KILOVAULT®



KiloVault® HAB™

INSTALLATION & INTEGRATION GUIDE

Rev: 5.0

\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.

No responsibility is assumed by KiloVault® or Sol-Ark for any consequences arising out of the use of this material.

Read and keep this Installation Guide for future reference.

Rev: 5.0

This manual is for use by qualified personnel only

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Abbreviations and Acronyms

Name	Abbreviations or Acronyms
UNIT	KiloVault® HAB™
CEC	California Energy Commission
CSA	Canadian Standards Accociation
GT	Grid Tie
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MPPT	Maximum Power Point Tracking
NEC	US National Electrical Code NFPA-70
PV	Photovoltaic
PVGFP	PV Ground Fault Protection
UL	Underwriters Laboratories
ETL	Intertek Testing Laboratories
VAC	Volts Alternating Current
VDC	Volts Direct Current

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WARNINIG

The KiloVault® HAB™ Battery is not intended for use in connection with life support systems or other medical equipment or devices.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

"DO NOT DISCARD CRATE AND INTERNAL PACKAGING."

Congratulations on your KiloVault® product purchase. Product registration is required for warranty coverage and allows for easier customer and technical support.

https://kilovault.com/register/

"VERIFY that your HAB firmware is Up To Date"

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

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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 KiloVault® HAB™ out of the reach of children and animals.
	**Warning:** The KiloVault® HAB™ is heavy, over 230 lb. (105 kg), and may cause serious back injury. Lift with multiple people and lifting equipment rated to lift and support at least 300 lb.
	**Warning:** Do not dispose of this product with household waste.
	**Caution:** Risk of electric shock.
	**Attention:** Disconnect the KiloVault® HAB™ before carrying out maintenance or repair.
	**Attention:** Read this instruction manual before installing and operating the KiloVault® HAB™ .
	**Note:** Indicates points of particular emphasis that make operation more efficient or convenient.
	**Recyclable:** Please contact your local solid waste recycling agency for recycling instructions.

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	**Warning:** Failure to follow the instructions in this manual may result in serious injury or death.
	**Warning:** Never connect KiloVault® HAB™ units in series!
	**Warning:** After powering down a HAB, you must wait at least 30 seconds before turning it back on again. Failing to wait at least 30 seconds risks causing internal short circuit events and causing damage to its internal resistors.

1.2. General Safety Precautions and Instructions

- 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 KiloVault® 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.

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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 230 lb., it should be moved with the help of multiple people and moving / lifting equipment rated over 300 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 KiloVault® HAB™ upside down.
- Store the KiloVault® HAB™ away from children and animals.

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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.

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2. Overview



Warning:
Never connect HAB™ units in series!

KiloVault® HAB™ Series wall-mount energy storage systems provide a 7.5 Kilowatt-hour (7 kilowatt-hour usable) battery in a single package. Up to 14 units can be connected in parallel 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 (LiFePO4) battery
- Wall mounted all-in-one design
- Integrated HAB to inverter Modbus communications
- Integrated HAB to HAB CAN bus communications
- Integrated Wi-Fi communications (KiloVault® 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 Followers) modules in parallel

The wiring panel of the HAB™ has been designed for function and convenience.

- The HAB™ wiring panel has access ports on the left and right sides, and the bottom
- Power and communication cables are now more easily attached
- The HAB™ case has integrated handles that fold completely out of the way when not in use
- The HAB™ now comes with replaceable vents for different operating environments:
    - o Vented plates for warmer environments
    - o Solid plates for cooler environments

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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.

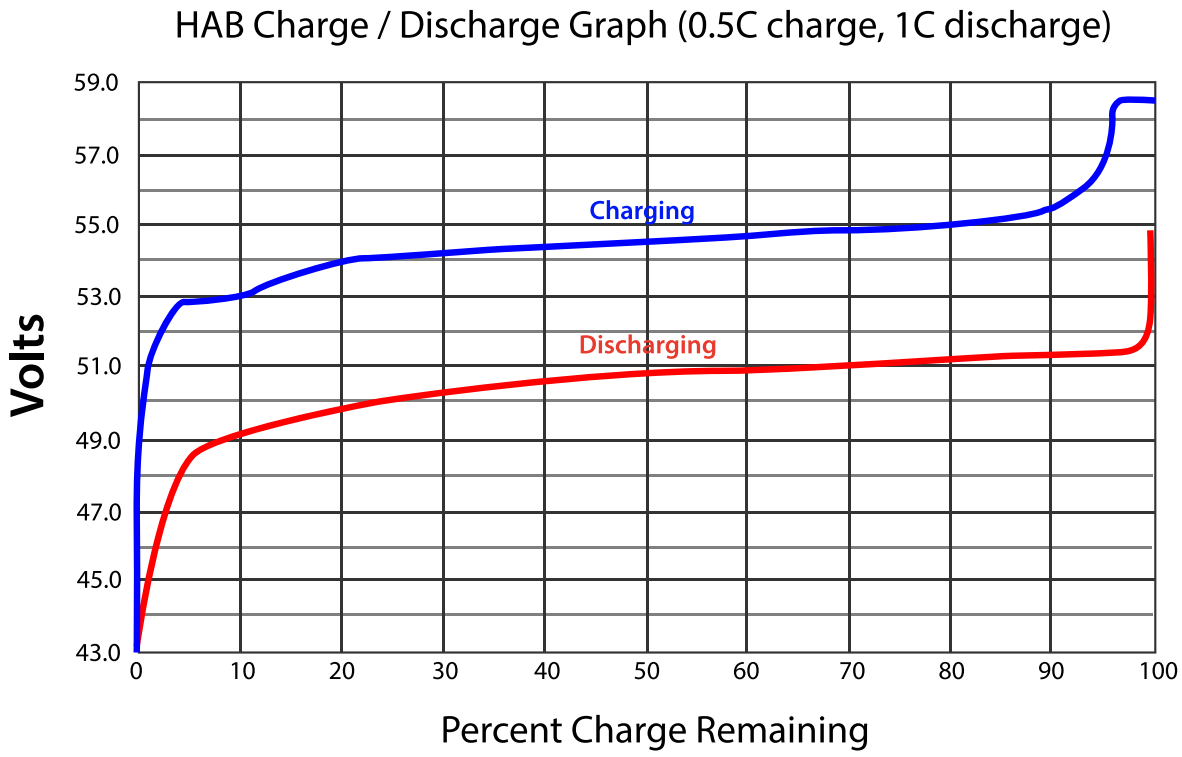


Figure 1: Charge/Discharge Graph

The following specifications describe the HAB™ system.

Item	Specification
Battery Type	LiFePO4
Internal Resistance	≤15mΩ

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Item	Specification
Battery Efficiency	94.5%
DC	Direct current
Fully Charged Resting Voltage	53.6 V
Full Charge Voltage	56 V
HAB™ to HAB™ (inter-battery) communication cable	RJ45 120 Ω Resistor Plug, 6-position, 4-conductor, male connectors both ends. Straight through. Maximum length, 10 feet
HAB™ to HAB™ (inter-battery) communication protocol	CAN Bus
HAB™ to Inverter communication protocol	Modbus / Can bus
High Voltage Cutout	60.0 ± .5 V (not a set point)
Low Voltage Cutout	48.0 V (not a set point)
Maximum Cell Balancing Current	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 mV
Minimum Discharge Voltage	48.0 V
Nominal Capacity	150 Ah
Nominal Energy	7.68 kWh
Nominal Voltage	51.2 VDC

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Item	Specification
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	54 V
Self-Discharge Rate	≤3% per month, ≤15% per year • Note: This rate is only achieved when the KiloVault® HAB™ is put to sleep by pressing down the Power button for 3 seconds. • The KiloVault® HAB™ will automatically shut down after 15 minutes of no activity.

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

3.2. Operating Environment Specifications

Item	Specification
Operational Temperature Range	Indoors away from direct exposure to rain or sun
Operating Temperature	32° to 113°F (0° to 45°C)
Recommended Operating Temperature	59 to 95°F (15°C to 35°C)
Short Term (less than one month) Storage Temperature	-4 to 110°F (-20° to 45°C)
Absolute Maximum Altitude	**Maximum 13,123 feet (4000 m)** • To operate the HAB™ at maximum outpu power, limit the altitude to <2000m • Between 6561 feet (2000m) & 4000m limit, the output power to 6.48 kW (max 120A)". • Do not operate above 4000 m

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3.3. Physical Specifications

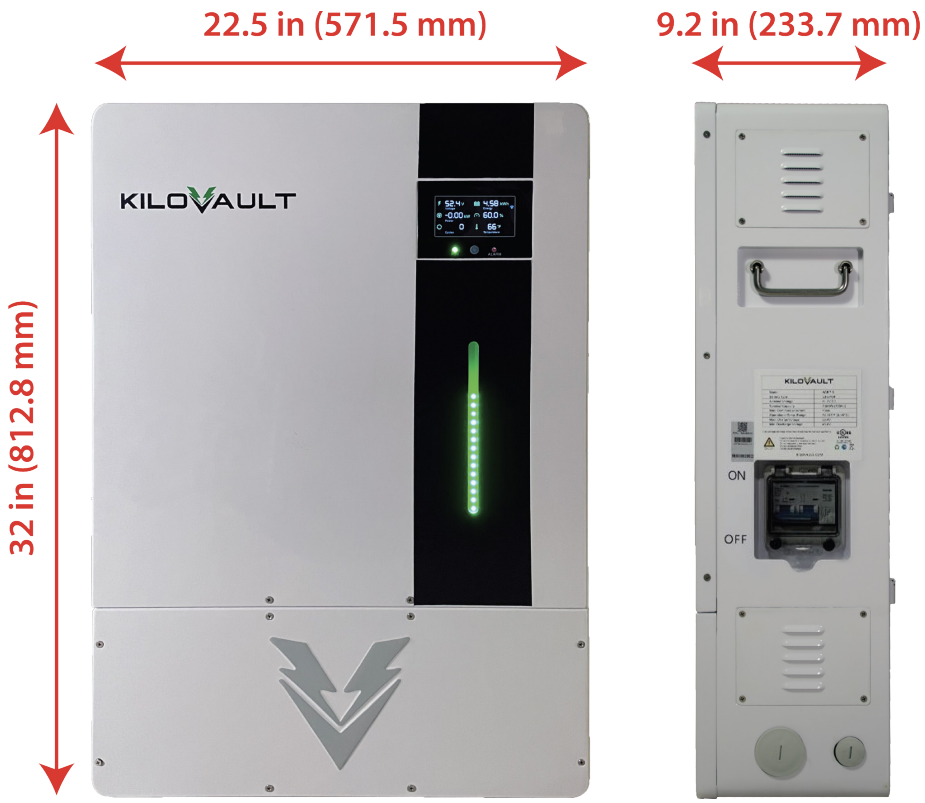


Figure 2: Physical Specifications

Item	Specification
KiloVault® HAB™ Weight	230 lb (105 kg) net 286 lb (130 kg) gross
KiloVault® HAB™ Height	32 in (812.8 mm)
KiloVault® HAB™ Width	22.5 in (571.5 mm)
KiloVault® HAB™ Depth	9.2 in (233.7 mm)
Mounting Plate Height	18 in (458.1 mm)
Mounting Plate Width	22.3 in (565.5 mm)

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Item	Specification
Mounting Plate Ears	1.7 in (42.5 mm)
Mounting Plate Lips	0.5 in (12.7 mm)
KiloVault® HAB™ Ingress Rating - Vents Installed	IP54
KiloVault® HAB™ Ingress Rating - Solid Plates Installed	IP55
Battery Terminal Torque	15 Nm, 11.06 ft-lb, 132.76 in-lb
Large (power) ports	PG42: Approx. 2.1 in (55mm)
Small (communication) ports	PG21: Approx. 1.1 in (28mm)

3.4. Certifications

• Cell Certifications

- o UL1642
- o UL9540
- o IEC62619
- o UN38.3

• Complete Unit Certifications

- o cETLus UL 1973
- o UN DOT 38.3 (acceleration three times each side)
- o 50 gn for 11 ms
- o 150 gn for 6 ms
- o IP54 – Vented plates installed
- o IP55 – Solid plates installed
- o OSHAS 18001 / ISO 45001
- o ISO 9001 / 14000

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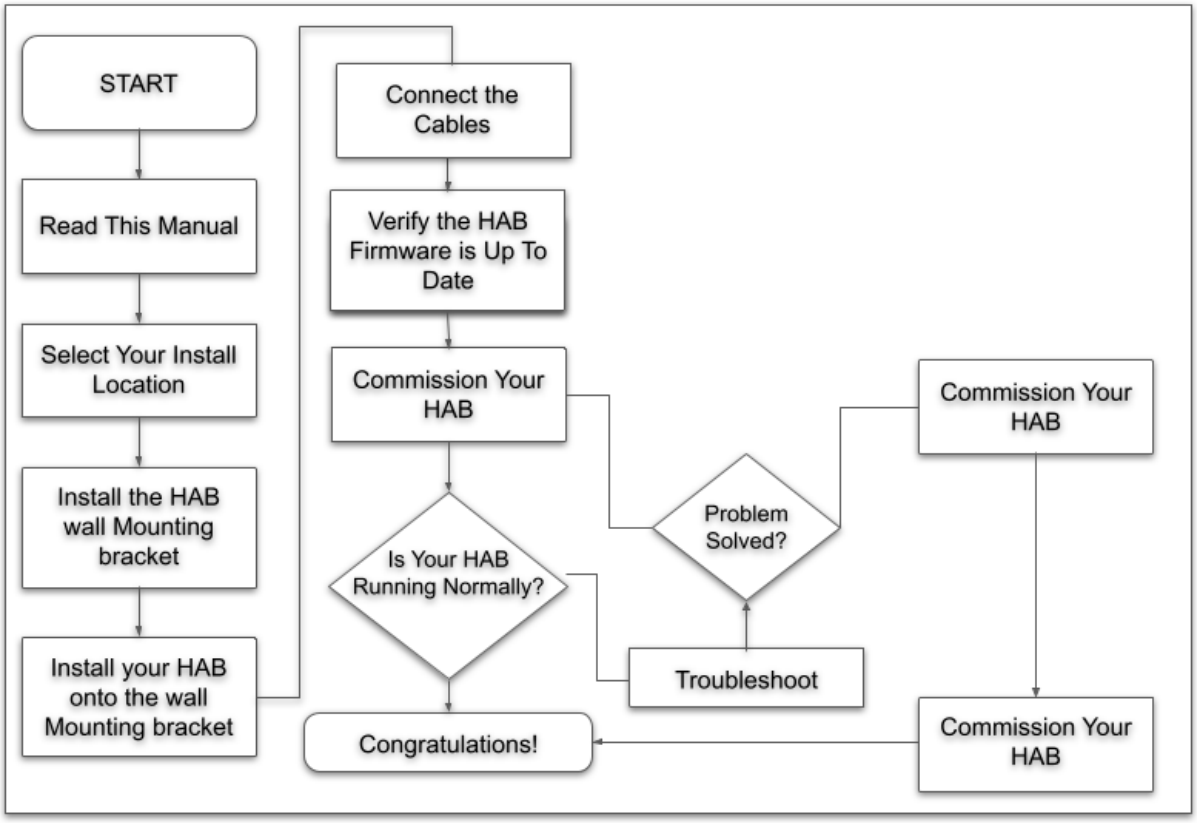
4. Installation

	**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 KiloVault® HAB™ out of the reach of children and animals.
	**Warning:** The KiloVault® HAB™ is heavy, over 250 lb. (105 kg), and may cause serious back injury. Lift with multiple people and lifting equipment rated to lift and support at least 300 lb.
	**Warning:** Do not dispose of this product with household waste.
	**Caution:** Risk of electric shock.
	**Attention:** Disconnect the KiloVault® HAB™ before carrying out maintenance or repair.
	**Attention:** Read this instruction manual before installing and operating the KiloVault® HAB™.

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4.1 Installation Flowchart

The following flowchart provides an overview of the installation process.



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™ unit's position, viewing this information after installation may be difficult.
- 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.

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4.2. Unpacking the KiloVault® HAB™

The HAB™ weighs 230 lb. (105 kg); wear appropriate protective equipment, such as gloves and protective footwear, when handling this unit.

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.

Do not attempt to lift or move the battery without sufficient equipment and human resources. Lifting equipment that is capable of securing the battery from tipping while moving and positioning is highly recommended.

There are built-in handles on the sides of the HAB to assist when lifting. The built-in side handles are designed to help lift the battery once up-righted but are of only partially helpful while the battery is still laying on it's back. At least 2 to 3 people are necessary to lift and upright the battery from its crate. The use of heavy gloves is highly recommended.

Retain all packaging material for the duration of your warranty period.

4.2.1. Package Contents

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



Figure 4: Standard KiloVault® HAB™ Packaging

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Figure 5: RJ45 HAB to HAB CAN Bus Cable



Figure 6: RJ485 HAB to Inverter Modbus cable

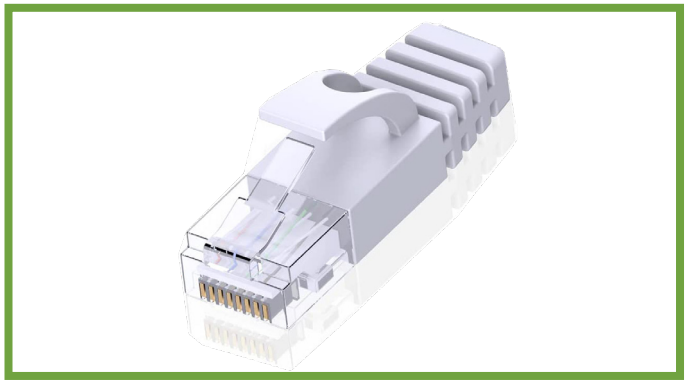


Figure 7: RJ45 120 Ω Resistor Plug

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Part	Quantity
59 in (1.5 m) HAB™ HAB™ CAN Bus cable.	1 each
59 in (1.5 m) RJ45 HAB™ to inverter Modbus cable	1 each
RJ45 120 Ω Resistor Plug	1 each
Wall Mounting Plate	1 each
M8*30 Expanding Screw	10 each
M8*16 mm Bolt	2 each
PG21 (1.1 in, 28 mm) Strain Relief	2 each
PG42 (2.1 in, 28mm) Strain Relief	1 each
Optional Vented Side Plates	4 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 230 lb (105 kg)
- 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 KiloVault® HAB™ batteries are being used)
- Level
- Pencil or marker

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4.4. Suitable Installation Locations

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 about 8 inches (approx. 200 mm) of clearance on both sides.

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 from derating the output or shutting down due to overheating
- Keep away from fire, flammable, or explosive items
- Keep 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 300 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.

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4.5. Install the HAB™ Wall Mounting Plate

The HAB™ comes with the single mounting plate option.

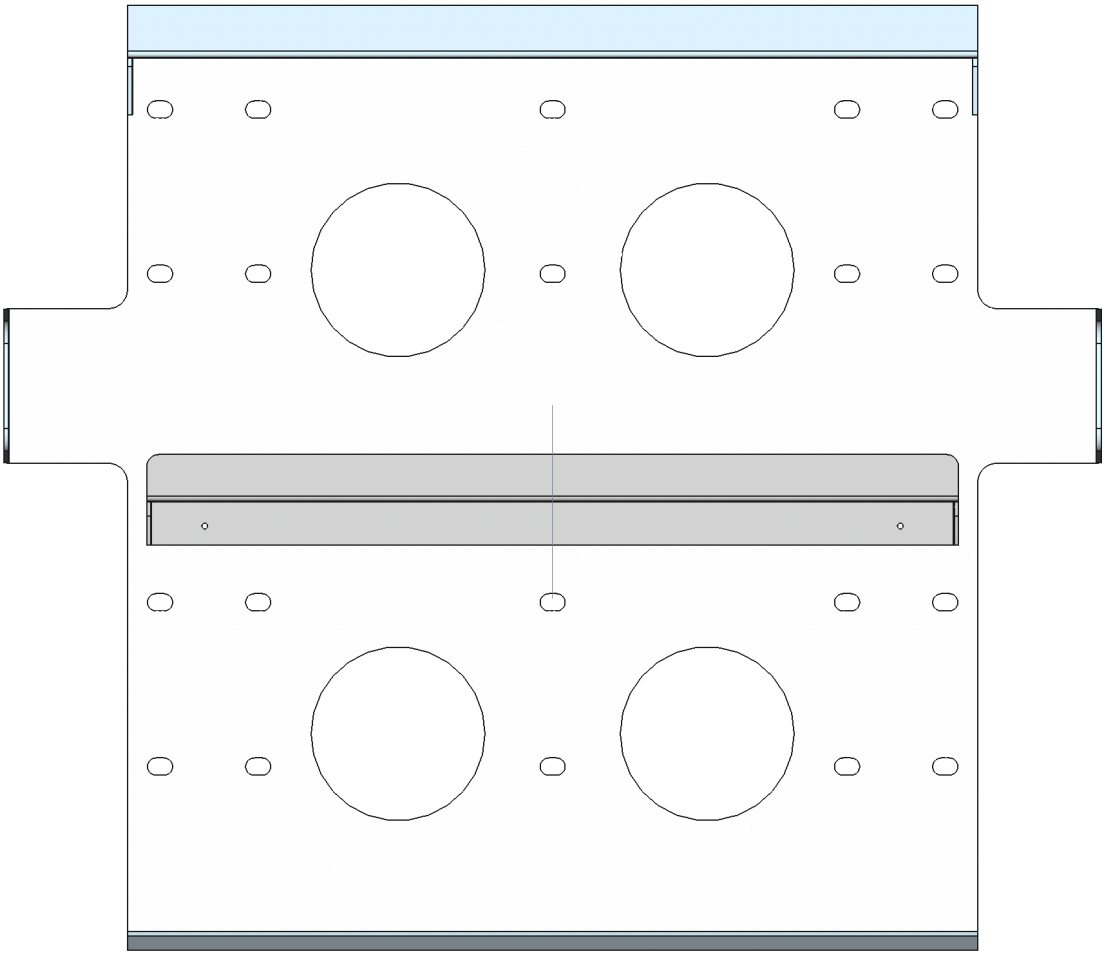


Figure 8: Wall Mointing Plate

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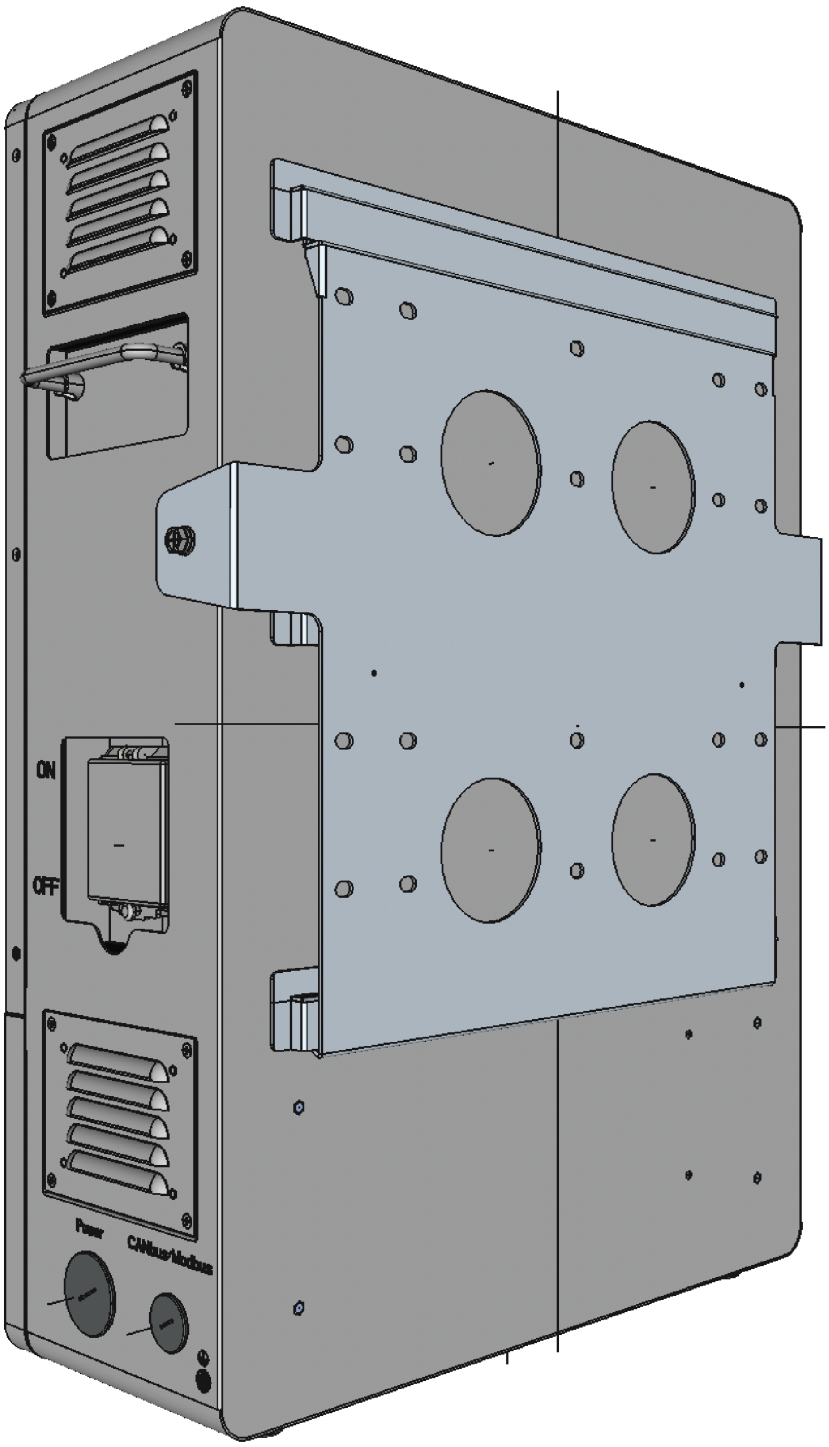


Figure 9: Wall Mounting Plate Attached

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.

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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.

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™

Using sufficient resources lift the HAB™ onto the wall bracket. Using the two M8*16mm bolts provided, secure the HAB to the wall bracket. We strongly recommend using lift equipment and straps to secure and steady the KiloVault® HAB™.

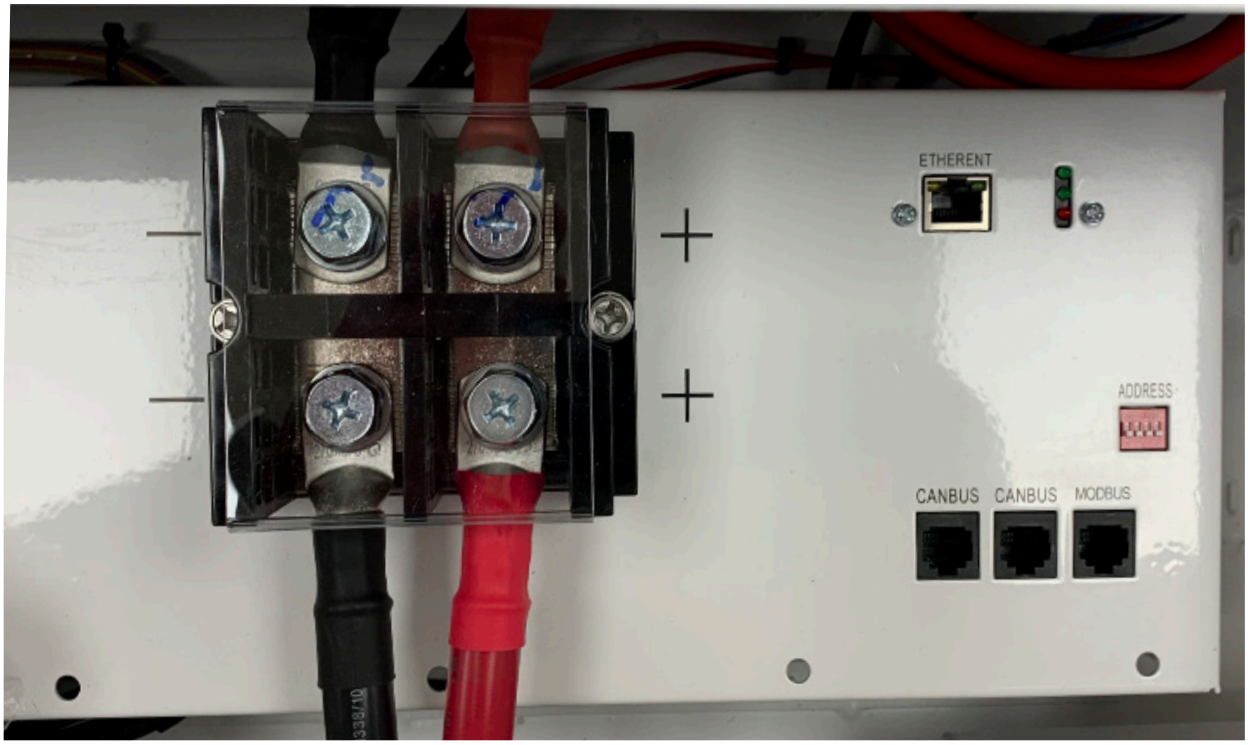
	**Warning:** DO NOT reverse the polarity (positive and negative) of your unit's connections. NEVER short circuit your KiloVault® HAB™.
	**Warning:** After powering down a HAB, you must wait at least 30 seconds before turning it back on again. Failing to wait at least 30 seconds risks causing internal short circuit events and causing damage to its internal resistors.
	**Warning:** The KiloVault® HAB™ is for use with 48 V systems only. DO NOT connect them in series!

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4.6. Connecting the HAB™ to Your Inverter

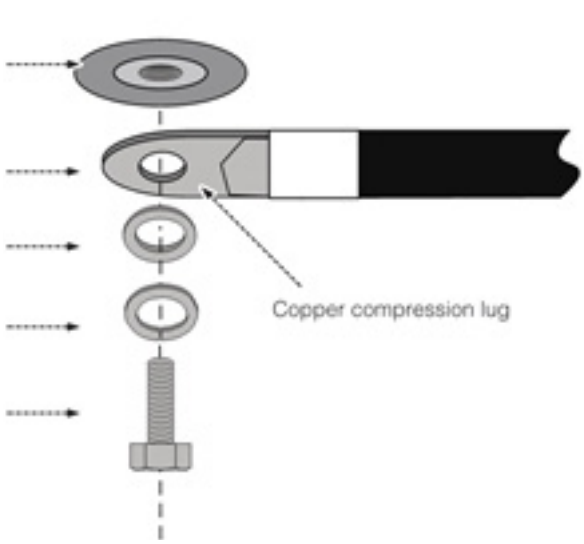
There are access ports on the bottom left, bottom right, and on the bottom of the wiring access panel.

One large and two small strain reliefs are included in the HAB™ packaging. To use them remove the plugs from the relevant access ports and replace them with the included strain reliefs. The large strain relief will accept up to 2/0 wire.



NOTE

Note: When making the connections, be sure to observe correct hardware stacking and proper polarity, and ensure that nothing obstructs the connection between the terminal surface and the battery cable lug,



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WARNING

UNGROUNDED EQUIPMENT

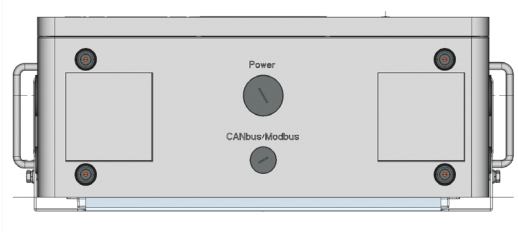
Equipment ground terminals must be reliably connected to ground by appropriately sized grounding conductors. All installations must comply with national and local codes. Consult local and national codes for specific grounding and bonding requirements.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

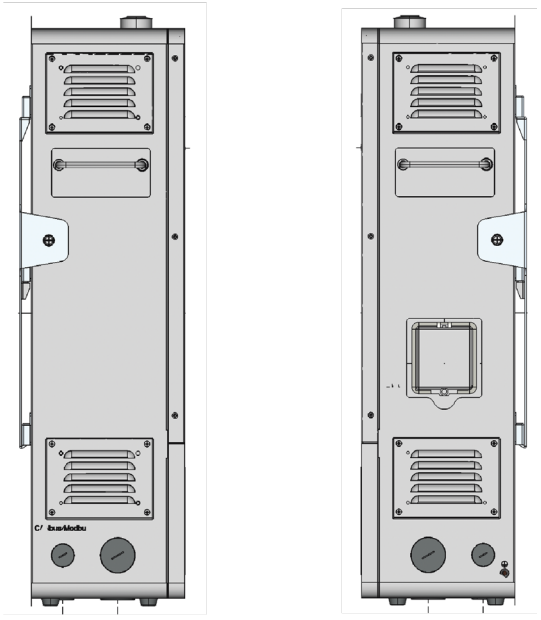
⏚ Protective (grounding) conductor terminal

The KiloVault® HAB™ is provided with ground terminals that must be reliably connected to ground (protective earth) by appropriately sized equipment grounding conductors. System grounding for the AC and DC systems must be done according to all applicable NEC and local installation codes. To connect the HAB™ to the DC grounding system, use the ground lug at the bottom of the chassis (see Figure below). The terminal accepts wires from #14 AWG (1.63 mm) to #2AWG (6.54 mm).
System grounding for the DC system, which typically involves

Note: If a grounded DC system is required, ensure that the system bonding is done in one location only, and that all conductors and connections comply with all applicable NEC and local installation codes.



HAB™ Bottom Access Ports with Plugs in Place



Bottom Left Ports

Bottom Right Ports

Figure 11: HAB™ Access Ports

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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 have multiple HAB™ units, daisy chain the RJ45 HAB to HAB CAN Bus cable between each unit. This leaves an empty CanBus port on either end of the string to install the provided RJ45 120 Ω Resistor Plug. (Refer to Section 4.6.3) **Note:** If a longer cable is needed,please contact KiloVault® Customer service.
3	**Optional:** Connect the Modbus communication cable between the Leader HAB™ and the inverter. Contact KiloVault® for a list of supported inverters.
4	Connect the power cables from the HAB™ to the inverter (or to the DC bus if installing to multiple units), making sure to use overcurrent protection as required. Torque the battery cable terminals to 15Nm (11 ft-lb or 132 in-lbs) **Note:** Only 1/0 or 2/0 battery cables are permitted.
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 and hold the power button until the red “RUN” LED flashes. (Approx. 3 - 5 seconds).
8	Wait five seconds for the HAB™ units pre-charge function to complete.
9	If installing more than one HAB™ simply repeat steps 7 & 8 until all the units have been energized.
10	Activate inverter function on your inverter, if applicable.

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4.6.2. Disconnecting the HAB™

⚠	**Warning:** After powering down a HAB, you must wait at least 30 seconds before turning it back on again. Failing to wait at least 30 seconds risks causing internal short circuit events and causing damage to its internal resistors.

DO NOT reverse polarity or short circuit. Doing so will result in damage.

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 all communication cables, as applicable.
4	Disconnect the DC power cables from the HAB™ to the inverter or to the DC bus as applicable, making sure to use overcurrent protection as required.

4.6.3. RJ45 120 Ω Resistor Plug Resistor Plug Installation

A RJ45 120 Ω Resistor Plug resistor plug is enclosed in each KiloVault® HAB™ unit. Plug one end into the first and last units in the string as shown.

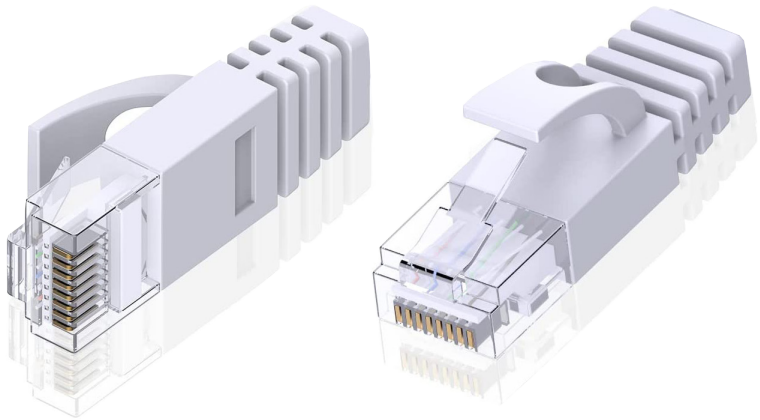


Figure 12: 120 Ω Resistor Plug

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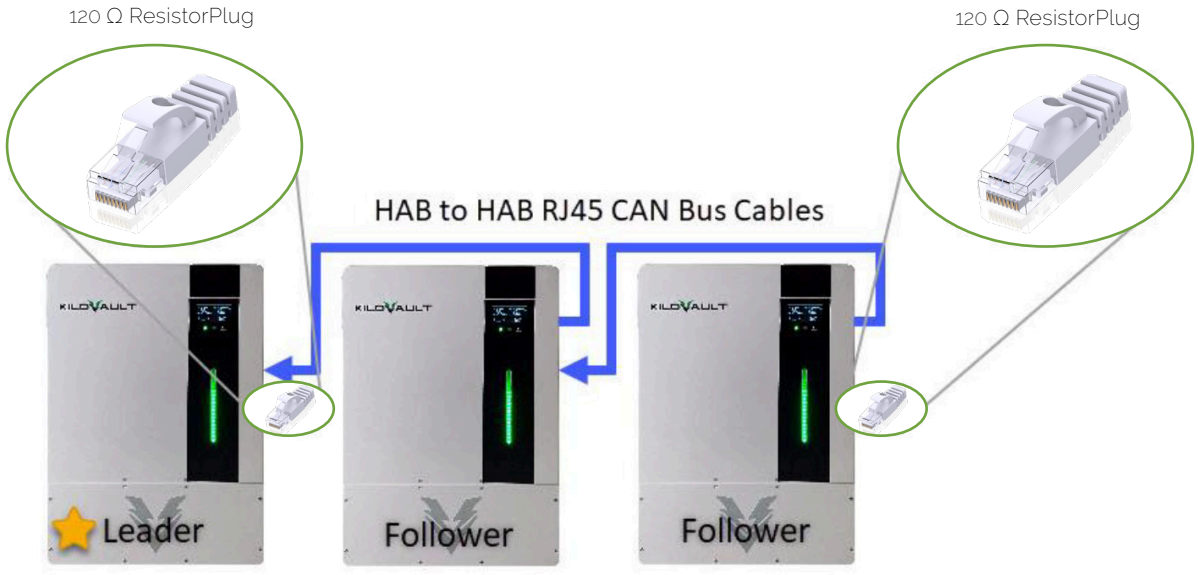


Figure 13: Resistor Plug Installation

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.

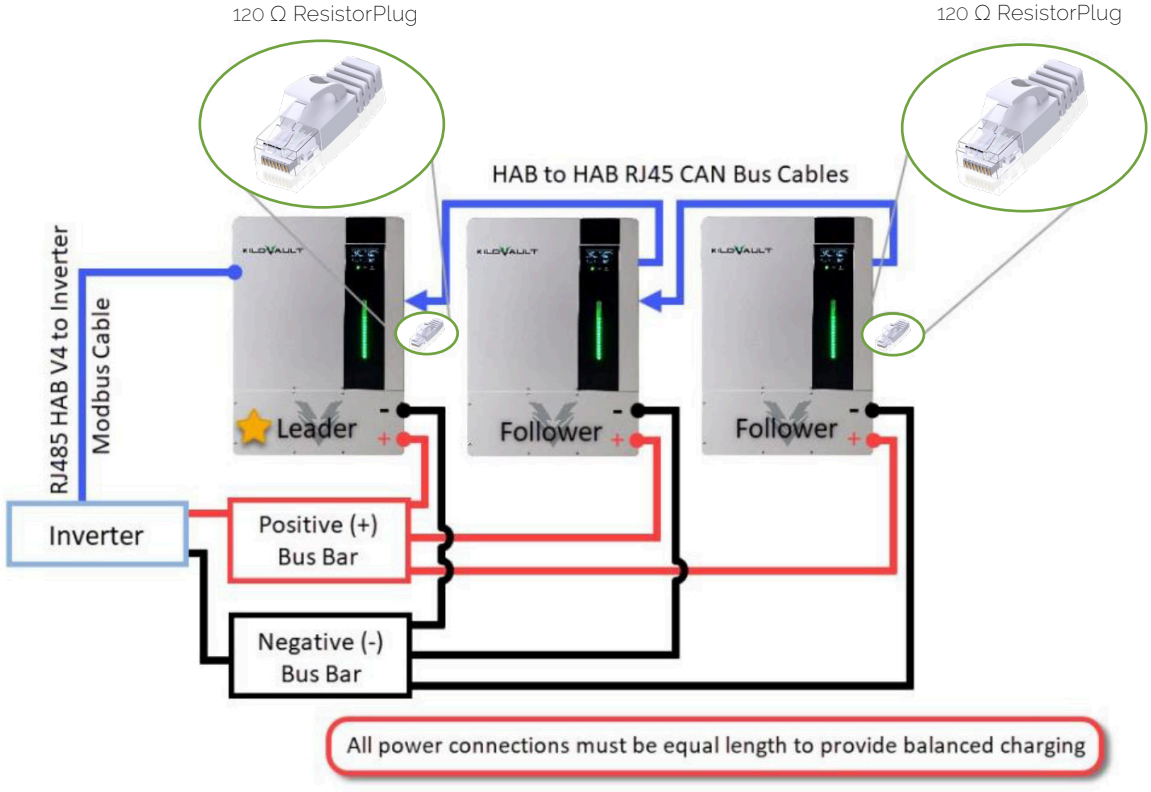


Figure 14: Single Inverter Installation

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

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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.

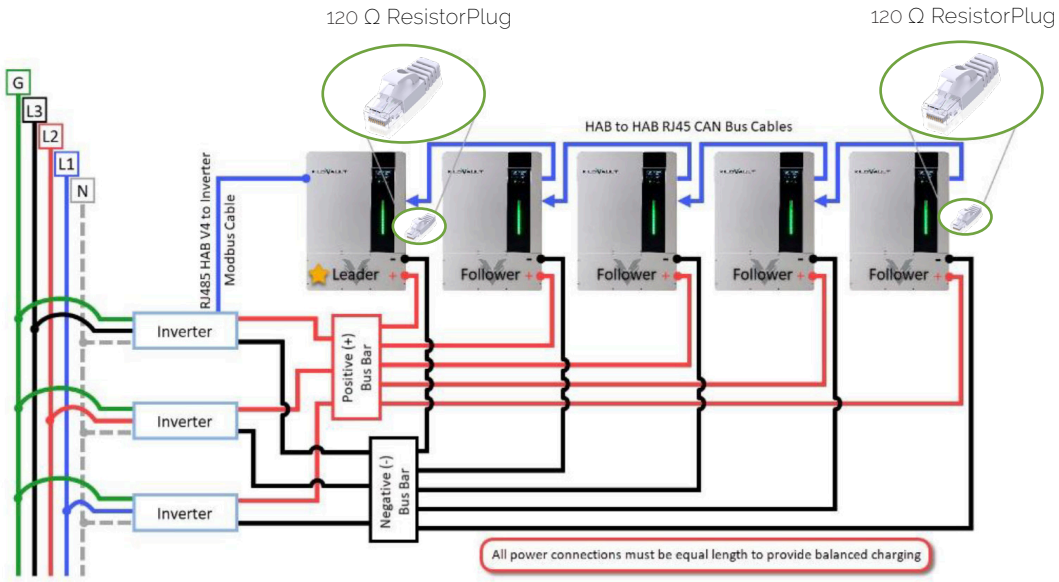


Figure 15: Multiple Inverter Installation

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 following figure shows a typical installation.

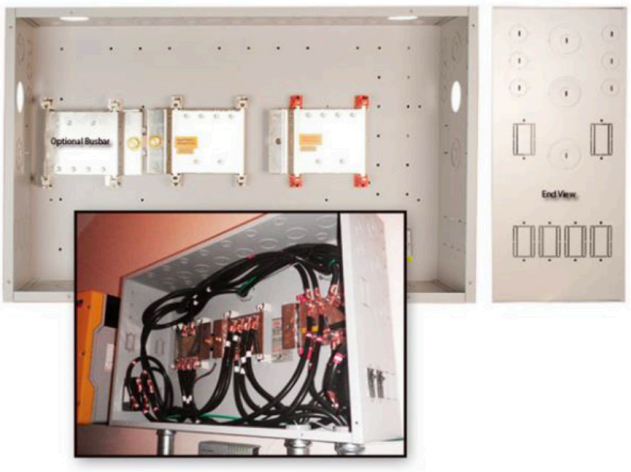


Figure 16: Optional Bus Bar

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4.6.7. Setting the KiloVault® HAB™ Address

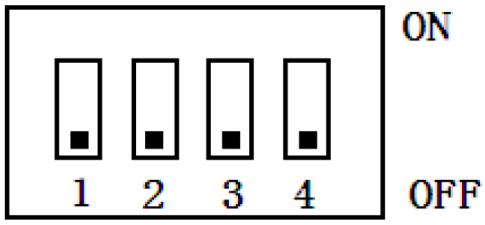


Figure 17: DIP Switches

- 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 address must be (on off off off).

Module Number	DIP Switch Settings			
	Switch 1	Switch 2	Switch 3	Switch 4
Leader - Singles KIloVault® HAB™	OFF	OFF	OFF	OFF
Leader - Multiple KIloVault® 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

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4.6.8. HAB to HAB and HAB to Inverter Communication Cable Pin Definitions

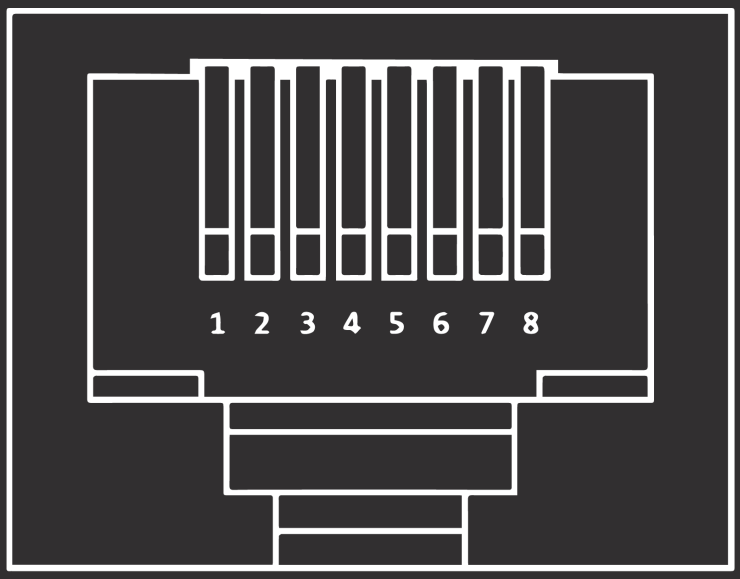


Figure 18: RJ45 CAN BUS AND RS485 Modbus Connector

The provided inter-KiloVault® HAB™ Can-Bus communication cable is a standard, straight thru RJ45 comm cable. The provided battery to inverter Modbus communication is a custom RJ485 (non-standard).

⚠	**Warning:** Do not plug the HAB to Inverter Modbus cable into the CAN Bus port. Do not plug the HAB to HAB CAN bus cable into the Modbus port.

CAN Bus Pin Number	CAN Bus Definition
1	NC
2	NC
3	CANL
4	CANL
5	CANH
6	CANH
7	NC
8	NC

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Modbus Pin Number	Modbus Definition
1	Inverter RS485B
2	Inverter RS485A
3	NC
4	NC
5	NC
6	NC
7	BMS debug RS485A
8	BMS debug RS485B

5. Operation, Maintenance & Monitoring

5.1. HAB™ Control Panel

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

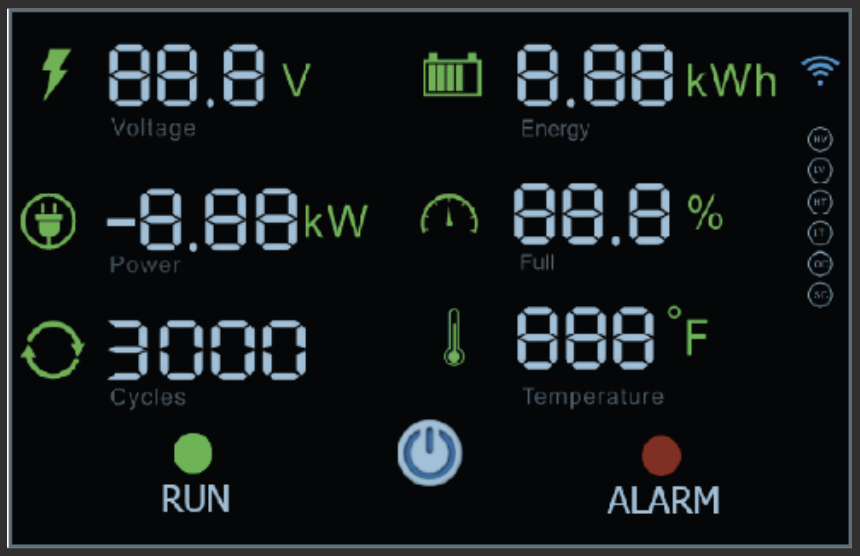
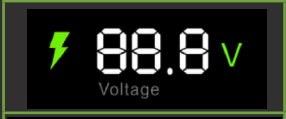


Figure 19: KiloVault® HAB™ V4 Control Panel

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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 HAB™ is configured for a router connection, but the connection has failed. • Rolling = One-Click configuration. The user can check the status through a local connection. • Flashing = The 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.
	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.

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5.2. Calibrating Your HAB™

Calibrate the State of Charge calculator and kWh using the following procedure.

• Fully charge the battery to 56V.

- o 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.
- o 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 56V.
- o Once the battery has reached 56v, discontinue charging even if the SoC is not yet showing 100% it should recalibrate to 100% at this time. You may want to record the displayed kWh for your records.

Or Fully discharge your battery(s) to 48.5v

- o 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.
- o 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™ unit'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 in the following table:

Device	Setting	Under 40A Charger	40-60A Charger	60-150A Charger
All	Standard Charge Voltage	56V		
	Peukert Coefficient	1.05		
	Internal Resistance	≤15mΩ		
	Recommended Charge Current	100 Ah per HAB™ in Parallel (Solar Charge Controller Amps + Percentage of Inverter/Charger Maximum DC Output). Example: For a single HAB™ system with an inverter/charger maximum DC output of 100 A and a solar charge controller capable of 50 A, limit the inverter/charger output to 50 A (so the total is 100 A).		

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Device	Setting	Under 40A Charger	40-60A Charger	60-150A Charger
Inverter Charger	Absorb Time (some controllers do not allow a selection under 6 minutes, please contact KiloVault for additional information)	Under 6 minutes	Under 4 minutes	Under2 minutes
	Battery Capacity	150 Ah (7.5 kW) per KiloVault® HAB™		
	Battery Type	Lithium Ion or Custom - whichever provides access to the required settings		
	Absorption	56V		
	Bulk (98% to 100% of Absorption)	56V		
	Bulk Current	75 A		
	Charge Cycle	2 Stage No Float		
	HBCO (High Battery Cut Out)	57 V (58V for Sol-Ark Equipment)		
	LBCO (Low Battery Cut Out)	48.2 V (48V for Sol-Ark Equipment)		
	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 100 A		
	Absolute Maximum Charge Rate	120A per HAB™ in Parallel (Solar Charge Controller Amps + Percentage of Inverter/Charger Max DC Output. Example: For a single HAB™ system with an inverter/charger maximum DC output of 100 A and a solar charge controller capable of 80 A, you would limit the inverter/charger output to 40 A (so the total is 120 A).		
	Recharge / Re-Bulk Volts (80% DoD)	51.4 V (used to set voltage that triggers charge start)		

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Device	Setting	Under 40A Charger	40-60A Charger	60-150A Charger
Charge Controller	Absorb Time	Under 6 min	Under 4 min	Under 2 min
	Absorb Voltage	56 V		
	Battery Capacity	150 Ah (7.5 kWh) per HAB™		
	Battery Temperature Compensation	Do not use an external battery temperature sensor with these batteries. If the sensor is required for a charge controller or inverter charger to work, set the battery temperature compensation to 0mV / °C.		
	Battery Type	Lithium Ion or Custom - whichever provides access to all the required settings		
	Battery Voltage	48 V		
	Bulk Voltage	56 V		
	Charge Cycle	3 Stage		
	Equalization	Disabled		
	Max Float Current	10 A		
	Float Voltage	52.8 V		
	Maximum Charge Rate	1C		
	Recharge / Rebulk Volts	Set to start charging from solar before charging by AC (just above the inverter/charger's recharge/rebulk voltage of 51.4 V).		
Battery Monitor	Midpoint Sensor	If you are using a battery monitor with midpoint sensors, secure the midpoint sensor leads out of the way and electrically isolate the midpoint sensors with electrical tape, shrink wrap, or any other appropriate method. Midpoint sensors are only used on strings of batteries in series. Since the units are NEVER connected in series, midpoint sensors are not used.		
	Battery Temperature Sensor	Do not use an external battery temperature sensor with these batteries.		
	Battery Temperature Compensation	If the sensor is required for the battery monitor to work, set the battery temperature compensation to 0mV / °C		

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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 20: KiloVault® HAB™ iT Basic Screen Slider Switch. The status should change to “No charge or discharge.”

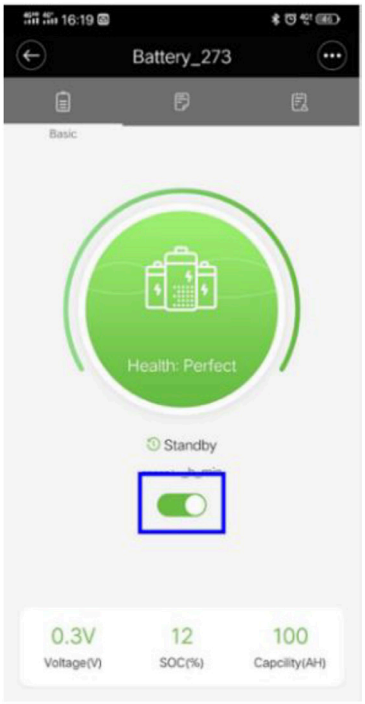


Figure 20: HAB™ iT Basic Screen Slider Switch

- KiloVault® HAB™ firmware updates take about 10 minutes.
- 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.

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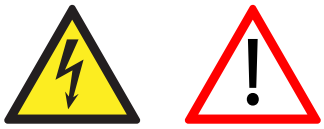
If there are no alarms, the green **RUN** LED will be lit, and the control panel will be populated with information about the running condition of your HAB™. The control panel will remain lit for 1 minutes and then go blank. If you briefly (less than three seconds) press the HAB™ unit's power button, the control panel will again light for 1 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.

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5.5. Monitoring



You can monitor the KiloVault® 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



Do not remover the upper panel without authorization. Simply keep the exterior clean, dry, and dust free.

5.7. Disposal

Please contact your local solid waste recycling agency 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.

HAB POWER BUTTON REST FUNCTION CHART

HAB Power Button	Amount of Time & Number of Times Pressed	Result
HAB	1 press, momentarily	The display lights up after battery power on
HAB	3 presses in 5 seconds	WiFi Configuration. The HAB enters Wi-Fi pairing mode. The Wi-Fi symbol in the display flashes. The red and green LEDs flash.
HAB	1 press, 3 to 5 seconds	Power on or power off. After power off, the HAB will enter sleep mode after 15 minutes.
HAB	1 press, 9 to 12 seconds	BMS reset

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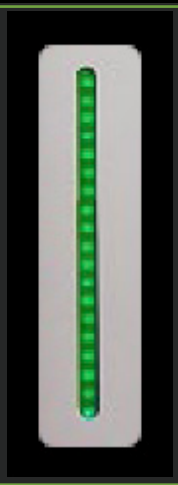
Alarm / Protection Condition	Trigger Values
High Voltage Alarm for each Cell	3.55±0.03 V
High Voltage protection for each cell	3.65±0.03 V, Delay time: 1s
High Voltage release for each cell	3.40±0.03 V
High Voltage alarm for total voltage	56.6 V±0.5 V
High Voltage protection for total voltage	60.0 V±0.5 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 Displayed Capacity Alarm	10% of Capacity or lower
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	45.5V±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

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Alarm / Protection Condition	Trigger Values
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)
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)

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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 discharging the battery. Recharge within 15 days.
	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 battery using the power button on the front of the unit.

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6.3. Parallel Alarm Conditions and Connection Test

Setup Conditions	Symptoms	Diagnosis	Actions to Rectify	Notes
HAB™ units connected in parallel.	No output power, all run LED's are lit and all the alarm LED's are flashing	Leader ID Communication address fault protection. No units 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™	
2 KiloVault® HAB™ units connected in parallel.	No output power, all run LED's are lit and all the alarm LED's are flashing	Leader Communication ID Address Repeated. More than one KiloVault® 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.	
HAB™ units connected in parallel. KiloVault® HAB™ units have similar voltages.	Leader outputs power. Follower units do not output power. All LCD Screens are lit. Leader RUN LED is ON. Follower RUN LEDs are OFF. One or more followershas all the alarm LED's flashing	Follower Communication ID Address Repeated. More than one follower HAB™ has the same address.	Check the addresses of the HAB™ units with the alarms. Set each to a unique address. Restart the units 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 communication cables, port terminators, then set each units address to (OFF, OFF, OFF, OFF), (0,0,0,0).
Units are connected in parallel. Units are connected in parallel and have similar voltages.	Leader units outputs power. Follower units do not output power. All LCD Screens are lit. Leader RUN LED is ON. Follower RUN LEDs are OFF. One or more follower ALARM LED's flashing.	The followers with the flashing ALARM LEDs have lost communication with the Leader.	Ensure the communication cables between units are secure and the RJ45 120 Ω Resistor Plug is fully inserted.	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.
Units are connected in parallel. Units are connected in parallel and have similar voltages.	Leader is charging. Follower units are not charging. All LCD Screens are lit. Leaders RUN LED is ON. Followers RUN LEDs are OFF. One or more follower ALARM LEDs flashing	The followers with the flashing ALARM LEDs have lost communication with the Leader.	Replace any damaged cable(s) or RJ45 120 Ω Resistor Plug.	

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Setup Conditions	Symptoms	Diagnosis	Actions to Rectify	Notes
HAB™ units connected in parallel. All units with similar voltages. Only Leader discharging.	Leader is discharging. Follower units are not discharging. All LCD Screens are lit. Leader RUN LED is ON. Follower RUN LEDs are OFF. One or more follower ALARM LEDs flashing	The followers with the flashing ALARM LEDs have lost communication with the Leader.	Replace any damaged cable(s) or RJ45 120 Ω Resistor Plug. Restart each KiloVault® HAB™ using the front panel power switch.	
HAB™ units are connected in parallel and have different voltages.	Power from all units. All LCD Screens are lit. Lower voltage units charging. High voltage units not charging. High voltage unit RUN LED flashing.	The high voltage unit has been removed from parallel connection. The bank is charged to within 1 V of the high voltage unit, it is added back into parallel connection.	Normal operation. No action needed.	
Units are connected in parallel and have different voltages. Units discharging.	Power from all the units. All LCD Screens are lit. High voltage units are discharging. Low voltage units are not discharging. Low voltage RUN LED flashing.	The low voltage unit 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 unit , 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 KiloVault® HAB™ unit's "HT" light is lit. Non-discharging unit's ALARM LED is flashing. Rest of the units continue discharging and their RUN LEDs are lit.	The non-discharging units have entered High Temperature protection. They are removed from operation until high temperature protection is released.	Normal operation. No action needed.	
Units are connected in parallel and are charging.	1 or more units have stopped working. Non-charging unit's "HT" light is lit. Non-charging unit's ALARM LED is flashing. Rest of the units continue charging and their RUN LEDs are lit.	When high 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 operation.		

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6.4. 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.

Kilovault recomends recalibration every 6 months & more frequently if they're not being cycled.

6.5. Initial HAB™ Unboxed Voltage

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

If, when you turn on your KiloVault® 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 KiloVault® 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 KiloVault® HAB™ .

7.0 Technical Support

7.0.1. Downloads and Documentation

Downloads and documentation are available on the KiloVault® website: https://kilovault.com/

7.0.2. Software

The KiloVault® 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 KiloVault® HAB™ iT.

7.3. Contact Us

Email – info@kilovault.com
Phone - +1 (888) 218-5924
KiloVault®, LLC
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Boxborough, MA 01719

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For information about operating the Sol-Ark Hybrid inverter, see the SOl-Ark Owner's Guide .



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

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