



# TL-LFP Series Lithium-ion Battery

## OPERATION MANUAL ( V4.0)



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## Part 1 – Safety & Warning

The TL-LFP series LiFePO<sub>4</sub> battery system installation, operation, maintenance should follow important recommendations in this manual:

- The equipment shall be installed by the professional training staff
- Battery maintenance should be carried out by the experienced professionals and aware of the preventive measures on the potential harm of the battery.
- Note: Be care of the risk of electric shock for large current in case of battery short circuit, pay attention to the following points during operation
  - Remove watches, rings or other metal objects
  - Use tools with insulated handles
  - Do not place tools or metal objects on the battery
- Do not direct access to the battery system to the mains grid power outlet
- Do not put the battery system into fire, do not use or storage the battery near to the high temperature source
- Do not use liquid or other objects placed into the battery system.
- Do not open or cut the battery, not to hit, throw or step on the battery
- Using special communication between battery module and power plant to charge battery
- Be sure to subject to charge and discharge parameters setting in this manual
- The output interface of the system is still voltage when grid power cut, avoid electric shock or short circuit when operation
- Please check if the box is damaged. If damaged, please immediately notify the supplier
- If you find leaking liquid or white powder residue on product, prohibit operation.

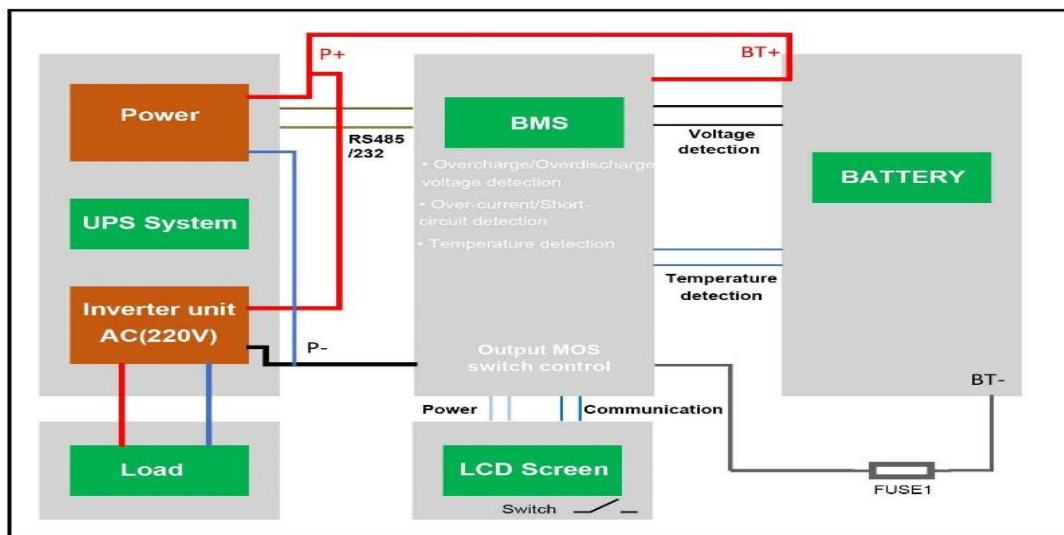
## Part 2 – Product Introduction

### 2.1 – Overview

TL-LFP series lithium ion battery is a series of battery pack with advanced LiFePO<sub>4</sub> technology and intelligent integrated BMS, which has the advantages of long cycle life, light weight, small size, safety and environmental protection. TL-LFP series lithium ion batteries can be used in a variety of indoor and outdoor applications.

### 2.2 – Working Principle

The communication standby power supply consists of several lithium iron phosphate battery units in series with the dedicated high performance and high reliability battery management system (BMS). The +/- output terminal of the battery is connected to the +/- terminal of the rectifier. When the mains supply is normal, the telecommunication equipment is supplied by mains rectified power, and the battery pack is charged by rectified power. When the mains power is interrupted, the backup power supply will be supplied to the telecommunication equipment without delay to ensure that the power supply of the telecommunication equipment is not interrupted until the mains power supply is restored or BMS automatically starts to protect the power failure due to overdischarge protection.



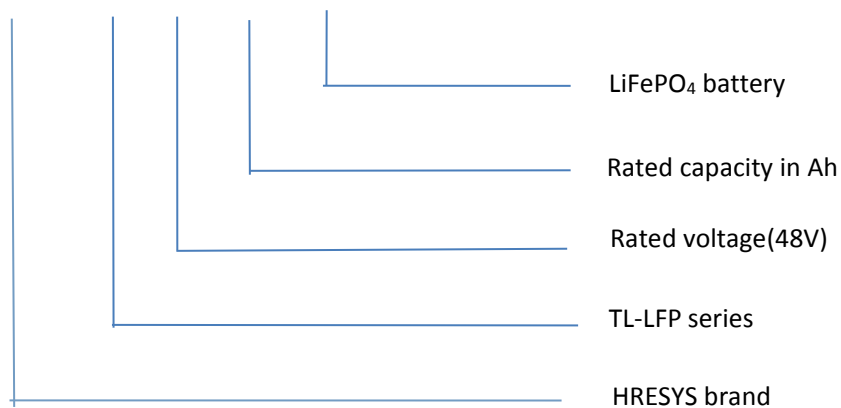
### 2.3– Applications

- Telecommunication
- Terminal of FTTX

- Access network system
- Indoor distribution system
- Integrated outdoor power cabinet
- Internet data center (IDC)
- Energy storage system

## 2.5– Battery Model Name

**VHR TL48xxxLFP**



## Part 4 – Operation & Maintenance

### 4.1 – Requirements for Operation Environment

Table 4.1 – Requirements for Operation Environment

Temperature Range (°C)	Discharge	-20 ~ +60
	Charge	0 ~ +60
	Storage	0~ 40
Recommended Temperature (°C)	Discharge	+15 ~ + 35
	Charge	+15 ~ + 35
	Storage	+15 ~ + 30
Humidity		5% ~ 95%

### 4.2 – Parameter Settings of Power Plant

Lead-acid batteries can be replaced by lithium battery of TL-LFP series if power is matched.

Table 4.2 Parameter settings of power plant for lithium-ion battery.

Table 4.2 – Parameter Settings of Power Plant for TL48V-LFP Series Batteries

No.	Parameters	Units	Defaults
-----	------------	-------	----------

1	Float voltage charge	V	54
2	Equal voltage charge	V	NA or 54
3	Standard charge current	A	0.2C
4	Charge current limitation	A	0.5C ~ 1.0C
5	LVLD (Low voltage load disconnection)	V	>44
6	LVBD (Low voltage battery disconnection)	V	>41
7	Temperature compensation for float charge	-mV/°C	NA
8	Temperature compensation for equalization charge	-mV/°C	NA

NOTE: 1.Equalization charge is requested to switch off for TL-LFP series battery.

2.Rectifier parameter shall be set according to specific site requirement based on battery units used.

3.system instantaneous discharge and charge current shall be less than 250A for each module.

### 4.3 – Charge/Discharge Modes and Conditions

Table 4.3 Charge Modes and Conditions

Cell Temperature	Recommended Charge	Fast Continuous Charge
<0°C	No Charge Allowed	No Charge Allowed
0°C~ 10°C	Charge Current: 0.1C	Charge Current: 0.2C
10°C~20°C	Charge Current: 0.2C	Charge Current: 0.5C
20°C~30°C	Charge Current: 0.3C	Charge Current: 1.0C
30°C~40°C	Charge Current: 0.3C	Charge Current: 1.0C
40°C~60°C	Charge Current: 0.3C	Charge Current:0.5C
>60°C	No Charge Allowed	

Table 4.4 Discharge Modes and Conditions

Cell Temperature	Recommended Discharge	Fast Discharge
< -20°C	No Discharge Allowed	No Discharge Allowed
-20°C~0°C	Discharge Current: 0.2C	Discharge Current: 0.5C
0°C~20°C	Discharge Current: 0.5C	Discharge Current: 1.0C
20°C~50°C	Discharge Current: 0.5C	Discharge Current: 1.0C
50~60°C	Discharge Current: 0.2C	Discharge Current: 0.5C
>60°C	No Discharge Allowed	

#### 4.4 – Layout of Front Panel

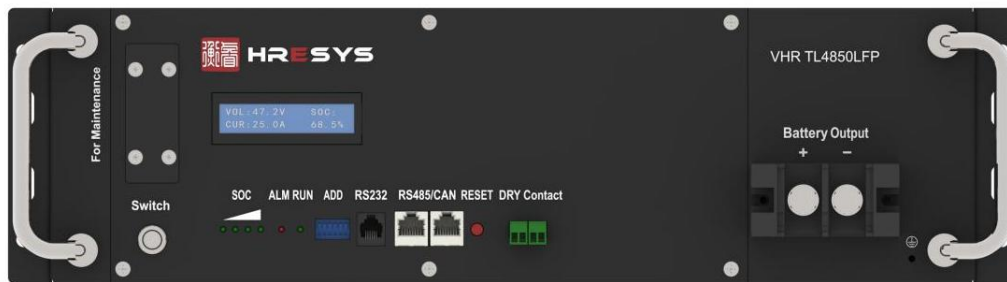


Fig. 4.1 – Layout of Front Panel for TL-LFP Series Batteries

Table 4.5 – Instruction for Layout of Front Panel

No.	Marks	Functions	Detailed Information
1	Power Switch	ON/OFF switch	When turn-off, battery get into sleep mode, and cut-off output, the alarm output also will be stopped.
2	SOC	Indicators for capacity	There are four green LED lights in front panel indicating SOC. SOC is short for state of charge. Each SOC LED light represents 25% of rated capacity. Detailed information is shown in <i>Annexed Table 1.1</i> .
3	ALM	Indicator for alarms	There is one red LED light in front panel indicating alarms. Detailed information is shown in <i>Annexed Table 1.2</i> .
4	RUN	Indicator for running status	There is one green LED light in front panel indicating running status. Detailed information is shown in <i>Annexed Table 1.2</i> .
5	ADD	Address of communication	ADD is applicable to modules connected in parallel. ADD consists of four binary bits, and maximum quantity of batteries connected in parallel is 64pcs (2 <sup>6</sup> ). Detailed information is shown in <i>Annex 2</i> .
6	RS232	Up-link communication port	It is adopting RS-232 series port to upload data. Contents of data transmit include BMS parameters, battery running status, alarms, etc. Generally, speed rate of RS-232 is 1200bps. RS232 up-link communication can be available for the battery module with a binary communication address of 0000 (Master PACK). Protocol for RS232 communication is shown in <i>Annexed Table 3.1</i>
7	RS485	Cascading communication port	It is adopting RS485 series port communication pattern to upload data. Communication of modules connected in parallel (Slave PACKs) is available through RS 485. Data of slave PACKs will be transmitted to Master PACK. Protocol for RS232 communication is shown in <i>Annexed Table 3.2</i>
8	RESET	Reset button	Press RESET button when abnormality occurs to assure stability of battery performance.
9	DRY CONTACT (Optional)	The signal interface	It is usually triggered by alarm or protection
10	Battery Output	Terminals for battery output	Using terminals with two or four cores. Polarities are +, -, +, - from left to right. The two '+' and '-' are equal relatively.
11	For Maintenance	For maintenance	N.A.

12	LCD (Optional)	LCD display	Displays current system total voltage, current and battery status
13	GND	Protective ground	M4 screw

## 4.5 - Shipment

The battery should be packed in cartons under the condition of half capacity 20%-50% for shipment. The violent vibration, impaction or squeezing should be avoided in the transport process; neither is exposed in the sunlight nor rain. The batteries shall be shipped by normal transportation such as by road, by train, by ocean or by air.

## 4.6 – Installation

### Unboxing & Inspection







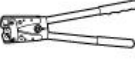

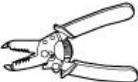





- Please read this manual before installation.
- Please inspect the package before unboxing, if any destroy with appearance, contact with the supplier as soon as possible.
- This device shall be installed and operated by professionals.

### Preparation for Installation

- Batteries shall not be placed in direct sunshine or close to heat source.
- Batteries shall be installed in place with good ventilation to assure enough heat dissipation.
- Batteries shall be placed in are with clean ambient and low humidity.
- Heavy weight shall not be placed on any cable.
- Required tools and materials are available. Use insulated tools. The following figure is for reference only.

Item	Tool Item	Remark for use
1	Insulation gloves	Insulation protection for body
2	Insulation taps	Insulation protection for tools
3	Screw drivers	Fix the cables of the batteries & power plant
4	Multi meter	Measure the module voltage in commission
5	Current meter	Measure the module current in commission
6	USB to rs485 cable	For communication between the batteries and laptop
7	Laptop	Operate the software



 Phillips screwdriver	 Flathead screwdriver	 Adjustable torque wrench	 Heat shrink tubing
 Diagonal plier	 Power cable cutting pliers	 Power cable crimping tool	 Network cable pliers
 Wire clippers	 Clamp meter	 Hot air gun	 Heat shrink tubing
 Protective gloves	 Protective gloves		

## Installation of Battery Modules

### 1) Installation and fixation

Battery modules of TL-LFP series are applicable to installation in 19-inch cabinets and wall-hanging.

- 19inch cabinet installation  
Insert battery module into 19 inch cabinet, and fix two handles of battery module with cabinet rack using 4pcs M6 screws.
- Wall-hanging installation  
Wall-hanging installation also can be adopted, fix two handles of battery module with triangle rack on the wall using 4pcs M6 screws.

### 2) Ground connection

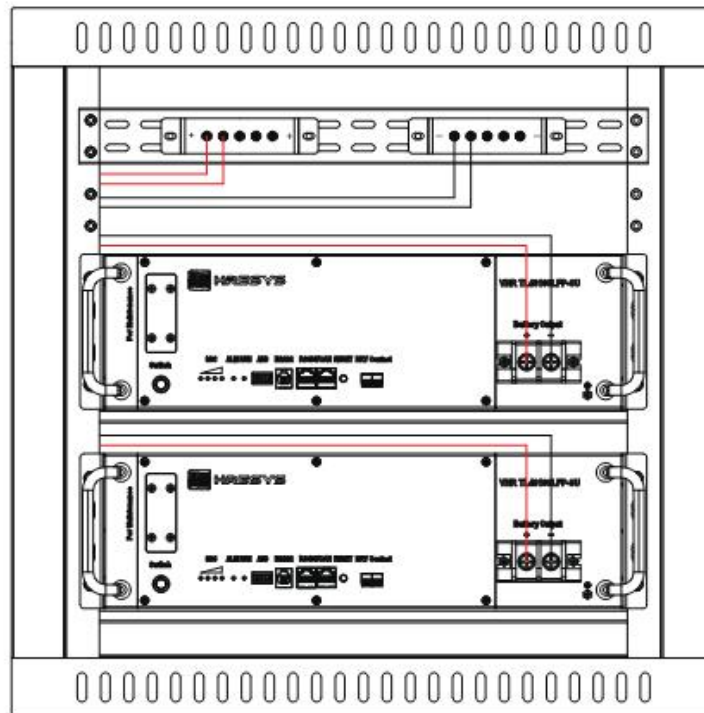
- GND screw in front panel of battery is connected with ground through a flexible cable no less than 6AWG.

### 3) Battery output connection

- Before connect battery power cable, open the circuit breaker of the rectifier which controls the battery circuit and make sure the circuit is disconnected.
- Connect ‘+’ of Battery Output with positive copper bus bar of power plant, and ‘-’ with negative copper bus bar.
- If multi battery modules will be connected in parallel, connect ‘+’ of Battery Output of each battery module with positive copper bus bar of power plant, and ‘-’ with negative

copper bus bar separately.

- Length of cable between battery module and power plant shall be less than 2.0m. To make sure similar voltage drop of cable for each battery, length of all positive and negative cables should be the same.
- Color for cable between '+' and positive female bar is suggested as red, and cable between '-' and negative breaker or fuse as black.



#### 4) Power on for battery module

- When installation is accomplished, firstly turn on the battery switch and the LED indicator will light up, then close the circuit breaker of the rectifier to power on. Once power on for power plant, battery module will go into normal running status, and discharge/charge can be available.
- Parameter settings for lithium battery modules in power plant are shown in Table 4.2.

#### 5) RS232/RS485 connection

- If there is only one battery module in operation, communication between battery module and upper computer can available through both RS232 and RS485.
- If there are more than one battery modules in operation, parallel communication can be available using RS485.
- Communication protocols for RS232 and RS485 are shown in *Annex 3*.

#### 6) Discharge with dummy load

- Dummy load cannot be larger maximum discharge current of each battery model in

Table 2.1, and LVBD is larger than 41.0V.

Voltage drop on cable between battery module and power plant shall be less than 0.5V.

## 4.7 – Storage

### 4.7.1 Storage Requirements

1. Place modules according to the signs on the packing case during storage. Do not put modules upside down or sidelong.
2. Stack modules packing cases by complying with the stacking requirements on the external package.
3. The storage environment requirements are as follows:
  - Ambient temperature: 0–40°C; recommended storage temperature: 20–30°C
  - Relative humidity:  $\leq 95\%$
  - In a dry clean place with proper ventilation
  - In a place that is away from corrosive and organic substances (including gas)
  - In a place free from direct sunlight
  - At least 2 meters away from heat sources (such as a heater)
4. The warehouse keeper should collect TL-LFP modules storage information every month and periodically report the modules inventory information to the planning department. The modules that have been stored overdue should be recharged in a timely manner.
5. The modules should be delivered based on the "first in, first out" rule.
6. Install modules in a dry, clean, and ventilated environment that is free from sources of strong infrared radiation, organic solvents, and corrosive gases. Do not expose the modules to sunlight or water and keep them far away from sources of ignition.

### 4.7.2 Judgement Conditions for Overdue Storage

The battery storage shall be in the clean and dry ventilation room at the temperature of 0~40°C. It is recommended that the modules should not be stored for a long period.

Actual Storage Temperature	Recharge Interval	Acceptance Criteria
$0^{\circ}\text{C} \leq T \leq 30^{\circ}\text{C}$	12 month	Not reaching the time for recharge: Use the module as soon as possible.
$30^{\circ}\text{C} \leq T \leq 40^{\circ}\text{C}$	8 month	Reaching the time for recharge: Recharge the module.

**Note:**

1. storage battery over 45°C or under 0°C will reduce battery life.
2. The storage duration (t) starts from the latest charge time on the module. The latest charge time is updated after every charge.
3. If an module is qualified after charge, mark the latest charge time and the next recharge time on the module packing case. The next recharge time is 8 months (stored above 30°C) or 12 months (stored below 30°C) later than the latest charge time. The total storage duration should

not exceed the warranty period.

4. Directly handle bulging modules, no matter how long they are stored.

5. Battery performance degradation after long-term storage, please shorten shelf time as possible as you can.

### 4.7.3 Recharge process

Recharge the module using a power system: Connect the positive and negative terminals of the module to the output positive and negative terminals on the DC regulated power supply, respectively.

Recharge parameter setting

Recharge parameter	Recharge Interval
Charge voltage	54.0V
Charge current	Using the default charge current limit; typically $\leq 0.2C$
Termination condition	The charge duration is greater than 10 minutes and the charge current is less than 0.03C, or the BMS is protected.

**Note:** Do not perform operations with power on when connecting the recharge cables.

### 4.8 – Maintenance

- Please clean the dust by the dust collector when dust is accumulated on vent
- Please use clean and dry cloth/fabric to clean up the cabinet, if need further cleaning, please use neutral cleanser. Alcohol or ammonia synthesis is forbidden.
- Carrying shall be handled gently, prevent from severe compact
- Prevent battery from splashing liquid
- Suggest inspect the tighten of output screw every two years

## Part 5 – Troubleshooting & Solutions

Table 5.1 –Troubleshooting and Solutions

Troubles	Troubleshooting	Solutions
Battery cannot discharge	Protection against under-voltage	Charge battery
	Protection against over-temperature or under-temperature (Ambient temperature is lower than -20℃ or higher than 60℃)	Regulate ambient temperature in the range of -20℃ to 60℃ for discharge
	Battery output is short circuit	Relieve short circuit and charge battery
	Protection against over-current	Remove some unimportant load and charge battery
	System failure	Shutdown system and call maintenance service
Battery cannot charge	Battery is fully charged. Normal charge management	Do not need to solve, will recovery automatically
	The positive and negative power cable inversely connected to the terminal of the battery	Check the cable connection
	Protection against over-temperature or under-temperature (Ambient temperature is lower than 0℃ or higher than 60℃)	Regulate ambient temperature in the range of 0℃ to 60℃ for charge
	System failure	Shutdown system and call maintenance service
Fail to start	The total battery voltage is too low, so the BMS cannot start.	Contact the supplier to recovery the battery voltage
	The switch damaged, unable to start.	Contact the supplier to replace the switch
	LED damaged, battery on.	Observe whether the battery can operate normal or not, contact the supplier to replace the LED
	The battery is disconnected internally	Shutdown system Call for maintenance service
	BMS power supply circuit damaged	Shutdown system Call for maintenance service
All LED indicators on	System failure	Shutdown system Call for maintenance service
Communication failure	Fault of communication cable	Inspect communication cable,check the cable definition
	System failure	Shutdown system Call for maintenance service
	Plug the wrong communication port	Check the communication port
Alarm light flash during charging or	Cell temperature abnormal	check the environment temperature, if only one cell temperature abnormal,

discharging		maybe connection is abnormal.call maintenance service for help. If all temperature nearly the same, check the environment temperature.
	Low SOC alarm	Do not need to solve
	Cell or system low voltage alarm	Do not need to solve
	Environment temperature abnormal	Do not need to solve
Battery display capacity different from actual capacity	SOC display deviation	Calibrate the SOC by fully charge and discharge battery

Different flash status of LED indicators represents corresponding running status or alarms.  
Detailed information is shown Annex 1.

## Annex 1 – Instructions for LED Flicker

Annex Table 1.1 – SOC LED Indicators Description

●	●	●	●	SOC
☀	☀	☀	☀	75%~100%
☀	☀	☀	○	50%~75%
☀	☀	○	○	25%~50%
☀	○	○	○	0%~25%

Note: ☀ mean light on, ○ mean light off

Table 1.2 LED instructions:

Pack Status	Protect /Alarm /Normal	RUN	ALM	SOC LED				Description
		●	●	●	●	●	●	
Power down/Sleep	—	OFF	OFF	OFF	OFF	OFF	OFF	—
Standby	Normal	Flash 1	OFF	According to the SOC				Standby
	Alarm	Flash 1	OFF					—
Charge	Normal	Flash 3	OFF	According to the SOC				—
	temperature Alarm	Flash 3	Flash 2					—
	Overcharge voltage protection	Flash 1	OFF					
	Over temperature,	Flash 1	Flash 2					

	under-temperature, over-current protection				
Discharge	Normal	Normally on	OFF	According to the SOC	——
	Temp Alarm	Normally on	Flash 2		——
	Under voltage protection	Flash 1	OFF		
	Over temperature, under-temperature, over-current protection	Flash 1	Flash 2		
Charge / Discharge / Standby	The fault	OFF	Normally ON	OFF	

LED Flash State

	Light	Extinguish
<b>Flash1</b>	0.25S	3.75S
<b>Flash2</b>	0.5S	0.5S
<b>Flash3</b>	0.5S	1.5S

## Annex 2 – Instructions for ADD Dialing

ADD is applicable to modules connected in parallel. ADD consists of four binary bits, and maximum quantity of batteries connected in parallel is 64pcs (2<sup>6</sup>). BMS only identify ADD dialing one time after reset, so reset BMS as change ADD dialing.

Annexed Table 2.1 –Instruction for Addresses of Communication

Instructions for ADD Dialing						Module No.	Binary Code	Remarks
1	2	3	4	5	6			
OFF	OFF	OFF	OFF	OFF	OFF	PACK 1	000000	Master PACK, supports RS232
ON	OFF	OFF	OFF	OFF	OFF	PACK 2	000001	Slave PACK
OFF	ON	OFF	OFF	OFF	OFF	PACK 3	000010	Slave PACK
ON	ON	OFF	OFF	OFF	OFF	PACK 4	000011	Slave PACK

OFF	OFF	ON	OFF	OFF	OFF	PACK 5	000100	Slave PACK
ON	OFF	ON	OFF	OFF	OFF	PACK 6	000101	Slave PACK
OFF	ON	ON	OFF	OFF	OFF	PACK 7	000110	Slave PACK
ON	ON	ON	OFF	OFF	OFF	PACK 8	000111	Slave PACK
OFF	OFF	OFF	ON	OFF	OFF	PACK 9	001000	Slave PACK
ON	OFF	OFF	ON	OFF	OFF	PACK 10	001001	Slave PACK
OFF	ON	OFF	ON	OFF	OFF	PACK 11	001010	Slave PACK
ON	ON	OFF	ON	OFF	OFF	PACK 12	001011	Slave PACK
OFF	OFF	ON	ON	OFF	OFF	PACK 13	001100	Slave PACK
ON	OFF	ON	ON	OFF	OFF	PACK 14	001101	Slave PACK
OFF	ON	ON	ON	OFF	OFF	PACK 15	001110	Slave PACK
ON	ON	ON	ON	OFF	OFF	PACK 16	001111	Slave PACK
OFF	OFF	OFF	OFF	ON	OFF	PACK 17	010000	Slave PACK
ON	OFF	OFF	OFF	ON	OFF	PACK 18	010001	Slave PACK
OFF	ON	OFF	OFF	ON	OFF	PACK 19	010010	Slave PACK
ON	ON	OFF	OFF	ON	OFF	PACK 20	010011	Slave PACK
OFF	ON	OFF	OFF	ON	OFF	PACK 21	010100	Slave PACK
ON	OFF	ON	OFF	ON	OFF	PACK 22	010101	Slave PACK
OFF	ON	ON	OFF	ON	OFF	PACK 23	010110	Slave PACK
ON	ON	ON	OFF	ON	OFF	PACK 24	010111	Slave PACK
OFF	OFF	OFF	ON	ON	OFF	PACK 25	011000	Slave PACK
ON	OFF	OFF	ON	ON	OFF	PACK 26	011001	Slave PACK
OFF	ON	OFF	ON	ON	OFF	PACK 27	011010	Slave PACK
ON	ON	OFF	ON	ON	OFF	PACK 28	011011	Slave PACK
OFF	OFF	ON	ON	ON	OFF	PACK 29	011100	Slave PACK
ON	OFF	ON	ON	ON	OFF	PACK 30	011101	Slave PACK
OFF	ON	ON	ON	ON	OFF	PACK 31	011110	Slave PACK
ON	ON	ON	ON	ON	OFF	PACK 32	011111	Slave PACK

## Annex 3 – Communication Protocol for RS232 and RS485

There is one RS232 port in front panel for up-link communication between batter module and upper computer, and one or two RS485 port in front panel for cascade communication for battery modules connected in parallel.

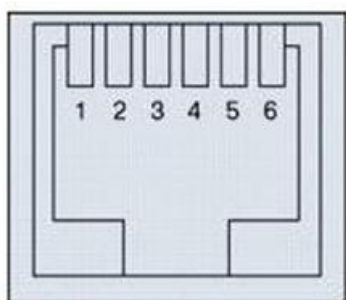
### 1) RS-232

The system uses/through 6Pin straight PCB welding socket(RJ11) to provide RS-232 protocol, the pin

assignment of RJ11 is defined as follows

Table 1 RJ11 Pin Assignment



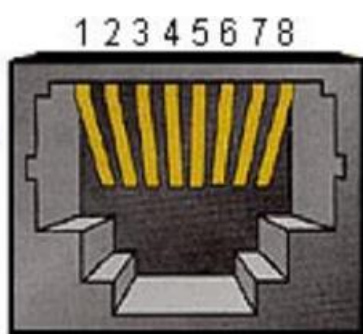
**RS232**

RJ11 Pin	Definition Description
1	GND
2	SWCLK
3	Pack transmit; Computer receiver
4	BMS receiver; Computer transmit
5	RS232_GND
6	SWDIO

## 2) RS-485

The system uses/through 8Pin straight PCB welding socket(RJ45) to provide RS-485 protocol, the pin assignment of RJ45 is defined as follows.

Table 2 RJ45 Interface definition

**RS485**

RJ45 Pin	Definition description	
	TL4850/48100	TL48150
1	RS485_B	RS485_B
2	RS485_A	RS485_A
3	RS485_B	GND
4	CAN_L	CAN_L
5	485_B	485_B
6	485_A	485_A
7	GND	GND
8	CAN_H	CAN_H

