PYLONTECH



LFP Lithium Ion Battery System

RT12100G31 Operation Manual

Information Version: 21P1RT0701

DA0UPY121001

Please read this manual before install the battery and follow the instruction carefully during the installation process. Any confusion, please contact Pylontech immediately for advice and clarification.

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1. Symbol in label, manual and product

	Do not reverse connection the positive and negative
	Do not place near open flame
	Do not place at the children and pet touchable area
	Caution! Reminding! Safety related information Risk of battery system failure or life cycle reduces
	Warning! Risk of battery system damage or personal injury Do not pull out the connectors while the system is working! De-energize from all multiple power sources and verify that there is no voltage
	Danger! Battery strings will produce high voltage DC power and can cause a lethal voltage and an electric shock Only qualified person can perform the wiring of the battery strings
	Keep away from strong magnetic field
	Warning Fire Do not place near flammable material

	Read the product and operation manual before operating the battery system!
	Certification Mark for the U.S Market
	Certification Mark for the EU Market
	Recycle label
	Label for Waste Electrical and Electronic Equipment (WEEE) Directive (2006/66/EC) and its amendments
	The certificate label for Bluetooth SIG
	The Bluetooth Certification Mark for Janpanese market
	The TUV Mark certificate label for Safety Testing (EN62619) by TÜV Rheinland
	The cTUVus Mark certificate label for Safety Testing (UL1973) and Functional Safety (IEC60730-1/UL60730-1) by TÜV Rhein land

2. Safety Precautions

	**Caution**

1) It is important and necessary to read the user manual carefully (in the accessories) before installing or using battery. Failure to do so or to follow any of the instructions or warnings in this document can result in electrical shock, serious injury, or death, or can damage battery, potentially rendering it inoperable.
2) If the battery is stored for long time, it is required to charge them every six months, and the SOC should be no less than 90%.
3) Battery needs to be recharged within 12 hours, after fully discharged
4) Do not install in an environment out of the operation temperature or humidity range listed in manual.
5) Do not expose cable outside.
6) Do not connect power terminal reversely.
7) All the battery terminals must be disconnected for maintenance.
8) Please contact the supplier within 24 hours if there is something abnormal.
9) Do not use cleaning solvents to clean battery.
10) Do not expose battery to flammable or harsh chemicals or vapors.
11) Do not paint any part of battery, include any internal or external components.
12) Do not connect battery with PV solar wiring directly.
13) The warranty claims are excluded for direct or indirect damage due to items above.
14) Any foreign object is prohibited to insert into any part of battery.

2.1 Before Connecting

	**Caution before connecting**

1) After unpacking, please check product and packing list first, if product is damaged or lack of parts, please contact with the local retailer.
2) Before installation, be sure to cut off the grid power and make sure the battery is in the turned-off mode.
3) Wiring must be correct, do not mistake the positive and negative cables, and ensure no short circuit with the external device .
4) It is prohibited to connect the battery and AC power directly.
5) The battery supports up to 4 groups of batteries in series. The maximum charge/discharge voltage should not exceed 57V to avoid the backward voltage generated by the BMS when the input/output is cut off exceeds the withstand voltage value of BMS.
6) Please ensure the electrical parameters of battery system are compatible to related equipment.
7) Keep the battery away from water and fire.

2.2 In Using

	**Caution in using**

1) If the battery system needs to be moved or repaired, the power must be cut off and the battery is completely shut down.
2) It is prohibited to connect the battery with different type of battery.
3) It is prohibited to connect batteries with faulty or incompatible inverter.
4) It is prohibited to disassemble the battery (QC tab removed or damaged);
5) In case of fire, only dry powder fire extinguisher can be used, liquid fire

extinguishers are prohibited.

6) Please do not open, repair or disassemble the battery except staffs from Pylontech or authorized by Pylontech. We do not undertake any consequences or related responsibility which because of violation of safety operation or violating of design, production and equipment safety standards.

3. Introduction

RT12100G31 is a lithium iron phosphate battery module used to replace the typical lead-acid battery. The battery can be charged by solar power, diesel generator, and utility power via relevant AC/DC converter. The battery can be used for energy storage and providing back-up power for typical electrical appliances. Due to the long life and high energy density of lithium batteries, there is a broad market prospect to replace lead-acid batteries.

3.1 Features

1) Products with strong environmental adaptability, structural reliability and electrical reliability, able to adapt to the harsh automotive environment.
2) Robust power performance. Available for 1C-rate continuous operation and up to 2C-rate instantaneous discharge.
3) Support both serial and parallel connections. Up to 16 batteries (max. 4 groups in serial) can be connected together per single system.
4) The battery module with low self-discharge loss can be stored for more than 6 months during normal condition and more than 2 months during empty condition.
5) Built-in battery management system, supporting intelligent monitoring via CANBUS/Bluetooth.
6) Cathode material is made from LiFePO4 with safety performance and long cycle life.
7) Battery management system (BMS) has protection functions including over-discharge, over-charge, over-current, short circuit and high/low temperature.
8) The system can automatically manage charge and discharge state and balance voltage between each cell.
9) The size is compatible with the US BCI G31 standard and can completely replace lead-acid batteries of the same size.
10) Build-in heating film which will automatically heat up the module during minus temperature for critical environment operation.
11) Build-in Bluetooth unit for remote monitoring and control purpose.

3.2 Specification

RT12100G31 Battery Dimension







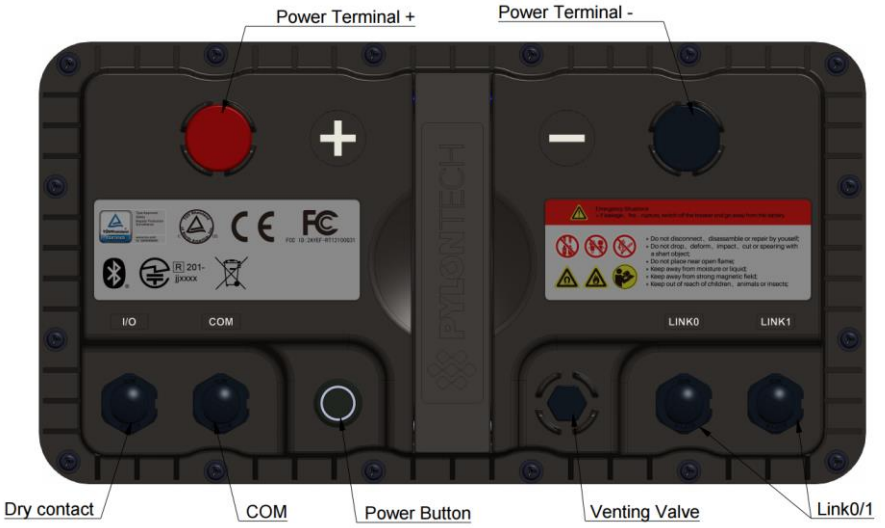
Basic Parameters		Value
Nominal Voltage (V)		12.8
Nominal Capacity (Ah)		100
Dimension (mm)		325(L)*173.5(W)*226(H)
Weight (Kg)		12±0.2
Discharge Voltage Range (Vdc)		10.8~14.4
Recommended Charge Voltage (Vdc)		14 ~ 14.4
Recommend Charge/Discharge Current (A)		50
Max. Continu Charge/Discharge Current (A)		100
Peak Discharge Current (A)		200@30sec
Communication	CAN	500Kbps
	RS485	Default for console

		115200bps
	Bluetooth	BLE5.0
	Dry Contact	2*input,2*output
Maximum series-parallel configuration		4S4P
Maximum number of battery modules supported(pcs)		16
Working Temperature		-40℃～60℃*
IP rating		IP67
Short-circuit Current/Duration time		<1KA/100uS
Humidity		5 ~ 95%(RH) No Condensation
Altitude(m)		<4,000
Certification		IEC/ CE /FCC/ROHS/ Telec /UN38.3
Design life		10+yrs
Cycle Life		>4,500 25℃
Reference to standards		UL1973,IEC62619,FCC,CE,Bluetooth SIG, Telec

* Charge is available between 0℃ ~ 60℃； Discharge is available between -20℃ ~ 60℃； Between -40℃ ~ -20℃, heating film can operate to heat up the module via external charger.

3.3 Panel

RT12100G31 Panel Description



3.4 Equipment interface instruction

Power Button

Power button pressed: Ready to turn on.

Power button pops back: Power off. For storage or shipping.

LED Status Indicators:

Power on/Normal	Flash 1, OFF 1.5S, on 0.5s,
Waiting for Addressing or Communication time out	Flash 2,OFF 1s, on 1s,
System Protect	Flash 3,OFF 0.5s on 1.5s,
Sleep/Power off/System error	OFF

External Communication Interface (Dry contact and COM port)

PIN	Dry Contact	COM
1	IN1+	-
2	IN1-	GND
3	IN2+	
4	NO1	CANH
5	COM1	CANL
6	IN2-	
7	NO2	RS485A
8	COM2	RS485B



PIN Assignments Front View of Cable

Dry Contact

Definition:

Pin1	Input, passive signal. Close: Enable Heater function.	+
Pin2	Open Disable Heater function	-
Pin3	Input, passive signal. Reserved	+
Pin6		-
Pin4	Output1 Open: stop charging	+
Pin5	(Charge MOSFET OPEN)	-
Pin7	Output 2 Open: stop discharging	+
Pin8	(Discharge MOSFET OPEN)	-

Notes:

1. Input signals should be passive signals

2. The voltage value of output signal is less than 25V, and the current value is less than 10mA.

CAN(COM)

500 Kbps. 120Ω terminal resistance.

RS485/Console(COM)

For manufacturer or professional engineer to debug or service.

Default Communication speed 115200 bps.

Link 1 / Link 0

For battery internal communication between multiple parallel/serial batteries.

Power Terminal +/-

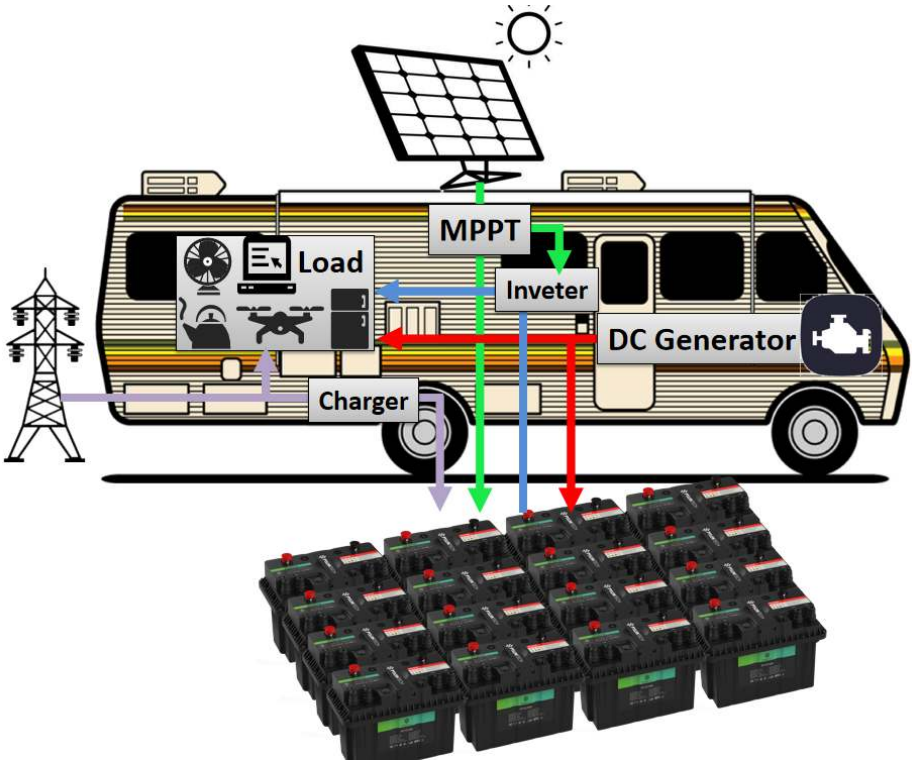
There is a pair of positive and negative terminals with M8 bolts.

BMS basic function

Protection and alarm	Management and monitor
Charge/Discharge End	Cells Balance
Charge Over Voltage	Intelligent Charge Model
Discharge Under Voltage	Capacity Retention Calculate
Charge/Discharge Over Current	Administrator Monitor
High/Low Temperature(cell/BMS)	Operation Record
Short Circuit Protection	Heater Control

4. Safe handling guide

4.1 Schematic diagram of solution



4.2 Danger label



4.3 Tools



Wire cutter



Screwdriver

NOTE

Use properly insulated tools to prevent accidental electric shock or short circuits. If insulated tools are not available, cover the entire exposed metal surfaces of the available tools, except their tips, with electrical tape.

4.4 Safety gear

It is recommended to wear the following safety gear when dealing with the battery pack



Gloves



Safety goggles

5. Installation and operation

5.1 General guidance

- All batteries must be connected in parallel before series connection. Please make sure the modules are having less than 0.1Vdc voltage difference between each other, or ideally fully charge the modules in parallel, before connecting them in serial to avoid capacity imbalance.
- The activation voltage shall keep within the charging voltage range, lower voltage values may cause the battery cannot activate.
- Imbalance between modules may occur after a period of using in serial connection, suggest to do a fully charge of the system during 10 - 40℃ once per month.
- Up to 4 batteries can be connected in series. If the charging and discharging equipment has a large inductance, there is a possibility of damaging MOSFET, add a pre-charge resistance to avoid this.
- If the battery is entering into sleep mode after running out of power, please charge it immediately, or at least disconnect the load to avoid over-discharging the battery due to Long-term shelving.

- When multiple batteries are connected in parallel, ensure that the voltage difference does not exceed 0.5Vdc, to avoid battery charging each other with high current leads to overcurrent protection between batteries.
- When connecting multiple units in parallel, try to ensure that the positive and negative terminals of each battery to the bus bar are of equal length and have the same internal resistance.
- Please keep at least 2S interval for switching on/off key frequency. Otherwise, it may cause the battery cannot be turned on.
- Please make the wire harness according to the specified wire sequence and make sure the PIN sequence of the communication harness is the same as the specified one. Otherwise, the battery may not work properly or be damaged.
- When using the Bluetooth function, please do not let the battery covered by metal shielding, ensure that there is no metal around the battery to shield it, otherwise it will affect the Bluetooth signal strength.
- When multiple batteries are connected in series or parallel, it is possible to work without connecting the communication cable between the batteries to an upper controller but it is required to connect the internal communication cable in order to ensure the consistency of SOC and better performance of the batteries.
- The LINK1 port of the previous unit in the cascade line needs to be connected to the LINK0 port of the next unit, please do not connect it wrongly to avoid damaging the battery BMS.

5.2 Package items

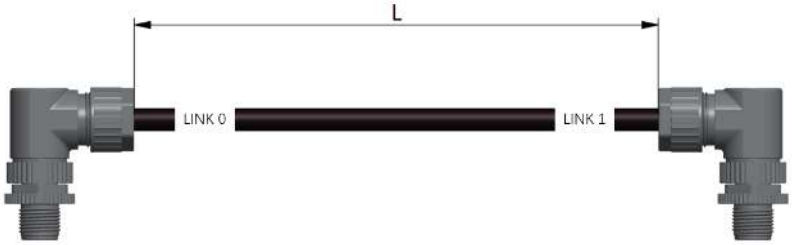
Unpacking and check the Packing List

1) For battery module package:

a. Battery module



b. 1 set of internal communication cable



Internal Communication Cable	Length(M)	Description
	0.4	For internal serial connection between batteries

Pin assignment	
Link 0	Link 1
1	2
2	1
3 ~ 8 is pin - pin	

c. 1 set of Dry contactor heater terminal



Dry Contact Heater Terminal	Description
	After power on the system, insert into the I/O port on the master battery, the heater feature will be enabled to automatically function when necessary

d. 1 set of spare communication terminal



Spare communication terminal	Description
	Empty comm. terminal acting as spare part or further insert comm. cable to connect to upper controller.

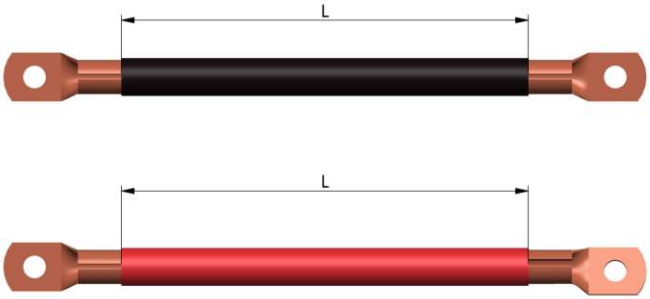
2) For External cable kits:

NOTE

External Cable Kit, NOT include in battery carton box.

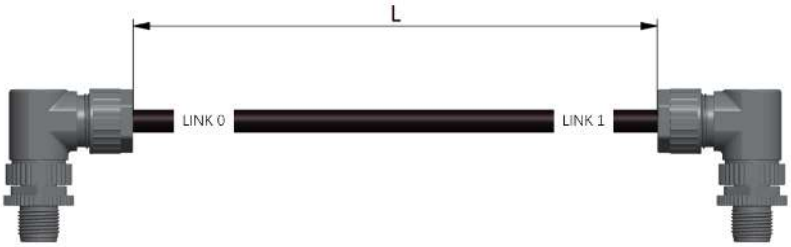
It`s acting as an option for customer to purchase relevant power/comm. cable to connect to the inverter. Below list the article number for varying size/type of cable might be used. Skilled installer can also follow below definitions to build the cable locally.

a. Power cable



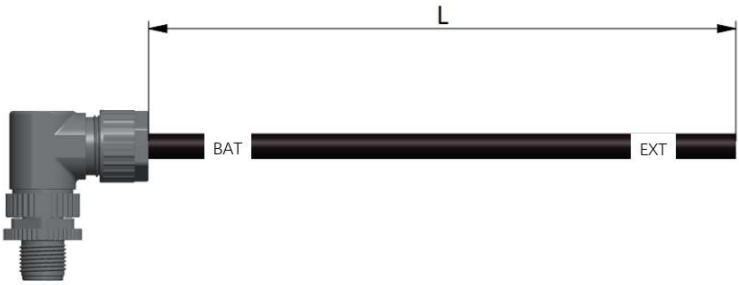
Power Cable		Length(M)			
		0.4	1	3	5
4AWG , GT25-8 Terminals	Positive (Orange)	WI0PRT121266	WI0PRT121267	WI0PRT121268	WI0PRT121269
	Negative (Black)	WI0PRT121262	WI0PRT121263	WI0PRT121264	WI0PRT121265

b. Internal Communication cable



Internal Communication cable	Length(M)			
	0.4	1	3	5
CAT6，Black，2*ALTW M12 Connector	WI0SRT121171	WI0SRT121255	WI0SRT121256	WI0SRT121257

c. External Communication cable



External Communication Cable	Length(M)			
	0.4	1	3	5
CAT6，Black，ALTW M12 Connector	WI0SRT121258	WI0SRT121259	WI0SRT121260	WI0SRT121261

5.3 Installation location

Make sure that the installation location meets the following conditions:

1) The floor is flat and level.
2) There are no flammable or explosive materials.
3) The ambient temperature is within the range from -40°C to 60°C.
4) The temperature and humidity is maintained at a constant level.
5) The installation areas shall avoid of direct sunlight.
6) There are no mandatory ventilation requirements for battery module, but please avoid of installation in confined area. The aeration shall avoid of high salinity, humidity or temperature.

⚠	**Caution**

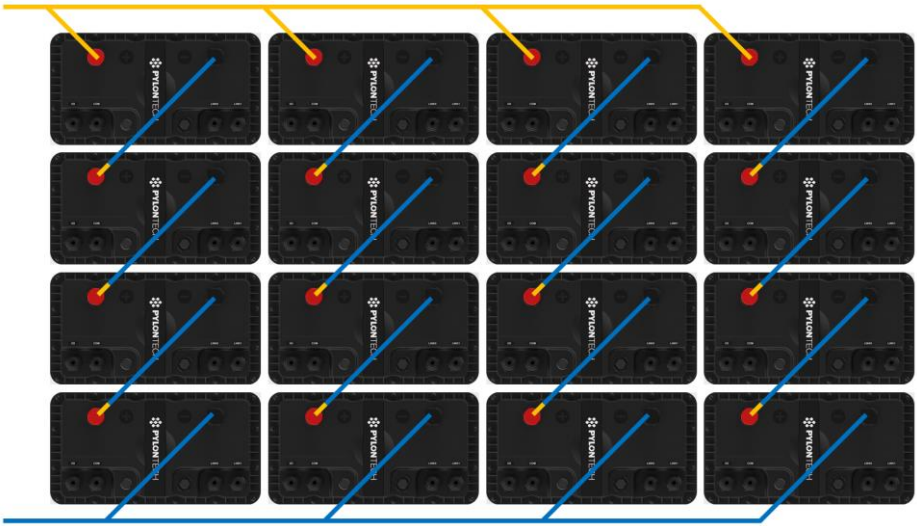
If the ambient temperature is out of the operating range, the battery stops operating to protect itself. The optimal temperature range for the battery pack to operate is 10°C to 40°C. Frequent exposure to harsh temperatures may deteriorate the performance and life of the battery.

5.4 Installation method of multiple batteries

The battery can be placed flexibly according to the actual site environment. If the battery is placed on a vehicle or a mobile object, the battery needs to be well fixed. The upper surface of the battery is flat, the battery and the vehicle can be fixed with a pressure strip in the horizontal or vertical direction.

1) Place the battery in the designated location;
2) Fix the battery modules tight with vehicle or other objects;
3) Connect the power cables and communication cables according to customer's configuration;
4) Press the Power button from the last battery in order to turn it on.

Diagram of battery power cable connection:



Series Configuration	Recommended Charge Voltage Value (Vdc)	Discharge Voltage Range (Vdc)
1S	14 ~ 14.4	10.8 ~ 14.4
2S	28 ~ 28.5	22~ 28.5
3S	42~ 43	33 ~ 43
4S	56 ~ 57	44 ~ 57

Parallel Configuration	Maximum Charge /Discharge Current Value
1~8P	100A*N (N= module amount, 1~8)
9P~16P	80A*N (N = module amount, 9-16)

Diagram of battery communication cable connection:



Diagram of battery communication cable connection:

The internal communication port LINK0 of the 1st battery remains in EMPTY, and LINK1 is connected to the 2nd battery's internal communication port LINK0. All the way connected to the last module`s LINK0. The batteries are numbered sequentially and the last battery's internal communication port LINK1 is remained in EMPTY.

5.5 Production and adjustment of communication plugs

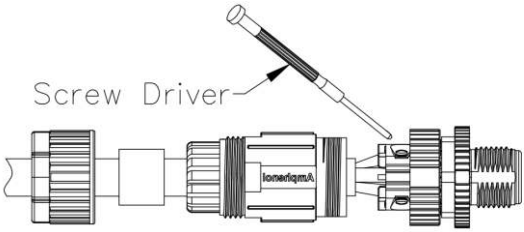
1) The communication plug can be flexibly adjusted to the direction of actual placement of the battery during installation, follow below procedure.



Align the plugs and sockets with the Navigation key and insert the plugs. Fasten the screw to secure the plug. Loosen the screw to adjust the direction of the wire (every 45°), then fasten screw and .

2) External communication cable making

There are 2 connectors has been attached within battery carton for external communication cable build-up purpose. Loosen the dismantle screws of the corresponding pin. Put the stripped communication wire through it and tighten the wire with a small screwdriver.



NOTE

All the installation and operation must follow local electric standard.

After installation, do not forget to register online for full warranty:

http://www.pylontech.com.cn/service/support

	Warning

The power cables' current capacity is 120A max. If the battery string's design current over 100A, it must configure 2 pare external power cables to extend current capacity.

Follow local electric safety and installation policy, a suitable manual disconnecting device (breaker, etc.) between battery system and inverter could be required.

5.6 Power on

Double check all the power cable and communication cable.

1) The one with **empty Link Port 0** is the **Master Battery** Module, others are slaves (1 master battery configure with maximum 15 slave batteries).

2) Switch on (press Power Button) all the battery modules from **last battery to the 1st battery.**



3) The battery will assign the address of each battery one by one automatically. If system is normal the battery LED will indicate as follow:

Battery Condition	Indicator Status
Power on/Normal	Flash 1, OFF 1.5S, on 0.5s
Waiting for Addressing or Communication time out	Flash 2，OFF 1s, on 1s，
System Protect	Flash 3，OFF 0.5s on 1.5s，
Sleep/Power off/System error	OFF

4) If require enable heater feature, insert the Dry contact heater terminal into the I/O port of the **Master Battery only.**



Dry Contact Heater Terminal	Description
	After power on the system, insert into the I/O port on the **master battery**, the heater feature will be enabled to automatically function when necessary

Note:

1) After the battery module powered on, the pre-charge circuit of the battery will last for 300mS to ensure current-limited charging to the capacitor of external load/charger.
2) During capacity expansion or replacement, please shut down all the batteries and ensure that the voltage of the battery is similar to each other (voltage: <0.1Vdc OCV difference),or fully charge the system.
3) If determines to not use the modules for long term or disable the heater feature to save power, remember to disconnect the heater terminal.

5.7 Power off

1) Turn external power source off.
2) When the slave is in the switch-closed state, the master module can control the switch status of all batteries. When the master is switched off, other batteries will go into sleep mode (in sleep mode self-consumption at 100uA).
3) If the battery does not work for long term, it is recommended to manually turn off all the batteries to avoid over discharge.

6. Trouble shooting

① Single device power on

Symptom: button switch pressed, the indicator does not light
Inspection steps:
(1) Measure the output voltage of battery with multimeter to check whether the battery has output or not, if so this means that only the indicator is malfunction.
(2) Pop-up the button switch 2s and then press again, observe whether the indicator light is on or flashing - to check whether it`s a button poor connection.
(3) Try to use a DC charger with relevant charge voltage to charge to the module - to see whether the module is over-discharged.
(4) The error code will present via CAN BUS/Bluetooth/RS485. - if the battery is in the system error stage, then it will need to return to the local distributor for further repair activity.

② Single device shut down

Symptom: Battery goes into sleep mode/shut down, and there is still output voltage at the DC side of the battery
Possible condition: The discharge MOSFET shutdown failure. Need a swap of the component inside the module. Contact your local distributor for further help.

Symptom: The switch button pops up and the battery still has output.
Possible condition: If the battery can still communicate or the indicator light flashes normally, Switch button cannot be disconnected, switch failure. Contact your local distributor for further help.

③ Communication serial connection wake-up

Symptom: After the first device is powered on (Press the button to start or Voltage Activated Circuit), only some of the devices are powered on successfully (light blinks)
Inspection steps:
(1) According to the communication cable wiring order, if a device and its subsequent devices fail to power on, please check if the communication cable between the device and the previous device is loose, misconnected or if the wire is broken.
(2) Follow the "single device power on" problem to investigate.

④ Cascade battery power off

Symptom: After the first device is powered off, only some of the devices are powered down successfully (light blinks)

Inspection steps:

(1) According to the communication cable wiring order, if a device and its subsequent devices fail to power on, please check if the communication cable between the device and the previous device is loose, misconnected or if the wire is broken.

(2) Follow the "single device power down" problem to investigate.

⑤ Cascade device address assignment

Symptom: The indicator flashes (1s on and 1s off) or via close-loop communication, the host computer indicates address assignment failure

Inspection steps:

(1) First check whether the number of cascade units exceeds 16pcs - product design only supports a maximum of 16 cascade units.

(2)Then check whether the cascade is connected in the correct order - the correct order is the previous module link1 to the next module link0.

(3) Re-plug the cascade internal communication wire in order to observe whether the final number of assigned devices via CAN BUS/Bluetooth/RS485 and the actual number of connections are consistent.

⑥ Cascade equipment in operation

Symptom: Protocol communication or the host computer indicates that a device is offline

Inspection steps:

(1) Check the communication or the history of the host computer to determine whether the device is in the state of under voltage protection before it goes offline - the device will enter into sleep mode after under voltage protection, it is necessary to re-charge the battery at earliest.

(2) If the state before the device dropped is normal and there is no undervoltage protection, check whether the device link port wire is loose or connection problem.

Symptom: Communication with the first devices via CAN BUS/Bluetooth/RS485 is interrupted

Inspection steps:

(1) Check whether the communication wire connection with the first battery is loose.

(2) Read the battery's history records to check whether the first unit is in the under-voltage protection state before the connection is interrupted or the first unit is offline and the under-voltage protection state exists before it is offline - the first unit will notify all devices to enter hibernation after the under-voltage protection, or the first unit will notify all devices to enter hibernation forcibly when it monitors the under-voltage protection state before other devices are offline, at which time it is necessary to access the power supply to activate the device and charge it.

⑦ Battery's heating film does not work at low temperature

Symptom: Low temperature access to the power supply, battery cannot be charged. Heating film is not turned on and the battery did not start heating
Inspection steps:
(1) Check whether the heating film dry contact enable signal of the master battery is at off state (default is ON).
(2) Check whether the heat enable is active via CAN BUS/Bluetooth/RS485.
(3) Confirm the power output voltage and current are appropriate.
(4) Check whether the heating film has failed via CAN BUS/Bluetooth/RS485.

⑧ BMS system error

Symptom: Read the error code is system error via CAN BUS/Bluetooth/RS485
Inspection steps: Switch the battery on and off again, and if the fault code is not eliminated. Please switch off the module and contact your local distributor.

Excluding the points above, if the faulty still cannot be located, turn off battery and contact your local distributor.

7. Emergency Situation

1) Leaking Batteries

   If the battery pack leaks electrolyte, avoid contact with the leaking liquid or gas. If one is exposed to the leaked substance, immediately perform the actions described below.

   a) Inhalation: Evacuate the contaminated area and seek medical attention.

   b) Contact with eyes: Rinse eyes with flowing water for 15 minutes and seek medical attention.

   c) Contact with skin: Wash the affected area thoroughly with soap and water and seek medical attention.

      Ingestion: Induce vomiting and seek medical attention.

2) Fire

   NO WATER! Only dry powder fire or carbon dioxide extinguisher can be used; if possible, move the battery pack to a safe area before it catches fire.

3) Wet Batteries

   If the battery pack is wet or submerged in water, do not let people access it, and then contact Pylontech or an authorized dealer for technical support. Cut off all power switch on inverter side.

4) Damaged Batteries

   Damaged batteries are dangerous and must be handled with the utmost care. They are not fit for use and may pose a danger to people or property. If the battery pack seems to be damaged, pack it in its original container, and then return it to Pylontech or an authorized dealer.

	**Danger**

Damaged batteries may leak electrolyte or produce flammable gas.

8. Remarks

Recycle and disposal

In case a battery (normal condition or damaged) needs disposal or needs recycling, it shall follow the local recycling regulation (i.e. Regulation (EC) Nº 1013/2006 among European Union) to process, and using the best available techniques to achieve a relevant recycling efficiency.



Storage, Maintenance and Expansion

1) It is required to charge the battery at least once every 6 months, for this charge maintenance make sure the SOC is charged to higher than 90%
2) Every year after installation. The connection of power cable and screw are suggested to be checked. Make sure there is no loose, no broken, no corrosion at connection point. Check the installation environment make sure it is suitable for IP67 battery system.
3) If the battery is stored for long time, it is required to charge them every six months, and the SOC should be higher than 90%.
4) A new battery module can be added onto an existing system at any time. Please make sure the new battery is acting as the master. The new module, due to a higher SOH may have a difference on SOC with existing system, but it will not affect the parallel connection system performance.



PYLONTECH

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