

48V Lithium iron phosphate battery module FP-FS48100

Version: V1.0

Date: 2020-03-07

Version information

| Version | Prepared | Checked | Approved | Date |
|---------|----------|---------|----------|------------|
| V1.0 | | | | 2020-03-07 |
| | | | | |

1. Summary

FR-FS48100 is a lithium iron phosphate battery system produced in China on behalf of Farco AS, which can be used to provide safe, reliable, and stable energy for various equipment. At the same time, the module supports expansion on both capacity and power by multiple parallel uses. It supports RS485, RS232 communication, and can meet the requirements of various PV inverter communication protocols. ZR-FS48100-1630P1 has the advantages of high safety performance, long life span, wide charging voltage range, simple installation, and standard modular design. Products can be widely used in household energy storage, industrial and commercial energy storage and other fields.

2. Technical Specification

2.1. Battery Pack Specification

| No. | Item | Unit | Value | Remark |
|-----|-----------------------------|------|--|--|
| 01 | Cell model | - | 100Ah/3.2V | |
| 02 | Combination Mode | - | 1P16S | |
| 03 | Nominal Capacity | Ah | 100 | |
| 04 | Rated energy | Wh | 5120 | |
| 05 | Initial Internal Resistance | mΩ | <50 | AC 1KHz |
| 06 | Rated Voltage | V | 51.2 | |
| 07 | Charge Cut-off Voltage | V | 56.0 | Unit cell max. charge voltage not exceed 3.55V |
| 08 | Discharge Cut-off Voltage | V | 48.0 | Unit cell min. discharge voltage not lower than 3.0V |
| 09 | Standard Charge Current | A | 20 | 0.2C |
| 10 | Max. Charge Current | A | ≤100 | |
| 11 | Standard Discharge Current | A | 50 | |
| 12 | Max. Discharge Current | A | ≤100 | |
| 13 | Operating Temperature | °C | -0~+45°C | Charge |
| | | | -10~ +55°C | Discharge |
| 14 | Open Circuit Voltage | V | 44.8~57.6 | |
| 15 | Shell type | - | Painted metal | |
| 16 | Weight | kg | 45±1 | About |
| 17 | Dimension | mm | 408(L)*440(W)*132(H) Exclude extended part, handle, wiring terminal, | Standard 3U size |
| | | | 446(L)*482.6(W)*132(H) Outer Maximal dimension | |

2.2. Protection Board Specification

| No. | Item | Value | Remark | |
|-----|--|---|------------------------|---|
| 1 | Cell Overcharge Protection | Overcharge alarm voltage | 3450mV | |
| | | Overcharge protection voltage | 3550mV | |
| | | Overcharge protection delay time | 1.0S | |
| | Cell Over Voltage Protection Release Condition | Overcharge protection release voltage | 3330mV | |
| | | SOC release | SOC < 96% | |
| | | Discharge release | Discharge Current > 1A | |
| 2 | Cell over-discharge protection | Over Discharge alarm Voltage | 3110mV | Over discharge 30 seconds, if it still can't recover, enter into low-power mode |
| | | Over Discharge Protect Voltage | 3000mV | |
| | | Over Discharge Protect delay time | 1.0S | |
| | Cell Over Discharge protection release | Over Discharge protection release voltage | 3200mV | |
| | | Charging release | Access charger | |
| | | | | |
| 3 | Pack overcharge protection | Overcharge alarm voltage | 55.5V | |
| | | Overcharge protection voltage | 57.0V | |
| | | Overcharge protection delay time | 1.0S | |
| | Pack over voltage protection Release Condition | Overcharge protection release voltage | 53.3V | |
| | | SOC release | SOC < 96% | |
| | | Discharging release | Discharge | |
| 4 | Pack over-discharge protection | Over Discharge alarm Voltage | 49.5V | Over discharge 30 seconds, if it still can't recover, enter into low-power mode |
| | | Over Discharge Protect Voltage | 48.0V | |
| | | Over Discharge protect delay time | 1.0S | |
| | Pack over Discharge protection release | Over Discharge protection release voltage | 51.2V | |
| | | Charging release | Access charger | |
| | | | | |
| 6 | Charge over-current protection | Charge Over-current alarm | ≥125A | If it appears 10 times, will lock the status, and won't release automatically |
| | | Charge Over-current protection | ≥130A | |
| | | Charge Over-current protection delay time | 1.0S | |
| | Charge over-current protection release | Automatic release | 1min | |
| | | Discharging release | Discharge Current > 1A | |
| | | | | |
| 7 | Discharge Over Current | Discharge Over-Current alarm | ≥125A | If it appears 10 times, will |
| | | Discharge Over-Current Protect | ≥130A | |

| | | | | | |
|----|--|--|---|---|--|
| | Protect_1st | Over-current protection delay time_1st | 1.0S | lock the status, and won't release automatically | |
| | Discharge Over Current Protect Release Condition_1st | Automatic release | 1min | | |
| | | Charging release | Charge Current>1A | | |
| 8 | Discharge Over Current_2nd | Discharge Over-Current Protect | $\geq 150A$ | If it appears 10 times, will lock the status, and won't release automatically | |
| | | Discharge Over-current protection delay time_2nd | $100\pm 50mS$ | | |
| | Discharge Over Current Release Condition_2nd | Automatic release | 1min | | |
| | | Charging release | Charge Current>1A | | |
| 9 | Short Circuit Protect | Short protection current | $\geq 350A$ | | |
| | | Short Circuit Protect Delay Time | $300\mu S$ | | |
| | | Short Circuit Protect Release | Charging, short circuit protection release | | |
| | | | After removing load, will release automatically | | |
| 10 | MOS Over-Temperature protection | MOS Over-Temperature alarm | $90^{\circ}C$ | | |
| | | MOS Over-Temperature protection | $110^{\circ}C$ | | |
| | | MOS Over-Temperature release | $85^{\circ}C$ | | |
| 11 | Cell Over-Temperature protection | Charge Low Temperature alarm | $0^{\circ}C$ | | |
| | | Charge Low Temperature Protect | $-5^{\circ}C$ | | |
| | | Charge Low Temperature Protection Release Condition | $0^{\circ}C$ | | |
| | | Charge High Temperature alarm | $50^{\circ}C$ | | |
| | | Charge High Temperature Protect | $55^{\circ}C$ | | |
| | | Charge High Temperature Protection Release Condition | $50^{\circ}C$ | | |
| | | Discharge Low Temperature alarm | $-15^{\circ}C$ | | |
| | | Discharge Low Temperature Protect | $-20^{\circ}C$ | | |
| | | Discharge Low Temperature Protect Release Condition | $-15^{\circ}C$ | | |
| | | Discharge High Temperature alarm | $55^{\circ}C$ | | |
| | | Discharge High Temperature Protect | $60^{\circ}C$ | | |
| | | Discharge High Temperature Protect Release Condition | $55^{\circ}C$ | | |
| 12 | Ambient Over-Temperature protection | Low Temperature alarm | $-20^{\circ}C$ | | |
| | | Low Temperature Protect | $-25^{\circ}C$ | | |
| | | Low Temperature Protect Release Condition | $-20^{\circ}C$ | | |

| | | | | |
|----|--------------------------|--|------------------------|-------------------------|
| | | High Temperature alarm | 65°C | |
| | | High Temperature Protect | 70°C | |
| | | High Temperature Protect Release Condition | 65°C | |
| 13 | Consumable current | Consume current while working | ≤30mA(With display) | |
| | | | ≤20mA(without display) | |
| | | Low-power mode current | ≤100μA | |
| 14 | Balance | Balance threshold voltage | 3400mV | |
| | | Bleed Voltage | 30mV | |
| 15 | Capacity default setting | Low capacity Alarm | SOC < 10% | No alarm while charging |
| | | rated capacity setting | 100AH | |
| 16 | sleep mode | Voltage | 3100mV | |
| | | Delay Time | 5min | |

2.3. Electrical performance test

| Test Item | Test Method | Technical Requirement |
|--|---|---|
| Discharge capacity | Under standard charging mode, charge the battery pack. Then discharge with 0.2C, record the discharge capacity. | ≥100% Minimum capacity |
| -20°C Low Temperature Discharge Capacity | Standardly charge the batter pack, then put it into the constant temperature and humidity oven with -20±2°C for 8H, then discharge with 0.1C to cut-off voltage, record the discharge capacity. | ≥65% Nominal Capacity(Without BMS) |
| 55 °C High Temperature Discharge Capacity | Standardly charge the batter pack, then put it into the constant temperature and humidity oven with 55±2°C for 4H, then discharge with 0.1C to cut-off voltage, record the discharge capacity. | ≥97% nominal capacity |
| Charge Retention(Residual Capacity) and Capacity Restoration Ability | Standardly charge the battery pack, record initial capacity. Under 15°C~30°C, place it for 28 days, then discharge and record the residual capacity. Then standardly charge, record the restoration capacity. | Residual capacity(Charge Retention) ≥95% Restoration capacity ≥97% |
| Cycle life | Standardly charge the battery pack, then discharge with 0.3C. When discharge capacity is less than 80% of initial capacity, ending cycle test | ≥3500 times |
| 55°C 7 days storage | Standardly charge the battery pack, record initial capacity. Under 55±2°C, place it for 7 days, then discharge and record the residual capacity. Then standardly charge, record the restoration capacity. | Residual capacity≥90% Restoration capacity≥95% |

3. Battery Pack Function Description

3.1 LED indicators Description LED



3.2 SOC Indicators Tablets SOC

| Status | | Charge | | | | Discharge | | | |
|----------------------|---------|---------|--------|--------|---------|-----------|------|------|------|
| Capacity Indicators | | L4 ● | L3 ● | L2 ● | L1 ● | L4 ● | L3 ● | L2 ● | L1 ● |
| Capacity (%) | 0~25% | Off | Off | Off | Blink 2 | Off | Off | Off | On |
| | 25~50% | Off | Off | Blink2 | On | Off | Off | On | On |
| | 50~75% | Off | Blink2 | On | On | Off | On | On | On |
| | 75~100% | Blink 2 | On | On | On | On | On | On | On |
| Running Indicators ● | | On | | | | Blink 3 | | | |

3.2.1 Status Indicator Description

| Status | Normal/ Warning/ Protection | RUN | ALM | LED Capacity Indicator | | | | Instruction |
|-----------|---|--------|--------|--|-----|-----|-----|---|
| | | ● | ● | ● | ● | ● | ● | |
| Power off | Sleep | off | off | off | Off | Off | Off | All off |
| Standby | Normal | Blink1 | Off | According to capacity | | | | Standby |
| | Warning | Blink1 | Blink3 | | | | | Low voltage Module |
| Charge | Normal | on | off | According to Capacity Indicator (Capacity Indicate Max. LED blinks 2 times) | | | | Maximum Capacity LED blinks (blink 2 times), overcharge alarm ALM not blink |
| | Warning | On | Blink3 | | | | | |
| | Overcharge protection | on | Off | On | On | On | On | Indicator Status without AC input |
| | Temperature, Overcurrent and Failure Protection | Off | On | Off | Off | Off | Off | Stop charging |
| Discharge | Normal | Blink3 | Off | According to capacity | | | | |
| | Warning | Blink3 | Blink3 | | | | | |
| | Under voltage Protection | Off | Off | Off | Off | Off | Off | Stop discharge |
| | Temperature, Overcurrent, Short Circuit, Reverse Connection, Failure Protection | Off | on | off | Off | Off | Off | Stop discharge |
| Failure | | Off | on | Off | Off | Off | Off | Stop charge and discharge |

3.2.2 Indicator Blink Description

| Blink pattern | on | off |
|---------------|-------|-------|
| Blink 1 times | 0.25S | 3.75S |
| Blink 2 times | 0.5S | 0.5S |
| Blink 3 times | 0.5S | 1.5S |

3.3 Standby Function

When the battery pack is not charged or discharged and communicated after boot-strap, the battery is in standby mode.

3.4 Dormancy Function

When the standby time is more than 24 hours, the battery triggers under-voltage protection; execute the key shutdown or the upper computer executes the shutdown command; BMS enters the sleep (shutdown) mode.

Wake-up conditions: 1. Charging activation; 2. Keyboard boot; 3. RS232 communication.

3.5 Buzzer function

In case of failure, the buzz lasts 0.25S for every S;

In the case of protection, the buzz lasts for 0.25S every 2S (except overvoltage protection);

In case of failure, the buzz lasts 0.25S for every S;

In the case of protection, the buzz lasts for 0.25S every 2S (except overvoltage protection);

In the case of warning, the buzz lasts for 0.25S for every 3S (except overpressure warning);

The buzzer function can be enabled or prohibited by the host computer, factory default is prohibited.

3.6 Reset Key Function

When BMS is in a dormant state, press the key (3-6S) to release, the protective board is activated, and the LED indicator lights "RUN" are lit for 0.5 seconds successively.

When BMS is activated, press the button (3-6S) to release, the protective board is dormant, and the LED indicator lights up 0.5 seconds in turn from the lowest power lamp. Press the button (6 ~ 10S) to release, the protective board is reset, and all the LED lights are lit for 1.5 seconds at the same time.

3.7 Communication function

- The battery pack has RS232 and RS485 communication functions. RS232 communication wiring is used to communicate with the host computer, so as to monitor battery information through the host computer.

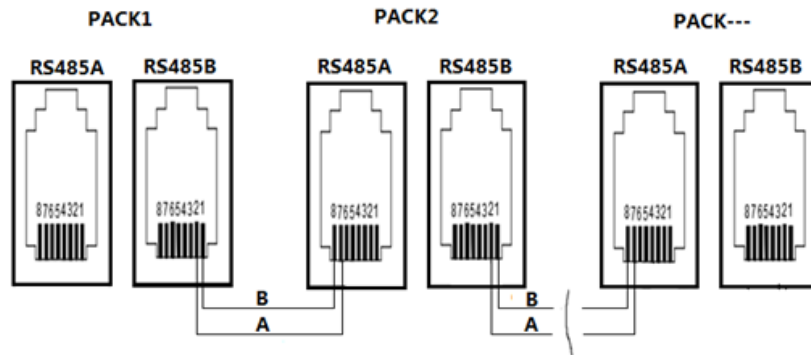


- RS485 communication wiring is used for communication between master Pack and slave Pack in parallel connection of battery packs.

| RS485--Using 8P8C Vertical RJ45 Socket | |
|--|------------|
| RJ45 Pin | Definition |
| 1、 8 | RS485-B |
| 2、 7 | RS485-A |
| 3、 6 | GND |
| 4、 5 | NC |


3.8 Multi-device parallel connection definition



BMS batteries can communicate with devices with RS485 bus in parallel, and RS232 interface can communicate with PC or other intelligent terminals. Human-computer interaction RS485 bus can communicate with any battery package information in parallel. The multi-computer parallel bus interface is shown in the following figure.



3.9 Address Dial Switch



In the operation of multi-machine parallel communication, it is necessary to configure the dial address of each PACK first. Dialing is in BCD code format. Address 0 is defined as  ON/OFF

(black dot is OFF state, blank is ON state, the same below), Address 1  ON/OFF, Address 2  ON/OFF,

please refer to the table below for details.

| Address | Dial Switch Position | | | | | | Instruction |
|---------|----------------------|-----|-----|-----|--------------|--------|--------------------|
| | #1 | #2 | #3 | #4 | #5 | #6 | |
| 0 | OFF | OFF | OFF | OFF | No use | No use | Use lonely |
| 1 | ON | OFF | OFF | OFF | | | Set as Pack1(Main) |
| 2 | OFF | ON | OFF | OFF | | | Set as Pack2 |
| 3 | ON | ON | OFF | OFF | | | Set as Pack3 |
| 4 | OFF | OFF | ON | OFF | | | Set as Pack4 |
| 5 | ON | OFF | ON | OFF | | | Set as Pack5 |
| 6 | OFF | ON | ON | OFF | | | Set as Pack6 |
| 7 | ON | ON | ON | OFF | | | Set as Pack7 |
| 8 | OFF | OFF | OFF | ON | Set as Pack8 | | |

4.3、 Interface View

| No. | Instructions | NO. | Instructions |
|-----|-------------------------------------|-----|-------------------------------------|
| 1 | Battery cathode(same as the port 2) | 9 | Address Dial Switch |
| 2 | Battery cathode(same as the port 1) | 10 | RS232 communication port |
| 3 | Power Switch | 11 | Multi-device parallel connection 1 |
| 4 | GND | 12 | Multi-device parallel connection 2 |
| 5 | SOC indicator | 13 | Reset button |
| 6 | Dry contact | 14 | Battery anode (same as the port 15) |
| 7 | Alarm indicator | 15 | Battery anode (same as the port 14) |
| 8 | Run indicator | 16 | |

5 Storage and Transportation

5.1 Storage

When the product is not in use for a long time, please put it in a dry and ventilated place to avoid inflammable and explosive articles; charge and maintain the battery pack regularly every three months to ensure that the battery is in the best performance state.

5.2 Transportation

Battery pack should be packed with outer packing before they can be transported. In the course of transportation, severe shock, shock or extrusion should be prevented, and sunshine and rain should be prevented.

6 Warning and Tips

- 6.1 Never put batteries in water or wet them。
- 6.2 It is forbidden to charge and use batteries outside the temperature range we prescribe. Do not store, charge and use this product near the source of fire or heat.
- 6.3 When the battery pack emits odor or leaks, it should stop using or charging immediately, and move to an open ventilated place, away from the source of fire, and contact us in time.
- 6.4 Do not connect the positive and negative poles in connection with the load.
- 6.5 Do not short-circuit the positive and negative poles of the battery pack with metal conductors
- 6.6 Do not put the battery pack into the fire or heat it.
- 6.7 It is strictly forbidden to dissect the battery pack artificially, to pierce the battery pack with nails or sharp objects, to strike the battery pack with hammers or other external forces, and to trample and drop the battery pack artificially.

- 6.8 It is strictly forbidden to put batteries in microwave ovens or pressure vessels.
- 6.9 If any abnormal phenomena occur during charging or using, please stop charging and using immediately.
- 6.10 The optimum operating temperature of the product is $25\pm 5^{\circ}\text{C}$. If the product is not in this temperature range in the course of using, the discharge capacity will be reduced.
- 6.11 If any malfunction or abnormality occurs during the use, please contact us and do not disassemble the battery pack without permission.
- 6.12 The above test is for new batteries whose arrival time is not more than one month.