-one for each rectifier module, in the **Systems > DC System > Inventory > Rectifiers > Phase Mapping** table.*

Notice: *The rectifier modules can also be assigned to a particular phase. This can be done through the **System > DC System > Inventory > Rectifiers > Phase Mapping** table.*

*Rectifier modules that are left at the default setting of **No Phase** will be assumed to belong to Phase 1. If a rectifier module has been set to a phase that does not exist, that rectifier module's voltage values will not be included in the voltage calculations for the AC source.*

13. Cordex® CXPS-HSS Hyperboost Converter System

This section provides a brief overview of the components and functions of a Cordex® CXPS-HSS hyperboost converter system.

13.1. Introduction to Cordex® CXPS-HSS Hyperboost Converter Systems

A Cordex® CXPS-HSS Hyperboost converter system takes a DC input voltage 48 volts and converts it to a different output voltage 58 volts. The system provides flexibility that allows you to maintain a single voltage battery system. Converter modules provide DC-DC power conversion (for example, from –48 to –58 volts) to produce a consistent voltage source for equipment that is not compatible with the primary plant voltage. Converter modules can be used to create dual voltage capability in new systems **or** upgrades to existing DC plants. They provide tight voltage regulation for sensitive loads as well as galvanic isolation.

Components of a Cordex® CXPS-HSS Hyperboost System

The system consists of a DC source, converter modules, and a load as shown in the following diagram. Converter modules should have dedicated fuse or circuit breaker positions on the main DC power system for protection and isolation.

Figure 13-1 Example Cordex® CXPS-HSS hyperboost converter system

13.2. Creating a Cordex® CXPS-HSS Hyperboost Converter System

There is no hyperboost system on a new system controller. Creating a hyperboost system is done using the **Create System** wizard. In the current release, more than one hyperboost system is supported.

You can also import a configuration file containing a hyperboost system from another system controller.

A new power system can be created from the LCD panel or the web interface, via the **Systems > Add or Remove Systems** menu. Both have wizard assistance to help step you through the process to create the new system. You can create a 48V-58V system. When the system is created, an associated load is also created.

The hyperboost system created will have a reasonable set of defaults and associated alarms. Optional converter descriptors, such as name, description, system number, and serial number, can be used to describe and organize your system.

Newly discovered converter modules are automatically assigned to the hyperboost system. However if there is more than one hyperboost system, converter modules are grouped into **Unassigned Modules**, and then you can add them to the system manually.

You can configure the converter module alarms associated with the system. You can enable or disable the alarms, change the priority, map relays to the alarms, and where applicable, modify the thresholds.

To create a converter system:

1. Go to **Systems > Add or Remove Systems**.
2. Select **Create Converter System**. Name the system if required.
3. From the **Select System Type** dropdown list. Select **Hyperboost System 48V-58V**
4. Step through the rest of the wizard instructions.
5. Launch the **Configure Hyperboost System** wizard to configure the basic system settings and the system inventory.

13.3. Configure Cordex® HP Hyperboost Converter Modules

These settings include start delay, output voltage, or overvoltage protection threshold.

> 📢 *Notice: The load bus output voltage is also the voltage that the converter modules default to if they lose communication with the system controller. The converter modules will drop any of the adjustments made by the system controller to perform load sharing and just try to meet the configured output voltage.*

To configure the converter modules:

1. Go to **Systems > Hyperboost System > Inventory > Converters > Configuration**.
2. In the **Configuration** table, set up your converter module group configuration settings. These include, **Load Bus Output Voltage** and **Load Bus Overvoltage Limit** threshold.
3. Configure the settings for the converter modules. The values for these settings depend on your specific system.

13.4. Configure the shunts

By default the system has no shunts. You may add or remove shunts as needed.

To configure a shunt you need an ADIO module with current inputs. The shunt will map the current inputs from the ADIO module to the **Load Current Source** field of the **Load** configuration table or the **Battery Current Source** field of the **Battery Configuration** table.

To configure the shunts:

1. Go to **Systems > Converter System > Inventory > Shunts**. You will see a list of shunts in the system. Add or remove shunts from this page.

2. Select the **Go To** button for the shunt you want to configure.

3. In the **Configuration** table, assign the shunt a name and description. We recommend that you assign the shunt a name that represents the actual shunt. For example you might name it **Battery Shunt**.

4. Select the **Shunt Current Source**.

   This is the current input on an ADIO module that takes a voltage reading across the shunt.

5. Enter the **Range in Amps** for the shunt.

6. Enter the **Range in Millivolts** for the shunt.

7. Enter the **Offset Calibration** for the shunt if the shunt reading error is too low or high.

13.5. Configure the loads

By default the system has one load. You may add or remove loads as needed.

To configure the loads:

1. Go to **Systems > Converter System > Inventory > Loads**. You will see a list of loads in the system. Add or remove loads from this screen.

2. Select the **Go To** button for the load you want to configure.

3. In the **Configuration** table, assign the load a name and a description. We recommend that you assign the load a name that represents the actual load.

4. Select the **Load Voltage Source**. This is the voltage input on an ADIO module that takes a voltage reading near the load.

   If you do not have a sensor connected, you may want to select the **Average Converter Output Voltage**.

5. Select the **Load Current Source**. This is the shunt input that reads the load current. If you have a real shunt reading for the load current, then select the shunt from the dropdown list. If you don't see the shunt you want, then create it.

   If you do not have a shunt for reading the load current, you may want to select the **Total Output Current** for the converter system.

6. Select the **Edit** button for the **Load Breaker/Fuse Source**. Select the digital input on the ADIO module which is connected to monitor the breaker or the fuse.

   If you need to change the polarity for the **Load Breaker/Fuse Open** alarm, go to the **Modules** page, from the **All Modules** table, select the ADIO module required, and then select the **Go To** button to access the **Digital Inputs** table.

7. Configure the load alarms.

13.6. Configure the current transducer module

The system, by default does not contain any current transducer modules. You can add or remove current transducer modules as needed. To configure a current transducer module you need a voltage input on an ADIO module.

To configure a current transducer module:

1. Go to the system where you want to add the transducer module and navigate to the inventory page. Go to **Systems > Inventory > Other Transducers > Current Transducer**. There will be a list of current transducer modules in the system. Add or remove them from this page.
2. Select the **Go To** button for the current transducer module you want to configure.
3. In the **Configuration** table assign the **Current Transducer** a name and a description.
4. Select the **CT Current Source**. This can be any voltage source.
5. Enter the **Range in Amps**.
6. Enter the **Range in Volts**.
7. Optional: enter the **Offset** calibration for the **Current Transducer** if the reading error is too low or high.

13.7. Configure the general purpose transducer module

The system, by default does not contain any general purpose transducer modules. You can add or remove general purpose transducer modules as needed. To configure a general purpose transducer module you need a voltage input on an ADIO module.

To configure a general purpose transducer module:

1. Go to the system where you want to add the transducer module and navigate to the inventory page. Go to, **Systems > Inventory > Other Transducers > General Purpose Transducer**. There will be a list of general purpose transducer modules in the system. Add or remove them from this page.
2. Select the **Go To** button for the general purpose transducer module you want to configure.
3. In the **Configuration** table, assign a name and a description.
4. Select the **Transducer Input Source**. This can be any voltage source or a custom data.
5. Enter the **Transducer Input Minimum in Volts** and **Transducer Input Maximum in Volts**.
6. Enter the **Transducer Output Minimum** and **Transducer Output Maximum**.
7. Select the **Units and Precision**
8. Optional: Enter the **Offset** calibration for the calculated **Value** if the reading error is too low or high.

The **Calculated Slope** and the **Offset** are used to convert the **Input Source Value** to the **Value**. The value is displayed in the selected units and precision.

13.8. Matrix C16™ High Density Connectorized DC Distribution Breaker Panel

This section provides a brief overview of the components and functions of Matrix C16™ high density connectorized DC distribution breaker panel.

13.8.1. Introduction to the Matrix C16™ Distribution Breaker Panel

The Matrix C16™ high density connectorized DC distribution breaker panel provides high reliability, high power, DC distribution in a compact 1RU form factor to maximize rack space for signal equipment.

Traditional telecom breaker and fuse panels use terminal lugs for output connections and therefore require specialized technicians to add or change loads. The Matrix C16™ breaker panel uses locking plug-in connectors offering a significant improvement in ease of use and cost of installation. The 1RU configuration, with 400 amps of current capacity and 16 breaker positions, offers industry leading density. Accepting single-pole breakers rated up to 100 amps each, the Matrix C16™ breaker panel can support the majority of network loads within headends, central office, and hub sites. The internal buswork has been enlarged, adding 33 percent more total ampacity than our standard Matrix 300™ high density DC power distribution system.

13.8.2. Matrix C16™ Distribution Breaker Panel in a Cordex® CXPS-HSS Hyperboost System

On the system controller, when connected via CAN bus and acquired, the Matrix C16™ high density connectorized DC distribution breaker panel (device) is seen as a module (**Model:** Matrix™). After the Matrix C16™ distribution panel is connected to the CAN bus, a user can go to the **Modules** page of the user interface to view that module within the **CAN Modules** table. Use the **Go To** button to see the information presented by the module.

The Matrix C16™ panel data can be observed through the **Modules** page of the user interface, it can also be assigned to a hyperboost system. The benefits of assigning a module to a hyperboost system:

- Data from all assigned Matrix C16™ breaker panels will be aggregated.
- Alarming capabilities are available.
- Data from the modules will be presented on the Cordex® CXPS-HSS hyperboost system power flow diagram.

  Modules are auto-assigned by default but assignment to another hyperboost system can be done if desired.

To assign Matrix C16™ distribution breaker panels to a system:

1. Go to **Systems > Hyperboost System > Inventory > Matrix Modules**
2. Any modules available for assignment will appear in the **Unassigned Modules** table.

After modules are assigned, aggregated data can be viewed in the **Distribution Summary** table found at **Systems > Converter System > Status**.

14. Generator systems

This section provides an overview of the components and functions of the system controller's support for AC and DC generator systems.

A generator system is a specialized type of AC or DC source which can automatically control the starting and stopping of a generator system with the use of a relay, based on start and stop conditions specified.

By customizing the start and stop conditions, the user can adjust the generator system control for their specific situation. For example, start and stop conditions can be added which run the generator system based on a schedule in order to exercise the generator system.

The generator system has a built in and configurable **Minimum Runtime** to protect the generator system from short start ups. If a stop condition causes the **Call to Stop** to be true, the control system will first wait for the generator system to run for the minimum runtime before it commands the generator system to stop.

The generator system ensures stable operation with its configurable **Equation Stability Delay**. For example, while a start condition may become true, the **Call to Start** will evaluate all the enabled start conditions for the length of the **Equation Stability Delay** before it becomes true. This means that if a change in the dependent start or stop conditions is not stable for the configured time, it will not affect the generator system control. This effectively filters out sensor noise and further protects the generator system from frequent and short start up cycles.

Several statistics are available to give insight into the historical behavior of the generator system. By default, the **Startups in Time Period** keeps track of the number of start ups in the last 24 hours. The **Total Startups** and **Total Runtime** are also recorded.

In the event of hardware malfunction or misconfiguration, several alarms are supplied with the generator system to alert the user in a variety of adverse situations, such as the **Startup Frequency High** alarm, which activates when the **Startups in Time Period** exceeds a given threshold.

14.1. Create an AC generator system

To create an AC generator system:

1. If an AC source system does not already exist, create it at **Systems > Add or Remove Systems** and launch the **Create System** wizard. Select the **AC Source System** from the dropdown list and finish the wizard.
2. Go to **Systems > AC Source System > Inventory**.
3. In the **AC Sources** table, select **Add AC Source**. The **Add AC Source** wizard will launch.
4. Set the **Name** and then select **Next**.
5. Select **Generator** from the **AC Source Type** dropdown list. Select **Next**.
6. Select the **Phase** for your **AC Source**. Select **Next**.

7. On the **Alarms** page, select whether the AC input fail alarm should be enabled for this source. Select **Yes** or **No**.

8. On the **Voltage Readings** page, select the system from where the AC source will obtain its readings.

9. Review your settings and select **Next**.

10. In the **Results** step, there will be an option to launch the **Configure Off-Grid Settings** wizard. Alternatively, this wizard can be found in the **Status & Config** page inside the **Configuration** table of the new AC generator system.

11. After the AC generator system has been added, select the **Go To** button. From here, the generator system can be configured.

14.2. Create a DC generator system

To create a DC generator system:

1. If a DC source system does not already exist, create it at **Systems > Add or Remove Systems** and launch the **Create System** wizard. Select the DC source system from the dropdown list and finish the wizard.

2. Go to **System > DC Source System > DC Sources**.

3. In the **DC Sources** table, select **Add DC Generator**.

4. After the DC generator system has been added, select the **Go To** button. From here, the generator system can be configured.

14.3. Configure the generator system

1. Configure the **Generator Control Relay**. Inside the **Generator Control** page and in the **Generator Control** table, select the **Edit** button of the **Generator Control Relay** to choose the relay that will control the starting and stopping of the generator system. This relay can also be driven by other features like alarms. This provides maximum flexibility in generator system control, but requires extra caution to ensure this generator system relay is shared only when intended.

2. Configure the **External Status Signal Source**. Inside the **Status & Config** page and in the **Configuration** table, select the **Edit** button of the **External Status Signal Source** to choose the digital input which signifies whether or not the generator system is running.

   📢 *Notice: Configuring the **Generator Status Signal Source** is optional. If it is configured, it will be used for the **Generator Status Mismatch** alarm. if the **Generator Status Signal Source** is not configured, the **Generator Status Mismatch** alarm will never activate.*

3. See Start and stop conditions *(on page 163)* to create specific conditions where the generator system should start up and shutdown.

4. See Start and stop logic *(on page 166)* to understand how the start and stop conditions are used to calculate the **Call to Start** and **Call to Stop.**

5. See Generator state *(on page 167)* to understand how the generator system control processes the **Call to Start**, **Call to Stop**, and **Manual Generator Start** and **Manual Generator Stop** button pushes. This section also describes what to do if the generator system state shows suspended because of a configuration error.

6. See Alarms *(on page 169)* to configure the alarms in the event of an adversely functioning system.

7. Once fully configured, enable the **Generator Control**. Inside the **Generator Control** page and in the **Generator Control** table, select the **Edit** button of **Generator Control** to enable the automatic generator system on/off control to command the **Generator Control Relay**

14.4. Start and stop conditions

The automatic on/off control of the generator system is based on start conditions and stop conditions. By customizing the start and stop conditions, the user can adjust the generator system control for their specific situation. For example, start and stop conditions can be added which run the generator system based on a schedule in order to exercise the generator system.

The start and stop conditions add great versatility to the generator system control; however, care must be taken to ensure the user's customization behaves as anticipated. For example, if the generator system has run past the configured **Minimum Runtime** and the **Call to Stop** becomes true, it will shutdown. But if the **Call to Start** is also true, the generator system will immediately start up again.

14.4.1. Default start and stop conditions

When a generator system is created on a power system with a DC system and battery, the generator system will be setup by default to start up on low DC system voltage, and stop when the battery returns to float mode.

Table 14-1 Default start and stop conditions when a DC system and battery are present

	Condition name	Value to test
Default Start Condition	StartOnLowVoltage	DC System: System Voltage
Default Stop Condition	StopWhenBatteryCharged	Battery: Battery Mode

If there is no battery, the generator system will be setup by default to start up on low DC System voltage, and stop when the it approaches to System Float Voltage.

Table 14-2 Default start and stop conditions when a DC system is present without a battery

	Condition name	Value to test
Default Start Condition	StartOnLowVoltage	DC System: System Voltage
Default Stop Condition	StopOnFloatVoltage	DC System: System Voltage

If there is no DC system, then no default start or stop conditions will be created. To add custom start and stop conditions, see Add start and stop conditions .

14.4.2. Add start and stop conditions

The user can add an unlimited number of start or stop conditions, and can remove the default start and stop conditions if desired.

1. From within the **Generator Control** page, select the **Add Start Condition** or **Add Stop Condition** button.
2. The wizard will guide you through all the steps required to add a start or stop condition. After completing the wizard, no further configuration is needed for that start or stop condition.

> *Notice: Start conditions and stop conditions must be given a name. This name cannot have spaces or special characters, as it is used to automatically write the **Start Equation** or **Stop Equation**. If it is misnamed, an error will be presented in **Call To Start** or **Call To Stop**, and the **Generator State** will show suspended. See* Generator state (on page 167) *for more details.*

> *Notice: The **Limit** is not configured in the **Add Start Condition** or **Add Stop Condition** wizard if it is not needed. The **Limit** is only used for less than or greater than comparisons, and otherwise can be left blank.*

> *Notice: If the **Value to Test** needs to be changed to a different entry, a new start or stop condition should be made, and the old removed.*

14.4.3. Adding complex start and stop conditions

For some complex situations, the start and stop conditions may not provide enough flexibility to control the generator system start and stop as desired. In this case, the complex logic can be created using custom data, and then a start condition or stop condition can select that custom data as the **Value to Test.** See the *Custom Data* section for more details.

14.4.4. Testing start and stop conditions

To simplify testing the control logic and ensure expected generator system operation, each start and stop condition has a **Test** button.

If the test is active, the **Test Time Remaining** will show the time until the test stops. When the test is active, the start or stop condition's **Value** will be true regardless of the **Value To Test**. The test will run 60 seconds longer for each time **Extend Test** is selected, or until it is manually stopped. This test can be useful to ensure the generator system start and stop logic is working as expected. If **Generator Control** is **Enabled**, the test can cause the generator system to start up or shutdown.

14.4.5. Example: Start and stop the generator system on a schedule

Scheduled start ups and shutdowns can be useful in order to exercise a diesel or gas generator system. Sometimes more complex logic is needed for generator system control, and starting and stopping based on a schedule is an example of this.

1. Go to **Controller > Programmability > Custom Data**.

2. Select the **Add Delay Timer** button in the **Timers** table.

3. Select the **Go To** button in the new line item to edit the configuration.

4. Set the **Name** of the timer to **Exercise Generator**.

5. Set the **Delay** for the amount of time the generator system should run for when it is exercised.

6. No other entries need to be configured in the delay timer.

7. Go to **Controller > Programmability > Scheduler**.

8. Select the **Create Scheduled Action** button to launch the wizard to create the scheduled times when the generator system should start up. Follow the wizard through to the action page. On the **Action** page, select the **Exercise Generator (Delay Timer): Force Timer to Start** option.

9. Review and complete the wizard. Now, whenever the scheduled action runs, the **Exercise Generator** timer will begin counting down, and the **Output** will be **True** during this time.

10. Return to the **Generator Control** page, and launch the **Add Start Condition** wizard.

11. Name the start condition **ExerciseGeneratorStart** with no spaces, and select **Next**.

12. From the **Value to Test** dropdown menu, find the **Exercise Generator** delay timer in the list, and select the **Output**. Select **Next**.

13. From the **True If** dropdown menu, select **True** to indicate that the start condition should be true when the **Exercise Generator Output** is **True.**

14. Review and complete the wizard.

15. Next, launch the **Add Stop Condition** wizard.

16. Name the stop condition **ExerciseGeneratorStop** with no spaces, and select Next.

17. From the **Value to Test** dropdown menu, again, find the **Exercise Generator** delay timer in the list, and select the **Output**. Select **Next**.

18. From the **True If** dropdown menu, this time select **False** to indicate that the stop condition should be true when the **Exercise Generator Output** is **False**.

19. Review and complete the wizard.

> 📢 *Notice: The generator system control now has a start condition and a stop condition that will become true or false according to the schedule you created. To ensure correct generator system on/off control, ensure that other start and stop conditions do not interfere with this schedule by using the test buttons on the start and stop conditions.*

14.5. Start and stop logic

In addition to the automatic on/off control, the generator system can be started and stopped manually with the **Manual Generator Start** and **Manual Generator Stop** buttons. The generator system cannot be manually started or stopped when the **Generator State** shows disabled or suspended. See Generator state *(on page 167)* for more details.

The **Equation Stability Delay** sets the time that the **Start or Stop Equations** must hold their new value before the **Call to Start** or **Call to Stop** changes.

14.5.1. Start logic

The **Start Logic** choice decides whether just one, or all start conditions must be true for the **Call to Start** to become true. This decides how the start conditions will be assembled into a logical equation.

The **Start Equation** is an automatically written equation of all the enabled start conditions. If there is more then one start condition, the equation will be assembled with '&' or '|' symbols according to the **Start Logic**. If all start conditions must be true for the **Start Equation** to evaluate to true, then the equation will be written as "MyStartCondition1 & MyStartCondition2". If just one start condition must be true for the **Start Equation** to evaluate to true, then the equation will be written as "MyStartCondition1 | MyStartCondition2".

The **Call to Start** is based on the logical result of the **Start Equation**, as true or false. For example, if a start condition causes the **Start Equation** to change from false to true, then the **Call to Start** will begin counting down for the configured duration of the **Equation Stability Delay**. If the **Start Equation** continues to evaluate as true through the whole stability delay, then the **Call to Start** will become **True**. Otherwise, if the **Start Equation** evaluates as false at any point during the stability delay, the count down will stop, and the **Call to Start** will remain **False**.

> *Notice: The **Call to Start** will always be evaluating the start conditions, even when the **Generator Control** is **Disabled**, so that the user can test the logic without starting the generator system. Furthermore, the **Call to Start** will be evaluated even while the generator system is running. If the **Call to Start** is **True** when the generator system shuts down, the generator system will immediately start up again. Therefore, care should be taken when defining start and stop conditions so that they do not interfere with each other.*

14.5.2. Stop logic

The **Stop Logic** choice decides whether just one, or all stop conditions must be true for the **Call to Stop** to become true. This decides how the stop conditions will be assembled into a logical equation.

The **Stop Equation** is an automatically written equation of all the enabled stop conditions. If there is more then one stop condition, the equation will be assembled with '&' or '|' symbols according to the **Stop Logic**. If all stop conditions must be true for the **Stop Equation** to evaluate to true, then the equation will be written as "MyStopCondition1 & MyStopCondition2". If just one stop condition must be true for the **Stop Equation** to evaluate to true, then the equation will be written as "MyStopCondition1 | MyStopCondition2".

The **Call to Stop** is based on the logical result of the **Stop Equation**, as true or false. For example, if a stop condition causes the **Stop Equation** to change from false to true, then the **Call to Stop** will begin counting down for the configured duration of the **Equation Stability Delay**. If the **Stop Equation** continues to evaluate as true through the whole stability delay, then the **Call to Stop** will become **True**. Otherwise, if the **Stop Equation** evaluates as false at any point during the stability delay, the count down will stop, and the **Call to Stop** will remain **False**.

> *Notice: The **Call to Stop** will always be evaluating the stop conditions, even when the **Generator Control** is **Disabled**, so that the user can test the logic without starting the generator system. Furthermore, **the Call to Stop** will be evaluated even while the generator system is stopped. If the **Call to Start** is **True** when the generator system shuts down, the generator system will immediately start up again. Therefore, care should be taken when defining start and stop conditions so that they do not interfere with each other.*

14.6. Generator state

The **Generator State** describes whether the generator system is running or not, and what action the generator system control is doing before moving to the next state. Except if the generator system is disabled, suspended, or manually started or stopped, the actions follow this order:

1. Stopped and waiting for Call to Start to be true.

2. Start is requested. Activating control relay.

3. Running and waiting for generator to run for minimum runtime.

4. Running and waiting for Call to Stop to be true.

5. Stop is requested. Deactivating control relay.

Figure 14-1   Generator state flowchart

> 📢 *Notice: The **Manual Generator Start** button can be selected when the **Generator State** is **Stopped and waiting for Call to Start to be true.** The generator system cannot be manually started when the **Generator State** shows disabled or suspended.*

> 📢 *Notice: The **Manual Generator Stop** button can be selected when the **Generator State** is **Running and waiting for generator to run for minimum runtime** or **Running and waiting for Call to Stop to be true**. The generator system is already stopped when the **Generator State** shows disabled or suspended.*

The **Generator State** shows **Disabled** if the **Generator Control** is set to **Disabled.** The mapped **Generator Control Relay** will not be energized in this state.

The **Generator State** can also show suspended due to a configuration error. The following are all possible suspended states along with recommendations to get out of the suspended state:

- **Suspended - No Relay Mapped:** Select a relay which controls the generator system in the **Generator Control Relay** entry.

- **Suspended - No Start Conditions:** Either there are no start conditions, or all the start conditions are disabled. Add a start condition, or enable a start condition that is already present to leave this suspended state.

- **Suspended - No Stop Conditions:** Either there are no stop conditions, or all the stop conditions are disabled. Add a stop condition, or enable a stop condition that is already present to leave this suspended state.

- **Suspended - Start Equation Error:** Given the enabled start conditions, The **Start Equation** could not be evaluated. **The Call to Start** has further details regarding the reason for this error. If the **Call to Start** shows "Error: Unrecognized Symbol" or "Error: Equation did not Parse" then a start condition needs to be renamed. The name cannot contain spaces or special symbols (except an underscore). If the **Call to Start** shows "Error: Variable Not Mapped", it means that the **Value to Test** of one of the start conditions was removed from the system controller. The user should remove that start condition and add it again after ensuring the **Value to Test** exists on the system controller once again.

- **Suspended - Stop Equation Error:** Given the enabled stop conditions, The **Stop Equation** could not be evaluated. **The Call to Stop** has further details regarding the reason for this error. If the **Call to Stop** shows "Error: Unrecognized Symbol" or "Error: Equation did not Parse" then a stop condition needs to be renamed. The name cannot contain spaces or special symbols (except an underscore). If the **Call to Stop** shows "Error: Variable Not Mapped", it means that the **Value to Test** of one of the stop conditions was removed from the system controller. The user should remove that stop condition and add it again after ensuring the **Value to Test** exists on the system controller once again.

14.7. Alarms

The generator system alarms are available in the **Status & Config** page. The following alarms are available to alert the user of adverse situations:

- **Generator Startup Frequency High:** This alarm will activate when the **Startups in Time Period** exceeds its configured threshold during the given **Statistics Time Period**. This alarm could activate from a wide variety of adverse situations, such as low battery health, where the battery charge cycle becomes shorter as its health degrades.

- **Generator Running too Long:** If this alarm is active, then the generator system has run longer than the threshold configured in the alarm's details page. The generator is still running because either the generator's **Call to Stop** is not **True**, or it has not exceeded its configured **Minimum Runtime**.

- **Generator Status Mismatch:** The **Generator Status Signal** is detecting that the status of the generator system does not match what is expected. Either the generator system is running when the **Generator Status** indicates it should not be, or else it is not running when it should be. This alarm does not activate until approximately 30 seconds after the mismatch is first measured, to allow time for the generator system to start up or shutdown.

14.8. Legacy generator system

A **Legacy Generator** system is a specialized type of AC source or DC source which allows a generator system to be started and stopped with a relay. The legacy generator system has been succeeded by the generator system, as described in the previous section.

The standard condition on which to start or stop a generator system is based on a voltage. The system controller allows the user to choose any voltage in the system and set it as the **Voltage to Monitor**, with a start threshold and a stop threshold. The generator system will be started if the **Voltage to Monitor** falls below the **Start Voltage Threshold**, and will be stopped if the **Voltage to Monitor** climbs above the **Stop Voltage Threshold**.

The optional start or stop conditions can be used to start and stop the generator system based on other types of conditions. For example, the battery State of Charge could be used. The ability to use custom data or other system values gives the generator system control a lot of flexibility; however, care must be taken to ensure that the start and stop conditions make sense. Otherwise, it is possible for the user to create, for example, a start condition that is always true, in which case the generator system would not stop running.

The minimum runtime assures that the generator system will not be started to only run for too short a period of time. Once the generator system has started, it will continue to run for the minimum runtime even if a stop condition has become true.

The maximum runtime is intended to ensure that the generator system does not continue to run indefinitely even if no stop condition comes true. After running for the maximum runtime, the generator system will attempt to shut down. It should be noted that if a start condition is still true, it would start up

again immediately. In that case, an event message will be logged. Additionally, there is a **Generator Running Too Long** alarm that may be enabled to help alert the user to this situation.

14.8.1. Create a legacy AC generator system

To create a legacy AC generator system:

1. If an AC source system does not already exist, create it by going to **Systems > Add or Remove Systems** and launch the **Create System** wizard.
2. Go to **Systems > AC Source System > Inventory**.
3. In the **AC Sources** table, select **Add AC Source** button to launch the wizard.
4. Set the **Name** and then select **Next**.
5. Select **Legacy Generator** from the **AC Source Type** dropdown list. Select **Next**.
6. Select the **Phase** for your **AC Source**. Select **Next**.
7. In the **Alarms** page, select whether the AC input fail alarm should be enabled for this source. Select **Yes** or **No**.
8. In the **Voltage Readings** page, select the system from where the AC source will obtain its readings.
9. Review your settings and select **Next**.
10. In the **Results** step, there will be an option to launch the **Configure Generator Control** wizard. Alternatively, this wizard can be launched from the **Generator Control** table within the details of the new legacy AC generator system source.

14.8.2. Create a legacy DC generator system

To create a legacy DC generator system:

1. If a DC source system does not already exist, create it at **Systems > Add or Remove Systems** and launch the **Create System** wizard
2. Go to **Systems > DC Source System > DC Sources**.
3. In the **DC Sources** table, select **Add Legacy DC Generator**.
4. After the legacy DC generator system has been added, select the **Go To** button. From here, the generator system control and alarms can be configured.

14.8.3. Configure legacy generator system control

From inside the legacy generator system:

1. In the **Generator Control** table, select the **Configure Generator Control** button to launch the configuration wizard.
2. In the **Generator Control** dropdown menu choose from the following:
   - **Enabled:** Chose enabled if the generator system can be controlled by a relay.
   - **Disabled:** If disabled is chosen no further configuration is required.

3. Under **Generator Control Signals** select the **Generator Control Relay** and the **Generator Status Signal Source**. Select **Next**.

> 📢 *Notice: The **Generator Control Relay** is mandatory as it is the relay that will be used to start and stop the generator system. This relay can also be driven by other features like alarms. This provides maximum flexibility in generator system control, but requires extra caution to ensure this generator system relay is shared only when intended.*

> 📢 *Notice: The **Generator Status Signal Source** is optional, but it should be mapped to a digital input which can be used to monitor whether or not the generator system is running.*

4. Under **Voltage to Monitor**, choose a voltage signal to be monitored.
   a. Enter a **Start Voltage Threshold**.
   b. Enter a **Stop Voltage Threshold**.
   c. Select **Next**.
5. Review your settings and select **Next**.

The generator system has now been configured.

If the user wishes to use the optional start and stop conditions to start and stop the generator system, these may be configured in the **Optional Start/Stop Conditions** table.

14.8.4. Configure legacy generator system alarms

Additionally, the alarms for **Generator Control** may be configured. The **Generator Status Mismatch** alarm will be active if there is a **Generator Status Signal Source** configured, and the status does not match what is expected. For example, if the **Generator Command Status** indicates that the generator system should be running, but the **Generator Status Signal Source** indicates that it is not (as reported in the **Generator Running** status field), the **Generator Status Mismatch** alarm will become active. Similarly, if the **Generator Command Status** indicates that the generator system should not be running, but the signal indicates that it is, the alarm will activate. The **Generator Running Too Long** alarm is disabled by default. If enabled, it will indicate if the generator system has run past the **Maximum Runtime** due to a start condition that is still true.

15. Alpha® FXM HP UPS Modules

For the components and functions of Alpha® FXM HP uninterruptible power supply (UPS) modules, please see **Alpha® FXM HP Uninterruptible Power Supply Modules User Guide, User Guide ID: 0170022-J0**.

16. Thermal systems

This section provides a brief overview of the components and functions of a thermal system.

16.1. Introduction

A thermal system provides insight into a thermally controlled outdoor enclosure. It is intended to be used together with one or more FlexAir® thermal controller modules. A thermal system enables activities such as logging system temperature measurements or monitoring fan speed, and holds various alarms related to an outdoor enclosure, such as unsuitable internal temperature alarms or fan failure alarms, if the thermal controller module has fans.

16.2. Create a thermal system

To create a new thermal system:

1. Go to **Systems > Add or Remove Systems** and select the **Create System** button to launch the **Create System** wizard.
2. In the **Create System** wizard, in the dropdown list, choose to create an **HVAC System**, then select **Done**.
3. In the **HVAC System** wizard, in the dropdown list, choose to create a **Thermal System**, then select **Done**.

16.3. Thermal system configurations

The thermal system is designed with the expectation of a 1:1 relationship with a physical cabinet. If the system controller handles hardware in more than one cabinet, multiple thermal systems should be created. There may be situations where there is more than one thermal controller module in a given cabinet.

16.3.1. Single cabinet setup

When the system controller handles equipment in only one cabinet, a single thermal system should be created. When a thermal controller module is connected via CAN to the system controller, by default, it is automatically added to the thermal system. If it has been setup for manual configuration, then add the modules to the thermal system manually as described in the multiple cabinet setup.

16.3.2. Multiple cabinet setup

When the system controller handles equipment in multiple cabinets, a thermal system should be created for each physical cabinet. When there are multiple thermal systems, it is important to give each thermal system a custom name to differentiate them from each other. The system controller does not know however, which cabinet the thermal controller modules are installed in. Therefore the modules must be manually added to the respective thermal systems. To do this:

1. From the **System** menu, in one of the previously created and named thermal systems and select the **Thermal Controllers** page.

2. In the **Modules Available for Assignment** table, all the available thermal controller modules should appear.

3. Select **Locate** on a thermal controller module to activate flashing LEDs on the respective hardware. Repeat this procedure until you are able to identify which cabinet each module resides in. Once it is clear, select **Assign** on the modules which belong to the thermal system you are viewing.

4. Repeat this process for each thermal system until all thermal controller modules are assigned to a system.

16.4. Logging temperatures

The thermal system obtains cabinet temperature data from the thermal controller modules inside the cabinet. Once the thermal system has access to the temperature data, it is automatically logged in the controller module's performance logs.

The thermal system has a placeholder for an internal system temperature, an external system temperature, and three additional generic system temperatures, in the case that more than two measurements are desired to be logged. Each of these system temperatures can be custom named to suit specific needs.

To configure the thermal system's cabinet temperature data:

1. Go to **System > Thermal System > Status & Config** page.

2. In the **System Temperatures** table, select the **Go To** button on one of the system temperatures.

3. In the table for that system temperature, configure the **Name** as desired.

4. Select the second **Edit** button to choose a temperature probe from a thermal controller module inside the thermal system. For more advanced settings (such as obtaining the average value of two temperature probes), a **Custom Data** can also be selected. Please see the user manual section regarding **Custom Data** for more information.

5. To view the logged data (available in both live charts and exportable CSV format), go to **Logs > Performance** and select the respective **System Temperature** from the **Performance Logs** table.

16.5. Logging filter replacement date

The filter replacement date can be logged to keep track of the cabinet's filter usage. Note that recording the replacement date does not activate any sort of time-based replacement indicator or replacement schedule, it is simply an optional tool to keep track of the date it was replaced.

1. Go to **Systems > Thermal System > Status & Config**.

2. In the **Status** table, select the **Log Filter Replacement** button. This will automatically set the date to today's date, and will additionally create a record in the **Events & Alerts** page. Note that

this button is not available when browsing through the system controller's LCD panel. It is only available through the web interface.

3. This entry can also be manually set by selecting the **Edit** button to allow customization of the value. When manually set, there is no record created in the **Events & Alerts** page.

16.6. Logging fan replacement dates

The fan replacement dates can be logged to keep track of the fan usage. Note that recording the replacement date does not activate any sort of time-based replacement indicator or replacement schedule, it is simply an optional tool to keep track of the date it was replaced.

1. Go to **Systems > Thermal System > Thermal Controllers** and select the respective thermal controller module.

2. Inside the **Fans** table, select the **Go To** button to view the table for a single fan. Once viewing a single fan's table, select the **Log Fan Replacement** button at the top of the table. This will automatically set the date to today's date, and will additionally create a record in the **Events & Alerts** page.

3. This entry can also be manually set by selecting the **Edit** button to allow customization of the value. When manually set, there is no record created in the **Events & Alerts** page.

16.7. Alarms and alerts

This section provides a brief overview alarms and alerts for a thermal system.

16.7.1. Thermal controller module alert to thermal system alarm propagation

The thermal system's alarms table is located inside the **Status & Config** page. The alarms in this table are generated from aggregated data from the alerts table from each of the thermal controller modules in the thermal system. For example, if a thermal controller module activates its **Internal Temperature High** alert, then the thermal system that it belongs to will activate its **Internal Temperature High** alarm. Likewise, if one or multiple fans fail on a thermal controller module inside the thermal system, then the thermal system's **Fan Fail** alarm will activate.

The exception to this propagation rule is the **Thermal Controller Comms Lost** alarm, which activates in the event that any thermal controller module in that system loses communication with the system controller.

> 📢 *Notice: A thermal controller module must be assigned to a thermal system for its alerts to be counted in the **CAN Modules** table of the **Modules** page. Otherwise its alerts will show as unknown.*

16.7.2. Identifying the origin of an active alarm

In the event that a thermal system's alarm is active, select the active alarm graphic, or go to **Alarms > Active Alarms**. There is an **Active Alarms** table, as well as an **Active Module Alerts** table displayed.

For most thermal system alarms, the respective module alert will appear in the **Active Module Alerts** table. This will help identify which thermal controller module is responsible for activating the system alarm. If the alarm was a **Fan Fail** alarm, the alert will also identify which fan on the thermal controller module has failed.

16.7.3. Alarms where hardware does not exist

There is no concern if alarms exist in the software for hardware that does not exist. For example, if a cabinet is not configured with a filter, the **Filter Replacement Required** alarm will never activate.

17. Environment manager systems

This section provides a brief overview of the components and functions of an **Environment Manager**.

17.1. Introduction

An environment manager provides cooling control to systems with fans and air conditioner units that can be commanded with relay control. During creation, the environment manager can be configured to control between one to 10 fans and air conditioner units. After system creation the number of fans and air conditioner units cannot be changed.

17.2. Create an environment manager

To create a new environment manager:

1. Go to **Systems > Add or Remove Systems** and select the **Create System** button to launch the **Create System** wizard.
2. In the **Create System** wizard, in the dropdown list, select **HVAC System**, then select **Done**.
3. In the **HVAC System** wizard, in the dropdown list, select **Environment Manager System**, then select **Done**.
4. Follow the wizard steps to complete. Ensure to select the appropriate number of fans and air conditioner units to be created, as this cannot be changed after the wizard is complete.

17.3. Cooling modes

In the menu **Systems > Env.Manager > Status**, the **System** table shows a **Cooling Mode** entry. This shows the status of the system with the following possible cooling modes:

- **Testing:** This is the mode when the system controller first turns on, and it tests to determine if each configured cooling device is physically present.
- **Economy Cooling:** Fans will run according to their configured turn on and turn off temperatures; air conditioner units will not run.
- **Air Conditioning:** Air conditioner units will run according to their configured turn on and turn off temperatures; fans will not run.
- **Emergency:** All fans and air conditioner units will run in an effort to reduce the internal temperature as quickly as possible.
- **Staff Comfort:** This mode can be manually engaged by a user. It will run the air conditioner units to reduce the internal temperature to a comfortable working environment for a defined time period.
- **Shutdown:** This mode will be engaged if the system cannot run due to mains failure or detected smoke.
- **Purge:** All fans will run in an effort to remove the possibility of harmful gas in the internal working environment.

The following diagram describes the movement between cooling modes.

Figure 17-1 Environment manager cooling modes

Events:

In Temp Low: Internal temperature is below the economy mode temperature threshold.

In Temp High: Internal temperature is below the air conditioning mode temperature threshold.

In Temp Too High: Internal temperature exceeds the emergency temperature threshold.

Out Temp Low: External temperature is below the difference between the reference external temperature and the temperature deviation value.

Test Ends: User configured test timer has ended.

Staff Comfort Ends: User configured staff comfort timer has ended.

Staff Comfort Button Pressed: Staff Comfort button on the controller UI has been pressed.

Staff Comfort low Temp reach : Internal temperature is lower than the Staff Comfort Mode threshold temperature.

Main Fail : When the digital input attached to the main AC fail alarm is active.

Smoke Shutdown: when the digital input mapped to the smoke shutdown alarm is active.

17.4. Configuration

For an environment manager system to be fully functional, the following entries must be configured.

To view the configuration for the system, go to **Systems→ Env. Manager→ Configure System**.

In the **Configuration** table:

- **Internal Temperature Source** and **External Temperature Source**: Select temperature probes that are wired to the internal and external areas of the system. 'Internal' refers to the area which is being cooled, while 'external' refers to the area outside of this.
- **Temperature Deviation Value:** This value acts as a hysteresis. When the system changes from **Economy Cooling** mode to **Air Conditioning** mode, it keeps track of the external temperature and saves it as its reference temperature. For the system to revert to **Economy Cooling** mode, in

addition to the internal temperature having to be below the **Economy Cooling Mode Temperature Threshold**, the external temperature must be lower than the reference temperature by the amount specified in the **Temperature Deviation Value**.

In the **System Durations and Delays** table:

- **Cooling Device Start Delay:** This is the time required by each cooling device to start. Any time cooling devices should all be started, the environment manager system will wait this long between starting each device. The purpose is to stagger start up and reduce peak power consumption.
- **Cooling Device Stability Delay:** This is the delay used by the system to ensure that the cooling devices are receiving a stable signal. This configuration is used to determine cooling device failure states; the device will only move into and out of failure state if the feedback signal is stable for longer than this configured delay.
- **Fan Start up Min. Duration:** This is the time required by each fan to start. The system will wait this long during the fan's test state before checking for a feedback signal. The purpose of this delay is to avoid receiving any false positive feedback from fans as they begin starting up.
- **Fan Start up Max. Duration:** During the fan's **Testing** or **Starting** states, this is the maximum time duration that the system will remain waiting for a feedback signal to determine if the fan is running or not. This value must be greater than value configured for the **Fan Start up Min. Duration**.
- **Air Conditioner Start up Min. Duration:** This is the time required by each air conditioner unit to start. The system will wait this long during the air conditioner unit's test state before checking for a feedback signal. The purpose of this delay is to avoid receiving any false positive feedback from air conditioners as they begin starting up.
- **Air Conditioner Start up Max. Duration:** During the air conditioner unit's **Testing** or **Starting** states, this is the maximum time duration that the system will remain waiting for a feedback signal to determine if the air conditioner unit is running or not. This value must be greater than value configured for the **Air Conditioner Start up Min. Duration**.
- **Air Conditioner Decompression Duration:** This is the time it takes an air conditioner unit to decompress after it has been running. The system cannot start an air conditioner unit while it's decompressing.

In the **Mode Properties** table:

- **Economy Cooling Mode Temperature Threshold:** This is the temperature threshold where the system will leave **Air Conditioning** mode and enter **Economy Cooling** mode.
- **Air Conditioning Mode Temperature Threshold:** This is the temperature threshold where the system will leave **Testing** or **Economy Cooling** mode and enter **Air Conditioning** mode.
- **Emergency Mode Temperature Threshold:** This is the temperature threshold where the system will leave **Testing**, **Economy Cooling**, or **Air Conditioning** mode and enter **Emergency** mode.
- **Emergency Mode Temperature Min. Threshold:** This is the temperature threshold where the system will leave **Emergency** mode and enter **Air Conditioning** mode.

In the **Alarm Thresholds and Sources** table:

- **Economy Cooling Fail Temperature Deviation:** If the internal temperature rises to the point where the **Air Conditioning Mode Temperature Threshold** is crossed, but the external temperature is still relatively low, the **Economy Cooling Fail** alarm will activate. It is calculated by subtracting the external temperature from the **Air Conditioning Mode Temperature Threshold** when **Air Conditioning** mode is entered. If the difference is greater than the **Economy Cooling Fail Temperature Deviation**, it means that the fans were not able to adequately cool the area in spite of the low external temperature.

- **Main Fail Shutdown Duration:** This is the delay before cooling devices are configured to turn on after the **Main Fail** alarm is cleared. During this delay, the system will be in **Shutdown** mode, and will then return to the previous mode it was in beforehand.

- **Voltage Alarm Source:** This is the voltage input source mapped to the **24V Undervoltage** and **24V Overvoltage** alarms.

- **Shelter Door Open Digital Source:** This is the digital input source mapped to the **Shelter Door Open** alarm.

- **Smoke Shutdown Digital Source:** This is the digital input source mapped to the **Smoke Shutdown** alarm.

- **Main Fail Digital Source:** This is the digital input source mapped to the **Main Fail** alarm.

17.5. Staff comfort mode

Staff comfort mode can be manually engaged by a user. It will run the air conditioner units to reduce the internal temperature to a comfortable working environment for a defined time period.

> 📢 *Notice: Staff Comfort mode can only be started when **Economy Cooling** or **Air Conditioning** modes are active.*

To configure **Staff Comfort** mode, go to **Systems→ Env. Manager→ Configure System**, and scroll down to the **Staff Comfort Mode** table.

Staff Comfort Mode can be started by selecting **Start Staff Comfort Mode** at the top of the table. Once started, it can be stopped by selecting the **Stop Staff Comfort Mode** button. On the LCD panel, it can also be started via a maintenance shortcut from the home screen: **Maintenance > Env. Manager > Start Staff Comfort Mode**.

The **Duration** is the amount of time that the system will remain in **Staff Comfort** mode, before it returns to its previous mode, unless it is stopped beforehand by selecting the **Stop Staff Comfort Mode** button or if **Purge** mode is engaged.

Exit Staff Comfort Threshold: This is the temperature that the system will leave **Staff Comfort** mode and return to its previous mode.

Temperature On Threshold: This is the lowest temperature that **Staff Comfort** mode can be started.

17.6. Purge mode

In **Purge** mode, all fans will run in an effort to remove the possibility of harmful gas in the internal working environment.

> 📢 *Notice: **Purge** mode will not start when **Testing** mode is active. When the system leaves **Testing** mode, if the **Digital Input Trigger Source** or the **Analog Input Trigger Source** is active, **Purge** mode will begin at this time.*
>
> *To configure **Purge** mode, go to **Systems→ Env. Manager→ Configure System**, and scroll down to the **Purge Mode** table.*
>
> *Purge mode can be started automatically by mapping a digital or analog input to the **Digital Input Trigger Source** or the **Analog Input Trigger Source** respectively. If the **Analog Input Trigger Source** is mapped, the **Voltage Trigger Threshold** must also be mapped.*
>
> *Purge mode can also be started manually by selecting **Manually Start Purge Mode**. If **Purge** mode is manually started, it will not leave this mode until **Manually Stop Purge Mode** is selected.*
>
> *At any point, **Purge** mode will activate if either of the automatic sources are active, or if it is manually started. The system will not leave this mode until all sources are inactive.*

17.7. Shutdown Mode

In **Shutdown** mode, all cooling devices are turned off to prevent damage to the devices due to power failure or fire.

Shutdown mode is automatically started based on two alarms and have different behavior based on the alarms.

In the case that the **Shutdown** is caused by **Main Fail** Alarm, the system will not go to **Shutdown** mode immediately until the alarm becomes inactive. Once the system enters **Shutdown** mode due to **Main Fail**, the system will stay in **Shutdown** mode until the **Main Fail Shutdown Duration** has elapsed.

To configure **Main Fail Shutdown Duration**, go to **Systems→ Env. Manager→ Configure System**, and scroll down to the **Alarm Thresholds and Sources** table.

In the case that the **Shutdown** is caused by **Cooling System Smoke Shutdown** Alam, the system will go immediately to **Shutdown** mode inhibiting all cooling devices to be turned on and will stay in **Shutdown** mode until the **Cooling System Smoke Shutdown** Alarm is inactive.

17.8. Energy consumption

The environment manager is able to keep track of energy consumed for each cooling device. This can be done by configuring a pulse signal and an energy rate per pulse.

The energy consumption overview is available in the following menu: **Systems > Env. Manager > System Functions > Energy Consumption**. To configure the feature, select the **Go To** button on the row for a given cooling device and then find the **Energy Consumption** table.

The **Pulse Count** can be obtained from a digital input or a voltage input, by configuring the **Pulse Source** or the **Voltage Source** respectively. If a **Voltage Source** is configured, the **Voltage Threshold** must also be configured.

Each time a digital input is measured as active, or the voltage rises above the configured threshold, the **Total Energy Consumption** will increment by the amount configured in the **Energy per Pulse**.

17.9. Runtime statistics

The environment manager is able to keep track of the runtime statistics (duration and percent time running) for each cooling device.

The runtime statistics overview is available in the following menu: **Systems > Env. Manager > System Functions > Runtime Statistics**.

The usage statistics for a cooling device can also be viewed by opening the details page for that cooling device via the following menu: **Systems > Env. Manager > Status**, select the **Go To** button on the row for a cooling device and then find the **Runtime Statistics** table.

17.10. Fans

When the environment manager is created, it can be configured to control between 1 to 10 fans. After creation, the number of fans cannot be changed.

To view the details of a fan, go to **Systems > Env. Manager > Status**, and select the **Go To** button on the row for the specified fan.

17.10.1. Fan states

When viewing the details of a fan, the **Status** table shows a **State** entry. This shows the status of the fan with the following possible states:

- **Off:** The fan is commanded to be stopped.
- **Starting:** The fan is starting up.
- **Running:** The fan is commanded to be running.
- **Testing:** The environment manager is testing to determine if the fan is physically present. It commands the fan to run and waits for a feedback signal to determine if it is available.
- **Fault:** The fan is commanded to be running, but the feedback signal has been lost for longer than the environment manager's configured **Cooling Device Stability Delay**. This happens when the

digital feedback signal source is set but the signal is inactive, or if the fan's revolutions per minute (RPM) is a valid number but is less than the fan minimum speed.

- **Not Available:** The fan was tested but the environment manager did not receive a feedback signal. The fan will remain in the **Not Available** state until the system controller is restarted and this fan is tested again.

- **Suspended - Device Not Configured:** The **Control Relay** entry and both **Digital Input Source** and **Analog Input Source** entries in the **Configuration** table have not been set. Until a relay is selected and either the **Digital Input Source** or **Analog Input Source** are set, the fan will not run and will stay in this state.

The following diagram describes the movement between states.

Figure 17-2 Fan states

17.10.2. Fan configuration

For a fan to be fully functional in an environment manager system, the following entries must be configured.

To view the configuration of a fan, go to **Systems→ Env. Manager→ Status**, and select the **Go To** button on the row for the specified fan.

- **Control Relay:** The relay that turns the fan on and off. If this entry is not set, the fan **State** will be **Suspended - Device Not Configured**.

- **Turn on Temp in Economy Cooling** and **Turn off Temp in Economy Cooling:** The respective temperatures that this fan will turn on and off at when the system is in **Economy Cooling** mode. For the fan to function properly, the turn on temperature must be greater than the value chosen for the turn off temperature so that these two entries create an effective hysteresis.

- A configured **Fan Speed** or **Digital Input Source**. At least one of these must be configured to provide feedback to the environment manager system to let it know if the fan is running or not. If neither of these are configured, the **State** will go to **Not Available** after it is tested on system controller start up. This feedback is also used to activate the **Fan Fault** alarm, which will activate if the fan is found to be not running for longer than the configured **Cooling Device Stability Delay**. This happens when the digital feedback signal source is set but the signal is inactive, or if the fan's RPM is a valid number but is below the fan minimum speed. This alarm will clear the next time the fan enters the **Running** state. If one of these entries is not set, the fan state will be **Suspended - Device Not Configured.**

  - To configure the **Fan Speed**, the **Analog Input Source**, **RPM Calculation Slope**, **RPM Calculation Offset** and **Fan Min. Running Speed** must be configured in the **Fan Speed Configuration** table. The **Fan Max. Display Speed** can optionally be configured.

17.11. Air conditioner units

When the environment manager is created, it can be configured to control between one to 10 air conditioner units. After creation, the number of air conditioner units cannot be changed.

To view the details of an air conditioner unit, go to **Systems > Env. Manager > Status**, and select the **Go To** button on the row for the specified air conditioner unit.

17.11.1. Air conditioner unit states

When viewing the details of a given air conditioner unit, the **Status** table shows a **State** entry. This shows the status of the air conditioner unit with the following possible states:

- **Off:** The air conditioner unit is commanded to be stopped.
- **Starting:** The air conditioner unit is starting up.
- **Running:** The air conditioner unit is commanded to be running.
- **Decompressing:** The air conditioner unit was previously commanded to start up and cannot be commanded to start up again until it is finished decompressing.
- **Testing:** The environment manager is testing to determine if the air conditioner unit is physically present. It commands the air conditioner unit to run and waits for a feedback signal to determine if it is available.

- **Fault:** The air conditioner unit is commanded to run, but the feedback signal has been lost for longer than the configured **Cooling Device Stability Delay**. This happens when the **Digital Input Source** is set but the signal is inactive.

- **Not Available:** The air conditioner unit was tested but the environment manager did not receive a feedback signal. The air conditioner unit will remain in the **Not Available** state until the system controller is restarted and this air conditioner unit is tested again.

- **Suspended - Device Not Configured:** The **Control Relay** entry and the **Digital Input Source** entry in the **Configuration** table have not been set. Until a relay is chosen and a digital source is set, the air conditioner unit will not run and will stay in this state.

The following diagram describes the movement between states.

Figure 17-3 Air conditioner unit states

17.11.2. Air conditioner unit configuration

For an air conditioner unit to be fully functional in an environment manager system, the following entries must be configured.

To view the configuration of an air conditioner unit, go to **Systems→ Env. Manager→ Status**, and select the **Go To** button on the row for the specified air conditioner unit.

- **Control Relay:** The relay that turns the air conditioner unit on and off. If this entry is not set, the air conditioner unit **State** will be **Suspended - No Relay Mapped**.
- **Digital Input Source:** Used to determine if the air conditioner unit is running or not. If not configured, the **State** will change to **Not Available** after it is tested on system controller start up. This feedback is also used to activate the **Air Conditioner Fail** alarm, which will activate if the air conditioner unit is found to be not running for longer than the configured **Cooling Device Stability Delay**. This happens if the **Digital Input Source** is set but the signal is inactive. If this entry is not set, the air conditioner unit **State** will be **Suspended - Device Not Configured**.

📢 *Notice: The **Turn on Temp in Air Conditioning** and **Turn off Temp in Air Conditioning** entries must be configured for each air conditioner unit when the environment manager system is created, and cannot be changed afterward due to air conditioner unit cycling.*

17.11.3. Air conditioner unit cycling

When there is more than one air conditioner unit available, the air conditioner units will routinely cycle their role so that their usage over time is evenly distributed. The air conditioner units will rotate their role every time all the air conditioner units turn off.

The air conditioner unit with the **Air Conditioner Number** 1 will always have the lowest turn on temperature, and therefore it will accumulate the most running hours over time. After a cycle, this air conditioner unit's **Air Conditioner Number** will be rotated to have the highest number so that it accumulates the least running hours.

Consider the following example, with three air conditioner units: air conditioner unit A, air conditioner unit B, and air conditioner unit C. After the air conditioner units are cycled, air conditioner units A and B are shifted to a lower **Air Conditioner Number**, and air conditioner unit A is shifted to have the highest **Air Conditioner Number**.

Table 17-1 Air conditioner units before cycling

Name	Air conditioner unit number	Turn on temperature
Air conditioner unit A	1	91°F (33°C)
Air conditioner unit B	2	95°F (35°C)
Air conditioner unit C	3	99°F (37°C)

Table 17-2 Air conditioner units after cycling

Name	Air conditioner unit number	Turn on temperature
Air conditioner unit B	1	91°F (33°C)
Air conditioner unit C	2	95°F (35°C)
Air conditioner unit A	3	99°F (37°C)

18. Alpha® DPX Distributed Power Transport System

This section provides an overview of the Alpha® DPX distributed power transport system, which provides the ability to power remote loads over a high voltage power line.

Distributed power transport architecture enables use of a centralized power hub for backup, eliminating the need for AC utility or battery backup at the remote site. This reduces installation and operating expenses, and provides flexibility related to site selection for the installation of the remote communication equipment.

18.1. Introduction to Alpha® DPX systems

An Alpha® DPX distributed power transport system is comprised of a 380VDC system and a fault managed system. Usually, a second 48VDC system is also required to power the local node. All of these systems can be created by running the DPX system creation wizard, described in the next section.

The 380VDC system contains 380V rectifier modules which power the 380V input of the fault managed system. The 380VDC system is exactly like other DC systems supported on the system controller, so its functionality is not described here in detail. Please see the section on DC power systems in this manual for more information.

The fault managed system is comprised of DPX 2kW fault managed power distribution modules with EnShield™ technology and DPX 1500W downconverters. The DPX fault managed power distribution modules provide fault tolerant 380V power across longer distances to the DPX downconverters at the remote nodes. The DPX fault managed power distribution modules communicate to the system controller via the CAN network. The DPX fault managed power distribution modules communicate to the DPX downconverters via the Power Line Communication (PLC) protocol which enables communication over the power line cables. The system controller does not directly communicate to the DPX downconverters, but instead receives information from the DPX downconverters via the DPX fault managed power distribution modules.

The DPX downconverter provides power down conversion at the remote node. The outputs of the DPX downconverters are wired into a DPX 48VDC load disconnect box which provides a manual on/off switch. After this point, they can power one or more radios or other electrical equipment at the remote node. The DPX downconverter outputs may be wired together at the DPX load disconnect box to power loads which require a high wattage.

In order to power the local node where the system controller is installed, a 48V power source is required. This is usually done via a second 48VDC system, with 48V rectifier modules. Since this DC system is also exactly like other DC systems, see the section on DC power systems for more information.

Note that at this time, no battery backup power is supported in the DPX system configuration. The installation of an AlphaCap 665 short duration backup supply module provides a few minutes worth of backup in the case of an power transient event or outage to allow relevant traps and alarms to be sent out by the system controller so that operators are aware of the situation.

18.2. Create an Alpha® DPX system

All required subsystems of the DPX system necessary for remote load powering can be created at once. To do this:

1. Go to **System > Add or Remove Systems** and select the **Create System** button.
2. Choose **Distributed Power Transport System** from the dropdown menu. Select **Done**.
3. Choose to create the **Fault Managed System** and answer **Yes** or **No** if the system will contain a second 48VDC system to power the local node. Select **Next**.
4. Optionally give each power system a name. Select **Next**.
5. Review the changes and select **Next**.
6. The DPX system is successfully created. Select **Done**.

18.3. Fault managed system

The fault managed system manages the fault tolerant transfer of high voltage power, as well as the down conversion at the remote load. The fault managed system must be used in conjunction with a 380VDC system, and can optionally be connected with a 48VDC system as well to provide power for 48V loads at the local node.

The fault managed system communicates with DPX downconverters through the DPX fault managed power distribution modules via Power Line Communication, over the same connection that supplies the DPX downconverter's power. For more details, see the section on **Maintaining Modules**.

18.3.1. Shared alarm configuration

While the DPX fault managed power distribution modules and DPX downconverters have their own alarms, the configuration for these alarms is shared across all modules so that the configuration only needs to be set once for that alarm, regardless of the number of modules in the system. For example, the **FM Channel Module Overcurrent Internal** alarm on the DPX fault managed power distribution modules can be configured under the system settings to change its enable or disabled it or change its priority. This change will then apply to all DPX fault managed power distribution modules in the system. The alarms will still be raised against the individual modules for which the fault is occuring.

- The alarm configuration for the shared alarms can be found at **FM System > Configure System** inside the **Shared Alarm Configuration** table.
- The DPX fault managed power distribution module alarms can be found at **FM System > Inventory > FM Modules > Specific Module** inside the **Alarms** table.
- The DPX downconverter alarms can be found at **FM System > Inventory > Downconverters > Downconverter** inside the **Alarms** table.

18.3.2. Alpha® DPX Downconverter loads

Loads are available to be named and configured from the **FM System > Inventory > Loads** page.

Note that in the DPX system, the concept of a load is intended to encapsulate everything that is powered by the output of the DPX downconverter. In most cases this will include a DPX load disconnect box plus one or more radios or other electrical equipment.

By default, at the creation of the DPX system (or at the time of acquiring a new DPX downconverter in the system), one load is created per DPX downconverter. However, this does not signify that the DPX downconverter can only power one remote device. It is intended, however, that everything past the output of the DPX downconverter is modeled by this load entity on the system controller. So, the load itself may be comprised of multiple devices. It is recommended to name the loads in descriptive ways so that this meaning is clear. There are also extra **Downstream Equipment** text fields provided within the load page to allow the users to name any subcomponents of the load for additional clarity. This can be done by editing the text fields directly, or by running the **Add Labels for Downstream Equipment** wizard, described in the following section.

It is also possible that the outputs of multiple DPX downconverters will be wired together at the DPX load disconnect box in order to power larger loads. This may also be modeled on the system controller by configuring two or more DPX downconverters to point at the same load. This can be done manually by editing which load each DPX downconverter output is pointing to, or by running the **Configure Downconverter to Load Mappings** wizard, described in the following section.

18.3.2.1. Configuring and grouping Alpha® DPX Downconverter loads

Loads may be configured manually by editing the fields of each load, on the **FM System > Inventory > Loads > Specific Load** page. Outputs of multiple DPX downconverters can also be grouped by editing the **Load Powered By This Output** field on the **FM System > Inventory > Downconverters > Specific Downconverter** page in the **Output** table. If outputs have been grouped, any orphaned loads which were created by the system but which are no longer mapped to a DPX downconverter should be removed. Note that the **Remove** button is only available for loads which are not associated to a DPX downconverter, as it is a functional feature of the system controller's model of the DPX system to have each DPX downconverter output represented by a load.

However, loads can also be configured using the **Configure Downconverter to Load Mappings** wizard, which provides the opportunity to add and remove loads, name them, and associate them to the correct DPX downconverter. To do that, follow the steps listed:

1. Launch the **Configure Downconverter to Load Mappings** wizard from the **FM System > Inventory > Loads** page.
2. A preview step will explain how to use the wizard. Select **Next**.
3. If the FM system already contains the maximum number of loads (one per DPX downconverter), no option will be given to add more loads. If the FM system contains less than the maximum number of loads, the first step will allow the user to add more loads, up to the maximum. Note that loads are not removed in this step. That will be done at the end of the wizard by removing any loads that are no longer mapped to a DPX downconverter. After specifying the number of loads to add, if any, select **Next**.
4. In the next step, the user will be able to name the loads, including any new loads that they are adding. It is extremely helpful for the subsequent mapping step (and for viewing this load later on

the Power Flow diagrams) to give the load a unique and descriptive name. In naming the load it should also be kept in mind that the load concept is intended to represent everything powered by the DPX downconverter output. After naming the loads, select **Next**.

5. The final step is the mapping step, where the DPX downconverters are listed, and the loads that each one powers should be selected to link them together. It is in this step that any grouping can be done, by linking two DPX 1500W downconverters to the same load. After matching the DPX downconverters with their loads, select **Next**.

6. In the results step, the number of loads added or removed will be listed. The linking of DPX downconverters with loads will also be shown. Any load which is not linked with a DPX downconverter will be removed from the system.

7. From the results step, the user can either select **Done** to end the wizard, or choose to run the **Add Labels for Downstream Equipment** wizard, described in the following section.

18.3.2.2. Labeling downstream equipment

As described in previous sections, the concept of a load within the fault managed system is intended to represent everything powered by the output of the DPX downconverter. Therefore, it is quite likely that there will be multiple devices represented by each load. For this reason, extra text fields have been provided to help identify what each load contains.

These fields may be edited directly on the **FM System > Inventory > Loads > Specific Load** page in the **Downstream Equipment** table, where five text fields are provided for this purpose. Alternatively, it may be done from the **Add Labels for Downstream Equipment** wizard.

The **Add Labels for Downstream Equipment** wizard may be run for all loads at once by running it from the **FM System > Inventory > Loads** page. Alternatively, it can also be run for an individual load by running the wizard from inside that load's specific page, at the top of the **Downstream Equipment** table.

If the wizard is run for all loads at once, the user will step through each load, and can edit the **Downstream Equipment** text fields for each load, one by one. If the wizard is run for just one individual load, there will be just one step containing the **Downstream Equipment** text fields for the single load.

Once these labels have been added, they are visible on the load page, and they will also be displayed on the Power Flow diagram for the load in order to help users identify the equipment contained in each load.

18.3.3. Powering on and off devices

The FM system allows the various devices within the system to be powered on and off in several ways.

The DPX fault managed power distribution modules may be powered on or off, using the buttons located on the individual DPX fault managed power distribution modules pages at **FM System > Inventory > FM Modules > Specific Module**. When an DPX fault managed power distribution modules is powered off, it will stop all power that is going over the high voltage power line, so it will cause the DPX downconverter to power off as well. This means there will be no communication with the DPX downconverter while the DPX fault managed power distribution modules is off.

The DPX downconverter outputs may also be powered on or off, using the buttons on each row of the DPX downconverter table at **FM System > Inventory > Downconverters**, or inside of each DPX downconverter's individual page on the **Output** table. When the DPX downconverter output is powered off, the DPX downconverter itself is still powered, and the high voltage power line is still powered. Communication to the DPX downconverter remains intact.

Additionally, the loads may be powered on or off, using the buttons on each row of the load table at **FM System > Inventory > Loads**, or inside of each load's individual page. The buttons on the load table send the same command to the DPX downconverter as described in the previous paragraph, so the result is that the DPX downconverter output that is turned on or off. The DPX downconverter itself is still powered, and the high voltage power line is still powered. Communication to the DPX downconverter remains intact. Note that in the most common case where each DPX downconverter powers one load, there is no difference between using the on/off buttons on the load, or on the DPX downconverter output. However, in the case where DPX downconverter outputs have been wired together, the on/off command from the load will be sent to each DPX downconverter that is powering that load. In that case, the result will be that all DPX downconverters powering the load are shut down or powered up.

18.3.3.1. Powering on and off grouped loads

If loads are grouped, there are special considerations for using the on and off buttons.

As previously described, the on/off buttons on the load will shut down or power up all associated DPX downconverters, so it is recommended to always use these buttons to shut down or power up the load. However, the on/off buttons are still available on the DPX downconverters and DPX fault managed power distribution modules, in case they are needed for some reason. An example might be if the load is light, although grouped and therefore capable of higher capacities. In that case, a single DPX fault managed power distribution module and DPX downconverter might be capable of carrying the load, and it might be possible to shut down the other set without dropping the load. In any case, a user should be aware that using the buttons on the DPX fault managed power distribution module or DPX downconverter to partially shut down power to the load will cause the available capacity to the load to be lowered.

For example, if two DPX downconverters are both powering the same load, that load now has a capacity of 3000W. If the current power draw of the load is only 1200W, it would be safe to shut down only one of the DPX downconverters for maintenance, either from the DPX downconverter or the DPX fault managed power distribution module **Turn Off Output** button. However, if the load was drawing 2800W and one of its sources was turned off, the load would be dropped.

Powering on the load requires the same consideration. If the load is small enough to be carried by a single DPX downconverter, it should be powered as soon as the first DPX downconverter is turned on. However, if the load is bigger, the first powered DPX downconverter may overload and will be unable to keep the load powered.

For these reasons, it is recommended when possible to use the buttons on the load page to turn on and off all DPX downconverters powering the load. It should be noted that the commands sent to the DPX downconverter still take time to propagate over the CAN network and then over the power line communication to the downconverters, so it is possible that all DPX downconverters will not receive the command at the exact simultaneous moment. Therefore, there may briefly be overload or other alarms

raised. However, the timing will be as close as possible, unlike manually using the separate buttons on the DPX downconverters.

If the load is grouped, even if it is desired to shut down the power over the power line from the DPX fault managed power distribution module, the buttons on the load could be used first to shut down the output of all DPX downconverters powering the load. After that, the buttons on the DPX fault managed power distribution module can be used to shut down the power and communication over the power line.

19. Standalone battery systems

This section provides a brief overview of the components and functions of an **Standalone Battery System**.

19.1. Introduction

A standalone battery system provides monitoring to a single or multiple battery modules. During the creation, the standalone battery system can be configured based on the controller current supported battery chemistry type and voltage.

19.2. Create a standalone battery system

Creating a standalone battery is done using the **Create System** wizard. Either a single DC system or multiple standalone batteries with the same battery chemistry and voltage are supported, so if a DC system already exists on the system controller, the system controller will prevent the creation of a standalone battery system and vice versa. Additionally, when a standalone battery system already exists, the system controller will prevent creating a standalone battery system with different chemistry and voltage than the standalone battery system that is already created.

1. Go to **System > Add or Remove Systems** and select the Create System button to launch the **Create System** wizard.
2. In the **Create System** wizard, in the dropdown list, select **Standalone Battery System**, then select **Done**.
3. Follow the wizard steps to complete.

19.3. Configure lead acid or nickel cadmium battery parameters

1. Go to **Systems > Battery > Status & Config,** you will see several tables, with **Status, Configuration, Alarms, Battery Strings, and Charging/Discharging Threshold**. There is also a table with a list of battery strings, and a button to add more.
2. In the **Configuration** table, assign the battery a name and description if required.
3. Edit the **Battery Voltage Source** and **Battery Current Source** if necessary. Note that it is possible to map the entire battery to an ADIO module input for the voltage and current sources, but it is recommended to leave those values at their defaults at this level. The defaults will average the voltages of the battery strings and sum the currents.
4. In the **Battery Strings** table, select the **Add Battery String** button to launch the wizard which will add more battery strings if necessary.

19.4. Configure third-party lithium-ion battery module parameters

1. Connect a Cordex® HP protocol bridge peripheral on the CAN bus. Ensure the protocol bridge is configured and the third-party lithium-ion battery modules are connected to the protocol bridge peripheral.

2. The third-party lithium-ion battery modules connected via the Cordex® HP protocol bridge peripherals will begin to appear in the **Third-party Li-ion Battery Modules** table. If the battery modules do not appear, the Cordex® HP protocol bridges may not be assigned to the battery system. If this is the case, use the **Configure Third-party Li-ion Battery wizard** to manually assign the appropriate Cordex® HP protocol bridge peripherals to the battery system.

3. By selecting the details button for a given battery module, the name and description can be set if desired; this can be helpful to record the battery replacement date, for example.

20. System controller redundancy

For information on the system controller redundancy function, please see the *System Controller Redundancy Integration Guide (0350142-J0)*.

21. Power flow

This section provides an overview of the **Power Flow** feature.

21.1. Introduction to power flow

Power Flow is only available via the web interface of the system controller. From the main dashboard, it displays live information about the power system and its inventory items, as well the relationships and the flow of power between them.

Power Flow is intended to be a single point for monitoring and troubleshooting the system. Key information and alarms are shown and you can use power flow to quickly drill down and investigate any alarms. A **Power Flow** for a **DC System** as shown in the following figure.

Figure 21-1 Power flow for a DC system

21.2. Access power flow

Power flow can be accessed through the menu bar in the web interface. If a system that is supported by power flow has been created, the **Power Flow** for that system will automatically appear in the menu when the **Power Flow** menu item is selected.

📢 **Notice:** *Version 6.20 and later, power flow supports DC, Alpha® AMPS HP2 inverter, distribution, and line power systems. If your site has one or more of these systems, go to **Systems > Add or Remove Systems** to create them.*

21.2.1. Getting help

Help for the power flow feature can be accessed from any **Power Flow** by selecting the **Help** icon.

21.2.2. Use power flow configuration suggestions

Power flow can detect a missing configuration from the system's inventory. In such instances, a special node will appear to allow quick configuration of the system. Selecting the node will bring up a dialog to set the missing configuration.

Figure 21-2 Power flow configuration suggestions

This feature can be disabled under **Controller > Settings > User Interface > Power Flow Configuration Suggestions**.

21.2.3. Configure the default power flow

If your site has multiple systems supported by **Power Flow**, you can configure a default. The chosen **Power Flow** will display whenever you select **Power Flow** in the menu.

To set or change the default **Power Flow**, go to **Controller > Settings > User Interface** and set the **Default Power Flow** field.

21.3. Interact with power flow

Power Flow is an interactive diagram, as such one can expand elements to view more information, or select element icons to navigate. The following figure highlights the interactive elements of the power flow diagram.

Figure 21-3 Interacting with power flow

The controls are located alongside the **Help** button in the top left corner of the power flow. The **Expand All** button lets you immediately view all the details of the power flow by showing all fields and alarms. The **Collapse All** button returns the diagram to the compact status summary state.

21.4. System controller power flow

The system controller **Power Flow** presents an overview on the systems configured on the site and the flow of power between them. From here you can go to the **Power Flow** of individual systems by selecting that system's icon.

Grayed out **Inventory** items are there to help draw a more complete picture, or can be placeholders for future systems.

Figure 21-4 system controller power flow

21.5. Power flow for systems managed by different system controllers

For systems that are managed by different system controllers but are electrically connected, **Data Sharing** can be used together with the **Controller Power Flow** to visually see the flow of power between the two systems.

Notice: In system controller software version 6.20 and later, DC and Alpha® AMPS HP2 inverter systems can be shared and shown on the Controller Power Flow.

Figure 21-5 Using data sharing to create power flow across different system controllers

Components presented on **Power Flow** that are managed by a different system controller will have a reference to the **Data Subscription** from where they originate. Selecting these references will navigate to the user interface of the managing system controller.

22. Maintaining the system

When maintaining your system always check for known issues within the read me file that ships with your software. This section of the document covers the following:

- Rectifier module maintenance

- Inverter and Alpha® T2S inverter controller module maintenance

- Line power system maintenance

- Batteries and battery maintenance

- LVD maintenance

22.1. Rectifier module maintenance

This section covers the following: rectifier module alarms, rediscovering CAN devices, and inserting unassigned modules.

22.1.1. Rectifier module alarms

Possible problems with rectifier modules are indicated by either a **Rectifier Minor** or **Rectifier Fail** alarm. These alarms are activated if one or more rectifier modules have active alerts. Individual devices that are normally controlled as a group, such as rectifier modules, have alerts instead of alarms.

Go to the *Troubleshooting* section for more detailed information on rectifier alarms and alerts.

22.1.2. Insert unassigned modules

To assign rectifier modules:

1. From the main menu go to **Systems > DC System > Inventory > Rectifiers > Status**.
2. In the **Modules Available for Assignment** table, select the **Assign** button next to the rectifier module you want to assign. You can also assign all the rectifier modules by selecting **Assign All**. If this table is empty, there are no compatible rectifier modules detected.
3. The rectifier module moves from the **Modules Available for Assignment** to the **Status** table and is automatically configured to match what is contained in **Systems > DC System > Inventory > Rectifiers > Configuration** menu.

22.2. Inverter module and Alpha® T2S Inverter Controller Module maintenance

This section covers inverter module and Alpha® T2S inverter controller module maintenance including: replacing, identifying, alarms and alerts, DC priority, and AC input power limit.

Change the system configuration

Once the system has been created, most of the system configuration cannot be changed. The number of phases, number of DC groups, and number of AC groups cannot be changed. If any of these values are incorrect the inverter system must be re-commissioned and all inverter modules unplugged.

Add or remove inverter modules

If more inverter modules are needed to increase capacity, the **Add Inverters** wizard guides users through this process.

📢 *Notice: To ensure the inverter system is configured correctly, it is necessary to use these wizards to add or remove inverter modules from the system. This ensures that the correct number of inverter modules, and the correct number of redundant modules in each phase. This is important for the operation of inverter system alerts and alarms.*

Go to **Systems > Inverter System > Inventory > Inverters > Status** to access the **Add Inverters** wizard.

If inverter modules must be removed from the system, use the **Remove Inverters** wizard. Go to **Systems > Inverter System > Inventory > Inverters > Status** to access the **Remove Inverters** wizard.

22.2.1. Maintenance bypass

For system configurations that use a generator for the AC input, the safest way to initiate a maintenance bypass is to follow the instructions in the **Initiate Zero Phase Shift** wizard. This wizard should be used whenever the inverter system has to be put into or taken out of bypass. This prevents the inverter modules from turning off when the bypass switch briefly short-circuits the AC input and output.

Go to **Systems > Inverter System > System Functions > Zero Phase Shift** to access the **Initiate Zero Phase Shift** wizard.

The wizard shifts the phase and voltage of the AC output to match the input.

22.2.2. Taking power from DC source

The inverter system can take power from the DC source (usually batteries) under three conditions:

1. AC mains is lost

2. Manual DC priority is enabled

3. Input power limit is enabled.

When AC mains is lost, the inverter modules will always take power from the DC source if available.

22.2.2.1. Using manual DC priority

It is possible to manually instruct the inverter modules to take some amount of power from DC. This can be useful for testing or to manually reduce the AC input power during peak periods. When both **Manual DC Priority** and **AC Input Power Limit** are enabled, the feature with the higher resultant **Desired DC Input Power** will take priority. To use **Manual DC Priority:**

1. Go to **Systems > Inverter System > System Functions > Manual DC Priority**.
2. From the **Manual DC Priority** table, select the **Edit** button.
3. Select **Enable** in **Manual DC Mode** dropdown menu and select save.
4. Select the **Edit** button to set the **Desired DC Input Power** to the desired value. This value is a percentage of output power that will be taken from DC (with the rest coming from AC input).
5. Disable **Manual DC Mode** when complete.

22.2.2.2. Use AC input power limit

The AC input power limit is a feature that allows the system controller to dynamically adjust the amount of power taken by the AC input, by taking some power from the DC input. The system controller will continue to take power from the AC input until a user configured power limit threshold is reached. At this point, the inverter system will begin to draw power from its DC bus. When both **Manual DC Priority** and **AC Input Power Limit** are enabled, the feature with the higher resultant **Desired DC Input Power** will take priority.

1. Go to **Systems > Inverter System > System Functions > AC Input Power Limit**.
2. Enable the **AC Input Power Limit**.
3. Set the **Desired AC Input Power** to the required value. The system controller will attempt to limit the AC input power to this value by taking some power from the DC input.
4. Disable **AC Input Power Limit** when complete or when the battery needs to be charged.

The battery may be depleted and require charging.

22.2.3. Replace the fan

The fan inside each inverter module has a limited lifetime. When this lifetime has expired the inverter module will have an active alert called **Fan Life Elapsed**. To prevent an unexpected fan failure that could compromise system redundancy, it is recommended that the fan be replaced when this alert occurs.

To clear the alert, go to **Systems > Inverter System > Inventory > Inverters > Status**, and select the **Go To** button of the inverter module with the alert, then select the **Clear Fan Life Elapsed Alert** button.

22.2.4. Identify an inverter module

If an inverter module is in alert it is usually necessary to identify and locate the inverter module in the rack. There are two ways to do this:

1. Go to **Systems > Inverter System > Inventory > Inverters > Status**. This view shows all inverter modules within the system in a table view. One column within the table displays the number of active alerts. Find an inverter module with an alert and select the **Locate** button. This will cause the LEDs on the front panel of the inverter module to flash for two seconds.

2. You can also select the **Go To** button of the inverter module. This view shows the bay ID, shelf ID, and slot ID of the inverter module in the **Inverter Mapping** table. Normally this information is populated during system commissioning, but it can also be changed here in case it is incorrect or was not initially set.

> 📢 **Notice:** *If these values have been set, use them to physically locate the inverter module. If the values have not been set or appear to be incorrect, you can use the **Locate** button to find the inverter module and set the bay ID, shelf ID, and slot ID as required.*

22.2.5. Alarms and alerts

The inverter system has a set of alarms that are generated by the alerts on the Alpha® T2S inverter system and inverter modules. The system alarms are shown in the **Active Alarms** table.

To see all the active alerts within the system, go to **Systems > Inverter System > Live Alerts**. This live information comes from the inverter system, and is the source of inverter system alarms.

When the inverter system has an active alarm, go to the **Live Alerts** table. The information in this table indicates which inverter system or inverter module to investigate to find the cause of the alarm.

22.2.6. Replace an Alpha® T2S Inverter System

If an Alpha® T2S inverter system fails and needs to replaced, remove the old inverter system and plug in the new inverter system. Go to **Modules > All Modules** and use the **Replace T2S** wizard to partially transfer configuration from the old inverter system to the new inverter system. It may be necessary to wait for up to 20 minutes as the new inverter system continues to be configured by communicating with the inverter modules.

If system is not operating properly after waiting, then the system needs to be recommissioned for the inverter system to be configured correctly. Follow these instructions:

1. Unplug the failed inverter system.

2. Go to **Systems > Inverter System > Inventory > T2Ss** and select **Forget All in Comms Lost**. The inverter system will disappear from the table.

3. Insert the new inverter system, and then wait for it to display in the **Modules Available for Assignment** table. It will take several minutes for the system controller to acquire the new inverter system. In general it is assigned to the system automatically, and displays in the **T2Ss** table. If it does not occur, use the **Assign All** button to do this manually.

4. Put the system in bypass to keep the load powered during the commissioning process.

5. Go to **Systems > Inverter System > Configure System** and select the **Commission Inverter System** wizard in the **Configuration** table.

6. Follow the wizard instructions to recommission the system.

7. When completed, select the **Add Inverters** button to launch the add inverter wizard and add all the inverter modules to the system. You can also launch this wizard from **Systems > Inverter System > Inventory > Inverters > Status**.

The Alpha® T2S inverter system has been replaced, and the inverter system has no active alarms.

22.2.7. Shelf layout

Shelf layout is only available via the web interface.

When the inverter modules have been configured with bay ID, shelf ID, and slot ID, the **Shelf Layout** page displays a physical view of the inverter modules, the alert status and the output power of each inverter module. The text that shows the output power is a link that opens a new page to display the inverter module details.

For inverter systems that use four Alpha® T2S inverter system and TSI Universal Synchronization (TUS) modules; TSI Universal Synchronization (TUS) modules will display in the **Shelf Layout** page, but because they do not have bay ID, shelf ID, or slot ID they are only displayed in the table.

22.3. Line power system maintenance

This section covers line power system maintenance including: replacing line power modules, and turning off power to the loads.

22.3.1. Power off and on line power loads

A line power load usually has multiple channels from different line power modules assigned to it. It may be necessary to occasionally power off then power on the load.

To power off or on a load:

1. Go to **Systems > Line Power System > Inventory > Line Power Loads** and select the **Go To** button for the load to be powered off.

2. In the **Status** table, verify that the **Channels** value is at least one. The **Power On/Off** buttons will only work if there are one or more channels assigned to the load.

3. In the **Configuration** table, select the **Power Off** button. After a few moments, the **Channels Enabled**, **Total Output Current** and **Total Output Power** values in the **Status** table will go to zero. This indicates that the load has been turned off. The **Power Off** button will become disabled and the **Power On** button becomes enabled.

4. To turn on the load, select the **Power On** button.

22.3.2. Replace line power modules

If a line power module is found to have failed it can be easily replaced without losing any configuration.

To replace a module:

1. Go to **Systems > Line Power System > Layout** to identify the shelf and slot of the failed module. A module causing an alarm will be highlighted with a red border. If there is more than one module in alert it may be necessary to select the channel, then select the module details link to determine the cause of the failure.

2. Unplug the failed module and replace it with a new module.

3. Select the **Forget All in Comms Lost** button in order to clear the **LP Module Comms Lost** alarm.

The new module is acquired and its channels are automatically assigned to the same load that the old module was assigned to.

22.4. Battery maintenance

This section covers the following: battery alarms, charging batteries, and maintaining batteries.

22.4.1. Battery alarms

To view the **Battery Alarms** menu go to **Systems > DC System > Inventory > Battery**.

When the battery charge current exceeds the threshold, the **Battery Charge Current High** alarm is active. The alarm may occur during battery charging if there are large load fluctuations. The alarm can also be caused by an incorrect alarm threshold or battery charge current limit setting. The alarm will clear when the battery charge current is less than or equal to the threshold minus the hysteresis.

When the highest battery temperature value rises above the threshold, the **Battery Temperature High** alarm is active. The alarm will clear when the highest battery temperature value is less than or equal to the threshold minus hysteresis.

When the lowest battery temperature value has fallen below the threshold, the **Battery Temperature Low** alarm is active. The alarm will clear when the lowest battery temperature is greater than or equal to the threshold plus hysteresis.

In a battery system, the **Battery Breaker/Fuse Open** alarm will trigger when every battery string within the battery system has a breaker or fuse that has opened.

Each battery string within a battery system has its own **Battery Breaker/Fuse Open** alarm which can go active when the battery breaker or fuse is open. The alarm can occur when the digital input that detects the state of the breaker or fuse is active. To verify configuration, the **Breaker/Fuse Source** on each battery string can be verified. This source is typically assigned to a digital input source that detects the state of a breaker or fuse. The alarm may also be caused by incorrect or faulty wiring or incorrect digital input settings. The alarm will clear when the digital input is not active.

When the battery voltage minus the midpoint voltage measurement is greater than the threshold, the **Midpoint Unbalanced** alarm is active. The alarm can be caused by an imbalance in battery cells or blocks and may indicate an equalize charge is necessary. The alarm may also be caused by damaged or end-of-life cells. The alarm will clear when the difference between half the battery voltage and the midpoint voltage is less than or equal to the threshold minus the hysteresis.

Also available in the battery **Alarms** table are the alarms related to **System Functions** related to the battery, such as temperature compensation, battery runtime, and battery health.

The **Battery on Discharge** alarm will activate if the **Battery Voltage** is below the lowest battery string's **Open Circuit Voltage** and The **Battery Current** is below the **Current Threshold for Discharging**.

The **Battery on Discharge** alarm will also activate if, for a duration of two minutes or more, the **Battery Voltage** is below the lowest battery string's **Open Circuit Voltage** and the **Battery Current** is at or below 0 amps. The alarm activates under this condition in an attempt to capture slowly discharging batteries in incorrectly configured systems.

> 📢 *Notice: The **Open Circuit Voltage** value can be found in the **Configuration** table in the following page **Systems > DC System > Inventory > Battery > Battery Strings table > Battery String**.*

> 📢 *Notice: The **Current Threshold for Discharging** value can be found in the **Charging/ Discharging Thresholds** table on the following page: **Systems > DC System > Inventory > Battery**.*

22.4.2. Charging batteries

To access the charging menus go to **Systems > DC System > System Functions > Charging**. Note that you must have a battery defined in the DC system in order to have this menu item available under **System Functions**.

Lead acid batteries should be charged in three stages, which are constant-current charge, absorption charge, and float charge. The constant-current charge applies the bulk of the charge and takes up roughly half of the required charge time; the absorption charge, also known as topping charge, continues at a lower charge current and provides saturation, and then goes into **Float** mode.

Charge Current Control during bulk charging helps increase battery longevity by keeping the battery current to within specified limits. Charge current to the battery during recharge will be limited to a value as programmed in the **Charge Current Control** table.

This value is derived from the battery manufacturer's specification sheet.

Charge current control may at times be suspended. For example: a large negative load current that indicates a fail current sensor. When this occurs **Charge Current Control State** will read **Suspended** and **Charge Current Control Suspended Reason** will describe the reason. This information can be used in assisting with troubleshooting.

Elevated absorption charging can be used after a prolonged AC power failure, when the battery voltage has decreased to a low level. Once the batteries have decreased beyond the absorption low voltage threshold, the system controller will enter an armed mode. When AC power returns, the system voltage begins to increase, which charges the batteries.

Once the system voltage increases to the high voltage threshold, the system controller begins to absorption charge the batteries at the elevated absorption voltage for a period specified in the **Absorption Charging** table.

This is done to ensure the **Elevated Absorption Timeout** is not effectively reduced by the time it takes to recharge the battery back to nominal system voltage.

Elevated absorption charging can be terminated on the battery current to prevent over-charging of the battery. Elevated absorption will terminate when the battery current falls below the specified threshold. Elevated absorption charging can also be terminated or prevented from starting by setting the **Terminate/ Disallow Elevated Absorption When True** setting to a custom data condition.

Upon initial activation of elevated absorption charging, the battery current is checked to see if it has fallen below the **Elevated Absorption Termination Threshold**. When the battery current falls below the threshold, and remains below the threshold for 30 seconds, the absorption charging continues at the nominal system voltage. Once the charging current is low and stable the system returns to **Float** mode.

22.4.3. Maintaining batteries

To view the **Battery Maintenance** menus go to **Systems > DC System > System Functions**. There are three sub menus related to battery maintenance: **Equalize and Boost**, **Battery Test** and **Battery Runtime & Heath**. Note that you must have a battery defined in the DC system in order to have these menu items available under **System Functions**.

Figure 22-1 Battery maintenance system functions

Equalize is a protective feature designed to ensure optimal lead acid battery life and performance. Over time, individual battery cell voltages may vary greatly. To ensure that batteries remain in optimum condition, they should be periodically equalize charged. An equalize charge is a forced overcharge. It removes sulfation that may have formed during low-charge conditions. This functionality can be started manually when the batteries are fully charged and floating.

Boost is similar to equalize but usually has a higher voltage. In order to start **Boost**, the **Terminate/ Disallow Boost When False or '---'** condition must be configured to a value to is true, or active. This is to provide a means to detect when dropping diodes have been switched into the bus first (between the rectifier modules and the load), before allowing **Boost** to activate.

Refer to the battery manufacturer's recommendations.

A **Battery Test** is used to verify the health of a lead acid battery.

Battery Runtime & Health among other things, this menu provides information related to the battery's estimated State of Charge, estimated runtime in the event of AC mains loss, and estimated battery health.

A battery runtime prediction is performed while the battery is supplying power to the load. The system controller collects data to estimate the time it will take the battery to be drained. If the battery estimation is enabled and the battery is sourcing current to the load, the estimated battery runtime if **AC Mains** is lost displays.

During an AC outage or battery test, data is collected to calculate the estimated State of Charge and the estimated health of the battery. The accuracy of this data improves as the battery undergoes more discharge cycles.

22.4.3.1. Run a manual battery test

Battery test parameters are found in **Systems > DC System > System Functions > Battery Test**. Note that you must have a battery defined in the DC system in order to have this menu item available under **System Functions**.

To run a manual battery test, the **DC System** must be in **Battery Conditioning** mode.

1. Go to **Systems > DC System > System Functions > Battery Test**.
2. In the **Configuration** table set the **Battery Test Termination Voltage** to the voltage at which the battery test should stop. A lower battery test termination voltage gives more accurate test results, but also generates more wear on the battery.

   For high voltage rectifier modules, or when using the rectifier modules with extended voltage range, it is also important to set the **System > Inventory > Rectifiers > Configuration > Minimum Test Voltage** to a value below the **Battery Test Termination Voltage** or the rectifier module may start to source current making the battery test results invalid.
3. In the **Configuration** table set the **Battery Test Timeout** to the maximum time to run the battery test.
4. In the **Configuration** table set the **Battery Test Termination SoC** the State of Charge at which the battery test should stop. A lower battery test termination State of Charge gives more accurate test results, but also generates more wear on the battery. The termination State of Charge must be less than 80 percent for the battery health estimate to work. Set **Battery Test Termination on SoC** to **Enabled**.
5. If the DC system is in **Battery Conditioning** mode, select the **Start Manual Battery Test** command in the **Status** table.

- The **DC System** mode should change to **Test Discharging**

- The **Time Remaining in BT** should start counting down

- The **Last Battery Test Error Condition** should have the value: **None**

22.4.3.2. Set up an automatic battery test

In addition to the **Manual Battery Test**, you can set up an interval to schedule a regular battery test. Battery test parameters are found in **Systems > DC System > System Functions > Battery Test**. Note that you must have a battery defined in the DC system in order to have this menu item available under **System Functions**.

To run an automatic battery test, the **DC System** must be in **Battery Conditioning** mode.

1. Go to **Systems > DC System > System Functions > Battery Test**.
2. In the **Configuration** table set the **Battery Test Termination Voltage** to the voltage at which the battery test should stop. A lower battery test termination voltage gives more accurate test results, but also generates more wear on the battery.
3. In the **Configuration** table set the **Battery Test Timeout** to the maximum time to run the battery test.
4. In the **Configuration** table set the **Battery Test Termination SoC** the State of Charge at which the battery test should stop. A lower battery test termination State of Charge gives more accurate test results, but also generates more wear on the battery. The termination State of Charge must be less than 80 percent for the battery health estimate to work. Set **Battery Test Termination on SoC** to **Enabled**.
5. In the **Automatic Testing** table, set the **Interval Between Tests** to the number of days (for example, 182).
6. In the **Automatic Testing** table, set the **Start Hour** to the time of day you want the test to start on (for example, 3 for 3:00 am).
7. *Optional:* In the **Automatic Testing** table, set the **Days to Retry Failed Test** to the number of consecutive days to retry a battery test if it fails to start.
8. In the **Automatic Testing** table, select the **Reschedule Next Test** button to calculate the date of the next test which is shown in the **Next Battery Test** field.

The **Next Battery Test** field displays the expected date and time of the next scheduled battery test.

22.4.3.3. Run a remote battery test

Battery test parameters are found in **Systems > DC System > System Functions > Battery Test**. Note that you must have a battery defined in the DC system in order to have this menu item available under **System Functions**.

1. Go to **Systems > DC System > System Functions > Battery Test**.

2. In the **Configuration** table set the **Battery Test Termination Voltage** to the voltage at which the battery test should stop. A lower battery test termination voltage gives more accurate test results, but also generates more wear on the battery.

3. In the **Configuration** table, set the **Battery Test Timeout** to the maximum time to run the battery test.

4. In the **Configuration** table set the **Battery Test Termination State of Charge** the State of Charge at which the battery test should stop. A lower battery test termination State of Charge gives more accurate test results, but also generates more wear on the battery. The termination State of Charge must be less than 80 percent for the battery health estimate to work. Set **Battery Test Termination on State of Charge** to **Enabled**.

5. In the **Remote BT Configuration** table, set the **Trigger Input** for the digital input being used to remotely trigger the battery test.

6. In the **Remote BT Configuration** table, set **Remote BT** field to **Enabled**. Once enabled, the **Trigger State** displays a value, either **Active** or **Inactive**.

7. Activate the digital input which was configured as the **Trigger Input** and the a battery test starts.

- The **Trigger State** in the **Remote BT Configuration** table should go **Active**.

- The **DC System** mode should change to **Test Discharging**.

- The **Time Remaining in BT** should start counting down.

- The **Last Battery Test Error Condition** should have the value: **None**.

- A remote battery test is started when the **Trigger Input** goes from **Inactive** to **Active**.

- A remote battery test is normally terminated when the **Trigger Input** goes from **Active** to **Inactive**. As a safety measure, the battery also terminates if the voltage drops below the termination voltage threshold or the test times out.

22.4.4. Battery temperature compensation

To view the battery temperature compensation go to **Systems > DC System > System Functions > Temperature Compensation > Status**. Note that you must have a battery defined in the DC system in order to have this menu item available under **System Functions**.

Battery temperature compensation uses the temperature probes connected to the temperature inputs on the ADIO modules which are part of the system. This feature will not function optimally if these probes are damaged or disconnected from the system.

To view the values of the temperature inputs go to **Modules**, In the **CAN Modules** table select the ADIO modules that have battery temperature probes attached. Confirm all probes are working correctly and the temperatures are reasonable.

22.5. Low voltage disconnect maintenance

Low voltage disconnects (LVDs) are used to disconnect loads or the battery during low voltage conditions. When an LVD activates, the system displays an alarm and a message. There can be a deep discharge of the batteries during an AC fail. Discharging the battery to an extremely low voltage can cause damage to the load and to the battery. The LVD is used to disconnect the battery, or one or more loads during extremely low voltage conditions to avoid damage to the load or the battery. Once AC power returns, and the low voltage condition no longer exists, the LVD automatically reconnects the loads.

Disconnects allow you to program a number of different disconnect or connect conditions. Creating multiple LVD controls provides the capability of load shedding, which means the least critical loads are disconnected first.

Conditions that could trigger an LVD are as follows:

- Disconnect at disconnect voltage threshold; connect at connect voltage threshold.

- Disconnect at time after **AC Fail**; connect at connect voltage threshold.

- Disconnect when battery State of Charge falls below a threshold; connect when State of Charge is five percent above the State of Charge threshold.

> 📢 *Notice: If the LVD were to disconnect, the calculated State of Charge value displays as "- - -". The LVD only reconnects once the State of Charge value is properly calculated again, which happens once the battery is reconnected and fully charged.*

- Up to three user definable disconnect and reconnect conditions.

> 📢 *Notice: The connect voltage should be higher than the disconnect voltage by at least 1V for a 48V system and 0.5V for a 24V system.*

Each disconnect can have three digital inputs defined to close the loop on the status of the contactor.

- **Disconnect Open Source:** Indicates whether the disconnect is open or closed.

- **Manual Closed Source:** Disconnect is set to stay closed.

- **Manual Open Source:** Disconnect is set to stay open.

To view the **Disconnects** menu, go to **Systems > DC System > Inventory > Disconnects**.

23. Maintaining the system controller

When maintaining your system controller always check for known issues within the read me file that ships with your software. This section covers the following:

- Ethernet communications

- Working with alarms

- system controller maintenance

- Working with logs

- User account maintenance

- File maintenance

23.1. Ethernet communications

By default, the rear Ethernet port on the system controller is configured to acquire an IP address automatically, and the front Ethernet port is configured to use a static IP address of 10.10.10.201. The LCD panel can be used to view and configure the IP addresses that are being used on both Ethernet ports.

To view or configure the IP addresses:

1. From the LCD panel main dashboard select **Shortcut** and then select **Ethernet**.
2. The LCD panel displays the IP address currently used on both Ethernet ports.
3. Select to highlight the row of the port you want to view or configure.
4. Select the arrow on the right-side of the screen and then LCD panel displays the menus: **Status**, **IPv4 Address**, **IPv6 Addresses** and **Configuration**.

To change the IP address settings:

5. Select the **Configuration** menu to highlight, then select the arrow on the right-side of the screen to enter.
6. Select **Change Network Configuration** to highlight that row, and then select the arrow on the right-side of the screen to launch the wizard.
7. Enter the desired IPv4 settings using the **Previous**, **Next**, and **Cancel** buttons.

> 📢 **Notice:** *If you are configuring a manual IPv4 address, you must supply all four values: IP address, subnet, gateway, and DNS server. If you do not know the gateway or DNS server address, they may be left blank, but it is recommended to fill them in if possible. If you do not have a gateway address, it is common to substitute the number 1 for the last entry. If your IP address is 192.168.0.90, then you can set your gateway to 192.168.0.1.*

8. When complete, select **Finish** and the changes are applied.

9. Select the back arrow, on the upper-left side of the screen twice and go back to the **Ethernet** screen to confirm the new settings.

On the Ethernet screen, verify that the new IP address settings are in use.

23.1.1. Connect via the web interface

To configure the IP addresses via the web interface:

1. From the main dashboard, go to **Controller > Communication > Ethernet**.

2. In the **Ethernet** table, select the **Go To** button on the row you want to configure.

3. In the **Configuration** table, select **Change Network Configuration** and follow the steps in the wizard.

From the **Ethernet** table, view and verify the new IP address settings.

> **Notice:** *If you change the IP address that you are using, you will need to enter the new IP address into your browser so that you can sign in again.*

23.2. Working with alarms, alerts, and hints

23.2.1. Active alarms

When there are active alarms in the system, both the LCD panel and web interface display these alarms prominently.

Depending on how the alarms are configured, an internal speaker (if present and installed) may sound an alarm tone, and one or more relays may be activated. The internal speaker is intended to give the on-site technician audible notification that an alarm is active. The relays are intended to give external monitoring equipment notification through a relay contact closure (or opening) that an alarm is active.

On both the web interface and the LCD panel, the top left region of the page displays the most recent alarms in order of the highest priority. This area of the display will be red when there are critical or major alarms, yellow for minor alarms, and green if there are only warnings or no alarms. Selecting this region takes you to the **Active Alarms** table where you can get more details.

The **Active Alarms** table displays the name of the alarm, time of activation, priority, and status. The status of an active alarm can be active or acknowledged. An alarm moves from the active to the acknowledged state when the alarm cut-off (ALCO) button is selected. The ALCO button is at the top of the **Active Alarms** table.

On the web interface there is also a small ALCO button in the **Active Alarms** region of the main dashboard that will acknowledge any active alarms, and then take you to the **Active Alarms** list.

On the LCD panel, ALCO can also be accessed via the **Maintenance** button on the main dashboard.

To view details of an active alarm select the **Go To** button on the right-side of the row in the **Active Alarms** table. This screen shows you the state of the alarm, time of activation, time of acknowledgment, priority, and the relay that is mapped to the alarm. To get troubleshooting information about the alarm, select the information icon beside the row that shows the alarm state.

23.2.2. Alerts

Alerts are status information that is read from modules. An alert can only be **Active** or **Inactive** and has no user configuration.

A list of all active alerts is viewable from the **Active Alarms** page on the web interface. To view the alerts on the LCD panel, select the active alarm area on the dashboard. The **Alerts** button will have a count of how many active alerts are present. Alerts can also be viewed on a module details view from the **Modules** page.

Active alerts may mean that the modules are not properly configured, or in some cases may mean the module has failed.

23.2.3. Hints

A hint is information about the system controller or a system that may help with how to configure the system controller, or indicate the system controller is in a particular state. The presence of a **Hint** does not necessarily indicate a problem. For example:

- When the hint is about configuration, it can offer a suggestion that may be important for system operation. Example: when battery current is not configured.
- When the hint is about status, it can act as a reminder. Example: the system is operating normally and temperature compensation may be changing the system voltage.

Hints can be hidden and shown depending on whether they are relevant for the configuration.

To view the details of a hint, go to **Alarms > Active Alarms** and select the pencil icon beside the hint to be viewed in the **Hints** table. This details view will provide useful information about why the hint is being shown, and what parts of the system controller may be affected. If this hint is related to configuration, there will be a button beside the **Hide Hint** button to assist in fixing the configuration issue, which will in turn make the hint go away.

23.2.3.1. Hide hints

Follow the instructions below to hide or show hints.

1. Go the screen that shows the hints.

    ◦ From the LCD panel dashboard, select the dashboard area, then select the **Hints** button to show any visible hints.

    ◦ From the web interface, select **Alarms** on the main menu and view the **Hints** table.

2. Select the details button of the hint to be hidden.

3. Select the **Hide Hint** button. A pop-up will appear indicating that the hint will disappear and not appear again until something changes related to the hint, or if the **Show All Hidden Hints** button is selected. Select **Yes**.
The hint is now removed from the table.

4. To view all hidden hints again, select the **Show All Hidden Hints** button on the **Hints** table.

It is possible to hide all hints in the table by selecting the **Hide All Hints** button.

23.2.4. Alarm cut-off (ALCO)

The **Alarm Cut-off** (ALCO) button is used to silence the speaker (if installed) while technicians are investigating and troubleshooting an active alarm. ALCO can also be configured to deactivate alarm relays.

ALCO functionality is configured via **Settings > Alarm Cut-Off & Global Settings**.

ALCO can be configured to either:

- Acknowledge active alarms, deactivate relays, and silence speaker
- Silence the speaker only

When the **Alarm Cut-off** button is selected, the user configured ALCO period begins to countdown. When the countdown reaches zero the ALCO period expires.

When ALCO expires the configured action is canceled. If you configured ALCO to acknowledge active alarms, deactivate relays, and silence speaker then alarms return to the active state which means the alarm relays are activated and the speaker begins sounding. If you configured ALCO to silence the speaker only, the speaker will start sounding as long as there are active alarms.

If a new alarm activates after **Alarm Cut-off** button is selected, the speaker will sound the appropriate alarm tone. Any existing alarms that have been acknowledged from a previous ALCO selection will remain acknowledged.

23.2.5. Alarm activation delay at start up

Depending on system configuration there may be some alarms that activate shortly after start up then clear a few seconds later. These nuisance alarms are often caused due to the time it takes for the system controller to reacquire modules on the CAN bus. To prevent these alarms from activating and triggering relays or SNMP traps there is a setting that delays alarm activation at start up.

The alarm delay is configured under **Alarms > Settings**.

The default value of 30 seconds works for most systems, however this value can be increased to accommodate systems that have a slower start up time, that is, large inverter systems.

23.2.6. Alarm summary relays

There are three alarm summary relays that can be configured on the system controller. These relays are connected to external monitoring equipment which provides a notification when the system controller enters an alarm state.

- • Controller critical relay

- • Controller major relay

- • Controller minor relay

To view them, go to **Alarms > Settings > Alarm Summary Relay**.

The relay mapped to the **Controller Critical Relay** is active whenever one or more critical alarms are active. **Controller Major Relay**, **Controller Minor Relay**, and **Controller Warning Relay** work in the same way.

23.2.7. Create user alarms

The system controller has a set of default standard alarms that are associated with a system or an inventory item such as a load or a disconnect. These standard alarms may be enough to support many system configurations. It is also common to need additional alarms, based on the status of the digital inputs or on the threshold of an analog value read from the input of an ADIO module.

You can create any number of digital or threshold alarms. These alarms have the same behavior as standard alarms such as alarm cut-off, SNMP traps, and relay mapping. These user-defined alarms can be created and removed via the **Controller > Programmability > User Alarms** menu.

To create a user alarm:

1. Go to **Controller > Programmability > User Alarms**.
2. Select the type of user alarm to create. A new row for the user alarm will display in the table.
   ◦ If you want to create a digital alarm select the **Add Digital User Alarm** button.
   ◦ If you want to create a high or low threshold alarm select the **Add Threshold User Alarm** button.
3. Select the **Go To** button in the alarm line item. Two tables display. One table shows the fields to configure that are specific to the selected user alarm. The other table shows the standard alarm configuration.
4. Give the alarm a descriptive name. This is important since the same type of user alarms have the same default name. The alarm description is optional.
5. Select the alarm input source. There are different options depending on the type of user alarm you are creating.

- ◦ A threshold alarm allows you select from ADIO module voltage and temperature inputs, current readings from shunts or DC current transformers (DCCTs) and any status count data about rectifier modules or converter modules.

  - ◦ A digital alarm allows you to select digital inputs on any ADIO modules.

6. Set the priority and relay. If you want to set a severity value for the SNMP trap, use the Parameter 1 field.

7. If you are configuring a digital alarm, this is all that is required. If you are configuring a threshold alarm, continue as described below.

8. Select the type of threshold alarm from the **Alarm When Value** field.
   - ◦ Selecting **Above** turns this alarm into a high threshold alarm.

   - ◦ Selecting **Below** turns this alarm into a low threshold alarm.

9. Set the threshold. For a high threshold alarm to activate, the source value must be greater than this value. For a low threshold alarm to activate, the source value must be less than this value.

10. Set the hysteresis. The hysteresis is important when using an alarm input source that may be noisy or fluctuate periodically. Be sure to set the hysteresis large enough to avoid false alarms, but not too large to prevent the alarm from clearing properly.

The new alarm has been configured. Whenever possible, test to ensure that new alarm operates as expected.

23.3. System controller maintenance

23.3.1. Restart the system controller

You can perform a restart via the web interface or the LCD panel. This first procedure covers restarting from the web interface.

> 📢 **Notice:** *Ensure that a backup has been performed before starting this process. Use the **Backup** feature accessed through the LCD panel at **Shortcuts > Backup**.*

> 📢 **Notice:** *Ensure that the system controller software or operating system is not being updated.*

To restart the system controller from the web interface:

1. From the main dashboard go to **Controller > About > General**.

2. Select the **Restart Controller** button.

3. Select **Restart** when prompted.

4. The **Controller Restart** window displays progress via a progress bar.

5. The system controller screen goes black, and the LEDs cycle while restart is in progress.

Once complete, the sign in page displays on the web interface, and the Cordex® HP logo displays on the system controller.

23.3.2. Restart the system controller via the LCD panel

📢 **Notice:** *Ensure that the system controller software or operating system software is not being updated.*

To restart the system controller via the LCD panel:

1. From the main dashboard of the system controller, select **Shortcuts**, then select **Restart**.
2. Select the **Execute** button to confirm.

The front screen blacks out, and the LED status lights cycle until the restart is complete. Once the restart completes, the Cordex® HP logo displays.

23.3.3. Power down the system controller

Sometimes it may be necessary to power down the system controller to replace, remove, or repair system components.

📢 **Notice:** *You must use the LCD panel or web interface to reset the system controller. This ensures that recent changes and files are saved properly.*

1. From the main dashboard on the web interface, go to **Controller > About > General** and then select system controller reset.

- or -

2. From the main dashboard on the LCD panel, select **Shortcuts**, then select **Reset**.
3. Select **Execute** to confirm.
4. While the system controller LEDs are performing a chase pattern, power down the system controller by removing the power pin on the right-side of the system controller.

   After a reset, the system controller LEDs will perform a chase pattern that indicates that the system controller is booting. It is safe to remove power while the system controller is booting. Once that chase pattern stops, the boot sequence is over and it is no longer safe to remove power.

23.3.4. Change the time and date

There are three options to change the date and time:

• Manually with the date/time picker

• Using the local browser on the management computer

• Using simple network time protocol (SNTP)

To set the date and time:

1. Go to **Controller > Settings > Time & Date**. In the **Time & Date** table, select the **Edit** button on the **Time Zone** row.

2. From the **Time Zone** dropdown menu, select your time zone, and then select **Save**.

3. If setting the time manually, select the **Edit** button on the **Current Time and Date** row. Use the date/time picker to change the date and time.

4. If setting the time and date with the local browser select **Synchronize Time and Date to Web Browser**. This reads the time from the browser and sends it to the system controller.

5. If setting the time and date using SNTP, first enter a valid SNTP server address (DNS name or an IPv4/IPv6 address), and then select **Synchronize Time and Date to Network Time Server**. If you do not want to use the SNTP server, clear the **Network Time Server Address** field.

   It is common for gateways and routers to also be SNTP servers. If you are unsure of a valid SNTP server address, try using the system controller's assigned gateway or router address. If this does not work, consult your IT personnel.

The system controller time and time zone have been correctly set.

> 📢 *Notice: Whenever the time or time zone has been changed, an entry is recorded in the event log.*

23.3.5. Change the language for the LCD panel

To change the default language from the web interface:

1. Go to **Controller > Settings > User Interface**.

2. In the **LCD Preferences** table, find the **LCD Language** row and select the **Edit** button.

3. From the dropdown menu, select your language preference, and then select **Save**.

23.3.6. Change the language for the web interface

To change the default language for the web interface:

1. On the sign in screen, in the top-right corner, select the dropdown menu and select language preference.

2. Alternatively, after a successful sign in, select the dropdown menu in the top-right corner of the web interface and select language preference.

23.3.7. Change user interface strings

In rare occasions it may desired to change some of the strings displayed on the user interface to conform to local terminology standards. The system controller allows a user to download a strings file that can be edited in a spreadsheet program. The strings file can then up uploaded to the system controller and after a restart, the changed strings will be used.

Notice: *Use of this feature must be approached with caution as it may result in undesired consequences:*

- *Editing the strings requires familiarity with a spreadsheet program in order to correctly import the file and save the file with UTF-8 encoding.*
- *Edited strings that are longer than the original can distort the user interface and make navigation difficult.*
- *Spelling or grammar errors can make the user interface hard to understand.*
- *Uploading an incorrectly generated strings file can result in unexpected or missing strings that make the interface unusable.*
- *The changed strings can result in confusion when seeking technical support since the user interface may be unfamiliar to support personnel.*
- *Strings on the OLED display panel cannot be changed.*

To change one or more strings on the user interface:

1. Go to **Controller > Settings > User Interface**.
2. In the **User Interface Preferences** table, select the **Export All English Strings** button. The file will be downloaded to the PC (when using the web interface) or to a USB drive (when using the LCD panel). It is also possible to only export previously uploaded user strings by selecting the **Export User Strings** button.
3. Import the file as a UTF-8 encoded CSV file to a spreadsheet program. Failure to do this may result in missing or unexpected strings.
4. Make the necessary edits to the strings in the second column. Do not change anything in column 1 or strings may not be imported as expected.
5. Save the file as a UTF-8 encoded CSV file. Failure to do this may result in missing or unexpected strings.
6. Select the **Import User Strings** button and select your strings file. If using the LCD panel, the uploaded file name must contain the word "strings" and end in ".csv".
7. Restart the system controller to load the new strings.
8. On start up, the new strings will be loaded. Any errors found while loading the new strings will be logged into the event log.

When interacting with technical support, you may be requested to hide the user strings from the user interface. To do this go to **Controller > Settings > User Interface** and change the **Visibility of User Strings** setting to **Hide User Strings**. Restart the system controller. The strings can be shown again by changing the setting to **Show User Strings** and restarting the system controller.

23.3.8. Change the web session language

To support situations where users want different language options, you can change the language used for a specific sign in session. Most corporate security policies ban the storage of browser cookies, which means that the browser will not remember your selection from sign in to sign in so you need to select your web session language each time you sign in.

> **Notice:** *Without cookie support, if you force a refresh (**F5** for most browsers), the browser will not remember the language selection and you will need to change the web session language again.*

To change the web session language:

1. Go to the top right corner of the webpage.
2. From the **Language** dropdown menu, select your language preference.

23.3.9. Change the system status bar

By default, the system controller dashboard displays your systems in the original order created, from left to right. The **System Summary Option** is **Automatic** by default but can be customized to display up to four systems slotted in any order required. This is done via the **System Summary Option**, in the **Web UI Preferences** table.

To customize the system status bar view:

1. Go to **Controller > Settings > User Interface**.
2. In the **Web UI Preferences** table, select **System Summary Option**.
3. From the **System Summary Option** dropdown menu, select how many systems to display, and then select **Save**.
4. To change which system displays in the left most area of the system status bar, select the **Edit** button for first system, and then select an option from the dropdown menu.
5. Continue to assign systems to the second, third, and fourth slots as required.

The system status bar displays the selected systems in the order selected.

23.3.10. Change the dashboard values

It is possible to change the values that show for a system on the **System Status Bar**, the LCD panel dashboard, and the web interface dashboard.

To change which values appear for a system:

1. Go to **Controller > Settings > User Interface**.
2. Look at the table for the system you wish to configure (DC system 48 V dashboard values for example).
3. Select the **Edit** button beside the **Dashboard Value** you would like to edit.

> 📢 **Notice:** *The values in this table will appear on the different dashboards in the order they appear in this table (for example, **Dashboard Value 1**, then **Dashboard Value 2**, ...). To change the order, set the fields in this table in the desired order.*

4. Select the value to show for this **Dashboard Value**, then select **Save**.

The new value selected will appear in the position of the **Dashboard Value** that was configured.

23.3.11. Data sharing

The data sharing feature allows to share individual data point, or select systems between system controllers. This data sharing feature consists of two parts:

- Published data
- Data subscriptions

Data sharing can be useful in situations where systems were installed at different times. These systems may have different system controllers, but share the same bus (for example, a DC system was installed, then later-on, an Alpha® AMPS inverter system was installed, each with their own system controllers).

Using this feature, the Alpha® AMPS inverter system controller provides the DC system controller with data on how much DC input current it will require during an outage.

The DC system controller provides the Alpha® AMPS inverter system controller with data on how much runtime the battery has remaining.

23.3.11.1. Share published data and systems

Each system controller can publish 10 data points and up to five systems which other system controllers can read and use for various purposes.

> 📢 **Notice:** *Currently the data points are limited to numeric data and only DC and Alpha® AMPS HP2 inverter systems can be published.*

To share which published data or which published systems should be shared with other system controllers:

1. Go to **Controller > Communication > Data Sharing > Published Data and Systems**.
   - **Published Data:** Select the **Edit** button next to one of the published values.

     Select the data point to be shared with other system controllers, then select **Save.**

⚬ **Published Systems:** Select the **Edit** button next to one of the published values

Select the system to be shared with other system controllers, then select **Save.**

2. This process can be repeated to share multiple data points or systems with other system controllers.

After performing the above procedure, other system controllers will be able to subscribe to this system controller to receive data from it.

23.3.11.2. Data subscriptions

Data Subscriptions are a way for users to read and use **Published Data and Systems** from other system controllers.

To configure a Data Subscription:

1. Go to **Controller > Communication > Data Sharing > Data Subscriptions.**
2. Select **Add Data Subscription**.
3. Select the **Go To** button of this newly created **Data Subscription**.
4. Select the **Edit** button beside **IP Address**, enter in the IP address (DNS name or an IPv4 or IPv6 address) of the system controller to read data from, then select **Save**.

After configuration, the **Data Subscription** will start reading any configured **Published Data and Systems** from the remote system controller. Data will be read and updated every ten seconds.

If there are any problems communicating with the remote system controller, those will be indicated in **Communication Status**, potentially being raised as an alarm through the **Communication Error** alarm. Some common errors could be:

- IP address configured incorrectly.
- The system controller or the remote system controller are not connected to any network, not connected to the same network, or not publicly visible.
- No published data configured on the remote system controller (this will be indicated as a **No Published Data** status).

23.3.12. Maintenance mode

In software version 7.40 and later, a feature called **Maintenance Mode** is available on the system controller. This feature is intended for users who want to communicate to other users that the system controller is undergoing maintenance, and can also be used to inhibit the alarm summary relays during the maintenance.

At its simplest, maintenance mode provides an alarm, which has the behavior inherent to system controller alarms. It can be mapped to a relay, or monitored via the web interface, LCD panel, or SNMP. This can be used to signal other users that some maintenance is being performed on the system. Using the relay or SNMP interfaces, external systems can be notified of the maintenance.

Maintenance mode also provides an option to **Inhibit Alarm Summary Relays During Maintenance**. If a user chooses to enable this feature, any relays which are in use as alarm summary relays will be inhibited during maintenance. This allows a user to do maintenance which may cause alarms without the alarm summary relays being activated. Relays that are not mapped to alarm summary relays will not be affected and will behave as usual. One caveat is that if the same relay is mapped to both an alarm summary relay and the maintenance mode alarm itself, that particular relay will not be inhibited, as it is possible that external systems would be using this relay to determine whether the maintenance mode is active.

While the system is not in maintenance mode, the **Status** of the feature will be **Inactive**. Users can have the maintenance mode triggered automatically, or they can start it manually by a button press. To use the automatic trigger, the **Trigger Source** must be mapped to a digital input, custom data value, or other Boolean system value. If maintenance mode is started automatically using this trigger, the status of the feature will be **Started by Trigger** Alternatively, the user can select **Manually Start Maintenance Mode** to start the mode manually.

Maintenance mode must be stopped in the same way it was started. If it was started by trigger, **Manually Stop Maintenance Mode** will be disabled until the trigger is false and maintenance mode is once again **Inactive**. If maintenance mode is started manually via button press, the status will be **Manually Started**. Note that if maintenance mode is already started by the trigger, the button to start it manually will be disabled. Similarly, if maintenance mode is started manually, any changes to the trigger status while maintenance mode is **Manually Started** will be ignored until the mode has been manually stopped via button press.

On the **Maintenance Mode** page, there is a table titled **Relay Behavior During Maintenance**. This table will show all the relays in the system and their expected behavior when maintenance mode is active. If **Inhibit Alarm Summary Relays During Maintenance** is set to **No**, all relays in this table should show **Not Inhibited (Inhibit Disabled)**. If the user does want relays to be inhibited during maintenance, set the **Inhibit Alarm Summary Relays During Maintenance** option to **Yes**. Once that is done, the relay table will be updated to show how this affects each relay in the system. Most relays will still behave normally, and so their entry in this table will read **Not Inhibited**. The relays that are mapped to the **Alarm Summary Relays** will read **Inhibited (Alarm Summary Relay)**. If a relay has been mapped to the **Maintenance Mode Active** alarm, the entry will read **Not Inhibited (Maintenance Mode Relay)**. The same information is available on each individual relay page.

23.3.13. System use notification

This feature is intended for admin to provide appropriate privacy, security notices, security policies, or any other information to other users accessing the system. It can also be used to inform other users accessing the system of the authorization requirements, to get the user to accept the terms and condition before signing in, or to display any other information that the admin wants to make users aware of.

23.3.13.1. Enabling or disabling system use notification

This section describes how to enable or disable the system use notification. When enabled the notification will be shown before a user signs in to the system controller web interface or the LCD panel.

This feature can only be configured by those with administrator or account manager privileges.

To enable or disable system use notifications:

1. Go to **Controller > Settings > Notifications**.

2. In the **System Use Notification** table, on the right-side of the **System Use Notification** line, select **Edit** button.

3. From the dropdown menu, set to **Enabled** (enabling the feature) or set to **Disabled** (disabling the feature) and select **Save**.

23.3.13.2. Set up system use notification

This section describes how the user can setup the content of the system use notification. The administrator can configure the notification title and 10 content entries.

This feature is only available to those with administrator or account manager privileges.

To set up system use notifications:

1. Go to **Controller > Settings > Notifications**.

2. In the **System Use Notification** table, on the **Notification Title** line, select **Edit** Button.

3. Type in the title of the notification and select **Save**

4. Edit the contents by selecting the **Edit** button on each content line.

5. Type in the contents and select **Save**.

23.3.13.3. Preview system use notification

This section describes how to preview the system use notification. This feature will allow the administrator to view and review the contents of the notification and see how other users will see the notification.

To preview system use notification configuration:

1. Go to **Controller > Settings > Notifications**.

2. From the **System Use Notification** table, select the **Preview System Use Notification** command.

3. The system use notification dialog box will appear. Select **Accept**, to close.

23.3.13.4. Reset system use notification

This section describes how users can reset the system use notification. This feature allows the administrator to reset all notifications and disable the system use notification.

This feature is only available to those with administrator or account manager privileges.

To reset system use notification configuration:

1. Go to **Controller > Settings > Notifications**.

2. From the **System Use Notification** table, select the **Reset System Use Notification** command.

3. Select **Yes**, system use notification contents will be reset to default.

23.4. Working with logs

This section covers the following:

- Events and alerts log

- Battery activity log

- Power outage log

- Datalogs

- Performance log

23.4.1. Events and alerts logs

Figure 23-1 Events Log

Events

The **Events** log table keeps a record of changes to the state of the system to help with troubleshooting. The types of state changes that are logged include:

- Alarm states

- Configuration changes

- Battery mode changes (for example, discharging)

To view the **Event** log, go to **Logs > Events & Alerts**.

Events are stored in a first in first out (FIFO) buffer holds up to 3000 events. Of the most recent events, up to 25 can be viewed on the LCD panel, and up to 300 can be viewed via the web interface. From the web interface, all 3000 events can be exported as a CSV file.

To export an Event log go to **Logs > Events & Alerts**, and select the **Export** button at the top of the **Event** table.

Module alerts

The **Modules Alerts** log table tracks what is happening on individual modules without interfering with **Alarms** or the **Event** log.

23.4.2. Battery activity log

The **Battery Activity** log records the duration and change in capacity in amp hours (Ah) for every charge and discharge of a battery. If you have **Battery Runtime & Heath** enabled, the log will also record the change in State of Charge and State of Health.

Because of the large quantity of information that can be collected for battery charges and discharges, a complete dataset can only to obtained by exporting the log. The following three figures provide examples of the data.

When viewed on the LCD panel, the log shows time, activity type, duration and amp hours delivered.

When viewed on the web interface, the log includes the battery ID, battery capacity, State of Charge, State of Health, and the activity results.

When exported to a CSV file, the log includes the Peukert exponent, starting and ending voltages plus the minimum, maximum and average battery currents and temperatures.

The battery log will hold up to 300 entries in a first in first out (FIFO) method. When viewing entries on the LCD panel, up to 25 can be viewed. All 300 entries may be viewed on the web interface or exported to a CSV file.

Figure 23-2 Battery log on the web interface

Figure 23-3 Battery log in Excel

23.4.3. Power outage log

The **Power Outage** log records time and duration of every power outage to the system. If you have **Battery Runtime & Heath** enabled, you can refer to the battery log to determine the change in State of Charge and State of Health.

When viewed on the LCD panel, the log shows start time, end time, and time and duration of each power outage.

When viewed on the web interface, the log includes the system ID, start time, end time, and duration of each power outage.

When exported to a CSV file, the log includes the system ID, start time, end time, and duration of each power outage.

23.4.4. Datalogs

Datalogs allows users to record measurements (data signals) at set intervals over a period of time. The datalog uses the system controller sensors and calculated values as inputs. The system controller supports up to 10 datalogs, each of which may be recording up to 20 data signals.

The interval between samples can be configured, as well as the number of samples collected. When the maximum number of samples have been collected, the newest sample replaces the oldest sample. Data capture can either be started and run continuously or an equation can be used to control data capture.

Datalogs are saved to the file system when the system controller is reset by a user, as well as being automatically saved once every day. If power is lost to the system controller, there is potential for some data loss.

If any data signals are not configured, a datalog will not start.

If there is a **Clock Error Alarm**—which means that the date has not been set, a datalog will not start.

If a datalog is running and a system controller reset occurs, the datalog will try to resume data collection on system controller start up.

If there is data available, a **Preview Chart** displays up to 30 samples. If there are more than five data signals, only the first five signals are displayed in the preview. If a value is unknown, it is displayed on the preview as a zero value.

23.4.4.1. Create a datalog

There are three stages to setting up a datalog:

- Add a **Datalog**

- Add the **Data Signals**

- Run the **Start Capture** command

To create a datalog:

1. Go to **Logs > Datalogs** and select **Add Datalog**.

   Up to 10 datalogs can be created.

2. Select the **Go To** button of the new datalog.

3. From the **Configuration** table, select the **Edit** button to setup the following information:

   a. **Name:** The datalog name.

   b. **Description:** Describe the purpose or usage of the datalog.

   c. **Number Of Samples To Capture:** From 60 to 3600 samples.

   d. **Sampling Method:**

      Datalogs can be configured to either **Sample at Fixed Time Intervals**, or **Sample on Trigger Data Signal Change** in which case a new sample of all data signals will be taken only when the **Trigger Data Signal** changes by more than the **Trigger Data Signal Deadband** compared to its value when the previous sample was taken.

   e. **Sample Interval:** Set the interval from two seconds to three hours (10,800 seconds).

   f. **Trigger Data Signal:** The data signal which triggers sampling, when the **Sampling Method** is set to **Sample on Trigger Data Signal Change**.

   g. **Trigger Data Signal Deadband:** Determines how much the **Trigger Data Signal** has to change before a new sample is taken.

   h. **Capture When True:** Controls whether data is captured continuously or only under certain conditions.

      If the **Capture When True** value goes unknown, the datalog will ignore it. If the datalog is in the waiting state (or the sampling state), when the **Capture When True** value goes unknown, the datalog will stay in its current state, either waiting (or sampling) state.

4. From the **Data Signals** table, select **Add Data Signal** to add the number of data signals you need.

   Up to 20 signals can be created.

5. From the **Configuration** table, select the **Edit** button to setup the following information for each **Data Signal**:

   a. **Name:** The signal name.

   b. **Description:** Document what the signal means or how its value should be interpreted.

c. **Field:** Bring up the field picker and select the ADIO module input or other value you want to monitor.

You cannot leave data signal fields unknown. You cannot select state or Boolean values for data signals.

6. Run the **Start Capture** command.

If all of the **Data Signals** are not configured when the **Start Capture** button is pressed, the capture will still start, but an entry is made in the event log to indicate a Data Signal is not configured.

You can configure the **Datalog** to run at certain times of day, or to stop after a certain time or number of samples, by configuring a Boolean **Custom Data** and then configuring **Capture When True** to use it.

If you change the **Data Signals**, **Sampling Method**, **Trigger Data Signal**, **Trigger Data Signal Deadband** or **Number Of Samples To Capture**, that will make the old data is incompatible with the new data. The old data will be deleted when you run the **Start Capture** command.

23.4.4.2. Transfer datalogs configuration to other system controllers

By importing and exporting a configuration file, some datalogs configuration can be transferred to a new system controller. A datalog sources information from data signals coming from various physical measurements on its system, and the data signal will only transfer to a new system controller if that measurement also exists on the new system.

For example, the **Total Load Current** is an attribute of the DC system. A datalog measuring the **Total Load Current** will only transfer to the new system controller if it has a DC system in its inventory.

However, signals such as a rectifier module's ambient temperature measurement are attributes of that specific rectifier module. If a configuration file is exported from one system controller and imported onto another, the ambient temperature data signal will not import, and it will raise an **Invalid Config Ignored** event. The new rectifier module will need to be reconfigured to the new system controller.

23.4.5. Performance logs

The **Performance** log holds up to one year's worth of daily roll ups with a minimum, maximum, and average value for key usage statistics. For systems, this includes: input voltage and current, and the output voltage and current. For the system controller, the CPU and memory usage are tracked.

To create the daily roll ups, the performance log is rolling up second data into minute data, minute data into hour data, and hour data into daily data. The web interface displays previews of all four sets of data as they are collected. In these previews, the horizontal axis shows the data sampled, not the time stamp. Daily statistics with minimum, maximum, and average values can be exported for each log by selecting the **Export data to CSV** button under the **Days** graph. Alternatively, you can export every log by selecting **Export All** via **Logs > Performance Logs**.

If the system controller is shut down for some period of time, the preview window will not show the gap in time.

If there is a clock error, indicating that the time and date is unknown, a **Performance Log** will not collect data.

📢 *Notice: The performance log for the **DC System Total Rectifier O/P Current** has an additional table **Top Hourly Averages** that shows the top-three hourly averages and timestamps for the system total rectifier module output current. This table does not exist on any other performance log.*

23.5. File maintenance

This section of the manual covers the following:

- Using file preferences to name files

- Upgrading the system controller operating system via the LCD panel

- Upgrading the system controller software

- Configuration restore points

- Importing and exporting configuration files

- Exporting diagnostic information

- Importing and exporting license keys

- Exporting a snapshot of system controller and system status

23.5.1. File preferences

If working with multiple systems, use the file naming options to keep your files organized. You can add the system controller name or the date to exported and saved files.

If adding a date, the date string format is YYYY-MM-DD making it easy to sort in file browsers.

If adding the system controller name, and that name contains whitespace, illegal characters for file names, or some extended characters, those characters will be removed from the string that is added to the file name. This naming convention applies to most files that can be saved or exported from the system controller for example: configuration files, log files, licensing files, and backup files.

To append a name or date:

1. Go to **Controller > Settings > User Interface**.
2. In the **File Preferences** table,

   ◦ Select the **Edit** button in the **Append a Date String to Filenames** field to enable the add date to file names.

   ◦ Select the **Edit** button in the **Change the Add the Controller Name to Filenames** field to add the system controller name to file names.

23.5.2. File maintenance from the LCD panel

To enable more to be done with the LCD panel and USB storage devices, most of the file maintenance functions available via the web interface are available on the LCD panel. LCD panel file operations take place using the top-level or root directory of a File Allocation Table 32 (FAT32) formatted USB drive.

File operations that are available on both the web interface and LCD panel are as follows:

- **Import** and **Export** of configuration files.

- **Upgrade** of the system controller software.

- **Upgrade** of the system controller operating system.

- **Import** and **Export** of license key files.

- **Upgrade** of module software using ACAN files.

- **Downloading** of event logs and module alerts.

- **Export Backup** of the system controller software and configuration.

File operations that are available only via the LCD panel:

- **Restore** of the system controller software and configuration.

File operations that are available only via the web interface:

- **Downloading** of performance logs, datalogs, and tables.

23.5.2.1. Import and export

On the LCD panel, go to **Controller > Files & Upgrades > Configuration & Software Backup > Configuration File**. The **Export Controller Clone** command allows you to export the entire system controller configuration to a connected USB drive. The other options **Export System or ADIO** and **Export Partial** are not supported on the LCD panel. The **Import** command allow you to import configuration files with limitations as noted.

Alternatively, go to **Shortcuts > Browse USB**. Here you can select a configuration file to perform an **Import**.

> 📢 *Notice: Using the **Import** command from the LCD panel has limitations. Importing a configuration file that is a clone of a system controller will always work. However, importing a configuration file that is for a system, an ADIO module or a partial configuration will only work if the import can be achieved unambiguously. For example, if the import is intended to change some configuration for an ADIO module, but there are more than one ADIO module of the same type it will be ambiguous as to which ADIO module should receive the configuration. Therefore the import will fail. In this scenario, the web interface should be used to do the import so that the user can choose which ADIO module should receive the configuration.*

23.5.2.2. Software upgrade

There are two ways to upgrade the system controller software:

1. On the LCD panel, go to **Menu > Controller > Files & Upgrades > Software Upgrade**. The **Upgrade New Controller Software and Reboot** command will allow you to upgrade the software using an appropriate upgrade file.

2. On the LCD panel, go to **Shortcuts > Browse USB**. You can upgrade the system controller software via an appropriate upgrade file that has been stored on a USB drive.

The software upgrade takes several seconds. The system controller reboots automatically when complete.

23.5.2.3. Operating system upgrade

On the LCD panel, go to **Shortcuts > Browse USB**. You can upgrade the system controller operating system via an appropriate upgrade file that has been stored on a USB drive.

> 📢 *Notice: There must be at least 33 Megabytes (MB) of free space to upgrade the operating system. To check the available free space, go to **Controller > About > Storage & Memory**. In the **Application Storage** table, check the **Free Space** row.*

The operating system upgrade takes several minutes. The system controller reboots automatically when the upgrade completes.

23.5.2.4. Backup and restore

The **Backup** command allows you to make a full backup of a system so that it may be restored to a known state. To access the **Backup** function on the LCD panel, go to **Shortcuts > Backup**.

The **Restore** command allows you to take a previously created backup file and restore the contents of that file to the system. All existing application software and configuration information will be deleted and replace by the contents of the backup file. To access the **Restore** function on the LCD panel, go to **Shortcuts > Restore**.

See section *Backup and Restore* for additional information and procedures.

23.5.3. Upgrade the system controller software

To perform a system controller software upgrade:

1. Go to **Controller > Files & Upgrade > Software Upgrade**.
2. Select the **Upload New Controller Software and Reboot** button.
3. From the **Upload File** window, select **Select File**, and then select the upgrade file.
4. Select **Upload** to begin upgrading.
5. After the upgrade is finished, the system controller will restart automatically.

Once complete, the **Login** page displays and you must sign back in to the system controller.

After an upgrade, it is common to see a number of **Event Log** entries showing configuration fields being set. This is normal on an upgrade when the system needs to set up new features or options that have been added.

23.5.4. Export a configuration file

There are three options when exporting a configuration file.

Export Controller Clone: Is used to transfer the entire configuration. A common use for this type of export is to make a backup of the current settings. When using this export, almost all information is saved to the exported file. See the following note for an explanation of what is not included in the export file.

Export System or ADIO: Is a way to copy a system or an ADIO module to another system controller. Only a single system or an ADIO module may be selected. If selecting system, any ADIO module referenced by that system is also exported. For example, if an Cordex® HP L-ADIO smart peripheral is used for voltage measurements and Cordex® HP 6i-ADIO smart peripheral is used for shunt measurements they are saved to the export file.

Export Partial: Is used to select a specific set of information for export. This is commonly used for transferring user alarms, custom data, alarm thresholds or other configured data that may need to be common between system controllers. A partial export must be performed on a set of related configurations. The wizard allows you to select either a system controller, one or more system or ADIO modules. After the selection is made, all associated configurations are presented in a list and are exported by selecting the check box. For example: to export a set of custom data, select system controller; to export a set of DC system alarm configurations, select the required system from the dropdown list. If any of the selected configuration references an ADIO module, that ADIO module is also exported.

Some items must be exported as a whole. This includes items that can be created and removed by a user (other than systems) or items that are permanent to the system controller. For example if selecting:

- **Controller:** You can export a whole SNMP destination, but not a particular configuration within a destination; or if exporting custom data, you can export a whole custom data with all its variables, but not a specific variable defined within the custom data. The same applies to user alarms, datalogs, schedules.

- **DC system:** You can export a whole battery, load, shunt, or disconnect, but not the configuration within these items.

- Multiple systems of the same type such as line power system cannot be exported in the same configuration file.

  📢 *Notice: Some configurations cannot be exported:*

- *system controller description and location information (this is unique to each system controller)*

- *IP configuration (to avoid loss of Ethernet connectivity)*

- *Web server port configuration (to avoid loss of Ethernet connectivity)*

- *Line power channels (unique to line power modules)*

- *Power module (power modules are unique to a system)*

- *Users (to maintain password security)*

- *Server passwords (for example, email server password; to maintain password security)*

To export settings:

1. From the main dashboard go to, **Controller > Files & Upgrades > Configuration & Software Backup**.

2. Select the type of export required:

   - **Export Controller Clone**: A file is generated and uploaded to your browser.

   - **Export System or ADIO**: A wizard displays in which you can select a system or an ADIO module. Select an item to export and then select **Next**. Use the **Download File** option to save your export file.

   - **Export Partial**: A wizard displays in which you can select a configuration source, select **Next**. In the **Select Configuration to Export** window, select each configuration item for export, select **Next**. In **Select Another Configuration** window, select **Yes** and select **Next** to select another configuration source. Select **No** and select **Next** when all configuration item are selected. Once the configuration file is prepared, use the **Download File** option to save your export file.

3. To help distinguish among configuration files rename your export file with a unique identifier. This can important when making a backup files for archiving or if a system controller replacement is required.

23.5.5. Import a configuration file

When importing a configuration file, the system controller will analyze the file to determine the type of import to perform. There are three types of import corresponding to the three types of export.

Clone

Clone is performed when a file that has been exported using **Export Clone Controller** is uploaded. The configuration of the system controller is matched to that contained in the file. In addition all existing

systems, custom data, timers, counters, datalogs are removed. Clone is also performed if a configuration file from a software version previous to software version 4.00 is uploaded.

Copy system or ADIO module

Copy system or ADIO module is performed when a file that has been exported using **Export System or ADIO** is uploaded. The system or ADIO module contained in the file is added to the system controller. If a system is being imported, the new system is created and added to the system controller under the **System** menu. If importing a DC system and a DC system already exists the import will fail because only one DC system is supported. It is necessary to first delete the existing DC system before doing the import. This also applies to converter systems. All other types of systems do not have this limitation. If importing an ADIO module, the ADIO module is added under the **Modules** page. After importing the ADIO module, use the **Replace ADIO** command to transfer the configuration of the imported ADIO module to an existing ADIO module.

Partial import

Partial import is performed when a file that has been exported using **Export Partial** is uploaded. The configuration contained in the file replaces that of any matching existing configuration settings. It is possible that the destination of the imported configuration cannot be automatically determined. For example, if configuration for a line power system is imported and there exists more than one line power system, the user will be required to select the which system should receive the configuration. Partial import can also be used to transfer custom data, counters and timers from one system controller to another. If the file contains configuration of more than one system, each system will be imported one at time until done.

Importing may not always be fully successful. Configuration values that point to another value, such as 'source' values that point to voltage, current or temperature, may not exist or may be ambiguous. If this is the case, the value is ignored and an entry is made in the event log. It is then necessary to remap the source field to a valid value.

📢 *Notice: Some configurations cannot be exported:*

- *system controller description and location information (this is unique to each system controller)*

- *IP configuration (to avoid loss of Ethernet connectivity)*

- *Web server port configuration (to avoid loss of Ethernet connectivity)*

- *Line power channels (unique to line power modules)*

- *Power module (power modules are unique to a system)*

- *Users (to maintain password security)*

- *Server passwords (for example, email server password; to maintain password security)*

To import settings:

1. From the main dashboard go to, **Controller > Files & Upgrades > Configuration & Software Backup**.

2. Select the **Import** button, select a file to import and select the **Upload** button.

3. If the configuration cannot be imported without ambiguity, there will be a dropdown list on **Select System** page to select the destination system or ADIO module. This only happens if trying to do a partial import. Select the destination system and select **Next**.

4. A page displaying an **Settings to Import** is shown. Review the summary and select **Next** to import. If the summary looks incorrect, you can close the wizard and try **Import** again to select another file.

5. Perform **Replace ADIO** if required. When this operation is done, the system controller gives special attention to the status of relays mapped to a disconnect. If, as a result of the replace operation, a disconnect relay will be shared with an alarm relay or if the state of a disconnect relay will change because of a change to the relay polarity, the replace will fail and an entry made in the event log identifying the alarm relay was causing the failure.

23.5.5.1. Import a system

It is common to create a system on the system controller that has been already configured on a different system controller. This can be done by first exporting a configuration file from the already configured system controller, then importing it. When exporting, choose the appropriate export method, either clone or copy, as previously described.

To import a system in a configuration file:

1. Go to **Controller > Files & Upgrades > Configuration & Software Backup**.

2. Select the **Import** button to launch the import wizard.

3. Use **Select File** to browse to the configuration file on your local computer (for example, `exportconfig.xml`).

4. Select **Upload** to upload the file to the system controller.

5. Review the **Import Summary** page. This shows a summary of what you are about to import. If it is not correct, close the wizard and start over to select a different configuration file.

6. Select **Next**, and then wait for the import to complete. If the import fails or encounters an error an error message is displayed.

7. Perform **Replace ADIO**, if necessary. If the imported system referenced one or more ADIO modules the import included these ADIO modules, and they now show up as **Comms Lost**. You should replace these **Comms Lost** ADIO modules with existing ADIO modules of the same type via the **Modules** menu.

The system has been imported and configured to use the existing ADIO module.

23.5.6. Configuration restore points

The **Configuration Restore Point** feature will automatically capture the configuration of the system controller daily (if anything has changed), providing automatic backups that can be used in situations where changes may have been made by mistake. This feature also enables you to:

- Create a configuration restore point manually. This can be useful to keep a backup before a big configuration change, or to create a known good configuration that can be restored to at a later point.
- Restore to a configuration restore point. This will restore the configuration of the system controller to the configuration it had when the configuration restore point was created.

Configuration restore points can be found by going to **Controller > Files & Upgrades > Configuration & Software Backup**. On this page there are two tables related to configuration restore points:

- **Configuration Restore Point Information:** This table provides general information about how the feature works, such as how many restore points will be kept, the frequency they are created, and which restore points will be deleted if the maximum is reached.
- **Configuration Restore Points:** This table provides information about the actual restore points. Each row represents a restore point, and provides information about when it was created, a user-defined description, and if the specific restore point can be deleted or not.

Notice: These restore points only keep a copy of the configuration of the system controller, not the software. It is possible that restoring to a restore point from an older software version could cause unexpected behavior. Please read the warnings and help in the wizard to ensure the restore will restore what is expected.

23.5.6.1. Create configuration restore points

Configuration restore points will be created daily (if any configuration changes have been made). It is also possible to manually create a restore point. To manually create a configuration restore point:

1. Go to **Controller > Files & Upgrades > Configuration & Software Backup**.
2. On the **Configuration Restore Points** table, select **Create Configuration Restore Point**.
3. Read the **Preview**, then select **Next**.
4. Enter in a **Description** and specify the **Deletion Policy** for this restore point, then select **Next**.

   *Notice: A maximum of five restore points can be marked as **Never Delete**. This should be used to ensure important restore points will never get deleted when daily restore points are created.*

5. Review the data you entered in, then select **Next**.

A new configuration restore point has now been created, and can be used to restore a configuration of the system controller if necessary.

23.5.6.2. Restore to a configuration restore point

If a configuration was changed by mistake, it is possible to undo those changes by restoring to a configuration restore point. To restore to a configuration restore point:

1. Go to **Controller > Files & Upgrades > Configuration & Software Backup**.
2. In the **Configuration Restore Points** table, select the details arrow beside the restore point you wish to restore to.
3. On the details page of the restore point, select **Restore Configuration To This Point**.
4. There will be three tables shown: **Items To Be Added**, **Items To Be Removed**, and **Configuration Changes**. These tables explain the changes you will see if the system controller configuration is restored to this restore point. After reading through and ensuring these changes are desired, select **Next**.

   📢 *Notice: Before the configuration is restored, a new restore point will be created. This will allow you to restore back to the current configuration if necessary.*

5. If restoring will cause anything to be removed from the system controller, another step will appear warning that these items will be removed. To proceed with the restore, enter **confirm** in the text box, then select **Next**.

After a short period of time, the wizard will display that the configuration has been restored.

23.5.7. Export diagnostic information

📢 *Notice: To facilitate any support request, export a diagnostic information package before contacting support.*

Exporting a diagnostic information package helps the support team provide assistance with any issues you may experience. This information package is an archive that contains the following:

- System controller clone
- Device log
- Event log
- Battery log
- Daily statistics for all performance logs
- Datalogs

Additionally, if any Alpha® T2S inverter controller modules for the Alpha® AMPS HP2 inverter system are acquired, an additional step will be available in the **Export Diagnostic Information** wizard to include their logs and configuration files in this package.

23.5.7.1. Export a diagnostic information package

This package can be obtained in the following ways, from the LCD panel or the web interface.

1. From the dashboard of the LCD panel, go to **Shortcuts > Export Diagnostic Information** to launch a wizard that will generate save the package to a USB drive.
2. From the web interface, select the **Accounts > Export Diagnostic Information** on the top bar to launch a wizard that will generate the file and let you download the file to your computer. This wizard is also available from **Controller > About > General**.

23.5.8. License key

Some features and functions on the system controller require a separate license key. Most system controllers have the correct license keys installed at the factory. If a system controller is purchased as a spare or is being re-purposed from a different type of system, it may be necessary to update the license key.

License key operations available on both the web interface and LCD panel are as follows:

- **Import** and **Export** of license key files

- **Enable** and **Disable** a temporary license

23.5.8.1. Export a license key file

To update the license key on a system controller, the first step is to export the current license key, and then send it to the company from which your system was purchased.

To export a license key:

1. From the main dashboard, go to **Controller > Files & Upgrades > Licenses**.
2. Select the **Export License Key File** button.

   From the web interface, this downloads a licenses.txt file to your downloads folder. From the LCD panel, this saves a licenses.txt file on your USB drive.

23.5.8.2. Import a license key file

Once you have an updated license key file you can import it into your system and enable the new license.

To import a license key:

1. From the main dashboard, go to **Controller > Files & Upgrades > Licenses**.
2. Select the **Import License Key File** button. From the web, you are prompted to locate the file (for example, licenses.txt) and upload to the system controller. From the LCD panel, select from the *.txt files on your USB drive.

There are three possible results depending on the license key file imported.

The license key file is valid and raises the level of at least one license key	Three things should happen: 1. The value or level of at least one license key in the **Licenses** table should change. You can check the event log to confirm which values changed. 2. If a temporary license was enabled, that temporary license is now disabled. This prevents the temporary license from expiring after a permanent license key has been uploaded. 3. If there were licensing alarms, they should have cleared.
The license key file is valid but does not raise the level of any license keys	No errors will be generated but no license key values will be changed either. It is not possible to downgrade a license key. Any license keys that are less than or equal to the current license key will be ignored.
The license key file is not valid, is corrupt or is for a different controller	An error message states that the licensing information is not valid for this system controller and the file will be ignored. Look at the text of the licensing file, and ensure that the first line matches your system controller ID.

23.5.8.3. Temporary license

It is possible to enable a temporary license that will enable all licenses on the system for one month in total. This is intended to be used in situations where it is not possible or convenient to wait for a permanent license to be sent. You can able the temporary license, get everything up and running, and then request the permanent license at some later time. The time remaining on the temporary license will count down from 31 days and it can not be easily reset.

To enable or disable a temporary license:

1. From the main dashboard, go to **Controller > Files & Upgrades > Licenses**.
2. Select the **Enable Temporary License** button.

   As long as the time remaining is not zero, the **Temporary License Status** value changes to enabled.

   The time remaining counts down the number of days remaining.

3. Select the **Disable Temporary License** button.

   The **Temporary License Status** value changes to disabled.

   The time remaining shows the number of days remaining.

23.5.9. Upload the software manual

The system controller software manual can be uploaded to the system controller so it is directly accessible via the web interface. The system controller can only contain one version of the software manual at a time.

To upload the user manual:

1. Go to www.alpha.ca, and then download the HTML version of the software manual for system controller upload.

2. Go to **Controller > Files & Upgrades > Software Manual**.

3. Select **Upload Software Manual**, and then select a file to import.

4. Select **Upload**. It takes several minutes for the file to upload and install. When the upload is complete, a notification is displayed.

5. Select **Account and Shortcuts** dropdown menu on the top right-side of the browser window to confirm that the file is installed.

6. Select the **Software Manual** entry at the top of the list. A new browser tab should open with the software manual. If not, try refreshing the browser using F5 on your keyboard.

A navigation and search pane opens on the left-side of the browser window. Use this to search for content. If required, it is also possible to print pages from this pane.

23.5.10. Export inventory file

A common system maintenance activity is to gather, record and archive a set of data about the system controller and connected systems. This can be a tedious process depending on the amount of data required. To facilitate this the system controller provides a set of data, both live status data, and configuration, as a downloadable file. This file contains most of the information that is viewable from the LCD panel and web interface and serves as a snapshot of the present state of the system controller.

To download this file:

1. If using a system controller with the LCD or OLED display panel, insert a USB drive.

2. Go to the menu location to find the download button:
   a. On the LCD panel, go to **Maintenance** and scroll down to the **Export Inventory to CSV** button and select it.

   b. On the web interface, go to **Systems > Add or Remove Systems** and select the **Export Inventory to CSV** button in the **Add or Remove Systems** table.

   c. On the in-shelf system controller with the OLED display panel, select the **Menu** button and scroll down to **ExpInv** and select the **Menu** button again.

3. Select the **Export** button to initiate the download.

Once started, the file is downloaded to the USB drive or PC depending on where the export was initiated from. If initiated from the LCD or OLED display panel it is downloaded to the USB drive. If initiated from

the web interface it is downloaded to the PC. Depending on the amount of data to download, it may take several minutes to complete.

This file can now be opened in a spreadsheet program for analysis.

> 📢 **Notice:** *Sensitive data related to users and user permissions, passwords, and licensing is not included in the exported file.*

23.5.11. Backup and restore

A full backup of the system controller can be created using the backup feature. The created backup can then be used to restore to a known software version and configuration. The **Backup** command will make a copy of the software and configuration information for that version of application in a single backup file. This includes system controller-specific information such as IP addresses, usernames, and passwords.

The **Restore** command provides the ability to take an existing backup file and restore the contents of that file into a system controller. All existing software and configuration information will be deleted and replaced by the contents of the backup file.

The **Backup and Restore** feature is intended to be used to recover from severe errors. If a system controller is damaged and requires a replacement, then a backup file can be used to restore a new system controller to the same software version and configuration as the previous system controller.

A **Backup** command can be initiated on the web interface or LCD panel while a **Restore** command can only be initiated via the LCD panel.

> 📢 **Notice:** *In version 8.30 and later, restoring a configuration from an EnVision™ Elite controller backup is supported. The controller software is not restored.*

23.5.11.1. Export system controller backup on the web interface

To create a system controller backup on the web interface:

1. Go to **Controller > Files & Upgrades > Configuration & Software Backup > Backup File** table.
2. In the **Backup File** table, find the **Export Controller Backup** button.
3. Select the **Export Controller Backup** button.
4. After about a minute, the **Backup File** is created and downloaded to local PC.

23.5.11.2. Export system controller backup on the LCD panel

To create a system controller backup on the LCD panel:

1. Insert a USB drive into the system controller USB port.

2. Go to the **Shortcuts** menu and select the **Backup** shortcut.

3. After about a minute, the **Backup** is created and added to the USB drive.

23.5.11.3. Export system controller backup via scheduled action

A **Scheduled Action** can be configured to automatically backup the system controller to a USB drive at configurable intervals.

To automatically backup a system controller at configurable intervals using a USB drive:

1. Insert a USB drive into the system controller USB port.

2. On the web interface or LCD panel, go to **Controller > Programmability > Scheduler**.

3. Select **Create Scheduled Action** to start the **Create Scheduled Action** wizard.

4. In the wizard, configure the schedule type and schedule details. In the **Action** section, select the **Backup Controller to USB Drive** action.

5. Finish the wizard and the action will be displayed in the **Scheduled Actions** table. The action will run at the configured time interval.

23.5.11.4. Restore a system controller using a backup file on the LCD panel

To restore a system controller using the LCD panel:

1. Insert a USB drive that has a previously created **Backup** file into the system controller USB port.

2. Go to **Shortcuts > Restore**.

3. Select the displayed **Backup** file from the USB drive.

4. Select the **Execute** button to start the restore.

5. After about a minute, the system controller restores to the backup file contents.

23.5.11.5. Restore a Cordex® HP system controller using a backup file from an EnVision™ Elite controller on the LCD panel

In version 8.30 and later, restoring system configuration using an EnVision™ Elite controller backup file is supported.

To restore a Cordex® HP system controller using a backup file from an EnVision™ Elite controller on the LCD panel:

1. Insert a USB drive that has a previously created EnVision™ Elite controller **Backup** file into the Cordex® HP system controller USB port.

2. Go to **Shortcuts > Restore**.

3. Select the displayed **Backup** file from the USB drive.

4. Select the **Execute** button to start the restore.

5. After about a minute, the system controller restores to the backup file contents.

23.6. User account maintenance

23.6.1. Set up users and permissions

📢 **Notice:** *These features are only available to those with administrator or account manager privileges.*

By default, the system controller has seven user accounts: one administrator, one account manager, and five operators. The **Name** field in these accounts is not editable. User accounts cannot be added or deleted, but they can be enabled or disabled.

Within the **Users & Security** menu in the **Users** table, you can configure what privileges each user has when accessing the system or changing passwords.

This section of the document covers the following:

- Edit user permissions

- Enable new users

- Disable users

23.6.2. Edit user permissions

These features are only available to those with administrator or account manager privileges.

To edit user permissions:

1. Go to **Controller > Users & Security > Users**.
2. In the **User** table, select the **Go To** button on the line of user whose access must be changed.
3. On the right-side of the **User Role** line, select the **Edit** button.
4. From the dropdown menu, set the **User Role** and select **Save**.

23.6.3. Enable new users

Within the **User & Security** menu you can enable, edit, and disable users. Only users with administrator or account manager privileges can enable users. Within the **User Roles** dropdown menu you can configure the privileges each user has as well as create passwords. The different levels of user permissions are as follows:

- **Administrator:** Can modify all configurations, perform any actions with the exception of factory information.

- **Account Manager:** Can only create and modify user accounts.

- **Operator:** Can modify all configurations, can change their own password.

- **Restricted Operator:** Can modify configuration values, but cannot add or remove systems or inventory, can change their own password.

- **Guest:** Can read any field, but can not configure any settings.

To enable a user:

1. Go to **Controller > Users & Security > Users**.
2. From the **Users** table, select the **Go To** button on the operator1 line.
3. **Optional:** Edit the **Description** and select **Save**.
4. **Optional:** Edit the **Alias** and select **Save**.

   The alias field allows sign in names that a user is more familiar with. For example, if you set the *operator1* alias to *TL1*, you can sign in to the operator1 account using the *TL1* user name.

5. Set the **User Role** (permissions) and select **Save**.
6. From the operator1 table, select **Change User Password** to set the password and select **Save**.
7. Sign in using the updated password or permissions.

23.6.4. Disable users

These features are only available to those with administrator or account manager privileges. User accounts are not actually deleted, they are edited to remove a user's access to the system.

To disable users:

1. Go to **Controller > Users & Security > Users**.
2. From the **Users** table select the **Go To** button on the line of user account whose access must be changed.
3. On the right-side of the **User Role** line select the **Edit** button.
4. From the dropdown menu, set the **User Role** to **No Access**.
5. Select **Save**.

23.6.5. Change the default password on the LCD panel

This section describes how to change user passwords on the LCD panel.

You must be signed in to the system controller to change passwords.

To change the default password:

1. From the main dashboard, select the **Menu** button.
2. Select **Controller** to highlight it and then select the arrow on the right-side.
3. Select to highlight **Configure Controller** and then select the arrow on the right-side.

4. Swipe with an upward motion on the touchscreen to scroll down to **Users and Security** and select to highlight it.

5. Select the arrow on the right-side and then select **admin**.

6. Select **Change User Password**.

7. Select the **Execute** button to modify the default and then select the check mark to save your changes.

23.6.6. Change the default password from the web interface

This section describes how to change the default password on the web interface.

To change the default password on the web interface:

1. From the main dashboard, go to **Controller > Users & Security > Users**.

2. From the **admin** line in the **Users** table, select the **Go To** button on the right-side of the table.

3. From the admin table, select the **Change User Password** button.

4. Enter your existing password, enter a new password, and then again re-enter that new password to confirm the change. Select **Save** to save the password change.

23.6.7. User account password requirements

When changing a user account password, the following requirements apply:

• **Minimum password length:** 4 characters.

• **Maximum password length:** 60 characters.

• Any characters (including those from non-Latin alphabets) are allowed.

• By default, there are no complexity requirements, such as requiring numbers or symbols.

• Passwords do not expire.

> **Notice:** *The use of some non-Latin characters may reduce the maximum allowable password length.*

23.6.8. Machine user

In addition to the regular users mentioned in a previous section, there is also a machine user. This user is not shown on the **Users** page. This user is not used by a person, but rather is used to allow external software to interact with the system controller. By default, the machine user is disabled. This can be seen by looking at the **Machine Account Status** table on the **Users** page. The machine user will only ever become enabled if a user provides external software authorization to perform operations on the system controller. This authorization process is done in the external software, and uses the same authentication mechanism as normal sign ins via the web interface.

When external software performs operations on the system controller, event log entries can be seen showing the machine user signing in, as well as which external software is performing the operations, and who initiated them.

When the machine user is enabled, that authorization can be revoked by:

1. Go to **Controller > Users & Security > Users**
2. In the **Machine Account Status** table, select **Disable Machine Account**, and select **Yes**
   The external software will no longer be able to use the machine user to perform operations on the system controller.

23.6.9. Remote configuration lockout

The **Remote Configuration Lockout** feature allows for a complete lockout of configuration changes from the web interface. When this feature is active, no user, regardless of permission level, will be able to change or modify the configuration via the web interface. Configuration changes will still be possible via the LCD panel.

To enable this feature:

1. On the LCD panel, go to **Maintenance > Remote Configuration Lockout**.
2. Select the **Edit** button beside **Remove Configuration Lockout**, change the value to **Disabled** (sign in if required), then save.
3. Select the **Edit** button beside **Lockout Override Time**, enter in the desired time to override the lockout (more on the override in the following sections), then select **Save**.

After the **Remote Configuration Lockout** feature is enabled, no configuration changes will be allowed from the web interface.

23.6.9.1. Override the remote configuration lockout from the LCD panel

After the **Remote Configuration Lockout** feature has been enabled, it is possible to override the lockout for a user-specified amount of time. This will allow a technician on site to override the lockout temporarily to allow for a user off-site to perform some configuration via the web interface.

To override the remote configuration lockout from the LCD panel:

1. On the LCD panel, go to **Maintenance > Remote Configuration Lockout**.
2. Select **Override Remote Configuration Lockout**, then select **Execute**.

The configuration lockout will be overridden for the amount of time that has been configured. The time remaining in the override can been seen via **Lockout Override Time Remaining**.

23.6.9.2. Override the remote configuration lockout from the OLED display panel

To override the remote configuration lockout from the OLED display panel:

1. On the OLED display panel, go to the menu by selecting the **Select** button.

2. Scroll down and select the **RemCfg** button.

You will be shown a **Lockout Overridden success** confirmation message, and the configuration lockout will be overridden for the amount of time that has been configured.

23.6.10. Password reset using security questions

The **Password Reset Using Security Questions** feature allows users to reset their password by answering the security questions that are configured on their account. This feature allows a quick recovery of access to an account in the case that the user forgot the password of the account. By default, this feature is disabled. When this feature is active, users can easily reset their password through the web interface or from the LCD panel. When this feature is enabled, users can set security questions and answers which will allow them to reset their password.

Password complexity is configurable. See the section on Password options

23.6.10.1. Enabling or disabling password reset using security questions

This section describes how to enable or disable the password reset using security questions. When the feature is enabled, any user may set up security questions.

This feature is only available to those with administrator or account manager privileges.

To enable or disable password reset using security questions:

1. Go to **Controller > Users & Security > Password Management**.

2. In the **Password Reset Options** Table, on the right-side of the **Use Security Question** line, select **Edit** button.

3. From the dropdown menu, set to **Enabled** (enabling the feature) or set to **Disabled** (disabling the feature) and select **Save**.

23.6.10.2. Set up security questions

This section describes how user can set up their security questions.

You must be signed in to the system controller to set up the security questions. When the feature is enabled, any user may set up security questions.

To set up security questions:

1. Go to **Controller > Users & Security > Users**.

2. In the **User** table, select the **Go To** button on your user account.

3. From the **Password Reset Security Questions** table, select the **Configure Security Questions** command.

4. Select the security questions and enter the answers and confirm the answers of each questions, select **Next**.

5. **Review** the values and select **Next**.

6. Select **Done** to close the wizard.

23.6.10.3. Password reset from the web interface

This section describes how to reset user passwords from the web interface.

This feature requires the account security questions to be configured.

To reset password from the web interface:

1. From the sign in screen, select **Forgot Password?**

2. Enter the username or alias of the account which requires a password reset, and then select **Next**.

3. Answer all three security questions correctly, and then select **Next**.

4. Enter the new password and confirm it by entering it again in the **Confirm New Password** field. Select **Next**.

5. Upon successful password reset, close the wizard and sign in using the new password.

23.6.10.4. Password reset from the LCD panel

This section describes how to reset user passwords from the LCD panel.

This feature requires the account security questions to be configured.

To reset password from the LCD panel:

1. Select **Login** or go to **Shortcut > Forgot Password**.

2. From the sign in screen select **Forgot Password** icon.

3. Select to highlight **User name or Alias**, and then select arrow on the side.

4. Enter the user name or alias of the account whose password need, select **Check** icon to set the value and select **Next**.

5. Swipe with an upward motion on the touchscreen to scroll down and highlight the answer, and then select arrow on the side.

6. Enter the correct answer, select the **Check** icon to set the value.

7. Answer all three security questions correctly, select **Next**.

8. Select to highlight **New Password** and then select arrow on the side.

9. Enter the new password, select the **Check** icon to set the value.

10. Confirm the new password by entering it again in the **Confirm New Password** field. Select **Next**.

11. Upon successful password reset, close the wizard and sign in using the new password.

23.6.10.5. Reset security questions

This section describes how users can reset the security questions.

This feature can be enabled by those with administrator or account manager privileges.

To reset all security questions:

1. Go to **Menu > Controller > Users & Security > Password Management**.
2. From the **Password Reset Summary** table, select the **Reset Security Questions**.
3. Select **Yes**, security questions for all user accounts will be reset to default.

23.6.11. Configure password options

The password options feature enhances the security of user account passwords on the system controller. By default, user account passwords are required to have a character limit ranging from 4 to 60 characters. To strengthen passwords, password options provide a range of customization options for user passwords. If there is any modification in the status of password options (from enabled to disabled or vice versa) then user accounts that have the user roles assigned as Administrator, Operator, and Account Manager will be prompted to change their password on the next succeeding sign in. The updated password must comply with the password options that are enabled.

To configure password options, go to **Controller > Users & Security > Password Management > Password Options** table. There is flexibility to enable specific options based on security preferences. The following options are available which are disabled by default:

1. Include Uppercase Letter: This will enforce the presence of at least one uppercase letter in the password.
2. Include Lowercase Letter: This will enforce the presence of at least one lowercase letter in the password.
3. Include Number: This will enforce the presence of at least one number in the password.
4. Include Special Character: This will enforce the presence of at least one special character in the password. Valid special characters include: ! " # $ % & ' ( ) * + , - / : ; < = > ? @ [\ ] ^ _ { | } ~ .
5. Reject Common Passwords: This will prevent commonly used passwords.

23.7. Remote authentication

The system controller is configured with local user accounts by default, where sign in credentials are verified against encrypted data on the system controller. Remote authentication provides an additional ability to verify sign in credentials from a remote server. This can be an advantage from a network security standpoint, as sign in credentials can be updated from one central server rather than being updated individually on each system controller. Enabling remote authentication has no effect on the already configured default user accounts stored locally on the system controller.

The system controller supports credential caching. In the case that the system controller is not able to contact the specified remote server, the system controller will verify the user's credentials against the last ten authenticated credentials encrypted and stored locally on the device.

The system controller can support remote authentication through either the Remote Authentication Dial-in User Service (RADIUS) or Terminal Access Controller Access Control System Plus (TACACS+) protocol.

> **Notice:** *Sign in access to the default user accounts are unaffected when a remote authentication server is inaccessible.*

> **Notice:** *Remote authentication passwords are limited to 32 characters. Shared secrets and secret keys are limited to 52 characters. The **User Roles Configuration** fields are case-sensitive when matched against the values stored on the remote server.*

23.7.1. Remote Authentication Dial-In User Service (RADIUS) authentication

Remote Authentication Dial-In User Service (RADIUS) is a client-server protocol and software that enables clients to communicate with a central server to authenticate and authorize their access to the requested system or service. This section of the document describes RADIUS authentication, its features, and how to setup the system controller as a RADIUS client.

> **Notice:** *See your RADIUS server documentation for information about setting up the RADIUS server.*

23.7.1.1. RADIUS authentication

The system controller can be configured to use a RADIUS server to remotely authenticate users. In this case, the system controller is acting as a RADIUS client. A RADIUS server, such as FreeRADIUS, must be configured separately for remote authentication to work correctly.

> **Notice:** *See your RADIUS server documentation for information about setting up the RADIUS server.*

The following are features for using RADIUS authentication.

- **Encryption Protocol:** Provides encrypted password authentication protocol (PAP) or challenge-handshake authentication protocol (CHAP).
- **Encrypted RADIUS Shared Secret:** Provides a securely encrypted, shared secret authentication on the RADIUS server.
- **Test RADIUS Server Settings:** Provides an authentication request to test the RADIUS server settings.
- **Network:** Operates on the user datagram protocol (UDP).

How RADIUS authentication works

When the **Remote Authentication Type** field is set to **RADIUS (TACACS+ is disabled)** on the system controller, the user credentials are encrypted, and an authentication request is sent to the RADIUS server. When the **Remote Authentication Type** field is set to **None (RADIUS and TACACS+ are disabled)**, only local user accounts can sign in.

By default, the system controller expects the RADIUS server to return the user's authentication using **Group Attribute ID** 11 (Filter-ID). When a RADIUS response is received from the RADIUS server, the value of attribute **Filter-ID** contains a string **Group Attribute Value** that defines the user role. The system controller uses the **User Role Configuration** table to match the string received from the RADIUS server to authenticate the user. If the user's **Group Attribute Value** matches one of the assigned user roles, the matching user privilege is granted. For example, if the received **Filter-ID** attribute has a value **operator**, the user has operator user role permission. If there are no match, the user is denied access. Upon a successful sign in, the encrypted user credentials are saved in the system controller's cache. This can be used if there is a situation where the RADIUS server is unavailable.

> 📢 *Notice: The user can pick any attribute supported by RADIUS to return the user role. The important thing is that the attribute ID used must match the attribute used to define the user's role in the RADIUS server's user configuration.*

- **Remote Authentication Type:** When set to **RADIUS (TACACS+ is disabled)**, users are allowed to be authenticated by a RADIUS server.
- **RADIUS Authentication Server Address:** The DNS name or the IPv4 or IPv6 address for the RADIUS server.
- **RADIUS Authentication Server Port:** The default port is 1812.
- **RADIUS Timeout:** The time, in seconds, that the system controller waits for a response from the RADIUS server.
- **RADIUS Encryption Protocol:** The authentication method used by the system controller to encrypt user passwords. This is either password authentication protocol (PAP) or challenge-handshake authentication protocol (CHAP).
- **RADIUS Server Shared Secret:** The shared secret between the system controller and the RADIUS server. Set this value by using the **Set Shared Secret** button. You can clear the configured shared secret by using the **Clear Shared Secret** button.

23.7.2. Terminal Access Controller Access Control System Plus (TACACS+) authentication

Terminal Access Controller Access Control System Plus (TACACS+) is a client/server protocol and software that enables clients to communicate with a central server to authenticate and authorize their access to the requested system or service. This section describes TACACS+ authentication and authorization, its features, and how to setup the system controller as a TACACS+ client.

> 📢 *Notice: See your TACACS+ server documents for any detailed information on setting up the TACACS+ server.*

23.7.2.1. TACACS+ authentication

The system controller can be configured to use a TACACS+ server to remotely authenticate users. In this case, the system controller is acting as a TACACS+ client. A TACACS+ server, such as TACACS.net, must be configured separately for remote authentication to work correctly.

The following are features for using TACACS+ authentication.

- **Encryption Protocol:** Provides encrypted password authentication protocol (PAP), challenge-handshake authentication protocol (CHAP), or American Standard Code for Information Interchange (ASCII) authentication.
- **Encrypted TACACS+ Secret Key:** Provides a securely encrypted, secret key which is not sent between the system controller and the TACACS+ server. The secret key must be set identically on both the system controller and the TACACS+ server.
- **Test TACACS+ Server Settings:** Provides a check to determine if the basic TACACS+ configuration is set correctly. This feature additionally completes a trial authentication request to ensure it can contact the TACACS+ server.
- **Network:** Operates on the transmission control protocol (TCP).

> 📢 *Notice: The **Test TACACS+ Server Settings** feature cannot determine if the attribute name and group attribute values are spelled correctly since these are set on the TACACS+ server side.*

How TACACS+ authentication works

When a user signs in when the **Remote Authentication Type** field is set to **TACACS+ (RADIUS is disabled)** on the system controller, the system controller will begin communication with the TACACS+ server. A packet body containing the user's credentials will first be encrypted and sent to the server; depending on the **TACACS+ Encryption Protocol** selected, there may be multiple messages sent between the system controller and the TACACS+ server.

If the TACACS+ sever authenticates the user, the system controller will then send a TACACS+ authorization request. At this point, the TACACS+ server will respond with any attribute-value pairs that are set within the server configuration. If any of these pairs match the **Attribute Name** and one of the **Group Attribute Values** of the **User Roles Configuration** table, the system controller will assign the respective user privilege and proceed to sign the user in. If there are no matches, the user is denied access. If two or more **Group Attribute Values** are assigned the same value, the system controller will assign the first matching user role in the following order: admin user role, then accounts user role, then operator user role, then restricted operator user role, then guest user role.

Upon a successful sign in, the encrypted user credentials are saved in the system controller's cache. This can be used if there is a situation where the TACACS+ server is unavailable.

The following TACACS+ server settings can be configured:

- **Remote Authentication Type:** When set to **TACACS+ (RADIUS is Disabled)**, users are allowed to be authenticated by a TACACS+ server.
- **TACAS+ Authentication Server Address:** The DNS name or the IPv4/IPv6 address for the TACAS+ server.
- **TACAS+ Authentication Server Port:** The default port is 49.
- **TACAS+ Timeout:** The time, in seconds, that the system controller waits for a response from the TACAS+ server.

- **TACAS+ Encryption Protocol:** The authentication method used by the system controller to encrypt TACACS+ packet bodies. The encryption protocol can be password authentication protocol (PAP), challenge-handshake authentication protocol (CHAP), or ASCII authentication.
- **TACACS+ Server Secret Key:** The secret key stored on both the system controller and the TACACS+ server. Set this value by using the **Set Shared Secret** button. You can clear the configured shared secret by using the **Clear Shared Secret** button.

> *Notice: TACACS+ credentials (user name, secret key, and password), the attribute name, and group attribute values must contain only printable ASCII characters.*

23.8. Flash maintenance

This section of the document covers **Storage and Memory** to see disk usage and memory usage.

23.8.1. Storage and memory

The **Storage and Memory** page displays various information about flash, including:

- The types of files that are using disk space.
- The total amount of disk space remaining.
- The total amount of memory, and the amount of memory being used.
- Alarms. There is one alarm, **Disk Almost Full**.

The disk space information can be used to help determine which files are taking up the most space if the system controller runs out of disk space. All this information can be accessed by going to **Controller > About > Storage & Memory**.

23.9. Secure web server

The system controller supports secure web access via the hypertext transfer protocol secure (HTTPS) protocol using Transport Layer Security (TLS) version 1.2. Support for earlier versions of TLS such as version 1.1 and 1.0 have been discontinued.

23.9.1. HTTPS and certificate overview

The system controller can provide secured hypertext transfer protocol (HTTP) over transport layer security (TLS) HTTPS. HTTPS is provided by using the well-defined industry standard of implementing certificates for secured connections.

> *Notice: A subject matter expert or IT personnel is required to support private key and certificate management and installation to the system controller and any other HTTPS configuration activities. The use of a self-signed certificate is allowed within system controller. With first access to the web server, the browser will display a pop-up indicating a self-signed certificate and a*

📣 *"Trust" acknowledgment is required. Self-signed certificates allow you to secure a large number of system controllers using a self-managed domain name address for each system controller.*

📣 ***Notice:*** *Secure connection can only be achieved by the browser if a domain name is used (example, https://www.alpha.com). Based on web browser standards, an IP address cannot resolve to a secured connection to the system controller.*

Two files must be uploaded to enable HTTPS on the system controller. The public key, often referred to as the certificate, and the private key, which is a certificate verified by an independent certificate authority (CA). Most modern browsers will automatically trust and accept a certificate from a known CA. We recommend that subject matter expert or IT person with HTTPS experience complete this process.

23.9.2. Configure HTTPS

The settings for HTTPS are located under **Controller > Communication > Web Server**.

By default, HTTPS is disabled on the system controller on first start up.

23.9.2.1. Web server ports

The system controller has configurable web server ports on the web interface. The standard HTTP port defaults to port 80 and the standard HTTPS port defaults to port 443. If using a custom port number, it is recommended to use custom port numbers above port 1024.

📣 ***Notice:*** *A soft restart of the system controller is required after all configurations are made when changing HTTP server port values.*

23.9.2.2. Upload a certificate and key

HTTPS requires a valid certificate and a private key file to be uploaded to the system controller. Using an Rivest-Shamir-Adleman (RSA) key is recommended as it is the universally accepted key type by common web browsers. The system controller is compatible with certificates following the X.509 standard.

📣 ***Notice:*** *A subject matter expert or IT personnel are required to support private key and certificate management as well as installation to the system controller.*

The system controller requires a single certificate file, which contains the specific certificate issued to the system controller, along with the intermediate certificate immediately following. A copy-and-paste process can consolidate multiple certificates for this purpose. An example certificate file with two embedded certificates shown here.

Figure 23-4 Example certificate

A completed installation of the private key and certificate file result in a valid response.

Figure 23-5 Valid certificate

An incomplete installation will result in an Invalid response. An incomplete installation (if only the key or the certificate is installed), will result in an incomplete response.

If both the key and certificate have been uploaded, but there is a problem with either one of these the files, the status will also be Invalid.

The system controller ensures secured storage of the private key to prevent unauthorized access to the file.

23.9.2.3. Enable HTTPS

Once a valid Secure Sockets Layer (SSL) key and certificate have been uploaded, HTTPS can be enabled by editing the field called **Web Connection Protocol**. There are three choices available:

- **HTTP Only:** This is the default, the web server will only listen on the regular HTTP port.
- **Both HTTP and HTTPS:** This means that the web server will listen on both the regular HTTP port (port 80) and the HTTPS port (port 443). Users can connect using either. If you connect via http:// this is not a secure access protocol.
- **HTTPS Only:** This is the recommended setting for the most security. The web server will only listen and respond to requests on this port. Users must access the web server via a URL starting with https:// or they will be unable to connect.

After any change to the **Web Connection Protocol** setting, the system controller must be restarted before the changes take effect. The **Restart Required** alarm will activate as a reminder.

> ⚠️ *Attention: Enabling HTTPS means that every packet passed between the client, and the server is encrypted and then decrypted again on the other side. This slows the browser considerably. How much, depends on which browser and which type of encryption cipher is negotiated between client and server.*

23.10. Virtual Local Area Network (VLAN) support

If the system controller's operating system supports Virtual Local Area Network (VLAN) tagging (operating system version 4.30 and later), the system controller can operate on VLAN tagged networks.

To configure the VLAN feature, go to **Controller > Communication > Ethernet**, and go to **VLAN Support** table.

If the operating system does not support VLAN, the configuration fields are not editable.

If a **Restart Required** alarm activates after making the changes described , restart the system controller to have the changes take effect.

1. Set **VLAN Support** to **Enabled**.
2. Choose which interface to enable VLAN on: the rear Ethernet port, or the front Ethernet port.
3. Choose a VLAN tag number.
4. Restart the system controller if the **Restart Required** alarm activates. Restarting may take a few minutes. You will be automatically re-directed to the sign in page once the system controller is ready.

23.11. Test relays

A common maintenance activity is to periodically verify that system controller relays actuate and successfully communicate system controller alarms to remote monitoring equipment. Relays can be tested from the ADIO module details on the **Modules** menu or the **Maintenance** menu on the LCD panel.

To test relays on the LCD panel:

1. Go to the **Maintenance** menu from the LCD panel dashboard.

2. Scroll down to the **Test Relays** row.

3. Select the relay symbol on the right hand side. A list of all relays is shown.

4. Select a relay to and select the arrow on the right hand side. A **Test Relay** action is shown at the top of the screen with the relay status underneath it.

5. Select the **Test Relay** action and select the arrow on the right hand side. If you are prompted to sign in, select the **Login** button and enter user credentials.

6. Select the **Execute** button to start the test. The relay will change state for one minute before reverting.

7. To stop the test or to restart the test, select the back arrow.

23.12. Using the system controller as a proxy web server

For added security for Intelligent Distribution Products (IDP), the system controller can be used as a proxy server for logging in to the websites of the following products:

- Alpha® Matrix 300™ series power distribution system
- Alpha® Matrix C16™ distribution breaker panel
- Alpha® HDN™ DC distribution center
- Alpha® PowerBay+™ BDFB distribution bay
- Alpha® GMT 125 Series™ fuse panel
- Alpha® v30/30™ distribution panel

Once configured with the IDP device's IP address and credentials, this feature allows users to sign in to the system controller using whichever credentials have been configured, including remote authentication options such as RADIUS and TACACS+. Then the user can browse to the IDP device's website without further sign in required.

To configure this feature:

1. Go to **Controller > Communication > Website Proxies**.

2. Add a connection to a new IDP device by selecting the **Add Proxy Website** button. A new **Web Proxy** item should appear in the table.

3. Select the **Go To** button to configure the details of the IDP device.

4. Add an IP address for the device. Note that the IP address must be a local, non-routable address for security reasons. This includes all IP addresses which start with 10 or 192.168, or those within the range of 172.16 to 172.31.

5. Save the username and password for the device. The username can be saved by editing the **Username** field, while the password must be entered twice for validation, using the **Save Remote Password** button.

6. A name and description can also be added to help identify the IDP device.

Once an IDP device has been configured, it can be accessed by selecting the **Launch Website** button. This button will also be available on each row of the table at **Controller > Communication > Website Proxies**, and on the system controller **Dashboard** for quick access. The website of the IDP device will be opened full screen, but it is actually display in a frame within the system controller web interface. The user may return to the system controller web interface by selecting the browser back button, or selecting the frame arrows on the bottom right of the browser window.

Please note that this feature has been implemented specifically for the IDP devices aforementioned. Although it may be possible to add IP addresses and credentials for other types of devices, this has not been tested and may not work properly.

📢 *Notice: This is a HTTP-only proxy. Any other protocols used for accessing the device (such as SNMP) must still access directly, not through the system controller's IP address.*

24. Maintaining modules

When maintaining your modules always check for known issues within the read me file that ships with your software. This section of the document covers the following:

- ADIO module configuration and maintenance
- Module firmware upgrades

24.1. ADIO module maintenance

To locate connected ADIO modules, go to **Modules**, in the **CAN Modules** table find the device you want to locate and then select **Locate** button. The LEDs on the selected ADIO module will flash.

24.1.1. Configure an ADIO module

To configure an ADIO module:

1. To view status of inputs and outputs go to **Modules** and select an ADIO module.
2. To configure a digital input, select the **Go To** button for the selected digital input. Active when can be configured as **Energized** or **Not Energized**.
3. To configure a relay, select the **Go To** button for the selected relay. Normal position of the relay can be set to **Energized** or **Not Energized**. A relay can also be set to de-energize if communication is lost between the system controller and the ADIO module. To do this, set the **Comms Lost Action** to **De-Energize on Comms Lost**. This feature was added in system controller software version 6.10 and requires up-to date firmware on the ADIO module. This feature cannot be used on relays that are used for control functions, like disconnects.
4. To change the calibration, select the **Go To** button for the selected analog input. You must be logged in as an Administrator to launch the **Factory Calibration** wizard.
5. The **Comms Lost Timeout** should normally left at the default value. It is only used in advanced configurations with a redundant system controller and ADIO module.

24.1.2. Replace an ADIO module

ADIO modules have a lot of configuration and often have many links to things such as the system voltage or alarm relays. Because so much configuration is tied to an ADIO module, there is a command for replacing the ADIO module that retains all of its configuration.

To replace an ADIO module:

1. Go to **Modules**.
2. Use the **Locate** button to find the two ADIO modules, the old one (to be replaced) and the new one. It may be useful to note the two serial numbers, in the identity column, if there are multiple ADIO modules in the list.

   The **Locate** button will only work on ADIO modules that have normal communication status.

3. Select the **Replace ADIO** button and the wizard guides you through the process.

4. Select the **Finish** button to accept the change. The resulting table should have the new ADIO module in it along with all of the mappings and configuration from the old ADIO module.

5. Verify the ADIO module.

Verify that the new ADIO module is reading the inputs correctly, and that any inventory items are reporting the correct values. For example, check that the load or battery current readings are correct.

24.1.3. Calibrate analog inputs

📢 *Notice: Calibration is considered an expert user task. Users must be logged in with administrator privileges to perform this calibration.*

This section covers the calibration of analog inputs on the ADIO module including voltage, current, current transducer, and temperature. This calibration method is only supported for the Cordex® HP family of ADIO peripherals. Older ADIO modules such as the Cordex® shunt multiplexer can be monitored via the system controller but cannot be calibrated.

The factory calibration of Cordex® HP ADIO peripherals is very precise. It should not be a normal practice to recalibrate them in the field. If you need to apply a deliberate miscalibration, we recommend the use of custom data fields to document and perform this type of conversion.

If the factory calibration values need to be recalculated, there are three calibration modes:

- Slope/offset calibration

- Single-point calibration

- Two-point calibration

Table 24-1 ADIO module input calibration modes

Mode	Description
Slope/Offset Calibration	Use **Slope/Offset Calibration** mode to do all of the measurements and calculations manually and then enter results into the appropriate fields. If an input has been accidentally miscalibrated, use this mode to reset the **Calibration Slope** to one, and the **Calibration Offset** to zero, which provides reasonable values to start with.
Single-Point Calibration	Use **Single-Point Calibration** to adjust the **Calibration Offset** based on a single measured value. For voltage, current and DC current transformers (DCCT) inputs, use a **Single-Point Calibration** to confirm that zero volts (or millivolts) is reading as exactly zero volts on the ADIO module. For a temperature input, you may want to confirm that 3.0V is being read accurately.

Table 24-1 ADIO module input calibration modes (continued)

Mode	Description
	A **Single-Point Calibration** only changes the **Calibration Offset** value. It never changes the **Calibration Slope** value.
Two-Point Calibration	Use the **Two-Point Calibration** to update **Calibration Offset** and **Calibration Slope** based on two measured values (a low-point and a high-point). For a **Two-Point Calibration**, connect the ADIO module input to a stable voltage source that accurately generate values across the full range of the input sensor. Do not use a noisy or fluctuating input for calibration. Also, do not to try to generate an accurate millivolt signal on a device not intended to work in such a low range.

You can perform calibration from the LCD panel as well. You must sign in with administrator privileges to see the **Factory Calibration** commands on the LCD panel.

24.1.3.1. Voltage input calibration

📢 *Notice: Calibration is considered an expert user task. Users must be logged in with administrator privileges to perform this calibration.*

To calibrate an input correctly, you need hardware to generate and measure the input signal accurately.

This topic covers how to do a **Single-Point Calibration**. If you need to do a **Slope/Offset Calibration** or a **Two-Point Calibration**, a factory calibration document should be written showing, step-by-step, how both the hardware and the software need to be used to perform an accurate calibration.

To perform a single-point calibration on a voltage input:

1. Go to **Modules**, in the **CAN Modules** table select an ADIO module and select the **Go To** button to view the **Voltage Inputs** table.
2. Select the **Go To** button of a **Voltage Input** to view its individual menu.
3. Select the **Factory Calibration** button to launch the wizard.
4. At the **Select Type of Calibration** step, select **Single-Point Calibration**.
5. With a digital voltmeter, measure the voltage across the input.
6. At the **Single-Point Calibration** step, enter the reading on the voltmeter into the **Measured Value** field.
7. Select **Next** to go to **Apply Calibration**. The wizard displays the old slope and offset and the new slope and offset. Before accepting these values, ensure that the slope is very close to 1.0 and the offset is no more than a few volts from 0.0.
8. Select **Next** to send the new offset to the ADIO module.
9. Verify that the newly **Calibrated Value** matches the digital voltmeter reading. Select **Done** to close the Wizard.

24.1.3.2. Shunt input calibration

📢 **Notice:** *Calibration is considered an expert user task. Users must be logged in with administrator privileges to perform this calibration.*

To calibrate an input correctly, you need hardware to generate and measure the input signal accurately.

This topic covers how to do a **Single-Point Calibration**. If you need to do a **Slope/Offset Calibration** or a **Two-Point Calibration**, a factory calibration document should be written showing, step-by-step, how both the hardware and the software need to be used to perform an accurate calibration.

To perform a single-point calibration on a shunt input:

1. Go to **Modules**, in the **CAN Modules** table select an ADIO module and select the **Go To** button to view the **Shunt Inputs** table.
2. Select the **Go To** button of a **Shunt Input** to view its individual menu.
3. Select the **Factory Calibration** button to launch the wizard.
4. At the **Select Type of Calibration** step, select **Single-Point Calibration**.
5. With a digital voltmeter, measure the voltage across the input.
6. At the **Single-Point Calibration** step, enter the reading on the voltmeter into the **Measured Value** field.
7. Select **Next** to go to **Apply Calibration**. The wizard displays the old slope and offset and the new slope and offset. Before accepting these values, ensure that the slope is very close to 1.0 and the offset is no more than a few volts from 0.0.
8. Select **Next** to send the new offset to the ADIO module.
9. Verify that the newly **Calibrated Value** matches the digital voltmeter reading. Select **Done** to close the wizard.

24.1.3.3. Current transducer module input calibration

📢 **Notice:** *Calibration is considered an expert user task. Users must be logged in with administrator privileges to perform this calibration.*

To calibrate an input correctly, you need hardware to generate and measure the input signal accurately.

This topic covers how to do a **Single-Point Calibration**. If you need to do a **Slope/Offset Calibration** or a **Two-Point Calibration**, a factory calibration document should be written showing, step-by-step, how both the hardware and the software need to be used to perform an accurate calibration.

To perform a single-point calibration on a current transducer module input:

1. Go to **Modules**, in the **CAN Modules** table select an ADIO module and select the **Go To** button to view the **Current Transducer (CT) Inputs** table.
2. Select the **Go To** button of a **Current Transducer (CT) Input** to view its individual menu.

3. Select the **Factory Calibration** command to launch the wizard.

4. At the **Select Type of Calibration** step, select **Single-Point Calibration**.

5. With a digital voltmeter, measure the voltage across the input.

6. At the **Single-Point Calibration** step, enter the reading on the voltmeter into the **Measured Value** field.

7. Select **Next** to go to **Apply Calibration**. The wizard displays the old slope and offset and the new slope and offset. Before accepting these values, ensure that the slope is very close to 1.0 and the offset is no more than a few volts from 0.0.

8. Select **Next** to send the new offset to the ADIO module.

9. Verify that the newly **Calibrated Value** matches the digital voltmeter reading. Select **Done** to exit the wizard.

24.1.3.4. Temperature input calibration

📢 *Notice: Calibration is considered an expert user task. Users must be logged in with administrator privileges to perform this calibration.*

To calibrate an input correctly, you need hardware to generate and measure the input signal accurately.

This topic covers how to do a **Single-Point Calibration**. If you need to do a **Slope/Offset Calibration** or a **Two-Point Calibration**, a factory calibration document should be written showing, step-by-step, how both the hardware and the software need to be used to perform an accurate calibration.

To perform a single-point calibration on a temperature input:

1. Go to **Modules**, in the **CAN Modules** table select an ADIO module and select the **Go To** button to view the **Temperature Inputs** table.

2. Select the **Go To** button of a **Temperature Input** to view its individual menu.

3. Select the **Factory Calibration** button to launch the wizard.

4. At the **Select Type of Calibration** step, select **Single-Point Calibration**.

5. With a digital voltmeter, measure the voltage across the input.

6. At the **Single-Point Calibration** step, enter the reading on the voltmeter into the **Measured Value** field.

7. Select **Next** to go to **Apply Calibration**. The wizard displays the old slope and offset and the new slope and offset. Before accepting these values, ensure that the slope is very close to 1.0 and the offset is no more than a few volts from 0.0.

8. Select **Next** to send the new offset to the ADIO module.

9. Verify that the new **Calibrated Value** matches the digital voltmeter reading. Select **Done** to exit the wizard.

24.1.4. Calibrate shunts, current transducer modules, and temperature probes

This section covers the calibration of shunts, current transducer modules, and temperature probes that are connected to ADIO module inputs.

24.1.4.1. Shunt calibration

Notice: *Calibration is considered an expert user task.*

To calibrate a shunt correctly, you need hardware to generate and measure the input signal accurately.

This topic covers how to do a **Single-Point Calibration**. If you need to do a **Slope/Offset Calibration** or a **Two-Point Calibration**, a factory calibration document should be written showing, step-by-step, how both the hardware and the software need to be used to perform an accurate calibration.

A shunt **Current** reading is calculated as follows:

$$Current\,(A) \;=\; \left(\frac{ADIO\ Current\ Input\ Reading\,(mV)}{Range\ in\ Millivolts\,(mV)} \times Range\ in\ Amps\,(A)\right) + Offset\,(A)$$

To perform a single-point calibration on a shunt:

1. Go to **Systems > DC System > Inventory > Shunts** and select the **Go To** button to select one of the available shunts.
2. Set the **Offset** to zero.
3. Measure the actual current flowing in amps. It may be easiest to do this measurement at 0.0 amps.
4. Record the measured value: _____ A.
5. Subtract the displayed value: _____ A, from the web interface.
6. Calculate the new offset: _____ A. Offset = measured value - displayed value.
7. Select the **Edit** button of the **Offset** field. Enter the new offset in amps and select **Save**.
8. Verify that the **Offset** field was updated, and that the new displayed value matches the measured value.

24.1.4.2. Current transducer module calibration

Notice: *Calibration is considered an expert user task.*

To calibrate a current transducer module correctly, you need hardware to generate and measure the input signal accurately.

This topic covers how to do a **Single-Point Calibration**. If you need to do a **Slope/Offset Calibration** or a **Two-Point Calibration**, a factory calibration document should be written showing, step-by-step, how both the hardware and the software need to be used to perform an accurate calibration.

A current transducer module **Current** reading is calculated as follows:

$$Current\ (A)\ =\ \left(\frac{ADIO\ CT\ Input\ Reading\ (V)}{CT\ Range\ in\ Volts\ (V)}\ \times\ CT\ Range\ in\ Amps\ (A)\right)\ +\ CT\ Offset\ (A)$$

To perform a single-point calibration on a current transducer module:

1. Go to **Systems > Inventory > Current Transducers** and select one of the available current transducer modules by selecting the **Go To** button.

2. Set the **Offset** to zero.

3. Measure the actual current flowing in amps. It may be easiest to do this measurement at 0.0 amps.

4. Record the measured value: _____ A.

5. Subtract the displayed value: _____ A, from the web interface.

6. Calculate the new offset: _____ A. Offset = measured value - displayed value

7. Select the **Edit** button of the **Offset** field. Enter the new offset in amps and select **Save**.

8. Verify that the **Offset** field was updated, and that the new displayed value matches the measured value.

24.1.4.3. Temperature probe calibration

📢 ***Notice:*** *Calibration is considered an expert user task.*

To calibrate a temperature probe correctly, you need hardware to generate and measure the input signal accurately.

This topic covers how to do a **Single-Point Calibration**. If you need to do a **Slope/Offset Calibration** or a **Two-Point Calibration**, a factory calibration document should be written showing, step-by-step, how both the hardware and the software need to be used to perform an accurate calibration.

A temperature probe **Temperature** default calculation is as follows:

$$Temperature\ (°C) = (Voltage - 2.73) \times 100$$
$$Temperature\ (°F) = (Voltage - 2.73) \times 180\ +\ 32$$

To perform a single-point calibration on a temperature probe:

1. Go to **Modules**, in the **CAN Modules** table select an ADIO module and select the **Go To** button to view the available **Temperature Inputs**.

2. Form the **Temperature Inputs** table, choose from the available temperature inputs and select the **Go To** button

3. Set the **Calculation Offset** to zero.

   Do not confuse **Calibration Offset** with **Calculation Offset**. You should only read and change values in the table labeled **Temperature Probe**.

   Setting the offset to zero will make the temperature reading very high and may cause temperature compensation and other temperature alarms to activate.

4. Measure the actual temperature at the probe.

5. Record the measured value: _____ °F or °C.

6. Subtract the displayed value: _____ °F or °C, from the web interface.

7. Calculate the new offset: _____ °F or °C. Calculation offset = measured value - displayed value

8. Select the **Edit** button of the **Offset** field. Enter the new offset in degrees and select **Save**.

9. Verify that the **Offset** field was updated, and that the new displayed value matches the measured value.

24.1.5. Test relays

To test relays:

1. Go to **Modules** and select the **Go To** button of the device to be tested.

2. In the **Relays** table, select the **Test Relay** button of the selected relay.

3. If the relay is in and energized state it will become de-energized for one minute. If it is de-energized, it will be energized during the test. To end the test early, select the **Stop Test** button.

4. Relays can also be tested by going to the individual relay menu.

24.1.6. Test comms lost action

To test the comms lost action feature:

1. Go to **Modules** and select the **Go To** button of the device to be tested.

2. In the **Relays** table, select the **Go To** button of the relay to be configured for the **Comms Lost Action**.

3. Ensure the relay's normal position is set to **Energized**.

4. Once configured, go to **Controller > Communication > CAN** and disable each enabled CAN bus.

5. Wait five minutes.

6. After five minutes the relay configured as a comms lost relay will de-energize. To confirm, verify the relay state using a digital multimeter. Re-enable the CAN buses and the relay will energize.

> 📢 *Notice: The **Comms Lost Action** is only available on system controller software version 6.10 and later, and firmware in the CAN module must have a version that supports this feature.*

24.1.7. Enable temperature sensor failure alarms

The **Temperature Sensor Failure** alarm activates if the voltage on the temperature input is below or above the operating range of the input. If the sensor is unplugged, the voltage will be zero and the alarm activates. If you accidentally apply bus voltage to the temperature input, the alarm activates.

To enable temperature sensor alarms:

1. Go to **Modules** and select the **Go To** button on the device with **Temperature Sensors**.

2. In the **Alarms** table there is one alarm for each temperature sensor on the ADIO module. Select the **Go To** button to enable or disable the alarm for the required sensor.

3. Assign a relay or any other parameters as required.

24.1.8. Ground fault detection

Ground fault detection is available on the Cordex® HP HV-ADIO high voltage smart peripheral.

24.1.8.1. Cordex® HP HV-ADIO Smart Peripheral ground fault detection

The Cordex® HP HV-ADIO high voltage smart peripheral has a ground fault detection (GFD) feature, under the **Modules > HV-ADIO** menu in the **Configuration** table, which can be enabled or disabled. It is disabled by default.

When disabled, the two related values (Ground Fault Resistance and Ground Fault Current) read **Unknown**, and no related alarms are triggered. These values are found under the **Ground Fault Detection** table.

When enabled, the resistance and current across the ground fault circuit is reported under the **Ground Fault Detection** table. There are two alarms related to the ground fault detection located in the **Alarms** table of the smart peripheral.

- **Ground Fault Resistance Low** alarm will be raised if the resistance is lower than the configurable threshold, which is 20000 ohms by default.

- **Ground Fault Current High** alarm will be raised if the current is higher than the configurable threshold, which is 1 mA by default.

24.2. Module firmware upgrades

This section covers how to upgrade the firmware on CAN devices attached to the system controller.

24.2.1. Module firmware upgrade

To upgrade the firmware on a module, go to the **Modules** menu, then go to the **Firmware Upgrade** table from either the web interface or the LCD panel.

24.2.2. Upload a firmware file

Upload a firmware file from the LCD panel

From the LCD panel you can either choose a file uploaded from a USB drive or one from the local files folder. The **Local Files** menu contains a list of files previously uploaded via the web interface. Go to **Menu > Modules > Firmware Upgrade > File**.

Upload a firmware file from the web interface

To upgrade a module over the web interface the firmware file must be uploaded to the system controller first.

1. Go to the **Modules** menu. In the **Firmware Files** table, select the **Upload Firmware File** button.

   An **Upload Firmware File** dialog box displays.

2. Select **Select File** and choose the file to upload then select the **Upload** button.

Once the file is uploaded, the dialog closes. The uploaded file is now visible in the **Firmware Files** table and available to upgrade a module.

24.2.3. Select the file to upgrade

In the **Firmware Upgrade** table, there are buttons at the top to start or stop the firmware upgrade. These buttons are not active until a firmware file is selected. The first three rows of the **Firmware Upgrade** table display information about the selected upgrade file.

The rest of the table rows show information about the last upgrade that occurred.

The **File Info** field is informational, it displays information about how to proceed with an upgrade. Before a file is selected it displays the message **Select a Firmware (ACAN, APLC, AFOR, ASEC) File**.

The **File** field is used to select a file for the upgrade. From the web, the upgrade file must be chosen from those previously uploaded to the system controller. On the LCD panel, you can select either from the list of previously uploaded files (local files), or from a USB drive.

Once a file is selected, the first three rows of the table are updated with new status. If the file chosen is not a valid upgrade file or if there are no modules to which that file can be applied, the number of **Modules Compatible With File** will be 0 and the **File Info** field will display **Select a Different Firmware File**.

If the file is valid and applicable to your modules the **Modules Compatible With File** field will display how many devices need to be upgraded and the **File Info** field will display **Ready to Start**. If the number of **Modules Compatible With File** is smaller that you expected or zero, it may be because some or all of the modules have already been upgraded to this version. There is no need reload a module with the same version of firmware. Alternatively, if any modules are Comms Lost or in other states which are incompatible with upgrade, they will not be included in this count.

If the firmware is corrupt, the module will detect it and go into a **Waiting for Software** state.

If an upgrade has been completed since the last restart, the bottom rows of the table will still contain information about that last upgrade until the **Start Firmware Upgrade** button is selected.

24.2.4. Upgrade the module

Once a valid firmware file is uploaded and the **File Info** field displays **Ready to Start**, select **Start Firmware Upgrade**.

As the upgrade progresses, the **Firmware Upgrade** table updates with information about the upgrade. The **Last Upgrade Percent Complete** counts up from 0 percent, and then **Last Upgrade Remaining Modules** counts down (if there is more than one module being upgraded).

If there is more than one module being upgraded, the percent complete will show the total (100 percent will be reached once all modules are upgraded) instead of a per-module completion.

The firmware upgrade can be stopped if necessary. If you select **Stop Firmware Upgrade** button the system controller finishes upgrading the current module so as not to leave it in a non-functional state. If multiple modules are queued, the next module will not be upgraded.

If the upgrade fails on a module, the system controller stops the upgrade and will not attempt to continue on any further modules that have been queued.

Once the upgrade is finished, the **Last Upgrade Percent Complete** displays **100%**, and the **Last Upgrade Status** displays **Succeeded**.

25. Using custom views, data, timers, counters, scheduler, and custom actions

This section covers the following:

- Custom views
- Custom data
- Timers
- Counters
- Scheduler
- Custom actions

25.1. Custom views

The **Custom Views** feature allows you to create and customize a unique view. For example, a **Custom View** may be created to make a new dashboard view with its own unique components.

Components for a new **Dashboard View** can include:

- A pre-existing table from the system controller or connected systems.
- A new custom table with status and configuration values.
- A new custom table with inventory values.

Components for a new **Custom Data View** can include:

- A new custom table with inventory values.

25.1.1. Create custom views

To create a custom dashboard view:

1. Go to **Controller > Settings > User Interface > Custom Views** table.
2. In the **Custom Views** tab select either the **Add Custom Dashboard View** or **Add Custom Data View** button.
3. Select the **Go To** button to open the **Configuration** and **Components** tables.
4. In the **Configuration** table, give your new *Custom View* a name and description.

25.1.2. Add components in the custom view

The **Components** table has three buttons: **Add Existing Table**, **Add Custom Table with Status and Configuration**, and **Add Custom Table with Inventory**.

> 📢 **Notice:** *Depending on the type of view you choose, not all the component options will be available.*

The **Add Existing Table** option allows you to add tables from the system controller or its connected systems.

The **Add Custom Table with Status and Configuration** or **Add Custom Table with Inventory** will add a new row entry in the **Components** table.

> 📢 **Notice:** *Components will not display in the order that they were added. Tables will display in the following order: Existing Tables, Custom Tables with Status and Configuration, and Custom Tables with Inventory.*

25.1.2.1. Add an existing table to custom view

The **Add Existing Table** wizard allows a user to add tables from the system controller or its connected systems. These tables are then displayed in the custom view.

To add an existing table to the custom view:

1. Select the **Add Existing Table** button within the **Components** table to launch the wizard.
2. In the **Select Table Source** page, select the source of the table. Select **Next**.
3. In the **Select Tables** page, select the tables that will be added into the components table for the custom view. Select **Next**.

    > 📢 **Notice:** *Not all tables will be visible. If values from levels lower than what is visible are required, it is recommended to create a **Custom Table** component.*

4. Review your selections. Select **Next**.
5. The **Results** page notify you that your components have been successfully added. Select **Done**.

25.1.2.2. Add a custom table with status and configuration

A **Custom Table with Status and Configuration** allows a user to create a table which displays status or configuration values from the system controller.

To add status and configuration values to a table:

1. Select the **Add Custom Table with Status and Configuration** button within the **Components** table to create a custom table.
2. Select the **Go To** button on the newly created table.
3. Select the **Configure Custom Tables** button to launch the configuration wizard.
4. Follow the **Configure Custom Table** wizard until complete.

25.1.2.3. Add a custom table with inventory

A **Custom Table with Inventory** allows a user to create a table which displays inventory values from the system controller. This table allows for smaller groupings of the same type of item. For example, a user may want to only view 10 custom data items from a list of over 100.

To add inventory values to a table:

1. Select the **Add Custom Table with Inventory** button within the **Components** table to create a custom table.
2. Select the **Go To** button on the newly created table.
3. Select the **Configure Custom Tables** button to launch the configuration wizard.
4. Follow the **Configure Custom Table** wizard until complete.

> 📢 **Notice:** *Only the same type of inventory can be added to this custom table. For example, delay timers and interval timers can be added into this table, but counters or custom data cannot.*

25.1.3. Access and configure the default custom dashboard view

Access a custom dashboard view

All **Custom Dashboard Views** can be accessed via the navigation bar on the web interface. **Custom Dashboard Views** can be accessed and selected in under the **Dashboard** dropdown menu.

Configure a default custom dashboard view

A user may configure one dashboard as the default dashboard. The selected dashboard will be displayed when the **Dashboard** menu button is selected.

The default dashboard selection can be made under **Controller > Settings > User Interface**. In the **Default Dashboard** you can select the value.

25.1.4. Access the custom data view

Once you have created custom data you may select to view only this **Custom Data View**.

To select your custom data view:

1. Go to **Controller > Programmability > Custom Data**.
2. In the top right-hand corner you will find a dropdown menu. Choose your newly created custom data view.
3. At any point you may choose **All Custom Data** to return to the default display settings.

25.1.5. Remove a table from the custom view

Your custom view may reference a table from a system that has been deleted.

To remove a table from the custom view:

1. In the **Custom View**, make note of the name of the table from the deleted system.
2. Go to **Controller > Settings > User Interface**. In the **Custom Views** table navigate into the **Custom View** associated with the issue.
3. In the **Components** table, locate the table name from the deleted system.
4. In the **Actions** column of the **Components** table, select **Remove**.
Going back to the **Custom View**, the table will no longer be visible.

25.1.6. Add an existing table to the custom view

Your custom view may reference a table from a system that has been deleted.

To re-add an existing table:

1. Re-instate the previously deleted system to the system controller.
2. Go to **Controller > Settings > User Interface**. In the **Custom Views** table, navigate into the **Custom View**.
3. Select the **Go To** button.
4. In the **Components** table, launch the **Add Existing Table** wizard to add the required table that was unlinked or missing.

25.2. Custom data

The **Custom Data** feature allows you to create complex expressions that can be used to:

- Provide flexible ways to monitor and control a system
- Create custom conditions for user alarms and relay control

Custom data can be used to calculate values that represent voltages, digital inputs, or currents in the system.

For example, in a system that has multiple load shunts, custom data can be used to sum all the shunt currents, and then the custom data result can be mapped to a single-load inventory item in a DC system. Custom data can also be used as the input condition for a user alarm that allows for custom control of relay outputs on ADIO modules.

25.2.1. Configure custom data

Custom data has four configuration fields:

- **Name**
- **Description**
- **Equation**
- **Numeric Units and Precision**

There are also fields to help troubleshoot and fix equations that are not parsing correctly: **Custom Data Status**, **Error Position**, **Error Token** and **Expected Token**. These fields provide hints to potential equation parsing errors.

The result of the parsed equation can be displayed in three formats, as a numeric, Boolean (true or false), or as text.

- The **Result as Numeric** may show a number with up to six decimal places, if the value is numeric. Results of a Boolean expression will show the conventional representation of *True* as 1.000000 and *False* as 0.000000. The number of decimal places and units shown can be set using the **Numeric Units and Precision**.

- The **Result as Boolean** expresses the parsed equation as true or false. Any value greater than 0.000001 or less than -0.000001 is true.

- The **Result as Text** uses the entries in the **Text Mapping** table to map the result as numeric or the result as Boolean to meaningful text.

The custom data **Equation** field is constructed from a combination of operators, numbers, variables and functions. **Counters** and **Timers** are also supported and are described in a separate section.

Operators

Custom data supports the following arithmetic and logical operations:

- Add "+"
- Subtract "–"
- Divide "/"
- Multiply "*"
- AND "&"
- OR "|"
- Less than "<"
- Greater than ">"
- Equal "="
- Parenthesis "(" and ")"
- Unary minus "-"

Number formats

Custom data supports the following formats for numbers:

- Decimal: "10.33" or "– 4.7" or "0.45" or ".45"
- Integer: "10" or "–4"

Variables

There are two kinds of variables: numeric and state.

Numeric variables can be used for:

- ADIO module voltage, shunt, and temperature

  📣 **Notice:** *When using any temperature value as a variable, the value shown in the* **Variables** *table may appear in units of Celsius or Fahrenheit depending on the selected language. However, when the variable is used in the custom data equation it will always be evaluated using the internal representation in units of Celsius. If the calculations must be done in units of Fahrenheit it is necessary to explicitly convert the value in the equation itself. For example, if the variable is named "T" and is showing as "71.3°F", then the equation should use "(T×1.8+32)" instead of just "T". This will convert the internal Celsius value of "21.8" to the Fahrenheit value.*

- System values including **Total Load Current**, **Time Remaining in Equalize**

  📣 **Notice:** *Some time spans such as* **Time Remaining in Equalize** *may appear in the format "d h m s" rather than in decimal form. In this case, the time unit used to evaluate the custom data equation will be shown in the selection panel when choosing the numeric variable's* **Field** *source; the unit will be shown in parenthesis. For example, if the variable value shows as "1h 10m (m)", then the equation will be calculated using 70 minutes.*

- System inventory values including **Load Breaker/Fuse**, **Countdown to LVD**, **Load Disconnect**.
- Rectifier module group values including **Estimated AC Mains Voltage**, **Total Output Power**, **Number of Failed Rectifiers**.
- Converter module group values including **Total Installed Capacity**, **Number of Acquired Converters**.
- Counter and timer values including, **Counter Output**, **Delay Time Remaining**.
- Other **Custom Data**.

State variables can be used for:

- Alarms states (active, disabled, acknowledged, ...)

- Battery modes (charging, discharging, conditioning, ...)

- Charging states (idle, active, ...)

- Breaker states (open, closed)

- Digital inputs (active, inactive)

- Disconnect states (active, inhibited, pending, inactive, ...)

A state variable compares the live value of a state field to up to four of its possible values. The possible values are called **True If** values since the state variable will evaluate to **True** if the state field matches any of the possible values.

> **Notice:** *State variables will always evaluate to **True** or **False**. A state variable should always be used with a value that represents a state. Numeric values should not be used when creating a state variable.*

Tips on using variables:

- The keywords **True** and **False** can also be used in an equation. They are treated as built-in variables that represent the value of one and zero.

- Variables are created within the context of a single unique instance of **Custom Data**. A variable created for use in a specific **Custom Data** equation cannot be reused in another equation.

- Variable names must adhere to a specific format. The name must start with a letter, followed by letters, digits or underscores. Some valid names are T1, T_1, Vbat, BatteryCurrent, and Load_2_Current.

- Short but meaningful names offer the best readability when used in an equation.

Once a **Custom Data** has been created it can be used throughout the system controller and systems as input to various configurations.

For example, in a **User Alarm** all **Custom Data** equations are displayed in the selection list of the **Source** field. You can use this **Custom Data** to alarm and control relays based on any custom parameters required.

Another example is configuration for a load. The **Load Current Source** field displays all **Custom Data** so you can sum multiple currents to represent the load current.

Generally, any **Source** field that allows you select inputs will also provide all **Custom Data** as an option.

Functions

There are three supported functions: abs(), sqrt(), power(). The abs() and sqrt() accept a single input parameter, and the power() accepts two parameters. For the power() function, the first parameter is the base and the second parameter is the exponent. For example, power(2,3) would evaluate to 8.

25.2.1.1. Showing the result as text

Custom data equations normally represent a numerical or Boolean (true or false) value. At times though, it may be convenient to display those values on the dashboard as text; this can be especially useful if the custom data represents a system state. For example, an air conditioner unit may be *Off*, *Cooling*, or *Error*.

The **Result as Text** entry in the **Configuration** table uses the entries in the **Text Mapping** table to map the result as numeric or the result as Boolean to meaningful text.

On the details page of a row in the text mapping table, there are four entries:

- **Name**: This is the name of the mapped text. It will appear as the custom data's **Result as Text** if it is the highest priority mapped text that evaluates to true.

- **Logic**: The logical condition used to test if this text mapping is true. If the logic is set to equal-to, greater-than or less-than, it is tested against the **Result as Numeric**. If the logic is set to is-true or is-false, it is tested against the **Result as Boolean**.

- **Limit**: The value used to test against an equal-to, greater-than or less-than logic condition. For equal-to logic, the **Result as Numeric** must be within ± 0.00001 of the limit to evaluate to true. The **Limit** has no effect for is-true or is-false logic. The number of decimal places and units shown can be set using the custom data's **Numeric Units and Precision** entry.

- **Priority**: This is the evaluation priority of the mapped text. The name of the highest priority mapped text that evaluates to true is assigned to the **Result as Text**; priority 1 is highest, 6 is lowest.

The following image shows an example of how the text mapping table might be configured for a custom data representing an air conditioner unit's state. In this example, the **Result as Text** will show as **Off** for any **Result as Numeric** value less than 0.5, and will show as **Cooling** when the **Result as Numeric** is equal to 1. Note that there is no mapped text for numeric values between 0.5 and 1; meaning within this range, the **Result as Text** will show as unknown, "- - -". Also note, that if two mapped texts are true at the same time, the **Result as Text** will display only the mapped text name with the higher **Priority**; priority 1 is highest, 6 is lowest.

Figure 25-1 Text mapping for a custom data representing air conditioning unit states

Once the text mapping is complete for the given custom data, it can be selected as one of the dashboard values for a system (configured from the **User Interface Preferences** menu) for quick viewing on the system controller LCD panel dashboard, or the web interface system summary.

25.2.2. Create custom data

Creating custom data can be challenging, depending on the complexity of the equation required. The following section describes a basic work flow that applies to all custom data, followed by a more detailed work flow for how to create an equation with multiple variables.

Finally, there are two examples provided: one for summing shunt readings for a load, and a second for creating a user alarm to detect if an air conditioning unit in a room is set too low.

25.2.3. Create custom data - basic workflow

The basic workflow for custom data is the same, regardless of what kind custom data is being created.

To create new custom data here is the basic work flow:

1. Create the new **Custom Data**.
2. Configure a **Name** and **Description**.
3. Create the variables.
4. Enter the equation.
5. Verify that the equation is valid.
6. Test the equation.

25.2.4. Create custom data - detailed workflow

The following steps describe a general, detailed workflow for creating custom data.

1. Go to **Controller > Programmability > Custom Data**. This table displays all the custom data available in the system controller.
2. Select the **Add Custom Data** button. A new custom data line displays. Select the **Go To** button.
3. There are three tables: **Configuration**, **Variables**, and **Text Mapping**. The **Variables** table shows all the variables that have been created for this custom data. Initially it will be empty. The **Text Mapping** table is used to map numeric and Boolean (true or false) results into the **Result as Text** entry in the **Configuration** table.
4. In the **Configuration** table, enter a name and description for your custom data. The description is optional but a name is highly recommended.
5. In the **Variables** table, select the **Add Numeric Variable** or **Add State Variable** button depending on the type of variable to be used. A new variable line will display, select the **Go To** button.
6. In the new variable table, enter: **Name**, and optionally a **Description**. Give the variable a short, but meaningful name (with no spaces) because this is the name used in the equation.
7. Select the **Field Edit** button, and a selector screen displays. To use the selector, select an item from the left-most column. A new set of selections displays to the right. Select until you have the value needed. Select **Save**.

Once a field is selected, the bottom area of the screen displays the name, value and additional information within the **Help** text.

8. If this is a state variable, also select up to four "True If" values.

9. Repeat steps 5 through 8 to create as many variables as required.

10. After all variables have been created, select the **Edit** button for the **Equation** field on the **Configuration** table. Enter the desired equation.

11. Verify that the **Custom Data Status** field shows **Valid**. If it does not, use the information provided to find and fix the error. The **Error Position**, **Error Token** and **Expected Token** may provide helpful information.

If possible, test the equation to ensure it is providing the expected value.

25.2.5. Custom data examples

The following two examples illustrate the process of using **Custom Data** for summing load shunt currents and detecting if interior air conditioning unit is set too low and creating a **User Alarm**.

25.2.6. Custom data - summing load shunts

The following example shows how to create custom data that sums up three shunt currents, and maps the result to the system load inventory item.

1. Use the steps in the detailed work flow to create custom data which sums up three variables to compute a value for the total load current in a system. When selecting a current reading, it must be selected from a shunt in the system, not at the ADIO module input.

2. To set up the **Load** to use this **Custom Data**, go to **Systems > DC System > Inventory > Loads**, then select the **Go To** button for the **Load** that will represent the sum of the three shunts.

3. In the **Configuration** table, select the **Edit** button to edit the **Load Current Source** entry, and select the custom data's **Result as Numeric**.

4. When configured, the **Load Current Source** will use the custom data created in step 1 which will display the summed current of the three shunts on one load.

The load current now correctly shows the sum of the three shunts.

25.2.7. Custom data - AC cooling too low user alarm

The following example shows how to create a **User Alarm** that is active if it appears that the air conditioning unit in the room is set too low.

1. Use the steps in the detailed work flow to create custom data that has an equation which evaluates to "true" if the outdoor temperature is greater than 77°F (25°C), if the outdoor temperature is greater than the indoor temperature, and if the difference is greater than 41°F (5°C).

2. To set up a **User Alarm** to use this **Custom Data**, go to **Controller > Programmability > User Alarms.**

3. Select **Add Digital User Alarm**, and select the **Go To** button to edit the alarm details.

4. Configure the alarm name, relay and any other information required.

5. In the **User Alarm** table, select the **Edit** button on the **Source** line, and then select the **Custom Data** created to detect if air conditioning unit is set too low.

The **User Alarm** activates if the indoor temperature is too low as compared to the outdoor temperature.

25.3. Using timers

Using the **Timers** feature you create two types of timers: a delay timer or an interval timer.

- The **Delay Timer** can be used with **Custom Data** to produce a programmable delay when a certain event happens.

- The **Interval Timer** can be used with **Custom data** to measure the time between two events.

> **Notice:** *An event is defined as a Boolean expression that transitions from false to true or not unknown to true. Since some logical conditions can evaluate to unknown, for example when data cannot be retrieved from a CAN module, it is important to construct events so that they always transition from false to true.*

For example, a **Delay Timer** might be configured to delay the start of a generator once the voltage falls below a certain value. An **Interval Timer** might be used to measure how many generator restarts occur in a 24-hour period.

25.3.1. Configure the delay timer

A **Delay Timer** has eight configuration fields:

- **Name:** The editable name of the item.

- **Description:** Additional information to describe the item.

- **Delay:** The amount of time set for the timer delay. For custom data calculations this value is measured in seconds. For example, a value shown as '1m 3s' will be considered as 63 seconds in the equation.

- **Auto Reset:** When enabled, the timer is stopped and the output is set to **False**.

- **Output True When:** Determines when the timer output is true - **When Running** or **When Delay Over**.

- **Retrigger:** When enabled, the timer can be continuously re-triggered when the **Trigger** goes from false to true before the delay time elapses. When the timer is re-triggered, the **Delay Time Remaining** starts counting down again from the configured delay time and the output will stay true.

- **Trigger Source:** The field that represents the **Trigger** value. It is usually set to the result of a custom data.

- **Reset Source:** An optional field that represents the **Reset** value. It is usually set to the result of a custom data.

There are also fields to describe the state of the **Delay Timer**:

- **Output:** This value will be true when the timer is on and the delay is active.

- **Delay Time Remaining:** The time remaining in the delay. For custom data calculations this value is measured in seconds. For example, a value shown as '1m 3s' will be considered as 63 seconds in the equation.

- **Trigger:** The value of the timer trigger. When this value goes from false to true, the delay timer starts and the output goes true as long as the **Reset** value is false.

- **Reset:** The value of the timer reset. When this value is true, the timer output will be false.

The **Reinitialize Timer** button can be used if the timer configuration has been changed while the timer is active.

📢 *Notice: It is also possible to test the timer or force it into a desired state using the **Force Timer to Start** and **Force Timer to End** buttons, even if **Start Event** has not been configured.*

- **Force Timer to Start** simulates the **Start Event** going from false to true.
- **Force Timer to End** sets the **Delay Time Remaining** going to zero and the timer going into its terminal state.

Delay timer operation

The **Delay Timer** operates as follows:

- When the **Reset** is true, or if **Auto Reset** is enabled and the timer trigger source is false, the timer output is always false and the **Delay Time Remaining** is set to the initial value.

- When **Output True When** value is **When Running** and the **Trigger** input goes from false to true, the **Output** goes true and the **Delay Time Remaining** starts counting down from the delay value.

- When **Output True When** value is **When Delay Over** and the **Trigger** input goes from false to true, the **Delay Time Remaining** begins counting down and when it reaches 0, the **Output** goes true.

- If the timer is actively counting down seconds, and the **Output** is true when the **Trigger** input goes from false to true, the timer starts counting down seconds starting from the configured delay time for as long as the **Retrigger** is enabled.

- When the **Reinitialize Button** is selected, the timer **Output** will be set false and the **Delay Time Remaining** is set to the initial value.

25.3.2. Configure the interval timer

An interval timer has four configuration fields:

- **Name:** The editable name for this item.

- **Description:** Additional information to describe the item.

- **Start Event Source:** The field that represents the timer **Start Event**. It is usually set to the result of a custom data.

- **Stop Event Source:** The field that represents the timer **Stop Event**. It is usually set to the result of a custom data.

There are also fields to describe the state of the **Interval Timer**:

- **Output:** The output time of the timer. For custom data calculations this value is measured in seconds. For example, a value shown as '1m 3s' will be considered as 63 seconds in the equation.

- **Start Event:** The present value of the **Start Event** field. It will evaluate to true or false.

- **Stop Event:** The present value of the **Stop Event** field. It will evaluate to true or false.

The **Reinitialize Timer** button can be used if the timer configuration has been changed while the timer is active.

📢 *Notice: It is also possible to test the timer or force it into a desired state using the **Force Timer to Start** and **Force Timer to End** buttons even if **Start Event** and **Stop Event** have not been configured.*

- **Force Timer to Start** simulates the **Start Event** going from false to true.
- **Force Timer to End** simulates the **Stop Event** going from false to true.

Interval timer operation

The interval timer operates as follows:

- When **Start Event** goes from false to true, the timer **Output** begins incrementing seconds starting from 0.
- When **Stop Event** goes from false to true, the timer **Output** stops incrementing seconds and remains at the value it had at the stop event time.
- If the timer is incrementing seconds, and the **Start Event** goes false to true again, the **Output** starts incrementing seconds starting from 0.
- When the **Reinitialize Button** is pressed, the timer output will be set to '---'.

25.4. Counters

The **Counters** feature makes it possible to create an **Up Counter** or a **Down Counter** that keeps track of events. A counter can be used with **Custom Data** as a variable in an equation.

> *Notice: An event is defined as a Boolean expression that transitions from false to true.*

For example, an **Up Counter** might be configured to increment whenever the battery voltage goes below a certain value to count the number of discharges that have occurred.

25.4.1. Configure the up counter

An **Up Counter** has five configuration fields:

- **Name:** The editable name for this item.
- **Description:** Additional information to describe this item.
- **Input Source:** The field that represents the **Input** value. It is usually set to the result of a custom data.
- **Reset Source:** This optional field represents the **Reset** value. It is usually set to the result of a custom data.
- **Terminal Value:** This is an optional numeric value that is the maximum value.

There are also fields to describe the state of the counter:

- **Input:** The value of the field that was selected for the **Input Source**. It will evaluate to false or true.
- **Output:** The value of the counter.
- **Reset:** The value of the field that was selected for the **Reset Source**. It will evaluate to false or true.
- **Terminal Reached:** This value is true when the counter **Output** is equal to the **Terminal Value**.

The counter also has a **Reinitialize Counter** button. When this button is selected, the counter **Output** is set back to zero.

Up counter operation

The **Up Counter** operates as follows:

- When the **Input** value goes from false to true, the **Output** will increment by one, as long as it is less than the terminal value and the **Reset** value is false.
- When the **Reset** value is true, the **Output** will always be zero.

- The **Terminal Reached** value will be true whenever the **Output** is equal to the **Terminal Value**.
- When the **Reinitialize Counter** button is selected, the counter **Output** is set to zero. This allows for a manual reset of the counter in case the **Reset Source** has not been configured.

25.4.2. Configure the down counter

A **Down Counter** has five configuration fields:

- **Name:** The editable name for this item.
- **Description:** Additional information to describe this item.
- **Input Source:** The field that represents the **Input** value. It is usually set to the result of a custom data.
- **Initialize Source:** This optional field is used to represent the **Initialize** value. It is usually set to the result of a custom data.
- **Initial Value:** The initial value of the **Down Counter**.

There are also some fields to describe the state of the counter:

- **Input:** The value of the field that was selected for the **Input Source**. It will evaluate to false or true.
- **Output:** The value of the counter.
- **Initialize:** The value of the field that was selected for the **Initialize Source**. It will evaluate to false or true.
- **Counter at Zero:** This value is true when the counter **Output** is equal to zero.

The counter also has a **Reinitialize Counter** button. When this button is selected, the counter **Output** is set back to the initial value.

Down counter operation

The down counter operates as follows:

- When the **Input** value goes from false to true, the **Output** will decrement by one, as long as it is greater than zero and the **Initialize** value is false.
- When the **Initialize** value is true, the **Output** will always be equal to the **Initial Value**.
- The **Counter at Zero** value will be true whenever the **Output** is equal to zero.
- When the **Reinitialize Counter** button is selected, the counter **Output** is set to the **Initial Value**. This allows for a manual reset of the counter in case the **Initialize Source** has not been configured.

25.5. Scheduler

The **Scheduler** feature makes it possible to create actions which can occur or recur at specific times or dates. With this feature you can:

- Schedule a single action.
- Schedule a recurring action, hourly, daily, weekly, or monthly.

The **Scheduler** can be used to do the following:

- Equalize the batteries on a DC system.
- Run a battery test on a DC system.
- Put a DC system back into float mode (canceling any equalize or battery test).

📢 **Notice: Equalize** or **Battery Test** *have user configurable termination conditions in their menu settings, therefore it is generally not necessary to schedule an end within Scheduler.*

25.5.1. Configure a recurring action

To create a recurring action:

1. Go to **Controller > Programmability > Scheduler**. A table displays available options.
2. Select the **Create Scheduled Action** button to launch the wizard.
3. Follow the instructions to set up the schedule type, start date and time, recurrence interval, actions, and an end condition if required.

The table displays the new **Scheduled Action**, and when that action will run.

A **Scheduled Action** can also be triggered manually by selecting **Trigger Action Manually**. This is intended to be used for testing during configuration.

25.6. Configure a one-time action

To create a one-time scheduled action:

1. Go to **Controller > Programmability > Scheduler** . A table displays available options.
2. Select the **Create Scheduled Action** button to launch the wizard.
3. Follow the instructions to set up the **One Time**, **Scheduled type**, and the **Action** to be performed.

25.7. Configure scheduled actions

The system controller wizard is used to create and configure scheduled actions, with the exception of the **Action** field. The **Scheduler** has five configuration fields. The first four can only be configured via the wizard.

- **Schedule Type:** One time, hourly, daily, weekly, or monthly.
- **Start Date and Time:** This is the date the event takes place. For recurring events, time is the specific time of day each event runs (with the exception of hourly events).
- **Recurrence Interval:** The time between occurrences (every three hours, every six months, ...).
- **End Type:** Can be set to never end, end by a date, or end after a certain number of occurrences.
- **Action:** The specific action that runs at each interval.

Additional fields describe the state of a scheduled action:

- **Recurrence:** A message describing when and how ofter an action will occur.
- **End:** A message detailing when a recurring actions will end.
- **Scheduled Status:** A message describing either waiting, completed, or missed.
- **Last Run:** The time the last action ran.
- **Next Scheduled Run:** The time the next action will run.
- **Total Executed Runs:** The total number of times this scheduled action has run.

In addition to the information listed in the fields, the event log will contain a message each time an action has run or been missed.

> 📢 *Notice: In situations where the system controller has been off and daylight savings time occurs, the scheduler runs actions up to one-hour after they are scheduled to run. For example, if an action is scheduled for a single occurrence, at 9/1/2017 4:00 pm, and the system controller is off at 3:30 pm and back on at 4:30 pm, then the scheduled action will still run.*

25.8. Scheduled time spans

The **Scheduled Time Span** is used to create a daily time span using custom data, or other features that can take a Boolean input (true or false, yes or no).

Using the **Scheduled Time Span**, you can configure the following:

- A name for easy identification. For example, "Morning Rush Hour".
- A start time and end time.
- A scheduled date range, such as, on all days, on weekdays only, or on weekends only.

Once configured, the **Scheduled Time Span** outputs a Boolean signal called **Within Time Span**. This value is true if the current time is within the time span, and false otherwise.

This Boolean signal can be used in custom data to indicated whether or not the system controller is operating within a given time span. One example is to create a custom data equation that would only be evaluated during certain periods of the day, or conversely, not evaluated during certain periods of the day.

25.9. Custom actions

The **Custom Action** feature makes it possible to change a relay or field to different values based on a condition. With this feature you can:

- Activate or deactivate a relay based on a condition.
- Change the value of a numeric configuration field based on a condition.

- Change the value of a numeric configuration field to the value of a **Custom Data**.

25.9.1. Configure a change relay action

Change Relay actions can be used to control equipment, external to the system, based on specific conditions. For example, in a case where external equipment should be turned on or off based on the state of the system controller (that is, turn a generator system on when AC is lost). In this specific example, the condition would be to check if power has been lost, if yes, then the **Relay To Change** would activate, turning on the generator system. To access this feature go to **Controller > Programmability > Custom Data**.

A **Change Relay Action** has four configuration fields:

- **Name:** The editable name for this item.
- **Description:** Additional information to describe this item.
- **Relay To Change:** The relay that will be changing based on the specified condition.
- **Condition:** A Boolean field that will control the relay.

There are also fields that describe the state of the action:

- **Field Value When Condition True:** What state the relay will be in when **Condition Value** is true.
- **Field Value When Condition False Or ---:** What state the relay will be in when **Condition Value** is false or unknown.
- **Condition Value:** The present value of **Condition**.
- **Field Value:** The present value of **Relay To Change**.

Change relay action operation

The **Change Relay** action operates as follows:

- When the **Condition Value** is false or unknown, the relay will be in its normal state.
- When the **Condition Value** is true, the relay will be in its abnormal state.

25.9.2. Configure a change field to constant action

The **Change Field To Constant Action** feature can be used to change the value of a field based on specific situations. This can be useful to control the state of the system based on external conditions. For

example, when a generator system is on, the system can be set to charge the batteries at a lower rate so that it does not drain the generator system.

To access this feature go to **Controller > Programmability > Custom Data**.

A **Change Field To Constant** action has six configuration fields:

- **Name:** The editable name of this item.
- **Description:** Additional information to describe this item.
- **Field To Change:** The field that will be changing based on the specified condition.
- **Condition:** A Boolean field that will cause **Field To Change** to change to different values.
- **Field Value When Condition True:** The value of **Field To Change** when **Condition Value** is true.
- **Field Value When Condition False Or ---:** The value of **Field To Change** when **Condition Value** is false or unknown.

There are also fields that describe the state of the action:

- **Condition Value:** The present value of **Condition**.
- **Field Value:** The present value of **Field To Change**.

Change field to constant action operation

The **Change Field To Constant** action operates as follows:

- When the **Condition Value** is false or unknown, **Field To Change** will be set to **Field Value When Condition True**.
- When the **Condition Value** is true, **Field To Change** will be set to **Field Value When Condition False Or ---**.

25.9.2.1. Configure a change field to constant action

One way to use a **Change Field To Constant Action** is to set **Auto DC Priority**. The following describes how to configure a **Change Field Action To Constant** to control the amount of power the inverter system takes from DC, based on the time of day.

Go to **Systems > Inverter System > System Functions** and in the **Manual DC Priority** table, ensure that **Manual DC Mode** is **Enabled**.

1. Go to **Controller > Programmability > Scheduler**.
2. Select the **Create Time Span** wizard to select the days and times.
3. Go to **Controller > Programmability > Custom Data**.
4. Select **Add Change Field To Constant Action**, and select the **Go To** button.
5. In the **Configuration** table, select **Field To Change**, select the **AMPS HP2 system** and then **Desired DC Input Power**.
6. In the **Configuration** table, select **Condition > Time Span > Within Time Span**.

7. In the **Configuration** table, select **Field Value When Condition True** and set to 100%.

   This causes the inverter system to pull all its power from DC during the more expensive hours for power usage.

8. In the **Configuration** table, select **Field Value When Condition False** to 0%.

   This causes the inverter system to pull all its power from AC during less expensive hours of power usage, allowing the batteries to charge during that time period.

25.9.3. Configure a change field to variable action

The **Change Field To Variable Action** feature can be used to change the value of a field to the value of a **Custom Data.** This can be useful to control the state of the system based on external conditions. For example, the rectifier module's power output can be adjusted based on a limit to the amount of AC power that should be consumed.

To access this feature go to **Controller > Programmability > Custom Data**.

A **Change Field To Variable** action has five configuration fields:

- **Name:** The editable name of this item.
- **Description:** Additional information to describe this item.
- **Field To Change:** The field that will have its value changed to the value of the configured **Custom Data**.
- **Set Field To Custom Data:** The value of **Field To Change** will be set to the value of this **Custom Data**.
- **Field Value Change Interval:** The number of seconds between each time the value of **Field To Change** will be set to the value of **Set Field To Custom Data**.

There are also fields that describe the state of the action:

- **Last Error Condition:** Describes if there are any errors, either with the configuration or the operation of this action.
- **Field Value:** The present value of **Field To Change**.
- **Field Range:** The range for **Field To Change**. The value of **Field To Change** will only be set if the value of the configured **Custom Data** is within this range.
- **Custom Data Value:** The present value of **Set Field To Custom Data**.
- **Time To Next Possible Change:** The amount of seconds until the next time **Field To Change** will have its value set to the value of the configured **Custom Data**, if the value is different and within range.

Change field to variable action operation

The **Change Field To Variable** action operates as follows:

- The value of **Field To Change** will be set to the value of the **Custom Data** that **Set Field To Custom Data** is configured to use.

- This value will be set on an interval based on the value of **Field Value Change Interval**. For example, if this field is set to 300 seconds (the default), the value of **Field To Change** will be set every 300 seconds.

- **Field To Change** will only be set if the value of the configured **Custom Data** is different than the present value of **Field To Change**, and is within range for this field.

26. Troubleshooting

This section covers the following:

- Troubleshoot the system controller

- Troubleshoot a rectifier system

- Troubleshoot an inverter system

- Troubleshoot a line power system

26.1. Troubleshoot the system controller

This section covers possible issues and fixes for your system controller. Also see the read me notes that are released with the system controller software.

26.1.1. No communication

Check all connection cables.

Check the system controller settings, go to **Controller > Communication > Ethernet**.

Ensure that the system controller is configured to communicate via the web interface. See *Getting started* and *Setting up controller communication*.

Ensure that both ports in the Ethernet table have the address mode configured correctly.

📢 **Notice:** *The default IPv4 configuration for the system controller must have the rear Ethernet port set to automatic via DHCP and the front Ethernet port set to manual or static IP.*

26.1.2. Unable to communicate via Ethernet

Confirm that all cables are firmly connected.

1. Go to **Controller > Communication > Ethernet**.
2. Ensure that the IP address settings are correct. Note that having two ethernet ports connected on the same subnetwork is unsupported configuration. Therefore, if ethernet cables are connected to the rear and front ports, either ensure these are separate networks or unplug one cable.
3. Edit the settings if required.
4. Select **Save**.
5. If that does not work, then restart the system controller.

⚠️ **Attention:** *Selecting the reset button restarts the system controller and may result is lost data. It is always recommend to use the system controller **Restart** button from the menu system to ensure any outstanding configuration changes or log data is saved to disk.*

If the issue is not resolved, contact your IT department to confirm that both the system controller and the computer can communicate across the network.

26.1.3. Home button or LCD panel not responding

If the system controller is not responding to touch or the **Home** button is not responding to touch, you can perform a system controller reset.

> ⚠️ **Attention:** *Selecting the reset button does not ensure that the settings are saved.*

To perform a hardware reset: From the front of the system controller, select the reset button.

26.1.4. System controller fail

The system controller has a relay that can be used to indicate the system controller power has failed. This relay is labeled **Alarm** and is located beside the power connector. In-shelf versions of the system controller do not have this relay.

When the system controller is operational, the relay is in the normally open (NO) position. When the system controller power has failed this relay is in the normally closed (NC) position. If voltage is applied to the power connector and the **Alarm** relay is in the normally closed (NC) position and the system controller does not start up, it is likely the system controller has failed and should be replaced.

In-shelf system controllers (for example, Cordex® CXCi HP system controller) do not have a dedicated system controller fail relay. Failure of an in-shelf system controller may result in relays becoming de-energized. These de-energized relays function as a system controller fail relay.

> 📢 **Notice:** *The system controller fail relay is not programmable in any way.*

26.1.4.1. Alpha® FXM HP UPS System Controller fail

Failure of the system controller inside the Alpha® FXM HP UPS module may not result in any relay becoming de-energized since the relays are on a separate, independent CAN module.

It is recommended to use the **Comms Lost Action** setting on the **Relay Details** page. If communication is lost between the internal system controller and the Alpha® FXM HP UPS module, the relay will de-energize five minutes after communication is lost.

This feature is available in version 6.10 and later. The CAN module firmware also needs to be updated to a version that supports this feature.

26.2. Troubleshoot a rectifier system

This section covers possible issues and fixes for your system. Also see the read me notes that ship with the system controller software.

26.2.1. Relays not triggered during alarm conditions

If the relays are not triggered during alarm conditions try the following:

- Ensure alarm condition is mapped to a relay (**Alarms > All Alarm Settings**).

- Ensure polarity of the relay is set correctly

- Ensure **Cutoff All Alarms** has not been selected

- Ensure ADIO module is communicating

26.2.2. Rectifier module alarms and alerts

Alarm: An alarm is a notification of a change to the state of the system controller. Alarms can be configured with thresholds (if applicable), mapped to relays and will trigger SNMP notifications.

Alert: An alert is a notification from a device that indicates a problem or change in state. An alert is not configurable. The status of an alert is viewable from a device's detailed status page. For example, to view rectifier module alerts go to **Systems > DC System > Inventory > Rectifiers > Status**, and select the **Go To** button.

Rectifier Minor Alert: Indicates a potential minor problem that doesn't pose an immediate risk to the rectifier module's ability to output power.

Rectifier Fail Alert: Indicates a problem with the rectifier module's ability to output power.

If the system has an active **Rectifier Minor** or **Rectifier Fail** alarm, you can find out the source and cause of the alarm as follows:

1. Go to **Systems > DC System > Inventory > Rectifiers > Status** and look at the **# Alerts** column.

2. Look for a rectifier module in the list with more than zero alerts and select the **Go To** button. The page displays a **Rectifier Alerts** table listing all possible rectifier module alerts.

3. Sort the table to find the active alerts. Select the **Go To** button for a description of the alert. This information allows you to troubleshoot the problem.

> 📢 *Notice: A common reason for an unexpected Rectifier Fail alert is a very low load or no load resulting in a **Ramp Test Fail/No Output Power** alert. It is normal for a rectifier module to have this alert active if there is no load or very low load. If your system normally operates at very low load you can disable the ramp test under **Systems > DC System > Inventory > Rectifiers > Rectifiers Configuration** to clear this alert and prevent it from activating.*

26.2.3. Rectifier module not acquired

Ensure all rectifier modules are secured and tightly inserted into the shelf.

Ensure CAN cables are securely connected and routed between all necessary shelves, and to the system controller.

Go to **Systems > DC System > Inventory > Rectifiers > Status**, and then select **Assign** in the **Modules Available for Assignment** table for the specific rectifier module required.

> 📢 *Notice: Even if a system is configured to auto-assign devices, once a rectifier module has been unassigned from the system, it must be manually reassigned back into the system. This is necessary to avoid unintentional auto-assignment. If a device is unassigned using the **Forget** button, then it will auto-assign when discovered on the CAN bus.*

26.2.4. Rectifier module communication lost

If one or more rectifier modules have lost communication with the system controller for more than 10 seconds an alarm generates. The alarm will clear when communication is restored to all rectifier modules.

If rectifier module communication is lost, check the following:

1. Check all CAN cables for breaks or loose connections.
2. Ensure all rectifier modules are secured and tightly inserted into the shelves.
3. Go to **Systems > DC System > Inventory > Rectifiers > Alarms**.
4. On the alarms table, select the **Go To** button on the **Rectifier Comms Lost** row to see the details.

26.2.5. Replacing a defective rectifier module

When a rectifier module fails and or is permanently removed, the system generates a **Rectifier Comms Lost** alarm.

The alarm is cleared by removing the rectifier module from the system inventory.

To remove the rectifier module from the system inventory:

1. Remove the defective rectifier module from the shelf.

2. Go to **Systems > DC System > Inventory > Rectifiers > Status**.

3. Select **Forget** on the rectifier module to be removed and confirm.

4. Place the new rectifier module in the shelf.

5. Rectifier modules are plug and play, but you may still need to map the new rectifier module to an AC phase.

6. If the rectifier module shows in the **Modules Available for Assignment** table, instead of in the **Status** table, select **Assign** to assign the new rectifier module.

7. Confirm the assignment.

26.2.6. Using extended ranges

If your 12VDC, 24VDC, or 48VDC system has a battery and rectifier modules that can operate outside of the normal ranges, you can enable extended ranges to allow your DC system to run outside the normal ranges.

26.2.6.1. Extended ranges for battery testing

Normally, 12VDC, 24VDC, and 48VDC systems have a fairly narrow range of voltages allowed for battery testing. These voltages are based on what is considered normal for the batteries and what is possible for the rectifier modules. The ranges are set this way to avoid errors when configuring a new system. The 125VDC and 220VDC systems have a wider range of battery test voltages because there are a wider variety of battery configurations used with those systems.

1. Go to **Systems > DC System > Configure System**. In the configuration table, change the **Extended Ranges (Advanced)** setting from **Normal** to **Extended**.

2. Go to **Systems > DC System > Inventory > Rectifiers > Configuration**. In the configuration table, set the **Minimum Test Voltage** to the lowest value allowed by your rectifier module.

3. Go to **Systems > DC System > System Functions > Battery Test**. In the configuration table, set the **Battery Test Termination Voltage** to the voltage you want the battery test to run to.

   We strongly recommend that the **Battery Test Termination Voltage** on the battery test page be at least 0.5 volts higher than the **Minimum Test Voltage** on the rectifier module configuration page.

26.2.6.2. Extended ranges for battery equalization

Normally, battery equalization is a process designed to desulphate a battery's plates by holding a controlled overcharge over the period of a few hours. The **Extended Ranges** option will allow much longer durations than is generally used for the battery equalization process. This option helps to support systems with unusual configurations.

⚠ *Attention: Equalization for extended periods can cause excessive gassing and plate damage.*

1. Go to **Systems > DC System > Configure System**. In the **Configuration** table, change the **Extended Ranges (Advanced)** setting from **Normal** to **Extended**.

2. Go to **Systems > DC System > System Functions > Equalize & Boost**. In the **Equalize** table, change the **Equalize Duration** setting to the desired time length.

26.2.7. Rectifier module configuration error

If there is a configuration error alarm active, check the rectifier module settings:

1. Go to **Systems > DC System > Inventory > Rectifiers > Configuration**.

2. Check the **Overvoltage Protection Threshold** value. It must be set higher than any system equalize, boost, absorption, or system voltage settings. The exact margin required depends on the type of rectifier modules, but 48 volt rectifier modules required at least 1 volt.

3. Check that **System Float Voltage**, **Equalize Voltage**, **Boost Voltage**, and the **Overvoltage Protection Threshold** are set within the ranges supported by the rectifier modules on your site.

4. Try setting rectifier module configuration to the defaults.

5. Check the rectifier module manual information for setting ranges.

6. Save any changes. It may take several seconds for the changes to take affect.

26.2.8. Rediscovering CAN devices

If all of the installed equipment doesn't display after maintenance it may be caused by defective CAN bus cables or sequencing of removal and replacement of equipment with the system controller powered down removed.

1. Check that all CAN bus cables are installed and terminated.

2. Power cycle CAN devices if possible.

3. Update device firmware if needed.

26.2.9. Replacing a defective ADIO module

When an ADIO module fails or is permanently removed, the system generates an alarm. The alarm is cleared by removing the device from the inventory. To remove the device from the inventory:

1. Remove the defective ADIO module.

2. Install the new ADIO module and connect all the wires to the same terminals.

3. Go to **Modules**. In the **CAN Modules** table, location the ADIO and select the **Replace** button and follow the wizard instructions.

4. Check and update any other configuration parameters where required.

26.2.10. Troubleshoot a battery test

Calculations for State of Health, State of Charge, and Estimated Battery Runtime battery test algorithm used by the system controller are designed to work with lead acid batteries which have a Peukert exponent between 1.0 and 2.0. Check your battery manufacturers' specifications to ensure that the

battery is within these constraints. When a battery is new, and fully charged, a battery test should show the battery to have 100 percent **Estimated State of Charge** and 100 percent or more **Estimated Battery Health**. If it does not, check and correct the following:

1. Is the battery properly connected?
    a. Check the wiring between the battery, shunts, and the rectifier modules.
    b. Check that the shunts are properly connected and sized.
2. Is the configuration correct?
    a. Go to **Systems > DC System > System Functions > Battery Runtime & Health**. Confirm that **Battery Estimation** is **Enabled**, the **Load Model** is correct for your system, and the **Battery LVD** value is correct.
    b. Go to **Systems > DC Systems > Inventory > Battery**. Select the **Go To** button and confirm that the **Capacity Rating** and the **Peukert Exponent** are correct.
    c. Go to **Systems > DC System > System Functions > Battery Test**. For greatest accuracy, check that the **Battery Test Timeout**, which is the amount of time the battery test stays active before termination, has a time value that will allow the battery to reach an 80 percent depth of discharge. Check that the **Battery Test Termination Voltage** is realistic. It should be LVD + 1 volt: for example, a 24V system would be 22V.
3. Did anything unexpected happen during the test?
    a. Was the load changed?
    b. Did the AC power go out?
    c. Was the system controller restarted? Go to **Controller > About > General** and check the **Time Since Restart**.
4. Is the **Battery on Discharge** alarm active? During a discharge, it is normal to see the **Battery on Discharge** alarm activate. Please see the *Battery Alarms* section of this document for the exact conditions when the **Battery on Discharge** alarm activates.

If any corrections were made then allow the batteries to fully recharge (at least 24 hours) before starting another battery test. If a battery test shows **Estimated Battery Health** found in **Systems > DC System > System Functions > Battery Runtime & Health** to be lower than 80 percent then the batteries should be replaced.

26.2.11. Troubleshoot power save

If **Power Save** is either **Stopped** or **Suspended** it may be due to the following conditions. Please review the following table for possible causes and solutions. From the web interface go to **Systems > DC System > System Functions > Power Save**.

Table 26-1 Troubleshooting power save

Issue	Possible cause	Solution
Power Save status is: **Stopped - All Modules Failed,**	Units are not supported for power save, high	Replace failed rectifier modules. Wait for temperature to drop.

Table 26-1 Troubleshooting power save (continued)

Issue	Possible cause	Solution
In Foldback or Unsupported	temperature, or low AC input voltage.	For universal input rectifier modules operating at 120VAC nominal input voltage, power save cannot be used and should be disabled. These units typically can only be loaded to around 50 percent, due to low input voltage derating so power save has no beneficial effect.
Power Save status is: **Stopped - Total Load Current Invalid**	Incorrect configuration of load current; lost communication with rectifier modules.	Check configuration of loads and shunts. Restore rectifier module communication.
Power Save status is: **Suspended**	AC fail or battery test.	Restore AC. Wait for battery test to complete.
Power Save status is: **Stopped - System Voltage Invalid**	ADIO module communication lost or incorrect system voltage configuration.	Check ADIO module communication and restore. Check system voltage configuration.
Power Save status is: **Stopped - Battery Charge Current Limit Invalid**	Battery charge limit not configured.	Configure battery charge current limit.
Power Save status is: **Stopped - Invalid Data**	Data essential to power save cannot be computed.	Check all of the aforementioned items.
Not enough modules are on or battery is discharging	**Module Power For Maximum Efficiency** setting is above the maximum possible power achievable.	Check the values for current and power capacity under **Systems > DC System > Inventory > Rectifiers > Configuration** . These values limit the maximum output power achievable by the rectifier module and should be set to 100 percent.

26.3. Troubleshoot an inverter system

Incorrect system configuration

If the system has been incorrectly configured with the wrong number of phases, the commissioning wizard will need to be executed again.

If the number of **DC Groups** is incorrect, it is likely that some inverters have the incorrect DC group number. It is possible to fix this by manually changing the DC group number in the details screen of each inverter module.

If the number of shelves per phase is incorrect, it is likely that some inverter modules have the wrong bay ID, shelf ID, or slot ID. It is possible to fix this by manually changing these values in the details screen of each inverter module.

The details screen for an inverter module can be found at **Systems > Inverter System > Inventory > Inverters > Status**. Select the **Go To** button for the inverter module of interest.

📢 **Notice:** *Executing the commissioning wizard will turn off the inverter modules and will require them to be unplugged! The system must be bypassed or the load taken off line.*

26.3.1. Wrong inverter module AC input group

An inverter module's AC input group number is set automatically to the same value as the output phase number. It may take a minute or two for the number to be reflected on the user interface. If this number seems incorrect, unplug the inverter, wait for the fan to stop turning, and then reinsert it.

26.3.2. Wrong inverter module DC input group

The DC input group number is set automatically during commissioning, based on the configured number of DC groups as well as the slot ID. If this number seems incorrect, it can be changed from the details screen of the inverter module.

26.3.3. Alpha® T2S Inverter Module expert operations

To thoroughly troubleshoot an inverter system, there are some expert operations that a user may need.

📢 **Notice:** *These operations are not normally needed during operation of an inverter system. They should only be used by qualified technicians or under the guidance of technical support (www.alpha.ca/support).*

These expert operations are:

- **Get configuration file from the Alpha® T2S inverter module**

- **Upload configuration file to system controller**

- **Send uploaded configuration file to the Alpha® T2S inverter module**

- **Get log file from Alpha® T2S inverter module**

- **Clear history log**

- **Turn off inverter modules**

- **Turn on inverter modules**

- **Configuration helper**

26.3.4. Troubleshoot and clear the system error alarm

Occasionally the inverter system will activate a **System Error** alarm. This may happen after momentary AC outages, breaker trips, false communication problems, or other unusual events. The **System Error** alarm is a reminder to check the Alpha® T2S inverter module log file. It is recommended to download and view the log file for any possible problems. Downloading the log file will also clear the alarm.

To check the Alpha® T2S inverter module log file:

1. Determine which Alpha® T2S inverter module is the source of the alarm. Navigate to **Systems > Inverter System > Live Alerts** and look for the *Check Log File* alarm in the list. Whenever the *Check Log File* alert is active, the *System Error* alarm will also be active. The *Check Log File* alert will be shown with the serial number of the Alpha® T2S inverter module that is causing the alert.

2. Go to **Systems > Inverter System > Inventory > T2Ss** and select the **Go To** button of the Alpha® T2S inverter module identified in the previous step.

3. In the **T2S Expert Operations** table, select **Get Log File from T2S**. This will initiate a transfer of the log file from the Alpha® T2S inverter module.

4. Once the log file has been received, select **Download** to save the file to your computer.

5. Open the file and look for any event entries that might indicate a persistent issue. For example, module failures or communication problems. These problems may indicate the need to replace a module or inspect communication wiring.
   Once the log file has been transferred from the Alpha® T2S inverter module, the **System Error** alarm will clear.

26.3.5. Phase overload alarm

The **Phase Overload** alarm indicates that one or more phases are drawing too much power. The alarm activates when the ratio of actual output power, over the total installed power (excluding redundant inverter modules), exceeds the **Phase Overload Alarm Threshold** parameter configured on the Alpha® T2S inverter controller module. This value is normally set to 100 percent. To verify the threshold value, download the Alpha® T2S inverter module configuration.

To check the Alpha® T2S inverter controller module saturation threshold:

1. Go to **Systems > Inverter System > Inventory > T2Ss** and select the **Go To** button of the Alpha® T2S inverter module identified in the previous step.

2. In the **T2S Expert Operations** table, select **Get Configuration File from T2S**. This will initiate a transfer of the configuration file from the Alpha® T2S inverter module.

3. Once the file has been received, select **Download** to save the file to your computer.

4. Open the file in a text editor and search for "Saturation alarm threshold". The search should find a line similar to: ";556; ;Saturation alarm threshold ; ;80; ;%; ". The value 80 indicates the threshold is 80 percent.

5. If required, this value can be changed. The recommended value is 100. Change the value directly in the text editor and save. Ensure that only the value is changed and the enclosing semicolons are preserved.

6. Return to the system controller interface and select **Upload Configuration File to Controller** in the **T2S Expert Operations** table.

7. Select the Alpha® T2S inverter module configuration file that was just edited, and then select **Upload**.

8. In the **T2S Expert Operations** table, the **Send To T2S**. Wait for the transfer to complete.

26.4. Troubleshooting a line power system

This section describes to how to troubleshoot line power system alarms, overload, and transient events.

26.4.1. Resolving line power system alarms

Some of the alarms from the line power system are generated by the line power system modules. These alarms are *Input Voltage High/Low Shutdown*, *High Temperature Shutdown*, *Temperature Warning*, *Module Connection Error*, and any alarm with *Channel* in its name. This section describes how to identify the module causing the alarm.

1. When one of the line power systems previously mentioned is active, go to **Systems > Line Power System > Layout**.

2. On the **Layout** page, look for a module outlined in red, or a channel with the red exclamation mark icon that signifies a channel alert. The table shows the physical location of the module to help find it, should it need to be replaced.

3. Select the channel with the alert icon. If the module is outlined in red, but no channels appears to be in alert, select any channel.

4. The channel details display in another table.

5. Select the link to show the module details.

6. In the **Alerts** table, sort the **Value** column to show all the active alerts at the top. This identifies all the alerts that are active on the module. Use the help text for the alerts to decide on the corrective action.

26.4.2. Fan tray alarms

The line power system may be installed with one or more optional fan trays. The fan tray is a CAN connected ADIO device that has a **Fan Fail** alarm associated with it. This section describes how to identify the module causing the alarm.

1. Go to **Alarms > Active Alarms**.

2. In the **Active Alarms** table, find the **Fan Fail Alarm** and note the name of the fan tray that is responsible. This confirms the alarm is caused by the fan tray and not some other device.

3. Look for the physical fan tray with the red alarm LED. Repair or replace as required.

26.4.3. Line power system overload

If the line power system is overloaded, one or more modules will start flashing the front panel LEDs yellow. Eventually the input voltage low alarm may be activated if it is configured and enabled.

If this occurs it may be necessary to add more capacity at the input to the line power system, reduce the power drawn by the remote load or add more line power modules.

26.4.4. Line power system transient events

Depending on circumstances, a remote load may experience a brown-out or momentary loss of power. This is sometimes caused by a channel that has had a transient low output voltage, ground fault, or overvoltage protection shutdown. Since these transients occur too quickly to trigger an alarm they are instead logged to the module alert log. After a suspected transient event:

1. Go to **Logs > Events & Alerts** and view the **Module Alerts** table.

2. In the **Search** field, type "transient". The table now shows only the transient events that have occurred. If the table is empty then no transients were detected.

3. Each entry for a transient event shows the serial number of the module responsible. Note the serial number.

4. Go to **Systems > Line Power System > Inventory > Line Power Modules** and type the serial number of the module in the search field. All other modules should now be filtered out leaving only the module of interest.

5. Use the **Locate** button to visually identify the module in the rack.

6. Depending on the type of transient event detected, it may be necessary to unplug and insert the module to ensure it is fully seated, replace the module or check and fix any channel connections.

26.4.5. Line power channels file import errors

This section describes errors that may be presented when importing a line power channels file and how to potentially fix the related error.

Error Message on Import: No line powering modules found assigned to the system therefore the selected CSV file was not imported. Please check that there are line power modules present and assigned to the system and try again.

Solution:

1. Check that there are line power modules acquired. To see acquired modules, on the system controller, go to the **Modules** page and check the **CAN Modules** table.

2. If modules are acquired in the **CAN Modules** table, go to **Systems > Line Power System > Line Power Modules > Modules Available for Assignment > Assign All**.

3. If modules are acquired but the table in step 2 does not display anything, then verify that the correct line power system is created.

Error Message on Import: Line powering modules found to be communications lost therefore the selected CSV file was not imported. Check that the modules assigned to the system are communications normal. Check the eventlog for the modules that were found to be communications lost.

Table 26-2 Example of an event entry for error (time column not displayed):

Source	Name	Value
Import Line Power Channels	Module is Comms. Lost	396000014/0114

Solution:

1. Check that the module that is indicated in the **Value** column is plugged into the shelf.
2. Verify the CAN bus is enabled for whichever CAN bus the module is communicating on. To do this, go to **Controller > Communication > CAN**. Select the **Go To** button in the CAN table to view additional information and edit configuration.
3. If both CAN 1 and CAN 2 are enabled, then verify the physical CAN wiring to the shelf is working.

Error Message on Import: Found errors in imported CSV file. CSV file was not imported. Please check the eventlog to correct errors and then try again.

The source of the error in the **Events** table for a **Line Power Channels Import** will always be import line power channels.

Examples of possible name and value entries from the **Events** table are displayed in the following table.

Table 26-3 Troubleshooting errors in a line power channels CSV file

Name	Value	Analysis of value	Solution
No module found for channel	CSV Row #: 98; LP Ch: 3-1.1; Load: TestLoad	The error was caught in the CSV file on row 98. A module was not found on 3-1.1 which corresponds to Shelf-Slot.Channel. For the load to be created which was named **TestLoad**. *Note: The Load portion may be truncated if the load name exceeded available space.*	1. Check that a module is inserted for shelf 3 in slot 1 of the line power system. 2. Remove the **Load Name** entry if there was no load intended to be created for this channel.
Invalid Channel Entry	CSV Row #: 2; Value: 5; LP Ch: 1-1.5	The error was caught in the CSV file on row 2. A channel entry value was found to be 5 for 1-1.5 which corresponds to the Shelf-Slot.Channel.	A line power module only has up to four channels. Change the channel entry value from 5 to a value between 1 to 4.

Table 26-3 Troubleshooting errors in a line power channels CSV file (continued)

Name	Value	Analysis of value	Solution
Invalid Slot Entry	CSV Row #: 3; Value: @; LP Ch: 1-@.2	The error was caught in the CSV file on row 3. A slot entry value was found to be @ for 1-@.5 which corresponds to the Shelf-Slot.Channel.	A line power shelf can have up to 12 slots. There is an invalid character (@) for the slot. Change the value to be between 1 to 12.
Invalid Shelf Entry	CSV Row #: 5; Value: 1.3; LP Ch: 1.3-1.4	The error was caught in the CSV file on row 5. A shelf entry value was found to be 1.3 for 1.3-1.4 which corresponds to the Shelf-Slot.Channel.	A line power system can have up to nine shelves. The shelf entry was a decimal value. Change the shelf entry value to be between 1 to 9.

27. System controller reference guide

The following section is a reference guide for the system controller software.

27.1. CAN modules

This table provides information on support for CAN modules.

Table 27-1 Support for CAN modules

Category	Device name	System controller software support
ADIO	Cordex® HP L-ADIO low voltage smart peripheral	Version 2.00 and later
ADIO	Cordex® HP 6i-ADIO six input smart peripheral	Version 2.00 and later
ADIO	Cordex® shunt multiplexer module	Version 2.00 and later[1]
ADIO	Cordex® I/M1 ADIO peripheral	Version 2.20 and later
ADIO	Cordex® power supply unit (PSU)	Version 2.20 and later
ADIO	Cordex® HP HV-ADIO high voltage smart peripheral	Version 3.00 and later
ADIO	Cordex® 8R8D ADIO peripheral	Version 3.10 and later
ADIO	Cordex® 4R8D ADIO peripheral	Not Planned [2]
ADIO	Cordex® 12V BCM peripheral	Not planned
ADIO	Cordex® 24V BCM peripheral	Not planned
ADIO	Alpha® BDFB VI meter	Version 3.10 and later
ADIO	Cordex® LPS fan tray ADIO peripheral	Version 3.20 and later
ADIO	Alpha® smart E2 peripheral	Version 4.00 and later
Rectifier	Cordex® HP 250W 12VDC rectifier module	Version 2.10 and later
Rectifier	Cordex® 400W 24VDC rectifier module	Version 2.00 and later
Rectifier	Cordex® 3.1kW 24VDC rectifier module	Version 2.00 and later
Rectifier	Cordex® HP 300W 48VDC rectifier module	Not planned
Rectifier	Cordex® 650W 48VDC rectifier module	Version 2.00 and later
Rectifier	Cordex® 1kW 48VDC rectifier module	Version 2.00 and later

1. The Cordex® shunt multiplexer can be monitored by the system controller but it cannot be calibrated by the system controller.
2. The Cordex® 4R8D ADIO peripheral is not officially supported. If you connect one to the system controller, it will show up as a Cordex® 8D8R ADIO. All eight digital inputs will function correctly. The first four relays will function correctly and are mapped to the four physical relays on the Cordex® 4R8D ADIO peripheral.

Table 27-1 Support for CAN modules (continued)

Category	Device name	System controller software support
Rectifier	Cordex® HP 1.2kW 48VDC rectifier module	Version 2.00 and later
Rectifier	Cordex® 1.8kW 48VDC rectifier module	Version 2.00 and later
Rectifier	Cordex® HP 2.0kW 48VDC rectifier module	Version 2.00 and later
Rectifier	Cordex® HP 2.4kW 48VDC rectifier module	Version 2.00 and later
Rectifier	Cordex® HP 3.0kW 48VDC rectifier module (hardware revision 1)	Version 6.00 and later
Rectifier	Cordex® HP 3.0kW 48VDC rectifier module (hardware revision 2)	Version 7.20 and later
Rectifier	Cordex® 3.6kW 48VDC rectifier module	Version 2.00 and later
Rectifier	Cordex® HP 4.0kW 48VDC rectifier module	Version 2.00 and later
Rectifier	Cordex® HP 4.6kW 48VDC rectifier module	Version 5.00 and later
Rectifier	Cordex® HP 12kW 48VDC rectifier module (hardware revision 1)	Version 2.11 and later
Rectifier	Cordex® HP 12kW 48VDC rectifier module (hardware revision 2)	Version 6.00 and later
Rectifier	Cordex® 3.3kW 65VDC rectifier module	Not planned
Rectifier	Cordex® 1.1kW 125VDC rectifier module	Version 3.00 and later
Rectifier	Cordex® 1.1kW 220VDC rectifier module	Version 3.00 and later
Rectifier	Cordex® 4.4kW 125VDC rectifier module	Version 3.00 and later
Rectifier	Cordex® 4.4kW 220VDC rectifier module	Version 3.00 and later
Converter	Cordex® 2kW 24-48VDC rectifier module	Version 2.01 and later
Converter	Cordex® 2kW 48-24VDC rectifier module	Version 2.01 and later
Sub-controller	Alpha® T2S inverter controller module	Version 3.00 and later
Inverter	Alpha® AIM 1500 inverter module	Not planned
Inverter	Alpha® AIM 2500 inverter module	Version 3.00 and later
Inverter	TSI universal synchronization (TUS) module	Version 3.10 and later
Line powering	Cordex® HP LPS36 up converter module	Version 3.20 and later
Line powering	Cordex® HP eLimiter+ distribution system	Version 3.20 and later
FXM	Alpha® FXM UPS module	Version 6.00 and later

Table 27-1 Support for CAN modules (continued)

Category	Device name	System controller software support
ADIO	Alpha® external maintenance bypass switch (XMBS) (hardware revision 1)	Version 6.20 and later
ADIO	FlexAir® thermal controller module	Version 7.00 and later
ADIO	Alpha® external maintenance bypass switch (XMBS) (hardware revision 2)	Version 7.01 and later
Converter	Cordex® CXPS-HSS hyperboost converter system	Version 8.00 and later
Converter	Cordex® HP 3kW hyperboost converter module	Version 8.21 and later
ADIO	Matrix C16™ high density connectorized DC distribution breaker panel	Version 8.00 and later
ADIO	Matrix 300™ high density DC power distribution system	Version 8.30 and later
ADIO	Cordex® HP protocol bridge peripheral	Version 8.30 and later
ADIO	EnVision™ energy router 1RU remote controllable distribution panel with smart switch modules	Version 8.30 and later
Rectifier	DPX 5kW 380VDC rectifier module	Version 8.30 and later
Power distribution module	DPX 2kW fault managed power distribution module with EnShield™ technology	Version 8.30 and later
ADIO	DPX ground fault monitoring device	Version 8.30 and later

27.2. Communication ports

There are three sets of ports that are used for system controller communication:

- Two Ethernet ports, commonly referred to as the front and rear Ethernet ports.

- Two USB ports, commonly referred to as the front and rear USB ports.

- Two CAN ports, commonly referred to as CAN1 and CAN2.

27.2.1. Ethernet ports

The Ethernet ports support a standard RJ45 connection and can run at 10BASE-T or 100BASE-T speeds with auto medium dependent interface crossover (MDI-X) detection to eliminate the need for cross-over cables.

The Ethernet ports support the IPv4 and IPv6 internet protocols. The IPv4 protocol supports both static IP and Dynamic Host Configuration Protocol (DHCP) configuration. The IPv6 protocol will configure a link-

local address automatically. Addresses with other scopes are configured by Router Advertisements (RA). Both the system controller LCD panel and web interface will display the full list of IPv6 addresses that have been configured for each port.

You can also use IPv6 addresses for outgoing messages including email servers and SNMP destinations. SNTP does not support IPv6 at this time.

The system controller does not register itself with DNS servers nor can it be configured to join a domain or work group. However, the system controller is capable of using a DNS server to resolve domain names if the gateway is set up to allow that.

> 📢 **Notice:** *While there are two Ethernet ports available on the system controller, it is recommended that they are not both connected to the same network. There is a concern that network management systems and higher level control systems will see the system controller as two devices and get duplicate notifications (SNMP traps for example) for a single device.*

27.2.2. USB ports

The USB ports support a standard, full-size USB host connection.

Only USB mass storage devices that have been formatted with a FAT32 file system are fully supported for use in the USB ports. USB drives with the New Technology File System (NTFS) file system will not work.

USB ports can be disabled to provide enhanced anti-tampering above and beyond the normal local physical security of a typical installation. When disabled, the no USB device will function when plugged in and should this be required, go to **Controller > Settings > User Interface** and in the **User Interface** table you can disable and enable USB ports. To successfully disable the ports, first ensure that there are no USB devices plugged in. Failure to do so may prevent a port from being disabled, as it is in use; a reset or power cycle may be required before another attempt to disable will be successful. A disabled USB port should provide no power to the plugged in device. If the device has an LED on it, this may be used to determine if the port is actually disabled.

27.2.3. CAN ports

Introduction to CAN for the Cordex® HP System Controller

CAN is used by the system controller to discover, collect data from, control, and configure the power modules and I/O (ADIO) modules in the power system. The system controller has two up to CAN buses, each of which can control up to 127 power and ADIO modules.
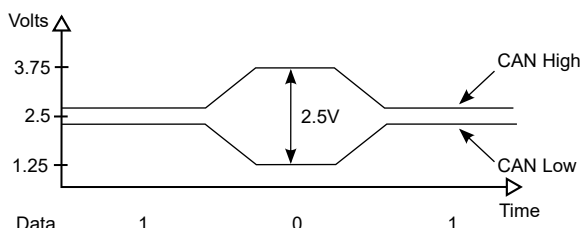
What is a CAN bus?

A controller area network (CAN) refers to a network of devices that communicate using the CAN serial protocol to support distributed real-time control.

How do CAN bus modules communicate?

A CAN bus uses two dedicated wires for communication called CAN high and CAN low. When the CAN bus is idle, both lines carry 2.5 volts. When data bits are being transmitted, the CAN high line goes to 3.75 volts and the CAN low drops to 1.25 volts, thereby generating a 2.5 volts difference between the lines. Since communication relies on a voltage difference between the two bus lines, the CAN bus is insensitive to inductive spikes, electrical fields or other noise. This makes CAN bus a reliable choice for networked communications in electrically noisy environments.
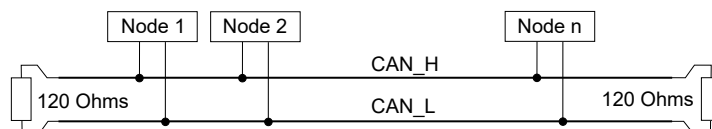
Figure 27-1 CAN differential signaling

CAN network topology

A CAN network uses a twisted pair cable to transmit the differential signals, terminated at both ends with 120 ohm resistors.
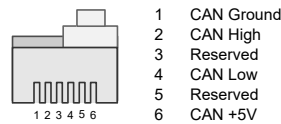
Figure 27-2 CAN network topology

What is CAN power?

CAN power can be supplied through CAN bus. Optionally a power supply for the CAN bus modules can be arranged separately. The power supply wiring can be either totally separate from the CAN bus lines using two, two-wire cables or it can be combined with the CAN bus lines into a single four-wire cable. CAN bus cabling is available from multiple vendors.

How are Alpha® CAN cables wired?

The Alpha® CAN connector is a 6P6C offset latch modular connector. The male connectors are called plugs and the female connectors are called jacks. You may also hear these connectors referred to by their registered jack (RJ) equivalent: RJ11, RJ14, and RJ25 are all physically compatible with 6P6C modular connectors. The following figure shows the CAN pinout for a 6P6C offset latch modular plug. Pins 1 and 6 are used for CAN power while pins 2 and 4 are used for CAN signaling.

Figure 27-3 Alpha® CAN connector

1	CAN Ground
2	CAN High
3	Reserved
4	CAN Low
5	Reserved
6	CAN +5V

Are there distance limitations?

The electrical characteristics of a typical CAN bus cable restrict the cable length. We recommend having no more than one long CAN cable on a CAN bus and to restrict the length of that long cable to less than 328 feet (100 meters).

Is the number of nodes (modules) limited?

CAN allows up to 127 modules per bus.

Where can I get more information about CAN?

CAN is specified by the International Standards Organization (ISO) standard ISO 11898.

27.3. Default system values and ranges

The following section provides tables of the default values and ranges for supported systems.

27.3.1. 12 volt system default values and ranges

This table provides the default values and ranges for a 12 volt system.

Table 27-2 12 volt system default values and ranges

Setting name	Default	Minimum	Maximum
Allowed Voltage Range	N/A	10.5	15
Float Voltage	13.5	11.875	14.55
Equalize Voltage	13.75	12.45	15.05
Boost Voltage	13.75	12.45	15.05
Rectifier - Minimum Test Voltage	11	N/A	N/A
Safe Voltage	12.85	11.5	14
Overvoltage Protection	14.25	12.125	15.75
Absorption Voltage	13.75	12.45	14.75
Absorption Arming Voltage	12	10.5	13.25
Temp. Comp. Max. Voltage	13.875	N/A	14.5
Temp. Comp. Min. Voltage	13.125	11.875	N/A

Table 27-2 12 volt system default values and ranges (continued)

Setting name	Default	Minimum	Maximum
Battery String Number of Cells	6	1	200
Temp. Comp. Voltage Warning	0.25	0	0.25
Battery Test Termination Voltage	11.125	11.125	15
Output Voltage High Alarm	13.875	10.5	15
Output Voltage Very High Alarm	14.125	10.5	15
Output Voltage Low Alarm	12	10.5	15
Output Voltage Very Low Alarm	11.625	9	15

27.3.2. 24 volt system default values and ranges

This table provides the default values and ranges for a 24 volt system.

Table 27-3 24 volt system default values and ranges

Setting name	Default	Minimum	Maximum
Allowed Voltage Range	N/A	21	30
Float Voltage	27	23.75	29.1
Equalize Voltage	27.5	24.9	30.1
Boost Voltage	27.5	24.9	30.1
Rectifier - Minimum Test Voltage	22	N/A	N/A
Safe Voltage	25.7	23	28
Overvoltage Protection	28.5	24.25	31.5
Absorption Voltage	27.5	24.9	29.5
Absorption Arming Voltage	24	21	26.5
Temp. Comp. Max. Voltage	27.75	N/A	29
Temp. Comp. Min. Voltage	26.25	23.75	N/A
Battery String Number of Cells	12	1	200
Temp. Comp. Voltage Warning	0.5	0	0.5
Battery Test Termination Voltage	22.25	22.25	26
Output Voltage High Alarm	27.75	21	30
Output Voltage Very High Alarm	28.25	21	30
Output Voltage Low Alarm	24	21	30

Setting name	Default	Minimum	Maximum
Output Voltage Very Low Alarm	23.25	18	30

27.3.3. 48 volt system default values and ranges

This table provides the default values and ranges for a 48 volt system.

Table 27-4 48 volt system default values and ranges

Setting name	Default	Minimum	Maximum
Allowed Voltage Range	N/A	42	60
Float Voltage	54	47.5	58.2
Equalize Voltage	55	49.8	60.2
Boost Voltage	55	49.8	60.2
Rectifier - Minimum Test Voltage	44	N/A	N/A
Safe Voltage	51.4	46	56
Overvoltage Protection	57	48.5	63
Absorption Voltage	55	49.8	59
Absorption Arming Voltage	48	42	53
Temp. Comp. Max. Voltage	55.5	N/A	58
Temp. Comp. Min. Voltage	52.5	47.5	N/A
Battery String Number of Cells	24	1	200
Temp. Comp. Voltage Warning	1	0	1
Battery Test Termination Voltage	44.5	44.5	52
Output Voltage High Alarm	55.5	42	60
Output Voltage Very High Alarm	56.5	42	60
Output Voltage Low Alarm	48	42	60
Output Voltage Very Low Alarm	46.5	36	60

27.3.4. 125 volt system default values and ranges

This table provides the default values and ranges for a 125 volt system.

Table 27-5 125 volt system default values and ranges

Setting name	Default	Minimum	Maximum
Allowed Voltage Range	N/A	90	160
Float Voltage	140.625	90	160
Equalize Voltage	143.23	90	160
Boost Voltage	143.23	90	160
Rectifier - Minimum Test Voltage	114.58	90	160
Safe Voltage	133.85	90	160
Overvoltage Protection	151.04	90	160
Absorption Voltage	143.23	90	160
Absorption Arming Voltage	125	90	160
Temp. Comp. Max. Voltage	144.53	N/A	160
Temp. Comp. Min. Voltage	136.72	90	N/A
Battery String Number of Cells	63	1	200
Temp. Comp. Voltage Warning	2.6	0	2.6
Battery Test Termination Voltage	115.89	90	160
Output Voltage High Alarm	144.53	90	160
Output Voltage Very High Alarm	147.14	90	160
Output Voltage Low Alarm	125	90	160
Output Voltage Very Low Alarm	121.09	93.75	160

27.3.5. 220 volt system default values and ranges

This table provides the default values and ranges for a 220 volt system.

Table 27-6 220 volt system default values and ranges

Setting name	Default	Minimum	Maximum
Allowed Voltage Range	N/A	180	320
Float Voltage	247.5	180	320
Equalize Voltage	252.08	180	320
Boost Voltage	252.08	180	320
Rectifier - Minimum Test Voltage	201.67	180	320
Safe Voltage	235.58	180	320

Table 27-6 220 volt system default values and ranges (continued)

Setting name	Default	Minimum	Maximum
Overvoltage Protection	265.83	180	320
Absorption Voltage	252.08	180	320
Absorption Arming Voltage	220	180	320
Temp. Comp. Max. Voltage	254.38	N/A	320
Temp. Comp. Min. Voltage	240.63	180	N/A
Battery String Number of Cells	110	1	200
Temp. Comp. Voltage Warning	4.58	0	4.58
Battery Test Termination Voltage	203.96	180	320
Output Voltage High Alarm	254.38	180	320
Output Voltage Very High Alarm	258.96	180	320
Output Voltage Low Alarm	220	180	320
Output Voltage Very Low Alarm	213.13	165	320