BigBattery

Your Source For Power

48V ETHOS
USER MANUAL

VERSION 1.5 | INFORMATION SUBJECT TO CHANGE WITHOUT NOTICE

SCAN QR CODE TO VIEW LATEST VERSION

MODEL SKU: FETHS-48051-G1

VERSION HISTORY

Version	Date	Chapters	Reason For Change
1.1	12/13/2023	All	Manual development
1.2	12/19/2023	3.1 & 3.2	Connections
1.3	12/20/2023	5.2	Product specifications
1.4	1/23/2024	All	Minor fixes
1.5	2/28/2024	All	Product specifications

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Table of Contents

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1. Definition of Terms

- **AWG** - American Wire Gauge
- **A** - Amp(s)
- **Ah** - Amp-hour(s)
- **AC** - Alternating Current
- **Battery Module** - Single battery
- **Battery System** - Two or more battery modules connected to a control box
- **BMS** - Battery Management System
- **Capacity** - Measure of stored energy, typically in Ah or mAh
- **Control Box** - Master BMS unit
- **Cell Balancing** - Process of ensuring uniform charging among battery cells
- **Cycle Life** - Total charge-discharge cycles before capacity decline
- **C-rating** - Charging/discharging rate relative to battery capacity
- **DC** - Direct Current
- **DOD** - Depth of Discharge
- **ESS** - Energy Storage System
- **kW** - Kilowatt
- **kWh** - Kilowatt-hour
- **LFP** - Lithium Iron Phosphate, or LiFePO4
- **mm** - Millimeter(s)
- **mV** - Millivolt(s)
- **Overcharge** - Charging beyond recommended voltage limits
- **PPE** - Personal Protective Equipment
- **PV** - Photovoltaic
- **Self-Discharge** - Natural battery discharge over time
- **State of Charge (SOC)** - Battery's remaining charge as a percentage
- **State of Health (SOH)** - Overall battery condition and performance
- **Thermal Runaway** - Dangerous overheating with potential battery damage
- **V** - Volt(s)

2. Safety Instructions

Before you start working, make sure to read and follow all safety instructions for handling the battery. When installing it, be sure to meet all the rules and regulations in your area. Ask your local authority for the right permits and approvals before you install it.

Lithium Iron Phosphate (LiFePO4) batteries have an inherently safe chemistry. However, safety measures should always be taken into consideration before, during, and after installation, as well as during ongoing use and maintenance. The following safety notices are crucial for both the installer and end users when operating this product normally.

Improper installation could result in harm to the installer, the operator, or others, as well as damage to the battery or connected equipment.

WARNINGS:

- ⚠ Do not make any connections or disconnections to the system when the batteries are in operation. Working with active batteries can lead to system component damage or pose a risk of electrical shock.
- ⚠ Do not charge with a charge voltage above 58.8V.
- ⚠ Do not charge nor discharge battery when ambient temperature is above 55°C (131°F).
- ⚠ Do not install battery where it may come into contact with conductive materials, water, seawater, strong oxidizers, or strong acids.
- ⚠ Do not install battery in a location exposed to direct sun, hot surfaces, or hot locations. Do not install batteries in a tight clearance compartment, as overheating may result.
- ⚠ Keep any flammable/combustible material (e.g. paper, cloth, plastic, etc.) that may be ignited by heat, sparks, flames, or any other heat source at a minimum distance of two feet away from the batteries.
- ⚠ Disconnect batteries immediately if, during operation or charging, they emit an unusual smell, develop heat, or behave abnormally.
- ⚠ Have a Class ABC or Class BC fire extinguisher on the premises.
- ⚠ Never short-circuit DC inputs. This may result in a risk of electric shock or fire.
- ⚠ Do not disassemble the battery. Contact BigBattery for proper handling instructions. Incorrect servicing or re-assembly may result in a risk of electric shock, fire, or voiding of the warranty.

PRECAUTIONS:

- ⚠ Qualified personnel must handle all product work to reduce risk of electric shock.
- ⚠ Follow local and national electrical standards for installation and confirm utility provider and local authority requirements before grid connection.
- ⚠ Maintain visibility of warning labels and nameplates.
- ⚠ Choose battery placement with future user safety in mind.
- ⚠ Keep children away from the battery and systems.
- ⚠ Use team lifting techniques due to battery weight.
- ⚠ Use batteries as directed. Do not open or modify.
- ⚠ Avoid inserting foreign objects into battery terminals.
- ⚠ Handle batteries and/or battery-powered devices cautiously when using metal tools or when around the system. Risk of electrical arcs or short-circuits can cause serious harm, death, and equipment damage.
- ⚠ Do not charge or discharge the battery if ambient temperature is below -20°C (-4°F).
- ⚠ Beware of the battery current. Ensure that the battery is “off” before installing or working on the battery. Use a voltmeter to confirm there is no voltage present.
- ⚠ Always wear protective gear when handling batteries (PPE).
- ⚠ Handle batteries carefully to prevent damage. Avoid pulling, dragging, or mishandling.
- ⚠ Inspect batteries before use. Do not use damaged or swollen batteries. Contact BigBattery immediately if damage or swelling is present.
- ⚠ Do not paint any part of the batteries, inside or out.
- ⚠ Make sure all cable connections are properly tightened and secured, in order to prevent any accident caused by improper installation.
- ⚠ Install and remove batteries using the handles provided.
- ⚠ Do not place any objects on top of batteries.
- ⚠ Before storing battery for more than 6 months, fully charge the battery and disconnect batteries from your system.

3. Introduction

Introducing BigBattery's ETHOS! These revolutionary, stackable, on-grid lithium battery systems, designed to push the boundaries of efficiency, flexibility, and reliability in energy management, are the best batteries money can buy. The ETHOS represents a leap forward in energy storage technology, offering a compact and scalable solution for seamlessly integrating renewable energy sources into your home or business. With its cutting-edge features and intelligent design, this advanced lithium battery system promises to empower individuals and organizations to take control of their energy usage like never before. Equipped with one of BigBattery's ETHOS battery systems, you'll stay powered and prepared!

This User Manual is designed to provide you with an understanding of the specs, features, capabilities, and installation of these batteries. Read and take note of all safety information prior to installing or operating your battery. This document applies to every ETHOS stackable battery system.

3.1 Product Description

BigBattery's 48V ETHOS stackable battery systems are ideal for low-voltage residential power (grid-tied homes), solar systems, off-grid power systems, emergency backup power, and more. Each single battery module is 51.2V and 100Ah and it can be expanded from 5kWh up to 80 kWh per control box. These batteries utilize lithium iron phosphate (LiFePO4 or LFP) cells, renowned for their top-notch safety.

They are equipped with an intelligent Battery Management System (BMS) that continuously monitors and records cell voltage, along with real-time data on current, voltage, and temperature for each module. The BMS features a passive balancing function and an advanced battery control method, which collectively enhance battery pack performance. Furthermore, the battery includes built-in fire-extinguishing modules for added safety. The battery utilizes standardized amphenol UL ESS connectors, which easily and safely secure power to your battery unit. Designed to endure, the ETHOS has a lifespan of over 10 years and is engineered to withstand more than 4000 - 8000 cycles at 80% Depth of Discharge (DOD) at a rate of 0.5C.

You can always monitor your battery's health and performance from the LED interface located on the control box, which will display BMS status codes alerting you to the condition of your battery.

3.2 Features & Applications

Applications:

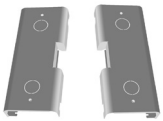
- Residential Power
- Commercial Power
- Grid-Tied Homes
- Off-Grid Cabins
- Backup ESS
- Emergency Power

Features:

- Advanced BMS (Battery Management System)
- Lithium-ion chemistry (LiFePO4/LFP)
- Easy connection to a larger power system
- Expandable system with modular stackability
- Multiple layers of safety and battery protection
- Built-in fire suppression system
- Good insulation performance
- Standardized amphenol UL ESS connectors
- Smart control box
- Parallel communication
- CANBus & RS485 communications with various inverters
- LED Smart Display
- Discreet cable management

4. Packed Components

4.1 ETHOS Battery Module

Included With SKU: FETHS-48051-G1			
			
	(x2) Side Covers	(x2) L-Brackets	(x4) Screws & Fasteners
			
(x1) 48V 5.12kWh ETHOS Battery Module	(x1) Battery Module Communication Cable (0.7 ft.)		(x1) Battery Module +/- Parallel Cables (0.7 ft.)

4.2 ETHOS Control Box

Included With SKU: CNT060			
			
(x1) 48V ETHOS Control Box	(x1) ETHOS Base	(x1) Control Box to Inverter Communication Cable (4.9 ft.)	(x2) Control Box to Inverter +/- Power Cables (4.9 ft.)

4.3 ETHOS Final Battery Module Cables

The ETHOS Final Battery Module to Control Box +/- Power Cables connect the last battery module in your configuration to the Control Box. These cables serve two main purposes: redundancy and completing the loop for parallel connections for both the 10kWh system (with 2 modules) and the 15kWh system (with 3 modules). See Section 6.4.1 and Section 6.4.2 for more information.

For 10kWh (2-Stack) Systems (SKU: CBL088)	For 15kWh (3-Stack) Systems (SKU: CBL091)
	
(x1) Final Battery Module to Control Box +/- Power Cables (31.5 in.)	(x1) Final Battery Module to Control Box +/- Power Cables (4 ft.)

4.4 ETHOS Parallel Kit

SKU: CNT081	SKU: CBL096	SKU: CBL089
		
(x1) ETHOS Base	(x1) Stack-to-Stack Communication Cable (6 ft.)	(x2) Stack-to-Stack +/- Power Cables (4.9 ft.)

The ETHOS Parallel Kit allows the system to expand from 15kWh up to 76.8kWh. Each Parallel Kit will allow you to add one more stack of modules to your system per kit.

4.5 ETHOS Battery System

10kWh System (SKU: K0949)	15kWh System (SKU: K0950)	20kWh System (SKU: K0951)	30kWh System (SKU: K0953)
			

The ETHOS Battery System supports up to 15 modules for a total capacity of 76.8kWh.

5. Product Specifications

5.1 ETHOS Overview

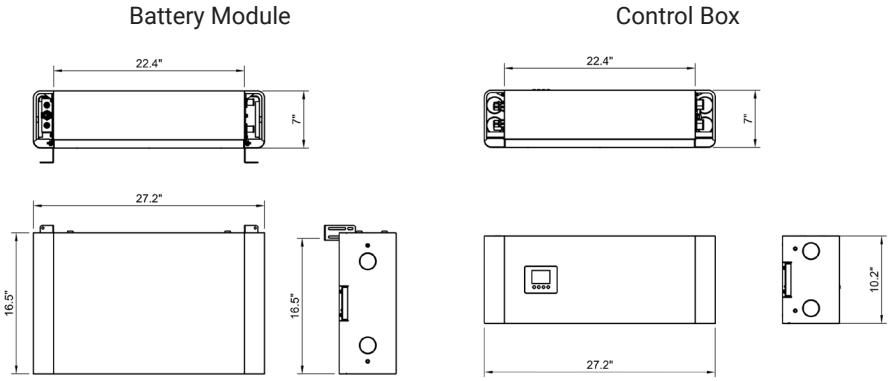


Figure 1: ETHOS Battery & Control Box Overview

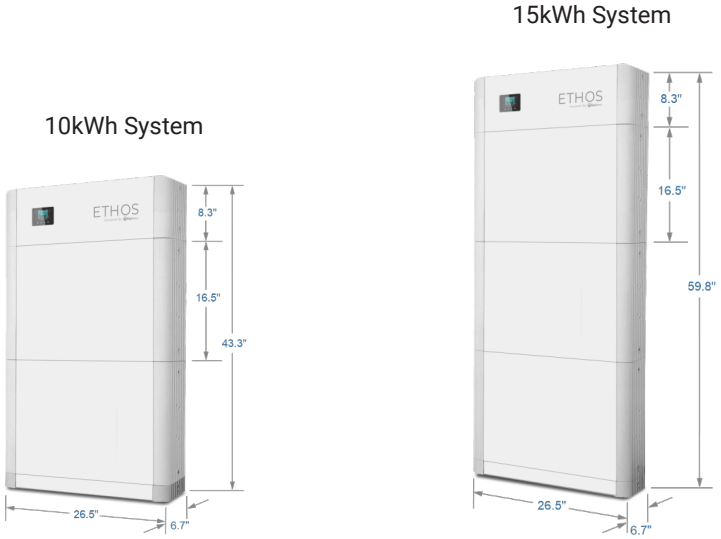


Figure 2: ETHOS System Overview

Before handling the battery, always switch it off and verify with a voltmeter that there is no voltage present in order to prevent accidental contact with live terminals. Failure to do so could lead to severe injury or fatality.

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5.2 ETHOS System Specs

SKU	K0949	K0950
System Voltage	48V	
Nominal Voltage	51.2V	
Chemistry	LiFePO4	
kWh Capacity	10.24 kWh	15.36 kWh
Ah Capacity	200 Ah	300 Ah
Charging Voltage Range	55.6V - 57V	
Max Charge Voltage	58.8V	
Operating Voltage Range	48V - 57V	
Suggested Low Voltage Cutoff	48V - 50.8V	
Cell Configuration	16S 2P	16S 3P
Max Cont. Discharge Current	200A	250A
Max Continuous Power	10240W	12800W
Max Discharge Peak Current	300A (Max 5 seconds)	
Max Charge Current	200A	
Charge Temperature Range	32°F - 113°F (0°C - 45°C)	
Discharge Temperature Range	-4°F - 140°F (-20°C - 60°C)	
Optimal Discharge Temp. Range	59°F - 95°F (15°C - 35°C)	
Storage Temp. Range (SoC >50%)	-4°F - 113°F (-20°C - 45°C) (Max 6 months)	
Dimensions (DxWxH)	6.7 x 26.5 x 43.3 in (170 x 674 x 1100 mm)	6.7 x 26.5 x 59.8 in (170 x 674 x 1520 mm)
Weight	273 lbs (123.8 kg)	387 lbs (175.5 kg)
Max Connections	Up to (16) parallel connections per control box	
Communications	CANBus / RS485	
Protection Rating	IP65 / NEMA 4X	
Certifications	UL9540, UL9540A, UL1973, & UN38.3	

SKU	K0951	K0953
System Voltage	48V	
Nominal Voltage	51.2V	
Chemistry	LiFePO4	
kWh Capacity	20.48 kWh	30.72 kWh
Ah Capacity	400 Ah	600 Ah
Charging Voltage Range	55.6V - 57V	
Max Charge Voltage	58.8V	
Operating Voltage Range	48V - 57V	
Suggested Low Voltage Cutoff	48V - 50.8V	
Cell Configuration	16S 4P	16S 6P
Max Cont. Discharge Current	250A	
Max Continuous Power	12800W	
Max Discharge Peak Current	300A (Max 5 seconds)	
Max Charge Current	200A	
Charge Temperature Range	32°F - 113°F (0°C - 45°C)	
Discharge Temperature Range	-4°F - 140°F (-20°C - 60°C)	
Optimal Discharge Temp. Range	59°F - 95°F (15°C - 35°C)	
Storage Temp. Range (SoC >50%)	-4°F - 113°F (-20°C - 45°C) (Max 6 months)	
Dimensions (DxWxH)	6.7 x 53.1 x 43.3 in (170 x 1349 x 1100 mm)	6.7 x 53.1 x 59.8 in (170 x 1349 x 1520 mm)
Weight	513 lbs (232.7 kg)	755 lbs (342.5 kg)
Max Connections	Up to (16) parallel connections per control box	
Communications	CANBus / RS485	
Protection Rating	IP65 / NEMA 4X	
Certifications	UL9540, UL9540A, UL1973, & UN38.3	

5.3 ETHOS Diagram

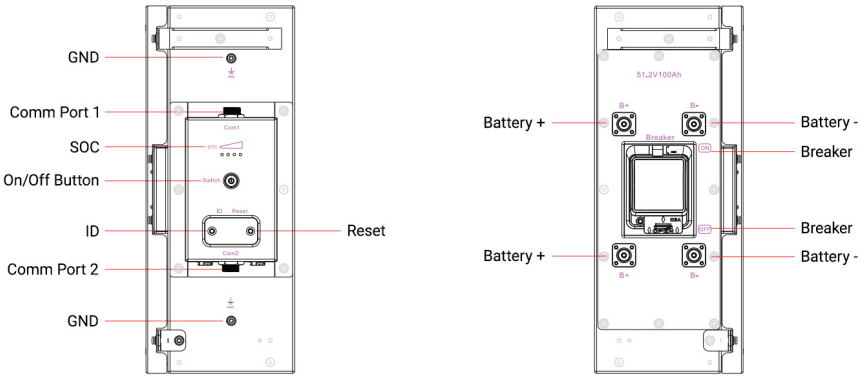


Figure 3: ETHOS Battery Module Diagram

Item	Name	Description	Details
1	GND	Ground terminal	Screw
2	Comm Port	RJ45 communication port	RS485 / CANBus
3	SOC	LED state of charge indicators	4 LEDs on = 100% 3 LEDs on = 75% 2 LEDs on = 50% 1 LEDs on = 25%
4	On/Off Button	Switches BMS on/off	
5	ID	Battery communication ID	Dip-switch
6	Reset	Reset button	
7	Batt -	Negative battery terminal	
8	Batt +	Positive battery terminal	
9	Breaker	Switches battery on/off	

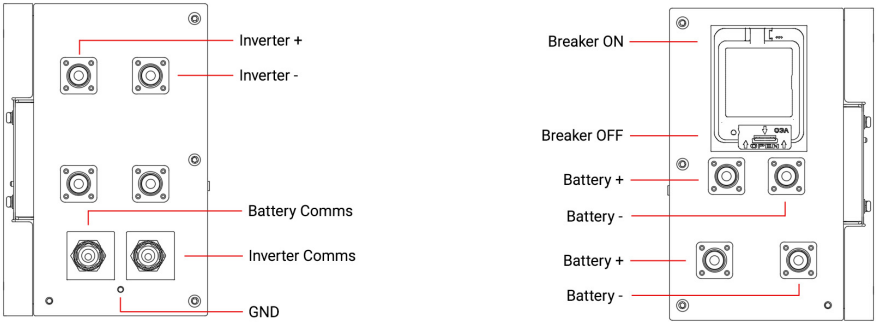


Figure 4: ETHOS Control Box Diagram

Item	Name	Description	Details
1	Inverter -	Negative inverter terminal	
2	Inverter +	Positive inverter terminal	
3	Battery Comms	RJ45 communication port	RS485 / CANBus
4	Inverter Comms	RJ45 communication port	RS485 / CANBus
5	Breaker	Control Box power on/off	
6	GND	Ground connection	
7	Battery -	Negative battery terminal	
8	Battery +	Positive battery terminal	

5.4 ID Addresses

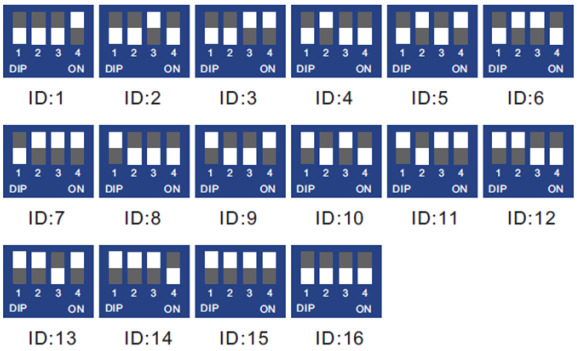
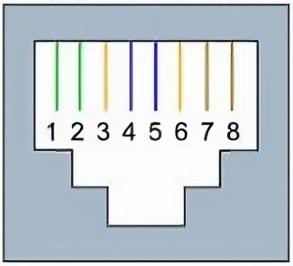


Figure 5: ETHOS Battery Module ID Address Configurations

ID code bits correspond to binary digits. Down represents "0" and up represents "1". The right side of the code bit is the low bit and the left side is the high bit. The code range is 0 - 15, and the communication mode can support up to 16 modules in parallel. Set the first battery as "0001" (ID:1) and the second as "0010" (ID:2), the third as "0011" (ID:3), and so on making sure every battery module has a unique ID address.

5.5 Communication Ports

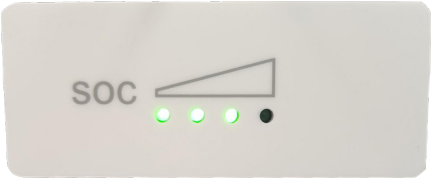


PIN	Description	PIN	Description
1	RS485 B- (T/R-)	5	CAN-L
2	RS485 A+ (T/R+)	6	-
3	-	7	RS485 A+ (T/R+)
4	CAN-H	8	RS485 B- (T/R-)

Note: Each RJ45 communication port can be used for RS485 or CAN protocols.

5.6 Battery LED Indicators

Each battery module has 4 LED lights that will display the current state of charge of that module according to the table below.



Status	SOC
Off / Sleep	All LEDs off
Standby	4 LEDs on = 100% 3 LEDs on = 75% 2 LEDs on = 50% 1 LEDs on = 25%
Charge	
Discharge	
Over Voltage	All LEDs on
Under Voltage	All LEDs off

Note: All LEDs are off when battery is off. Each LED represents 25% of total capacity.

6. Installation

⚠ WARNING: Before installing, make sure to review all warnings and precautions in Section 2, as well as the installation safety guidelines in Section 6.1 below.

6.1 Installation Safety Guidelines

- Inspect batteries upon receipt for any signs of damage before use. In case of battery damage, reach out to BigBattery for repair or replacement. Avoid using a defective battery as it may result in incorrect battery voltage that could potentially ruin your appliances. Damaged batteries have the potential to cause fire hazards.
- Check to ensure that all cables are in good condition.
- Be sure your battery packs are powered "**OFF**" before making or removing any connections.
- It is crucial to never create a short circuit on the external battery terminals. When installing the battery, ensure that each cable is properly connected to the correct

terminal. There should be no conductive material between the terminals that could cause a short circuit.

- Use a screwdriver with a rubber coated handle.
- **Do not put the ETHOS batteries in series.** The BMS and internal components are not designed to handle this setup, which could cause the modules to fail.
- Always mount the battery in an upright position.

6.2 Installation Requirements

The battery cabinet's placement significantly affects safety, longevity, and performance. It should allow for convenient system wiring, maintenance, and operation, while avoiding high-temperature, high-humidity environments. Ensure there's enough space and strong support for the battery. Use cable specifications that match the equipment's maximum current needs. Arrange the power equipment and batteries logically. Keep the wiring neat, moisture-proof, and corrosion-resistant. During installation, wear an anti-static wristband and have at least two people present.

6.3 ETHOS System Installation

6.3.1 ETHOS System Mounting

1. Install the bottom base on the ground about 1.2 inches (30 mm) from the wall, and ensure the base is oriented correctly, as shown in Figure 6 below.

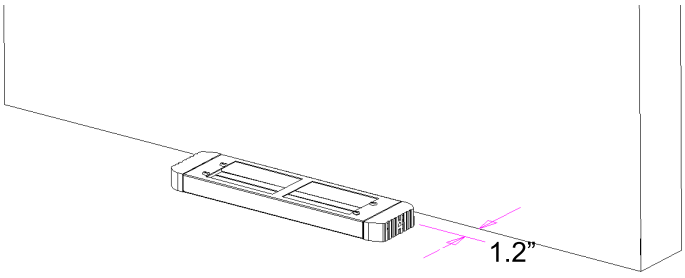


Figure 6: Bottom Base Installation

2. Stack one battery module on top of the bottom base. The side with visible screws should be facing the wall, as shown in Figure 7 below.

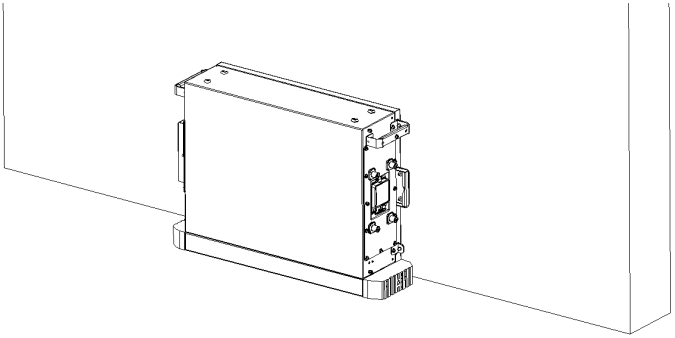


Figure 7: Battery Module Installation

3. Stack each battery module on top of the previous one until all modules are stacked top to bottom. Then, set the control box on top of the final battery module. Secure each module to the wall using the L-brackets and fastener screws provided, as shown in Figure 8 and Figure 9 below.

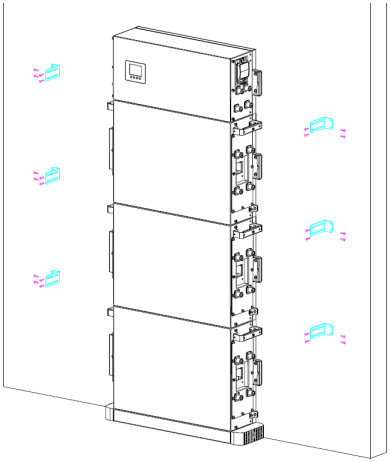


Figure 8: Control Box Installation

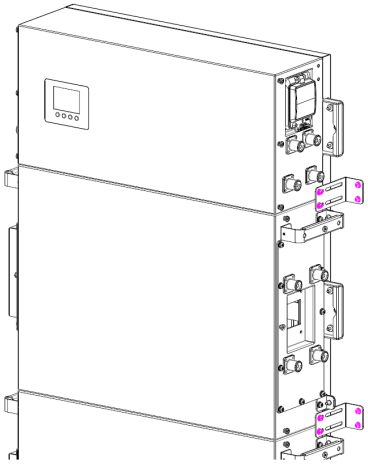


Figure 9: L-Bracket Installation

6.3.2 ETHOS System Connections

1. Communication Connections (Left Side)

Use the Battery Module Communication Cable to connect the bottom-most module's 'Comm Port 1' to 'Comm Port 2' on the module above. Continue this sequential connection with all modules' comm ports in a daisy chain until you connect the upper-most module's 'Comm Port 1' to the control box's 'Battery Comms' port.

Finally, set each of the module's ID addresses according to Section 5.4. The top-most module, connected directly to the control box, should be set to ID:1, the second to ID:2, the third to ID:3, and so on. Make sure every module has a unique ID address.

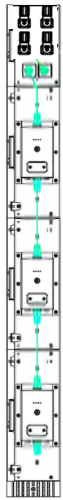


Figure 10: Communication Connections Diagram

2. Power Connections (Right Side)

First, connect the B+ terminal of the bottom-most module to the B+ terminal of the module above using the Battery Module +/- Parallel Cables. The connection is secure when you hear a click. Repeat this process until all modules are connected. Then, repeat this process with the B- terminals.

Next, connect the B+ and B- terminals of the upper-most module to the B+ and B- terminals of the control box using the Battery Module +/- Parallel Cables. Be sure to only connect positive terminals to positive terminals and negative terminals to negative terminals.

Lastly, connect the B+ and B- terminals of the bottom-most module to the B+ and B- terminals of the control box using the Final Battery Module to Control Box +/- Power Cables.

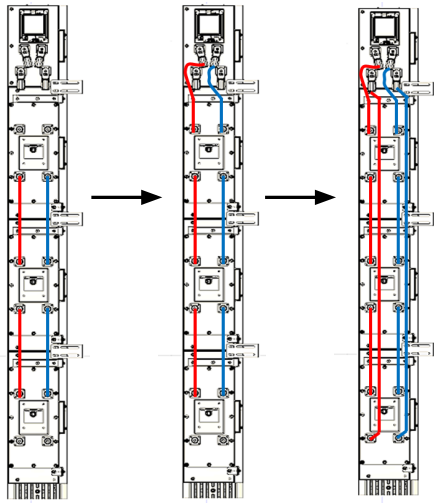


Figure 11: Parallel Battery Connections Diagram

For more connection diagrams of different system configurations, see Section 6.4.

3. Turn on the battery system by pushing in all of the power buttons on the left side of each battery module. Ensure the breakers are in the 'ON' position on the right side of each battery module. Check that the screen on the control box is detecting each battery module by verifying that the amp-hour capacity shown on screen matches the total rated capacity of the system.

4. Attach the side panels to each battery module and use the included screws to tighten and secure them, as shown in Figure 12 below.

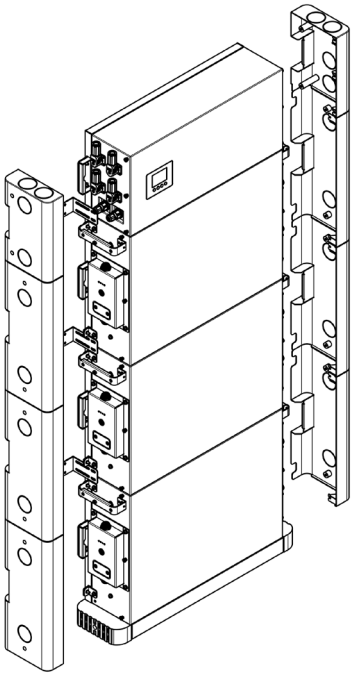


Figure 12: Side Panel Installation Diagram

6.4 ETHOS System Wiring Connections

6.4.1 10kWh System

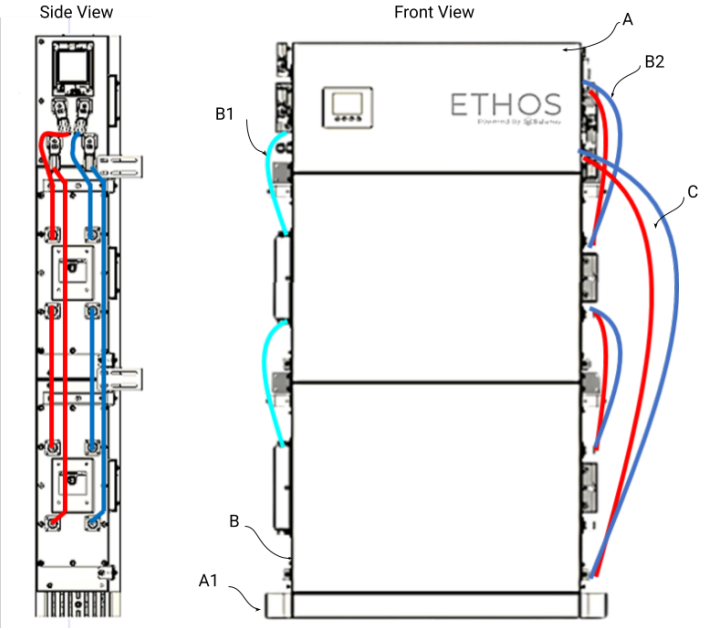


Illustration Components

A. (x1) ETHOS Control Box [CNT060]

Included with (x1) CNT060

A1. (x1) ETHOS Base

B. (x2) 5.12kWh ETHOS Battery Module [FETHS-48051-G1]

Included with (x2) FETHS-48051-G1

B1. (x2) Battery Module Communication Cable (0.7 ft.)

B2. (x2) Battery Module +/- Parallel Cables (0.7 ft.)

C. (x1) Final Battery Module to Control Box +/- Power Cables (31.5 in.) [CBL088]

Side View shows only an illustration of the cable connections in order to provide a better understanding of the installation.

6.4.2 15kWh System

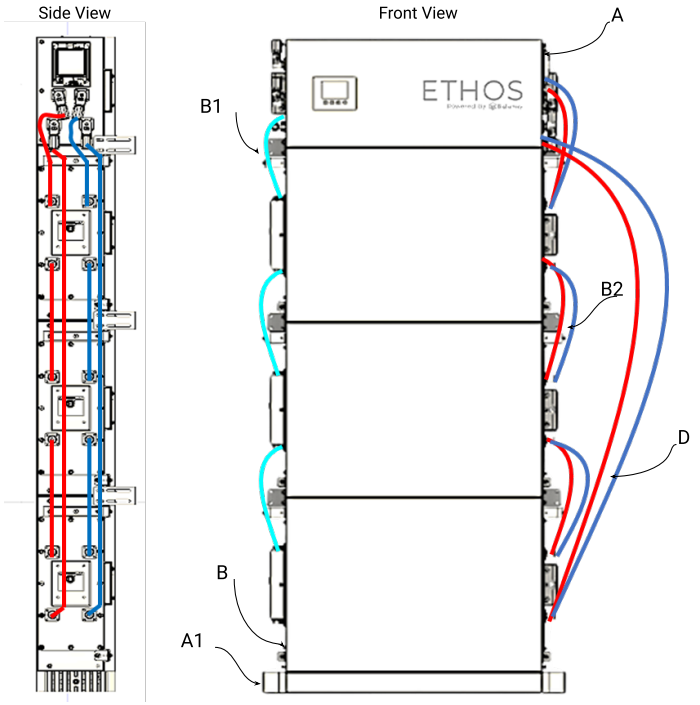


Illustration Components

A. (x1) ETHOS Control Box [CNT060]

Included with (x1) CNT060

A1. (x1) ETHOS Base

B. (x3) 5.12kWh ETHOS Battery Module [FETHS-48051-G1]

Included with (x3) FETHS-48051-G1

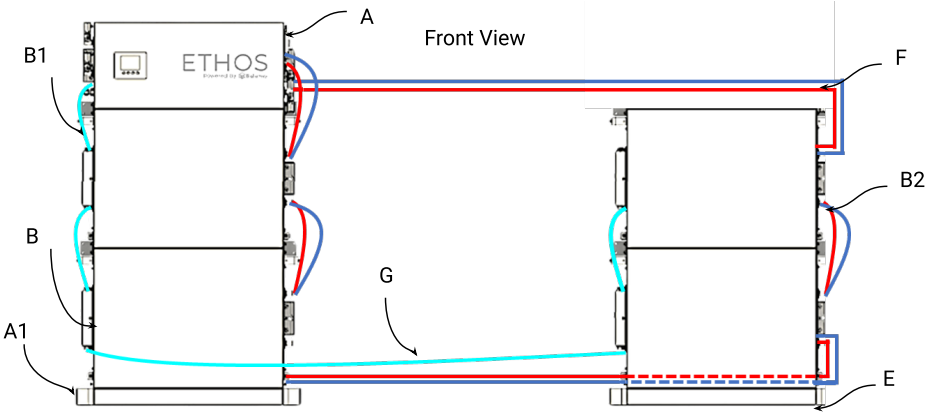
B1. (x3) Battery Module Communication Cable (0.7 ft.)

B2. (x3) Battery Module +/- Parallel Cables (0.7 ft.)

D. (x1) Final Battery Module to Control Box +/- Power Cables (4 ft.) [CBL091]

Side View shows only an illustration of the cable connections in order to provide a better understanding of the installation.

6.4.3 20kWh System



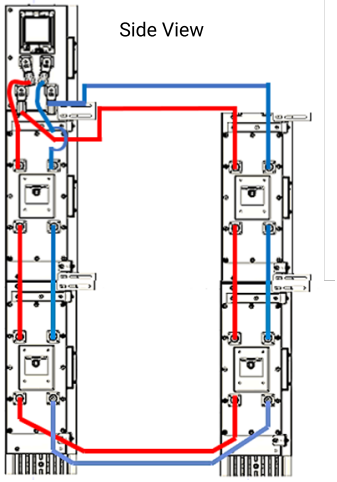


Illustration Components

A. (x1) ETHOS Control Box [CNT060]

Included with (x1) CNT060

A1. (x1) ETHOS Base

B. (x4) 5.12kWh ETHOS Battery Module [FETHS-48051-G1]

Included with (x4) FETHS-48051-G1

B1. (x3) Battery Module Communication Cable (0.7 ft.)

B2. (x3) Battery Module +/- Parallel Cables (0.7 ft.)

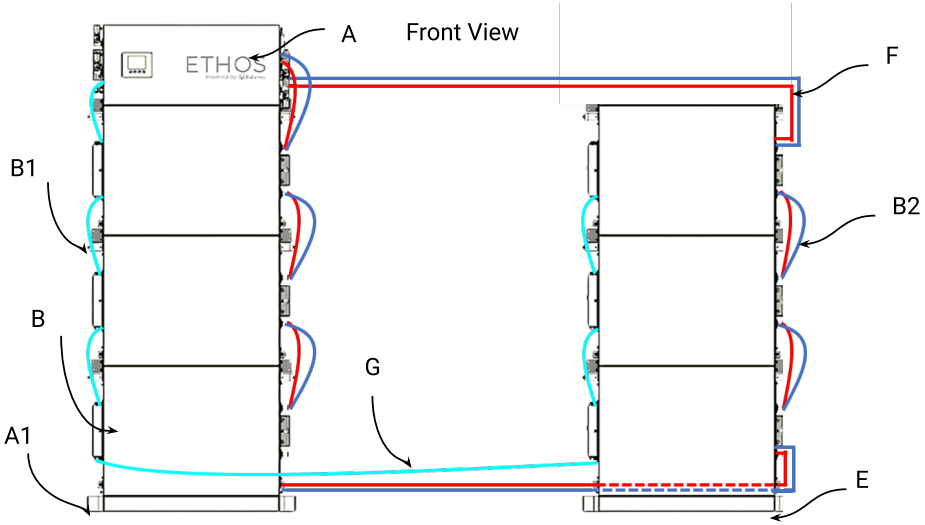
E. (x1) ETHOS Base [CNT081]

F. (x2) Stack-to-Stack +/- Power Cables (4.9 ft.) [CBL089]

G. (x1) Stack-to-Stack Communication Cable (6 ft.) [CBL096]

BigBattery recommends having at least 12 inches of space between each ETHOS stack. Side View shows only an illustration of the cable connections in order to provide a better understanding of the installation.

6.4.4 30kWh System



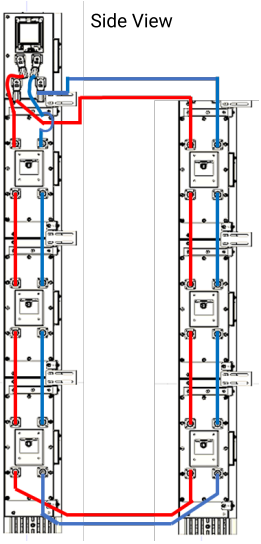


Illustration Components

A. (x1) ETHOS Control Box [CNT060]

Included with (x1) CNT060

A1. (x1) ETHOS Base

B. (x6) 5.12kWh ETHOS Battery Module [FETHS-48051-G1]

Included with (x6) FETHS-48051-G1

B1. (x5) Battery Module Communication Cable (0.7 ft.)

B2. (x5) Battery Module +/- Parallel Cables (0.7 ft.)

E. (x1) ETHOS Base [CNT081]

F. (x2) Stack-to-Stack +/- Power Cables (4.9 ft.) [CBL089]

G. (x1) Stack-to-Stack Communication Cable (6 ft.) [CBL096]

BigBattery recommends having at least 12 inches of space between each ETHOS stack. Side View shows only an illustration of the cable connections in order to provide a better understanding of the installation.

6.5 Installation With 12K Inverter

See Figures 13 & 14 for a wiring diagram between the ETHOS Control Box and the LUXpower 12K (EG4 18kPV) Hybrid Inverter. Additionally, you may refer to the LUXpower 12K (EG4 18kPV) Hybrid Inverter manual which will have further details for set up.

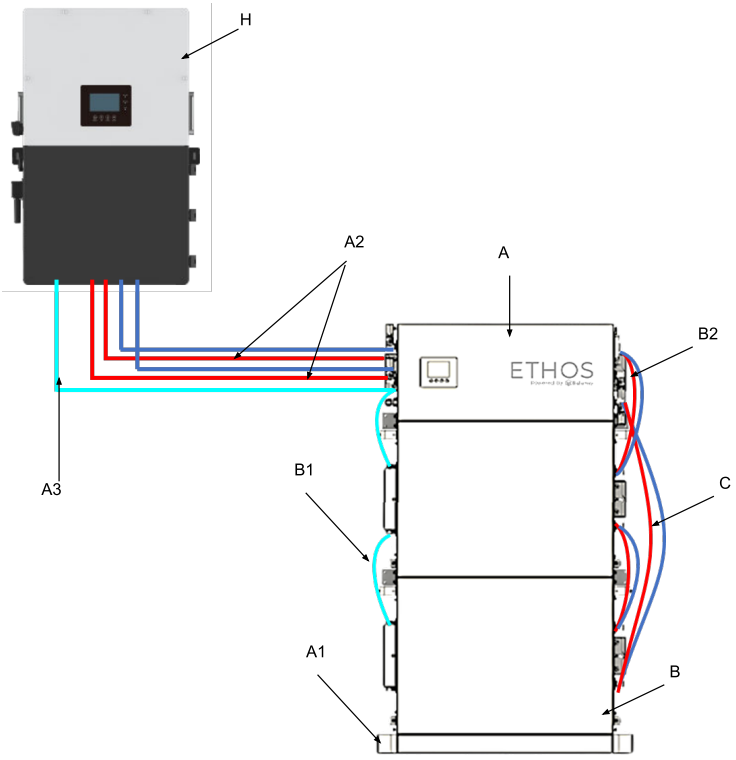


Figure 13: ETHOS With 12K Inverter

The LUXpower & EG4 inverters are compatible with any of the ETHOS system configurations. Figure 13 illustrates the 10kWh ETHOS System and the LUXpower 12K (EG4 18kPV) Hybrid Inverter.

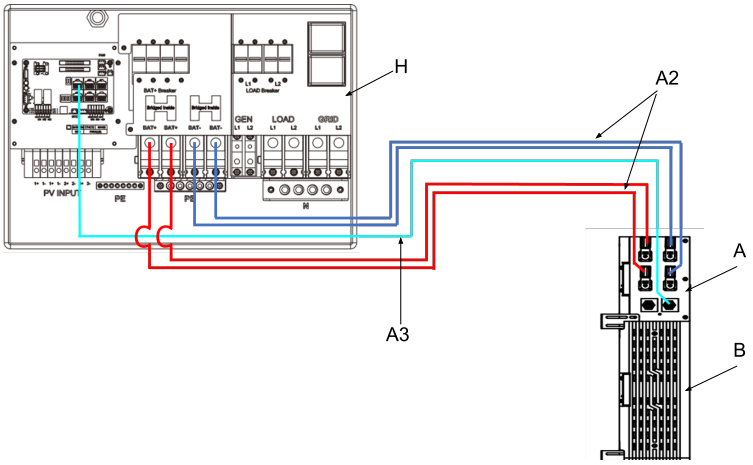


Figure 14: ETHOS With 12K Inverter Connections

Illustration Components

A. (x1) ETHOS Control Box [CNT060]

Included with (x1) CNT060

A1. (x1) ETHOS Base

A2. (x2) Control Box to Inverter +/- Power Cables (4.9 ft.)

A3. (x1) Control Box to Inverter Communication Cable (4.9 ft.)

B. (x2) 5.12kWh ETHOS Battery Module [FETHS-48051-G1]

Included with (x2) FETHS-48051-G1

B1. (x2) Battery Module Communication Cable (0.7 ft.)

B2. (x2) Battery Module +/- Parallel Cables (0.7 ft.)

C. (x1) Final Battery Module to Control Box +/- Power Cables (31.5 in.) [CBL088]

H. (x1) LUXpower 12K (EG4 18kPV) Hybrid Inverter

BigBattery recommends installing the LUXpower 12K (EG4 18kPV) Hybrid Inverter at least 12 inches of distance away from the rest of the ETHOS System.

6.6 Grounding (Optional)

The National Electrical Code (NEC) Article 706 recognizes that grounding is not mandatory for battery systems under 60VDC, including the ETHOS. However, for enhanced safety or system stability, we offer an optional grounding connection point. This grounding point can be used by installers who prefer to ground the ETHOS.

Please note that grounding cables are not included with the ETHOS. Grounding cables must be purchased separately based on your specific installation requirements.

For detailed instructions on grounding the ETHOS, please refer to Figure 15 on the right. This figure illustrates the grounding diagram and provides a clear visual guide for the grounding process.

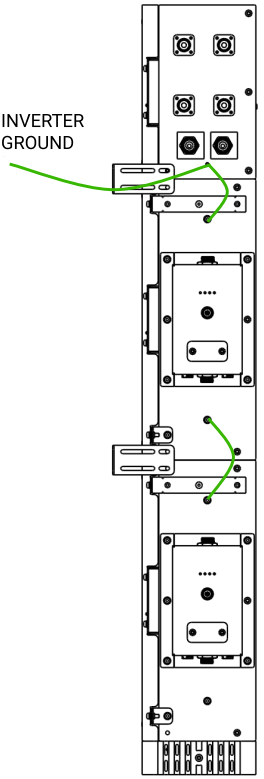


Figure 15: ETHOS Grounding Diagram

7. Battery Commissioning

If the ETHOS is connected to an inverter and you want the batteries to communicate with the inverter, the battery address and communication protocols need to be configured using the screen on the control box. If communication is not needed, the battery can be directly connected to the inverter and you would select the lead-acid or user-defined configuration on the inverter.

7.1 Screen Navigation & Protocol Selection

The LCD display is embedded in the control box. It's used to display information about the battery system, such as voltage, SOC, capacity, running status, etc. It is also used to configure the battery to communicate with a supported inverter.

Press any button to wake up the screen. You should see the BigBattery splash screen for a few seconds and then the home screen shown in Figure 16 below.

Figure 16: ETHOS Home Screen

Press 'BACK' to access the About screen, shown in Figure 17 below, which will display the currently selected RS485 & CAN protocols along with the current BMS and screen firmware version. Press 'ENTER' to return to the Home screen.

Figure 17: ETHOS About Screen

Hold 'BACK' for five seconds and release it to enter the Protocol Setting menu, shown in Figure 18 on the following page.

Figure 18: ETHOS Protocol Setting Menu

Use 'UP' and 'DOWN' to navigate the Protocol Setting menu and press 'ENTER' to enter either the RS485 or CAN protocol menu, shown in Figures 19 and 20.

Figure 19: ETHOS RS485 Protocol Menu

Figure 20: ETHOS CAN Protocol Menu

Use 'UP' and 'DOWN' to navigate the RS485 and CAN protocol menus and press 'ENTER' to select the highlighted protocol. The display will then return to the previous screen. See Section 7.2 for a list of supported inverters and their associated addresses. Once the proper protocol has been selected, press 'BACK' and then power off each battery module using its power button, and then power them back on. Once the control box is turned back on, the selected protocol will be saved.

For the 12kW (18kPV) LUXpower and EG4 inverters, select P02-LUX for RS485 communications, and P06-LUX for CAN communications.

7.2 Supported Inverters

P0	RS485	P0	CAN
1	Growatt	1	Growatt
2	LUXpower / EG4	2	Sol-Ark
3	Schneider	3	Deye
4	Inhenergy	4	Megarevo
5	Voltronic	5	Victron
		6	LUXpower / EG4
		7	SMA
		8	Inhenergy
		9	Solis

8. Battery Operation Guide

⚠ WARNING: Before installing, be sure to review all parameters listed in Section 5.2.

8.1 Charging

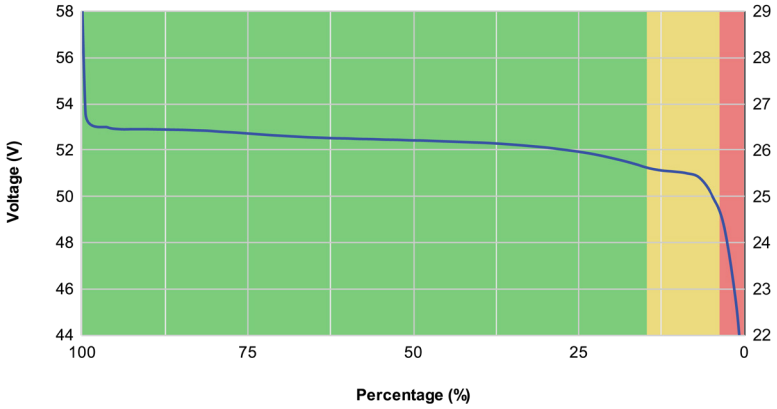
- During initial charging, monitor the battery's charge voltage to ensure it is within appropriate voltage limits.
- Only use the battery charger provided by BigBattery, or the inverter charging settings listed in Section 5.2. Using non-recommended chargers may cause improper charging and reduce the battery's capacity.
- The battery cannot be charged in freezing temperatures. When charging is attempted below 0°C (32°F), the BMS will prevent charging until the battery temperature is above 0°C (32°F).
- Use LiFePO4 batteries for "opportunity charging." Charge them whenever you can but do it with small amounts of energy. It's better to do this than using fast chargers. Fast charging can make the battery's lifespan shorter.
- It is recommended to charge the battery when it has a minimum of 10 - 20% SOC. Deep discharging won't harm the battery's health, but the BMS requires some voltage to function properly.
- The Bulk/Absorb Voltage of an LFP battery is the same as the Charging Voltage. BigBattery products do not use Float Voltage, Equalize Voltage, or Absorption Time.

8.2 Discharging

- The battery can be fully discharged. Unlike lead-acid batteries, the voltage of a lithium battery stays very constant during discharge, delivering the same amount of power and energy from 100% to 0% SOC.
- LFP batteries handle discharging down to 0% SOC safely, but shallower cycles offer benefits. Discharging down to 20% SOC, instead of 0%, extends the battery's lifespan to more than 6000 cycles.
- Do not discharge if the temperature is above 55°C (131°F).
- You will see an apparent loss of capacity when discharging at below-freezing temperatures that reverses when the battery's temperature gets above freezing.
- The BMS will automatically shut down when the battery reaches a low voltage, so there's no need for manual intervention. Avoid over discharging by removing the load when the battery's discharge is done.

8.3 State of Charge

This is the Depth of Discharge curve of an ETHOS battery.



	Cycling in this zone will ensure a reasonable life expectancy.
	Occasionally this zone is okay.
	Dropping into this zone can reduce lifespan.

8.4 Storage

- LFP batteries have an extremely low self-discharge rate, which makes long-term storage convenient. Storing a lithium battery for up to a year is not an issue, as long as it has some charge remaining before being placed in storage.
- Before storing lithium-ion batteries, charge them to at least 50% SOC. Do not store batteries that are fully discharged. In the case of a fully charged battery, it should be discharged to 80% SOC before it is stored.
- If you need to store batteries for longer periods, be sure to disconnect all wires from them. Thais will prevent any stray loads from slowly discharging the batteries.
- Make sure that you store the battery within the temperature range listed in Section 5.2. Storing them at lower temperatures is better than storing them at higher temperatures. The electrolyte in LFP cells does not contain any water, so even when it freezes it does not expand, and does not damage the cells. Be sure to let the battery warm up before you discharge it again, which is acceptable at -20°C (-4°F).

The table on the following page provides the acceptable temperatures that the batteries can be stored at, as well as the charging intervals and methods to do so.

Storage Temperature	Charging Interval	Charging Method
≤20°C (≤68°F)	Once every 9 mo.	56V 30A CC/CV Charging to 56V Cut-Off Current: 5A
20°C ~ 30°C (68°F ~ 86°F)	Once every 6 mo.	
30°C ~ 40°C (86°F ~ 104°F)	Once every 3 mo.	

8.5 Extending Battery Life

The ETHOS is designed to be used for 10 years or more when operated correctly. To ensure proper battery operation, follow the previously listed instructions and battery parameters. In order to extend the lifespan of your battery, follow these recommendations:

- Avoid discharging the battery to more than 80% Depth of Discharge (DOD) unless it is truly necessary.
- Keep the battery temperature under 95°F (35°C) and above 59°F (15°C).
- Keep battery charge and discharge currents under 0.5 of the capacity (C-rating).
- Never disassemble the battery unless our tech support guides you. If the battery has any problems, contact BigBattery for assistance.
- Keep the battery away from excessive physical shocks or vibration. These can damage the battery's internal structure and disrupt its operation.
- Dirty battery terminals can lead to improper flow of current during operation. It is recommended that you clean the terminals while installing the battery pack.

9. Service

9.1 Troubleshooting

If the battery enters a protection state, you will see that the status shows "Protection". In order to get more detailed information, you can access the BMS through the BMS_TOOLS software detailed in Section 9.3.

No.	Error	Description	Solution
1	Communication failure with inverter	Communication port connection error, or battery ID setting error	Check connection; Refer to Section 7
2	No DC output	Battery is off or low voltage	Turn on or charge the battery
3	Power supply time is too short	Battery capacity is reduced or not fully charged	Fully charge the battery; Maintenance or replacement

4	Battery can't be charged fully	Power system DC output voltage falls below the minimum charge voltage	Regulate DC output voltage of power supply to a suitable battery charging voltage
5	Battery output voltage is unstable	BMS does not operate normally	Press the switch to restart the battery
6	Charge and discharge capacity is insufficient	Unbalanced cell voltages	Examine/balance the cells
7	Unable to charge and discharge	BMS or cell/temperature sensor is damaged	Maintenance or replacement
8	Different SOC values of batteries in parallel	Normal occurence	No action required
9	Protection status	Over/under current protection	Charging or discharging current is too high and needs to be reduced
10	Protection status	Over temperature protection	Turn off the battery and cool down the battery's location
11	Protection status	Under voltage protection	Charge the battery
12	Protection status	Over voltage protection	Discharge the battery; Lower the charge settings on the charger/inverter

9.2 Maintenance

Item	Maintenance	Maintenance Intervals
Power Cables	Check whether there is mechanical damage to the power cables and whether the terminal insulation sleeve has fallen off. If there is such an occurence, please turn off the battery and carry out maintenance or replacement.	Once every 6 months
	Check whether the power cable is loose. If there is any sign of looseness, please use a standard torque wrench to tighten it.	
	Check the system for loose screws or discoloration of the copper bus bar. If the screws are loose, tighten them with a standard torque wrench. If the copper bus bar is discolored, contact the manufacturer for replacement.	

Communication Cables	Check whether the parallel communication cable terminal is loose. If it is loose, tighten it.	Once a year
	Check whether the color of the communication cable has obvious discoloration. If discolored, shut down the battery and replace the communication cable.	
Cabinet	Check the cleanliness of the front door, back door, and battery module inside the cabinet. If there is obvious dust, clean up in a timely manner.	Once every 6 - 12 months
System Running Status	Check if all parameters are normal when the system is running (voltage, current, temperature, etc.).	Once every 6 months
	Check whether the primary components of the system are normal, including system switches, contactors, etc.	
	Check whether the system air inlet and outlet and air ducts are normal. If there is blockage or congestion, clean up in a timely manner.	
Charge & Discharge Maintenance	Use a light load and shallow charging/discharging to check whether the SOC and SOH status of the battery is normal (using the provided computer software to check). It is recommended that the depth of discharge and charge/discharge power should not exceed 20% of the rated value.	Once every 6 months

9.3 Monitoring Software

In order to view real-time details of the BMS and see historical data, you can use the provided battery monitoring software and follow the steps below. You will need the following items:

- Laptop with a USB port
- USB to RS485 communication cable
- BMS_TOOLS monitoring software (provided)

How to Connect the Battery

1. Download the BMS_TOOLS folder onto the laptop.
2. Turn off the battery that you want to monitor and set the ID Address to ID:16, as shown in Section 5.4. Once set, turn the battery on.
3. Connect the RS485 end of the communication cable to the 'Comm Port 1' of the module you want to monitor, and connect the USB end to your laptop. Check your laptop's device manager to validate that the communication port is detected.

4. Open the BMS_TOOLS application which is located in BMS-TOOLS > BIN > BMS_TOOLS.exe. You will then see the screen shown in Figure 21 below.

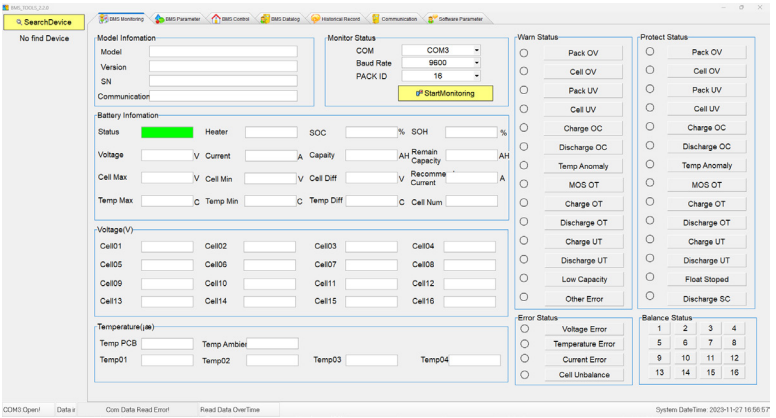


Figure 21: BMS_Tools Unconnected Screen

5. Under 'Monitor Status', make sure that the correct 'COM' setting is selected, 'Baud Rate' is set to 9600, and 'PACK ID' is set to 16 as shown in Figure 22 below.

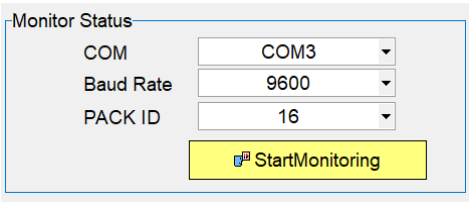


Figure 22: BMS_Tools Monitor Status

6. Click 'SearchDevice'. Once the program is done loading, you should see the detected battery as shown in Figure 23 below.

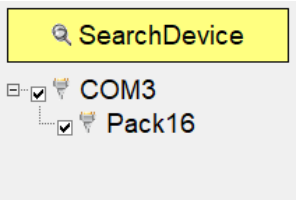


Figure 23: Detected Devices

The BMS data will now populate as shown in Figure 24 below. From this point, you can see real time data from your BMS and view historical data.

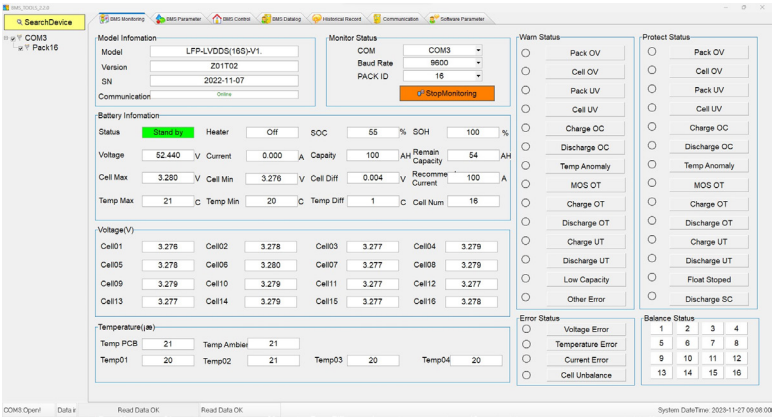


Figure 24: BMS_Tools Connected Screen

10. Recycling

Lithium-ion batteries are potentially dangerous and shouldn't be tossed in the trash. Many websites and organizations can recycle them for free. If you're in the U.S. or anywhere globally, search for "Lithium Battery Disposal Near Me" online. Numerous places can safely dispose of these batteries. Make sure to call first to confirm they're open.

If you can't find a safe disposal option, contact the BigBattery Customer Service team instead of improperly disposing of the battery. BigBattery can take care of recycling your batteries for you.

11. Warranty & Returns

In the unlikely event you are having an issue with one of our batteries we have developed a straightforward Warranty & Return Policy which is detailed at the following link: https://bigbattery.com/policies/. For more information and support, please visit our website or reach us at:

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