

06.09.2024

User Manual

Product Name: Thunor Low Voltage Energy Storage Battery Product Model: TH-48-LV280-1.0



Thunor Solutions OÜ

Table of Contents

Overview	2
Introduction	2
1.1. Product Identification	2
1.2. Requirements for the Installer	3
Safety Information	3
2.1. Important Safety Precautions	3
2.2. Energy Storage Safety Information	4
2.3. Product Storage Safety Information	4
2.4. Transport Safety Instructions	5
2.5. Emergency Procedures	5
2.6. Important Disposal Requirements	5
Installation	6
3.1. Important Information Before Installation	6
3.2. Requirements for the Installation Room	6
3.3. Installing a Single Battery Bank	7
3.4. Communication with the Inverter	8
3.5. Installation of Multiple Battery Banks	8
3.5.1. Guidelines and Requirements for Connecting Multiple Devices	8
3.5.2. Connecting Battery Banks	9
Technical Specifications	10
Battery Management System (BMS) Functions	11
5.1. General	11
5.2. Detection of Battery Cell/External Environment/MOSFET Temperature	11
5.3. Detection of Charging/Discharging Current	12
5.4. Short-Circuit Protection	12
5.5. Calculation of Battery Capacity and Cycle Count	12
5.6. Standby Mode	12
5.7. Power On/Off with Master Battery	12
5.8. Battery Data Logging	12
5.9. Pre-Charging	13
User Interface	
6.1. Front Panel Buttons and Connectors	13
6.2. Meaning of the LED Lights	15
6.3. LCD Screen	16
Inverter	17
7.1. Inverter Requirements	17
7.2. Inverter Settings	17
General Information and Warranty Conditions	19
Appendices	20
Appendix 1. Setting RS485 DIP Address	20
Appendix 2. CAN Bus DIP Address Configuration (Typically Not Required)	21

Overview

This manual contains product information as well as installation, usage, and maintenance instructions for the power bank. Before installing and using the device, carefully read this user manual and other related documents. These documents should be kept in a secure location, so they are always readily accessible. The content of the user manual may be regularly updated and changed without prior notice as a result of product development. The latest version of the manual can be found on Thunor's website under downloadable materials at <u>www.thunor.eu</u>. This guide is intended for both the device installer and the user.

Introduction

The Thunor power bank is a low-voltage energy storage device that is safe and has a long service life. It is designed for use in both households and businesses. To achieve greater capacity, up to 16 identical Thunor power banks can be connected in parallel, providing a total capacity of up to 227.2 kWh.

1.1. Product Identification

This manual contains information on the installation, use, and maintenance of the model TH-48-LV280-1.0. The product contains rechargeable lithium iron phosphate (LiFePo4) battery cells and is intended for use in both residential and commercial buildings. The energy storage system allows you to store energy produced by solar panels and use it at a convenient time. Ensure that the product being used is the TH-48-LV280-1.0 model. The model name, along with relevant technical information, can be found on a sticker located on the right side panel of the product. Each product comes with an additional sticker, which is recommended to be placed on the front panel of the device.

Thunor Solutions OÜ Model: TH-48-LV280-1.0 Voltage: 44.8-56.8V Nominal capacity: 280Ah Nominal power: 14.2kWh Temp. range: -10-50°C Charging temp. range: 0-50°C Weight: 129kg MADE IN ESTONIA

Serial No: XXXX-XXXX-XXX-XXXX-XXXX



1.2. Requirements for the Installer

This device may only be installed and maintained by authorized specialists. Only qualified professionals are allowed to remove safety seals and the front panel. Only authorized specialists are permitted to replace internal components of the device. Only authorized specialists are allowed to make changes to the device's software.

Safety Information

Lithium iron phosphate (LiFePo4) batteries are safe and have a long service life when used correctly. However, it is essential to follow all safety requirements to avoid potential injuries, damage, or fire. Thunor Solutions OÜ does not guarantee or take responsibility for products installed and used in conditions that do not comply with the instructions provided in this manual. Improper conditions may damage the product and cause harm, which is not covered by the device warranty. In addition to the documents provided with the product, ensure compliance with local laws and regulations during installation, use, and maintenance.

2.1. Important Safety Precautions

- Do not make changes to the device's software or hardware.
- Do not install the device in a location with extreme temperatures or large temperature fluctuations. The device should not be installed near water or fire hazards.
- Keep the device out of reach of children, pets, and unauthorized persons.
- Follow local requirements, regulations, and safety standards.
- Do not open the device casing.

- Ensure the device is not visibly damaged.
- If you suspect any malfunctions, damage, or unusual behavior, stop using the device immediately and contact customer support.
- Before installation, cable connections, or maintenance, make sure the device is turned off to avoid the risk of electric shock.
- Use proper personal protective equipment during installation.
- If necessary, notify the network operator about the device installation.

2.2. Energy Storage Safety Information

- Before handling the product, measure the voltage between the + and terminals to ensure the device is turned off.
- Before connecting cables, make sure the device is not damaged, as it may pose a risk of electric shock or fire.
- Ensure that all electrical connections and cables comply with local regulations.
- Do not connect or disconnect power cables while the device is powered on!
- Ensure that the + and terminals are correctly connected and do not come into contact with conductive materials.
- Never connect AC wires to the battery.
- Do not connect batteries with different voltage levels; only parallel connections of batteries with the same model and voltage are allowed.
- Overheating may cause batteries to deform, leak corrosive electrolytes, or emit toxic gases.
- Do not leave the battery in a high-temperature environment or in direct sunlight for an extended period, as this could cause a fire.
- Do not crush or damage the product casing. A damaged casing must not be used. Contact a local battery recycling facility.
- Do not use a device with water damage.
- Do not use a device that has been dropped during installation and shows significant dents or damage.
- To increase storage capacity, only connect batteries of the same model in parallel. Different battery models and types should not be connected together.
- Cables may only be replaced with those provided by Thunor Solutions or the local distributor.

2.3. Product Storage Safety Information

- The storage area must comply with local regulations and standards.
- Store the device in a cool, dry place, away from direct sunlight, water, and other hazards.
- Store the device in a clean, well-ventilated space with temperatures ranging from -20°C to +50°C.

- Keep the device away from heating devices, open flames, and other sources of ignition.
- Do not stack batteries on top of each other; use a special battery rack for this purpose. Do not place objects on top of the device.
- Do not remove the packaging until the device is ready for use. If storing the battery for an extended period, recharge it before storage, and then place it back in its original packaging.
- If the device has not been used for three months, recharge it to 50%.
- If the device has been stored for longer than allowed, it should be checked and tested by an authorized specialist every six months before use.
- Do not leave the device unused for a long period, as this may reduce its capacity.
- Handle the device with care; do not lift or position it upside down or on its side.

2.4. Transport Safety Instructions

- Charge and use the device in accordance with local laws, regulations, and standards.
- The device can only be transported by road or sea; rail and air transport are prohibited.
- Before transporting the device, ensure the battery charge level is approximately 30%.
- Handle the device carefully during transportation to avoid rough treatment.

2.5. Emergency Procedures

- In case of fire, turn off the device and disconnect it from the power source.
- If there is a malfunction or abnormal behaviour, switch off the system at the circuit breaker if possible.
- In the event of a fire, use a fire extinguisher (carbon dioxide, FM-200, or ABC powder).
- In case of flooding, turn off the device from the electrical system if possible.

2.6. Important Disposal Requirements

Proper disposal of lithium iron phosphate (LiFePo4) batteries is crucial to minimise environmental impact and potential hazards. Below are detailed instructions for disposal:

- Do not dispose of the device in household waste.
- Incorrect disposal of batteries may cause them to ignite and release harmful chemicals into the environment.
- Thunor Solutions has an agreement with OÜ Eesti Elektroonikaromu, which handles the collection and recycling of used electronic devices (including batteries) according

to legal requirements. You can find the nearest collection point at <u>www.elektroonikaromu.ee</u>.

- Eesti Elektroonikaromu operates a nationwide network for collecting electrical and electronic equipment. Consumers can dispose of their electronic waste at these collection points free of charge.
- Follow any additional guidelines or regulations that apply to your local area or country.

Installation

3.1. Important Information Before Installation

The device must only be installed by a trained and certified electrician. This manual provides an overview of Thunor TH-48-LV280-1.0 configurations, but due to software and component selection, your device configuration may vary. For specific details on your device, consult the installer.

Before installation, ensure compliance with local regulations and requirements:

- Follow local norms, regulations, and safety standards.
- Ensure that you have a compatible inverter for the battery system. The parameters of a suitable inverter are listed in section 7.1.
- Notify the local authorities or utility provider if necessary.
- Ensure that the installation area is dry and meets ventilation and temperature requirements.

IMPORTANT NOTE:

To ensure safety and compliance, a separate DC overcurrent protection or disconnect device must be installed between the battery and the inverter. The ratings of fuses, circuit breakers, and cables must meet the applicable standards. The device must always be installed with a charge controller/inverter and configured so that the energy storage unit is protected from potential high voltages from solar panels and other equipment. The Battery Management System (BMS) alone may not always protect the battery in extreme conditions. Incorrect installation voids the device warranty.

3.2. Requirements for the Installation Room

Failure to meet environmental requirements can damage the battery, shorten its lifespan, and pose risks to people and the environment. Ensure the following conditions are met before installing the device:

- The room complies with international, national, and local standards.
- The device must be installed indoors and placed on a stable, level surface.
- The room must be well-ventilated, clean, dry, and free from corrosive substances.

- Do not install the product near heating devices or materials that pose a fire or explosion risk.
- Do not install the device near water sources (e.g., pipes, taps, sprinklers).
- Do not install the device on moving vehicles (e.g., cars, trains, or ships).
- The operating temperature range of the device is -10°C (0°C for charging) to +50°C. If installed in a cold environment, the built-in thermal system will automatically heat the battery for better performance, but only when charging current is present.
- Before installation, it is recommended to keep the device in a warm environment for at least 12 hours. If the device has been stored in a cold environment, it requires time to warm up.
- **Warning:** The battery is heavy and requires at least four people to move it to ensure even weight distribution and reduce the risk of injury.
- Use proper lifting techniques and equipment when moving the device and ensure the path is clear.

3.3. Installing a Single Battery Bank

Follow these steps for installation:

- 1. Determine the best location for the battery installation. Before installation, review the space requirements and considerations.
- 2. Place the battery on a flat surface. Do not lay the device on its back, as this may cause uneven distribution of electrolytes within the battery cells, reducing the battery's lifespan, which is not covered by the warranty.
- 3. Ensure the battery and connected device are turned off before installation.
- 4. Connect the ring terminals of the connection cables to the DC circuit breaker or inverter. Do not reverse the polarity connections. Orange is positive, and black is negative.
- 5. Select the appropriate power cable diameter based on the cable length:
 - Up to 1 meter: minimum cable cross-section 50mm²
 - \circ 1-2 metres: minimum cable cross-section $70 mm^2$
 - 2-3 metres: minimum cable cross-section 95mm²
 - Cable lengths over 3 metres are not recommended.
- 6. Connect the power cable connectors to the ports on the front panel of the battery. To insert the power cable into the battery, press the locking button on the connector.
- 7. Reset the inverter settings for the desired configuration. See the relevant chapter for inverter connection requirements.
- 8. After confirming the inverter settings, turn on the battery by pressing the power button on the front panel.

Warning:

- It is recommended to use a DC circuit breaker or fuse between the inverter and the battery. Thunor batteries have a built-in 180A fuse, so use a DC circuit breaker/fuse with a lower rating.
- Do not disconnect power cables when the battery is powered on.

• To remove the power cable, press the locking button on the connector.

3.4. Communication with the Inverter

The battery can communicate with the inverter via CAN or RS485 interface (refer to your inverter's user manual). It is essential to use an 8P8C cable with the correct socket configuration.



PIN nr	Definition
1 or 8	B- (RS485)
2 or 7	A+ (RS485)
4	CAN-H
5	CAN-L
3, 6	GND

PIN nr	Definition
1 või 8	B- (RS485)
2 või 7	A+ (RS485)
4	CAN-H
5	CAN-L
3, 6	GND

CAN interface: transmission speed 500 Kbps.

RS485 interface: transmission speed 19200 bps.

3.5. Installation of Multiple Battery Banks

3.5.1. Guidelines and Requirements for Connecting Multiple Devices

When connecting multiple batteries together, you must follow these requirements:

- To create a powerful battery system, you can connect up to 16 identical Thunor battery banks in parallel. Series connection (connecting negative to positive) is prohibited!
- Do not stack the batteries directly on top of each other. Use a special battery rack that can support the specified weight.
- To connect multiple batteries to one or more inverters, use appropriate battery cables or busbars with sufficient cross-section.
- Use appropriately sized power cables.
- Ensure that the cables are of equal length and have a diameter that matches the desired amperage. This setup minimises power loss in the cables and allows for charging up to 140A per parallel-connected battery (refer to the diagrams below).



- Thunor battery cables allow for the parallel connection of multiple devices, but the maximum charging and discharging current for the entire parallel system must be limited to 150A in the inverter settings. Otherwise, the cable may overheat and cause a fire.
- When connecting batteries to the inverter, the power cable diameter should be chosen based on the cable length if a busbar is not used:
 - up to 1 meter minimum cable cross-section 50mm²
 - 1-2 metres minimum cable cross-section 70mm²
 - 2-3 metres minimum cable cross-section 95mm²
- Cable lengths longer than 3 metres are not recommended.

3.5.2. Connecting Battery Banks

When connecting batteries in parallel, it is important to establish communication between the devices to ensure optimal performance and safety. The first battery in the series is called the primary battery, which communicates with the other batteries via the RS485B port. The RS485A and RS485B ports are used to connect sequential secondary batteries (always from RS485A of one battery to RS485B of the next battery).

To create communication between the batteries, an 8P8C network cable must be used. It is important to note that this cable must not be a crossover network cable, where signals inside the cable are swapped. Both 8P8C and RJ45 cables are straight-through cables, with identical connections at both ends.

Take note that the device's front panel features 8-bit DIP switches. A switch in the down position means OFF, while a switch in the up position means ON. The first 4 DIP switches

(#1, #2, #3, #4) are reserved for identifying secondary batteries, while the remaining 4 DIP switches (#5, #6, #7, #8) are used to determine the number of connected secondary batteries. Appendices 1 and 2 at the end of the manual provide more details on the number of connected batteries and the corresponding DIP switch positions depending on the inverter communication protocol (RS485 or CAN Bus). For CAN connection, in most inverter cases, the DIP switches should be left in their default position (i.e., all OFF) because the address is assigned automatically through the communication cables.

Basic Parameters	TH-48-LV280-1.0
Nominal Voltage (V)	51.2V
Nominal Capacity (Ah)	280Ah @0.5C discharge current 25±2°C
Nominal Power (Wh)	14.2kWh
Dimensions (mm)	715x455x255mm
Weight (Kg)	129kg
Discharge Cut-off Voltage (V)	45V
Charge Voltage (V)	55.2-56.6V
Continuous Charge/Discharge Current (A)	140A @25±2°C
Max charge/discharge Current (A)	150A @25±2°C
Standard charge/discharge Current (A)	10-140A @25±2°C
Charging Temperature	0∼50°C (Charge)
Discharging Temperature	-10~50°C (Discharge)
Optimal Temperature	10~30 °C (Recommended)
Storage Temperature	-20~50°C (Storage)
SOC Range	0%-100%
Recommended SOC Range	15%-95% (50V-55.2V)
Communication Interface	CAN and RS485
Humidity	10%-85% (non-condensing)
IP level	Indoors
Battery Cell Configuration	16S1P
Battery Cell model	EVE LF280K (with test report from EVE)
Cooling mode	Natural cooling
Cell Balancing	Passive balancing (150mA@3.43V-3.54V)
Maximum Battery packs in Parallel	16
Display	LCD

Technical Specifications

Battery Management System (BMS) Functions

5.1. General

The Battery Management System (BMS) is pre-installed in the product at the factory. The BMS is used to monitor current, voltage, and temperature, as well as to protect the device from overcharging, excessive discharging, overcurrent, extreme temperatures, and short circuits. During charging, the BMS balances the battery cells and safeguards the device from overcurrent to ensure safe and optimal operation.

BMS Functions
Overcharge protection
Over-discharge protection
Overcurrent protection
Cell balancing
Temperature protection and activation of heating mats if necessary
CAN and RS485 communication interface

NOTE: Resetting the BMS history is strictly prohibited; any violation will void the device's warranty. The BMS history is critical for monitoring the proper operation of the battery system and must not be erased under any circumstances. Any attempts to reset the BMS history will invalidate the warranty terms and may seriously damage the device.

5.2. Detection of Battery Cell/External Environment/MOSFET Temperature

The NTC (Negative Temperature Coefficient) sensors detect, in real time, the temperature of the environment surrounding the battery cells (4 out of 16 cells) and the temperature of the PCB board. In case of high or low temperature, the BMS sends alerts and applies protections. The product is equipped with integrated heating mats that activate at low temperatures when charging current is present.

5.3. Detection of Charging/Discharging Current

The BMS uses current-sensitive resistors in the charging and discharging circuit to detect and monitor the input and output currents in real time, applying overcurrent warnings and protection as necessary.

5.4. Short-Circuit Protection

The BMS detects and protects the device from short circuits. A 180A fuse is installed in the system for this purpose.

5.5. Calculation of Battery Capacity and Cycle Count

The BMS calculates the battery cell capacity in real time. It begins counting the number of charge and discharge cycles from the moment the battery is first fully charged and then fully discharged. One charge cycle is considered complete when the accumulated charge reaches at least 80% of the battery's capacity. Accumulated charge means the total energy charged, which counts toward one full charge cycle. For instance, if you charge your battery by 20% daily, a full charge cycle is completed after four days.

5.6. Standby Mode

Automatic standby mode: If the device has not been charged/discharged for 48 hours, the BMS automatically switches to standby mode to minimise energy consumption.

5.7. Power On/Off with Master Battery

When the DIP address is correctly set, the secondary batteries power off together with the master battery. However, if a secondary battery has a different voltage and there is a current flow between devices, the secondary batteries cannot be turned off.

5.8. Battery Data Logging

The BMS records data regarding warnings and fuse activation/release. This data can be viewed via a computer and exported as an Excel file.

5.9. Pre-Charging

The pre-charging function protects your inverter's capacitors. Without this function, the high current from the battery may damage the inverter's capacitors or circuits. The input current can damage the capacitors, wires, or the wires leading to the capacitors. The pre-charging function limits the inrush current to the inverter. It automatically activates each time the battery starts supplying power. Pre-charging sends limited power to the inverter for a few seconds to gradually charge the capacitors. The default pre-charging time is 3000 ms (3 seconds), which is adequate for most situations.

Pre-charging is crucial because the capacitors in the inverter can discharge when the system is off or in standby mode for an extended period.

User Interface 6.1. Front Panel Buttons and Connectors



ON/OFF

The power button is used to turn the device on or off. To turn the device on, press the button, and it will light up. Once the device is powered on, it will operate according to the default settings. To turn the device off, press the button, and the device will shut down.

CAPACITY

SOC (State of Charge) indicator light: Four green LED lights indicate the battery's charge level. Each LED represents 25% of the capacity.

ALM

The red flashing LED is an alarm indicator. The red light turns on if the BMS detects deviations in temperature, overcurrent, or a short circuit.

RUN

The green LED indicates the operational status of the battery.

ADS

The ADS DIP switches are used for communication between the parallel-connected batteries and between the battery and the inverter. If you have only one battery, all switches must be in the downward position. The diagrams for the DIP switches for connecting multiple devices are in Appendix 1 of the manual.

CAN/RS485

This port is used for communication between the battery bank and the inverter. It is suitable for both CAN and RS485 protocols (see the correct terminal diagram in this guide!). To avoid damage, do not connect standard Internet cables to this port!

485A/RS485B

These ports are used for data transmission between parallel-connected batteries. The RS485A port is also used for connecting to a computer via a special Thunori USB adapter. To prevent irreversible damage, do not connect standard Internet cables or third-party USB adapters to this port!

RESET

Reset button (not for regular use).

P- ja P+

The front panel of the battery bank features two pairs of identical-function power sockets. One set of connectors is connected to the device, while the other can be used to connect additional battery packs. In the case of a single device, both power sockets can be used for charging and discharging.

The power cable is equipped with an 8.0 mm silver-plated connector that can be rotated if necessary.

6.2. Meaning of the LED Lights

The front panel has six LED lights. Four green LED lights indicate the charging status (SOC). One red LED (ALM) signifies a warning, activation of the protection function, or an error message. One green LED (RUN) indicates the battery's standby, charging, and discharging status.

Status	Charging					Disch	arging			
SOC indicator	•	•	•	•	•	•	•	•		
0-25%	OFF	OFF	OFF OFF Blink		OFF	OFF	OFF	Solid Green		
25%-50%	OFF	OFF	Blink	Solid Green	OFF	OFF	Solid Green	Solid Green		
50%-75%	OFF	Blink	Blink Solid Green Solid Green		OFF	Solid Green	Solid Green	Solid Green		
>75%	Blink Solid Green Solid Green Solid Green		Solid Green	Solid Green	Solid Green	Solid Green				
Operating indicator	Solid Green				BI	ink				

Charging Status (SOC) LED Lights

System Mode Indicators

		RUN	ALM	SOC		-	-	Remark
		•	•	•	•	•	•	
Battery Status	Operating Mode							
Power off	Standby	OFF	OFF	OFF	OFF	OFF	OFF	Hibernation
Standby	Normal	Slow Flash	OFF	OFF	OFF	OFF	OFF	Standby mode
	Normal	Solid Green	OFF					
Over current warning		Solid Green	Blink type 2	Acco	According to Battery SOC Status			
Charge Mode	Over voltage protection	Blink type 1	OFF	OFF	OFF	OFF	OFF	Charging terminated
	Temperature, overcurrent protection	Blink type 1	Blink type 1	OFF	OFF	OFF	OFF	Charging terminated
	Normal	Blink type 3	OFF					
	Warning	Blink type 3	Blink type 3	According to Battery SOC Status		tatus		
Discharge Mode	Over current, temperature, short-circuit protection	OFF	Solid Red	OFF	OFF	OFF	OFF	Termination of discharge
	Under voltage protection	OFF	OFF	OFF	OFF	OFF	OFF	Termination of discharge

Types of LED Blinking Patterns:

Blinking Pattern Types	LED light activation in seconds	LED light deactivation in seconds
Blink type 1	0.25s	3.75s
Blink type 2	0.5s	0.5s
Blink type 3	0.5s	1.5s

6.3. LCD Screen

The LCD screen provides access to battery bank information.

Screen Details:

- **PackV:** Battery bank voltage
- Current: Amperage of incoming and outgoing current
- SOC: Battery capacity as a percentage
- Warn: Warnings and information on activated protection functions

LCD Screen Buttons:

- Confirm (Select): To choose or confirm a selection
- Exit (Back): Return to the previous screen
- Up (Go Up): Navigate upwards
- **Down (Go Down):** Navigate downwards; pressing it on the home screen grants access to communication protocol selection.

To select submenus, press the "Up" and "Down" buttons on the menu screen. The item with the flashing number is the one selected. To enter a submenu, press the "Select" button. To return to the main menu or home screen, press the "Exit" button. In standby mode, press any button to activate the LCD screen.

The screen has four submenus:

- CellV: Monitor the voltage of individual battery cells
- Temperature: For monitoring temperature
- Warning: For viewing warnings
- **Capacity:** For monitoring battery capacity

Warning Status Submenu Explanations:

- **OV-Warn:** Overvoltage warning
- **OV-Prot:** Overvoltage protection
- UV-Warn: Undervoltage warning
- **UV-Prot:** Undervoltage protection
- **OT-Warn:** High-temperature warning

- **OT-Prot:** Over-temperature protection
- UT-Warn: Low-temperature warning
- UT-Prot: Low-temperature protection
- **OC-Warn:** Overcurrent warning
- **OC-Prot:** Overcurrent protection
- CAPA-Warn: Discharge warning
- SCP: Short-circuit protection

Inverter

7.1. Inverter Requirements

For low-voltage batteries, an inverter is a crucial accessory. It converts direct current (DC) from the battery into alternating current (AC) for household electrical devices.

When selecting the appropriate inverter, several parameters must be considered. One of the most important is the discharge cutoff voltage. For the **TH-48-LV280-1.0** model, this is set to **45V**. This means that if the battery bank's voltage drops below 45V, the BMS will automatically shut down to prevent damage. Another key parameter is the charging voltage, which is **56.6V** for the TH-48-LV280-1.0 model. The inverter will charge the battery until it reaches 56.6V. In some cases, the BMS may stop charging at a lower voltage, such as when an individual battery cell reaches 3.54V. The charging voltage can also be set lower (down to 55V), but in that case, the battery will not reach full capacity, and over time, cells may become unbalanced (balancing occurs within a voltage range of 3.43-3.54V).

It is important to limit the inverter's charging and discharging current to **140A** or less. For optimal operation, the inverter must be able to charge and discharge up to **140A** consistently without damaging the battery.

When choosing an inverter for the battery bank, consider the bank's voltage and the expected load tolerance. Additionally, ensure that the inverter is properly configured to guarantee the safe and efficient operation of the battery bank.

The **Thunor low-voltage battery bank** is compatible with inverters from various manufacturers. You can find more information about compatible models on our website: <u>www.thunor.eu</u>.

7.2. Inverter Settings

If the inverter does not support a CAN or RS485 interface, the battery bank parameters must be entered manually before connecting the devices.

Charging Settings:

Parameter	Setting
Battery Type	Lithium
Charge curve	Fixed
Absorption voltage	56.6V
Float voltage	55
Absorption time	1Hr

Additional Settings:

Parameter	Setting
DC input low shut-down	46V
DC input low restart	48V
DC input low pre-alarm	48V

Maintenance

The Thunor battery pack is easy to use and requires minimal maintenance. However, like any electrical device, it needs periodic inspections and upkeep to ensure optimal performance and safety. Below are general maintenance guidelines:

- Keep the battery terminals clean from dust and dirt. Use a dry cloth for cleaning the product.
- Regularly check the battery voltage and capacity through the BMS.
- Inspect the battery and surrounding components to ensure no physical damage (e.g., cracks, dents, or leaks) has occurred over time. If you notice anything unusual, immediately stop using the device and contact a local recycling service.
- Ensure that the batteries are properly and securely connected. Check for loose or corroded connections and replace them if necessary.
- If you do not plan to use the battery for an extended period, charge the device to 50-80% and store it in a cool (above 10°C) and dry place.

In addition to general maintenance instructions, the following tasks should be carried out periodically:

- Balance the battery cells regularly using the BMS. Balancing ensures equal charging and discharging of all cells, improving battery capacity and extending the device's lifespan. Passive balancing occurs at cell voltages between 3.43-3.54V (54.9-56.6V at the battery pack level) and is more effective with a 10A charging current. If the charging voltage is set to 55V or below, the battery cells may become unbalanced.
- If you don't plan to use the battery for an extended period, it should be fully charged to 100% at least once every six months and then discharged to 50-80%. This will help maintain the battery's capacity and prevent over-discharge.

By following these maintenance guidelines, you ensure the safe and optimal operation of your device.

General Information and Warranty Conditions

The product comes with a 10-year or 6,000 charging cycles (whichever comes first) limited warranty. Thunor Solutions OÜ guarantees that this product is free from material or manufacturing defects for one year from the original purchase date.

To claim the warranty, the customer must contact the retailer and return the device to the point of purchase. The limited warranty applies only to the original purchaser and is non-transferable.

The warranty does not cover damage or malfunction caused by any modifications or alterations (including unauthorised software changes) and improper or unreasonable use, misuse, neglect, exposure to excessive moisture, fire, improper packing, lightning, power surges, oxidative environments, or other natural effects. It also excludes damage or malfunction due to repairs by unauthorised personnel.

Failure to comply with the instructions provided in this manual voids the warranty. Thunor Solutions is not liable for indirect damages arising from the use or transportation of this product.

Under the valid warranty, Thunor Solutions OÜ will, at its discretion, repair or replace the product in the event of claims. Repaired or replaced products will be covered for the remainder of the original warranty period.

This document is subject to change without notice. The latest version of the manual, including warranty terms, can be found on the Thunor website at <u>www.thunor.eu</u>.

Thunor Solutions OÜ

Appendices

For a single device: DIP address does not need to be set.

The switch in the lower position is considered OFF, while the switch in the upper position is considered ON.

Appendix 1. Setting RS485 DIP Address

Primary battery (all OFF)



Parallel Connection of Multiple TH-48-LV280-1.0 Battery Banks via RS485 (**Applicable to Secondary Batteries**):



Appendix 2. CAN Bus DIP Address Configuration (Typically Not Required)

1 Pack	2 in Parallel
on	on
12345678	123456

0	n						
П	Π		П				
Ц	Ш	Ш	Ш	Ш	Ц		
1	2	3	4	5	6	7	8

12345678

on



on

4 in Parallel



니니







12345678

0	n						
1	2	3	4	5	6	7	8



5 in Parallel

0	n			_		_	
Н	Н	Н	Н				
1	2	3	4	5	6	7	8
0	n						
			\square				
1	2	3	4	5	6	7	8
0	n						
E		8	8	8	8	8	8
1	2	3	4	5	6	7	8
0	n						
		B	B	H	H	B	8
1	2	3	4	5	6	7	8
0	n						
B	B		B	B	H	B	-
1	2	3	4	5	6	7	8







on	
12345	678
00	010
	100
123450	678
on	
123456	578
on	
	188
123456	578
on	
	J.U.U.
123456	578
on	
12345	678
on	
	- A A
12345	678

8 in Parallel

on
12345678
on
1 2 2 4 5 6 7 9
12345070
12345678
on
12345678
on
12345678
on
12345678
on
12345678
00
12345678

9 in Parallel





12345678
ON 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8
ON 1 2 3 4 5 6 7 8
ON 1 2 3 4 5 6 7 8
ON 1 2 3 4 5 6 7 8
ON 1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8
ON 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8

10 in Parallel

on

11 in Parallel







0	n						
	A		A	H	A	A	H
1	2	3	4	5	6	7	8

0	n						
A			A	H	A	A	A
1	2	3	4	5	6	7	8

0	n						
			П	П	П	Д	П
1	2	2	4	5	6	7	8
1	2	3	4	5	0	1	Ø

on	
123456	78
00	

1	Second Second	1	Second Second	1000	5d	1	Second Second	
1	2	3	4	5	6	7	8	
0	n							i



12 in Parallel
on 1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8
1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8
ON 1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8



13 in Parallel
On 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8
0n 1 2 3 4 5 6 7 8
0n 1 2 3 4 5 6 7 8
0n 1 2 3 4 5 6 7 8
0n 1 2 3 4 5 6 7 8
0n 1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8
0n 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8
00 1 2 3 4 5 6 7 8

14 in Parallel	15 in Parallel
on	ON
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
00	0n
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
0N	0n
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
ON	ON
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
ON	ON
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
on	0n
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
0n	ON
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
on	ON
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
on	On
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
on	On
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
on	ON
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
on	00
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
on	00
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
	ON 1 2 3 4 5 6 7 8

On
ON 1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8
ON 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8
0n 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8
on 1 2 3 4 5 6 7 8
12345078
ON 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8 On 1 2 3 4 5 6 7 8 On 1 2 3 4 5 6 7 8
On 1 2 3 4 5 6 7 8 On 1 2 3 4 5 6 7 8 On
0n 1 2 3 4 5 6 7 8 0n 1 2 3 4 5 6 7 8 0n 1 2 3 4 5 6 7 8 0n 1 2 3 4 5 6 7 8 0n 1 2 3 4 5 6 7 8 0n 1 2 3 4 5 6 7 8 0n 1 2 3 4 5 6 7 8 0n 1 2 3 4 5 6 7 8 0n 1 2 3 4 5 6 7 8 0n 1 2 3 4 5 6 7 8 0n 1 2 3 4 5 6 7 8

16 in Parallel