EnergyCore Lithium 7

Service Manual

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Technical Support Site

If you encounter any installation or operational issues with your product, check the pertinent section of this manual to see if the issue can be resolved by following outlined procedures.

Visit https://www.vertiv.com/en-us/support/ for additional assistance.

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TABLE OF CONTENTS

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1 Important Safety Instructions

NOTE: This document is for Vertiv internal use only and is not intended for customers.

Read and follow these instructions

All the safety instructions in this manual are intended to ensure safety and prevent property damage. Before installing this product, be sure to read all safety instructions in this document for proper installation.

Failure to comply with safety instructions may result in a serious accident, causing death, or a severe injury.

WARNING! Risk of electric shock. May cause personal injury or death. Verify that all incoming line voltage (power) circuits are de-energized and locked out before installing cables or making connections in the unit. Equipment inspection and startup should be performed only by properly trained and qualified personnel wearing appropriate safety headgear, gloves, and shoes. Lethal voltages are present during startup procedures. Electrical safety precautions must be followed throughout inspection and startup. Only properly trained and qualified service personnel wearing appropriate safety headgear, gloves, shoes, and glasses should perform maintenance on the Vertiv™ EnergyCore Lithium 7. All voltage sources to the unit must be disconnected before inspecting or cleaning within the cabinet.

1.1 Critical Fire Safety Compliance

NOTE: This critical fire safety compliance is for customers and engineers.

This product test in accordance with UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems. Vertiv can make this test report available upon request for the purpose of assisting Vertiv's customers, their engineers, and other stakeholders in satisfying their obligations to comply with all applicable fire safety, building, and electrical regulations, as well as any other laws or guidelines governing installation or use of this product.

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2 Commissioning

2.1 Arc Flash Incident Energy Calculations

Arc flash incident energies are applicable when conducting commissioning or maintenance activities at the front of the battery cabinet with the CTL PWR circuit breaker in the OFF (handles down) position, the S1 switch in the OFF position, and all battery shelf terminal covers removed.

WARNING! Personal protective equipment is required when protective covers of battery shelf are removed.

Table 2.1 Arc Flash Data

Condition	Arcing Current (Half Bolted I_{bf})	Arc Duration	Working Distance	Incident Energy	Arc Flash Boundary
Single module short circuit	3360 A	2 Seconds	460 mm (18.11 in.)	284512 J/m^2	1130 mm (44.49 in.)
All modules series short circuit	5200 A	2 Seconds	460 mm (18.11 in.)	468608 J/m^2	1440 mm (44.88 in.)

The arc flash information provided above is intended to be for reference only, it is not intended to serve the purpose of, or replace, an arc flash hazard analysis performed by a professional engineer based on site-specific conditions. The calculated incident energy does not change significantly with the age of the batteries or their state of charge (SOC).

2.2 Battery Module Series Connections

NOTICE

To avoid a small spark resulting from power supply inrush current, prior to connecting the batteries in series, open the CTL PWR circuit breaker and the F7-F8 fuse holder and then turn the S1 switch to the OFF position on the power chassis assembly (PCA).

For maximum safety, the rear connectors in the PCA must be disengaged. The 6 screws (10 mm [0.4 in.] hex head) that attach it to the frame. Pull the PCA forward by 80 mm to 160 mm (3 in. to 6 in.), keeping it in the frame. This disconnects the battery voltage meter that is built into the PCA. After the battery string is connected in series, push the PCA back in and secure it to the frame with the 6 original screws.

For safety during shipment, the module connecting busbars are attached to the interior of the battery cabinet from the factory.
Refer to Module Connecting Busbars on page 6 for installation of busbars to connect the battery modules in series.

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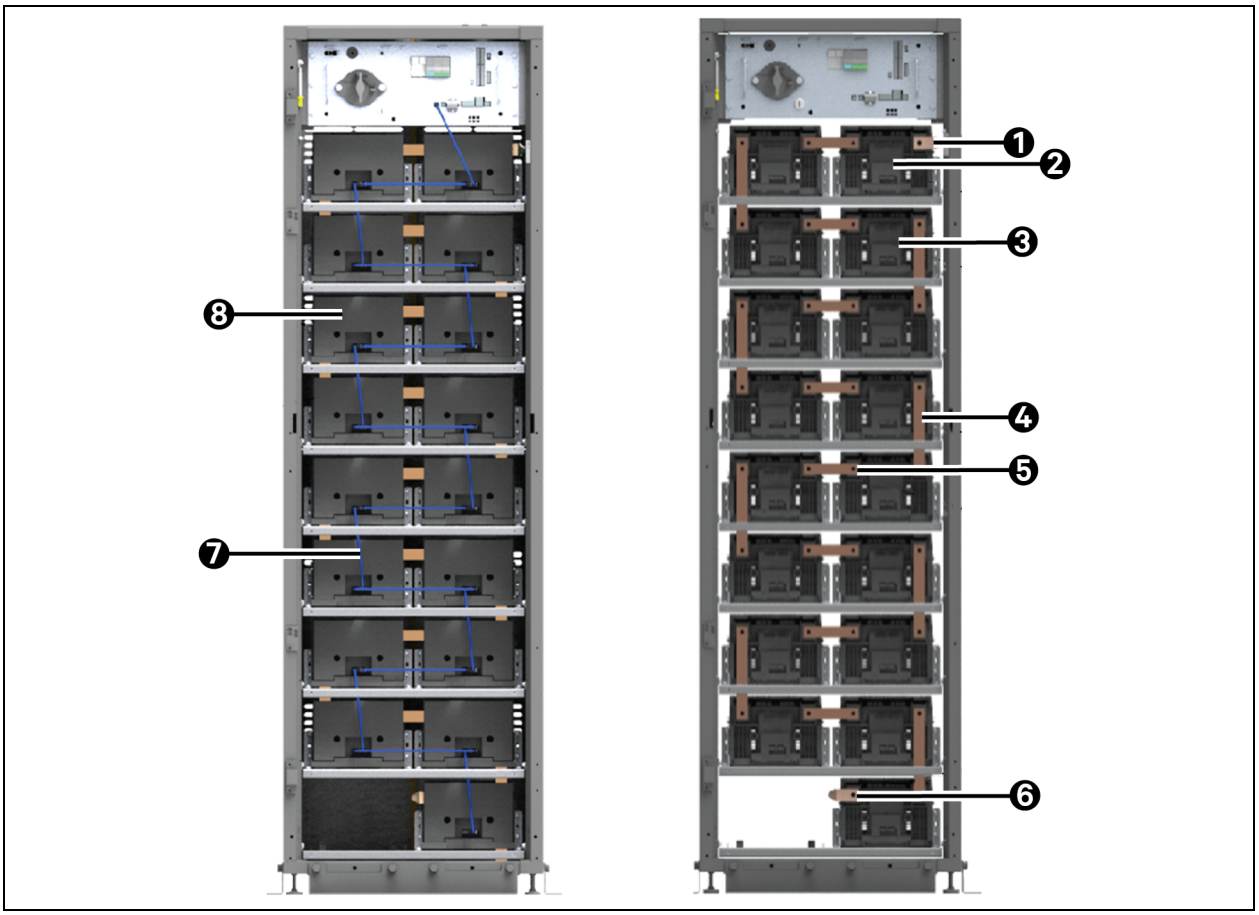
Figure 2.1 Connecting Each Battery Shelf in the Cabinet



Item	Description
1	Overall negative cable
2	Type B module
3	Type A module
4	Vertical connecting busbar
5	Horizontal connecting busbar
6	Overall positive cable
7	Communication cable
8	Module cover

NOTE: Ensure each connection is torqued to 124 in-lbs (14 Nm). Hardware for module-to-module busbars is in the busbar kit packaging.

NOTE: Do not install the shelf connecting busbars until the UPS to battery cabinet cables are installed.

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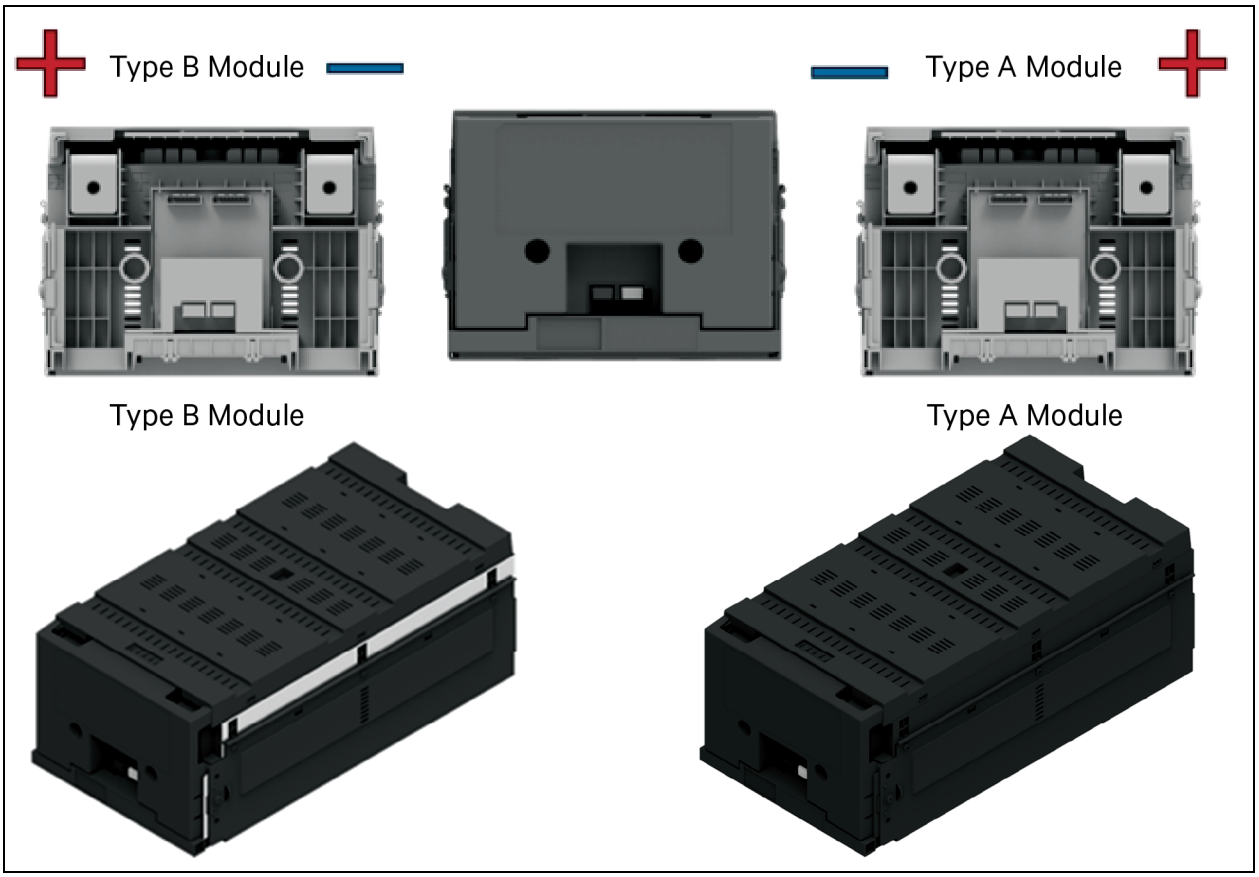
NOTE: If battery discharge with thermal scan is done during commissioning, the exposed portion of the shelf connecting busbars, with the busbar cover properly connected, and the overall positive cable, with the power cable cover properly connected, must not exceed 69 °C (156 °F).

Figure 2.2 Battery Modules



NOTE: The light grey stripe on the side of type B module can be utilized to distinguish between type A and type B module.

Prior to the final busbar connections, it is required for the battery terminals to use an electrically conductive grease on the module connecting busbars. This is done to reduce contact resistance and prevent potential overheating of the terminals.

Vertiv has utilized Timtronics EJC741, an electrically conductive compound, for internal testing. Apply a small amount per terminal and spread it evenly, and thinly, on the terminal surface using a wire brush. The terminals are now ready to have module connecting busbars and hardware installed through the next steps.

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Module Connecting Busbars

The module connecting busbars must be connected in the following order:

1. Remove the module covers from the modules 1 and 2. Set aside for reinstallation.

NOTE: Consider the wire harnesses when removing the battery covers. The communication cables may need temporarily removed.

NOTE: Do not remove the overall negative power cable cover connection from the negative terminal of module 1. Similarly, do not remove the overall positive connection located on the last module in series on the positive terminal.

2. Connect the horizontal busbar from module 1 positive terminal to module 2 negative terminal.
3. Reinstall the module cover to the module 1 and remove the module cover from the module 3. Set aside for reinstallation.
4. Connect the vertical busbar from module 2 positive terminal to module 3 negative terminal.
5. Reinstall the module cover on module 2 and remove the module cover of the next module in series.
6. Continue connecting busbar up until the module listed. This is done to split the string into two lesser voltages while connecting busbars, in an effort to reduce the voltage potential at the end of the battery installation, and to make the final connection located in an easily accessible area.
    a. 10 module configuration, module 5
    b. 12 module configurations, module 7
    c. 14 module configurations, module 7
    d. 16 module configurations, module 9
    e. 17 module configurations, module 9
7. Reinstall the module cover before moving to the bottom of the cabinet.
8. Move to the bottom of the cabinet and remove the cover off the last 2 modules in series. Set aside for reinstallation.

NOTE: Do not remove the power cable connection from the negative terminal of module 1.

9. Working from the last module backwards, connect the modules in series removing and reinstalling covers in the process.
10. Once the last module is reached, the final string connection can be made. Remove the module cover from the list module above and make the final horizontal busbar connection in the string. Reinstall module covers once completed.
11. Do an isolation check.
    a. Use a digital multimeter to measure resistance between the positive terminal of the top battery shelf to a non-painted screw head of the frame.
    b. If the resistance is lesser than 1 megaohm, there is a problem. Check for loose parts in the cabinet.
12. Verify all torque connections are correct.

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2.3 Configuration

2.3.1 Control Wiring and CAN Termination Resistor

Confirm the control wiring matches the applicable submittal drawing as shown in the Vertiv™ EnergyCore Lithium 7 Installation and Operation Manual SL-71369. All control wires on the drawing are required unless the drawing marks them as optional.

Reliable CANbus communication among the Vertiv™ EnergyCore Lithium 7 cabinets and the touchscreen HMI depends on the two-wire CANbus signal line being correct. The device on each end of the CANbus signal line must have its terminating resistor active, and other devices must have the terminating resistor disconnected. For easy installation, both the EnergyCore Lithium 7 control terminal block (CTB) and the touchscreen HMI have a CAN termination switch which connects an internal resistor at that location, so it is not necessary to install a separate resistor.

If the touchscreen HMI is installed, placing it at the end of the CANbus signal line results in the best signal reliability. The CANbus terminating resistor switch location is shown in Figure 2.3 on the next page.

To verify that the proper number of CANbus terminating switches are set correctly:

1. Turn off all the connected devices.
2. At one of the cabinets, use a digital multimeter to measure resistance from terminals CTB-19 to CTB-20.
3. If the measured resistance is 55 ohm to 70 ohm, the correct number of terminating switches are correct.

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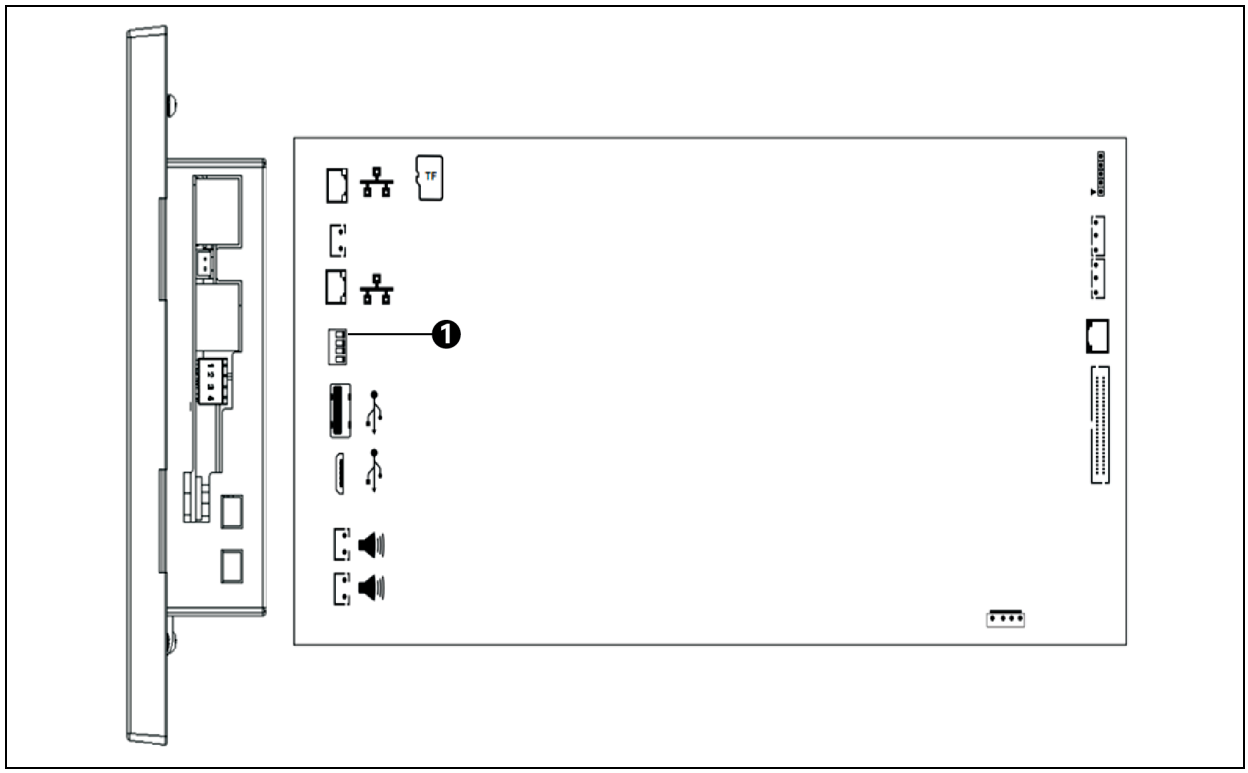
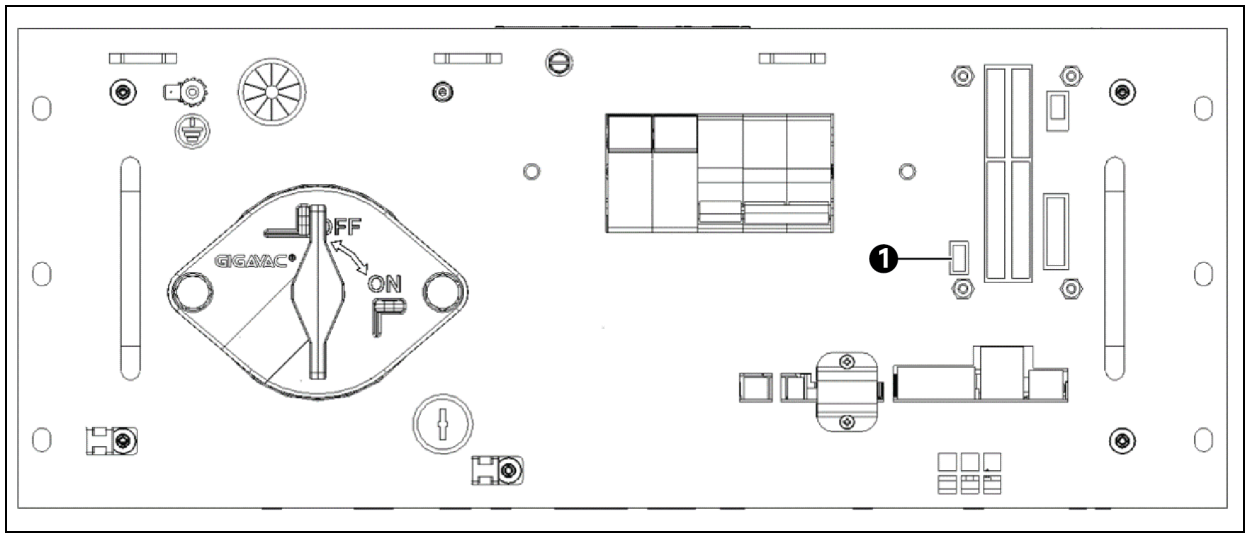
Figure 2.3 Touchscreen HMI CANbus Termination Switch Location



Item	Description
1	CAN 1 T_R: ON|OFF

Figure 2.4 CANbus Termination Switch Location at CTB on the PCA



Item	Description
1	CAN1 Terminal

Figure 2.5 Typical CANbus Wiring with Terminating Switch Positions

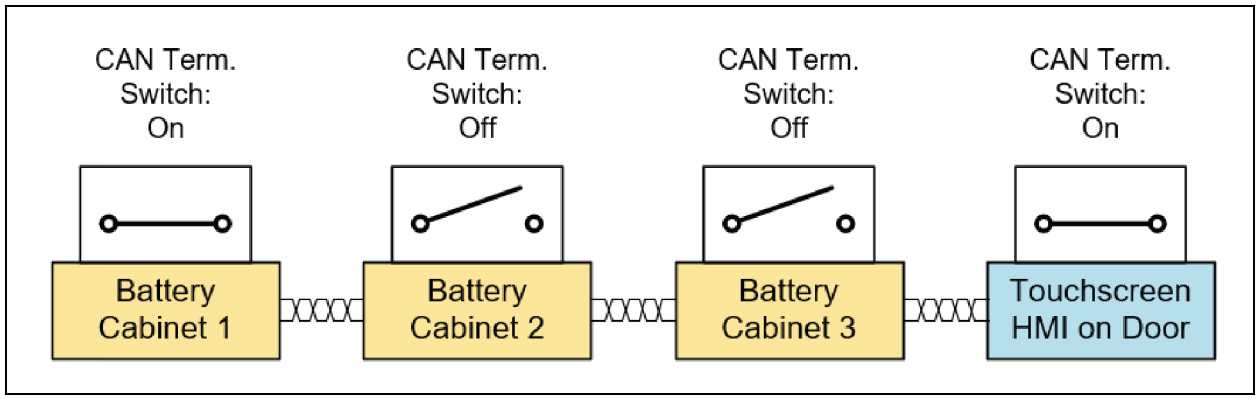
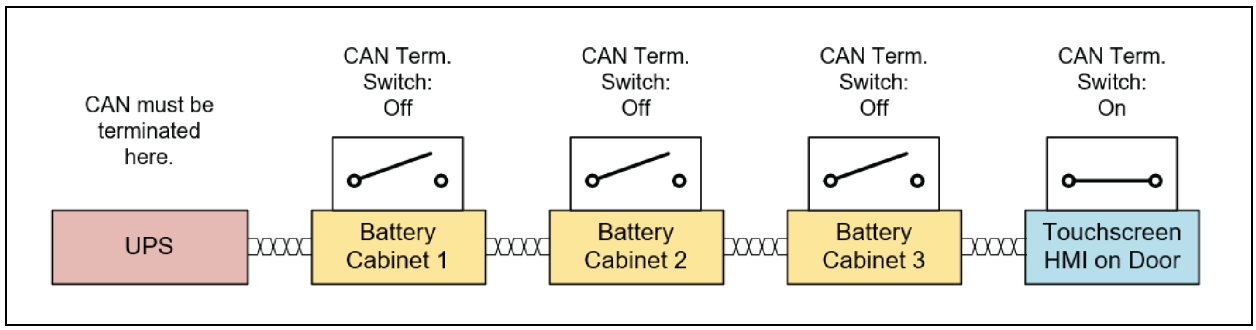


Figure 2.6 Alternate CANbus Wiring and Terminating Switch Positions with UPS Connected



NOTE: The battery cabinet with the HMI must be the furthest cabinet from the UPS. If not connected to the UPS, it must be one of the end cabinets.

2.3.2 Firmware Configuration

To configure the Vertiv™ EnergyCore Lithium 7 for operation:

1. Connect a USB to RS-232 serial cable directly to the CONSOLE port on the PCA and plug the USB connector into a USB port on the computer.
2. Open a terminal emulator program (such as puTTy, or terraterm), choose the communication port associated with USB to serial adapter, and choose serial port settings as follows.
    a. Baud rate: 115200
    b. Data bits: 8
    c. Stop bits: 1
    d. Parity: None
    e. Flow control: None
3. Close the S1 switch.
4. Ensure the following:
    a. The SERVICE/RUN switch is in the RUN position.
    b. The F7-F8 fuse holder is closed.
5. Close the CTL PWR circuit breaker (handle up).
6. Observe startup information of terminal emulator program on computer.

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NOTE: If start up information is not displayed, check the COM port settings. If this continues, contact Vertiv technical support.

7. After approximately one minute, the login prompt displays. The username for login is battery management system (BMS). The default (factory) password is BMS. If the unit has been configured already, its password will be encoded.
8. The encoded password can be determined by using the password decoder found in Vertiv technical knowledge online (TKO).
    a. To look up the password, press *Ctrl-D* at the login prompt and note the serial number which prints above the prompt.
    b. Enter the serial number into the TKO password generator.
9. At the $ prompt, type **polaris_config** and press *Enter*. The information as shown in **Table 2.2** below prompts.

Table 2.2 Required Information for the Configuration Program

Parameter	Description	Value
NUM_RACKS	Number of parallel battery cabinets/strings.	Integer, at least 1
BMS_ID	This battery cabinets number in the parallel set (typically 1 is closest to the UPS).	Integer, at least 1
EXPECTED_LOAD	Expected discharge load is in kW for this cabinet. Auto-adjusts later based on real load.	Integer
CELSIUS	Display temperature in celsius instead of fahrenheit	No (default)
UPS Type	Type of UPS that is being used (list is shown on the serial CONSOLE).	Integer
UPS_NAME	Free text field, UPS name such as UPS_East_B can be entered.	Free text field
Region	Time zone, list is shown on the serial CONSOLE.	Text entry
ENABLE NETWORKING?	Enable network connectivity on this cabinets Ethernet port.	No (default), Yes
DHCP[1]	Allows the IP address to be changed dynamically by the router.	No, Yes (default)
IP_ADDR[1]	This is the assigned IP address for the cabinet. Must be given by customer.	<customer provided>
NETMASK[1]	This is the assigned netmask for the cabinet. Must be given by customer.	<customer provided>
GATEWAY[1]	This is the assigned gateway for the cabinet. Must be given by customer.	<customer provided>
DNS	This is the assigned DNS server for the cabinet. Must be given by customer.	<customer provided>
Enable NTP?	Allows the realtime clock to synchronize with the internet. Requires NTP server from customer.	No (default), Yes
NTP Server	Only when NTP enabled. This is the NTP server.	<customer provided>
Enable Modbus TCP?	Enables Modbus/TCP (remote monitoring through Ethernet port).	No, Yes (default)
ENABLE MODBUS RTU?	Enables Modbus/RTU (remote monitoring through RS-485 port).	No (default), Yes
Modbus RTU Node ID	Node ID for Modbus/RTU. Given by customer.	Integer, at least 1
Modbus RTU Baud Rate	Baud rate for Modbus/RTU. Given by customer. List is shown on serial CONSOLE.	Integer

Table 2.2 Required Information for the Configuration Program (continued)

Parameter	Description	Value
Modbus RTU Parity	Parity selection for Modbus/RTU. Given by customer.	None/Even/Odd
Modbus RTU Number of Stop Bits	Number of stop bits for Modbus/RTU. Given by customer.	1 or 2
Enable SNMP?[2]	With networking enabled, this allows remote monitoring via SNMP, if desired by customer.	No (default), Yes
Enable SNMP v1/v2?	Information required from customer for SNMP setup (Only when SNMP enabled).	<customer provided>
Enable SNMP v3?	Information required from customer for SNMP setup (Only when SNMP enabled).	<customer provided>
Enable SNMP Traps?	Information required from customer for SNMP setup (Only when SNMP enabled).	<customer provided>
YEAR	Current year	Four-digit year (such as 2020)
MONTH	Current month	Two-digit month (such as 03)
DAY	Current day	Two-digit day (such as 09)
HOUR	Current hour	Two-digit hour (such as 08)
MINUTE	Current minute	Two-digit minute (such as 01)

NOTE:

1. Networking must be enabled. If the customer provides a specific IP address, turn DHCP off (set to 0). If the customer does not provide an IP address, turn DHCP on (set to 1). These options only appear when DHCP is disabled.
2. If SNMP is used, detailed information about the setup needs to be available from the customer, including number of users and engine ID format type.

- After configuring a cabinet, mark the unique **BMS_ID** (1, 2, 3) on the inside of the cabinet door to assist with troubleshooting in the future.
- After firmware configuration of a cabinet, the SD card becomes associated with that specific battery cabinet, it cannot be used for a different cabinet.
- If customer provided data is not available, enter No when asked to enable that feature.
- If networking or monitoring settings need to be updated, type **polaris_config --network** at the command line and press *Enter*. The script will then only change networking and remote monitoring settings.
  Similarly, **polaris_config --ups** changes only the UPS specific settings, and **polaris_date** allows changing only the date and time.

When configuration is complete, allow the firmware to stop and trip the CTL PWR circuit breaker. When this occurs, remove the USB to RS-232 serial cable from the CONSOLE port on the PCA. Repeat the above commissioning process on all connected units before proceeding to the next step.

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2.3.3 Control Wiring Test

NOTE: The following control wire test can only be conducted on battery cabinets with external push buttons.

After the installation of all connected cabinets and completing all steps in Firmware Configuration on page 9, it is required to test the coordinated disconnect function served by the control wiring.

1. On each connected cabinet, close (handle up) the CTL PWR circuit breaker on the PCA.
2. Wait for the boot process to be completed. Continue when each cabinet has its STOP/RESET button illuminated solid red.
3. At one of the CTB of the cabinets, use a small jumper wire to connect CTB-1 to CTB-2. The terminals are safe to touch.
4. When CTB-1 and CTB-2 are connected, confirm that the ENABLE button on all cabinets is illuminated with a pink or purple.
   If this does not occur, stop, and troubleshoot the control wiring, referring to the applicable submittal drawing shown in the Vertiv™ EnergyCore Lithium 7 Installation and Operation Manual SL-71369.
5. Remove the temporary jumper wire.

2.4 Initial Charging and Cell Balancing

Refer to the Vertiv™ EnergyCore Lithium 7 Installation and Operation Manual SL-71369 for cabinet voltage, current, and temperature requirements before running discharge tests as part of commissioning.

If unbalance in the SOC is present across series battery cells and the maximum and minimum cell voltages of a rack are greater than 80 mV after five days (120 hours) of continuous battery normal operation*, it is likely a battery cell has a capacitance issue, and needs replaced. Replace the battery module with the minimum cell voltage, reset the five day normal operation, and allow the cabinet to balance. If the issue occurs after the five day period, contact Vertiv engineering team.

NOTE: *Continuous normal operation consists of 120 hours of battery cabinet operation without warnings or faults.

2.5 Log Download

The BMS of each Vertiv™ EnergyCore Lithium 7 cabinet stores detailed log files. The BMS will automatically copy its log files to any connected USB drive formatted as FAT32 with a directory named VERTIV_SERVICE in the top directory of the drive (for example, D:\VERTIV_SERVICE). The log files will be automatically organized on the USB drive by serial number and download date.

To download log data:

1. Verify the VERTIV_SERVICE directory exists on the USB drive. If not, create it.
2. Install the USB drive into the USB port.

NOTE: It is recommended to use a USB drive with an LED indicator to monitor data transfer activity and to confirm when the download is complete.

NOTE: USB dimensions not to exceed the following measurements: 52 mm (2.05 in.) in length x 20 mm (0.79 in.) in width x 9 mm (0.35 in.) in height.

3. Remove the USB drive and repeat this process for each cabinet in the system.

3 Introduction of GHMI Touchscreen-Service

3.1 Navigating Through the Touchscreen Control Panel

Refer to **Vertiv™ EnergyCore Lithium 7 Installation and Operation Manual SL-71369** for information on navigating through the touchscreen control panel.

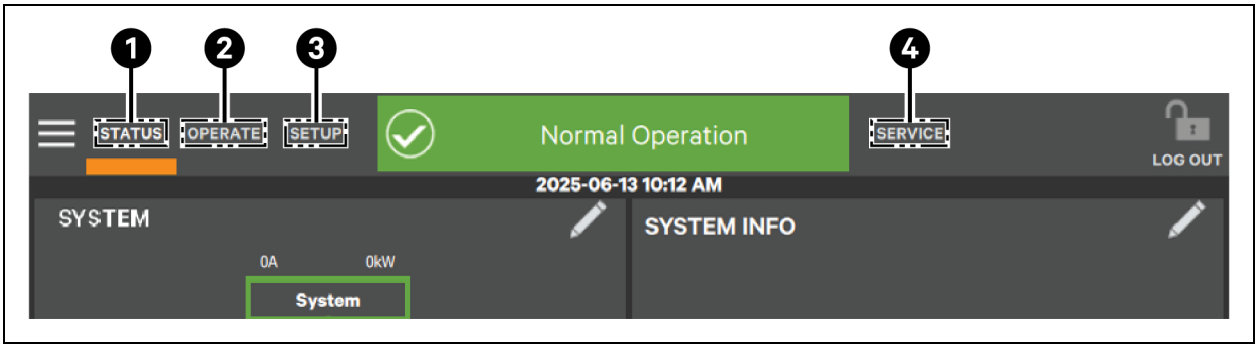
3.1.1 Login Information

The touchscreen control panel has four access levels, with one access level specific to Service.

The Service level, that allows configuration changes, is the only level that requires a PIN by default. To set or change a PIN, refer the Context Menu—SERVICE on page 15.

Figure 3.1 below shows the GHMI display based on the access level.

Figure 3.1 Opening Screen Service



Item	Description
1	Setup tab
2	Operate tab (only displayed in Administrator or Service mode)
3	Setup tab (only displayed in Administrator or Service mode)
4	Service tab (only displayed in Service mode)

SERVICE: shows the battery cabinet diagnostics, system updates, unit configuration, and menu usage history. It is visible only to Service level access.

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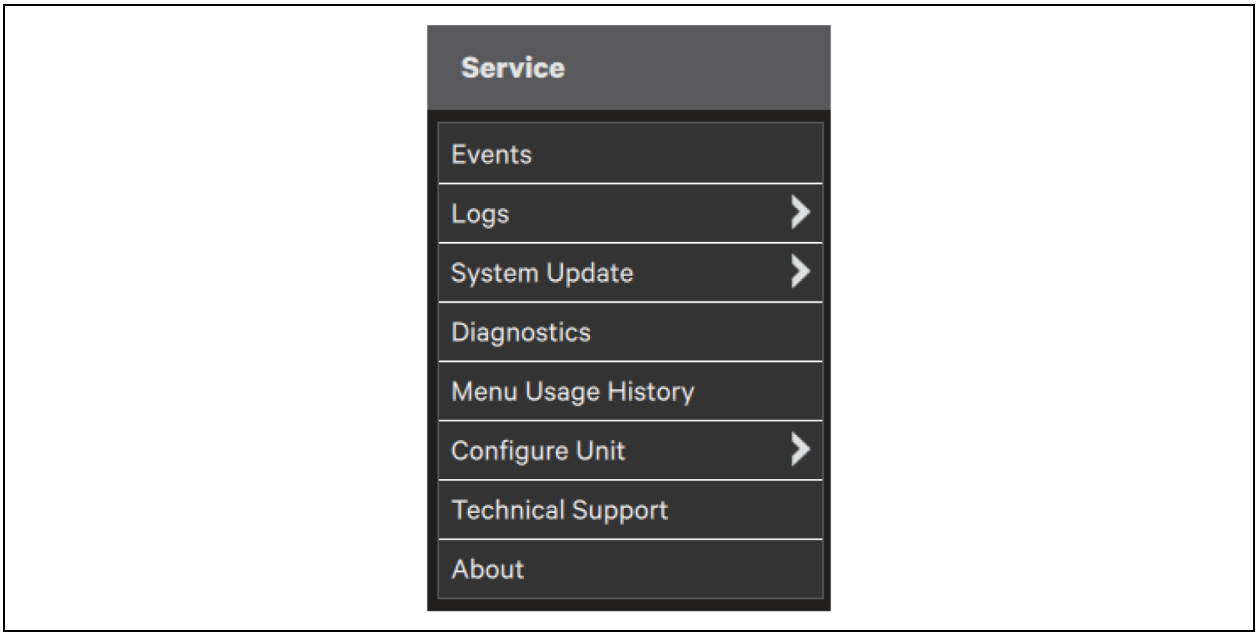
3.1.2 Context Menus

Click the *Menu* icon at the top left corner of the interface, a Context menu appears, showing information of the battery cabinet and allowing modifications of various settings.

The user's access level and the active Function Menu determine the functions that can be performed through the Context Menus (Status, Operate, Setup, and Service). For more information on the Service Context Menu, see Figure 3.2 below.

Figure 3.2 Context Menus



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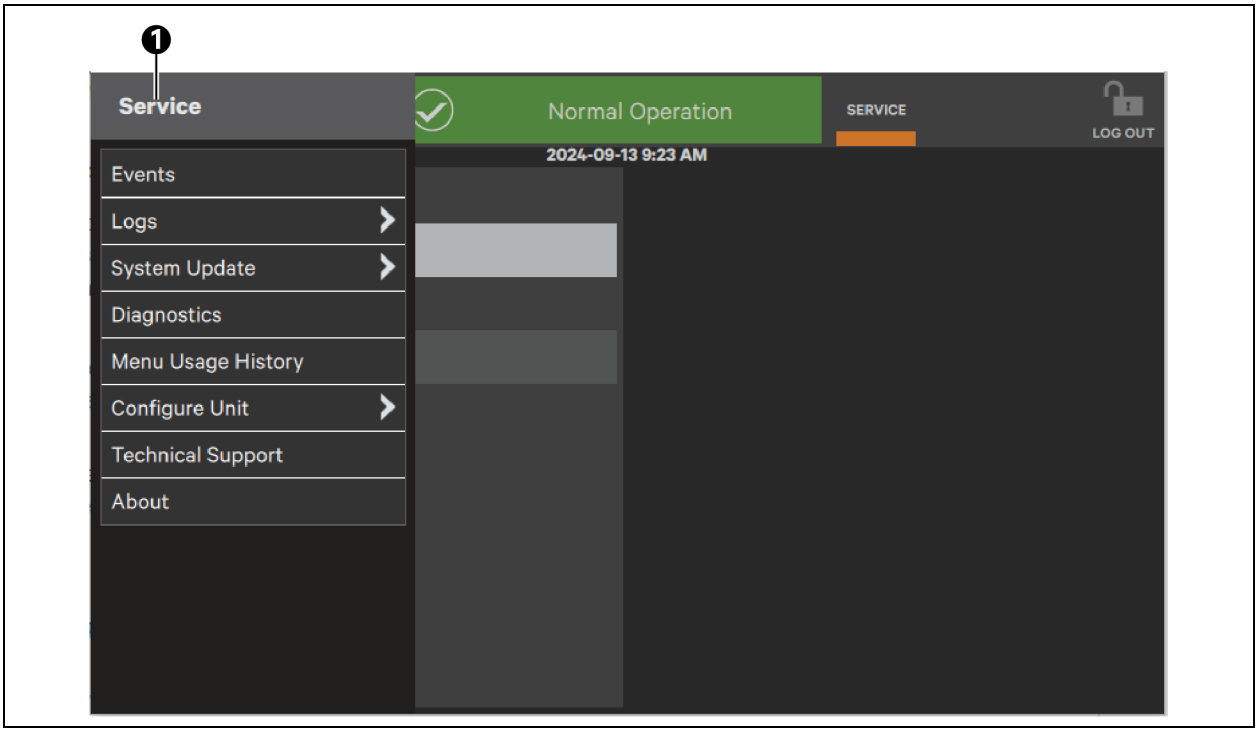
Context Menu—SERVICE

Click SERVICE icon and click the *Menu* icon, a service context menu appears that allows the user to access several actions or additional information. See Figure 3.3 below. Click a SERVICE context menu to show data, or expand the menu with more options. For more information see Figure 3.3 below.

Figure 3.3 Service Context Menu



Item	Description
1	Service context menu

The context menu for the SERVICE icon shows below items:

- Events: Date and time of occurrence, type of event, component affected and description. Events can be sorted by type, component, description. The touchscreen also allows filtering events by severity (Status, Alarm, or Fault) or by component (UPS or battery cabinet where the event occurred).
- Logs:
  - Audit Log: Audit Log shows date and time that users with battery cabinet Service or Admin access logged into and out of the system. In addition to date and time logging, the audit log shows user, event type, and ID data.
- System Update:
  - Display Update: Display software update information and available firmware versions for GHMI update. Shows the currently installed application and bootloader firmware versions.
- Diagnostics: Board versions, CAN health, and installed options.
- Menu Usage History: Shows user title, menu item, and screen presses used on the status, operations, settings, and service menu.
- Configure Unit:

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    - **Configure Wizard:** Pulls up configuration screen seen upon initial startup. Used to reconfigure the unit if needed.
    - **Serial Ports:** Serial port settings which include the name and location of the ports.
- **Technical Support:** Manufacturer provides support through e-mail address or telephone number.
- **About:** Information about the battery cabinet model, model number, and serial number.

Appendices

Appendix A: Technical Support and Contacts

A.1 Technical Support/Service in the United States

Vertiv Group Corporation

24x7 dispatch of technicians for all products.

1-800-543-2378

Liebert® AC and DC Power Products

1-800-543-2378

A.2 Locations

United States

Vertiv Headquarters

505 N Cleveland Ave

Westerville, OH 43082

Europe

Via Leonardo Da Vinci 8 Zona Industriale Tognana

35028 Piove Di Sacco (PD) Italy

Asia

7/F, Dah Sing Financial Centre

3108 Gloucester Road, Wanchai

Hong Kong

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A.3 Technical Support/Service in the Asia/Pacific Region

Australia

Email: au.service@vertiv.com

Phone: +61 1300 367 686

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Phone: +60 1800 221 388

Singapore

Email: sg.service@vertiv.com

Phone: +65 1800 467 2326

Philippines

Email: ph.service@vertiv.com

Phone: +63 2 8620 3655

Thailand

Email: callcenter.th@vertiv.com

Phone: +66 2 278 6650

Vietnam

Email: vn.service@vertiv.com

India

Phone: +91 18002096070

China

Email: vertiv.service@vertiv.com

Phone: +86 4008876510

A.4 Technical Support/Service in Europe, Middle East and Africa Region

https://www.vertiv.com/en-emea/contacts/

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 https://www.instagram.com/vertiv/

 https://www.linkedin.com/company/vertiv/

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