

User Manual

Product Name: Thunor Low Voltage Energy Storage Battery

Product Model: TH-48-LV280-1.0



Thunor Solutions Ü

Overview	2
Introduction	2
1.1. Identifying the product	2
1.2. Personal Requirements	3
Safety Precautions	3
2.1. General Safety Guidelines	3
2.2. Battery Safety Guidelines	4
2.3. Storage Safety Guidelines	4
2.4. Transport Safety Guidelines	5
2.5. Emergency Procedures	5
2.6. Disposal	5
3. Installation	5
3.1. To know before installation	5
3.2. Installation Environment Requirements	6
3.3. Installing TH-48-LV280-1.0 Single Battery Pack	6
3.4. Communication with inverter	7
3.5. Multiple battery packs in one stack	7
3.5.1. Guidelines and requirements for a multiple battery packs	7
3.5.2. Communication between batteries	8
4. Technical Specifications	9
5. Battery Management System (BMS) features	10
5.1. General	10
5.2. Cell/ambient/MOSFET temperature detection	10
5.3. Charging/discharging current detection	10
5.4. Short circuit protection	10
5.5. Pack capacity and cycle life calculation	11
5.6. Charging/discharging MOSFET	11
5.7. Hibernation mode	11
5.8. Power on/off with a primary pack	11
5.9. Battery information storage	11
5.10. Precharge	11
6. Interface	12
6.1. Front panel buttons and connectors	12
6.2. LED indicators	13
6.3. LCD screen	14
7. Inverter	16
7.1. Inverter requirements	16
7.2. Inverter settings	16
8. Monitoring Software	17
9. Maintenance	17
10. General Information and Legal disclaimers	18
Appendix	19
Appendix 1. RS485 DIP address setup demonstration	19

Overview

Welcome to the user manual for the TH-48-LV280-1.0 low-voltage lithium iron phosphate (LiFePo₄) battery energy storage system. This manual has been designed to provide essential information on the installation, operation, and maintenance of this energy storage system, as well as to provide detailed technical specifications, and warranty information.

This manual is intended for use by both technical support engineers and end-users and is organized into several chapters to help you quickly and easily find the information you need. The following chapters are included in this manual:

- **Introduction:** This chapter provides an overview of the TH-48-LV280-1.0 energy storage system, including its identification features, intended uses, and capacity of expansion.
- **Safety:** This chapter provides important safety information for the TH-48-LV280-1.0 energy storage system, including information on storage safety, and transportation safety requirements.
- **Installation:** This chapter provides detailed information on the installation requirements for the energy storage system, including environmental requirements, physical installation, and electrical connections.
- **Operation:** This chapter provides instructions on how to operate the energy storage system, including information on how to charge and discharge the batteries, and how to monitor system status.
- **Maintenance:** This chapter provides information on how to maintain the energy storage system, including recommended maintenance schedules, and replacement part information.
- **Technical Specifications:** This chapter provides detailed technical specifications for the energy storage system, including information on voltage and capacity, cycle life, and other performance characteristics.
- **Warranty:** This chapter provides information on the warranty terms, including the duration of the warranty and the coverage provided.

Introduction

This product is a low-voltage lithium iron phosphate (LiFePo₄) battery energy storage system with safe performance and longer cycle life. This energy storage unit is designed to be used in residential or commercial on-grid applications with the capacity for short-term energy backup, and in off-grid houses to achieve true energy independence. The product supports power and capacity expansion, up to 16 identical Thunor batteries can be connected in parallel to create a powerful energy storage system with a capacity of up to 224 kW.

1.1. Identifying the product

This manual is designed to provide you with all the necessary information to properly use and maintain your TH-48-LV280-1.0 model. The Thunor Energy Storage Battery is a high-quality, rechargeable lithium-ion battery designed for residential and commercial on-grid applications with the capacity for energy backup, and in off-grid houses to achieve true energy independence.

To ensure you are using the correct product manual, please confirm the product you are using is the TH-48-LV280 model. You can identify this by checking the product plate attached to the battery, which should display the product name, model number, and relevant technical specifications.

Thunor Solutions OÜ
Model: TH-48-LV280-1.0
Voltage: 43-57.6V
Nominal capacity: 280Ah
Nominal power: 14kWh
Temp. range: -10-50°C
Charging temp. range: 0-50°C
Weight: 127kg
MADE IN ESTONIA



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



1.2. Personal Requirements

- Use a licensed electrician or competent person (if allowed by local regulations) for installation and maintenance.
- Only qualified professionals are allowed to remove safety facilities and inspect the equipment.
- Only authorized personnel are allowed to replace the equipment or component.
- Only authorized personnel are allowed to make changes in software.

Safety Precautions

The low-voltage lithium iron phosphate (LiFePo4) battery energy storage system is designed to be safe and reliable when used properly. However, it is important to follow certain safety guidelines to prevent injury, damage, or fire. Please read and follow our safety instructions in this chapter carefully before installing or using the energy storage system. Thunor Solutions OÜ will not guarantee or accept liability for a product that is installed and operated in conditions that are not in accordance with the guidance manual. This equipment can be only used in environments that meet its design specifications. Otherwise, the product may become faulty, and the resulting component damage, personal injuries, or property damage are not covered under the warranty. During installation, operating, or maintaining the energy storage system, please follow local laws and regulations.

2.1. General Safety Guidelines

- Do not modify or alter the energy storage system in any way.
- Do not expose the energy storage system to extreme temperatures, water, fire, or other hazards.
- Keep the energy storage system away from children, pets, and unauthorized personnel.
- Follow local electrical codes, regulations, and safety standards when installing and using the energy storage system.
- Do not open the case of the product.
- Check that the equipment is not damaged.
- If you suspect any malfunction, damage, or abnormal behavior of the energy storage system, stop using it immediately and contact support.
- Do not perform installation, cable connection, maintenance, or replacement when the equipment is energized.

- Wear proper personal protective equipment (PPE) during installation.
- Inform local authorities if necessary before installing the equipment.

2.2. Battery Safety Guidelines

- Before handling the product, measure the contact point voltage and ensure that there is no risk of electric shock.
- Before connecting cables, ensure that the equipment is not damaged. Otherwise, electrical shocks or fire may occur.
- Ensure that all electrical connections comply with local electrical standards.
- Ensure that the cables meet local regulations.
- Do not connect or disconnect power cables with power-on.
- Do not short-circuit the battery terminals or expose them to conductive materials.
- Never connect AC main cables to the battery.
- Never connect batteries with different voltage levels (SOC).
- Never connect this battery in series, only parallel connection to the same model and SOC is allowed.
- When the battery is faulty, the temperature may rise very high. Therefore avoid touching the battery.
- Overheating may cause the battery to deform and leak corrosive electrolytes or toxic gas.
- Do not expose the battery to high temperatures or direct sunlight for extended periods of time. The battery may cause a fire if overheated.
- Do not puncture or damage the battery casing. If the battery casing is damaged, do not use the battery and contact point of purchase.
- Do not use a battery that has been soaked in the water. Contact a local battery recycling company for disposal.
- Do not use a system that is dropped or violently impacted during installation.
- Use only the recommended battery modules and components specified in the user manual. Do not mix different battery types or models.
- Cables can be replaced only with the ones provided by Thunor Solutions or your local dealer.

2.3. Storage Safety Guidelines

- The storage environment must comply with local regulations and standards.
- Storage the battery in a cool and dry place, away from direct sunlight, water, and other hazards.
- Storage the battery in a clean and well-ventilated room at ambient temperatures within -20 - 50°C.
- Keep the battery away from heat sources, open flames, and other sources of ignition.
- Do not stack batteries on top of each other, use a dedicated battery rack instead, and do not store heavy objects on top of it.
- Storage the battery in its original packaging.
- Do not remove the package before use. The battery should be charged during storage by professionals as required, put the battery back to the package after charge during storage.
- If the product is not used for three months, the battery must be charged to a 50% state of charge.
- If the system has been stored for longer than the allowed period, it must be checked and tested after every six months by professionals before use.
- Do not store batteries for extended periods as it may cause capacity loss.
- Handle the system with caution, do not put the system upside down or sidelong.
- Move the battery in the correct direction, do not tilt it or place it upside or on its back.

2.4. Transport Safety Guidelines

- Load and unload the system in compliance with local laws, regulations, and industry standards.
- When transporting the battery, use a container that is specifically designed for lithium-ion batteries and is approved for transportation by the applicable regulatory agencies.
- This product can be delivered only by land and water, transportation by rail or air is forbidden.
- Before transporting the system, establish a state of charge near 50%
- Do not handle the battery roughly, it is not allowed to roll the battery crate.

2.5. Emergency Procedures

- In case of a fire, turn off the energy storage system and disconnect it from the power source.
- In case of a malfunction or abnormal behavior of the energy storage system, power off the system from the circuit breaker if possible.
- Extinguish the fire with a fire extinguisher (carbon dioxide, FM-200, or ABC powder).
- In the case of a flood emergency, power off the system if it is safe to do so.

2.6. Disposal

Proper disposal of a lithium iron phosphate (LiFePo₄) battery energy storage system is important to minimize environmental impact and potential hazards. Here are some guidelines for disposing of the energy storage system:

- Do not dispose of the energy storage system in the regular trash or recycling bin. Lithium-ion batteries can pose a fire hazard and can release harmful chemicals if not disposed of properly.
- Contact your local waste management or recycling center to find out if they accept lithium-ion batteries or if they have a special program for disposing of them. They may require that the battery be fully discharged and packed in a specific way to prevent damage during transportation.
- If the energy storage system is no longer functional, it may be possible to recycle some of the components. Contact the manufacturer or a specialized recycling company to inquire about options for recycling the battery.
- Follow any additional guidelines or regulations that may apply in your local area or country for the disposal of lithium-ion batteries.

3. Installation

3.1. To know before installation

Safe and reliable installation requires trained and certified technicians. The following discussion of Thunor TH-48-LV280-1.0 configurations is a basic primer. Due to the variety of systems and components in the field, all possible scenarios are not covered. This is not the purpose of this section of the manual. Refer to professional installers regarding your system and its components and specifications.

Before installing the energy storage unit, please follow the pre-installation checklist below to ensure the installation meets local codes, regulations, and safety standards:

- Follow local electrical codes, regulations, and safety standards: Consult your local electrical codes and regulations to ensure the installation meets the requirements in your area.

- Ensure you have a proper inverter that is compatible with the energy storage unit. Please check the requirements in the Inverter chapter
- Inform local authority if required by your local regulations.
- Follow environmental requirements: Ensure that the installation site meets environmental requirements such as proper ventilation, temperature, and humidity levels.

IMPORTANT NOTE: Circuit Breakers, Disconnects, and Fuses should be employed throughout several points of a power storage and generation installation to effectively isolate and protect all components of the system to safeguard against faults, short circuits, polarity reversals, or a failure of any component in the overall system. Fuses, breakers, wiring ratings, and values should be determined by established standards and evaluated by certified electricians, licensed installers, and regional code authorities. The Thunor TH-48-LV280-1.0 must always be installed with a charge controller/inverter and the appropriate settings to protect the batteries from open PV voltage and other high-voltage charging sources. The Battery Management System (BMS) alone will not protect the batteries from these extreme electrical phenomena. Failure to adhere to installation protocol will void the Warranty.

3.2. Installation Environment Requirements

Please note that failure to meet the installation environmental requirements can cause damage to the battery, reduce its lifespan, and pose safety hazards. Before installing the energy storage battery, it is important to carefully review the following installation environment requirements:

- The installation environment must meet relevant international, national, and local standards for lithium batteries.
- This system must be installed indoors, make sure that the battery is secured on a solid and flat surface.
- This system must be installed in a well-ventilated, clean, non-corrosive, and dry environment.
- Install the system away from any fire source, and flammable or explosive materials.
- Do not install the system close to water sources such as sewer pipes, taps, and sprinklers.
- Do not install the system on a moving object, such as a car, train, or ship.
- The operating temperature of the system is between - 10°C (0°C for charging) to 50°C. If the system is installed in a cold environment and charging power is available, the built-in thermal system starts to heat the battery automatically to achieve better performance.
- It is advised to store the system for at least 12 hours in a warm place before installation. If it's kept in a cold environment before installation, it needs some time to warm up.
- Due to the weight of the battery, it is recommended that a minimum of four people be involved in moving the system. This will ensure that the weight is evenly distributed and reduce the risk of injury to any one person.
- When moving the system, use proper lifting techniques and ensure that the pathway is clear and free of obstacles.

3.3. Installing TH-48-LV280-1.0 Single Battery Pack

Please follow the next steps for the installation of the Single Battery Pack

1. Determine the best location to accommodate your battery unit for operation. Please familiarize yourself with Installation Environment Requirements and things to know before installation.
2. Place the battery on a level surface. Do not place the battery on its back as the electrolyte in cells will not be distributed evenly and the resulting loss in cycle life will not be covered by warranty.
3. Make sure the battery is turned off before making any connections to it.

4. Connect the ring terminals of the connector cables to the DC-rated breaker or inverter. **Negative and positive poles should not be reversed.** Red is positive and black is negative.
5. Connect the connector cable plugs to the receiving terminals located on the battery unit.
6. Configure the inverter settings based on the desired configuration/power distribution. See the requirements for a compatible Inverter in the relevant chapter.
7. After configuring inverter settings, turn the battery on by pressing the power button located on the front panel.

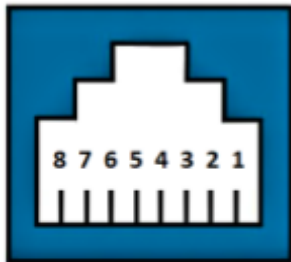
Attention

- It is recommended to use a DC-rated breaker or fuse between the inverter and the battery. Our battery has an inbuilt 180A fuse, so use a lower-value DC breaker/fuse.
- Do not disconnect the battery terminals when it's running.
- When pulling out the battery output line, the lock button on the plug of the output line must be pressed.

3.4. Communication with inverter

BMS can communicate with inverters via CAN protocol or RS485 protocol (check your inverter manual).

It is important to use an 8P8C cable with the correct pinout:



CAN/RS485 port

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

CAN communication: baud rate 500 Kbps.

RS485 communication: baud rate 19200 bps.

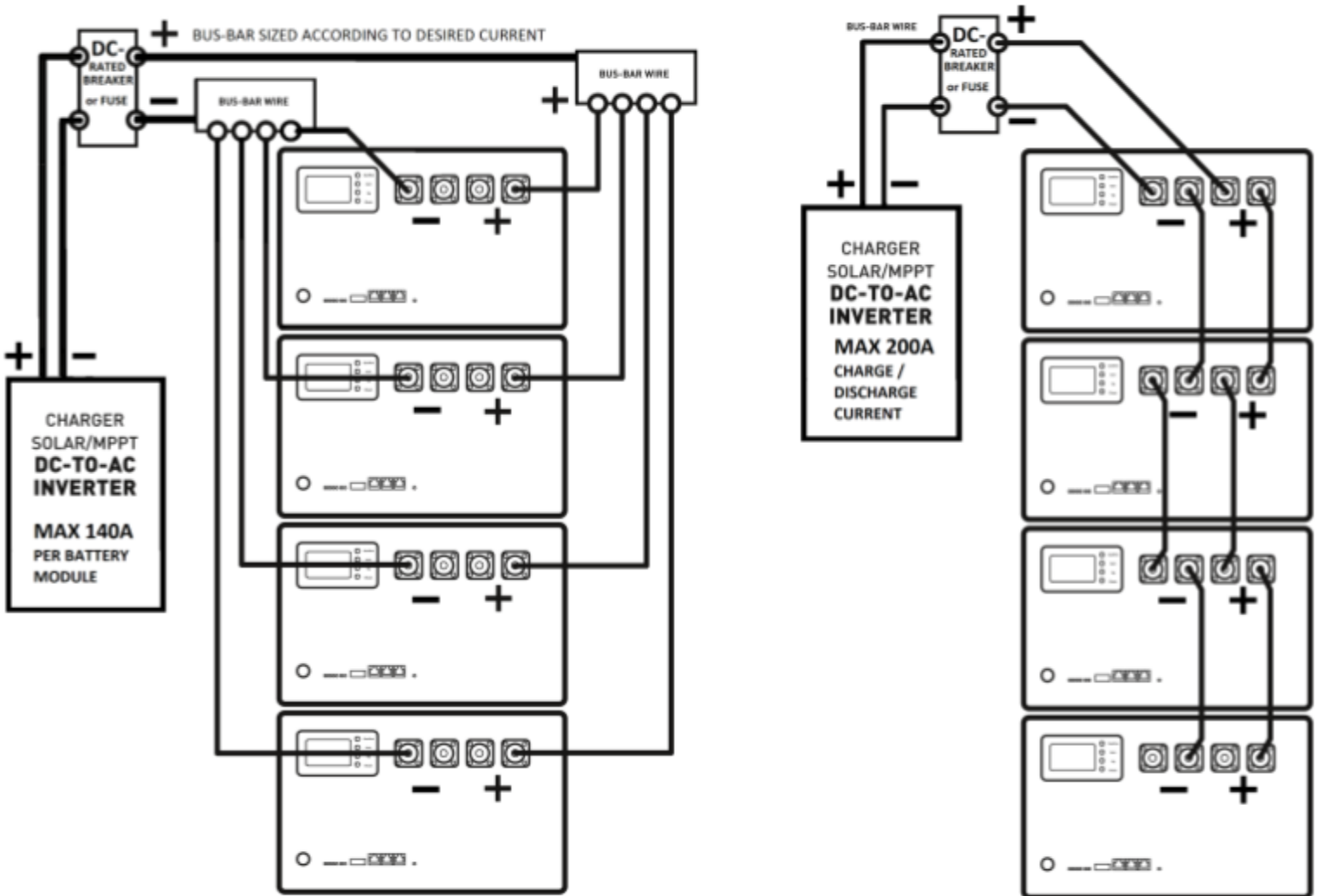
3.5. Multiple battery packs in one stack

3.5.1. Guidelines and requirements for a multiple battery packs

When considering a setup with multiple battery packs, you must follow these **requirements**.

- Up to 16 identical models of Thunor Batteries may be connected in parallel to create a very powerful battery system. **Series connection (connecting negative to positive) is forbidden and will damage the product**
- Do not stack batteries on top of each other, use a dedicated battery rack with shelves that are rated to withstand the mass of the battery packs.
- Use appropriately sized battery cables or bus-bars to connect multiple batteries to one or more inverters.
- The power cables must be an appropriate size to carry the current your inverter will draw.

- **Voltages of battery packs have to be at the same level(max 0.2V difference) when connecting.**
- It is recommended to use equal-length cables running to two appropriately sized bus-bars, one for negative and one for positive. This setup ensures minimal power loss due to cable resistance and allows drawing up to 140A per individual battery in a paralleled pack. (see figures in this chapter below)
- It is possible to connect multiple batteries with Thunor battery cables, but the maximum charge and discharge current for the entire parallel pack must be limited to 200A in inverter settings, or the cable may overheat and cause a fire. (see figures in this chapter below)



3.5.2. Communication between batteries

When connecting batteries in parallel, it is important to establish communication between them for efficient performance and safety. The first battery in the series is referred to as the primary and it communicates with the other batteries via the RS485B port. The RS485A and RS485B ports are used to connect consecutive secondary batteries.

To establish communication between the batteries, a straight-thru 8P8C network cable must be used. **It is important to note that this cable must not be a typical network cable where the signals cross within the cable.** Both 8P8C and RJ45

connectors are typically interchangeable. A straight-thru cable is one in which the connections are the same pin at both ends of the cable.

Please note that there are 8-bit DIP switches and a switch in the down position is considered OFF, while a switch in the up position is considered ON. The first 4 DIP switches(#1, #2, #3, #4) are reserved for identifying the secondary batteries. The remaining 4 DIP switches (#5, #6, #7, #8) are used to specify the number of secondary batteries to be connected. Please refer to Appendix 1 at the end of this manual for examples.

4. Technical Specifications

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)	14kWh
Dimensions (mm)	689x433x250mm
Weight (Kg)	129kg
Discharge Cut-off Voltage (V)	43.2V
Charge Voltage (V)	57.6V
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	5%-100%
Recommended SOC Range	15-95%
Communication Interface	CAN and RS485
Humidity	10%-85%(non-condensing)
IP level	indoors
Battery Cell Configuration	16S1P
Battery Cell model	EVE LF280K (with factory test report from EVE)
Cooling mode	Natural cooling
Maximum Battery packs in Parallel	16
Display	LCD
Built in heaters	2 x 80W

5. Battery Management System (BMS) features

5.1. General

The BMS has been installed inside the product at our factory. The BMS is applied to monitor current, voltage, temperature, and protection against over-charge, over-discharge, over-current, over-temperature, under-temperature, and short circuits. The BMS provides cell balancing and current limitations during the charging process to ensure reliable safety and performance.

BMS Functions
Over-charge protection
Over-discharge protection
Overcurrent protection
Cell balancing
Temperature protection and heating activation
CAN and RS485 communication

NOTE: Resetting the BMS history is strictly prohibited and will void the warranty of the battery system. The BMS history is critical for ensuring the proper functioning of the battery system and should not be tampered with under any circumstances. Any attempts to reset the BMS history will negate the warranty terms and may result in damage to the battery system.

5.2. Cell/ambient/MOSFET temperature detection

By detecting the temperature of cells (4 of the 16 cells), ambient temperature, and temperature of the PCB board in real-time via NTC, BMS provides high/low-temperature warnings and protections. Our battery has integrated heating pads that activate at low temperatures in the presence of charging power.

5.3. Charging/discharging current detection

With the current sense resistors in the charging/discharging circuit, BMS detects and monitors the input and output current in real-time, and provides over-current warnings and protections.

5.4. Short circuit protection

BMS features a short-circuit detecting and protecting function. The battery also has an in-built 180A fuse.

5.5. Pack capacity and cycle life calculation

BMS calculates the remaining capacity in real-time. The BMS gets the capacity the first time when the battery pack completes a full charging and discharging cycle. BMS counts the number of charging/discharging cycles a battery has experienced. When the accumulated discharge capacity is equal to 80% of the design capacity, the cycle count increases.

5.6. Charging/discharging MOSFET

Low impedance, high current MOSFET is the optimized design for the power-on, zero handoffs, and charging voltage withstanding for large capacitive loads backup power supply. When in charging or standby status, each cell can be equalized. Balancing will greatly increase the battery life span and cycle life.

5.7. Hibernation mode

Automatic hibernation: If the battery has not been charged/discharged for 48 hours. The BMS will enter hibernation mode automatically to minimize the power consumption of the BMS.

5.8. Power on/off with a primary pack

If the DIP address is set correctly, powering on/off the primary battery pack, the secondary battery packs will be powered on/off together with the primary battery pack. If any of the packs have different voltages, and there's current output between the paralleled packs, the connected secondary battery packs cannot be powered off.

5.9. Battery information storage

Each time the battery system changes status, BMS will save the information data, which includes warnings, protection triggering, and release. The data can be read and saved as an Excel file through the PC.

5.10. Precharge

The pre-charge/soft start function protects the capacitors in your inverter(s). Without this function, the high current capabilities of the battery could damage the capacitors or circuits in your inverter. The inrush current could damage the capacitors, wires, or circuit traces leading to the capacitors. The pre-charge function limits the amount of inrush current to your inverter.

This function is automatically enabled every time the battery starts supplying current. Pre-charge sends limited power to the inverter for a few seconds to gradually charge the capacitors. The default pre-charge time is 3000ms (3 seconds), which is sufficient for most situations.

Pre-charging is important, as the capacitors in the inverter may discharge when the inverter is idle for a period of time.

6. Interface

6.1. Front panel buttons and connectors



ON/OFF

ON/OFF is used to turn the device on or off. To turn on the device, push the button and it lights on. When the device is turned on, it will begin functioning according to its default settings. To turn the device off, press the button, and the device powers down.

CAPACITY

SOC(State of Charge) light: 4 green LED lights to show the capacity status of the battery pack. Each LED represents 25% of the capacity.

ALM

The alarm light indicates the status of the battery through a flashing red LED. A red light will also appear if the battery is in protection mode due to abnormal temperature, over-current, or short-circuit.

RUN

Working light: green LED to show the battery working status.

ADS

The ADS DIP switch is used to configure the battery address for identification and to enable communication between batteries, as well as between the battery and inverter. In the case of a single battery module, all switches should be in the down position. In case of connecting multiple packs refer to point 3.5.2 in this manual.

CAN/RS485

This port is used to transmit battery pack information to the inverter. It is used both for CAN and RS485 protocols(please refer to the correct pinout in this manual). **Do not connect regular internet cables to this port to avoid damage!**

485A & 485B

These ports are used to transmit battery pack information between parallel packs. The RS485A port is also used to connect to PC via a dedicated Thunor USB adapter. Do not connect regular internet cables or third-party USB adapters to this port to avoid irreversible damage!

RESET

A reset button is used to restore factory settings.

P- & P+

The battery pack features two pairs of power terminals with identical functions. One set of terminals is connected to the equipment, while the other set can be used to connect to additional battery packs for increased capacity. In the case of a single pack, both terminals can be used for charging and discharging.

The power cable is equipped with an 8.0 mm silver plated power plug with a lock button and is capable of a full rotation.

6.2. LED indicators







There are 6 LED indicators. 4 green LED indicators for SOC(state of charge) status. 1 red LED indicator(ALM) for warning, protection, and fault indicating. And 1 green LED (RUN) for battery standby, charging, and discharging status.

SOC (state of charge) Status LEDs

Status	Charge				Discharge			
	●	●	●	●	●	●	●	●
SOC indicator	●	●	●	●	●	●	●	●
0-25%	OFF	OFF	OFF	Blink	OFF	OFF	OFF	ON
25%-50%	OFF	OFF	Blink	ON	OFF	OFF	ON	ON

50%-75%	OFF	Blink	ON	ON	OFF	ON	ON	ON
>75%	Blink	ON	ON	ON	ON	ON	ON	ON
Operating indicator	ON				Blink			

System mode indicator:

Battery status	Operating Mode	RUN	ALM	SOC				Remark
								
Power off	Power save	OFF	OFF	OFF	OFF	OFF	OFF	Hibernation
Standby	Normal	Varies	OFF	OFF	OFF	OFF	OFF	Standby mode
Charge Mode	Normal	ON	OFF	According to battery SOC status				
	Overcurrent warnings	ON	Blink type 2	According to battery SOC status				
	Over voltage protection	Blink type 1	OFF	OFF	OFF	OFF	OFF	Termination of charging
	Temperature, overcurrent protection	Blink type 1	Blink type 1	OFF	OFF	OFF	OFF	Termination of charging
Discharge Mode	Normal	Blink type 3	OFF	According to battery SOC status				
	Warning	Blink type 3	Blink type 3	According to battery SOC status				
	Overcurrent, temperature, short-circuit protection	OFF	ON	OFF	OFF	OFF	OFF	Termination of discharge
	Under voltage protection	OFF	OFF	OFF	OFF	OFF	OFF	Termination of discharge

LED Blink types:

Blink Type	LED light ON time in seconds	LED light OFF time 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 gives the user access to battery status information.

Main screen:

PackV: Pack total voltage

Current: Current in and current out

SOC: The remaining capacity percentage

Warn: presence of warnings or protection triggers

LCD Buttons:

Confirm - Select

Exit - Back to last

Up - Go up

Down - Go down

On the menu page, press the 'Up' and 'Down' buttons to choose the sub-menus. The one with the blinking number is selected. Press 'Confirm' to enter the sub-menu.

Press the 'Exit' button to go back to the main menu or home page.

Press any button to light up the LCD Screen when at standby status.

There are four Sub-menus:

CellV: Individual cell voltage monitoring

Temperature: Temperature monitoring

Warn: Warning status monitoring

Capacity: Capacity monitoring

Warning status sub-menu explanation:

OV-Warn: High voltage warning

OV-Prot: Over voltage protection

UV-Warn: Low voltage warning

UV-Prot: Under voltage 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: Remaining capacity warning

OFF-USE: Cell failure protection

SCP: Short-circuit protection

7. Inverter

7.1. Inverter requirements

Inverters are an essential component of a low voltage energy storage system. They are responsible for converting the direct current (DC) output of the battery into alternating current (AC) that can be used to power electrical equipment.

When selecting an inverter for your low-voltage energy storage system, it is important to consider a few parameters. The discharge cut-off voltage of the inverter is an important factor to keep in mind. For TH-48-LV280-1.0, the discharge cut-off voltage is 43.2V. This means that when the battery voltage drops below 43.2V, the BMS will automatically shut off to prevent damage to the battery.

The charge voltage of the inverter is also an important parameter to consider. For this system, the charge voltage is 57.6V. This means that the inverter will charge the battery until it reaches a voltage of 57.6V, but BMS may terminate charging at a lower voltage if it detects any of the individual cells reaching 3.65V. The charge voltage can be set as low as 55V, but the full capacity will be lower as a result and battery cells may drift out of balance over time.

It is important to ensure that the charging and discharging current of the inverter can be limited to 140A or less. For optimal performance, the inverter should be capable of continuous charging and discharging up to 140A without causing any damage to the battery.

When selecting an inverter for your TH-48-LV280-1.0, be sure to choose one that is compatible with the system's voltage and can handle the expected load. Additionally, make sure that the inverter is set up properly to ensure safe and efficient operation of the system.

Our product is designed to be compatible with various brands of inverters. Please refer to our webpage at www.thunor.eu for recommended models.

7.2. Inverter settings

If the inverter does not support CAN or RS485 communication, the battery information must be manually adjusted using the following parameters before connecting the battery system.

Charging Settings:

Parameter	Setting
Battery Type	Lithium
Charge curve	Fixed
Absorption voltage	57.6V
Float voltage	55
Absorption time	1Hr

Additional Inverter Settings:

Parameter	Setting
DC input low shut-down	47V
DC input low restart	48V
DC input low pre-alarm	48V

8. Monitoring Software

The BATTERY MONITOR software enables remote monitoring of the battery pack. This software provides real-time information on the battery voltage, cell voltage (both individual and overall), SOC status, cell temperature, and voltage differentials. Historical records of the battery's status can be accessed through the software.

To connect the system to the primary computer, insert the Thunor USB-RS485 adapter cable to port 485A and configure the correct USB COM port in PC Device Manager to Baud rate 19200.

NOTE: Please be aware that inserting internet cable or aftermarket adapter may result in irreversible damage to BMS communication port!

NOTE: Download the software installation file at Google drive with this link:

<https://drive.google.com/drive/folders/10pxgNLHovcDZRVGrCZsSkfecBrRw-AdW?usp=sharing>

9. Maintenance

This product is designed to be low-maintenance and easy to use. However, like any other electrical equipment, it requires periodic inspections and maintenance to ensure optimal performance and safety. Here are some general maintenance guidelines for this product:

- Keep the battery terminals clean and free from dust, dirt, and debris. Use a dry cloth to clean the product.
- Twice a year, check the battery voltage and capacity utilizing a battery management system (BMS).
- Inspect the battery and the surrounding components for a sign of physical damage, such as cracks, dents, or leaks. If any damage is detected, stop using the energy storage system and contact a local recycling company for disposal.
- Verify that the battery modules are connected properly and securely. Check for loose or corroded connections and replace them if necessary.
- If the energy storage system is not used for an extended period of time, charge the battery to at least 50% of its capacity and store it in a cool and dry place.

In addition to the general maintenance guidelines, here are some maintenance tasks for the battery:

- Balance the battery cells regularly using a BMS. Balancing ensures that all the cells are charged and discharged evenly, which can improve the battery performance and extend its lifespan. Passive balancing occurs between individual cell voltages of 3.4-3.65V (54-57,6V at Battery pack level) and is more effective at 10A charge current. If charging voltage is set to 55V or less, battery cells may drift out of balance.
- Cycle the battery at least once every three months if it is not used for an extended period of time. This can help maintain the battery's capacity and prevent over-discharge.

By following these maintenance guidelines, you can help ensure that the energy storage system is operating safely and efficiently, and that it provides reliable backup power and energy independence for your home and business.

10. General Information and Legal disclaimers

This product has a 10-years or 6000 cycles (whichever comes first) limited warranty. Thunor Solutions OÜ warrants that this product is free from defects in materials and workmanship for a period of then years from the date of original purchase.

To claim a warranty, the customer must present the original receipt of purchase and return the product to the point of purchase. This limited warranty is only applicable to the original purchaser of the product and is not transferable.

This limited warranty does not cover damage, deterioration, or malfunction resulting from any alteration, modification (including unauthorized modifications to the software), improper or unreasonable use, misuse, neglect, exposure to excess moisture, fire, improper packing, lightning, power surges, oxidative environment or other acts of nature. This limited warranty also does not cover damage, deterioration, or malfunction resulting from any repairs attempted by anyone unauthorized by Thunor Solutions OÜ to make such repairs.

Non-compliance with the instructions provided in this manual will render the warranty void. Thunor Solutions OÜ shall not be held liable for any consequential damages arising from the use or transportation of this product.

In the event of a valid claim under this limited warranty, Thunor Solutions OÜ will, at its sole discretion, repair or replace the product. The repaired or replaced product shall be warranted for the remainder of the original warranty period.

This document is subject to change without notice.

Thunor Solutions OÜ

www.thunor.eu

Email: info@thunor.eu

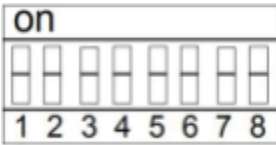
Appendix

Appendix 1. RS485 DIP address setup demonstration

Single pack: No need to set the DIP address

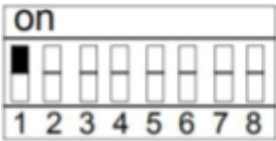
A switch in the down position is considered OFF, while a switch in the up position is considered ON.

The first 4 DIP switches(#1, #2, #3, #4) are reserved for identifying the secondary batteries. The remaining 4 DIP switches (#5, #6, #7, #8) are used on the primary battery to specify the number of secondary batteries to be connected.

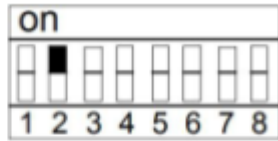


Multiple TH-48-LV280-1.0 packs in parallel(applicable to the secondary packs):

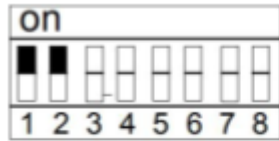
1



2



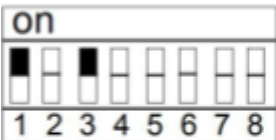
3



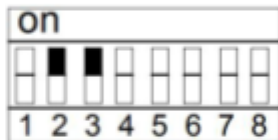
4



5



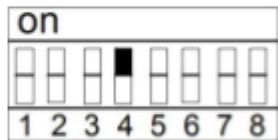
6



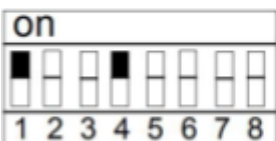
7



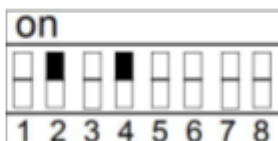
8



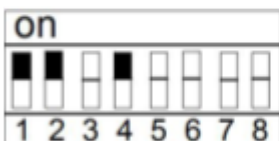
9



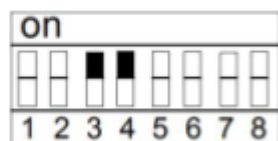
10



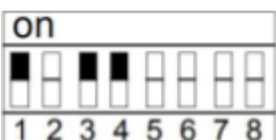
11



12



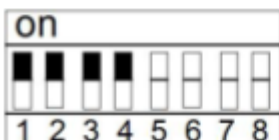
13



14

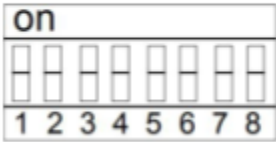


15



DIP address setup demonstration

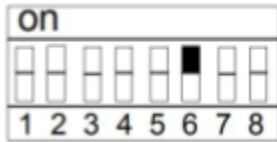
1 Pack



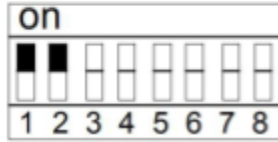
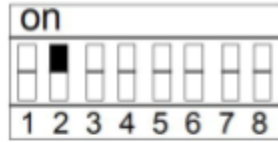
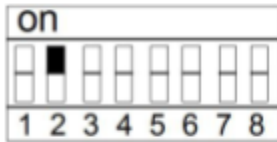
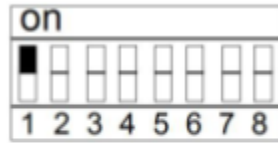
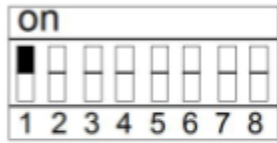
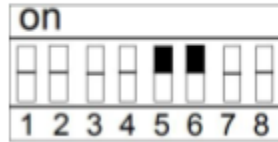
2 in Parallel



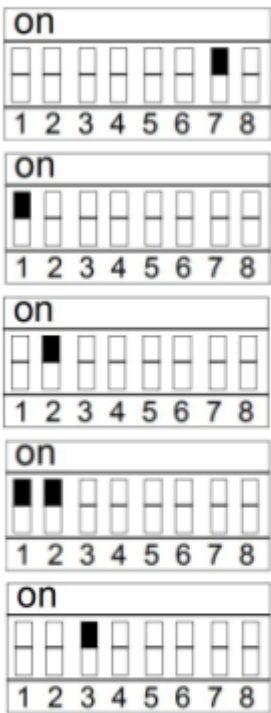
3 in Parallel



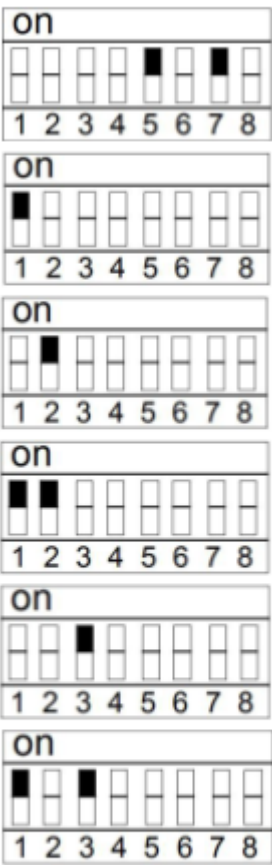
4 in Parallel



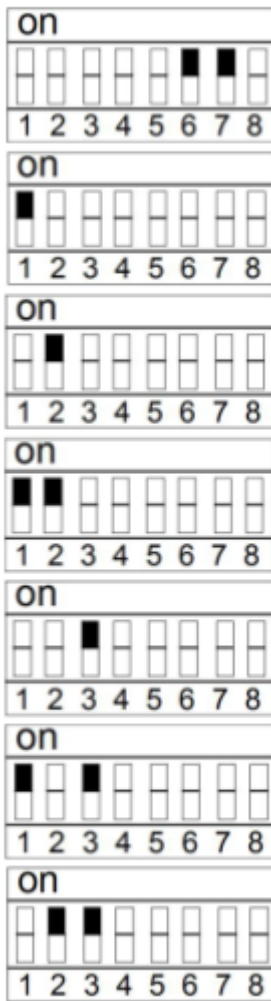
5 in Parallel



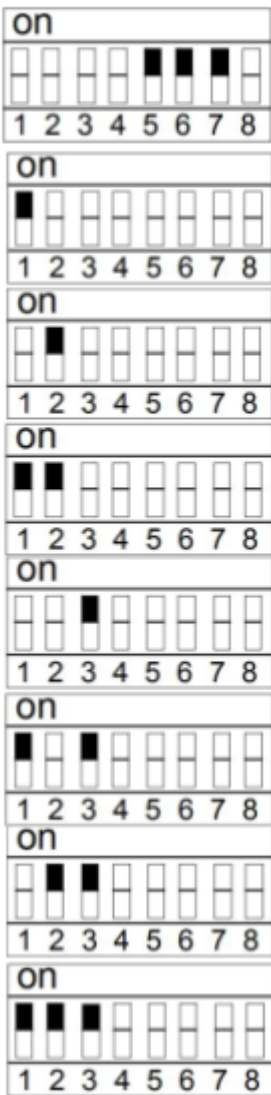
6 in Parallel



7 in Parallel



8 in Parallel



9 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
---	---	---	---	---	---	---	---

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

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
---	---	---	---	---	---	---	---

11 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
---	---	---	---	---	---	---	---

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
---	---	---	---	---	---	---	---

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
---	---	---	---	---	---	---	---

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
---	---	---	---	---	---	---	---

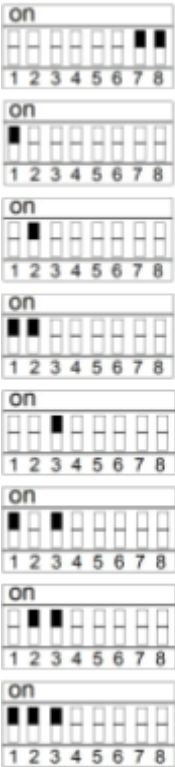
on

1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---

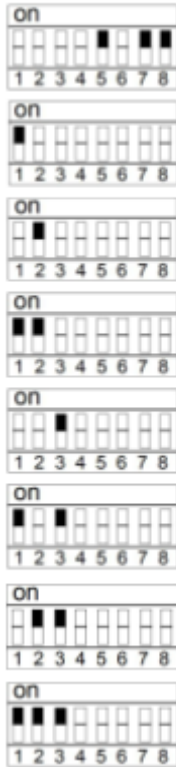
on

1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---

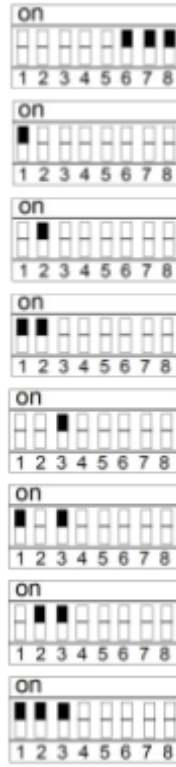
13 in Parallel



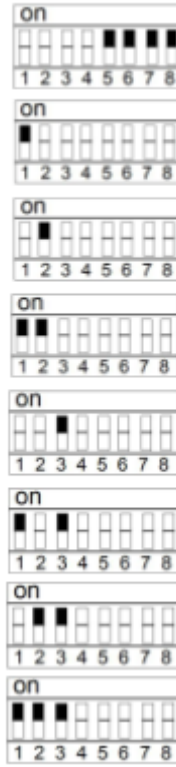
14 in Parallel



15 in Parallel



16 in Parallel



on

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8

on

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8

on

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8

on

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8

on

<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8

on

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8

on

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8

on

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8

on

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8

on

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8

on

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5	6	7	8