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|  <b>绿沃</b><br>LVWO ENERGY       | <b>Specification</b> | Versions                 | A0                         |
|                                                                                                                 |                      | Date                     | 27/09/2024                 |
|                                                                                                                 |                      | DOC No:                  | LW-YJY-CN2024071103-14-WXX |
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| Tel:+86-0564-8030526                                                                                            | Post Code:231300     | Web: www.lvwo-energy.com |                            |

NO. : LW-YJY-CN2024071103-14-WXX

**Product Development Agreement**

**24V7.5Ah Power Battery System**

**A0 Version**

| Prepared By | Checked By | Approved By |
|-------------|------------|-------------|
|             |            |             |

|                              |                                                    |
|------------------------------|----------------------------------------------------|
| <b>Customer<br/>Approved</b> | <b>Signature:</b>                                  |
|                              | <b>Date:</b>                                       |
|                              | <b>Company Name:</b><br><b>( Company Stamp ) :</b> |

## Specification

## Versions

A0

Date \_\_\_\_\_

27/09/2024

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**Anhui Lvwo Energy Technology Co, Ltd.**

**Contract NO.:**

**LW-YJY-CN2024071103-14-WXX**

## Description of changes to technical documents

**Changes to successive versions of this document are set out below:**

[illegible]

|                                                                                                                                |                  |                                                                   |                            |
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## I. Battery system design reference technical document

GB 2894 Safety Signs (neq ISO 3864: 1984)

GB 16179 Guidelines for the Use of Safety Signs

GB 8897.4-2008 Primary Batteries (Part 4) Safety Requirements for Lithium Batteries

GB 21966-2008 Safety Requirements for Lithium Primary Cells and Batteries in Transportation

GJB 4477-2002 General Specification for Lithium-ion Battery Packs

## II. Supply list

| NO. | Name             | Unit | Quantity | Notes |
|-----|------------------|------|----------|-------|
| 1   | 24V7.5Ah battery | pcs  | 1        |       |
| 2   |                  | pcs  |          |       |
| 3   |                  | pcs  |          |       |

## III. Battery system usage requirements

1. Battery system operating external ambient temperature requirements: charging and discharging: charging  $0^{\circ}\text{C} \sim 45^{\circ}\text{C}$ , discharging  $-40^{\circ}\text{C} \sim 60^{\circ}\text{C}$ ;
2. The working external environment humidity requirements of battery system:  $65 \pm 20\% \text{RH}$
3. Battery system operation state tries to maintain more than 30% SOC;
4. When the battery system is not in use for a short period of time, it is required to maintain more than 60% SOC and be stored in a dry, clean and well-ventilated warehouse at  $5^{\circ}\text{C} \sim 45^{\circ}\text{C}$ .
5. During the loading process of the battery pack, it is required to carry and put it gently, and strictly prevent it from falling, rolling and impacting;
6. The battery pack shall not be placed upside down or lying down in the storage state; it is strictly prohibited to expose the battery pack to sunlight, rain or water for a long time;
7. Ensure that the battery system in the operation or storage state is away from flammable and explosive substances and high temperature environment;
8. It is strictly prohibited to force the battery system to operate under the state of short circuit, overcharge and high temperature alarm;

|                                                                                                                 |                  |                          |                            |
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9. Strictly prohibit customers from disassembling the battery system without permission;

## IV. Battery parameters

### 4.1. Testing conditions

If there is no special requirement, the experiment should be carried out in the environment of temperature:  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , relative humidity:  $65 \pm 20\%$  RH, atmospheric pressure:  $86\text{kPa} \sim 106\text{kPa}$ .

### 4.2. Basic performance

| Cell Parameter           |                               |                                                                                                                 |                                  |
|--------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------------------|
| NO.                      | Item                          | Parameter                                                                                                       | Notes                            |
| 1                        | Battery type                  | Lithium Titanate Battery                                                                                        |                                  |
| 2                        | Rated voltage/capacity        | 2.4V/1.5Ah (18650)                                                                                              |                                  |
| 3                        | Cell voltage range            | 1.5V-2.8V                                                                                                       |                                  |
| 4                        | Cell weight                   | $\approx 43\text{g}$                                                                                            |                                  |
| 5                        | Dimension                     | Height: $64.8 \pm 0.2\text{mm}$<br>Diameter: $18.2 \pm 0.2\text{mm}$                                            |                                  |
| 6                        | Operating temperature         | Charging: $0^{\circ}\text{C} - 45^{\circ}\text{C}$ ;<br>Discharging: $-40^{\circ}\text{C} - 60^{\circ}\text{C}$ |                                  |
| 7                        | Charging retention capability |                                                                                                                 | ( $25^{\circ}\text{C}$ , 28days) |
| 8                        | Cycle times                   | $0.5\text{C} \geq 4000\text{cycle}$                                                                             |                                  |
| Battery System Parameter |                               |                                                                                                                 |                                  |
| 1                        | Rated voltage                 | 24V                                                                                                             | 10S 5P                           |
| 2                        | Pack voltage range            | 15-28V                                                                                                          | Per cell<br>1.5V-2.8V            |
| 3                        | Rated capacity                | 7.5Ah                                                                                                           |                                  |
| 4                        | Total energy                  | 180Wh                                                                                                           |                                  |
| 5                        | SOC range                     | 10%-100%                                                                                                        |                                  |
| 6                        | Charging and                  | $\geq 96\%$                                                                                                     |                                  |

|                                                                                                                 |                  |                          |                            |
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|    |                                         |                                            |                            |
|----|-----------------------------------------|--------------------------------------------|----------------------------|
|    | discharging efficiency                  |                                            |                            |
| 7  | Standard charging current (A)           | 4A                                         | Recommended 0.5C and below |
| 8  | Standard discharging current (A)        | 15A                                        | Recommended 0.5C and below |
| 9  | Total weight                            | 2.5kg(Estimation)                          |                            |
| 10 | Ambient relative humidity               | 10%-90%                                    |                            |
| 11 | Shell material                          | Epoxy board film                           |                            |
| 12 | Series-parallel system                  | 10S 5P in one PACK                         |                            |
| 13 | Operating temp. of battery system       | Charging: 0℃~45℃,<br>Discharging: -40℃~60℃ |                            |
| 14 | Product dimension (mm)                  | 181*127*71mm<br>(L*W*H) ±2mm               |                            |
| 15 | Input and output method                 | FASTIN-FASTON250                           | FASTIN-FASTON<br>178       |
| 16 | Whether to configure Bluetooth function | NO                                         |                            |

### 4.3. Environmental characteristics

(Charging according to the standards, and after full charge, let stand for 0.5h to do the following tests.)

| Ambient Temp. | Discharging current | Battery capacity requirements |
|---------------|---------------------|-------------------------------|
|               |                     |                               |

|                                                                                                                 |                      |                          |                            |
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|      |        |                                                                                                                                                   |
|------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 65℃  | 0.5I1A | The measured discharging capacity of the battery pack is not less than 98% of the nominal capacity, and the appearance is not deformed or burst.  |
| 25℃  | 0.5I1A | The measured discharging capacity of the battery pack is not less than 100% of the nominal capacity, and the appearance is not deformed or burst. |
| -20℃ | 0.5I1A | The measured discharging capacity of the battery pack is not less than 92% of the nominal capacity, and the appearance is not deformed or burst.  |
| -40℃ | 0.5I1A | The measured discharging capacity of the battery pack is not less than 76% of the nominal capacity, and the appearance is not deformed or burst.  |

#### 4.4. Safety characteristics

| Items                  | Specification                          | Notes                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Insulation electricity | $\geq 10\text{M}\Omega$                | With insulation resistance tester DC 500V test voltage, the battery positive and negative terminal interface (terminal) are tested on the battery pack metal shell, insulation resistance value $\geq 10\text{M}\Omega$ .                                                                                                                                                                                          |
| Insulation strength    | No breakdown and no flaring phenomenon | Battery positive and negative terminal interface respectively on the battery pack metal casing can withstand 50Hz, RMS 500V AC voltage (leakage current $\leq 10\text{mA}$ ) or 710V DC voltage for 1min. And there should be no breakdown, no flaring phenomenon.                                                                                                                                                 |
| Anti-soaking           | No leakage, smoke, fire or explosion   | The fully charged battery pack should be immersed in 3.5% NaCl solution, the water depth should be completely less than the battery pack, and the water depth should be kept for 2h. After taking out, the battery pack should be placed at the ambient temperature of $15^{\circ}\text{C} \sim 35^{\circ}\text{C}$ , relative humidity of 25% $\sim$ 85%, and atmospheric pressure of 86kPa $\sim$ 106kPa for 4h. |

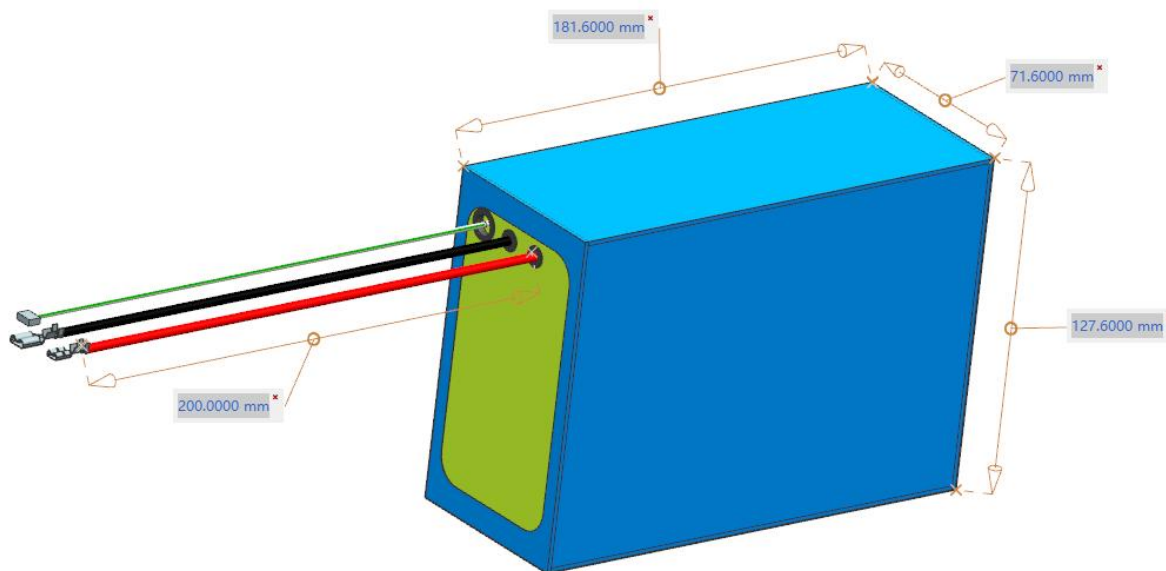
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|                       |                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Drop resistant        | No obvious damage, no leakage, shell rupture, fire or explosion, and the battery pack and each position have no displacement when shaking up and down. | When the battery pack is fully charged, choose any 6 angles, and drop to the cement floor once from the highest height set (0.8m ~ 1.8m).                                                                                                                                                                                                                                                                                                                                                                                                     |
| Constant humidity     | No obvious deformation, rust, smoke or explosion, its capacity should not be less than 90% of the measured base capacity.                              | Once the battery pack is fully charged and equipped with a Battery Management System (BMS), it is placed in a constant temperature and humidity chamber at 60°C ±2°C with a relative humidity of 90% to 95% for 12 hours. Subsequently, it is removed and allowed to stand for 2 hours at an ambient temperature of 25°C ±2°C for visual inspection before discharging with a current of 1.0I1A to the cut-off voltage.                                                                                                                       |
| Vibration measurement | No explosion, no fire, no deformation, no parts falling off, no abnormal voltage, no sharp discharge current.                                          | After fully charging the battery pack, it is securely fixed on a vibration table in the horizontal plane. The battery pack is then subjected to vibrations with an amplitude of 5mm and a maximum stroke of 10mm, with vibration frequencies ranging from 10Hz to 55Hz. Vibration tests are conducted in the x, y, and z directions of the battery pack, with each direction undergoing frequency-sweep testing between 10Hz and 55Hz for a duration of 90 minutes ± 5 minutes. After the completion of the test, it is left idle for 1 hour. |



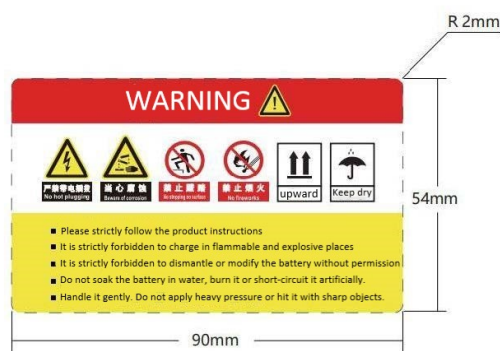
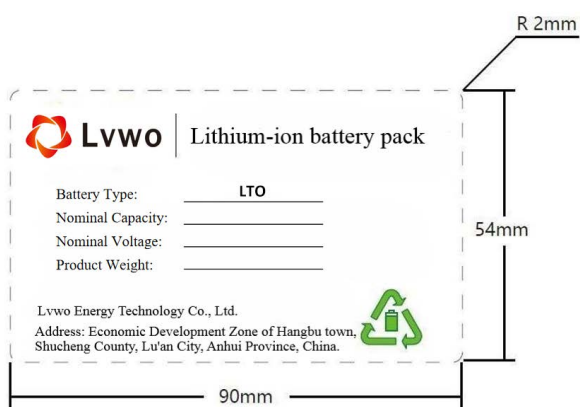
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## V. Schematic diagram of product external dimension



External dimension

## VI. Caution label and nameplate

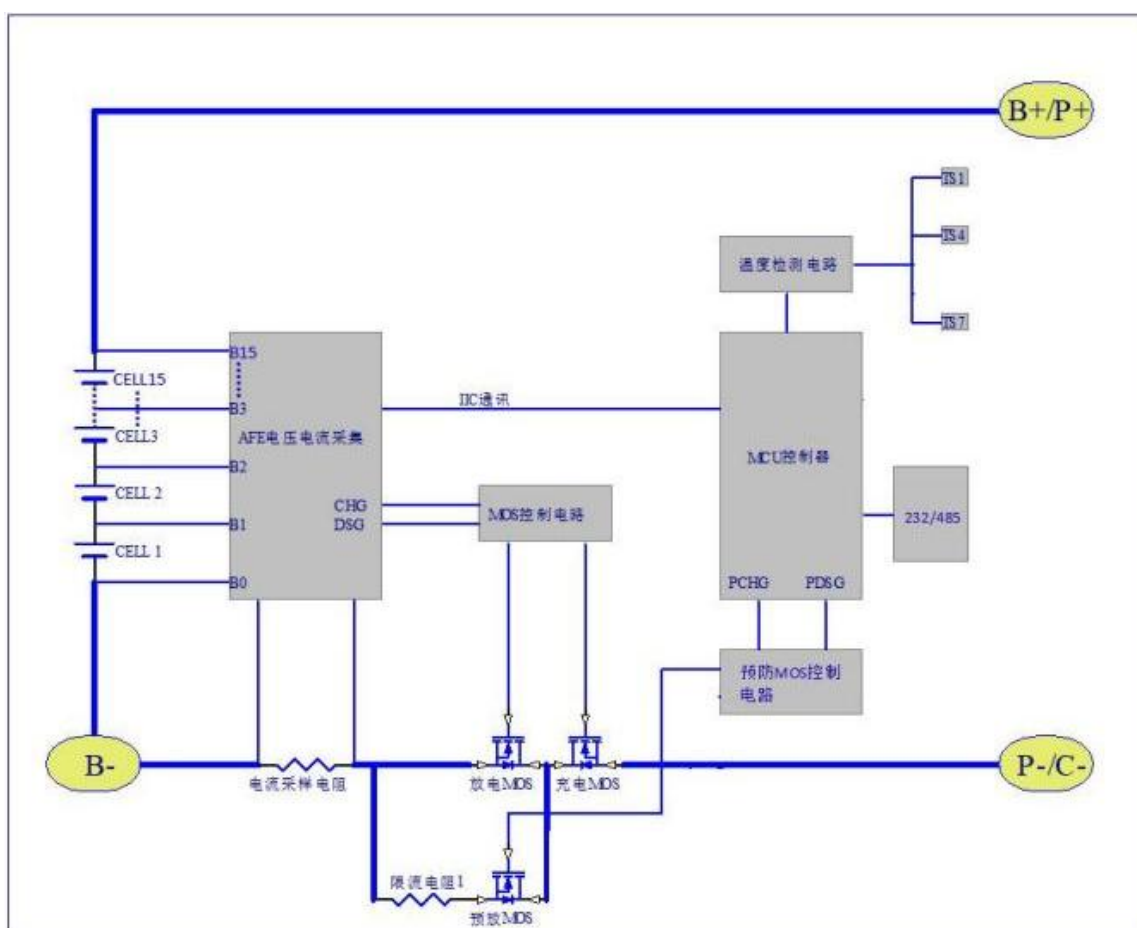
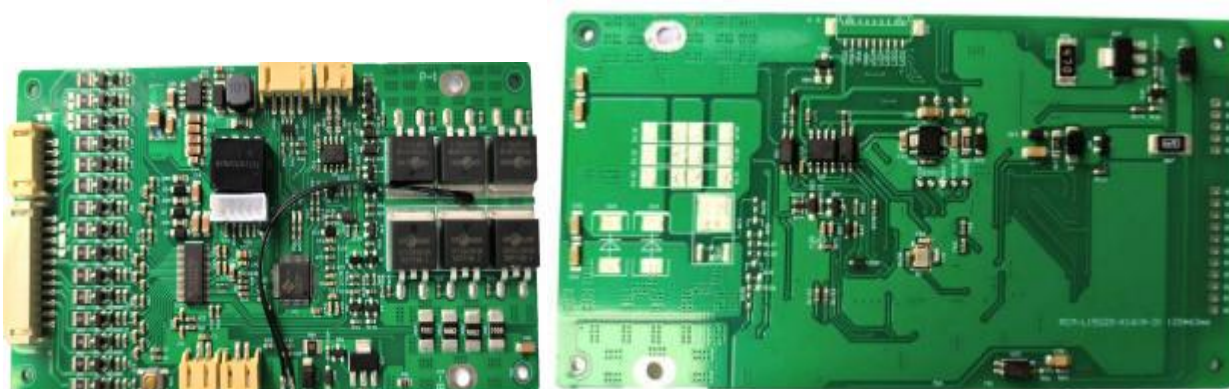


Nameplate

|                                                                                                                                 |                  |                                                                   |                            |
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## VII. Specifications and parameters of BMS

### 7.1. Physical and wiring diagram of BMS



|                                                                                                                 |                  |                          |                            |
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## 7.2. Electrical parameter

| Function            | Test item                       | Parameter                              | Precision | Unit |
|---------------------|---------------------------------|----------------------------------------|-----------|------|
| Charging voltage    | Rated charging voltage          | 28 V                                   | ±0.25     | (V)  |
| Continuous current  | Max. Charging                   | 15A                                    | Settable  | (A)  |
|                     | Max. Discharging current        | 15A                                    | Settable  | (A)  |
| Charging protection | Over charge protection voltage  | 2800                                   | ±25       | (mV) |
|                     | Over charge protection delay    | 1000                                   | ±500      | (mS) |
|                     | Over charge protection recovery | 2700                                   | ±50       | (mV) |
|                     | Over charge protection recovery | Each battery's voltage falls below the |           |      |
|                     | Charging over current           | 20                                     | ±0.05     | (A)  |
|                     | Charging over current delay     | 5000                                   | ±500      | (mS) |

|                                                                                                                 |                  |                          |                            |
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|                           |                                               |                                                  |        |      |
|---------------------------|-----------------------------------------------|--------------------------------------------------|--------|------|
|                           | Charging over<br>current release<br>condition | Disconnecting the charger                        |        |      |
| Equalization              | Equalizing turn-on<br>voltage                 | -                                                | -      | (mV) |
|                           | Equalizing current                            | -                                                | -      | (mA) |
|                           | Equalizing method                             | -                                                |        |      |
| Discharging<br>protection | Over discharge<br>protection voltage          | 1800                                             | ±80    | (mV) |
|                           | Over discharge<br>protection delay            | 1000                                             | ±500   | (mS) |
|                           | Over discharge<br>protection recovery         | 2000                                             | ±100   | (mV) |
|                           | Over discharge<br>recovery condition          | Disconnecting the load or plug in<br>the charger |        |      |
|                           | Discharging over<br>current protection        | 20                                               | ±100mA | (A)  |
|                           | Discharging over<br>current protection        | 5000                                             | ±100   | (mS) |
|                           | Short circuit                                 | YES                                              |        | (A)  |

|                                                                                                                 |                  |                                                      |                                               |          |                            |  |
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|                                                                                                                 |                  | Short-circuit protection delay                       | 400                                           | \        | (uS)                       |  |
|                                                                                                                 |                  | Over current/short circuit protection delay recovery | Disconnecting the load or plug in the charger |          |                            |  |
|                                                                                                                 | Temp. protection | Charging high temp. protection                       | 65                                            | ±3       | (°C)                       |  |
|                                                                                                                 |                  | Charging high temp. protection recovery              | 40                                            | ±3       | (°C)                       |  |
|                                                                                                                 |                  | Charging low temp. protection                        | -30                                           | ±3       | (°C)                       |  |
|                                                                                                                 |                  | Charging low temp. protection recovery               | -20                                           | ±3       | (°C)                       |  |
|                                                                                                                 |                  | Discharging high temp. protection                    | 65                                            | ±3       | (°C)                       |  |
|                                                                                                                 |                  | Discharging high temp. protection                    | 50                                            | ±3       | (°C)                       |  |
|                                                                                                                 |                  | Discharging low temp. protection                     | -30                                           | ±3       | (°C)                       |  |
|                                                                                                                 |                  | Discharging low temp. protection                     | -20                                           | ±3       | (°C)                       |  |

|                                                                                                                                 |                      |                                         |           |                            |      |  |
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|                                                                                                                                 | Self-consuming power | Cell self-consuming power               | 30        | $\leq 50$                  | (uA) |  |
|                                                                                                                                 | Internal resistance  | Internal resistance of charge/discharge | 5         | $\leq 30$                  | (mΩ) |  |
|                                                                                                                                 | Dimension            | L*W*H                                   | 120*63*10 |                            | (mm) |  |

## VIII. Charger

1. Specialized Charger for Lithium Titanate Battery
2. Max. Input Voltage  $\leq 28$  (CC/CV)
3. Max. Continuous Output Current  $\leq 15A$

**Notes:** To prevent overcharging due to charger or BMS failure, the charger shall cut off first at the end of charging.

## IX. Conditions of use

### 9.1. Packaging

9.1.1. Method: ☐ Neutral carton (Domestic) ☐ UN carton (Export) ☐ Wood pallet (Bulk container export).

9.1.2. Each battery pack should have outer packaging and should be accompanied by a product manual and a certificate of conformity. The packaged product should be placed in a dry, dust-free, and moisture-proof packaging box. The outer packaging of dangerous goods should indicate the product name, model, voltage, capacity, quantity, gross/net weight, logo, battery serial number, etc. Neutral packaging does not include the above content. There

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should be necessary signs such as “Handle with care,” “Keep dry,” “This side up,” “Keep away from fire,” and so on.

9.1.3. Shipping documents: Shipping inspection report, product manual, host computer software, communication protocol (electronic file), etc.

9.1.4. Shock and pressure prevention measures: Fill shock-absorbing materials on both external sides (top and bottom) of the battery module.

9.1.5. Waterproofing, anti-scattering, handling: Battery module in nylon bag, tightened with strapping, pallet.

## 9.2. Transportation

Battery packs should be packaged in boxes for transportation, ensuring protection against severe vibrations, impacts, or compression. They should be shielded from exposure to sunlight and rain, and can be transported using vehicles such as cars, trains, ships, or airplanes.

## 9.3. Storage

9.3.1. Battery packs are typically stored at a state of charge of 20%-40% in a clean, dry, well-ventilated indoor area with an environment temperature of -5°C to 35°C and a relative humidity not exceeding 75%. The packs should be placed flat with a minimum distance of 100mm from the ground.

9.3.2. Batteries should not be stored together with reactive chemicals or dusty items.

9.3.3. Batteries should not be subjected to any mechanical impact or heavy pressure.

9.3.4. Batteries should be kept away from direct sunlight, heat sources, with a distance from heat sources not less than 2 meters.

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|  <div><div>绿沃</div><div>LVWO ENERGY</div></div> | Specification    | Versions                 | A0                         |
|                                                                                                                                 |                  | Date                     | 27/09/2024                 |
|                                                                                                                                 |                  | DOC No:                  | LW-YJY-CN2024071103-14-WXX |
| Address: Address: Economic Development Zone of Hangbu town, Shucheng County, Lu'an City, Anhui Province, China.                 |                  |                          |                            |
| Tel:+86-0564-8030526                                                                                                            | Post Code:231300 | Web: www.lvwo-energy.com |                            |

9.3.5. Every 3 months from the date of manufacture, a 0.2-0.5C current charge should be applied for 30-60 minutes, at a temperature range of 25°C ± 5°C.

## X. User responsibility letter

Users must follow the instructions on the battery label or the Anhui Lvwo Energy Technology Co., Ltd. battery specification sheet. If improper use by the user leads to damage such as overheating, fire, or explosion in the power system, the company will not be liable.

## XI. Dangerous matters

Failure to carefully read the following items may result in battery leakage, explosions, or fires.

- 11.1. Do not submerge the battery in water or get it wet;
- 11.2. Do not use or store the battery near a heat source (such as fire or heater);
- 11.3. Do not reverse the positive and negative poles;
- 11.4. Do not directly connect the battery to a wall outlet or car cigarette lighter socket;
- 11.5. Do not throw the battery into fire or heat it;
- 11.6. Do not short-circuit the positive and negative poles of the battery with wires or other metal objects, and do not transport or store the battery with necklaces, hairpins, or other metal objects;
- 11.7. Do not strike, throw, or subject the battery to mechanical vibrations;
- 11.8. Do not pierce the battery casing with nails or other sharp objects, and do not hit or step on the battery;
- 11.9. Do not disassemble the battery in any way;
- 11.10. Do not charge the battery in a fire or under extreme heat conditions.



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## XII. Warnings and precautions

- ◆ No unqualified personnel are not allowed to dismantle or repair the battery system.
- ◆ Only use the designated charger for charging the battery system.
- ◆ Do not immerse the power system in water or saltwater. Store the battery in a cool, dry environment when not in use.
- ◆ If the power system emits odors, heats up, changes color or shape during charging or discharging, or shows any abnormalities, stop operation immediately and seek professional assistance.
- ◆ In case of a battery fire, use dry sand or a nitrogen fire extinguisher.
- ◆ Do not dispose of the battery system in fire or heat sources.
- ◆ When installing or using the battery, remove metal jewelry or other metal items, handle the battery carefully, especially when placing it in a metal container.