Test Report issued under the responsibility of:

TÜVNORD

TEST REPORT
IEC 62619
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications

Report Number. .....:	**BL-DG23B1252-301**
Date of issue .....:	**2024-02-28**
Total number of pages.....:	**43**
Name of Testing Laboratory preparing the Report.....:	Dongguan BALUN Testing Technology Co., Ltd.
Applicant's name.....:	SUZHOU JOHNRAY SOLAR ENERGY CO., LTD
Address .....:	Room 209, Building 1, Lejiahui Business Plaza, New District, Suzhou, Jiangsu, China
Test specification:	
Standard.....:	IEC 62619:2022
Test procedure .....:	CB Scheme
Non-standard test method.....:	N/A
TRF template used .....:	IECEE OD-2020-F1:2021, Ed.1.4
Test Report Form No.....:	IEC62619B
Test Report Form(s) Originator ....:	UL(Demko)
Master TRF .....:	Dated 2022-06-23

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This report is not valid as a CB Test Report unless signed by an approved IECEE Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

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Test item description ..... :	Residential Lithium-ion Battery System
Trade Mark(s) ..... :	JOHNRAY
Manufacturer ..... :	Same as applicant
Model/Type reference ..... :	1) JRH51-S4; 2) JRH51-S5; 3) JRH51-S6; 4) JRH51-S7; 5) JRH51-S8; 6) JRH51-S9; 7) JRH51-S10
Ratings ..... :	1) 204.8V, 100Ah, 20.48kWh; 2) 256.0V, 100Ah, 25.60kWh; 3) 307.2V, 100Ah, 30.72kWh; 4) 358.4V, 100Ah, 35.84kWh; 5) 409.6V, 100Ah, 40.96kWh; 6) 460.8V, 100Ah, 46.08kWh; 7) 512.0V, 100Ah, 51.2kWh

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):

☒	**CB Testing Laboratory:**	Dongguan BALUN Testing Technology Co., Ltd.	
Testing location/ address.....:		No. 6 Industrial South Road, Songshan Lake District, Dongguan, Guangdong, China	
Tested by (name, function, signature).....:		Van Xu (Engineer)	Van Xu
Approved by (name, function, signature)...:		Simon Qi (Reviewer)	Simon Qi
☐	**Testing procedure: CTF Stage 1:**		
Testing location/ address.....:			
Tested by (name, function, signature).....:			
Approved by (name, function, signature)...:			
☐	**Testing procedure: CTF Stage 2:**		
Testing location/ address.....:			
Tested by (name + signature).....:			
Witnessed by (name, function, signature) .:			
Approved by (name, function, signature)...:			
☐	**Testing procedure: CTF Stage 3:**		
☐	**Testing procedure: CTF Stage 4:**		
Testing location/ address.....:			
Tested by (name, function, signature).....:			
Witnessed by (name, function, signature) .:			
Approved by (name, function, signature)...:			
Supervised by (name, function, signature) :			

List of Attachments (including a total number of pages in each attachment):
This report contains 43 pages, incl. Annex 1 (Photos) with 12 pages.

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
cl.7.2.3.3 Edge and corner drop test (cell or cell block, and battery system) cl. 8.2.2 Overcharge control of voltage (battery system) cl. 8.2.3 Overcharge control of current (battery system) cl. 8.2.4 Overheating control (battery system) Cell LF100LA were CB approved according to IEC 62619: 2022, Certificate No.: SG PSB-BT-03455, Report No.: 085-282260325-000 The battery system consists of 4 to 10 battery modules JRH51 and 1 main control box JRH51-PDU of in series, which corresponds to 7 models of 1) JRH51-S4; 2) JRH51-S5; 3) JRH51-S6; 4) JRH51-S7; 5) JRH51-S8; 6) JRH51-S9; 7) JRH51-S10 All models of battery system have the same component module, using same cell, and the same BMS. For over-voltage protection, over-current protection and overtemperature protection, the safety mechanism would not be influenced by number of batteries in the system, therefore battery type JRH51-S4 could be chosen as the representative testing unit. Number of samples required for testing: 2 battery system (B1-B2). The samples comply with the requirement of IEC 62619: 2022.	**Dongguan BALUN Testing Technology Co., Ltd.** No. 6 Industrial South Road, Songshan Lake District, Dongguan, Guangdong, China

Summary of compliance with National Differences (List of countries addressed):

N/A

☐ **The product fulfils the requirements of _____.**

Use of uncertainty of measurement for decisions on conformity (decision rule) :

☒ No decision rule is specified by the IEC standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty ("simple acceptance" decision rule, previously known as "accuracy method").

☐ Other:… (to be specified, for example when required by the standard or client, or if national accreditation requirements apply)

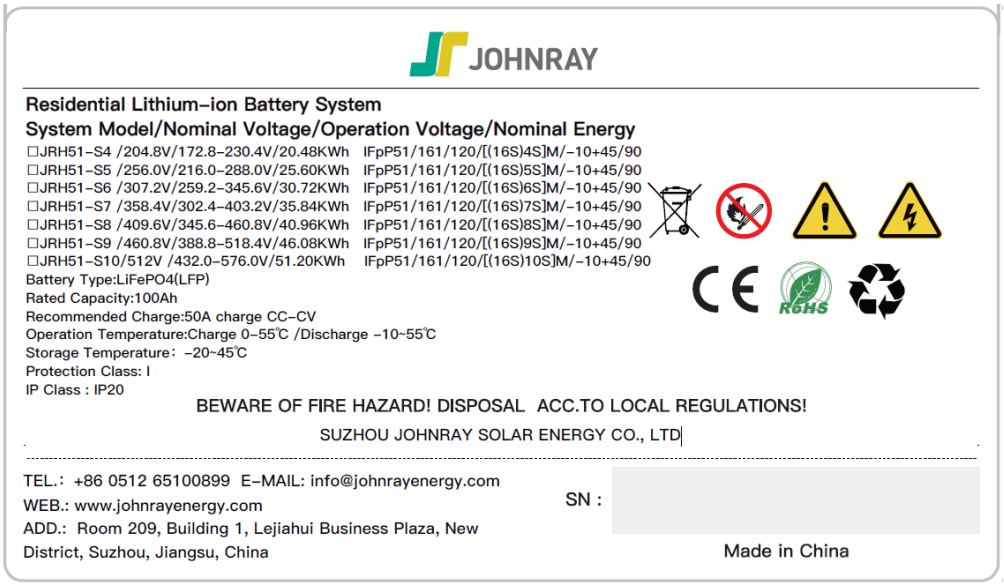
Information on uncertainty of measurement:
The uncertainties of measurement are calculated by the laboratory based on application of criteria given by OD-5014 for test equipment and application of test methods, decision sheets and operational procedures of IECEE.

IEC Guide 115 provides guidance on the application of measurement uncertainty principles and applying the decision rule when reporting test results within IECEE scheme, noting that the reporting of the measurement uncertainty for measurements is not necessary unless required by the test standard or customer.

Calculations leading to the reported values are on file with the NCB and testing laboratory that conducted the testing.

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.



Label of battery with model 1) JRH51-S4; 2) JRH51-S5; 3) JRH51-S6; 4) JRH51-S7; 5) JRH51-S8; 6) JRH51-S9; 7) JRH51-S10

Battery polarity

Remark: SN code encoding rules: BHAYYZZXXXXXX
1. B represent Lithium-ion battery system.
1. H represent product codes for different models, H or L, H is High-voltage battery. L is Low-voltage battery.
3. A represent product codes for different models. From A to Z.A is JRH51, B is JRH25, C is JRW48100, D is JRL5100.
4. YY represent year. For example, 22 is equal to 2022.
5. ZZ represent WEEK, From 01 to 53. For example, 01 is the first week.
6. XXXXXX is Check code

Test item particulars .....:	
Classification of installation and use .....:	To be defined in final product
Supply Connection.....:	DC connector
.....:	Charging the battery with 50A constant current until 230.4V, then constant voltage until charging current reduces to 0.05C.
Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A
- test object does meet the requirement.....:	P (Pass)
- test object does not meet the requirement.....:	F (Fail)
Testing.....:	
Date of receipt of test item .....:	2023-11-24
Date (s) of performance of tests.....:	2023-11-28 to 2023-12-25

General remarks:

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... :	☐ **Yes** ☒ **Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies).....:	Same as applicant

General product information and other remarks:

The battery system consists of 4 to 10 battery modules JRH51 and 1 main control box JRH51-PDU of in series, which corresponds to 7 models of 1) JRH51-S4; 2) JRH51-S5; 3) JRH51-S6; 4) JRH51-S7; 5) JRH51-S8; 6) JRH51-S9; 7) JRH51-S10.

All models of battery system have the same component module, using same cell, and the same BMS. For over-voltage protection, over-current protection and overtemperature protection, the safety mechanism would not be influenced by number of batteries in the system, therefore battery type JRH51-S4 could be chosen as the representative testing unit.

The main features of the battery are shown as below

Product information	Residential Lithium-ion Battery System	Residential Lithium-ion Battery System
Model	JRH51-S4	JRH51-S5
Nominal capacity	100Ah	100Ah
Nominal voltage	204.8V	256.0V
Nominal Charge Current	50A	50A
Maximum Charge Current	50A	50A
Nominal Discharge Current	60A	60A
Maximum Discharge Current	60A	60A
Maximum Charge Voltage	230.4V	288.0V
Upper limit charging voltage	/	/
Cut-off Voltage	172.8V	216.0V
Upper charge temperature	55°C	55°C
Lower charge temperature	0°C	0°C
Upper discharge temperature	55°C	55°C
Lower discharge temperature	-10°C	-10°C
Storage temperature range	-20°C - 45°C	-20°C - 45°C
Recommend charging method declared by the manufacturer	Charging the battery with 50A constant current until 230.4V, then constant voltage until charging current reduces to 0.05C	Charging the battery with 50A constant current until 288.0V, then constant voltage until charging current reduces to 0.05C
Recommend discharging method declared by the manufacturer	Discharging the battery with 60A constant current to discharge cut-off voltage 172.8V	Discharging the battery with 60A constant current to discharge cut-off voltage 216.0V
Nominal mass	(192.7±1)kg	(237.65±1)kg
External dimensions	440mm×650mm×580mm (W*H*D)	440mm×780mm×580mm (W*H*D)

The main features of the battery are shown as below

Product information	Residential Lithium-ion Battery System	Residential Lithium-ion Battery System
Model	JRH51-S6	JRH51-S7
Nominal capacity	100Ah	100Ah
Nominal voltage	307.2V	358.4V
Nominal Charge Current	50A	50A
Maximum Charge Current	50A	50A
Nominal Discharge Current	60A	60A
Maximum Discharge Current	60A	60A
Maximum Charge Voltage	345.6V	403.2V
Upper limit charging voltage	/	/
Cut-off Voltage	259.2V	302.4V
Upper charge temperature	55°C	55°C
Lower charge temperature	0°C	0°C
Upper discharge temperature	55°C	55°C
Lower discharge temperature	-10°C	-10°C
Storage temperature range	-20°C - 45°C	-20°C - 45°C
Recommend charging method declared by the manufacturer	Charging the battery with 50A constant current until 345.6V, then constant voltage until charging current reduces to 0.05C	Charging the battery with 50A constant current until 403.2V, then constant voltage until charging current reduces to 0.05C
Recommend discharging method declared by the manufacturer	Discharging the battery with 60A constant current to discharge cut-off voltage 259.2V	Discharging the battery with 60A constant current to discharge cut-off voltage 302.4V
Nominal mass	(282.6±1)kg	(327.55±1)kg
External dimensions	440mm×910mm×580mm (W*H*D)	440mm×1040mm×580mm (W*H*D)

The main features of the battery are shown as below

Product information	Residential Lithium-ion Battery System	Residential Lithium-ion Battery System
Model	JRH51-S8	JRH51-S9
Nominal capacity	100Ah	100Ah
Nominal voltage	409.6V	460.8V
Nominal Charge Current	50A	50A
Maximum Charge Current	50A	50A
Nominal Discharge Current	60A	60A
Maximum Discharge Current	60A	60A
Maximum Charge Voltage	460.8V	518.4V
Upper limit charging voltage	/	/
Cut-off Voltage	345.6V	388.8V
Upper charge temperature	55°C	55°C
Lower charge temperature	0°C	0°C
Upper discharge temperature	55°C	55°C
Lower discharge temperature	-10°C	-10°C
Storage temperature range	-20°C - 45°C	-20°C - 45°C
Recommend charging method declared by the manufacturer	Charging the battery with 50A constant current until 460.8V, then constant voltage until charging current reduces to 0.05C	Charging the battery with 50A constant current until 518.4V, then constant voltage until charging current reduces to 0.05C
Recommend discharging method declared by the manufacturer	Discharging the battery with 60A constant current to discharge cut-off voltage 345.6V	Discharging the battery with 60A constant current to discharge cut-off voltage 388.8V
Nominal mass	(372.5±1)kg	(417.45±1)kg
External dimensions	440mm×1170mm×580mm (W*H*D)	440mm×1300mm×580mm (W*H*D)

The main features of the battery are shown as below

Product information	Residential Lithium-ion Battery System	Cell inside the battery
Model	JRH51-S10	LF100LA
Nominal capacity	100Ah	102Ah
Nominal voltage	512.0V	3.2V
Nominal Charge Current	50A	50A
Maximum Charge Current	50A	100A
Nominal Discharge Current	60A	50A
Maximum Discharge Current	60A	250A
Maximum Charge Voltage	576.0V	3.65V
Upper limit charging voltage	/	/
Cut-off Voltage	432.0V	2.0V
Upper charge temperature	55°C	65°C
Lower charge temperature	0°C	0°C
Upper discharge temperature	55°C	65°C
Lower discharge temperature	-10°C	-30°C
Storage temperature range	-20°C - 45°C	-20°C - 45°C
Recommend charging method declared by the manufacturer	Charging the battery with 50A constant current until 576.0V, then constant voltage until charging current reduces to 0.05C	Charging the cell with 50A constant current until 3.65V, then constant voltage until charging current reduces to 0.05C
Recommend discharging method declared by the manufacturer	Discharging the battery with 60A constant current to discharge cut-off voltage 432.0V	Discharging the battery with 50A constant current to discharge cut-off voltage 2.0V
Nominal mass	(462.4±1)kg	(1.98±0.1)Kg
External dimensions	440mm×1430mm×580mm (W*H*D)	(49.9±1)mm×(160.0±1)mm×(118.5±1)mm (T*W*H)

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Clause	Requirement + Test	Result - Remark	Verdict
4	**PARAMETER MEASUREMENT TOLERANCES**		**P**
	Parameter measurement tolerances		P
5	**GENERAL SAFETY CONSIDERATIONS**		**P**
5.1	**General**		**P**
	Cells and batteries are safe under conditions of both intended use and reasonably foreseeable misuse... :	Clause 6, Clause 7, 8.1, and 8.2. See also table 5.1 for Critical components information	P
	Reduce the risk of injuries from moving parts		P
5.2	**Insulation and wiring**		**P**
	Voltage, current, altitude, and humidity requirements		P
	Adequate clearances and creepage distances between connectors and live parts at different voltages or between live parts and non-current-carrying accessible parts		P
	Protect from hazardous live parts, including during installation		P
	The mechanical integrity of internal connections	Wires and cables used are certified.	P
5.3	**Venting**		**P**
	Pressure relief function	Explosion-proof safety valve for venting exists.	P
	Encapsulation used to support cells within an outer casing		P
5.4	**Temperature/voltage/current management**		**P**
	The design prevents abnormal temperature-rise	Overcharge, over current and overheating proof circuit used in this battery. See tests of clause 8.	P
	Voltage, current, and temperature limits of the cells	See above.	P
	Specifications and charging instructions for equipment manufacturers	The charging limits specified in the user manual.	P
5.5	**Terminal contacts of the battery pack and/or battery system**		**P**
	Polarity marking(s)	See page 5.	P
	Polarity marking not provided for keyed external connector		P
	Capability to carry the maximum anticipated current	DC connector complied with the requirements.	P
	External terminal contact surfaces		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Terminal contacts are arranged to minimize the risk of short circuits		P
5.6	**Assembly of cells, modules, or battery packs into battery systems**		**P**
5.6.1	General		**P**
	Independent control and protection method(s)	Battery system has independent control and protective functions, and BMS is integrated into battery system.	P
	Recommendations of cell operating limits, mounting advice, storage conditions and other design recommendations by the cell manufacturer		P
	Batteries designed for the selective discharge of a portion of their series connected cells		N/A
	Protective circuit component(s) and consideration to the end-device application		P
5.6.2	Battery system design		P
	The voltage control function		P
	Maximum charging/discharging current of the cell are not exceeded		P
5.7	**Operating region of lithium cells and battery systems for safe use**		**P**
	The cell operating region..... :	Information mentioned in manufacturer's specifications.	P
	Designation of battery system to comply with the cell operating region	Information mentioned in manufacturer's specifications.	P
5.8	**System lock (or system lock function)**		**P**
	Non-resettable function to stop battery operation	Non-resettable protect function provided in the BMS security mechanism	P
	Manual with procedure for resetting of battery operation	Information mentioned in maintenance manual	P
	Emergency battery final discharge	Not for such application	N/A
5.9	**Quality plan**		**P**
	Manufacturing quality plan (for example: ISO9001, etc.) prepared and implemented..... :	Complied. ISO 9001: 2015 certificate provided. Certificate No. 02823Q10578R0S, issued by Beijing Zhong-An-Zhi-Huan Certification Center Co.,Ltd valid until: 2026-04-16.	P
	The process capabilities and the process controls		P

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Clause	Requirement + Test	Result - Remark	Verdict
6	**TYPE TEST CONDITIONS**		**P**
6.1	**General**		**P**
6.2	**Test items**		**P**
	Cells or batteries that are not more than six months old (See Table 1 of IEC 62619)		P
	Capacity confirmation of the cells or batteries		P
	Default ambient temperature of test, 25 °C ± 5 °C	Test complied.	P

7	**SPECIFIC REQUIREMENTS AND TESTS**		**P**
7.1	**Charging procedure for test purposes**		**P**
	The battery discharged to a specified final voltage prior to charging	Final voltage: 172.8V.	P
	The cells or batteries charged using the method specified by the manufacturer..... :	Discharging and charging are carried out in an ambient temperature of 25°C ± 5°C.	P
7.2	**Reasonably foreseeable misuse**		
7.2.1	External short-circuit test (cell or cell block)	CB approval cell used.	N/A
	Short circuit with total resistance of 30 mΩ ± 10 mΩ at 25 °C ± 5 °C		N/A
	Results: no fire, no explosion		N/A
7.2.2	Impact test (cell or cell block)	CB approval cell used.	N/A
	Cylindrical cell, longitudinal axis impact		N/A
	Prismatic cell, longitudinal axis and lateral axis impact		N/A
	Results: no fire, no explosion.		N/A
7.2.3	Drop test (cell or cell block, and battery system)		P
7.2.3.1	General		N/A
7.2.3.2	Whole drop test (cell or cell block, and battery system)	CB approval cell used.	N/A
	Description of the Test Unit..... :		—
	Mass of the test unit (kg)..... :		—
	Height of drop (m)..... :		—
	Results: no fire, no explosion		N/A
7.2.3.3	Edge and corner drop test (cell or cell block, and battery system)	Battery system applied.	P
	Description of the Test Unit..... :	Battery system.	—
	Mass of the test unit (kg)..... :	B1: 192.5kg	—
	Height of drop (m)..... :	0.025m	—

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Clause	Requirement + Test	Result - Remark	Verdict
	Results: no fire, no explosion	No fire, no explosion.	P
7.2.4	Thermal abuse test (cell or cell block)	CB approval cell used.	N/A
	Results: no fire, no explosion		N/A
7.2.5	Overcharge test (cell or cell block)	CB approval cell used.	N/A
	For those battery systems that are provided with only a single protection for the charging voltage control		—
	Results: no fire, no explosion ..... :		N/A
7.2.6	Forced discharge test (cell or cell block)	CB approval cell used.	N/A
	Cells connected in series in the battery system ..... :		N/A
	Redundant or single protection for discharge voltage control provided in battery system ..... :		N/A
	Target Voltage ..... :		N/A
	Maximum discharge current of the cell, Im..... :		N/A
	Discharge current for forced discharge, 1.0 It ..... :		N/A
	Discharging time, t = (1 It / Im) x 90 (min.) ..... :		N/A
	Results: no fire, no explosion ..... :		N/A
7.3	**Considerations for internal short-circuit – Design evaluation**		**P**
7.3.1	General		N/A
7.3.2	Internal short-circuit test (cell)	CB approval cell used.	N/A
	Samples preparation procedure: In accordance with Clause A.5 and A.6 of IEC 62133-2:2017		N/A
	Tested per 7.3.2 b) in an ambient temperature of 25 °C ± 5 °C.		N/A
	The appearance of the short-circuit location recorded by photograph or other means .....:		—
	The pressing was stopped - When a voltage drop of 50 mV was detected; or		N/A
	- The pressing force of 800 N (cylindrical cells) or 400 N (prismatic cells) was reached		N/A
	Results: no fire..... :		N/A
7.3.3	Propagation test (battery system)		**N/A**
	Method to create a thermal runaway in one cell ... :		N/A
	Results: No external fire from the battery system, no battery case rupture ..... :		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
8	**BATTERY SYSTEM SAFETY (CONSIDERING FUNCTIONAL SAFETY)**		**P**
8.1	**General requirements**		**P**
	Functional safety analysis for critical controls	Relevant documents provided by the client which indicate analysis for functional safety has been done according to IEC 60730-1 (Annex H)	P
	Conduct of a process hazard analysis for both the cell manufacturing process and the battery system manufacturing process		N/A
	Conduct of risk assessment and mitigation of the battery system	FMEA table has been submitted.	P
8.2	**Battery management system (or battery management unit)**		
8.2.1	Requirements for the BMS		P
	The safety integrity level (SIL) target of the BMS	Suitable for Class B control according to IEC 60730-1:2013, Annex H.	P
	The charge control evaluated by tests in clauses 8.2.2 to 8.2.4	Relevant tests (8.2.2, 8.2.3 and 8.2.4) have been performed and successfully passed.	P
8.2.2	Overcharge control of voltage (battery system)		P
	The exceeded charging voltage applied to the whole battery system	233.6V.	P
	The exceeded charging voltage applied to only a part of the battery system, such as the cell(s) ..... :		N/A
	Results: no fire, no explosion ..... :	See Table 8.2.2.	P
	The BMS terminated the charging before exceeding the upper limit charging voltage		P
8.2.3	Overcharge control of current (battery system)		P
	Results: no fire, no explosion ..... :	See Table 8.2.3.	P
	The BMS detected the overcharging current and controlled the charging to a level below the maximum charging current		P
8.2.4	Overheating control (battery system)		P
	The cooling system, if provided, was disconnected		P
	Elevated temperature for charging, 5 °C above maximum operating temperature ..... :	60°C	P
	Results: no fire, no explosion ..... :	See Table 8.2.4.	P
	The BMS detected the overheat temperature and terminated charging		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The battery system operated as designed during test		P

9	EMC		P
	Battery system fulfil EMC requirements of the end-device application ..... :	EMC has been evaluated in accordance with EN IEC 61000-6-1:2019, EN IEC 61000-6-3:2021., Certification No.: NE1105240021, issued by TÜV NORD.	P

10	INFORMATION FOR SAFETY		P
	The cell manufacturer provides information about current, voltage and temperature limits of their products	Included in datasheet.	P
	The battery system manufacturer provides information regarding how to mitigate hazards to equipment manufacturers or end-users.	Written in instruction manual.	P

11	MARKING AND DESIGNATION (REFER TO CLAUSE 5 OF IEC 62620)		P
	The marking items shown in Table 1 in IEC 62620 indicated on the cell, battery system or instruction manual.	The battery is marked in accordance with IEC 62620, also see page 5.	P
	Cell or battery system has clear and durable markings		P
	Cell designation		N/A
	Battery designation		P
	Battery structure formulation		P

12	PACKAGING AND TRANSPORT		N/A
	Refer to Annex D		N/A

ANNEX A	OPERATING REGION OF CELLS FOR SAFE USE		P
A.1	General		P
A.2	Charging conditions for safe use		P
A.3	Consideration on charging voltage	3.65V	P
A.4	Consideration on temperature		P
A.5	High temperature range		P
A.6	Low temperature range		P
A.7	Discharging conditions for safe use		P

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Clause	Requirement + Test	Result - Remark	Verdict
A.8	Example of operating region		P

ANNEX B	**PROCEDURE OF 7.3.3 PROPAGATION TEST BY LASER IRRADIATION**		**N/A**
B.1	**General**		N/A
B.2	**Test conditions**		N/A
B.2.1	Cell test (preliminary test)		N/A
	The cell fully charged according to the manufacturer recommended conditions ..... :		—
	Laser irradiation point on the cell ..... :		—
	Output power of laser irradiation..... :		—
	Tested in an ambient temperature of 25 °C ± 5 °C		N/A
	Repeat of cell test for 3 times		N/A
B.2.2	Battery system test (main test)		N/A
	The battery system fully charged according to the manufacturer recommended conditions ..... :		—
	Target cell to be laser irradiated ..... :		—
	The irradiation point on the target cell same or similar as that on the cell test		
	Output power of laser irradiation..... :		—
	Tested in an ambient temperature of 25 °C ± 5 °C		N/A

ANNEX C	**PROCEDURE OF 7.3.3 PROPAGATION TEST BY METHODS OTHER THAN LASER**		**N/A**
C.1	General		N/A
C.2	Test conditions:		N/A
	– The battery fully charged according to the manufacturer recommended conditions ..... :		—
	– Target cell forced into thermal runaway ..... :		—
	– A specially prepared sample (e.g. a heater or a hole for nail penetration provided) used for ease of testing..... :		—
C.3	Method used for initiating the thermal runaway. 1) Heater (Heater, Burner, Laser, Inductive heating 2) Overcharge 3) Nail penetration of the cell 4) Combination of above methods 5) Other methods..... :		—

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

ANNEX D	**PACKAGING AND TRANSPORT**		**N/A**
	The materials and pack design chosen in a way as to prevent the development of unintentional electrical conduction, corrosion of the terminals and ingress of environmental contaminants		N/A
	Regulations concerning international transport of secondary lithium batteries		N/A

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

5.1	TABLE: Critical components information	P

Object / part No.	Manufacturer/ trademark	Type / model	Technical data	Standard	Mark(s) of conformity[1)]
Enclosure of battery	Suzhou Highball Technology Co., Ltd.	JRH51-03	Dimensions(L*W*H), 580*440*130, SPCC thickness 1.5mm	IEC 62619:2022	Tested with apparatus
Enclosure of PDU	Suzhou Highball Technology Co., Ltd.	JRH51-06	Dimensions(L*W*H), 580*440*130, SPCC thickness 1.5mm	IEC 62619:2022	Tested with apparatus
DC Connector1 (P+)	General connectivity system CO., Ltd	PSR6XCBM5A	1000VDC 100A IP67, -40°C ~ +105°C	2 PFG 2740/04.20	TUV RH: R 50584986
DC Connector2 (P-)	General connectivity system CO., Ltd	PSR6XCBM5A	1000VDC 100A IP67, -40°C ~ +105°C	2 PFG 2740/04.20	TUV RH: R 50584986
DC Connector3 (B+)	General connectivity system CO., Ltd	PSR6XCBM5A	1000VDC 100A IP67 -40°C ~ +105°C	2 PFG 2740/04.20	TUV RH: R 50584986
DC Connector4 (B-)	General connectivity system CO., Ltd	PSR6XCBM5A	1000VDC 100A IP67 -40°C ~ +105°C	2 PFG 2740/04.20	TUV RH: R 50584986
Main Busbar1	Changyuan Electronics Group Co Ltd	JRH51-26	CuT2-M, Thickness: 2mm. Dimensions(LxWxH): 117x64.9x75mm	IEC 62619:2022	Tested with apparatus
Main Busbar2	Changyuan Electronics Group Co Ltd	JRH51-27	CuT2-M, Thickness: 2mm. Dimensions(LxWxH): 141x64.9x72mm	IEC 62619:2022	Tested with apparatus
Main Busbar3	Changyuan Electronics Group Co Ltd	JRH51-28	CuT2-M, Thickness: 2mm. Dimensions(LxWxH): 258x125x45mm	IEC 62619:2022	Tested with apparatus
Main Busbar4	Changyuan Electronics Group Co Ltd	JRH51-29	CuT2-M, Thickness: 2mm. Dimensions(LxWxH): 120x28x16mm	IEC 62619:2022	Tested with apparatus

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

Main Busbar5	Changyuan Electronics Group Co Ltd	JRH51-30	CuT2-M, Thickness: 2mm, Dimensions(LxWxH): 124.7x168.3x31.8 mm	IEC 62619:2022	Tested with apparatus
Main Busbar6	Changyuan Electronics Group Co Ltd	JRH51-31	CuT2-M, Thickness: 2mm, Dimensions(LxWxH): 295.2x161.9x9mm	IEC 62619:2022	Tested with apparatus
Main Busbar7	Changyuan Electronics Group Co Ltd	JRH51-31	CuT2-M, Thickness: 2mm, Dimensions(LxWxH): 332x55.5x6mm	IEC 62619:2022	Tested with apparatus
Tubing	CHANGYUAN ELECTRONICS GROUP CO LTD	CB-HFT(TM)	600V UL94 V-0 120°C	UL224	UL E180908
Air Switch	ProJoy Electric Co., Ltd.	PEBS-H-63	63A 3P 750V	IEC 62619:2022	Tested with apparatus
Contactor (positive)	Xiamen Hongfa Electroacoustic Co., Ltd	HFE82V-60B-24-HL5	60A 750VDC	EN 60947-1:2007/A2:2004	TUV SÜD: B 053286 0044 Rev.00
Contactor (negative)	Xiamen Hongfa Electroacoustic Co., Ltd	HFE82V-60B-24-HL5	60A 750VDC	EN 60947-1:2007/A2:2004	TUV SÜD: B 053286 0044 Rev.00
Contactor (precharge)	SHANGHAI CII ELECTRONICS CO LTD	EV20-24AD-E	20A 24VDC	IEC 62619:2022	Tested with apparatus
Contactor (soft start)	SHANGHAI CII ELECTRONICS CO LTD	EV20-24AD-E	20A 24VDC	IEC 62619:2022	Tested with apparatus
DC-DC Converter	Mornsun Guangzhou Science & Technology Co., Ltd	PV50-25B24	Input:150-650VDC, 0.9A, Output: 24VDC, 2083mA	IEC 62619:2022	Tested with apparatus
Internal wiring (B+ to PCB)	DANYANG WINPOWER WIRE & CABLE MFG CO LTD	10269	105°C, 10AWG, 1000Vac	UL 758	UL E330446

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

Internal wiring (B- to PCB)	DANYANG WINPOWER WIRE&CABLE MFG CO LTD	10269	105°C, 10AWG, 1000Vac	UL758	UL E330446
Internal wiring (BMS signal line X port)	HANSTAR FLUORO-PLASTIC INSULATED ELECTRIC WIRES	1569	90°C, 300Vac. 22AWG	UL 758	UL E159007
Internal wiring (BMS signal line Y port)	HANSTAR FLUORO-PLASTIC INSULATED ELECTRIC WIRES	1569	90°C, 300Vac. 22AWG	UL 758	UL E159007
Internal wiring (BMS signal line H port)	HANSTAR FLUORO-PLASTIC INSULATED ELECTRIC WIRES	1569	90°C, 300Vac. 22AWG	UL 758	UL E159007
Internal wiring (Precharge resistor)	KUNSHANYESSEN ELECTRONIC INDUSTRY CO LTD	1007	80°C, 20AWG, 300Vac	UL758	UL E523588
Internal wiring (temperature)	HANSTAR FLUORO-PLASTIC INSULATED ELECTRIC WIRES	1569	90°C, 300Vac. 22AWG	UL758	UL E159007
BMS Board, Model: P720-W					
BCU	Anhui Youdan Technology Co., Ltd	P720-W	Top: -40 to 85°C, 6-36V	IEC 62619:2022	Tested with apparatus
Shell of BCU	LG CHEM POLAND SP Z OO	LUTREL GP-2306	Thickness 1.5mm, V-0, 140°C	UL94	UL E353371
PCB of BCU	Ganzhou Beyond Sci-tech Co Ltd	BY003	130°C, V-0	UL 796	UL E243002
-Fuse (integrated) of BMS	POLYTRONICS TECHNOLOGY CORP	SMFS1206P100	1A, 32V	UL 248-1	UL E331807

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

-MCU (U54)	CHIPON	KF32A152	Supply voltage: 2.7 to 5.5V, Ta:-40 to 125°C	IEC 62619:2022	Tested with apparatus
-AFE (U9)	Cirrus Logic	CS5480-INZ	Supply voltage: 3.0 to 3.6V, T_a: -40 to 85 °C	IEC 62619:2022	Tested with apparatus
-High-Side Power Switch IC (U34, U38)	Infineon	BTS724G	Operating voltage: 5.5 to 40V, Operating temperature range: -40 to 150°C	IEC 62619:2022	Tested with apparatus
-High-speed CAN transceiver IC (U15)	NXP	TJA1042T/3	Supply voltage: 4.5 to 5.5V, T_{vj}: -40 to 150°C	IEC 62619:2022	Tested with apparatus
-Optical coupler (U8, U13, U33)	EVERLIGHT ELECTRONICS CO LTD	EL3H7	Isolation voltage: 3750Vrms, Operating temperature range: -55 to 110°C	UL 1577	UL E214129
-Optical coupler (U1, U24)	TOWARD	ELM440A(TA)	Isolation voltage: 3750Vrms, Operating temperature range: -55 to 110 °C	UL 1577	UL E214129
-Fuse (external) of BMS	Xi'an Sinofuse Electric Co Ltd	RS308-HB-4G50A	50A 750VDC	IEC 62619:2022	Tested with apparatus
-PTC of BMS (L3, L15, L16, L17)	PPTC	SMD1206P020TF/24	24V 4.8W	IEC 62619:2022	Tested with apparatus
-Control IC of BMS MCU (U54)	CHIPON	KF32A152	Supply voltage: 2.7 to 5.5 V	IEC 62619:2022	Tested with apparatus
-Optical coupler (U39, U63)	PANASONIC	AQV258HAXC88	Isolation voltage: 3750Vrms, Operating temperature range: -40 to 85°C	IEC 62619:2022	Tested with apparatus

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

-Isolation chip (U27, U20)	Shanghai Chipanalog Microelectronics Co Ltd	CA-IS3722HS	Isolation voltage: 3750Vrms, Operating temperature range: -40to 125°C	UL1577	UL E511334
-Isolation chip (U55)	2Pai Semiconductor Co., Limited	π141E61	Isolation voltage: 5000Vrms, Operating temperature range: -40 to 125°C	UL 1577	UL E494497
-Isolation chip (U47)	2Pai Semiconductor CO., Limited	∏220N31	Isolation voltage: 3000Vrms Operating temperature range: -40 to 125°C	UL 1577	UL_E494497
-Connector (U62)	JIANGSU YXT PRECISION ELECTRONICS CO.,LTD.	WTB41-B132HW1-001	1000V, 3A, T_a: -40°C to 125°C	UL 1977	UL E532919
-Connector (U60)	JIANGSU YXT PRECISION ELECTRONICS CO.,LTD.	WTB41-B136HW1-001	1000V, 3A, T_a: -40°C to 125°C	UL 1977	UL E532919
-Connector (J4)	DongGuan KD New Energy Technology Co.,LTD	PH3.5 12P	1000V, 3A, T_a: -40°C to 125°C	IEC 62619:2022	Tested with apparatus
-Battery (U57)	SEIKO INSTRUMENTS INC MICRO-ENERGY DIV	MS621FE	Max Charging Current: 300mA, Max Charging Voltage: 3.4V T_{vj}: -40 to 85 °C	UL 1642	UL MH15628
-MOSFET of BMS (Q7, Q11, Q78, Q79)	LRC	L2N7002KLT1G	V_{DS}: 60V	IEC 62619:2022	Tested with apparatus
Battery module					
BMU	Anhui Youdan Technology Co., Ltd	Model: M722	Hardware version: V1.0.2, Software version: V1.0.3	IEC62619:2022	Tested with apparatus
-PCB material	Ganzhou Beyond Sci-tech Co Ltd	BY003	130°C, V-0, thickness: 2.0mm	UL 796	UL E243002

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

-IC for AFE (U2, U4, U6)	CHIPWAY	XL8812-1	Supply voltage: 12 to 75V, Ta: -40 to 125 °C	IEC 62619:2022	Tested with apparatus
-MOSFET	DIODES	DMP3160L-7-01	V_{DS}: 30 V, V_{GS}: 20 V, I_D: 2 A, T_{stg}: -55 °C to 150 °C	IEC62619:2022	Tested with apparatus
-Communication (U1, U3, U5, U7)	Jwd Technology	S06107BA	Isolation voltage: 4300V, Operating temperature range: -40 to 85°C	IEC 62619:2022	Tested with apparatus
-Magnet Wire	ELEKTRISOLA HANGZHOU CO LTD	Polysol 180 FIW	MW 85-C, 180°C	UL 1446	UL E258243
-NTC (R90, R274)	TDK Electronics GmbH & Co OG	B57332V5103 F360	Resistance at 25°C: 10000k ohm, T_{moa}: 125°C	UL 1434	UL E69802
- Balanced resistance	YAGEO	RC1206FR-07100RL	100Ω±1%, T_{opr}: -55°C to 155°C	IEC 62619:2022	Tested with apparatus
Cell	EVE Power Co., Ltd.	LF100LA	3.2V, 102Ah	IEC 62619: 2022	CB Certificate No.: SG PSB-BT-03455
Supplementary information: 1) Provided evidence ensures the agreed level of compliance. See OD-CB2039.					

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

7.2.1	TABLE: External short-circuit test (cell or cell block)	N/A

Sample No.	Ambient (at 25°C ± 5°C)	OCV at start of test (V dc)	Resistance of Circuit (mΩ)	Maximum Case Temperature Rise ΔT (°C)	Results
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

Supplementary information:

A – No fire or Explosion
B – Fire
C – Explosion
D – The test was completed after 6 h
E – The test was completed after the cell casing cooled to 20% of the maximum temperature rise
F – Other (Please explain):___

7.2.5	TABLE: Overcharge test (cell or cell block)	N/A

Sample No.	OCV at start of test (V dc)	OCV at end of test (V dc)	Measured Maximum Charging Current (A)	Measured Maximum Charging Voltage (V dc)	Max. Cell Case Temperature (°C)	Results
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--

Supplementary information:

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D – Test concluded when temperature reached a steady state condition
E – Test concluded when temperature returned to ambient
F – Other (Please explain): _____

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

7.2.6	TABLE: Forced discharge test (cell or cell block)				N/A
Sample No.	**OCV before applying reverse charge (V dc)**	**Target Voltage (V dc)**	**Measured Reverse Charge Current It (A)**	**Total Time for Reversed Charge Application (min)**	**Results**
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

Supplementary information:

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D – Other (Please explain): ___

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

7.3.2	TABLE: Internal short-circuit test (cell)	N/A

Sample No.	OCV at start of test (V dc)	Particle location [1)]	Maximum applied pressure (N)	Results
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
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--	--	--	--	--
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--	--	--	--	--

Supplementary information:

[1)] Identify one of the following**:**

1: Nickel particle inserted between positive and negative (active material) coated area.

2: Nickel particle inserted between positive aluminium foil and negative active material coated area.

Results:

A – No fire or explosion
B – Fire
C – Explosion
D – Test concluded when 50 mV voltage drop occurred prior to reaching force limit
E – Test concluded when 800/400 N pressure was reached and 50 mV voltage drop was not achieved
F – Test was concluded when fire or explosion occurred
G – Other (Please explain): __

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

7.3.3	TABLE: Propagation test (battery system)				N/A
Sample No.	**OCV of Battery System Before Test (V dc)**	**OCV of Target Cell Before Test (V dc)**	**Maximum Cell Case Temperature (°C)**	**Maximum DUT Enclosure Temperature (°C)**	**Results**
--	--	--	--	--	--
--	--	--	--	--	--
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Method of cell failure [1)]	**Location of target cell**	**Area for fire protection (m^2)**
--	--	--
--	--	--
--	--	--

Supplementary information:

1) Cell can be failed through laser exposure, applied heat, overcharge, nail penetration or combinations of these failures or other acceptable methods. See supporting documentation for details on cell failure method

2) If the battery system has no outer covering, the manufacturer is required to specify the area for fire protection.

Results:
A – No fire external to DUT enclosure or area for fire protection or no battery case rupture
B – Fire external to DUT enclosure or area for fire protection
C – Explosion
D – Battery case rupture
E – Other (Please explain): __

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

8.2.2	TABLE: Overcharge control of voltage (battery system)				P
Sample No.	**OCV at start of test for Cell/Cell Blocks (V dc)**	**Maximum Charging Current (A)**	**Max. Charging Voltage (V dc)**	**Max. Voltage of Cell/Cell Blocks (V dc)**	**Results**
B2	2.774	50	221.6	3.722	A, D, F

	Charge Voltage Applied Battery System: 1)	
	Whole	**Part**
	233.6V	/

Supplementary information:

1. The exceeded voltage can be applied to only a part of the system such as the cell(s) in the battery system per Figure 6 of IEC 62619, if it is difficult to do it in using the whole battery system.

Results:
A – No Fire or Explosion
B – Fire
C – Explosion
D – The voltage of the measured cells or cell blocks did not exceed the upper limit charging voltage
E – The voltage of the measured cells or cell blocks did exceed the upper limit charging voltage
F – All function of battery system did operate as intended during the test.
G – All function of battery system did not operate as intended during the test.
H – Other (Please explain): ___

8.2.3	TABLE: Overcharge control of current (battery system)			P
Sample No.	**OCV at start of test (V dc)**	**Max. Charging Current (A)**	**Max. Charging Voltage (V dc)**	**Results**
B2	197.7	60	205.6	A, D, F

Supplementary information:

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D – Overcurrent sensing function of BMU did operate and then charging stopped
E – Overcurrent sensing function of BMU did not operate and then charging stopped
F – All function of battery system did operate as intended during the test.
G – All function of battery system did not operate as intended during the test.
H – Other (Please explain): ____

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

8.2.4	TABLE: Overheating control (battery system)		P
Model No.	**OCV at start(SOC 50%) of test (V dc)**	**Maximum Charging Current (A)**	**Maximum Charging Voltage (V dc)**
B2	212.3	50	230.4
Maximum Specified Temperature of Battery System (°C)		**Maximum Measured Cell Case Temperature (°C)**	**Results**
55.0		56.0	A, D, F

Supplementary information:

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D – Temperature sensing function of BMU did operate and then charging stopped
E – Temperature sensing function of BMU did not operate and then charging stopped
F – All function of battery system did operate as intended during the test.
G – All function of battery system did not operate as intended during the test.
H – Other (Please explain): ____

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

9	**TABLE: EMC**				**P**
Standard used for EMC test:					
Sample No.	**EMC Test Item**	**Battery Condition**	**EMC Test Level/ Parameters**	**Compliance Criteria**	**Results**

Supplementary information:

Battery Condition During EMC test

1 – In Operation Mode, [ ] Supplied at ____, [ ] Load at____

2 – In non-operation Mode, Battery state of charge (SOC) before test at around____

Compliance Criteria and Test Results:
A – No fire or Explosion
B – Fire
C – Explosion
D – Battery system did operate as intended during the test.
E - All function of battery system did operate as intended after the test.
F - All function of battery system did not operate as intended during the test, (Please explain): ____
G - Other (Please explain): ____

Battery system has fulfilled EMC requirements of the end-device application in accordance with EN IEC 61000-6-1:2019, EN IEC 61000-6-3:2021., Certification No.: NE1105240021, issued by TÜV NORD.

ANNEX 1: PHOTOS

Model type: 1) JRH51-S4; 2) JRH51-S5; 3) JRH51-S6; 4) JRH51-S7; 5) JRH51-S8; 6) JRH51-S9; 7) JRH51-S10

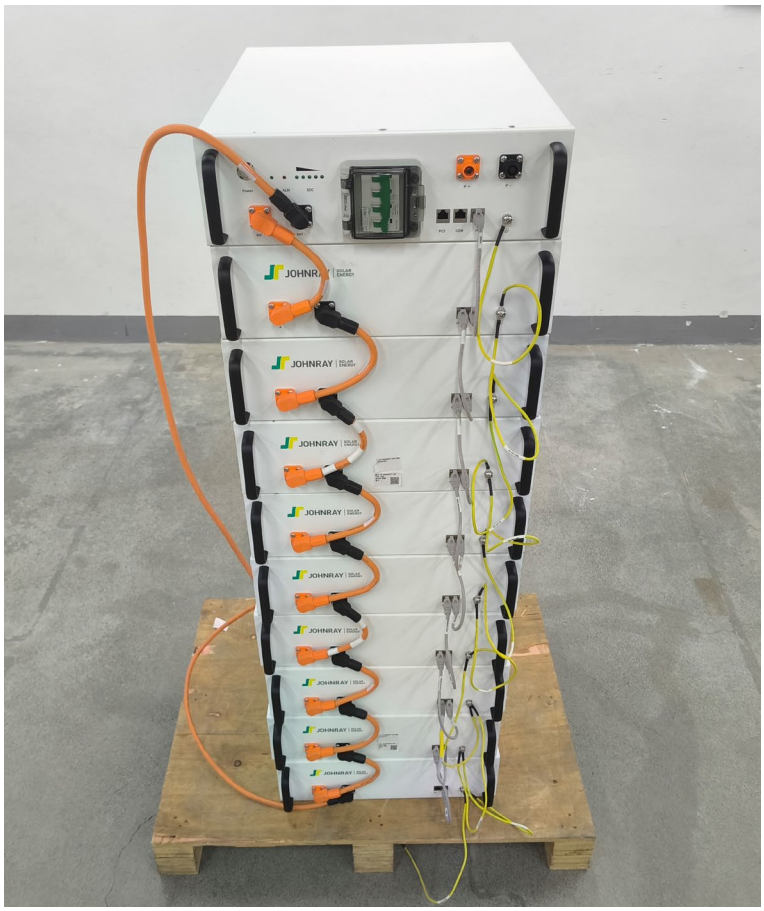
Front view of battery JRH51-S4

Front view of battery JRH51-S5

Front view of battery JRH51-S6

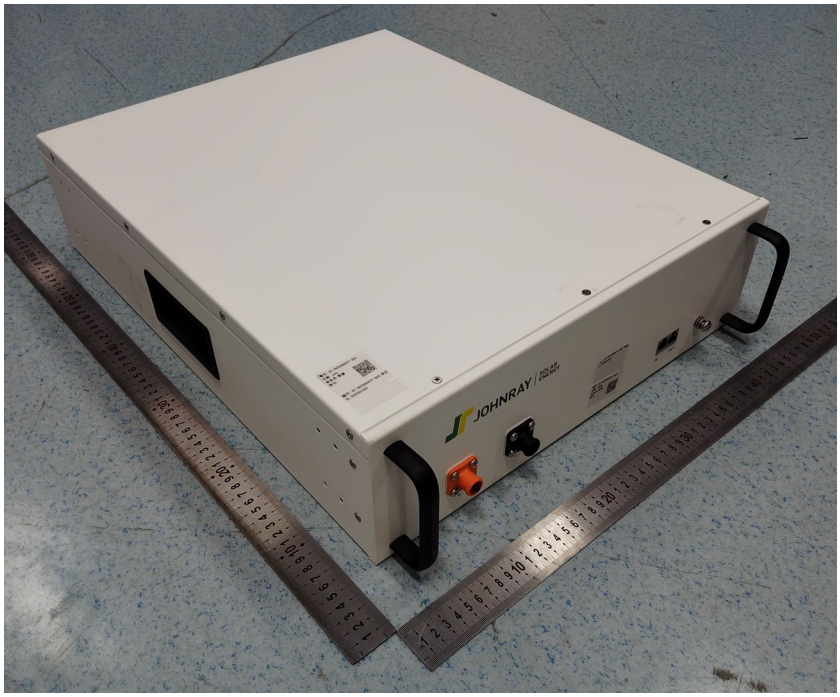
Front view of battery JRH51-S7

Front view of battery JRH51-S8

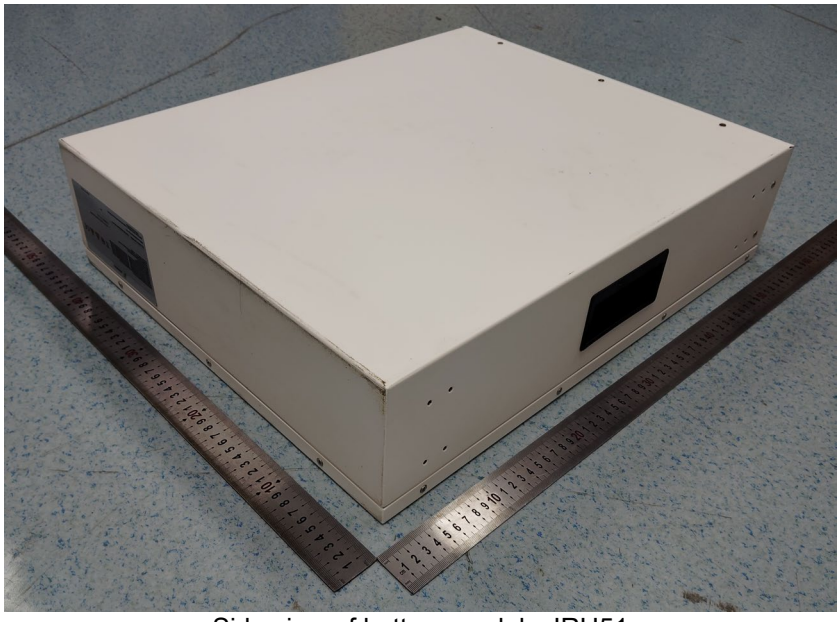


Front view of battery JRH51-S9

Front view of battery JRH51-S10

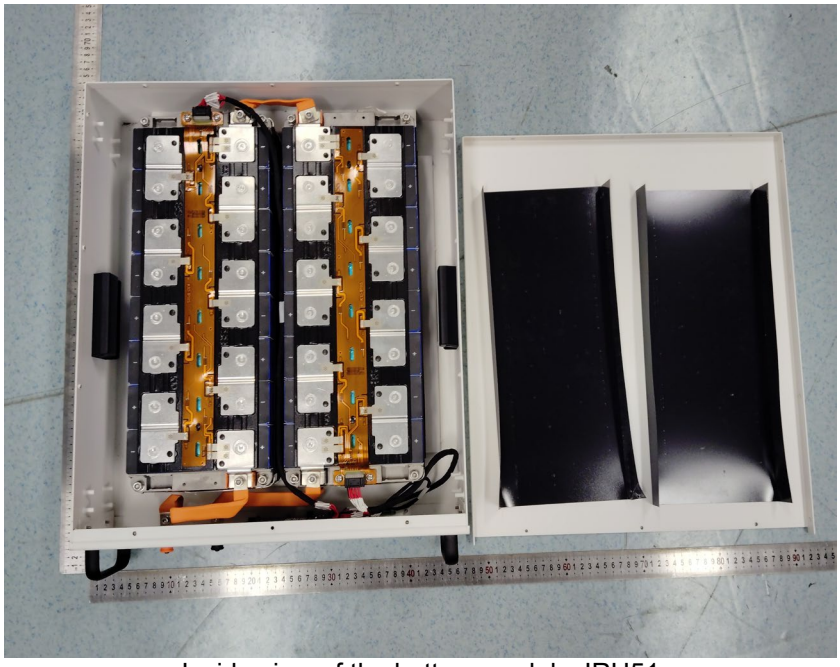


Side view of battery module JRH51

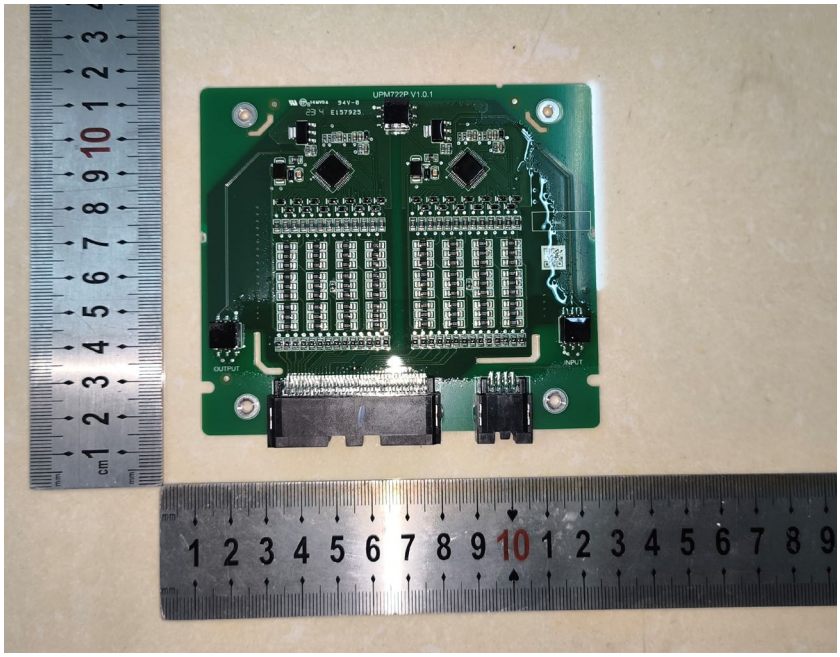


Side view of battery module JRH51

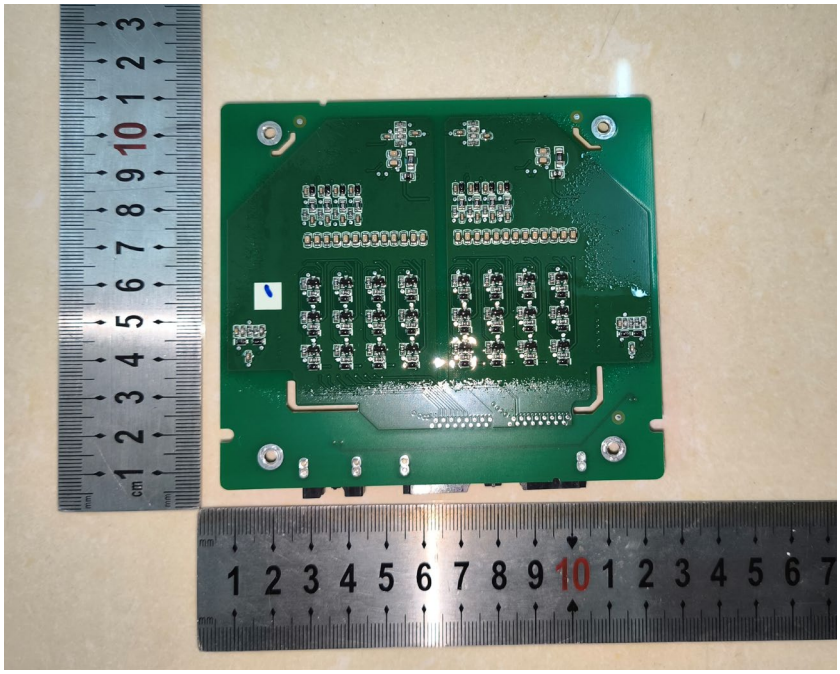
Battery module JRH51 communication port



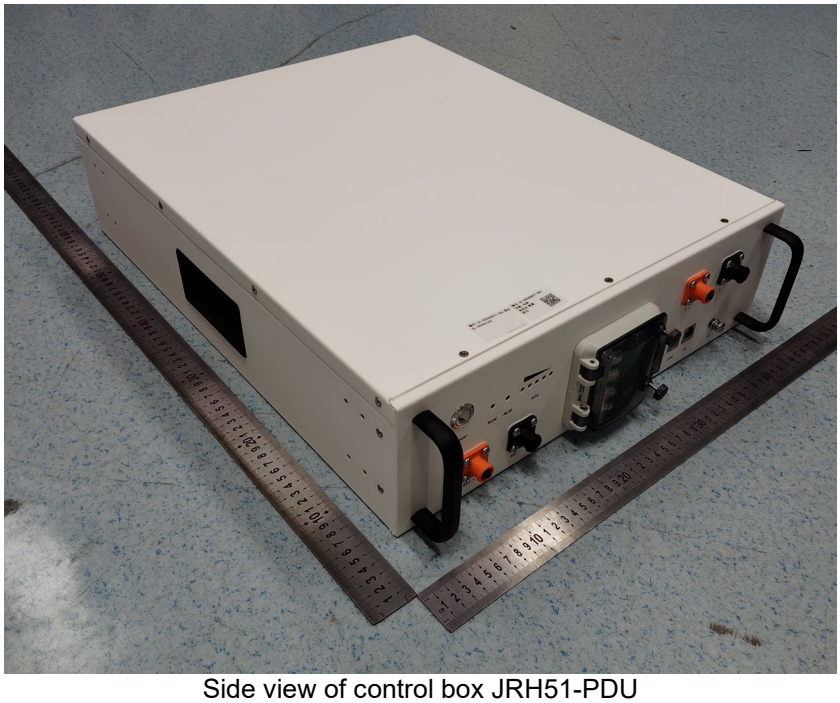
Inside view of the battery module JRH51



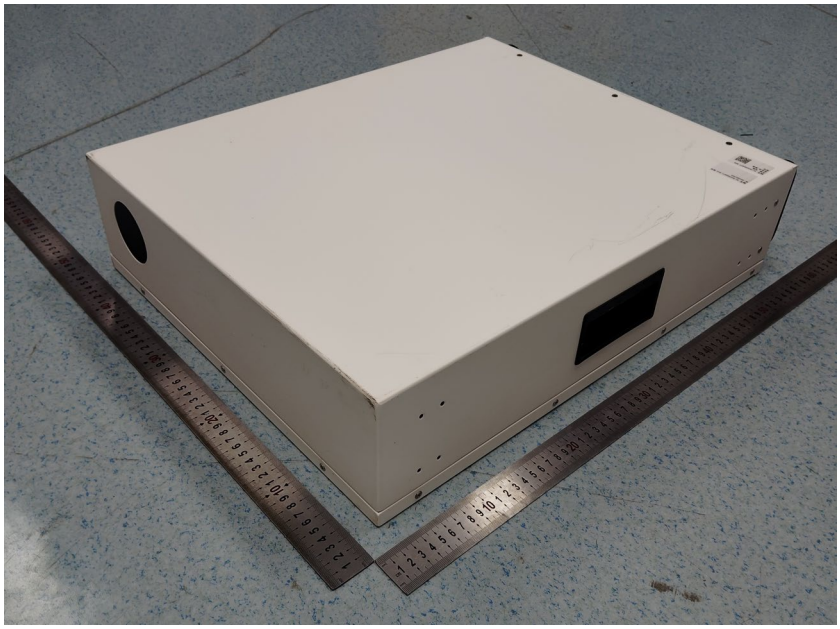
Acquisition board of the battery module



Acquisition board of the battery module

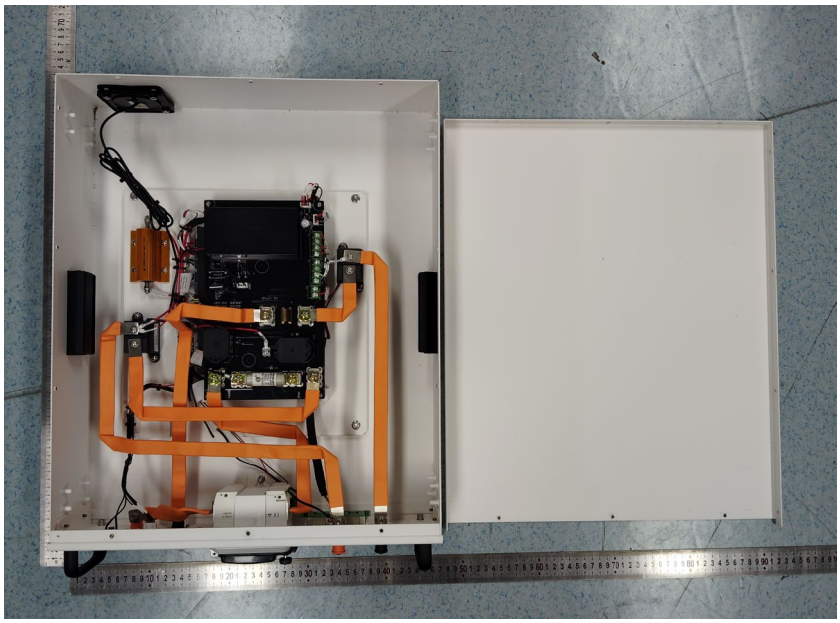


Side view of control box JRH51-PDU



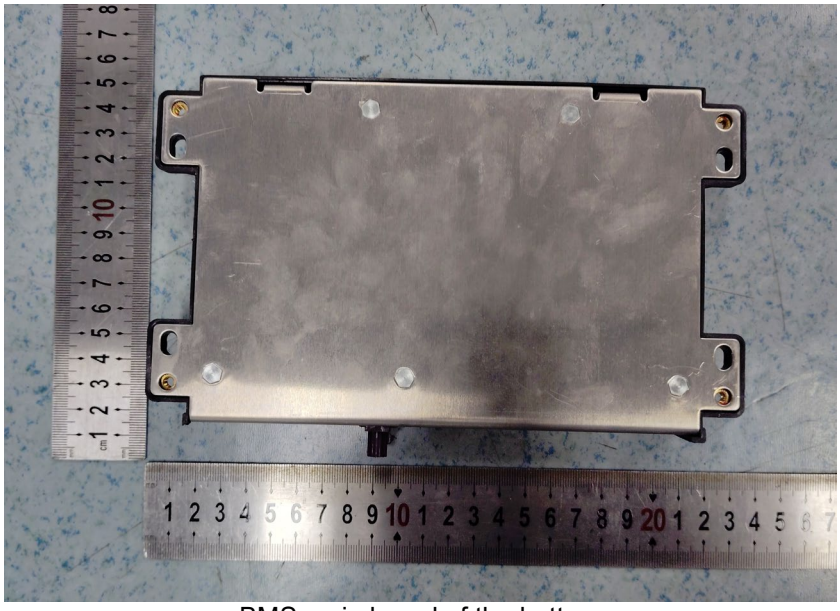
Side view of control box JRH51-PDU

control box JRH51-PDU communication port

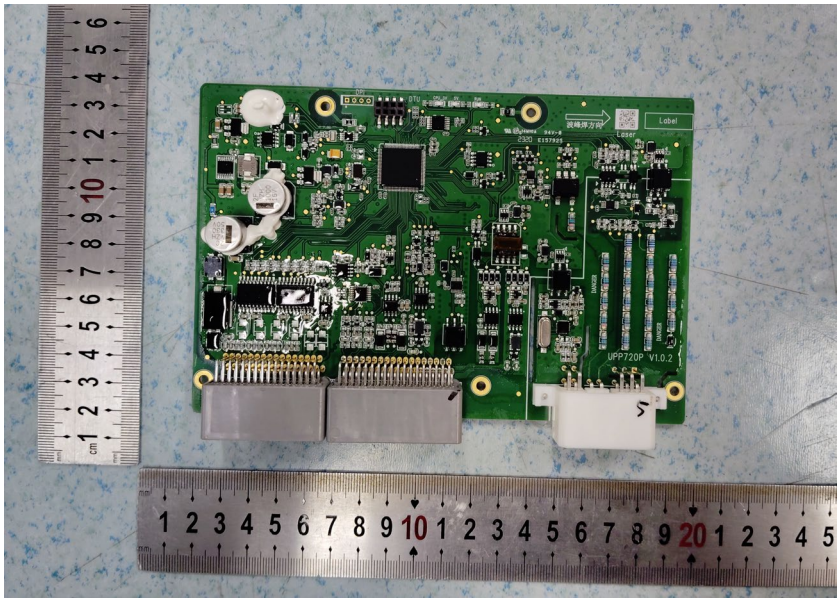


Inside view of the control box JRH51-PDU

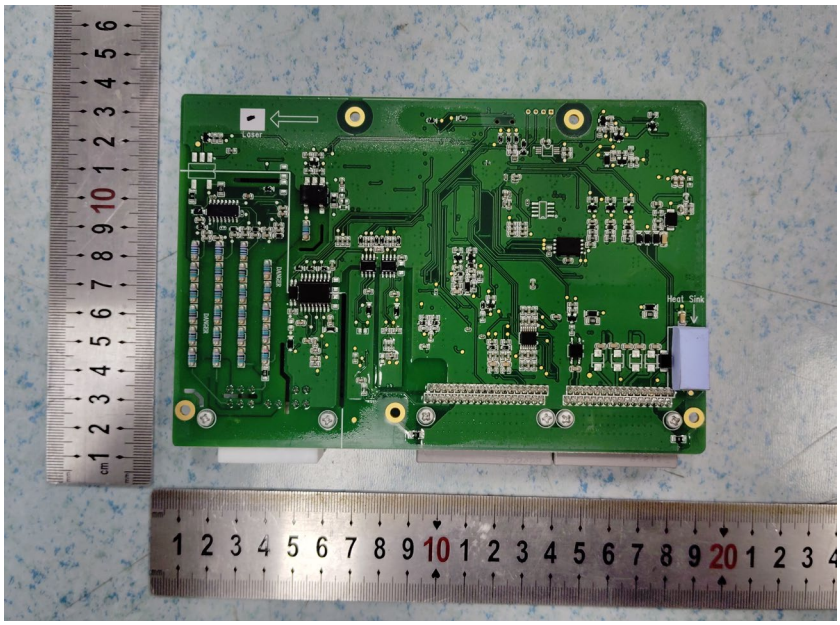
BMS main board of the battery



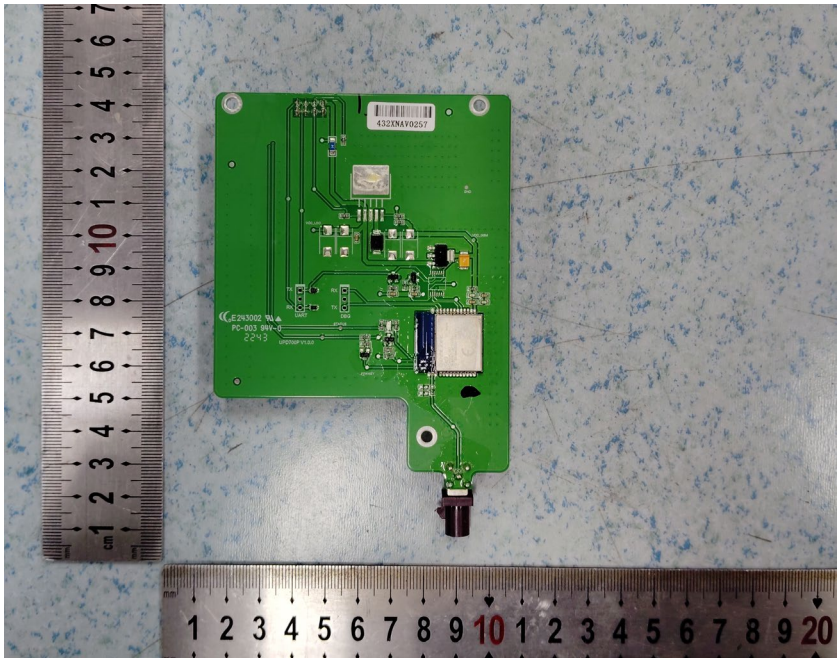
BMS main board of the battery



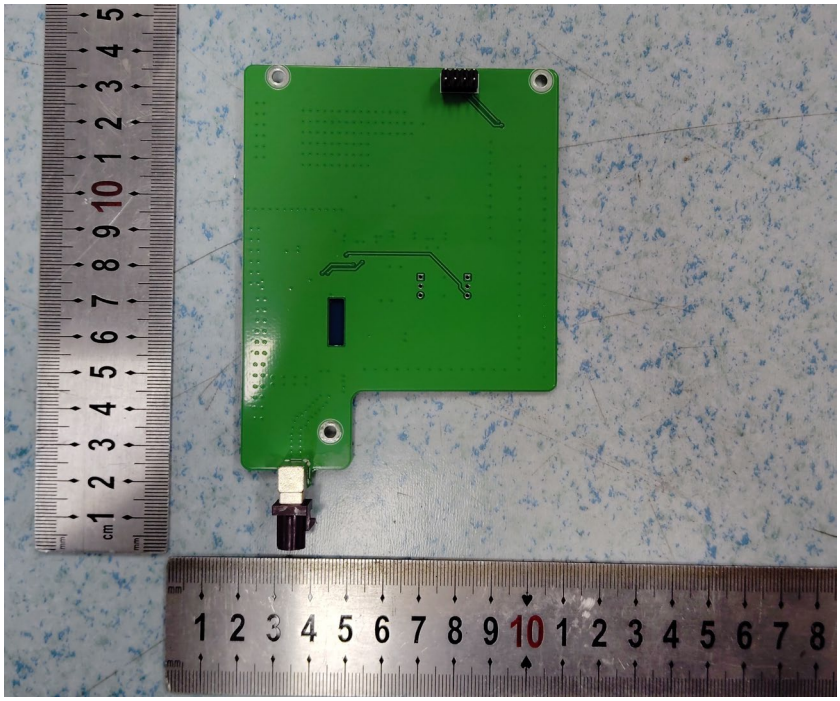
BMS main board of the battery



BMS main board of the battery



Communication Board of the battery



Communication Board of the battery

--End of test report--