KILOVAULT

KiloVault® HAB™ Series
Lithium Iron Phosphate (LiFePO4)
Deep Cycle Solar Batteries

Installation and User Manual

Revision: 2.06

2/15/2021

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.

This publication could include technical or other inaccuracies or typographical errors. Changes are periodically added to the information herein; these changes will be incorporated in new editions of the publication. KiloVault® may make improvements and/or changes in the services, facilities or specifications described in this publication at any time.

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.

Contents

1. Safety Information

1.1. Symbols Used in this Manual

It is essential to read, understand, and follow these instructions prior to installing or operating KiloVault® batteries.

	**Warning:** This is a hazardous situation which, if not avoided, could result in serious injury or death.
	**Warning:** Do not place or install near flammable or explosive materials.
	**Warning:** Install the HAB™ out of the reach of children and animals.
	**Warning:** The HAB™ is heavy, over 207 lb. (94 kg), and may cause serious back injury. Lift with multiple people and lifting equipment rated to lift and support at least 210 lb.
	**Warning:** Do not dispose of this product with household waste.
	**Caution:** Risk of electric shock.
	**Attention:** Disconnect the HAB™ before carrying out maintenance or repair.
	**Attention:** Read this instruction manual before installing and operating the HAB™.
	**Note:** Indicates points of particular emphasis that make operation more efficient or convenient.
	**Recyclable:** Please contact KiloVault® for recycling instructions.

1.2. General Safety Precautions and Instructions

	**Warning:** Failure to follow the instructions in this manual may result in serious injury or death.
	**Caution:** Risk of electric shock.
	**Warning:** Do not place or install near flammable or explosive materials.
	**Warning:** Install the HAB™ out of the reach of children and animals.
	**Warning:** The HAB™ is heavy, over 207 lb. (94 kg), and may cause serious back injury. Lift with multiple people and lifting equipment rated to lift and support at least 210 lb.
	**Warning:** Do not dispose of this product with household waste.
	**Attention:** Read this instruction manual before installing and operating the HAB™.

- Do not attempt to use any battery that appears damaged during shipment or otherwise.
- Do not submerge the HAB™. This could cause personal injury and will void your warranty.
- Do not attempt to disassemble the HAB™. Its components are not user serviceable. This could cause personal injury and will void your warranty.
- To avoid the risk of shock or fire, ensure all wire is properly sized and in good condition.
- Do not impact, pull, drag, or step on the HAB™.
- Verify that all equipment that is going to be connected to the HAB™ is turned off before making any connections.
- A small risk of spark does exist while making connections. Ensure the area is free of explosive gasses and liquids and is not installed in confined areas. This includes flammable fuel powered machinery, holding tanks, pipe fittings, and connectors.
- Respiratory irritation may be caused if the HAB™ is punctured or cracked; use appropriate respiratory and hand protection.
- Skin contact with a punctured or otherwise open battery can cause irritation.
- High voltage battery connections (configurations of greater than **36 V** DC nominal) can be dangerous in any DC system. The HAB™ is a **48 V** nominal battery system and is **greater** than 36 V DC at the terminals when fully charged! DC voltages over 52 V can stop the human adult heart; please be careful and wear insulated gloves.

1.3. Battery Handling Guide

In addition to the General Safety Precautions and Instructions, the following guidelines should be observed when handling the HAB™.

1.3.1. Transportation

- The HAB™ should kept horizontal while being moved, except when it is being lifted into place for mounting.
- Because the HAB™ weighs over 200 lb., it should be moved with the help of multiple people and moving / lifting equipment rated over 210 lb.
- Do not drop the HAB™ or damage will occur.
- If you are transporting HAB™ batteries while they are still in the packing crate, do not stack them more than two layers high and ensure they are strapped together to prevent tumbling.
- Only transport the HAB™ face up.
- Check the HAB™ immediately after transporting.
- If the HAB™ is damaged in any way, do not use it; contact KiloVault® immediately.

1.3.2. Storage

In addition to the General Safety Precautions and Instructions, the following guidelines should be observed when storing the HAB™.

- Long-term storage (between one and six months) of the HAB™ should be stored indoors in a clean, dry, shaded, and well-ventilated area at a temperature between 59° and 95°F (15° and 35°C).
- Store the HAB™ no longer than 6 months.
- The HAB™ must be charged to at least 70% (the state of charge upon delivery) before storage.
- Repeated 100% discharges will decrease the battery capacity. For example, 3000, 100% discharge cycles will reduce the battery capacity to about 75% of the original amp hour capacity.
- Fully charge the battery within 15 days of a deep discharge of 90% or more.
- Do not drop, stack, or turn the HAB™ upside down.
- Store the HAB™ away from children and animals.

1.3.3. Response to Emergency Situations

The HAB™ is comprised of multiple batteries and is designed to prevent hazards resulting from failures; however, no battery system is 100% safe, and KiloVault®, LLC cannot guarantee its absolute safety.

In the unlikely event of a fire first shut off the source of the electricity if possible. We recommend a fire extinguisher in close proximity of your power generating equipment. Class

ABC extinguishers are best suited for multipurpose fire types such as wood, flammable liquids, and electrical appliances.

1.3.4. Qualified Personnel

This guide, and the tasks and procedures described in this manual, are intended for use by qualified personnel only. Only qualified personnel shall install, operate, overhaul, or maintain the HAB™. During maintenance or overhaul, at least two people (equipped with protective measures, including but not limited to, safety glasses, insulated gloves, and safety shoes) must be present.

Qualified personnel are defined as being a trained and locally certified electrician or installer who has all the following skills and experience:

- Knowledge of the functional principles and operation of on-grid and off-grid (backup) electrical systems.
- Knowledge of the dangers and risks associated with installing and using electrical devices and acceptable mitigation methods.
- Knowledge of the installation of electrical devices.
- Knowledge of and adherence to the information in this guide, to all applicable safety precautions, and to electrical industry best practices.

2. Overview

KiloVault® HAB™ Series wall-mount energy storage systems provide a 7.5 Kilowatt-hour battery in a single package. Up to eight units can be used together for additional capacity. The HAB Series has been designed for trouble-free mounting and is easy to connect with other system components.

2.1. Features

- High safety Lithium Iron Phosphate ($LiFePO_4$) battery
- Wall mounted all-in-one design
- Integrated inverter CAN-bus support
- Integrated Wi-Fi communications (HAB iT – Please contact your KiloVault® salesperson for details)
- Long cycle life (≥4000cycles)
- Advanced High/Low temperature cycle performance
- Intelligent LED & LCD display
- Support for up to 14 HAB™ battery (Leader plus 13 Follower) modules in parallel

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3. Specifications

3.1. Electrical Specifications

	Note: • Specifications are subject to change without prior notice. • The following are specifications *only*, **NOT** set points.

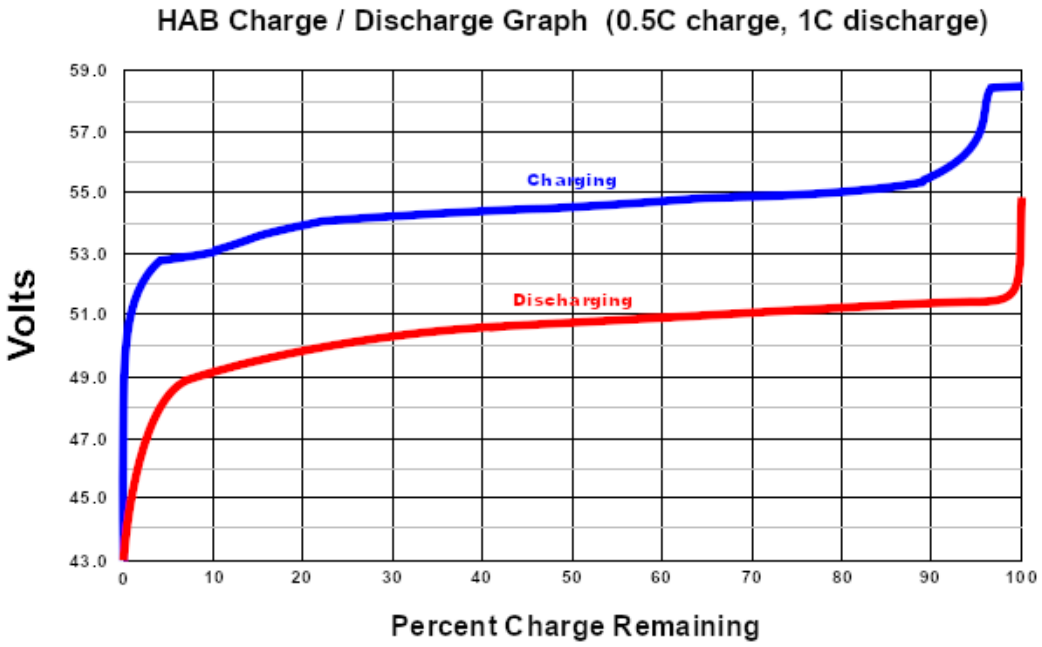

Figure 1: Charge/Discharge Graph

The following specifications describe the HAB™ system.

Item	Specification
Battery Type	$LiFePO_4$
Battery Efficiency	94.5%
BMS Type	Switching Shunt Resistor
Fully Charged Resting Voltage	53.6 V

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Item	Specification
Full Charge Voltage	56.4 V • Note: This rate is only achieved when the HAB is put to sleep by pressing down the Power button for 10 seconds. • If the HAB is shut down using the standard, short, 3-second-long, power button push, self-discharge can be as high as 9% per month.
HAB to HAB (interbattery) communication cable	RJ11, 6-position, 4-conductor, male connectors both ends. Straight through. Maximum length, 10 feet
HAB to HAB (interbattery) communication protocol	CAN bus
HAB to Inverter communication protocol	Modbus
High Voltage Cutout	60.0 ± .5 V (not a set point)
Low Voltage Cutout	48.0 V (not a set point)
Maximum Cell Balancing Voltage	70 mA
Maximum Continuous Charge Current	120 A (not a set point)
Maximum Continuous Discharge Current	150 A (not a set point)
Maximum Continuous Discharge Power	7.5 kW
Maximum HAB™ to HAB™ Cable Length	9.84 ft (3 m)
Minimum Cell Balancing Voltage	3350 mW
Minimum Discharge Voltage	48.0 V
Nominal Capacity	150Ah
Nominal Energy	7.68kWh
Nominal Voltage	51.2 VDC
Operational Temperature Range	32° to 113°F (0° to 45°C)
Peak Discharge Current (3s)	500 A
Peak Discharge Power (3s)	25k W
Recommended Floating Charge Voltage	55.2 V
Self-Discharge Rate	≤3% per month, ≤15% per year

Refer to Section 6 Troubleshooting for a complete list of protection limits.

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3.2. Environmental Specifications / Operating Environment

Item	Specification
Working Environment	Indoors away from direct exposure to rain or sun
Operating Temperature	32° to 113°F (0° to 45°C)
Recommended Operating Temperature	77°F (25°C)
Short Term (less than one month) Storage Temperature	-4 to 110°F (-20° to 45°C)
Absolute Maximum Altitude	9843 feet (3000 m)

3.3. Physical Specifications

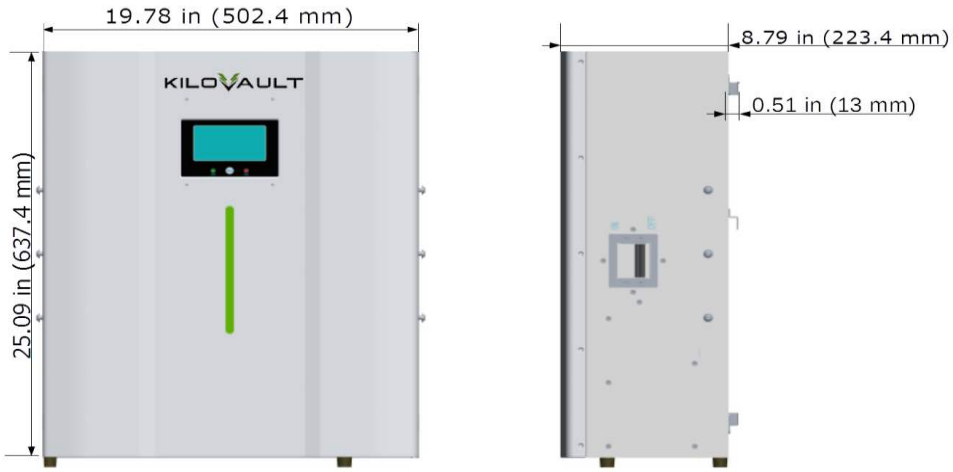

Figure 2: HAB™ Physical Specifications

Item	Specification
Weight	207.23 lb. (94 kg)
Height	25.09 in (637.4 mm)
Width	19.78 in (502.4 mm)
Depth	8.79 in (223.4 mm)
Hanging Bracket Depth	0.51 in (13 mm)
Ingress Rating	IP51
Battery Terminal Torque	5.65Nm or 4.17ft-lb or 50in-lbs

4. Installation

	**Warning:** This is a hazardous situation which, if not avoided, could result in serious injury or death.
	**Warning:** Do not place or install near flammable or explosive materials.
	**Warning:** Install the HAB™ out of the reach of children and animals.
	**Warning:** The HAB™ is heavy, over 207 lb. (94 kg), and may cause serious back injury. Lift with multiple people and lifting equipment rated to lift and support at least 210 lb.
	**Warning:** Do not dispose of this product with household waste.
	**Caution:** Risk of electric shock.
	**Attention:** Disconnect the HAB™ before carrying out maintenance or repair.
	**Attention:** Read this instruction manual before installing and operating the HAB™.

4.1. Installation Flowchart

The following flowchart provides an overview of the installation process.

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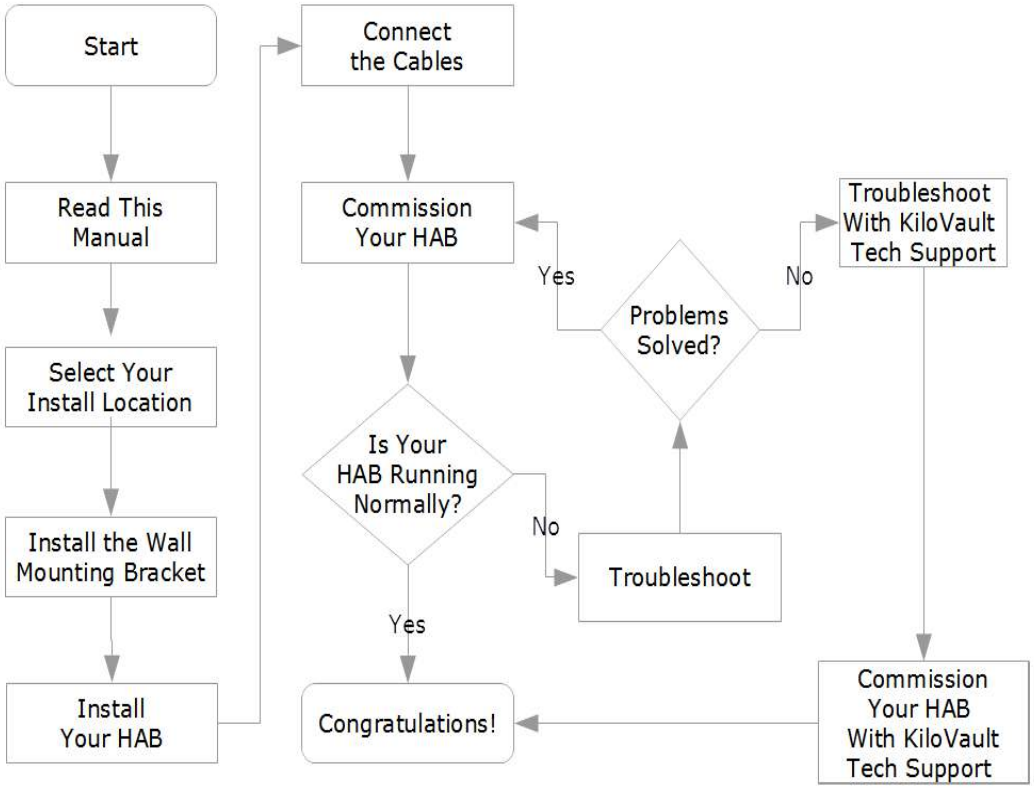

Figure 3: Installation Flowchart

4.2. Unpacking the HAB™

	Note: • Prior to installing your HAB™, please take pictures of the label on the left side, including the serial number, serial number barcode, QR code, and MAC address. Store this information for your records, it is valuable and may be necessary for system configuration or troubleshooting. Depending on your HAB's position, viewing this information after installation may be difficult.

The HAB™ weighs 207.23 lb. (94 kg); wear appropriate protective equipment, such as gloves and protective footwear, when handling this unit. Only move the HAB™ with enough personnel to safely lift and steady the HAB™. We strongly recommend using lift equipment and straps to secure and steady the HAB™.

Keep the HAB™ in its box until you are ready to install it. Open the box and inspect all contents to ensure all items in the box are undamaged. Remove the foam packing material to uncover the HAB™.

The box contains two lift **handles designed exclusively for lifting the HAB™ out of the box, not for mounting on to the wall**. When you are ready to remove the HAB™ from its box for

installation, attach the lift handles to the lifting screws located on the sides of the HAB™. **Do not attempt to unbox the HAB™ system without sufficient personnel.** When unboxing, use the provided lift handles (refer to Section Install the HAB™ Wall Mounting Plate) and place it on a safe, dry, clean surface.

4.2.1. Package Contents

The standard HAB™ packaging includes the battery unit, mounting brackets and screws, communications cables, and lift handles.

Figure 4: Standard HAB™ Packaging

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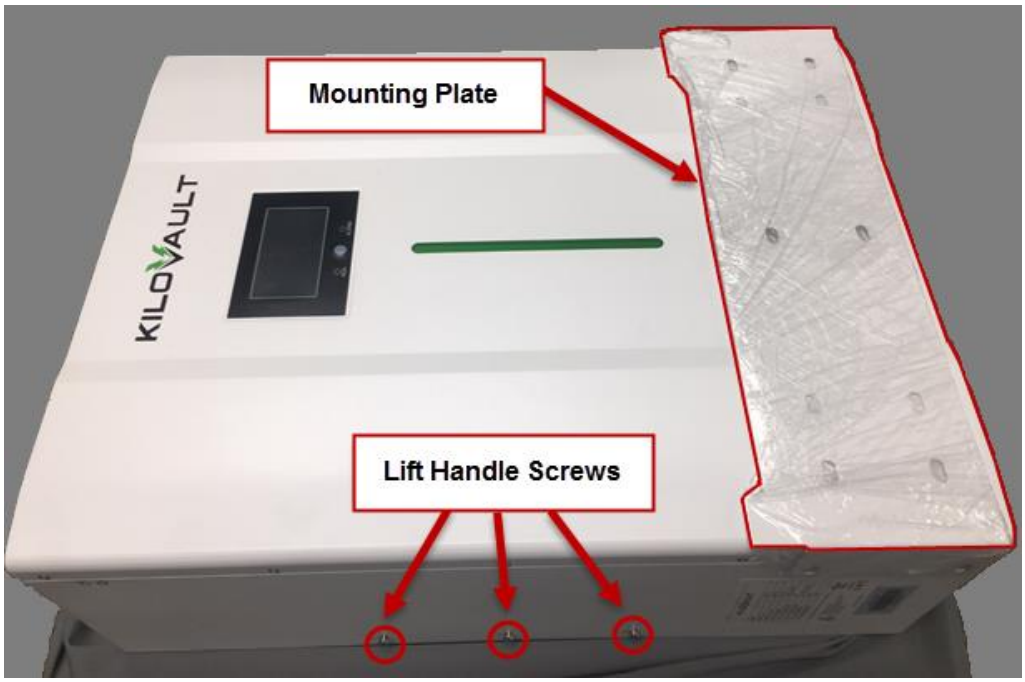

Figure 5: HAB™ Partially Unboxed

Part	Quantity
1.5-meter HAB™ to HAB™ CAN Bus communication cable (RJ11) Note: If a longer cable is needed, it can be replaced with any telephone handset cord. RJ11 6-position, 4-conductor, male connectors both ends. Straight through. Maximum length, 10 feet.	1 each (cables up to three meters may be required)
1.5-meter HAB™ to inverter Modbus communication cable - Amphenol AT06-6S (supported in a future upgrade)	1 each
RJ11 Clear Resistor Plug	1 each
Wall Mounting Plate (Standard)	1 each
Upper/Lower Wall Mounting Plates (Optional)	1 each
Expanding screw M8*30	12 each
Screw M8*16 mm	2 each
Screw M6*16 mm	2 each
Optional Communication Debug Cable	1 each (Optional)
Lift Handles	2 each
Lift Handle Screws (installed Into The HAB™ Case): M6x12mm, Fine Thread, 0.75 Pitch, Internal Hex Button Head	6 each

4.3. Tools, Materials, and Safety Equipment Required for Installation

- Personal protective equipment, including but not limited to, safety glasses, insulated gloves, and protective footwear
- Lift equipment capable of lifting and supporting at least at least 210 lb.
- Drill and drill bit for drilling pilot holes for the mounting plate
- If you will be mounting onto concrete or masonry, you will need a 12 mm drill bit for the included M8*30 expansion screws
- Conduit and conduit fittings (depending upon local electrical requirements)
- Various sized Phillips and flathead screwdrivers
- Torque wrench and sockets
- 1/0 battery to inverter cables
- Battery combiner box (when more than one HAB™ batteries are being used)
- Level
- Pencil or marker

4.4. Suitable Installation Locations

Note:

Prior to installing your HAB™, please take pictures of the label on the left side, including the serial number, serial number barcode, QR code, and MAC address. Store this information for your records, it is valuable and may be necessary for system configuration or troubleshooting. Finding this information after installation may be difficult.

The HAB™ should be installed high enough above the floor to allow the battery cables to bend without kinking and allow easy access to the knockouts on the bottom of the HAB. There should be at least 12 inches (approx. 300 mm) of clearance on both sides. Particular care should be taken to ensure that the bottom right corner of the HAB™ (where the power and communication cable access is located) is clear.

Observe the following:

- Install indoors in a cool, dry, ventilated space
- Do not install near a heat source, and keep away from direct sunlight; this prevents the HAB™ from derating its output or shutting down due to overheating
- Keep away from fire, flammable, or explosive items
- The HAB™ must be out of the reach of children and animals
- Do not install near a transformer or any other strong electromagnetic field. Strong electromagnetic fields can disrupt the HAB™ communication system

Choose a wall capable of supporting the full weight of the HAB™ (over 207 lb.) with one or more of the following characteristics: wood studs at regular intervals, plywood sheeting at least ¾ inch thick, solid concrete or masonry, or metal studs of at least 18 gauge.

The HAB™ communication and power cable entries are located at the bottom right corner of the unit. There must be enough clearance for the conduit and fittings.

4.5. Install the HAB™ Wall Mounting Plate

The HAB™ comes with the single mounting plate option. Previous releases used a dual mounting plate system.

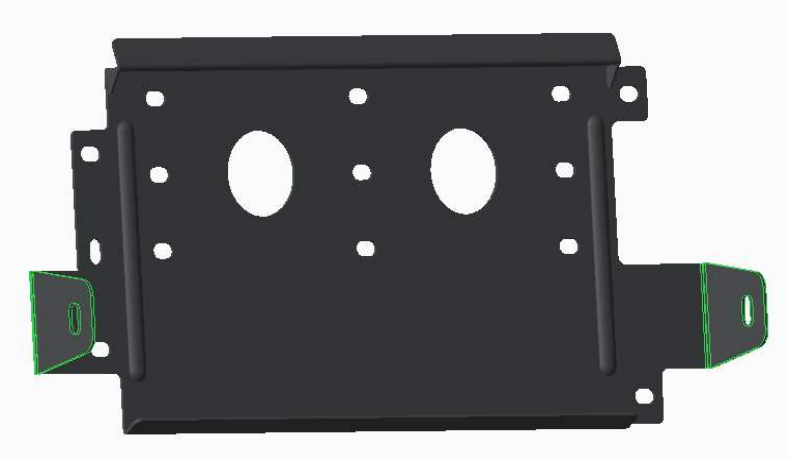

Figure 6: Single Wall Mounting Plate

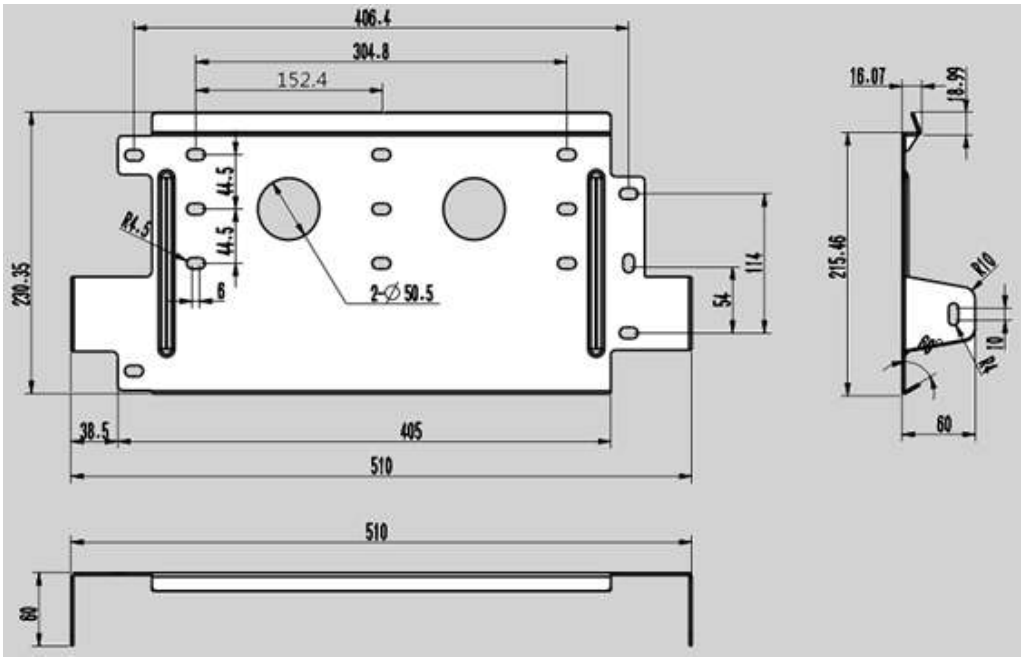

Figure 7: Single Wall Mounting Plate Technical Specifications

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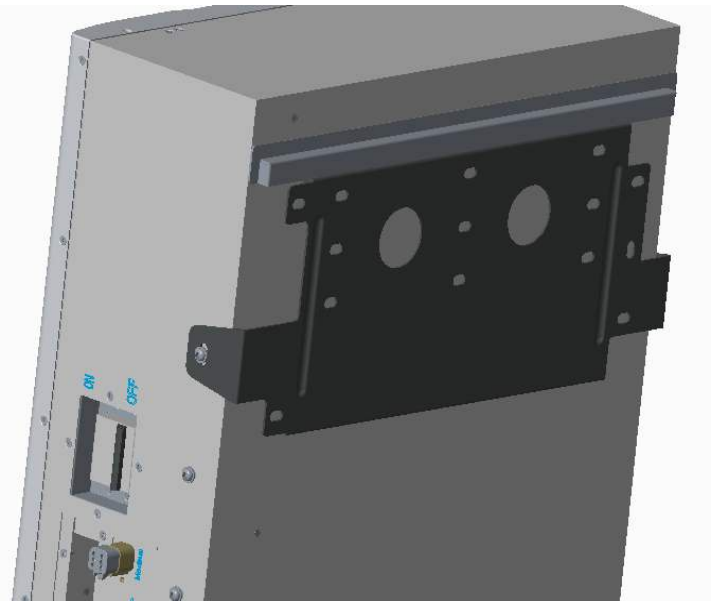

Figure 8: Single Wall Mounting Plate Installed

The HAB™ mounting plate can be used as a template to mark your pilot holes on the mounting surface. Choose holes so that you can mount the plate using at least four of the widely spaced holes. Use a level to ensure that the plate is level. Refer to Section 4.5.1 Mounting Surface for information regarding mounting surface requirements.

4.5.1. Mounting Surface

If you are anchoring the mounting plate into wood studs use at least four (one at each corner) #14 (1/4") wood screws with washers. The screws must be long enough to penetrate at least 1½" into the studs.

If you are anchoring into plywood wall material, the plywood must be at least ¾ inch thick. Use four (one at each corner) #14 (1/4") wood screws with washers. The screws must be long enough to penetrate at least ¼ inch beyond the back of the plywood. You can also use four (one at each corner) heavy duty ¼-inch toggle bolts, rated for at least 250 lb.

If you are anchoring into metal studs, the studs must be a minimum of 18 gauge. Use at least four (one at each corner) #14 sheet metal screws with washers. The screws must be long enough to penetrate at least three threads beyond the stud. If installing on a wall with metal studs less than 18 gauge, a mounting surface (such as a larger plywood surface to distribute the weight) must be attached to the wall prior to installing the HAB™.

If you are anchoring into concrete or masonry, the minimum strength of the concrete must be at least 2500 PSI, while the minimum strength of the masonry must be at least 1500 PSI. Drill holes into the concrete or masonry with the 12 mm drill bit at the marks you made earlier. Hammer the included M8*30 expansion screws into the wall. Attach the plate onto the wall with the M8 bolts.

4.5.2. Mounting and Securing the HAB™

	Note: It may be easier to open the tabs at the bottom (along the sides) of the box and remove the box from the pallet, rather than removing the top lid and lifting the HAB™ with the handles.

Using sufficient personnel lift the HAB™ until the unit's upper and lower mounting flanges are just above the mounting plate's upper and lower lips and the HAB™ is between the mounting plate's arms. We strongly recommend using lift equipment and straps to secure and steady the HAB™.

Figure 9: Unboxing the HAB™

Lower the HAB™ onto the mounting plate's upper and lower lips, making sure that both of the HAB™ unit's upper and lower mounting flanges are securely resting on both of the mounting plate's upper and lower lips. The holes in the mounting plate's arms should align with the lift handle screw holes. Attach the HAB™ to the mounting plate using 2 of the 6 lift handle screws with washers

4.6. Connecting the HAB™ to Your Inverter

	Warning: NEVER reverse the polarity (positive and negative) of your unit's connections. NEVER short circuit your HAB™.

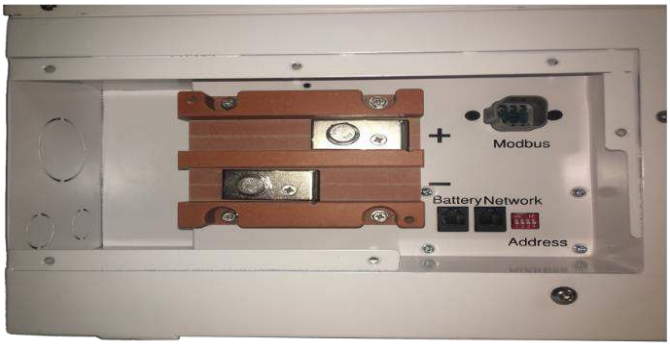

Figure 10: HAB™ Side Panel Connection Area

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4.6.1. Connecting the HAB™

Step	Description
1	Set the HAB™ address using the address DIP switch (refer to 4.6.7 Setting the HAB™ Address).
2	If you are installing multiple HAB™ units, connect the RJ11 COM cables between the HAB™ units (refer to Section 4.6.3 RJ11 Resistor Plug Installation and 4.6.4 Single Inverter Simplified Wiring Diagram). This leaves an empty port on either end of the string to install the clear resistor plug to terminate the COM loop. **Note:** If a longer cable is needed, it can be replaced with any telephone handset cord. RJ11 6-position, 4-conductor, male connectors both ends. Straight through. Maximum length, 10 feet.
3	Please contact KiloVault for a list of supported inverters. Connect the Modbus communication cable between the Leader HAB and the inverter.
4	Connect the power cables from the HAB™ to the inverter (or to the DC bus if installing more than one HAB™), making sure to use overcurrent protection as required. Torque the terminals in the HAB connection block to 5.65Nm or 4.17ft-lb or 50in-lbs **Note:** The HAB™ battery connection block will only accept 1/0 cables; do not attempt to use any other cables.
5	Close (switch to "On") the Inverter main DC Breaker.
6	Close (switch to "On") the battery breaker on the side of the HAB™
7	Press the HAB™ power button at least three seconds, until the RUN LED flashes five times.
8	Wait five seconds for the HABs pre-charge function to complete.
9	If installing more than one HAB™, start the other units one-by-one by pressing the power button on the front of the HAB™ for at least three seconds. The "Run" LED will flash five times, the HAB™ control panel will light up, indicating the HAB™ is operating and supplying power to the inverter. Repeat steps 6 - 8 for each HAB.
10	Start the inverter.

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4.6.2. Disconnecting the HAB™

NEVER reverse the polarity (positive and negative) of your unit's connections. NEVER short circuit your HAB™.

Step Number	Step Description
1	If disconnecting more than one HAB™, power off the other units one-by-one by pressing each unit's power button.
2	Set the disconnect switch on the side of the HAB™ to the OFF position.
3	Disconnect the power cables from the HAB™ to the inverter (or to the DC bus if installing more than one HAB™), making sure to use overcurrent protection as required.
4	Disconnect the Modbus communication cable between the Leader HAB™ and the Inverter (if available).

4.6.3. RJ11 Resistor Plug Installation

A clear RJ11 resistor plug is enclosed in each HAB™ unit. Plug one end into the first and last units in the string as shown.

Figure 11: RJ11 120 Ω Clear Resistor Plug

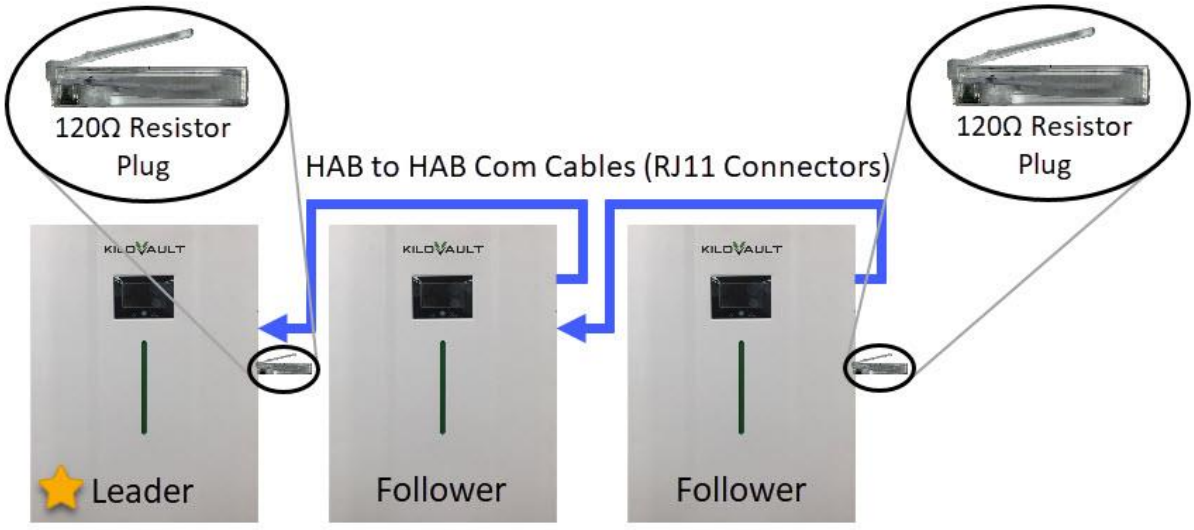

Figure 12: Resistor Plug Installation

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4.6.4. Single Inverter Simplified Wiring Diagram

These diagrams may not exactly match your specific system and may not include all the safety equipment required by regional authority. This is purely a graphical representation.

	Note: The *PSC Communication Cable* shown in figures 12 and 13 is an upcoming feature.

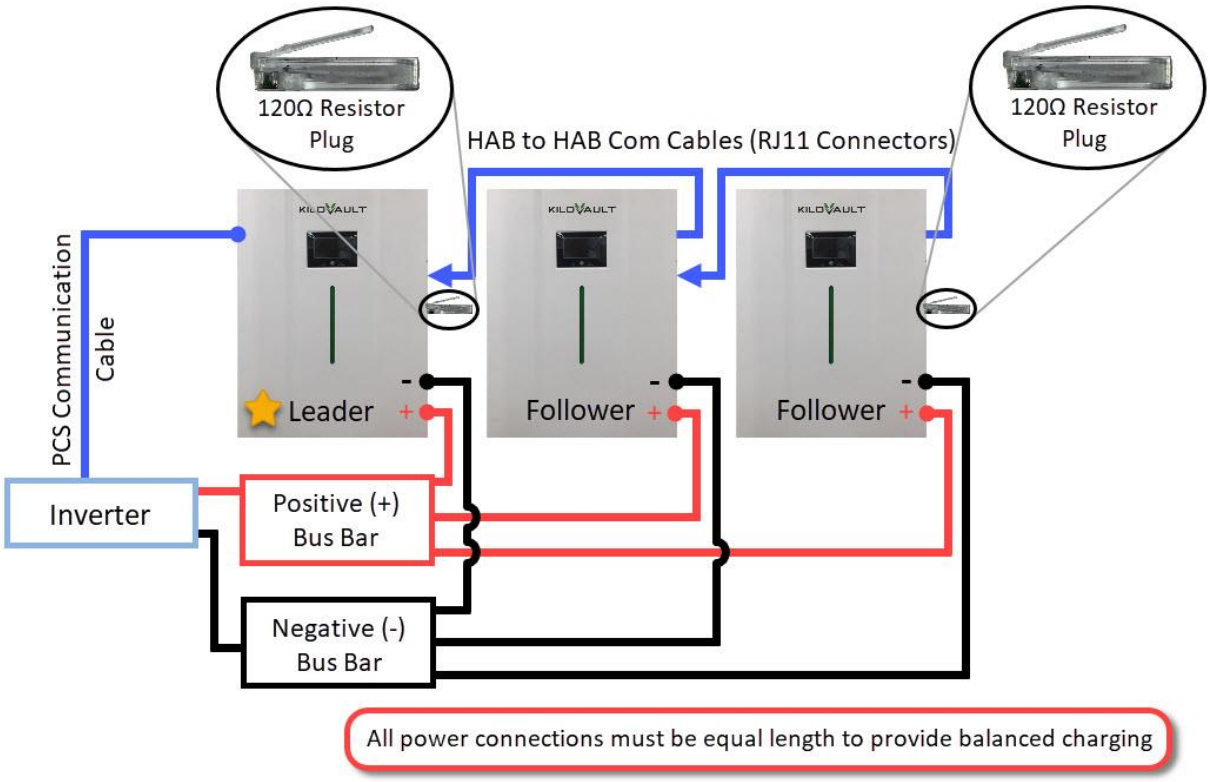

Figure 13: Single Inverter Installation

It is extremely important to make all conductors to each battery the same length to help ensure they contribute balanced current to the HAB™.

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4.6.5. Multiple Inverter Simplified Wiring Diagram

The following diagram describes a simplified multiple inverter system for installations greater than 7.5kW. This is purely a graphical representation.

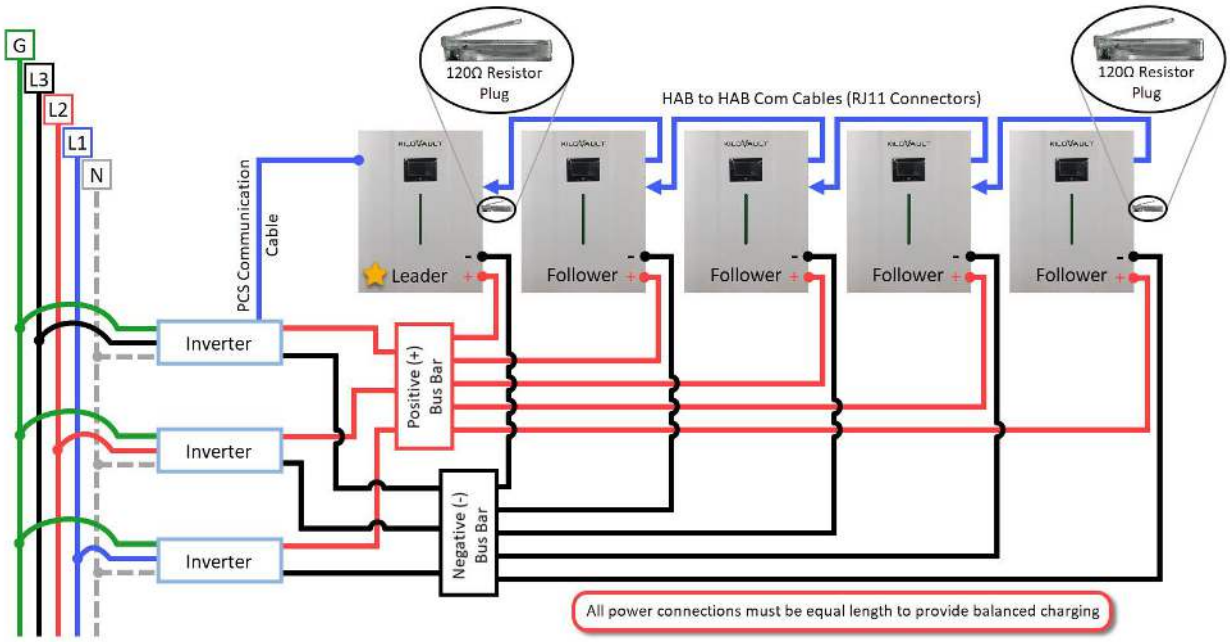

Figure 14: Multiple Inverter Installation

Wires G/L3/L2/L1/N in the previous diagram refer to the wires in a standard 3-phase system. Different inverters may have different wiring.

4.6.6. Optional Battery Combiner Box and Bus Bar

When using a battery combiner box and bus bar, it is still critical to get all circuits to each battery the same length to help ensure they contribute equal current to the total current. The figure below shows a typical installation.

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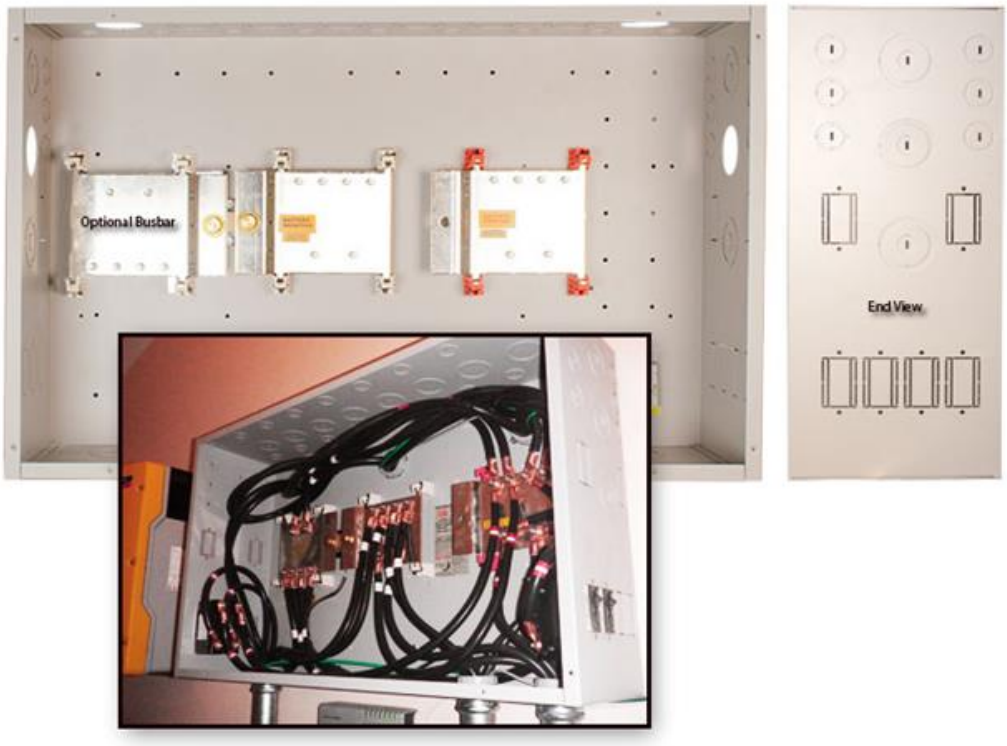

Figure 15: Optional Bus Bar

4.6.7. Setting the HAB™ Address

Figure 16: DIP Switches

- If your HAB™ serial number is below MWT2020010902014, please contact KiloVault® for addressing instructions.
- If you are installing a single HAB™ to be used by itself, the address must be set to (off off off off).
- If you are installing more than one HAB™ and connecting them with the communication cable, the Leader HAB™ address must be (on off off off).

Module Number	DIP Switch Settings			
	Switch 1	Switch 2	Switch 3	Switch4
Leader - Single HAB™	OFF	OFF	OFF	OFF
Leader - Multiple HAB™	ON	OFF	OFF	OFF
1st	OFF	ON	OFF	OFF
2nd	ON	ON	OFF	OFF
3rd	OFF	OFF	ON	OFF
4th	ON	OFF	ON	OFF
5th	OFF	ON	ON	OFF
6th	ON	ON	ON	OFF
7th	OFF	OFF	OFF	ON
8th	ON	OFF	OFF	ON
9th	OFF	ON	OFF	ON
10th	ON	ON	OFF	ON
11th	OFF	OFF	ON	ON
12th	ON	OFF	ON	ON
13th	OFF	ON	ON	ON

4.6.8. Inverter Communication Cable, Amphenol AT06-6S, Pin Pinouts

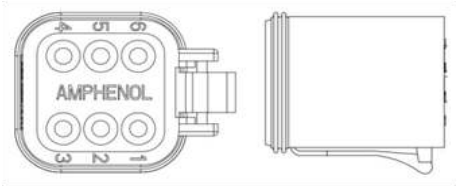

Figure 17: Inverter Communication Cable (Amphenol AT06-6S) Pinouts

Pin Number	Definition	Wire Color
1	N/A	Black
2	RS485A A1/ CANH (Inverter)	Yellow
3	RS485B B1/ CANL (Inverter)	Green
4	RS485A A2/ (BMS Debug)	
5	RS485B B2/ (BMS Debug)	
6	N/A	

The HAB to inverter communications feature will be supported in a future upgrade.

5. Operation, Maintenance & Monitoring

5.1. HAB™ Control Panel

The HAB™ control panel displays a variety of useful information regarding the operation of your system.

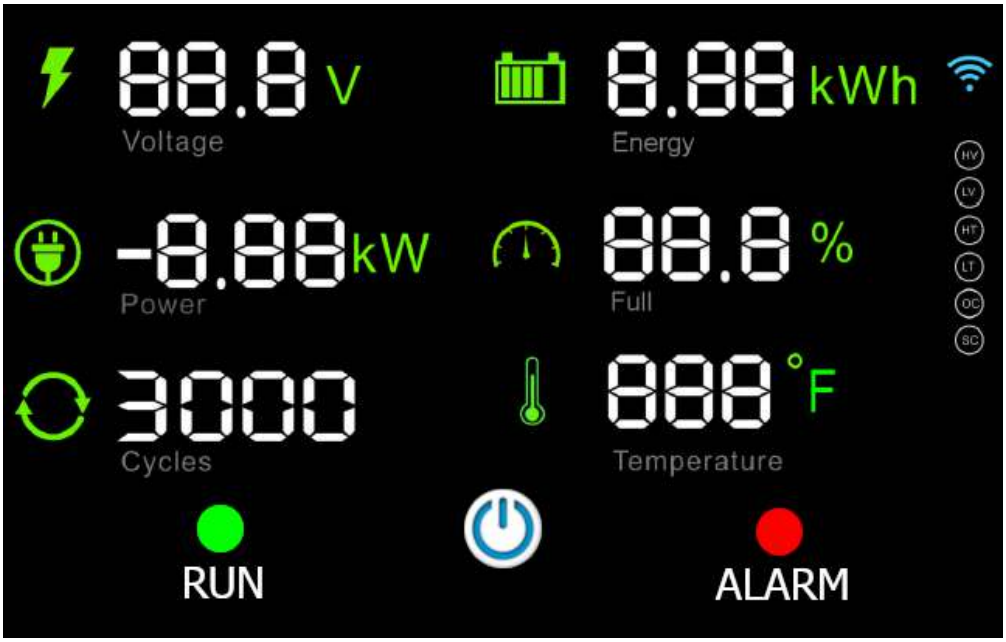

Figure 18: HAB™ Control Panel

5.1.1. HAB™ Control Panel Details

Display	Description	Notes
	Battery Voltage	
	Remaining Energy	
	Charge / Discharge Power	Negative value = Discharging Positive Value = Charging
	State of Charge	Approximate Percentage Full
	Number of Cycles	
	Battery Temperature	
	Wi-Fi Status	• Off = Not connected to router. The

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Display	Description	Notes
		HAB™ is configured for a router connection, but not connected. • Animated Rolling = One-Click configuration. In this mode you can check the HAB™'s status through the HAB™ unit's Wi-Fi hotspot using the mobile application. You can also configure the HAB™ to connect to a router. • Flashing = The HAB™ status can be checked only through the unit's Wi-Fi hotspot using the mobile application. • On Steady = Normal Wi-Fi status. Number of semi-circles (1 to 3) indicates the Wi-Fi signal strength. You can connect to the HAB™ through a router and check the HAB™ status remotely.
	Alarm or Warning Indicators	The HAB™ will light these indicators when a warning or alarm condition occurs: HV = Battery High Voltage LV = Battery Low Voltage HT = Battery High Temperature LT = Battery Low Temperature OC = Charge or Discharge Over Current SC = Short Circuit Refer to Section 6 Troubleshooting for action instructions if the indicators light.

5.2. Calibrating Your HAB™

Calibrate the State of Charge calculator and kWh for your HAB™ using the following procedure.

- Fully charge your HAB™ to 56.4 V.

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  - If a high voltage alarm occurs, you can ignore it. You will still be below the high voltage protection. Note: If this does occur, the alarm will not clear until the voltage falls below 54.4 ±0.5 V.
  - Even if the SoC (State of Charge) on the front panel gets to 100% before the voltage gets to 56.4 V, continue to charge until you reach 56.4 V.
  - After charging up to 56.4 V, please look at the display and write down the kWh shown for your records and to calculate the capacity of your HAB™. Multiply that number by 1000 to get the Watt hours, then divide the Watt hours by 48 V to get the Amp Hour capacity of your HAB™. Use that value where needed in configuring the rest of the equipment in your system.
- Then fully discharge the HAB™ all the way down to 49 V.
  - If a low voltage alarm occurs, you can ignore it. You will still be well above the low voltage protection threshold. Note, if this does occur, the alarm will not clear until the voltage rises above 49.6 V ± 5 V.
  - If a high voltage alarm occurs, you can ignore it. You will still be below the high voltage protection. Note: If this does occur, the alarm will not clear until the voltage falls below 54.4 ±0.5 V.
- The HAB™'s SoC and capacity should now be calibrated.

5.3. Charging Settings

Your battery charger (solar, inverter, or AC), should be set to stop charging at a maximum voltage and your inverter should be set to shut down at a certain voltage. See the inverter and charge controller settings table below:

Device	Setting	<40A Charger	40-60A Charger	60-150A Charger
All	Full Charge Voltage	56.4 V		
	Maximum Charge Current	120Ah per HAB™ in parallel		
	Absorb Time (some controllers do not allow a selection under 6 minutes, please contact KiloVault® for additional information)	Under 6 minutes	Under 4 minutes	Under 2 minutes
	Battery Temperature Compensation	Do not use an external battery temperature sensor with these batteries. If a sensor and Battery Temperature Compensation value are required for a charge controller or inverter charger to work, please set the battery temperature compensation to 0mV / °C		

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Device	Setting	<40A Charger	40-60A Charger	60-150A Charger
	Recommended Charge Current	100Ah per HAB in parallel. Solar charge controller Amps + a percentage of the inverter/charger's maximum DC output should be 100A for each HAB in parallel.		
Inverter/Charger	Battery Capacity	150Ah (7.5 kW) per HAB™		
	Battery Type	Lithium Ion or Custom - whichever provides access to the required settings		
	Bulk/Absorption Voltage	56.2 V		
	Charge Cycle	2 Stage No Float		
	High Battery Cut Out (HBCO)	57 V		
	Low Battery Cut Out (LBCO)	48.2 V		
	LBCO Delay	3 seconds		
	LBCO Hysteresis	2 V		
	Max Bulk Current	Set to whatever percentage of the inverter current plus the charge controller current is less than or equal to 100A		
	Maximum Charge Rate	120Ah per HAB™ in Parallel		
	Recharge/Re-bulk Volts (for 80% DoD)	51.4 V (51.4 V used to set voltage that triggers the start of a new charging cycle)		
	Absorb Time	Under 6 min	Under 4 minutes	Under 2 minutes
Charge Controller	Absorb Voltage	56.2 V		
	Battery Capacity	150Ah (7.5kW) per HAB™, or the sum of the new values after calibration		
	Battery Type	Lithium Ion or Custom - whichever provides access to all the required settings		
	Battery Voltage	48 V		
	Bulk Voltage	56.2 V		
	Bulk Current	75A		

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Device	Setting	<40A Charger	40-60A Charger	60-150A Charger
	Charge Cycle	3 Stage		
	Equalization	Disabled		
	Max Float Current	10A		
	Float Voltage	52.8 V		
	Maximum Charge Rate	1C		
	Recharge Volts	51.4 V (used in Schneider equipment to set voltage that triggers charge start)		

5.3.1. Firmware Updates

- Ensure that your HAB is connected to the internet and added into HAB iT (the HAB mobile application).
- Ensure your WiFi router and internet connection are not using power from your inverter. You do not want these devices to lose power during the update.
- If your HAB is using the scheduled charging feature, temporarily disable scheduled charging.
- On the HAB iT Basic screen flip the slider-like switch highlighted in blue shown in Figure 19: HAB iT Basic Screen Slider Switch. The status should change to "No charge or discharge."

Figure 19: HAB iT Basic Screen Slider Switch

- HAB firmware updates take about 10 minutes.

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- Firmware updates are usually timed to take place during the evening in North America.
- Depending on what part of the BMS is being updated, either the red “ALARM” LED will flash by itself, or the red “ALARM” LED will flash along with the two bottom red LEDs in the State of Charge bar.
- Firmware updates include BMS improvements to:
    - HAB™ to HAB™ Communications
    - Cycle Counting
    - State of Charge Calculation
    - Other BMS functions as needed.
- The WiFi adapter firmware cannot be updated.

5.4. Starting the HAB™ for the first time

1. Turn on (close) the inverter main DC breaker. If your inverter does not have its own power switch, and if completing the circuit between the inverter and the battery will start the inverter, please start with step #2 and save this step for last.
2. Turn on (close) the battery breaker on the side of the HAB™.
3. Press the power button on the control panel at least three seconds. The green RUN LED will flash five times, and then both the HAB™ control panel LCD screen and the state of charge light bar will light up.
4. Wait five seconds for the HAB™ battery management system to pre-charge.
5. If you are installing and commissioning more than one HAB™, after you have made the electrical and communication connections and set the HAB™ addresses, perform steps 2 - 4 for each HAB™, starting with the first follower HAB™, until all HAB™ units are energized.
6. Turn on the inverter.

If there are no alarms, the green **RUN** LED will be lit, and the control panel will be populated with information about the running condition of your HAB™. The control panel will remain lit for 5 minutes and then go blank. If you briefly (less than three seconds) press the HAB™’s power button, the control panel will again light for 5 minutes.

If there is an alarm condition, the **RED** Alarm LED will light, plus one or more of the alarm or protection state indicators at the right of the control panel will light. Please see the BMS Alarm and Protection table for details.

To turn off the HAB™, press the power button for three seconds. The run LED will flash five times, then the control panel and the state of charge bar will go dark. The HAB™ is now off.

5.5. Monitoring

You can monitor the HAB™ using either the front control panel or the “KiloVault HAB iT” mobile application. There are both Android and iOS versions of the app. The iOS app requires iOS 10 or above. The Android app requires Android 5.0 (Lollypop) and above. The apps are available from

the iOS App Store or the Google Play Store. Please see the KiloVault® website to download detailed HAB iT instructions.

5.6. Maintenance

There are no user serviceable parts inside of the HAB™. Do not open the HAB™ case. Simply keep the exterior clean, dry, and dust free.

5.7. Disposal

Please contact KiloVault® for recycling instructions. Do not dispose of this equipment with household waste.

6. Troubleshooting

6.1. BMS Protection / Alarm Conditions

Alarm events cause the ALARM LED on the front panel to flash. Protection events cause the ALARM LED to flash and will cause the HAB to shut down for the indicated time period.

Alarm / Protection Condition	Trigger Values
High Voltage Alarm for each Cell	3.55±0.03 V
High Voltage protection for each cell	3.75±0.03 V, Delay time:1s
High Voltage release for each cell	3.40±0.03 V
High Voltage alarm for total voltage	56.8 V±0.5 V
High Voltage protection for total voltage	60.0 V±0.5 V, Delay time:1s
High Voltage release for total voltage	54.4 V±0.5 V
High Voltage release method	Under the release voltage (54.4 V±0.5 V) for 1s
Low Voltage alarm for each cell	3.00±0.03 V
Low Voltage protection for each cell	2.70±0.03 V, Delay time:1s
Low Voltage release for each cell	3.10±0.03 V
Low Voltage alarm for total voltage	48.0 V±0.5 V
Low Voltage protection for total voltage	43.2 V±0.5 V, Delay time:1s
Low Voltage release for total voltage	49.6 V±0.5 V
Low Voltage release method	Charge to recovery
Charge over current alarm	165±5 A
Charge over current protection	180±5 A, Delay time:5s
Charge over current release method	Auto release after 1min
Discharge over current alarm	165±5 A
Discharge over current protection	180±10 A, Delay time:1s
Over current release method	Auto release after 1min
Charge High Temperature alarm	122°F ± 5.4°F (50°C ± 3°C)
Charge High Temperature protection	131°F ±5.4°F (55°C ± 3°C)
Charge High Temperature release	113°F ±5.4°F (45°C ± 3°C)
Discharge High Temperature alarm	140°F ±5.4°F (60°C ± 3°C)
Discharge High Temperature protection	149°F ±5.4°F (65°C ± 3°C)
Discharge High Temperature release	131°F ±5.4°F (55°C ± 3°C)
Charge Low Temperature Alarm	37.4°F ±5.4°F (3°C ± 3°C)

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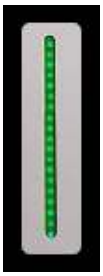
Charge Low Temperature Protection	32°F ±5.4°F (0°C ± 3°C)
Charge Low Temperature Release	41°F ±5.4°F (5°C ± 3°C)
Discharge Low temperature alarm	5°F ± 5.4°F (-15°C ± 3°C)
Discharge Low temperature protection	-4°F ± 5.4°F (-20°C ± 3°C)
Discharge Low temperature release	14°F ± 5.4°F (-10°C ± 3°C)

6.2. Warning / Alarm Indicators

Display	Description	Required Action
	Battery High Voltage	Reduce the charging voltage or stop charging
	Battery Low Voltage	Stop discharging the battery. Recharge within 15 days.
	Battery High Temperature	Stop charging or discharging the battery until the battery temperature falls below recover temperature.
	Battery Low Temperature	Stop charging or discharging the battery until the battery temperature rises above the recover temperature
	Charge or Discharge Over-Current	Reduce the charging or discharging current. The battery will auto-release in one minute.
	Battery Short Circuit	Check the external power connections of the battery. Eliminate the short-circuit.
	Flashing State of Charge Bar	The LCD control panel and/or the State of Charge light bar have lost connection to the BMS. Restart the HAB™ using the power button on the front of the unit.

6.3. Parallel Battery Alarm Conditions and Connection Test

Setup Conditions	Symptoms	Diagnosis	Action to Rectify	Notes
HABs connected in parallel.	None of the HABs output power. All HAB LCD screens are lit. All HAB RUN LEDs are OFF. All Alarm LEDs flash 0.5s on, 0.5s off.	Leader ID Communication address fault protection. No HABs in the bank have been set as the Leader.	Set the address DIP switch of one HAB to (1,0,0,0) or (ON, OFF, OFF, OFF), setting it as the Leader HAB	
HABs connected in parallel.	None of the HABs output power. All HAB LCD Screens are lit. All HAB RUN LEDs are OFF. All Alarm LEDs flash 0.5s on, 0.5s off.	Leader Communication ID Address Repeated. More than one HAB has been set as the Leader.	Set only one HAB address to 1,0,0,0. All others should be set as followers. After setting the correct address, restart the HAB using the front panel power switch.	

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Setup Conditions	Symptoms	Diagnosis	Action to Rectify	Notes
HABs connected in parallel. HABs have similar voltages.	Leader HAB outputs power. Follower HABs do not output power All HAB LCD Screens are lit. Leader RUN LED is ON. Follower RUN LEDs are OFF. One or more follower ALARM LEDs flash 0.5s on, 0.5s off.	Follower Communication ID Address Repeated. More than one follower HAB has the same address.	Check the addresses of the HABs with the alarms. Set each to a unique address. Restart the HABs using the front panel power switch.	If the problem persists, you have the option of operating your bank without interbattery communication. You can do this by removing all of the HAB to HAB communication cables, removing all of the communication port terminators, and setting each HABs address to (OFF, OFF, OFF, OFF), (0,0,0,0).
HABs connected in parallel. HABs with similar voltages	Leader HAB outputs power. Follower HABs do not output power All HAB LCD Screens are lit. Leader RUN LED is ON. Follower RUN LEDs are OFF. One or more follower ALARM LEDs flash 0.5s on, 0.5s off.	The followers with the flashing ALARM LEDs have lost communication with the Leader HAB.	Ensure the HAB to HAB communication cables between HABs are secure and the RJ11 retention clips are locked. If the retention clips are damaged or missing, replace the cable with another RJ11, 6-position, 4-conductor cable with male connectors on both ends, straight through. Maximum	If necessary, disconnect all communication cables from each other, set each unit address to (0,0,0,0) and operate the bank like a non-smart bank of parallel batteries.

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Setup Conditions	Symptoms	Diagnosis	Action to Rectify	Notes
HABs connected in parallel. HABs with similar voltages. Only Leader charging.	Leader HAB charging. Follower HABs are not charging. All HAB LCD Screens are lit. Leader RUN LED is ON. Follower RUN LEDs are OFF. One or more follower ALARM LEDs flash 0.5s on, 0.5s off.	The followers with the flashing ALARM LEDs have lost communication with the Leader HAB.	length, 10 feet. Restart each HAB using the front panel power switch.	
HABs connected in parallel. HABs with similar voltages. Only Leader discharging.	Leader HAB discharging. Follower HABs are not discharging charging. All HAB LCD Screens are lit. Leader RUN LED is ON. Follower RUN LEDs are OFF. One or more follower ALARM LEDs flash 0.5s on, 0.5s off.	The followers with the flashing ALARM LEDs have lost communication with the Leader HAB.		

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Setup Conditions	Symptoms	Diagnosis	Action to Rectify	Notes
HABs connected in parallel. HABs with different voltages. HABs charging.	Power from all HABs. All HAB LCD Screens are lit. Lower voltage HABs charging. High voltage HAB not charging. High voltage HAB RUN LED flashes 1s on, 1s off.	The high voltage HAB has been removed from parallel connection with the rest of the bank. When the rest of the bank is charged to within 1 V of the high voltage HAB, it is added back into parallel connection.	Normal operation. No action needed.	
HABs connected in parallel. HABs with different voltages. HABs discharging.	Power from all HABs. All HAB LCD Screens are lit. High voltage HABs discharging. Low voltage HAB not discharging. Low voltage HAB RUN LED flashes 1s on, 1s off.	The low voltage HAB has been removed from parallel connection with the rest of the bank. When the rest of the bank is discharged to within 1 V of the low voltage HAB, it is added back into parallel connection.	Normal operation. No action needed.	
HABs connected in parallel. HABs discharging.	1 or more HABs stop discharging. Non-discharging HAB's "HT" light is lit. Non-discharging HAB's ALARM LED is flashing. Rest of HABs continue discharging and their RUN LEDs are lit.	The non-discharging or non-charging HABs have entered High Temperature protection. They are removed from parallel connection until high temperature protection is released. When high	Normal operation. No action needed.	

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Setup Conditions	Symptoms	Diagnosis	Action to Rectify	Notes
HABs connected in parallel. HABs charging.	1 or more HABs stop charging. Non-charging HAB's "HT" light is lit. Non-charging HAB's ALARM LED is flashing. Rest of HABs continue charging and their RUN LEDs are lit.	temperature protection is released, the ALARM LED will go out and the RUN LED will start flashing 1s on, 1s off as it waits to be added back into parallel connection.		

6.4. Resetting / Recalibrating the HAB

The following section describes the reset / recalibration process.

6.4.1. Resetting the HAB™

If necessary, you can reset the HAB™ by first turning it on using the front power button, and then pressing and holding down the power button for 10 seconds. This will clear any alarms and protection locks. This **will not** reset the cycle count.

6.4.2. Recalibrating the HAB™

SoC is a calculated value meant as a guide for users but does not affect how the battery acts or performs. If you find the SoC becoming inaccurate or drifting, please try re-calibrating the battery SoC by charging it up to 56.4 V.

- If the SoC reaches 100% before the battery is at 56.4 V, please do not stop charging. Continue fully charging to 56.4 V.
- If a high voltage alarm occurs, you can ignore it. You will still be below the high voltage protection. Note: If this does occur, the alarm will not clear until the voltage falls below 54.4 ±0.5 V.

After fully charging to 56.4 V, please look at the display and write down the kWh shown for your records and to calculate the capacity of your HAB. Multiply that number by 1000 to get the Watt hours, then divide the Watt hours by 48 V to determine the Amp Hour capacity of your HAB. For example, if the display read 7.5 kWh, multiply by 1000 to get 7500 Watt hours, and then divide by 48 V to get 156.25 Ah, the capacity of your HAB™.

6.5. Initial HAB™ Unboxed Voltage

If your HAB™ has a low initial voltage when unboxed, refer to the following information.

6.5.1. Low HAB voltage when unboxed

If, when you turn on your HAB™, you measure a very low voltage (under 40 V) at the battery terminals, it is in Low Voltage Hibernation. Press the front power button for three seconds to turn the HAB off. Wait five seconds. Press and hold the power button for 10 seconds. Wait five seconds. Press and hold the front power button to start the HAB.

You can use this method if you ever need to reset the HAB™.

Note:

This reset will not reset the cycle count on your HAB™.

6.5.2. Reset the State of Charge Estimator

To reset the State of Charge (SoC) estimator, charge the HAB all the way up to 56.4 V. Ignore the high voltage alarm and the SoC in the display. Then discharge the HAB™ all the way down to 49 V, ignore the low voltage alarm. Then recharge the HAB™ normally. The SoC should now be reset.

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7. Technical Support

7.1. Downloads

Downloads will be made available on the KiloVault® website.

7.2. Documentation

Documentation for the HAB™ can be downloaded from the KiloVault® website - https://kilovault.com/

7.3. Software

The HAB iT monitoring software for iOS and Android mobile devices can be downloaded from both the iOS and Android app stores. There is not a desktop version of HAB iT.

HABs with serial numbers MWT20200229021102 and higher receive firmware updates through the cloud when they are connected to the Internet. Please see Section 5.3.1 Firmware Updates for details. Firmware updates include improvements to the BMS including HAB to HAB communications, cycle counting, state of charge calculation, and other BMS functions as needed. Please note that updating the Wi-Fi firmware is not currently supported. If your HABs serial number is below MWT20200229021102 and you would like the firmware updated, please contact KiloVault®.

7.4. Contact Us

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