eTower 2 INSTALLATION MANUAL

Modular LiFePO4 Energy Storage

Product of Freedom Won (Pty) Ltd
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About this manual

This manual covers the eTower 2 installation process. For a comprehensive overview of other Freedom Won product ranges, visit the Freedom Won website: www.freedomwon.co.za

Amendment Record

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1. Introduction

The Freedom Won eTower 2 is a stackable lithium iron phosphate (LiFePO4) energy storage system designed for 48V solar-integrated backup applications such as Uninterruptible Power Supplies (UPS), residential, telecoms and server room installations.

The eTower 2 module's depth of discharge (DoD) is recommended at 80% for average daily discharge, and has a maximum permissible DoD of 100% (max 90%DoD for normal operation).

The eTower 2 has a State of Charge (SoC) indicator that displays the battery's energy level, allowing easy monitoring. The eTower 2 features a settable addressing system that enables multiple eTower 2 modules to work together in parallel. It also comes equipped with advanced communication interfaces for device connectivity. The module includes digital output dry contacts that provide real-time monitoring and control capabilities (optional plug needed).

The eTower 2 introduces enhanced features for improved performance, monitoring and user convenience. These additional features include an integrated forced air-cooling system for improved thermal management and operational efficiency, as well as built-in Bluetooth and Wi-Fi connectivity. The eTower 2 is backwards compatible with previous generation eTower systems, allowing for seamless integration and system expansion.

The eTower 2 can also be monitored remotely via dedicated Android and iOS mobile applications, allowing users to conveniently access battery status, performance data and system information in real time. Over the air firmware updates are possible via the same application.

This manual provides instructions for installers to ensure successful installation and commissioning of the eTower 2 lithium iron phosphate (LiFePO4) energy storage modules. Additional information on programming the built-in battery management system for non-standard inverter interfaces can be obtained by approved installers directly from Freedom Won.

This manual does not cover the setup, interface or functionality requirements for third-party equipment integration with the eTower 2. However, Freedom Won is available to provide direct support specifically related to battery interfacing with supported third-party inverter brands.

2. Product Description

The Freedom Won eTower 2 module is designed to provide a compact and cost-effective energy storage solution that can be readily expanded as system requirements increase over time.

The eTower 2 is available with optional accessories that facilitate a fast and convenient installation process. The batteries are designed for floor mounting, 19-inch rack mounting and wall mounting installations, and can be vertically stacked into a tower configuration for ease of parallel connection. Each eTower 2 module, when stacked vertically, is supported by a plastic-moulded pedestal (optional accessory) positioned beneath it, ensuring a stable and secure stacked installation.

The eTower 2 is designed for applications requiring an initial storage capacity of at least 5 kWh, with the option to scale capacity in 5 kWh increments up to a maximum of 75 kWh. For installations requiring an initial capacity of 15 kWh or greater, the Freedom Won ENVA 16 may be more appropriate, depending on the specific requirements and preferences of the customer.

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Freedom Won offers a range of products based on LiFePO4 (lithium iron phosphate) technology, including the following options:

Home and Leisure	12V Range eTower 2 ENVA 5 ENVA 16
Small Commercial HV	ENVA 60HV
Commercial and Industrial	SOLVA AC261 BESS Cabinet SOLVA DC261 BESS Cabinet SOLVA RT261 BESS Cabinet SOLVA AC418 BESS Cabinet
Large Scale ESS	COREVA 5

The eTower 2 operates at a nominal voltage of 51.2 V, which is compatible with "48V" battery inverter systems.

Refer to Figure 1 for a labelled illustration of the Freedom Won eTower 2. The labelling corresponds with the legend table below the image.

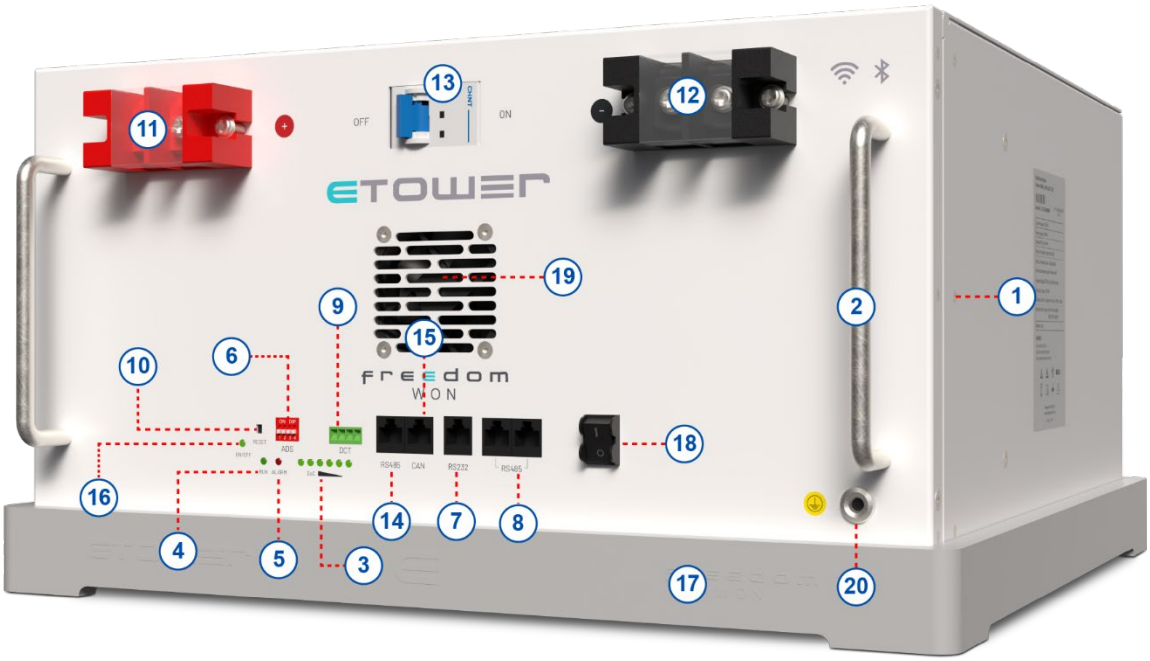

Figure 1: eTower 2 Front Panel - Annotated Diagram

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Label Number	Description
1	Fixing threads for optional accessory angle brackets required for 19-inch rack mount (rack not included) or wall mount applications (for wall mount, extra wall mount bracket accessory required)
2	Carrying handles
3	State of Charge (SoC) capacity indication LEDs
4	Run indication LED
5	Warning LED
6	Address dip switches
7	RS232 interface RJ11 plug
8	RS485 dual interface inter-module communication bus RJ45 plugs
9	Digital output dry contacts (DCT)
10	Reset button
11	Positive terminal
12	Negative terminal
13	Circuit breaker
14	Inverter RS485 interface RJ45 plug
15	Inverter CAN Bus interface RJ45 plug
16	ON/OFF indication LED
17	Plastic pedestal
18	BMS power ON/OFF switch
19	Forced air-cooling vent (outlet)
20	Earthing point

2.1 Installation Configuration

2.1.1 Floor Mount Installation

The eTower 2 is primarily designed for floor standing installation using the inter-module plastic pedestal.

2.1.2 eTower 2 Parallel Stack

For stacking multiple eTower 2 batteries that are connected in parallel, the inter-module plastic pedestal must be fitted on the top of one eTower 2 to serve as the platform for the next eTower 2 to be stacked on top of it (refer to Figure 8).

2.1.3 Wall Mount Installation

For installing the eTower 2 onto a wall, the following is required:

- **2x eTower rack mount brackets per eTower battery (Figure 3) –** There are six fixing threads on each side of the eTower 2 near the front, as indicated in Figure 1. The mounting brackets must be installed on the left and right sides of the eTower 2 using the 6x screws supplied with each bracket accessory.
- **1x eTower wall mount bracket –** The wall mount bracket must be installed securely onto a wall as shown in Figure 2. The eTower 2 battery can then be mounted onto the wall mount bracket using the rack mount brackets attached to it.

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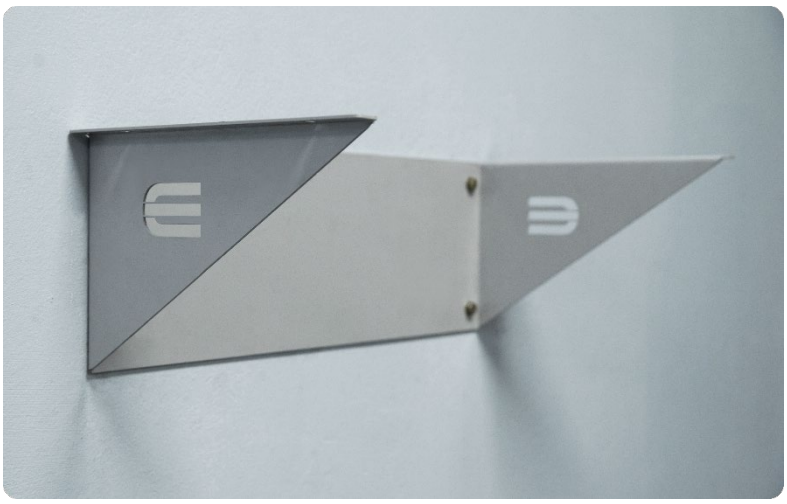

Figure 2: Wall Mount Bracket

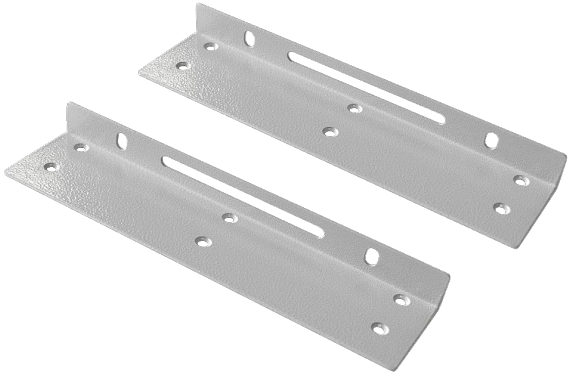

Figure 3: eTower 2 Rack Mount Brackets

Figure 4: eTower 2 Mounted on the Wall Mount Bracket

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2.2 Carrying Handles

Each module has two carrying handles on the front to make lifting easier. For safety and convenience, Freedom Won recommends having two people work together when stacking the eTower 2 modules.

2.3 State of Charge Indication

The State of Charge (SoC) of the battery is indicated by six green LEDs, which indicate the percentage of the module's maximum energy storage capacity. These LEDs are numbered one to six, where number one is the LED positioned furthest to the right and number six is the furthest to the left. When the battery receives a charge, the LED corresponding to the current SoC range will flash, providing a visual indication of the charging process.

Refer to Figure 1 Label 3 for visual reference to the State of Charge indication LED illustration.

Refer to the corresponding State of Charge (SoC) levels for each LED illumination pattern in Table 1 below.

Table 1: SoC Indicator Matrix for Discharging, Inactive and Charging States

Capacity Status	LED Capacity Indicator											
	Discharging or Inactive (No Current Flow)						Charging					
	●	●	●	●	●	●	●	●	●	●	●	●
	LED1	**LED2**	**LED3**	**LED4**	**LED5**	**LED6**	**LED1**	**LED2**	**LED3**	**LED4**	**LED5**	**LED6**
0-16.6%	Light on	Light off	Light off	Light off	Light off	Light off	Flash	Light off	Light off	Light off	Light off	Light off
16.6-33.2%	Light on	Light on	Light off	Light off	Light off	Light off	Light on	Flash	Light off	Light off	Light off	Light off
33.2-49.8%	Light on	Light on	Light on	Light off	Light off	Light off	Light on	Light on	Flash	Light off	Light off	Light off
49.8-66.4%	Light on	Light on	Light on	Light on	Light off	Light off	Light on	Light on	Light on	Flash	Light off	Light off
66.4-83.0%	Light on	Light on	Light on	Light on	Light on	Light off	Light on	Light on	Light on	Light on	Flash	Light off
83.0-100%	Light on	Light on	Light on	Light on	Light on	Light on	Light on	Light on	Light on	Light on	Light on	Flash

2.3.1 Run Indication LED

The green "Run" LED illuminates when the eTower 2 battery is operational and ready to use, indicating that the Battery Management System (BMS) is active and functioning without any errors.

2.3.2 Warning LED

The red "Warning" LED illuminates when an alarm or fault is detected:

- If the eTower 2 battery is fully charged (100% SoC) and the warning LED is illuminated, this indicates a cell overvoltage notification.
- If the battery's State of Charge (SoC) falls below 10%, the warning is likely triggered by either a low SoC alarm or a low cell voltage alarm.

2.3.3 ON/OFF Indication LED

The ON/OFF LED illuminates when the BMS power switch is set to the ON position, indicating that the eTower 2 Battery Management System (BMS) is active.

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2.4 Address Dip Switches

The Address Dip Switch (ADS) block, consisting of four binary dip switches, requires a specific configuration to assign a unique address to each eTower 2 module. This setup ensures that each battery has a dedicated address on the network and that there are no duplicate addresses. Each module must have a unique address, starting from 1 and increasing consecutively.

The eTower 2 module connected to the inverter through the communication cable must be assigned address 01. To simplify the setup process, assign address 01 to the top module, which connects the external communication port (CAN or RS485) to the inverter. Then assign consecutive addresses to each subsequent module below the top one, moving downwards in sequence through the binary numbers.

The dip switch configuration is illustrated in Figure 5, with the numbering and ON/OFF positions following a standard binary sequence. The dip switch configuration is read from left to right, with the leftmost switch representing the least significant bit.

Ensure that the dip switches are set correctly to ensure reliable communication and proper system operation.

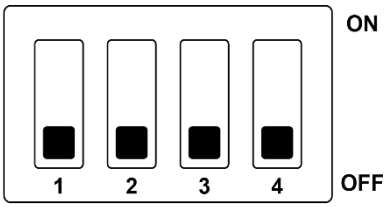

Figure 5: Dip Switch ON/OFF Positions

To configure the dip switches, refer to Table 2, which outlines the settings for each battery module based on its assigned address. If the system does not support communication between the battery and inverter, ensure that all dip switches are set to the OFF position.

Table 2 outlines the dip switch positions for address numbers 1 to 15. Set each module's dip switches according to the corresponding configuration in the table to ensure correct communication between modules.

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Table 2: Dip Switch Positions for Address Numbers 1 to 15

Address Number	Switch #1	Switch #2	Switch #3	Switch #4
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	ON	ON	OFF	OFF
4	OFF	OFF	ON	OFF
5	ON	OFF	ON	OFF
6	OFF	ON	ON	OFF
7	ON	ON	ON	OFF
8	OFF	OFF	OFF	ON
9	ON	OFF	OFF	ON
10	OFF	ON	OFF	ON
11	ON	ON	OFF	ON
12	OFF	OFF	ON	ON
13	ON	OFF	ON	ON
14	OFF	ON	ON	ON
15	ON	ON	ON	ON

Although the eTower 2 communication protocol can support up to 15 modules, it is recommended to limit the number of battery modules per physical stack to six units. Systems that require more than 30 kWh capacity can be arranged with multiple stacks connected in parallel with a DC combiner (not supplied).

2.5 ON/OFF Button

The ON/OFF button (labelled 18 in the Figure 1 legend table) is used to power the Battery Management System (BMS) ON or OFF. When switched ON, the BMS becomes active and manages the eTower 2 battery's protection, monitoring and performance functions. When switched OFF, the BMS is disabled, stopping the system from operating and disconnecting the eTower 2 battery mana

.gement functions for safety or maintenance purposes.

2.6 RS232 Interface RJ11 Plug

The RS232 interface RJ11 plug port (Figure 1 Label 7) is exclusively used for connecting a PC to the battery for the following purposes:

- Firmware updates
- Settings updates
- Real-time battery data monitoring
- Troubleshooting

These functions are reserved for authorised personnel, specifically Freedom Won technicians and certified Freedom Won partner technicians. Further information is available on request.

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2.7 RS485 Inter-Module Communication Bus

The RS485 inter-module communication bus is used to link the communications between all parallel-connected modules in the eTower 2 stack, allowing relevant data to be transmitted to Module 01 (Address Number 01). Module 01 then relays this data to the inverter through CAN Bus or RS485. Each module features two ports (Figure 1 Label 8), facilitating a "daisy chain" connection across all modules using standard Ethernet network cables. Refer to Figure 11 for an illustration of the connection.

2.8 Digital Output Dry Contacts

The digital output "dry" contacts (Figure 1 Label 9) include DO1 (pins 1 and 2) and DO2 (pins 3 and 4), which are normally closed potential-free contacts. DO1 opens when the battery has any type of fault protection enforced. DO2 opens when the battery raises a low State of Charge alarm.

The dry contact interfacing plug is available from Freedom Won as an accessory.

Do not exceed 2A through these contacts. If a higher current is required to drive an external device, use an interposing relay that is controlled by the battery and in turn controls the external device requiring more than 2A.

2.9 Reset Button

The reset button (Figure 1 Label 10) must be pressed and held for about five seconds to initiate a reset. While holding the reset button down during the reset process, the SoC indicator LEDs will flash in a sequence, cycling from left to right and then back from right to left, indicating that the reset is in progress. When this sequence is complete, the button can be released.

2.10 Multiple eTower Connection Configurations

The positive terminal has two fastening points supplied with M6x16mm bolts to accommodate interconnecting busbars and cable lugs. When connecting multiple modules (two or more) in a tower configuration, ensure that the busbars are staggered, alternating connections between the left and right terminals. Refer to Figures 9 to 11 for illustrations. When multiple cables are used for connecting the positive and negatives to the DC bus all positive cables must be terminated onto the same DC positive bus, and similarly all the negative cables must be connected to the same DC negative bus. Do not connect individual cables to separate devices directly.

2.10.1 Four-Module Tower Connection Configuration

When connecting four (4x) eTower 2 modules, two 35mm^2 cable pairs may be required to carry the current – one pair on the top module and one pair on the bottom module. The cables are to be fitted onto the spare terminals beside the busbars.

In cases where one cable pair is used, connect the negative cables to the bottom module and the positive cables to the top module, as this configuration helps maintain a consistent voltage across all eTower 2 modules.

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Figure 6: Four-Module Tower Example

2.10.2 Five-Module Tower Connection Configuration

For a five (5x) eTower 2 stack, the top, middle and bottom modules are fitted with one 35mm^2 cable per terminal to accommodate and distribute the maximum power capability of the battery stack connecting to the DC bus.

Figure 7: Five-Module Tower Example

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2.10.3 Six-Module Tower Connection Configuration

For a six (6x) eTower 2 stack, one 35mm^2 cable per terminal must be connected on units 1, 3 and 6 of the stack.

All the DC cables must be routed directly to a common DC bus with the same cable lengths.

Figure 8: Six-Module Tower Example

2.11 Circuit Breaker

Each eTower 2 module is equipped with a 125A DC-rated circuit breaker (Figure 1 Label 13), which protects against overcurrent and short circuits, as well as controls the connection and disconnection of the battery module to and from the DC bus. After connecting all eTower 2 modules and ensuring that it is safe to apply power to the DC bus, switch ON all module circuit breakers in quick succession, starting with the top module assigned as address 01.

When the eTower 2 is active, the SoC and Run LEDs will illuminate. The circuit breaker also functions as a disconnect switch for the battery. When the breaker is OFF, thereby disconnecting the module from an external voltage source such as the inverter, the Battery Management System (BMS) will automatically shut down after 24 hours of inactivity (assuming the BMS was not switched off already with the ON/OFF switch).

The Prospective Short Circuit Current (PSCC) for the eTower 2 is 5kA, and the circuit breaker short circuit rating is 6kA.

2.12 Inverter RS485 Interface RJ45 Plug

This RJ45 plug (Figure 1 Label 14) is used to connect the battery's external control communications to RS485-compatible inverters (refer to the Freedom Won Inverter Compatibility Guide for more details). The eTower 2 is supplied with the protocol compatible with Voltronic inverters, such as the Axpert range, selected as standard. Other inverter options can be selected by an authorised installer using the Android or iOS app. For support with other inverter types not listed using RS485 communication, contact Freedom Won. For reference, the pin configuration of the interface plug is provided below, which is required when making up the RS485 communications cable.

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Table 3: RS485 Inverter Interface Plug Pin Configuration

RJ45 Plug Pin Numbers	Corresponding Signal Wires
1, 8	RS485-B
2, 7	RS485-A
3, 4, 5, 6	No connection

2.13 Inverter CAN Bus Interface RJ45 Plug

This interface (Figure 1 Label 15) connects to CAN-Bus-compatible inverters and system controllers. A standard Ethernet cable will work for most inverters/devices, but some will require a non-standard pin configuration (such as Victron GX devices).

For reference, the pin configuration of the interface plug is as follows:

Table 4: CAN Inverter Interface Plug Pin Configuration

RJ45 Plug Pin Numbers	Corresponding Signal Wires
1, 2, 3, 6, 7, 8	No connection
4	CANH
5	CANL

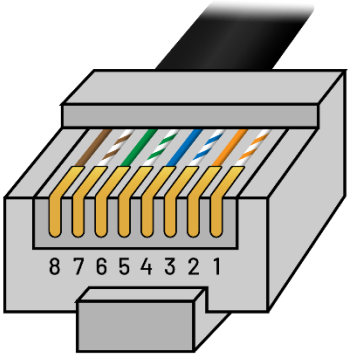

Figure 9: Pin Configuration for Standard RJ45 Plug (T568B)

2.14 RJ11 to USB Pinout

Figure 10 illustrates the RJ11 connector (illustrated also in Figure 1 Label 7). Table 5 displays the pinout for the RJ11 plug to USB.

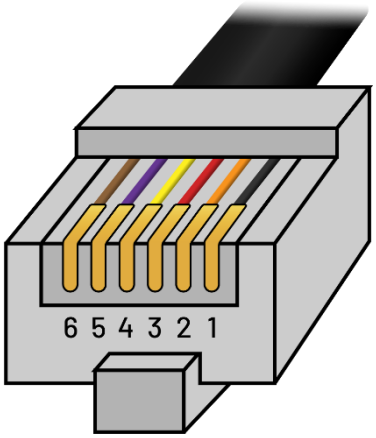

Figure 10: RJ11 Connector Pinout

Table 5: RJ11 to USB Connections

No.	RJ11	Signal
1	Pin 1	Not connected
2	Pin 2	Not connected
3	Pin 3	TX
4	Pin 4	RX
5	Pin 5	GND
6	Pin 6	Not connected

Pins 1, 2 and 6 on the RJ11 connector are not connected, while Pins 3, 4 and 5 are connected to the USB Type-A connector.

Figure 11 illustrates the RJ11 cable with a USB Type-A connector. The cable is available as an accessory from Freedom Won or a Freedom Won distributor.

Figure 11: RJ11 to USB Type-A Cable

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2.15 Optional Plastic Pedestal

The moulded plastic pedestal is a Freedom Won innovation that allows rapid on-site installation by stacking modules into a tower, utilising the pedestal as an interface between each module and as a convenient stand for the bottom module. The pedestal is designed to structurally support the weight of up to six modules stacked into a tower.

2.16 Optional DC Power Cables

The optional power cables available for the eTower 2 are 35mm^2 in cross-sectional area. Ensure that the cables used are sufficient for the current rating of the connected inverters or DC chargers. The positive cable is red, and the negative cable is black.

Figure 12: DC Power Cables

2.17 Earthing Point

For eTower 2 modules installed into a cabinet, the earth point (Figure 1 Label 20) can be used to ground all module casings to the cabinet's ground. Alternatively, if no cabinet is used, the earth point can be directly connected to the Protective Earth (PE).

3. Packaging, Transportation and Safe Handling

3.1 Verify Package Contents

The eTower 2 modules are packaged with protective foam and placed inside a cardboard box. This box should be lifted by two people.

The eTower 2 carton contains only the battery; no other accessories are included.

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Table 6: Package Contents

Item	Image (not to scale)
1 x eTower 2 module	

The following items are optional extras and can be obtained at an additional charge.

Table 7: List of Optional Items

Item	Image (not to scale)
eTower 2 pedestal	
Rack mounting brackets (pair)	
Wall mount bracket	
DC power cables (one pair, 35mm^2 x 1.8m)	
Parallel stacking accessory kit – one parallel busbar pair and eTower-to-eTower communication cable	

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Item	Image (not to scale)
RJ11 to USB cable	
Dry Contact Mating Plug	

3.2 Safe Handling

The eTower 2 modules weigh 52kg each, allowing two people to carry them in their boxes without the need for special handling equipment. The eTower 2 is available from Freedom Won in pallets only, with each pallet containing 24 eTower 2 units. The 24-unit pallets require a pallet trolley to move and a forklift for loading and offloading. When using a pallet jack or forklift to move the eTower 2 pallet, it is important to ensure that the centre of gravity is evenly balanced between the two forks and the load remains upright to ensure optimal stability and control.

The eTower 2 boxes must be kept dry.

The eTower 2 modules are secured with "cling wrap" as illustrated in Figure 13.

Figure 13: eTower 2 Shipping Pallet Configuration and Wrapping

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3.3 Transport

The eTower 2 incorporates the safe LiFePO4 lithium cell design, which is however classified, with all lithium batteries, as dangerous goods Class 9 "miscellaneous dangerous goods". The specific UN regulation covering the shipment is UN 3480.

The boxes can be stacked up to six high for storage or transportation purposes provided that they are adequately secured.

When shipped by sea in a crate or packaging not supplied by Freedom Won, label the package with the correct label as shown in Figure 14.

Figure 14: Dangerous Goods Label for Sea Freight

The packaging design must also comply with the dangerous goods regulations; therefore, the eTower 2 must always be transported in its original carton box.

For sea and road freight, the transporter will require the Safety Data Sheet for the product, which is available from your distributor or Freedom Won.

3.4 Environmental and Storage Requirements

- No specific venting is required since the eTower 2 emits no hazardous gases; however, air circulation is required to ensure room temperature is maintained at reasonable levels, preferably below 25°C (refer to the eTower 2 warranty for information regarding upper-temperature limits for hot environments).
- Room heating may be required in cold climates to keep the room above 0°C, since charging of the eTower 2 is not permitted below 0°C.
- To ensure optimal eTower 2 service life, it is recommended to use room cooling in environments where room temperatures would otherwise regularly exceed 30°C.
- Temporary storage or transport of the battery is permitted in the range -20°C to 45°C; however, extended storage longer than 60 days should be between 0°C and 25°C.
- The eTower 2 Ingress Protection (IP) rating is IP20. Keep away from moisture and corrosive environments.
- A battery in storage should not be left for longer than 6 months without receiving a charge/discharge cycle.
- Failure to maintain the 6-month charge/discharge cycle maintenance will void the warranty.

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4. Installing the Freedom Won eTower 2

4.1 Pre-Installation Preparation

Before starting the installation, carefully inspect all equipment for any signs of damage. If any damage is noticed, promptly contact Freedom Won and provide photographs for assistance.

4.2 Power Cables

Connecting the eTower 2 is made simple by purchasing the available accessories, including the power cables.

Prior to connecting the positive and negative cables and busbars to the inverter and eTower 2 modules, check and ensure that the main battery circuit breaker is switched OFF on all the eTower 2 modules. This will ensure that there are no short circuits between the loose ends of the cables and prevent the risk of metal tools causing a short circuit.

Connect the eTower 2 interconnecting busbars:

- Ensure that the red busbar is connected to the positive terminal and the black busbar is connected to the negative terminal.
- Observe the + and – labels and red and black colour coding of the terminals to ensure correct polarity.

Connect the 35mm^2 cables to the eTower modules:

- Connect the supplied 35mm^2 cables to the eTower 2 modules in the specified configuration depending on the number in the stack (see below).
- Where possible use the empty terminal (where no busbar is present) for the cables. In larger stacks it may be necessary to add a cable terminal on top of a busbar – the terminal bolts provided are long enough for this situation.
- Ensure sufficient cable pairs are fitted to manage the maximum current capability of the connected equipment.

Connect the DC cables for stacked units:

- For a stack of two (2x) eTower 2 units, connect the positive to the top module and the negative to the bottom module – this avoids voltage mismatches between the modules under high loads.
- For a stack of three (3x) eTower 2 units, connect the DC cable pairs to units 1 and 3.
- For a stack of five (5x) eTower 2 units, connect the DC cable pairs to units 1, 3 and 5.
- For a stack of six (6x) eTower 2 units, connect the DC cable pairs to units 1, 3 and 6.
- Connect the DC cables to a DC bus, or directly to the inverter if possible. This is to ensure that the eTower 2 busbars are not required to carry more than their rated current.

Secure the terminal bolts:

- Ensure that the lugs for the eTower 2 end of the DC cables are securely fitted.
- Use the M6x16mm terminal bolts to accommodate both a busbar and a lug on the same terminal when required.
- Torque all terminal bolts to 12Nm.

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The DC cable cross-sectional area is based on an acceptable voltage drop with the inverter being mounted on the wall adjacent to the eTower 2, with a maximum cable run of 5m. The standard length of the optional inverter cables is 1.8m – longer cables can be made up by the installer.

Cable installation:

- Cables that run longer than 5m should be assessed for voltage drop, and larger or more cables used. Double-insulated welding cable is recommended.
- Route the cables through trunking to the inverter or DC combiner.
- Connect the positive and negative cables to the corresponding terminals on the inverter or DC combiner.

4.3 Control Cables

To control external devices, connect either the CAN Bus cable or the RS485 cable, depending on the type of inverter being used. This connection enables the Battery Management System within the eTower 2 to control and communicate with these external devices. The cables used are CAT5e or CAT6 Ethernet cables with RJ45 plugs.

If you need to create your own cables, refer to the cable pin configurations for guidance (Tables 3 and 4). Figure 9 provides the pin numbering of the RJ45 connector. For more information on communication cables, refer to the Freedom Won Inverter Compatibility Guide.

4.4 Parallel Configurations

Multiple eTower 2 modules can be connected in parallel. However, it may be more cost-effective to opt for one or more Freedom Won ENVA 16 batteries instead of connecting multiple eTower 2 units in parallel.

Follow these steps to configure and connect multiple eTower 2 modules in parallel:

- Set one eTower 2 module as the Master by setting its address to 01.
- Set the addresses of the remaining eTower 2 modules to 02 upwards, which will automatically configure them as Slaves.
- Connect the eTower 2 modules in parallel, with a maximum of 15 modules allowed. Note that for larger capacity 51,2V battery system requirements, consider the Freedom Won ENVA 16.
- Connect the modules using standard Ethernet cables with RJ45 plugs (optional accessory) to create a "daisy chain" configuration, allowing each module to communicate with the Master module through an independent RS485 bus. Refer to Figure 15 for the eTower 2 "daisy chain" configuration.

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Figure 15: Parallel Configuration Example

Consider the eTower 2 intended use as a starting point for a system with planned future expansion in multiple phases. If a capacity upgrade is required after 4 years or more than 1,200 cycles used, it is recommended to trade in for new units rather than adding new units in parallel with old ones.

4.5 Mounting and Fixing

The first eTower 2 module can be placed on the floor, a stand or a shelf on its pedestal, with units stacked on top of it, each sitting on its own pedestal. Refer to Figure 16 for an example of a six-module stacked system.

Figure 16: Six-Module Tower

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The eTower 2 must be placed on a firm, level surface to ensure tower stability. The optional pedestal is designed to comfortably withstand the weight of six eTower 2 modules. It is not recommended to stack more than the recommended number of modules in a tower, as this may compromise stability.

Installation into 19-inch racks is made possible by ordering the required eTower 2 rack mount brackets from Freedom Won. The eTower 2 is five standard rack units high (5U). Two brackets are required per module.

If floor mounting on the pedestal is unsuitable for a specific application, the eTower 2 may also be installed with the terminals facing upwards – preferably not directly on the floor, but on a stand, shelf or wall mount bracket. Wall mount brackets can be ordered from Freedom Won on request and must be ordered along with the eTower 2 rack mount brackets, because they are incorporated into the wall mounting system.

Mount the eTower 2 at least 0.5m away from any heat source and in a dry, cool area free from moisture and direct sunlight.

The dimensions given are for the principal outlines of the steel housing and exclude items that protrude, such as the lifting handles and DC terminals.

Do not block the air inlets at the rear and outlet on the front of the eTower 2. Leave a gap of at least 100mm in front of these inlets and outlets and between adjacent eTower 2's or other equipment.

5. Operations and Configuration

5.1 CAN Bus Communication and Device Control

CAN (Controller Area Network) is a widely used communication protocol in systems comprising devices that are required to report their status or transmit commands to other devices within the same network. The eTower 2 BMS uses the CAN J1939 protocol to send messages and commands to control external devices.

Follow these steps to connect the eTower 2 BMS to external devices through the CAN protocol:

- Verify that the external device (inverter or charge controller) is equipped with a CAN interface and a suitable method for connecting the CAN wires.
- Set the eTower 2 BMS via the APP with a CAN messaging profile specifically developed for the inverter or charge controller being used. Note that the Freedom Won "Universal" profile selection suits nearly all inverters on the market.
- Connect the CAN High and CAN Low wires to the CAN Bus device.
- Consult the Freedom Won Inverter Compatibility Guide for more information on the developed CAN profiles for a wide range of inverters.

CAN Bus offers flexibility and simple installation, requiring only two wires: CAN High and CAN Low connected through RJ45 "Ethernet" plugs and cables.

Note that a twisted pair must be used for CAN H and CAN L. Ethernet cables offer twisted pairs when the correct corresponding colours are used. When longer cable runs are required, or if the environment has a lot of power cables or other interference sources, the cable should be shielded, with the shield terminated to ground on one end. Ensure that CAN cables are routed separately from power cables (both DC and AC), with a gap of at least 200mm where running parallel with power cables.

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The standard (Universal) protocol is compatible with most inverters. Should you experience communication problems, please contact Freedom Won for assistance – it may be necessary to select a specific protocol on the BMS via the Bluetooth app.

Freedom Won welcomes requests to develop BMS CAN profiles for other CAN-equipped inverters that can interface with the BMS.

The CAN interface can provide the following functionality to compatible devices:

- Charge current limit of all eTower 2 modules connected.
- Discharge current limit of all eTower 2 modules connected.
- Actual State of Charge (minimum of all eTower 2 modules connected).
- Actual battery temperature (highest of all eTower 2 modules connected).
- Actual DC voltage.
- Actual current (total of all eTower 2 modules connected).
- Maximum real-time charge voltage limit setpoint.
- Battery name.
- Highest cell voltage and respective module number of all eTower 2 modules connected.
- Lowest cell voltage and respective module number of all eTower 2 modules connected.
- Firmware version.
- Ah capacity of all batteries connected.

CAN Bus termination resistors

The eTower 2 uses the SAE J1939 standard based on the CAN 2.0 Part A and Part B specification. For reliable communication, a 120-ohm termination resistor is required at each extreme end of the main CAN bus. Splices or branch connections do not require a resistor. Note that the eTower already has an internal 120-ohm termination resistor.

Most devices operating on CAN have two plugs – one to connect an incoming cable and one for an outgoing cable on the CAN Bus. Follow these guidelines when installing termination resistors:

- Identify the first and last devices in the CAN Bus chain. The first and last devices in the chain must each have a termination resistor.
- Plug a termination resistor into the spare (second) plug where applicable.
- The eTower 2 has a built-in termination resistor on its single inverter communications port, as it is designed to be an end-of-line device.
- With the power off, measure the resistance across CAN High and CAN Low if possible. You should measure 60 ohm. A measurement of 120 ohm implies that one resistor is missing; an open circuit indicates that no resistors are connected.

For detailed instructions on connecting the CAN interface, refer to the manuals provided by the third-party device manufacturers.

Most inverter brands use a 500kbps baud rate, and so does the eTower 2. Systems requiring 250kbps are not compatible with the eTower 2.

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5.2 eTower 2 Range Overview

Table 8 provides an overview of key data for the eTower 2 modules, detailing specifications for six configurations: a single eTower 2 module, 2-module stack, 3-module stack, 4-module stack, 5-module stack and 6-module stack. Table 9 provides the general specifications applicable to all configurations.

Table 8: eTower 2 Scalability Overview

Parameter	eTower 2 (x1)	eTower 2 (x2)	eTower 2 (x3)	eTower 2 (x4)	eTower 2 (x5)	eTower 2 (x6)
Total Energy Capacity [kWh]	5	10	15	20	25	30
Energy, 90% DoD [kWh] [1]	4.5	9	13.5	18	22.5	27
Current Capacity [Ah]	100	200	300	400	500	600
Max/Cont. Charge Current [A] [2]	80/70	144/126	216/189	288/252	360/315	432/378
Max/Cont. Charge Power [kW] [2]	4.2/3.6	7.5/6.6	11.2/9.8	15/13.1	18.7/16.3	22.5/19.7
Max/Cont. Discharge Current [A] [2]	100/90	180/160	270/240	360/320	450/400	540/480
Max/Cont. Discharge Power [kW] [2]	5.2/4.7	9.4/8.4	14/12.6	18.7/16.8	23.4/21	28/25.2
Max Inverter Rated Power [kVA]	5	10	15	20	25	30
Combined Weight [kg]	52	104	156	208	260	312
Dimensions with pedestal(s) – H x W x D [mm]	249 x 467 x 426	483 x 467 x 426	718 x 467 x 426	952 x 467 x 426	1186 x 467 x 426	1420 x 467 x 426
DC leads to inverter or DC bus per positive & negative connection – minimum cable size [mm^2] (cables excluded – see optional accessories)	1 x 35	1 x 35	2 x 35	2 x 35	3 x 35	3 x 35

Notes:

1. DoD = Depth of Discharge, max recommended 90% DoD; max permissible DoD is 100%.
2. Max discharge and charge (current and power) duration – 5 minutes per 30-minute cycle.

Table 9: eTower 2 General Specifications

Nominal Voltage	51.2V, to suit 48V inverters, min 47V, max 56V. Do not connect modules in series (for high voltage batteries, refer to the Freedom Won HV range).
Dimensions – single unit without pedestal, H x W x D [mm]	224 x 442 x 384 (excluding busbars on front)
Boxed Dimensions – per module, H x W x D [mm]	310 x 532 x 502
Boxed Weight – per module [kg]	55
Installation Method	Stacked horizontally onto each other to form a tower with pedestals (one per module required as accessory option), or 19-inch rack mounted with brackets (sold as an accessory). Vertical mounting on floor or wall (shelf/bracket) with terminals facing upwards is also acceptable (wall-mount bracket available as accessory). Generally up to 6 x eTower 2 modules per system. For larger capacity requirements, see the Freedom Won ENVA 16.
Enclosure	Steel – painted off-white, rated for indoor use only, out of direct sun and away from other heat sources. Includes forced air-cooling fan. Do not obstruct air inlets and outlet.

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DC Connection – Integrated Terminals on Front	2 x M6 bolts each for positive and negative terminals for DC leads to inverter, and optional accessory busbars for connection of parallel eTower 2 modules in tower or rack configuration.
Tower Interconnecting Busbars – minimum cross-section area [mm^2]	70 (17mm x 4mm busbar available in accessories). Note that the Freedom Won busbar accessories are designed for the pedestal tower dimensions, not for 19-inch rack mounting, which has different spacing. Busbars excluded (see optional accessories).
Communication and Control Interfaces	• CAN Bus (RJ45 socket x 1) – for interfacing with compatible inverters and system controllers (the eTower 2 is fully compatible with all common CAN Bus compatible brands) • RS485 (RJ45 socket x 1) – for interfacing with inverter types compatible with RS485 communication, such as the Voltronic Axpert range equipped with an RS485 lithium battery interface and the applicable firmware • RS232 (RJ11 socket x 1) – for interfacing with a PC for firmware and setting updates (only by Freedom Won technicians) • RS485 (RJ45 x 2) – for the communication connection of parallel batteries, up to six in a tower • Digital outputs x 2 – for controlling external relays based on pre-set functions • Bluetooth – for local connection to the Android or iOS APP • Wi-Fi – for remote access to battery information via the APP
Protection	Internal electronic protection including overcurrent, cell under- and overvoltage, temperature out of range, weak cell detection, minimum SoC control, and active voltage-based charge current limiting. DO NOT short circuit or connect in reverse polarity.
Prospective Short Circuit Current [kA]	5
Recommended Ambient Operating Temperature Range [°C]	10 – 25
Human Interface	• State of Charge display (0 to 100%, indicated by six green LEDs) • Alarm LED (red) • Run LED (green) • On LED (green) • BMS reset button • Main power ON/OFF switch • BMS ON/OFF switch • Serial RS232 plug for programming via PC (by Freedom Won only) • Dip switch block for selecting module addresses • Android or iOS APP
Warranty	5 years (or 4,000 cycles at 80% DoD). Refer to the eTower 2 warranty document for further details.
Service Life	>10 years (assuming daily cycling and ideal conditions of temperature, charge and discharge rates, and depth of discharge per cycle)
Optional Accessories (enquire with your distributor)	• Freedom Won eTower 2 wall mount bracket • Freedom Won eTower 2 19-inch rack mount brackets/cleats (pair) • Freedom Won eTower 2 parallel stacking accessory kit – one parallel busbar pair and eTower-to-eTower communication cable • Freedom Won eTower 2 DC cable kit – one pair of DC cables (35mm^2 x 1.8m) • Freedom Won eTower 2 pedestal • Freedom Won eTower 2 Dry Contact mating plug
Packaging	One eTower 2 per cardboard box (optional accessories packaged separately)
Certificate of Compliance	UN 38.3 / *IEC 62619

*In progress

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5.3 Maximum Current and Time Limit

The maximum current for each configuration is governed by the rating of the built-in circuit breaker and the BMS. A built-in active cooling fan helps limit cell temperature rise during heavy-duty operation provided the battery room is cool. The time limit for operation at the maximum current is 5 minutes in a 30-minute cycle.

5.4 Continuous Current Value

To prevent the circuit breaker from tripping during normal operation and to avoid overloading the BMS power electronics, it is recommended to design the system to operate at or below the continuous current value in most scenarios.

5.5 Maximum Allowable Voltage

The absolute maximum allowable voltage when fully charged is 56V; however, a more typical inverter charge setting range is 55.5V to 55.8V.

5.6 Typical Inverter Charge Setting Range

The voltage normally used when setting up the inverter for the minimum cut-off is 48V; however, this will not typically be reached if operating down to 90% Depth of Discharge (DoD). The BMS will command the compatible connected inverter with a CAN Bus or RS485 interface to stop discharging the battery at 10% SoC (90% DoD), which roughly equates to 49.0V. Under high load, the voltage may drop to 48V whilst still above 10% SoC.

5.7 Undervoltage Protection

A voltage of 48V or even lower can be observed in systems without a CAN Bus interface, or where the standby current draw of the inverter has caused the battery to be discharged below 10% SoC. The BMS will eventually cut off the battery from the DC bus at around 46V to protect the cells from undervoltage.

5.8 Optimal Charging Guidelines

The eTower 2 is equipped with a high accuracy current sensor that can maintain SoC accuracy for several days without calibration, however regular calibration is still required. This is achieved by ensuring that the battery reaches a full charge at least every four to five days. A full charge is achieved when the pack voltage reaches at least 55.6V and remains there for at least one hour. A regular full charge is equally important to allow the BMS sufficient time to balance the cells, an operation that can only occur effectively when the battery is fully charged. Loss of accuracy of SoC or loss or adequate balancing status as a result of insufficient regularity of reaching full charge is not indicative of a faulty battery, but rather incorrect operation. Attendance to issues relating to such a scenario is not covered by the product warranty, and will attract service charges should remedial action be requested from Freedom Won.

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6. Setting up Inverters and Charge Controllers

The maximum and continuous discharge currents for the eTower 2 in configurations of one to six modules are provided in Table 8. The charge current limit must be observed for the current limit settings of the inverter(s). The average recommended charge current is one-third of the continuous rating of the battery.

The voltage settings to be set on the inverter when connected to the eTower 2 are as follows:

- Minimum (cut-off) – 47V (the eTower 2 should never reach this low voltage, but it is good practice to set this as a redundancy protection measure).
- Low battery voltage warning (if applicable, often used to revert to grid power in increased self-consumption applications as it approximates 30% SoC) – 51V.
- Maximum charge voltage – 55.8V (Bulk, Absorption and Float are all set to this value).

In many inverters with CAN bus and set to Lithium Battery mode, these settings are disabled or unused. Instead, the commands from the battery become the active control method.

The BMS integrated within the Freedom Won eTower 2 is designed to manage excessive cell voltage imbalance by balancing the cells through the cell tap wiring and internal balancing circuitry. If any cell reaches its voltage limit, the BMS will intervene by internally disconnecting the cells from the terminals while the breaker remains in the ON position. Once the condition has been corrected, the eTower 2 module may automatically reconnect.

A voltage threshold may also be configured on the inverter to suit user requirements, defining the point at which the system transfers from inverter supply to grid power (where grid power is available). This setting should correspond to the desired minimum battery State of Charge (SoC) to maintain adequate reserve capacity for grid outages or load shedding events. For a self-consumption system operating without communication integration, the following voltage thresholds are recommended for automatic transfer of the inverter supply back to grid power:

- 52.0V, corresponding to approximately 60% DoD.
- 51.0V, corresponding to approximately 70% DoD.

For applications in which voltages are measured during high-current discharge conditions, it may be necessary to slightly adjust the values specified above to account for the voltage drop resulting from the internal resistance of the cells.

For systems equipped with a communication interface between the battery and the rest of the system, it is recommended to use State of Charge (SoC) as the primary parameter for charge and discharge control algorithms, as this provides the most accurate method of battery management. Voltage-based control, as described above, should be regarded as an approximation only.

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7. Start-up and Shutdown

7.1 Starting up the eTower 2

To switch on the eTower 2, follow these steps:

- Switch the BMS ON/OFF button on the eTower 2 to the ON position.
- Switch on the circuit breaker.
- The DC terminals of the eTower 2 will immediately become live.
- If the BMS is not active after going into hibernation from a long idle period, the eTower 2 will come alive when it detects an external voltage source, indicated by the illumination of the LEDs on the front panel.

7.1.1 Pre-Charging the DC Bus (If Necessary)

The eTower BMS manages most inverter inrush current levels. Some inverters may however have a particularly large inrush current when switching on the DC supply. If high inrush is expected, pre-charge the DC bus before switching on the first eTower breaker. To pre-charge the DC bus, energise the inverter through the AC or PV (DC) input prior to switching on the battery.

7.2 Shutting Down the eTower 2

To switch off the eTower 2, follow these steps:

- Switch off the circuit breaker to disconnect the DC output from the eTower 2.
- To shut down the BMS, switch the BMS ON/OFF button to the OFF position.

If the BMS is not shut down manually, it will automatically shut down after 24 hours of being idle (no current flow).

8. Freedom Won App Bluetooth and Wi-Fi Setup Guide

The eTower 2 is fitted as standard with both Bluetooth and Wi-Fi. To access these interfaces download the Freedom Won APP from the Google Play or Apple store. The initial connection to the eTower 2 must be made on site using Bluetooth. Once the eTower 2 has been registered using Bluetooth, the eTower 2 can be shared with others for remote access via the Internet provided that the eTower has been paired with the site Wi-Fi.

The eTower 2 firmware can be updated Over The Air (OTA) by Freedom Won or authorised installers.

Please refer to the Freedom Won app Bluetooth and Wi-Fi Setup Guide for an explanation of how to configure and operate the Android or iOS app to interface with your eTower 2 battery.

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9. Warranty and Repair

The eTower 2 is sealed with a tamper-evident label to prevent unauthorised access. Only Freedom Won and approved repairers are authorised to open the unit. If the seal is damaged or missing, the warranty will be void.

In the event of an internal issue with the eTower 2, contact Freedom Won or the installer to return the unit to Freedom Won for further inspection.

The warranty does not cover damage caused by lightning strikes. Physical damage to the battery housing and external and internal components resulting from impacts, water exposure or other forms of physical damage is also excluded from the warranty.

The standard warranty period is 5 years or 4,000 cycles at an average of 80% DoD, whichever occurs first. The battery is required to provide at least 60% of its new capacity at the end of this period or cycle count. The BMS records the number of cycles used. If you suspect that your eTower 2 is delivering below its minimum performance, contact your distributor or installer for an investigation.

If the eTower 2 does not meet its performance standards, it must be returned to Freedom Won for service to restore its guaranteed performance. Freedom Won will determine whether the unit requires replacement.

For more detailed warranty information, refer to the Freedom Won eTower 2 Warranty Document.

9.1 Expected Product Life

The eTower 2 has an expected service life of more than 10 years if operated under ideal conditions. These conditions primarily include:

- **Temperature** – the eTower 2 measured internal temperature should not regularly exceed 30 degrees Celsius. The battery room temperature should be maintained between 18 and 25 degrees Celsius where practicable.
- **C-rate** – the C-rate is expressed as a decimal of the one-hour discharge rate of the battery. The eTower 2 is a 100Ah battery, and hence, would be discharged or charged in one hour at 100A. The recommended maximum continuous charging C-rate for the eTower 2 is 0,3C, which equates to 30A. The same value for discharge is 0,5C, or 50A. The C-rate should be kept below these levels whenever practicable to avoid causing the lithium cells inside the battery to reach elevated temperatures, especially levels above 40 degrees Celsius.

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10. Troubleshooting Procedure

For most issues relating to the eTower 2, refer to the troubleshooting table below for recommended corrective actions. If the issue persists after consulting Table 10, contact your authorised Freedom Won supplier for further technical assistance.

Table 10: Troubleshooting Guide

No.	Issue Description	Cause / Solution
1	When switching ON the breaker, the battery triggers an alarm and fails to connect.	The most likely cause of this issue is that the battery has been connected to another module or multiple modules with significantly different States of Charge, resulting in an overcurrent during charging or discharging when the battery is switched ON. If this is the issue, switch OFF all other modules and charge or discharge the problematic module until its voltage is within 1V of the others, then switch the other modules back ON. If this is not the cause, the issue might be due to an inrush current to the inverter; in this case, pre-charge the DC bus before switching on the battery (refer to Section 7.1.1).
2	The battery triggers an alarm and disconnects when it reaches 100% State of Charge (SoC).	One of the cells might be reaching its maximum voltage value. Reduce the charge voltage setting on the inverter to 55.5V and reset the battery by pressing the reset button for approximately five seconds.
3	The alarm light is activated when the battery reaches a low State of Charge (SoC).	This issue may be due to the low State of Charge (SoC) alarm, which is triggered below 15% SoC, or a low cell voltage alarm. To prevent recurrence, either increase the minimum pack voltage to 49V or increase the minimum SoC allowed in the inverter settings to 15% (if available).
4	The LEDs remain illuminated even after switching off the breaker.	The BMS will shut down after 24 hours of inactivity. On the eTower 2, it is possible to switch off the BMS with the ON/OFF switch. This is recommended if the battery will not be used for some time.
5	The battery will not charge at more than 20A.	The eTower 2 has an automatic charge limit feature where the maximum charge current is reduced to 20A using the internal MOSFET controller if the charge current exceeds 85A for too long. This condition will be cancelled once the charge current has reduced to zero, i.e. when the battery is fully charged.
6	The inverter shuts down.	If the battery SoC is below 10%, the inverter will be commanded to shut down. To restore the system, grid power, generator power or solar power is required to recharge the battery to a level above 15%.
7	The alarm light illuminates, and the system shuts down when running at a high load.	Reduce the loads to within the performance specification of the eTower 2 module(s), or add more eTower 2 modules to the system to support the high loads.
8	The system automatically shuts down during a grid outage (load shedding).	This is usually caused by the spike of discharge current required from the battery when the inverter takes over from the grid. Proceed with the following two steps: (1) Adjust the AC grid low cut-off voltage higher if your inverter allows this setting – set up to 210V. This allows the inverter to reject the grid earlier and reduces the spike of discharge current required from the battery when the inverter takes over from the grid. (2) If step 1 is not possible or does not resolve the issue, it may be necessary to add another eTower 2 to the system to share the load.

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11. List of Abbreviations

Abbreviation	Definition
A	Ampere
AC	Alternating Current
BMS	Battery Management System
CAN	Controller Area Network
CB	Circuit Breaker
DC	Direct Current
DoD	Depth of Discharge
IP	Ingress Protection
kVA	Kilovolt-Ampere
kWh	Kilowatt-Hour
LED	Light-Emitting Diode
LiFePO4	Lithium Iron Phosphate
MPPT	Maximum Power Point Tracking
PE	Protective Earth
PSCC	Prospective Short Circuit Current
RJ	Registered Jack
RS	Recommended Standard
SCC	Solar Charge Controller
SoC	State of Charge
UPS	Uninterruptible Power Supply
USB	Universal Serial Bus
V	Volt

Technical and Installation Assistance

Please contact your Freedom Won Distributor or Reseller Installer for technical and installation support.
A distributor list is available at www.freedomwon.co.za.

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