

KiloVault HLX and CHLX Lithium Iron Phosphate Deep Cycle Solar Batteries



Installation and User Manual

Revision: 2.1.2, 04/2021



****WARNING High Voltage Risk of Personal Injury or Death****

As is the case with all batteries, the risk of shock is present. When handling batteries, use protective measures including, but not limited to, safety glasses, insulated gloves, and protective footwear.

When working with or installing batteries, use electrically insulated gloves and tools. Remove personal metal items such as watches, rings, bracelets, etc.

The information included in this manual is accurate at the time of publication. However, this manual is subject to change without prior notice as we continuously improve our products.

Additionally, the illustrations in this manual are for demonstration only and are intended to help explain the KiloVault® HAB™ system concepts and installation instructions. Details may vary slightly depending upon the market region and the product version.

Please note: If this unit is installed by someone other than the end-user, the installer must explain the contents of this installation and user's manual to the end-user.

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1 - About the HLX and CHLX batteries

The KiloVault® HLX and CHLX series of solar lithium batteries are specifically designed and tested for the beating that serious hybrid, off-grid inverters, and solar charge controllers can throw at them. Compared to traditional deep cycle batteries, the HLX and CHLX series' lithium battery technology more efficiently stores and delivers the renewable energy that you have generated, with no maintenance on your part.

This manual contains important information regarding the safe use of KiloVault® HLX series batteries. Your battery is an electrical device that will provide years of useful service with proper care. Ensure you read and understand the instructions contained in this manual before use.

1.1 - Features - HLX & CHLX

- 12 V Lithium Iron Phosphate (LiFeP04) with Bluetooth
- Models: KLV1200HLX and CHLX (100 Ah/1200 Wh), KLV1800HLX and CHLX (150 Ah/1800 Wh), KLV3800HLX and CHLX (300 Ah/3600 Wh)
- Flexible: Works in 12 Volt (V), 24 V, or 48 V configurations
- Gives You More: Use the full battery capacity if necessary. HLX withstands occasional 100% discharges. **Please Note: frequent 100% discharges will decrease battery life.**
- Long-life: Even after 2000 full discharges, 80% of the total battery capacity remains
- Maintenance Free: No watering or cleaning of hazardous chemicals required
- High Efficiency: 94.5%, providing up to 12% more usable stored energy
- Smart Investment: Lower cost per watt-hour/cycle and longer lifespan than lead batteries
- Safer: No thermal run-away issues as with other lithium technologies
- Heavy Duty: The 1200 HLX takes up to 80 continuous charging amps, 100 continuous discharging amps. 1800 and 3600 HLX take up to 150 amps of continuous charging/discharging current, all three meeting the tough demands of serious inverters and chargers
- Integrated Battery Management System (BMS)
- HLX iT Bluetooth Monitoring Application (iOS and Android)
- 7.5 Years Limited Manufacturer's Warranty

1.1.1 - Battery Management System

Every KiloVault® battery contains a BMS that helps protect it from over voltage charging/discharging, over current charging/discharging, and extreme temperatures while charging and discharging. While this system is robust, batteries must be installed using appropriate inverter charge controller settings, devices to protect them from open photovoltaic (PV)/solar panel voltage, and other high voltage charging sources. Failure to adhere to proper installation requirements will void the warranty and may damage the system.

1.1.2 - HLX iT, the Bluetooth Monitoring Application

The KiloVault® smartphone Bluetooth app enables you to view general information about the selected individual battery. It can help troubleshoot when attempting to detect the cause of the battery bank going off-line. The app is available for free download for both Android and iPhone phones. Each battery is identified by a unique name assigned at the factory.

1.1.3 - CHLX Only

CHLX Series lithium batteries include all the advantages of the HLX Series with the added benefit of cold weather operation. Internal heating technology allows the battery to continue charging, even when the ambient temperature is well below zero.

The 1200 CHLX heater is 64 W. The CHLX 1800 heater is 96 W, and the CHLX 3600 heater is 192 W. The heater is powered by charging current, not by the battery. The battery does not self-discharge to warm itself.

In all of the batteries the heater starts at an internal temperature of 0°C (32°F). Below an external temperature of -30°C (-22°F), the heat dissipation is too great to bring the battery up to temp.

When the batteries are on an AC charger, it takes about 2 hours to warm the battery from an internal temperature of -30°C (-22°F) to 10°C (50°F). It will take about 1.5 hours to warm the battery from an internal temperature of -20°C (-4°F) to 10°C (50°F).

When the batteries are charging with solar, it might take a longer time, depending upon the charger output.

The CHLX also differs from the HLX in that they communicate with each other over the battery cables to coordinate heating. To make sure this communication can take place CHLX can only be wired up to 4 batteries in parallel **OR** up to 4 batteries in series, *but not both*. They cannot be wired in a combination series & parallel configuration. Doing so will disrupt the coordination between CHLX batteries.

1.2 - Contact Us

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+1 (888) 218-5924
info@kilovault.com
www.kilovault.com

2 - Safety Information

2.1 - Symbols Used in this Manual

	Warning: Indicates a condition that can cause personal risk or injury.
	Caution: Indicates a condition that can cause equipment damage.
	Note: Indicates points of interest of particular emphasis that make operation more efficient or convenient.

**Disclaimer:**

Indicates information limiting the scope of responsibility.

2.2 - Warnings



High Voltage Risk. Improper use may cause personal injury or death.

Do not use a battery that appears damaged in any way.

All batteries present the risk of shock, use protective measures when handling. When working with or installing batteries use electrically insulated gloves and tools. Remove personal metal items such as watches, rings, bracelets, etc.

High voltage connections of batteries (configurations of greater than 36 V DC nominal) are dangerous. DC voltages over 52 V can stop the adult human heart and a fully charged 48 V nominal system is over this level. Use appropriate safety measures including the removal of metal personal items and insulated gloves.

A small risk of spark exists while making electrical connections. Ensure the installation area is free of explosive gases and liquids. Ensure the batteries are not installed in confined areas containing explosive substances. This includes flammable fuel powered machinery, holding tanks, pipe fittings, and connectors.

In the unlikely event of a fire, when possible first shut off the source of electricity. Class ABC extinguishers are recommended in close proximity of your power generating equipment and are best suited for multipurpose fire types such as wood, flammable liquids, and electrical appliances.

Respiratory irritation may be caused if the battery is punctured or cracked.

Skin contact with a punctured or otherwise open battery can cause irritation.

To avoid risk of shock or fire, ensure all wires are properly sized and in good condition.

Verify all equipment to be connected to the batteries is turned off before making any electrical connections.

Do not submerge the batteries. This can cause personal injury and will void your warranty.

Do not attempt to disassemble the batteries. This can cause personal injury and will void your warranty.

KiloVault® batteries can be used in RV applications for electrical appliances ONLY. They can NOT be used to crank over motors in such vehicles.

3 - Installation

3.1 - Before You Install Your Batteries

1. When gathering your tools for your installation, please make sure that you have a digital multimeter with a 0.1 V accuracy. It will help you to verify battery polarity before you make any connections. You can also use the multimeter to ensure that your batteries are at the same voltage.
2. Please write down and save the serial numbers of your batteries along with the rest of your system information. If you have already downloaded and installed the HLX iT battery monitoring application, also write down and save the battery names.
3. Each battery **must** be commissioned by individually charging it to exactly 14.1 V before placing it into operation with other batteries. Otherwise, the batteries will be fully charged or fully discharged at different times and could cause a low voltage or high voltage disconnect.
 - a. You will see 14.1 V while the battery is still on the charger and actively charging. When charging is finished and the charger shuts off or the battery is disconnected, the voltage will slump to 13.3 > 13.6 V. This is normal. The battery is still fully charged.
 - b. Due to transportation regulations, lithium batteries cannot be shipped fully charged. As a result, if you have purchased more than one battery for your system all batteries must be fully charged to exactly 14.1 V before using.
 - c. Many automotive type battery chargers will not reach 14.1 V. Please check charger specifications when selecting your charge. You can contact your KiloVault® distributor for a list of recommended chargers. An acceptable charger
 - i. Must be a 12 V charger.
 - ii. Maximum charge voltage - 14.2 V.
 - iii. Must have Equalization disabled.

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- iv. 1200 HLX/CHLX maximum charge amperage - 80 A.
 - v. 1800/3600 maximum charge amperage - 150A.
 - vi. Charger must taper the amps as the battery approaches 14.1 V.
 - d. After batteries are fully charged and disconnected from the charger, allow them to rest for a minimum of two hours. During this time, the voltage will relax, even as low as 13.3 V. Your batteries are still fully charged. This is normal.

3.2 - Location

Locate your battery bank in a place that is dry and as well protected from extreme temperatures as possible. No ventilation is required as these do not off-gas like lead-acid batteries do.

HLX and CHLX batteries must be placed flat on their bottoms. Any other orientation will void the warranty. Also, do not stack them one directly on top of another.

Batteries warm up while in use. Please consider your local average and seasonal temperature when positioning your battery bank. If they will be in a warmer environment you may want to leave a minimum of one inch spacing between each of the batteries.

If they will be subjected to cold temperatures you may want to place them as closely as possible to each other. Consider adding insulation or an insulated enclosure around the batteries if they will be exposed to temperatures that approach 32°F (0°C). The BMS will not allow charging below freezing. Using insulation when it is cold will maintain more of the heat generated during normal charging and reduce the chance of the BMS shutting the battery down to protect the battery cells.

Please note: Battery capacity is reduced by 20% as its internal temperature falls between room temperature (approximately 77°F (25°C)) and just above 32°F (0°C).

If you purchased CHLX batteries and if there is a charging current, the battery heaters will activate.

Please remember to remove the insulation in warmer months. Overheating the batteries will shorten their life and the BMS will shut down the battery in temperatures above 149°F (65°C).

3.3 - Cabling

All wire must be the appropriate gauge and construction to handle the loads that will be placed upon it. Heavy gauge, fine stranded copper wire is the industry standard. A minimum of 2/0 or 4/0 AWG copper cable is recommended for battery interconnect cables.

The cables connecting batteries in series into rows must be the same length. The cables connecting the rows in parallel must be the same length. The home run cables to the inverter must be the same length. Cables of different lengths will cause voltage differences in your battery bank. The rows in your battery bank must be kept within 0.2 V of each other to ensure that they work correctly and that large currents between rows aren't generated.

If your battery bank suddenly shuts down as one or more rows approaches fully charged or fully discharged, it is likely either the batteries are not all at the same state of charge or, if they are measured with a multimeter to be all the same voltage, the voltage drop across the cables connecting the rows is not equal. Also use the voltmeter to make sure that the voltage drops across each battery interconnect is very close.

Torque all bolts and battery terminals to 88.51 to 97.36 in lb (10 - 11 Nm). Terminals left insufficiently tightened will lead to overheating, melting the battery and potentially causing a fire. Be careful when using thin washers. You may think you're applying sufficient torque, but if the washers are too thin, the cable lugs can still move. Add additional washers until you can tighten and the cable lugs cannot move.

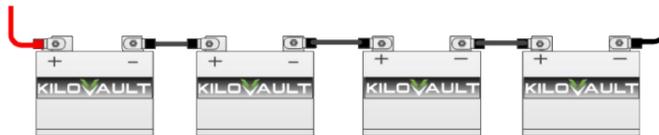
3.4 - Configurations

The KiloVault® HLX series of batteries can be used 12 V, 24 V, 36 V, and 48 V configurations where one, two, three or four batteries are connected in series, plus to minus, in a row. The maximum number of batteries in a bank is limited to sixteen (4 in parallel and 4 in series). Each row of batteries must be kept within 0.2 V of each other or the battery bank may prematurely shut down during charging and discharging.

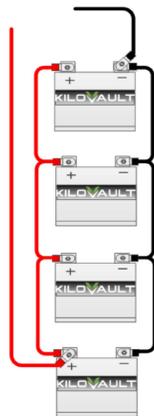
Exception: CHLX can only be wired up to 4 batteries in parallel **OR** up to 4 batteries in series, but not both. They cannot be wired in a combination series & parallel configuration.



Maximum HLX Configuration



Maximum CHLX Series Configuration



Maximum CHLX Parallel Configuration

4 - Operation

It is very important that your battery chargers (solar charge controller, inverter/charger or AC) can be set to settings appropriate for the HLX & CHLX. If it cannot, please contact KiloVault Technical Support for guidance.

Also, some chargers just have settings for broad battery types like; flooded, gel, agm or lithium. Before using these chargers on your battery, please contact KiloVault technical support for guidance.

Note: If you cannot find a specific setting, remember to check the settings for guidance. Also, please don't hesitate to contact KiloVault technical support for help.

Voltages are per HLX in a single series string. Amperages are per total HLX strings in parallel.

Adjust your settings as necessary until your system best fits your power use patterns and needs.

4.1 - Inverter/Charger Settings

Setting	Values - Volts are per battery in a single string, Amps are per string in parallel
1200 - Battery Capacity	1200 Wh. 100 Ah
1800 - Battery Capacity	1800 Wh. 150 Ah
3600 - Battery Capacity	3600 Wh, 300 Ah
1200 - Max Charge Current	80 A
1800/1600/3600 Max Charge Current	150 A
Absorb End Amps	2 A
Absorb Time (some controllers do not allow a selection under 6 minutes, please contact KiloVault for additional information)	2 minutes or less
Absorb Voltage	14.1 V

Battery Temperature Compensation	0 mV/°C
Battery Type	Lithium or Custom, whichever lets you set the recommended settings
Bulk Voltage	14.1 V
Charge Cycle	2 stage no float
Default Battery Temperature	Warm
Equalization	Disabled
Float Voltage	n/a
HBCO (High Battery Cut Out)	14.4 V
LBCO (Low Battery Cut Out)	12.25 V (or as close as it can be set)
LBCO Delay	5 seconds
LBCO Hysteresis	0.5 V
Max Bulk Current	Set to whatever percentage of the inverter current plus the charge controller current is less than or equal to 100 A
Peukert Factor	1.05
Recharge/Re-Bulk Volts (≈80% DoD)	12.75 V
1200 - Recommended Charge Current	60 A per HLX in Parallel (Solar Charge Controller Amps + Percentage of Inv/Charger's Max DC Output. Ex: For an XW Pro, it would be a percentage of 140 A, the XW Pro's Max DC Output Current)
1800/3600 - Recommended Charge Current	100 A per HLX in Parallel (Solar Charge Controller Amps + Percentage of Inv/Charger's Max DC Output. Ex: For an XW Pro, it would be a percentage of 140 A, the XW Pro's Max DC Output Current)
1200 - Standard Charge Current	60A
1800/3600 - Standard Charge Current	100 A

4.2 - Solar Charge Controller Settings

A couple of notes regarding charge controller settings. When used along with an inverter charger, we suggest that the solar charge controller be set to 3-stage charging, while the inverter/charger is set to 2-stage No Float. That way you're floating your batteries for free with the sun.

Also, set your charge controller's Recharge / Rebulk voltage, where a new charge cycle starts, to just above your inverter/chargers recharge setting, so the solar charge controller starts charging before the inverter does.

Setting	Values - Volts are per battery in a single string, Amps are per string in parallel
1200 Battery Capacity	1200 Wh, 100 Ah
1800 Battery Capacity	1800Wh, 150 Ah
3600 Battery Capacity	3600Wh, 300 Ah
Absorb Time	2 minutes or less
Absorb Voltage	14.1
Battery Temperature Compensation	Do not use an external battery temperature sensor with these batteries. If the sensor or compensation value is required for a charge controller or inverter charger to work, set the battery temperature compensation to 0mV/°C
Battery Temperature Compensation	0.00 mV/degC
Battery Type	Lithium or Custom, whichever lets you set the recommended settings
Battery Voltage - Nominal	12 V
Bulk Termination Voltage (if applicable)	13.9 V
Bulk Voltage	14.1 V
Charge Cycle	3 stage
Equalization	Disabled
Float Voltage (set below the resting voltage of the battery bank)	≈13.6 V or lower. Low enough to not trigger float when the battery "relaxes" after charging stops.
Max Float Current	10 A
Maximum Charge Rate - 1200	1.25C, 80 A
Maximum Charge Rate - 1800	1C, 150 A
Maximum Charge Rate - 3600	C/2, 150 A

Recharge Volts (≈80% DoD)	Just above your inverter/charger recharge/rebulk volts so it starts charging from the sun before the inverter starts charging from the grid or generator.
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4.3 - Battery Monitor Settings

Not all battery monitors will have all of these settings. We've tried to include as many as are common between manufacturers.

Setting	Values - Volts are per battery in a single string, Amps are per string in parallel
1200 Battery Capacity	1200 Wh, 100 Ah
1200 C-Rating	1.25 C
1800 Battery Capacity	1800 Wh, 150 Ah
1800 C-Rating	1C
3600 Battery Capacity	3600 Wh, 300 Ah
3600 C-Rating	C/2
Battery Efficiency	94.50%
Charge Ending Amps	2 A
Charger Float Current - 1800 - 1% of capacity	1.5 A
Charger Float Current - 3600 - 1% of capacity	3 A
Charger Float Voltage	≈13.6 V
Fully Charged Voltage	14.1 V
Nominal Temperature	77°F (25°C)
Peukert's Exponent	1.05
Recharge / Re-Bulk Volts (≈80% DoD)	12.25 V
Self Discharge Rate	≤2% per month
Temperature Coefficient	0 mV / °C

4.4 - Generator / Automatic Generator Control Settings

With one exception that we know of, the battery related settings for using a generator and/or an automatic generator start/stop (AGS) control with HLX/CHLX batteries can be found in the inverter/charger and solar charge controller settings.

Some generators and/or AGS have settings for 2 minute, 2 hour and 24 hours (or similar duration) start voltages. They set time limits the battery voltage can sit at before activating the generator. They are related to the Low Voltage Disconnect/Cut-Off voltage and the Recharge/Rebulk voltage. Expect to adjust all of them to get exactly the generator behavior you wish.

- 2 minutes - Set just above the inverter/charger Low Voltage Disconnect (12.25 V) so the generator starts before the inverter stops inverting.
 - Start at approx. 12.3 V.
- 2 hours - Set above the 2 minutes volts.
 - Start at approx. 12.4V.
- 24 hours - Set just below the Recharge/Rebulk voltage. If the Recharge/Rebulk setting hasn't already started the generator in this time, the generator will start.
 - Start at approx. 12.7 V if Recharge/Rebulk is 12.75 V.

4.5 - HLX iT Bluetooth Mobile Application



Disclaimer:

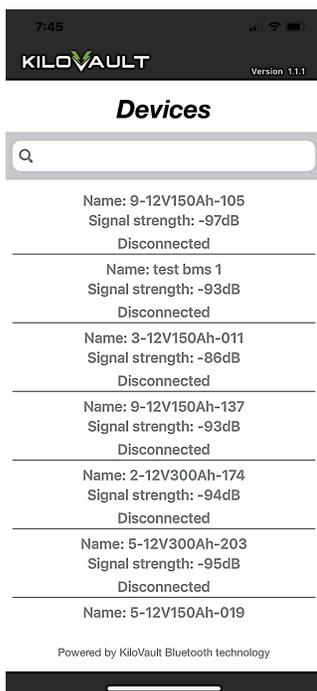
The KiloVault® Bluetooth® mobile application is provided as is and is solely intended to gather general information. It is not intended to replace a voltmeter, ammeter, or any other testing / measurement device. Nor is it guaranteed to work with every mobile device.

The KiloVault® smartphone Bluetooth® app enables you to view general information about the selected individual battery. It can help troubleshoot when attempting to detect the cause of the battery bank going off-line. The app is available as a free download for both Android and iOS devices on the iOS and Google Play app stores.

Your Android / iOS mobile device must support Bluetooth® 4.0 and Bluetooth® Low Energy (BLE). The iOS version requires iOS 10.0 or later and is compatible with iPhone, iPad, and iPod touch. The Android version requires Android 4.3 (Jelly Bean) and up. Additionally, the Android version must have permission to access both *Location* and *Local Storage*.

4.5.1 - HLX iT Screens & Operation

When you first start HLX iT, if you have bluetooth enabled, the screen will show all of the HLX batteries within a 100m radius, depending on the physical or electrical interference.



Battery List Screen



Basic Information



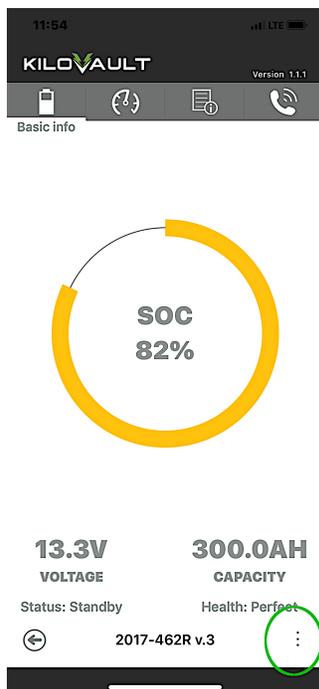
Closeup - Tabs

Tap on any of the batteries shown. The Basic information screen will load, along with 4 menu tabs or buttons or icons at the top of the screen.

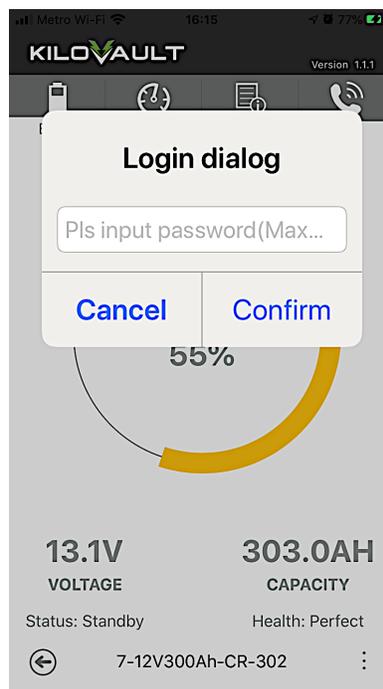
The Basic Information screen shows the voltage, state of charge, capacity, status (charging / discharging / standby), and health of that battery. The state of charge (SoC) is an estimated value and does not drive any battery behaviors / performance. To get back to your list of batteries, tap the arrow in the lower left corner of the screen.

From the Basic screen you can also get detailed information on battery current alarms, individual battery cells and if you wish, rename your batteries.

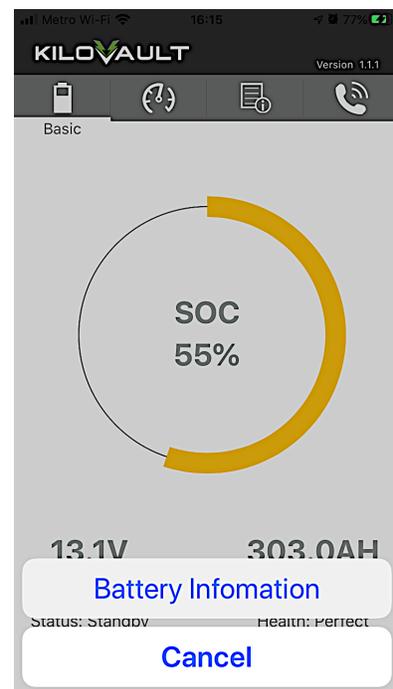
To get information on individual cells, first tap the ":" symbol in the lower right corner of the Basic Information screen. A login dialog will appear. Type "1234" into the login dialog and tap "confirm". A button called "Battery Information" will appear. Tap that button. A semi-transparent screen will appear with 8 button-like icons. They indicate if the battery has any active alarms. The indicators are normally green. They will be red if there is an alarm. They are High Voltage (HV), Low Voltage (LV), Overcurrent Charging (OCC), Overcurrent Discharging (OCD), Low Temperature Discharging (LTD), Low Temperature Charging (LTC), High Temperature Discharging (HTD), High Temperature Charging (HTC).



Location of the ":" Symbol



Login Dialog



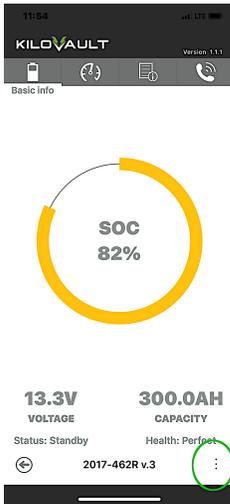
Battery Information Button

Below the alarm indicators are 4 battery shaped icons. They represent the 4 cells that make up the battery. Their color does not indicate anything. They are always the same color. Below each battery icon is a number showing each cell's voltage in mV (millivolts). The color of the numbers do not mean anything. They're always the same color. The difference between the highest and lowest should be 300mV or less. Tap anywhere to dismiss this screen.

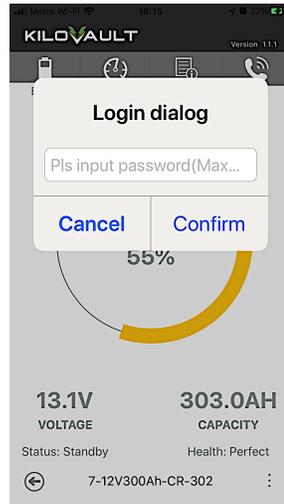


Battery Details Screen

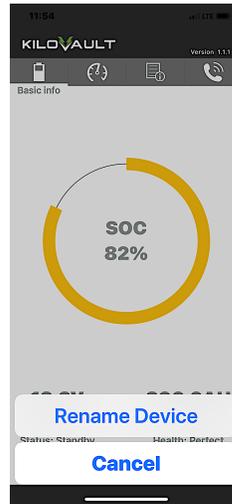
To rename your batteries, first write down the original battery name, the battery serial number, and store this information in a safe place. Then tap the ":" symbol in the lower right corner of the Basic Information screen. A login dialog will appear. Type "5678" into the login dialog and tap "confirm". A button called "Rename Device" will appear. Tap that button. The "Rename" dialog will appear. Type in the new name and tap "Confirm". The battery is now renamed.



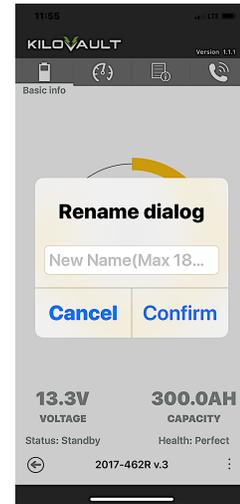
Location of the ":" Symbol



Login Dialog



Rename Device Button



Rename Dialog

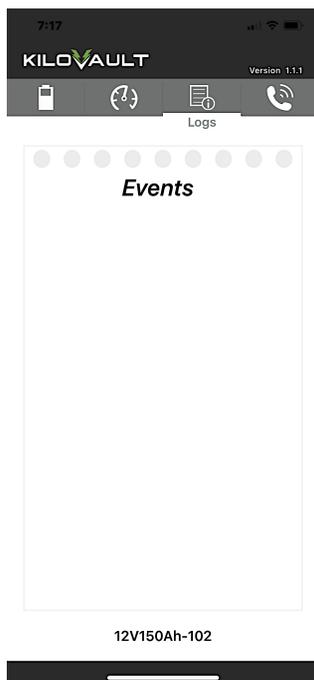
Tap the dial shaped tab (the second from the left) at the top of the screen or swipe across the screen to get to the Advanced information screen. It shows the battery voltage, amps, the battery internal temperature and the cycle life (number of times cycled).

Tap the paper shaped tab (the third from the left) at the top of the screen, or swipe across the screen to get to the alerts screen. Here you'll find any active Events on the HLX. Events are not saved into any kind of history.

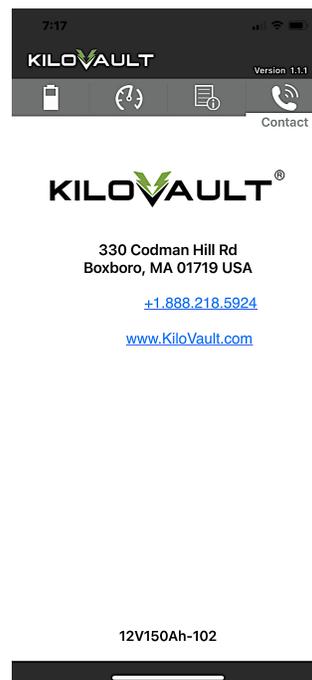
Tap the telephone tab (the fourth from the left) at the top of the screen, or swipe across to get to the KiloVault communications screen. Here you'll find links to email or call KiloVault directly.



Advanced Information Screen



Events Screen



Communications Screen

5 - Troubleshooting / Q&A

1. Why is the battery bank suddenly shutting off?

- Likely, one or more of your batteries are not at the same voltage as the others. Those batteries are hitting the upper or lower voltage cutoffs ahead of the others. When those batteries shut themselves off to protect themselves, the battery bank drops below the operating voltage of the inverter. Check all of the battery connections. Charge each battery up to 14.1 V. If the problem persists, please contact KiloVault.
- Your loads (DC load or inverter) have exceeded the current capacity of the batteries bank. KiloVault batteries can handle 150 A continuous and 500 A very briefly. If your known loads are close to 150 A continuous or have very high surge loads like pumps or HVAC systems, your loads may simply be too high for your bank. Please contact KiloVault about adding an additional parallel row of KiloVault batteries to your bank.

2. Why aren't the battery voltages staying equal over time?

- The battery cables are not of equal length or are damaged. Check to make sure that all battery interconnects are of equal length, gauge and are in good condition.
- Cable terminal hardware is not tightened properly. Check to make sure that all terminal hardware is tightened to 88.51 to 97.36 in lb (10 - 11 Nm). Check to make sure all of the crimps on all cables are tight and solid. Use the Ohms (Ω) setting on a voltmeter to measure the resistance of the battery interconnect cables. They should all be within 0.1 ohms of each other.

3. Why has the battery reversed polarity?

- Verify the voltmeter probe orientation.
- The battery has dropped into the low voltage protection range and the BMS has shut down the battery. If so, you can wait for the battery to reset or you can connect the battery to a 14.1V charge.

4. Why is the battery turning off and off when it is connected to a small DC device or inverter?

- The KiloVault® batteries have an automatic standby mode where they will shut themselves down if they do not see a load of more than 200-250 mA. That is about 3 Watts per series battery (i.e. 3 watts for a single 12 V battery, 6 watts for 24 V series, and 12 watts for 48 V). In the standby mode the battery turns back on about every 15-20 seconds to search and

see if there is load connected to it. If your load is not larger than this minimum current then the battery will not stay on.

- Consider connecting an additional small DC load to the batteries to increase the current draw to over 250 mA. If you are using an inverter, it is possible that it is going into its own standby mode and it is consuming less than the minimum current required to keep the batteries on. Also, for this case of the inverter, consider adding another small additional DC load to increase the current draw to over 250 mA.

5. Can an HLX / CHLX battery be charged with an auto / RV alternator?

- Yes, as long as the alternator provides less than 150 A of charging current and does not exceed 14.0 V.

6. What is the terminal mounting hardware size?

- M8 x 1.25 x 16mm (Models shipped before 10/31/2018 will be M8 x 1.25 x 12mm)

7. What are the recommended voltage settings for a generator?

- We recommend a low-voltage start of 12.3V and a cut-off voltage of 13.9V (multiply those numbers by 2 for 24V and 4 for 48V systems).

8. What voltage settings are recommended for an 80% depth of discharge?

- We recommend an absorption voltage of 14.1 V, float voltage of ≈ 13.6 V or lower (low enough to not trigger float when the battery "relaxes" after charging stops) and a low voltage disconnect (for the inverter or DC load) of 12.25V. Multiply those values by 2 for a 24V system and 4 for a 48V system.

9. Is there a special mobile application to connect to the batteries via Bluetooth?

- HAB iT, the KiloVault® mobile Bluetooth® application, enables you to view general information about the selected individual battery. It can help troubleshoot when attempting to detect the cause of the battery bank going off-line. The app is available as a free download for both Android and iOS devices on the iOS and Google Play app stores.
- Your Android / iOS mobile device must support Bluetooth® 4.0 and Bluetooth® Low Energy (BLE). The iOS version requires iOS 10.0 or later and is compatible with iPhone, iPad, and iPod touch. The Android version requires Android 4.3 (Jelly Bean) and up. Additionally, the Android version must have permission to access both *Location* and *Local Storage*.
- Please note that the app is provided as is to serve as a free troubleshooting tool. Also, please be aware that a good voltmeter provides a more accurate voltage reading than the Bluetooth application.

10. Is there a desktop or Wi-Fi application to connect to the batteries?

- No, there are neither desktop nor Wi-Fi applications for the HLX.

11. What do I do if my inverter does not have an AC charger?

- Use a 12 V AC charger (capable of charging up to 14.1 V) connected to a generator or the utility company's power to charge each battery. We recommend the Iota Engineering DLS series of 12 V AC Chargers that are capable of being configured for this slightly higher voltage.
- Use a 12 V solar charge controller (set to 14.1 V or 'sealed battery' charging, as long as it gets to 14.1 V) with a solar panel to charge up the batteries individually. This method will take longer than an AC charger unless you are using a high amperage charge controller with sufficient solar panels.

12. Why is the battery turning on and off when it is connected to a simple battery monitor?

- The KiloVault® batteries need a minimum of 250mA to be drawn or they will go into their power saving, standby mode. The simplest solution is to connect additional loads to reach at least 250mA (3 Watts).

13. Why does the battery voltage momentarily drop when a load is initially connected?

- This is the normal result of the battery switch from its pre-charge function to provide enough current when connected to devices that have input capacitors and, in turn, high current surges in an extremely short period of time. The battery will resume its normal voltage and function mode within a few short seconds afterwards.

14. Why isn't the battery working when it is connected to the inverter?

- Some inverters have higher input capacitors whose current draw overcomes that of the pre-charge function of the battery. To minimize the initial discharge when the batteries are initially connected to the inverter, make sure that the inverter is off while connecting. Then wait 45 seconds before powering up the inverter.

15. Why does the HLX iT show short circuit events in the log?

- When the battery is connected to a DC load or a charging load the pre-charging function of the battery is disabled. That pre-charging function is used to compensate for the surge capacitors on the input side of inverters and other devices. This order of connecting devices may trigger the short circuit protection in the BMS once the high inrush device (usually an inverter) is connected. The solution here is to disconnect all

devices from the battery (even battery monitors), first connect the inverter, wait 45 seconds and then connect the remaining devices.

16. Do high temperatures affect how the batteries perform?

- Yes. Similar to lead acid batteries, the battery cycle life will be reduced if they are regularly charged and discharged above temperatures of 100 degrees F.

17. Do low temperatures affect how the batteries perform?

- Yes. Below freezing, to protect the battery cells, the HLX BMS will not allow charging. Also, the battery capacity reduces by 20% between room temperature (approximately 77°F (25°C)) and just above 0°C (32°F).
- The CHLX batteries are a special case. At 0°C (32°F), if there is a charging current, the CHLX will try and warm themselves up to 10°C (50°F).
 - Because of this, you cannot mix HLX and CHLX in situations where the battery bank will go below freezing.

18. Why is the voltage shown in HLX iT not the same as what is measured at the terminals?

- The gap between the volts shown in HLX iT and the volts measured at the terminals can be as large as 0.3 V, especially near the middle of a charge / discharge cycle. The gap closes at the beginning and ends of a cycle.

19. Why does HLX iT show my battery at 100% SoC when the battery voltage hasn't reached 14.1 V? Why are my batteries showing different States of Charge (SoC) even though they are at the same voltage?

- The SoC needs to be re-calibrated. Please try re-calibrating the battery SoC by doing the following:
 - Charging the HLX all of the way up to 14.1 V. If the SoC reaches 100% before the battery is at 14.1 V, please do not stop charging. Keep charging all of the way to 14.1 V.
 - Then Discharge the HLX all of the way to 12V.
 - Then re-charge the HLX normally, once again up to 14.1V.
- The SoC should now be re-calibrated.

Remember, the SoC reported in the app is an approximation for people to use, but the battery behavior is actually driven by the Volts and Amps.

20. My 1800 HLX is stuck in a protection mode. The voltage is in the single digits and it does not show up in HLX iT. How do I wake it up?

- If your HLX has a reset button, press it for 5 seconds. That should wake the HLX. Currently, only the 1800 HLX has a reset button.

6 - Storage and Recommissioning

For long term storage (i.e. 6 months or more) simply disconnect all sources of charge and discharging from the battery bank.

Although the batteries have a very low self discharge rate ($\leq 2\%$ /month, $\leq 12\%$ /year) they should be charged a minimum of every six months. Connecting a trickle charger is not recommended, unless the charger can be configured to stop charging at 14.2V or below. Most trickle chargers are not smart enough to provide this charge voltage ability. Over-charging the battery triggers the over-charge protection which shuts the battery down until the voltage goes down enough by itself. Once that happens the trickle charger would quickly raise the voltage up too high once again. As a result, the constant cycling of this circuitry will shorten the life of the entire battery.

Recommended Storage Temperature and Humidity: 15°C to 35°C, 45% to 75% Relative Humidity.

They can be stored at 4°F to 113°F (-20°C to 45°C), 45% to 75% Relative Humidity for 1 month or less.

They can be stored at 14°F to 95°F (-10°C to 35°C), 45% to 75 Relative Humidity for 3 months or less.

Re-commissioning your HLX / CHLX batteries is the same as commissioning them. Charge each battery up to 14.1V.

If the ambient temperature is below 39°F (4°C), reduce the initial charge current to no greater than 60A until the batteries have had a chance to warm up. If you have CHLX batteries and the temperature is below 32°F (0°C), the heater will activate and speed up warming.

7 - Specifications

These are HLX / CHLX specifications. Please see the Operation section for charger and other equipment settings.

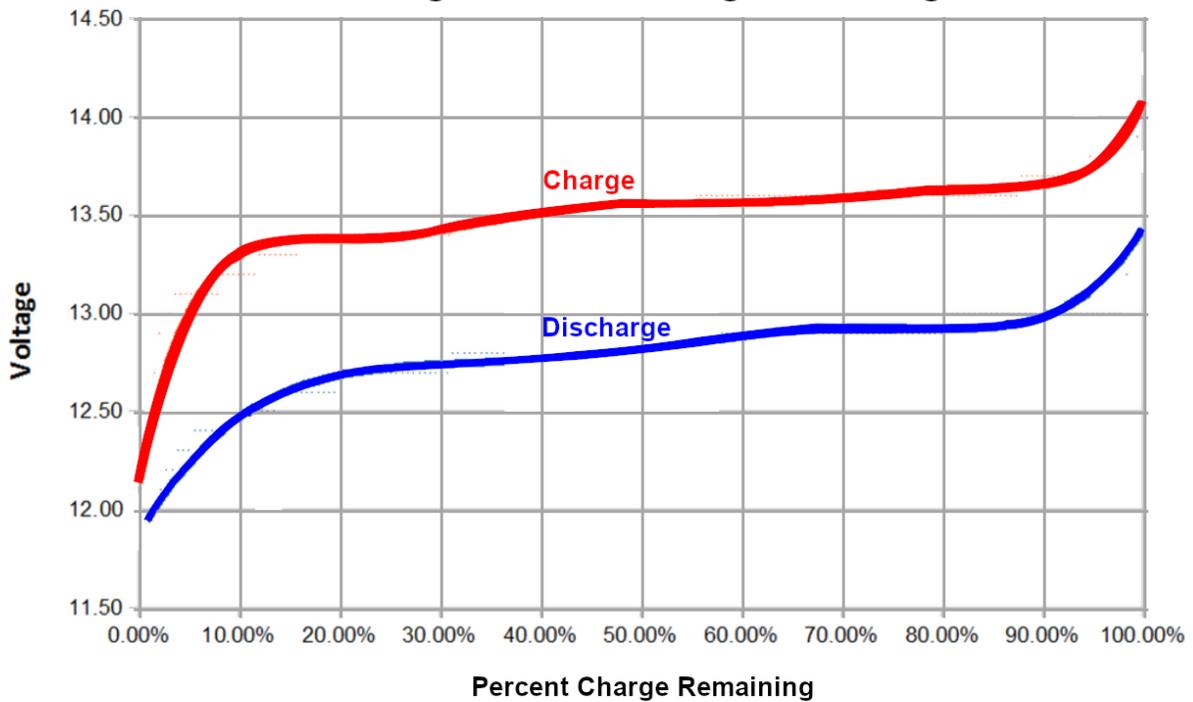
7.1 - Electrical

Specification	Value
1200 - Delay until Discharge Overcurrent Protection Cut Off @120 A	20 Seconds
1200 - Delay until Discharge Overcurrent Protection Cut Off @280	3.5 Seconds
1200 - Maximum Charge Current	80 A
1200 - Maximum Continuous Discharge Current	100 A
1200 - Peak Discharge Current (<3 seconds)	350 A
1200 - Rated Capacity	100 Ah
1200 - Standard Charge Current	60 A
1800 - Delay until Discharge Overcurrent Protection Cut Off @ 180 A	20 Seconds
1800 - Delay until Discharge Overcurrent Protection Cut Off @ 400 A	3.5 Seconds
1800 - Rated Capacity	150 Ah
1800/3600 - Delay Until Discharge Overcurrent Protection is Released	30 seconds after the load is disconnected.
1800/3600 - Maximum Charge Current	150 A
1800/3600 - Maximum Continuous Discharge Current	150 A
1800/3600 - Peak Discharge Current (<3 seconds)	500 A
1800/3600 - Standard Charge Current	100 A
3600 - Delay until Discharge Overcurrent Protection Cut Off @ 200 A	20 Seconds
3600 - Delay until Discharge Overcurrent Protection Cut Off @ 400 A	3.5 Seconds
3600 - Maximum 30 minute Discharge Current	200 A
3600 - Rated Capacity	300 Ah
Efficiency	94.50%

Estimated number of cycles at 100% DoD until 80% of rated watt hour capacity remains	2000
Estimated number of cycles at 80% DoD until 80% of rated watt hour capacity remains	5000
High Voltage Shutoff Protection	14.4 ±0.2 V
Low Voltage Shutoff Protection	11.5 V
Maximum Configuration - All CHLX Battery Bank	Up to 4 batteries in series OR 4 batteries in parallel but not both.
Maximum Configuration - All HLX or Mixed Battery Bank	Up to 4 parallel strings of 4 batteries in series (total of 16)
Maximum Time Between Charges	6 Months
Normal Self-Discharge Current	≤20 mA
Peukert Coefficient	1.05
Rated Voltage	12.8 VDC
Self-Discharge Rate	≤2% per month
Standby Mode Activated	Current Draw from Load < 0.25 A (250 mA)
Voltage Configurations	12 V, 24 V, 36 V, 48 V
1200 CHLX Heater	64 W
1800 CHLX Heater	96 W
3600 CHLX Heater	192 W
Minimum Cell Balancing Voltage	3500 mV/Cell
Maximum Cell Balancing Current	70 mA
BMS Type	Switching Shunt Resistor
Internal Resistance	≤10mΩ

7.1.1 - Charge / Discharge Curve

Kilovault HLX 1200, 1800 & 3600
Voltage v. Percent Charge Remaining



7.2 - Environmental

Specification	Value
Charging Temperature Range	32°F to 113°F (0°C to 45°C)
Discharging Temperature Range	-4°F to 140°F (-20°C to 60°C)
High Internal Temperature Charge Protection	149°F (65°C) with protection release at 122°F (50°C)
High Internal Temperature Discharge Protection	149°F (65°C) with protection release at 122°F (50°C)

Ingress Protection - Dust	Dusty environment OK. Ingress of dust not entirely prevented but does not enter in sufficient quantity to interfere with the satisfactory operation of the battery.
Ingress Protection - Water	Water jets: Water projected by a nozzle (6.3 mm (0.25 in)) against enclosure from any direction shall have no harmful effects.
Low Internal Temperature Charge Protection	32°F (0°C) with protection release at 39°F (4°C)
Low Internal Temperature Discharge Protection	-4°F (-20°C) with protection release at 14°F (-10°C)
Maximum Altitude	3000 meters
Optimal Temperature Range	59 – 95°F (15 – 35°C)
Recommended Humidity	45% to 75%

7.3 - Physical

Specification	Value
1200 HLX/CHLX Height	8.5 in (215 mm)
1200 HLX/CHLX Width	6.5 in (165 mm)
1200 HLX/CHLX Length	12.5 in (318 mm)
1200 HLX/CHLX Battery Weight	27 lbs (12.2 kg)
1200 HLX/CHLX Shipping Weight	27 lbs (12.2 kg)
1800 HLX/CHLX Height	9.4 in (240 mm)
1800 HLX/CHLX Width	6.7 in (170 mm)
1800 HLX/CHLX Length	19.1 in (485 mm)
1800 CHLX Battery Weight	45.2 lbs. (20.5 kg)
1800 CHLX Shipping Weight	48.7 lbs (22.1 kg)
1800 HLX Battery Weight	41.7 lbs (18.9kg)
1800 HLX Shipping Weight	45.2 lbs (20.5kg)
3600 HLX/CHLX Height	8.7 in (221 mm)
3600 HLX/CHLX Width	10.6 in (269 mm)

3600 HLX/CHLX Length	20.5 in (520 mm)
3600 CHLX Battery Weight	84.2 lbs (38.2 kg)
3600 CHLX Shipping Weight	101.4 Lbs (46 kg)
3600 HLX Battery Weight	84.4 lbs (38.3 kg)
3600 HLX Shipping Weight	103.4 lbs (46.9 kg)
Terminals	Stainless Steel M8 - 1.25 x 16 mm Bolts

8 - Certifications

- UN DOT 38.3 (acceleration 3 times each side)
 - 50 gn for 11 ms
 - 150 gn for 6 ms
- Ingress Protection Rating: IP55
 - First Digit - 5 - Solid Particle Protection - Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory operation of the equipment.
 - Second Digit - 5 - Liquid Ingress Protection - Water jets: Water projected by a nozzle (6.3 mm (0.25 in)) against enclosure from any direction shall have no harmful effects.
 - Test duration: 1 minute per square meter for at least 3 minutes.
 - Water volume: 12.5 litres per minute Pressure: 30 kPa (4.4 psi) at distance of 3 meters (9.8 ft).

9 - Disposal

- Do not incinerate.
- Please recycle in accordance with local laws and disposal services.

10 - Limited Warranty

Model	Free Replacement or Repair Period (months)	Prorated Credit Period (months)	Total Warranty Period (years)
HLX/CHLX 1200	36	54	7.5
HLX/CHLX 1800	36	54	7.5
HLX/CHLX 3600	36	54	7.5

NON-TRANSFERABLE

This Limited Warranty is to the original purchaser of the Product and is not transferable to any other person or entity. Please contact the place of purchase regarding any warranty claim.

WARRANTY EXCLUSIONS AND LIMITATIONS

The Manufacturer has no obligation under this Limited Warranty for Product subjected to the following conditions (including but not limited to):

- Damage caused during shipping or mishandling of the Product
- Damage due to improper installation; loose terminal connections, under-sized cabling, interconnect cables of non-equal lengths/voltage drops, incorrect connections (series and parallel) for desired voltage and amp-hour requirements, reverse polarity connections or insufficient space for airflow
- Environmental damage; inappropriate storage conditions as defined by the Manufacturer; exposure to extreme hot or cold temperatures, fire or freezing, or water damage
- Damage caused during operation; by collision, over-charging or over-discharging the Product as defined by the Manufacturer
- Damage caused by lightning, fire, water or Acts of God
- Damage due to improper maintenance; under- or over-charging the Product, lack of cleaning resulting in corroded terminal connections or build-up of dirt, debris, organic matter, fossil fuels or chemicals on the Product casing
- Product that has been opened, modified or tampered with

Please see <https://kilovault.com/kilovault-hlx-series/> for the complete provisions of the warranty.