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.....:	AZT022011200034B-IE010
Date of issue.....:	2020.11.25
Total number of pages.....	23pages
Name of Testing Laboratory preparing the Report .....:	Shenzhen AZT Technology Co., Ltd.
Applicant's name.....:	Mica Power Co., LTD
Address.....:	153# ChangShun Road, DaLang Town, Dongguan City, PR China
Manufacture name .....:	Mica Power Co., LTD
Address.....:	153# ChangShun Road, DaLang Town, Dongguan City, PR China
Test specification:	
Standard.....:	IEC 62619: 2017
Test procedure.....:	Test Report
Non-standard test method.....:	N/A
Test Report Form No.....:	IEC62619A
Test Report Form(s) Originator.....:	UL(Demko)
Master TRF.....:	Dated 2018-06-07

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

General disclaimer:

The test results presented in this report relate only to the object tested.
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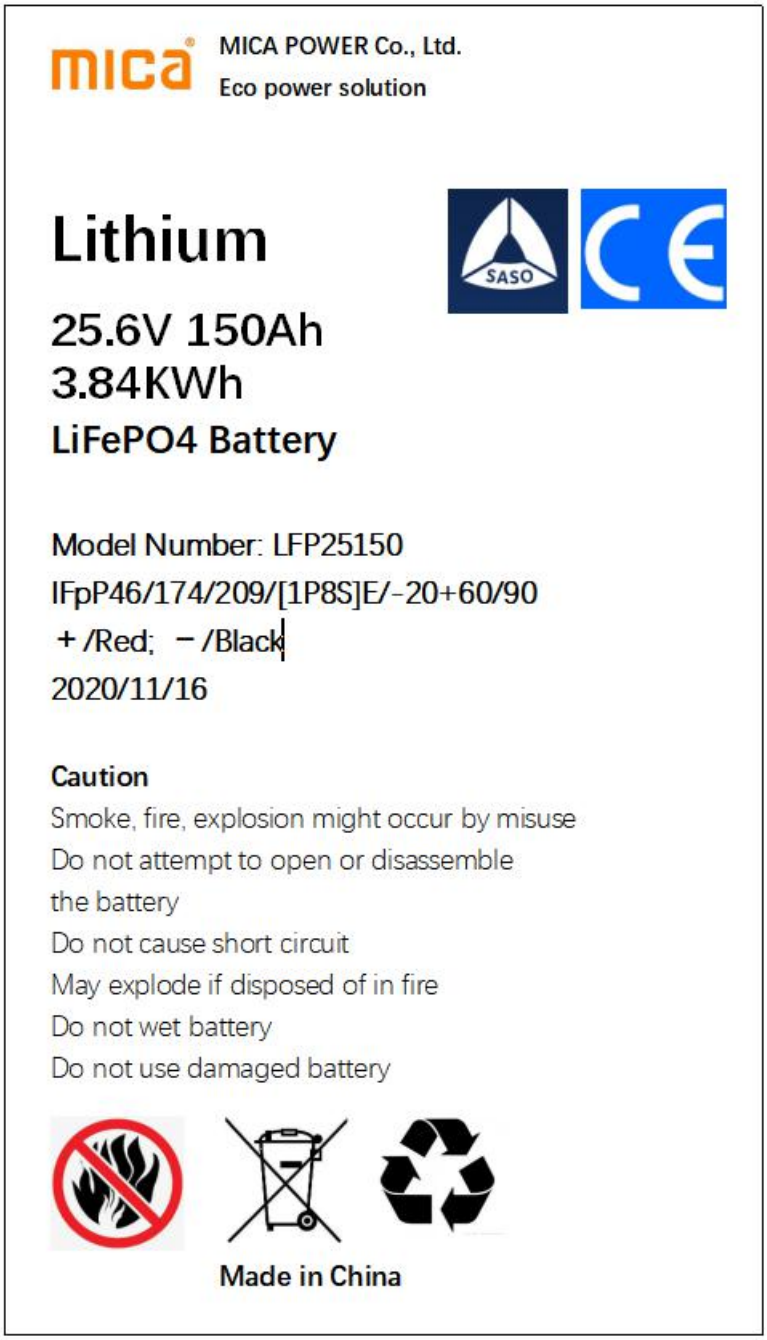
Test item description.....:	Back-up LiFePO4 Battery Pack
Trade Mark.....:	mica
Manufacturer.....:	Mica Power Co., LTD. 153# ChangShun Road, DaLang Town, Dongguan City, PR China
Model/Type reference.....:	LFP25150
Ratings.....:	25.6V 150Ah

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**Testing Laboratory:**	**Shenzhen AZT Technology Co., Ltd.**	
Testing location/ address.....:		No.513-514 , Huaide Yinshan Building, 107 National Road, Fuwei Community, Fuyong Street, Baoan District, Shenzhen, China	
Tested by (name, function, signature).....:		Roly Yu	Roly
Approved by (name, function, signature)...:		Simon Guan	Simon
☐	**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):	
Summary of testing:	
Tests performed (name of test and test clause): cl 7.2.3 Drop test (battery system) cl8.2.2 Overcharge control of voltage(battery system) cl8.2.3 Overcharge control of current(battery system) cl8.2.4 Overcharge heating control (battery system)	**Testing location:** 513-514 , Huaide Yinshan Building, 107 National Road, Fuwei Community, Fuyong Street, Baoan District, Shenzhen, Guangdong, China
Summary of compliance with National Differences (List of countries addressed): N/A	

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.



Test item particulars..... :	
Classification of installation and use.....:	Use in energy storage applications
Supply Connection.....:	Screw Terminal
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.....:	2020-10-28
Date (s) of performance of tests.....:	2020-10-29 – 2020-11-19

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.

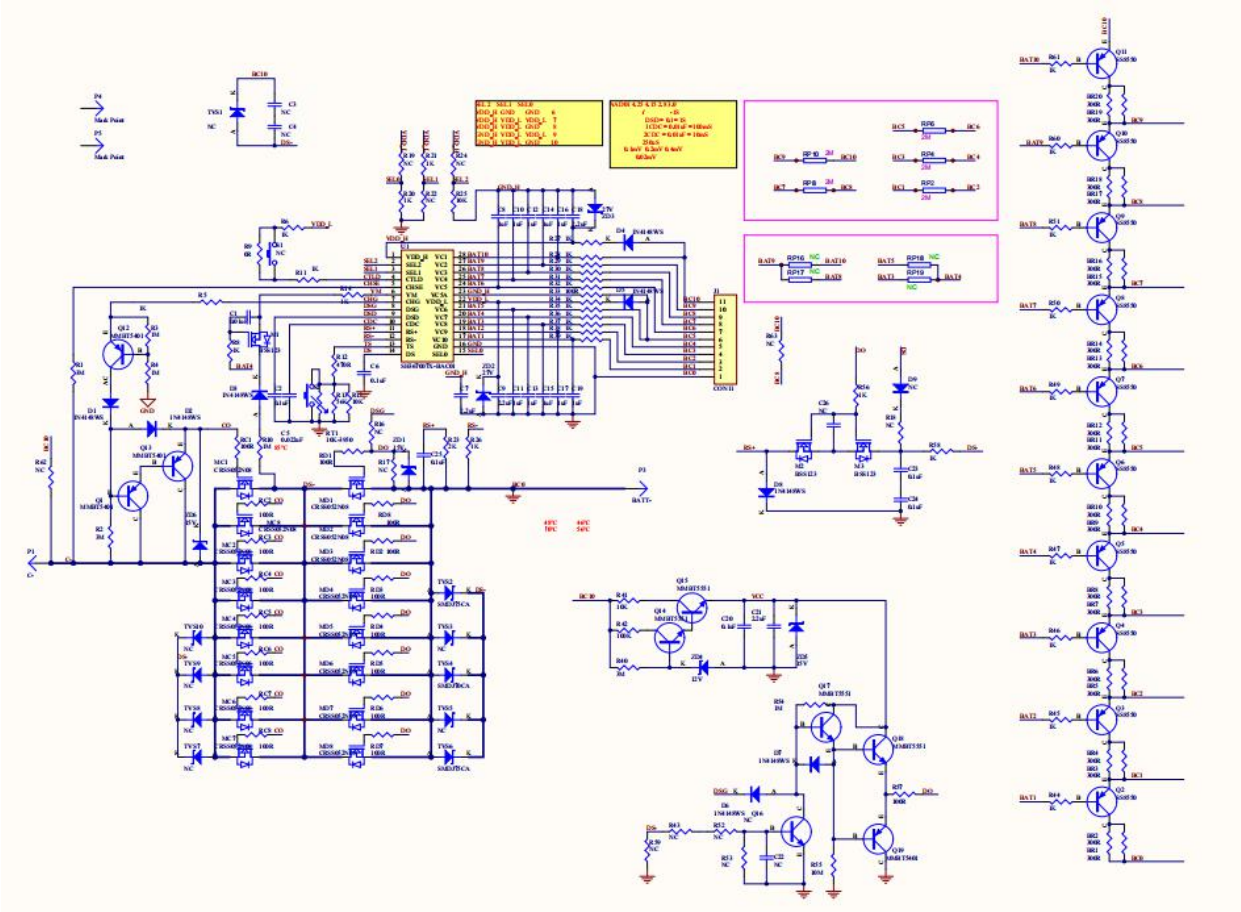
Name and address of factory (ies).....:	Same as manufacturer

General product information and other remarks:
The Back-up LiFe Battery is used as energy system. It consists 8 cells in parallel and series connected (1P8S), and the battery is integrated with the protective device, which is intended to protect battery against abnormal operations.
The battery module mainly consists of:
one strings in parallel, and one string consists of 8 cells in series
Limit current circuit board
Plastic enclosure
Screw terminal as charge and discharge interfaces

Battery and cell general parameters:

Product name	LiFePO4 Battery
Type/model	GLFP45173209-8S1P
Nominal voltage	25.6V
Rated capacity	150Ah
Recommended charging voltage by manufacturer	28.8V
Upper limit charging voltage	29V
Recommended charging current by manufacturer	30A
Maximum charging current	30A
Charging temperature Range	0°C～60°C
Discharging temperature Range	-20°C～45°C
Standard charging method by manufacturer	Charge at constant current 30A until voltage reaches 28.8V, then charge at constant voltage 28.8V till charge current is 7.5A.
Maximum discharging current	30A
Final discharge voltage	20V
Dimension	L522*W 240*H222mm
Weight	**≤33Kg**
The cell is used in battery as follow:	
Product name	Rechargeable Lithium-ion Cell
Type/model	FP45173209A/150Ah
Nominal voltage	3.2V
Rated capacity	150Ah
Recommended charging voltage by manufacturer	3.65V
Upper limit charging voltage	3.7V
Recommended charging current by manufacturer	75A
Recommended Discharging current by manufacturer	150A
Discharge Cut-off voltage	2.5V
Charge temperature Range	-20～60℃
Discharge temperature Range	-20～45℃
Standard charging method by manufacturer	Charging the cell with 75A constant current until to 3.7V, then constant voltage until charging current reduces to 3A.
Dimension	209mm x 174mm x 45.5mm
Weight	3200g

Circuit Diagram for BMS Board



IEC 62619			
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.. :	See also table 5.1 for Critical components information	P
5.2	**Insulation and wiring**		P
	Voltage, current, altitude, and humidity requirements		P
	Adequate clearances and creepage distances between connectors		P
	The mechanical integrity of internal connections		P
5.3	**Venting**		**P**
	Pressure relief function		P
	Encapsulation used to support cells within an outer casing		N/A
5.4	**Temperature/voltage/current management**		P
	The design prevents abnormal temperature-rise		P
	Voltage, current, and temperature limits of the cells		P
	Specifications and charging instructions for equipment manufacturers		P
5.5	**Terminal contacts of the battery pack and/or battery system**		P
	Polarity marking(s)		P
	Capability to carry the maximum anticipated current		P
	External terminal contact surfaces		P
	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)		P
	Recommendations of cell operating limits by the cell manufacturer		P
	Batteries designed for the selective discharge of a portion of their series connected cells		P
	Protective circuit component(s) and consideration to the end-device application		N/A
5.6.2	Battery system design		P
	The voltage control function		P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	The voltage control for series-connected batteries		P
5.7	**Operating region of lithium cells and battery systems for safe use**		P
	The cell operating region.....:		P
	Designation of battery system to comply with the cell operating region		P
5.8	**Quality plan**		P
	Manufacturing quality plan (for example: ISO9001, etc.) prepared and implemented.....:		P
	The process capabilities and the process controls		P
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 IEC62619)		P
	Capacity confirmation of the cells or batteries		P
	Default ambient temperature of test, 25 °C ± 5 °C		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		P
	The cells or batteries charged using the method specified by the manufacturer.....:		P
7.2	**Reasonably foreseeable misuse**		N/A
7.2.1	External short-circuit test (cell or cell block)		N/A
	Short circuit with total resistance of 30 mΩ ± 10 mΩ at 25 °C ± 5 °C		N/A
	Results: no fire, no explosion	See Table 7.2.1	N/A
7.2.2	Impact test (cell or cell block)		N/A
	Cylindrical cell, longitudinal axis impact		N/A
	Prismatic cell, longitudinal axis and lateral axis impact		N/A
	Results: no fire, no explosion.	See Table 7.2.2	N/A
7.2.3	Drop test (cell or cell block, and battery system)	Battery system	P
7.2.3.1	General		P
7.2.3.2	Whole drop test (cell or cell block, and battery system)		N/A

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	Description of the Test Unit.....:		—
	Mass of the test unit (kg).....:		N/A
	Height of drop (m).....:		N/A
	Results: no fire, no explosion		N/A
7.2.3.3	Edge and corner drop test (cell or cell block, and battery system)		P
	Description of the Test Unit.....:	Battery system	—
	Mass of the test unit (kg).....:	30.74kg	—
	Height of drop (0.1m).....:	0.1m	—
	Results: no fire, no explosion		P
7.2.4	Thermal abuse test (cell or cell block)		N/A
	Results: no fire, no explosion	See Table 7.2.4.	N/A
7.2.5	Overcharge test (cell or cell block)		N/A
	For those battery systems that are provided with only a single protection for the charging voltage control		N/A
	Results: no fire, no explosion.....:	See Table 7.2.5.	N/A
7.2.6	Forced discharge test (cell or cell block)		N/A
	Upper limit charge voltage of the cell.....:		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, I_m.....:		N/A
	Discharge current for forced discharge, 1.0 It.....:		N/A
	Discharging time, t = (1 It / I_m) x 90 (min.).....:		N/A
	Results: no fire, no explosion.....:	See Table 7.2.6.	N/A
7.3	**Considerations for internal short-circuit – Design evaluation**		**N/A**
	General		N/A
7.3.2	Internal short-circuit test (cell)	Certified cell used	N/A
	Samples preparation procedure: a), in accordance with 8.3.9 of IEC62133:2012; or b), the nickel particle inserted before charging, or c), the nickel particle was inserted before electrolyte filling.....:		N/A
	Tested according to Cl. 8.3.9 of IEC 62133:2012 test method, except all tests were carried out in an ambient temperature of 25 °C ± 5 °C.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The appearance of the short-circuit location recorded by photograph or other means..... :	See Attachment # __	—
	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	400N	N/A
	Results: no fire, no explosion.....:	See Table 7.3.2.	N/A
7.3.3	**Propagation test (battery system)**	Certified cell used	N/A
	Method to create a thermal runaway in one cell .... :	See Annex B	N/A
	Results: No external fire from the battery system or no battery case rupture.....:	See results in Table 7.3.3	N/A
8	**BATTERY SYSTEM SAFETY (CONSIDERING FUNCTIONAL SAFETY)**		P
8.1	**General requirements**		N/A
	Functional safety analysis for critical controls		N/A
	Conduct of a process hazard, risk assessment and mitigation of the battery system		N/A
8.2	**Battery management system (or battery management unit)**		P
8.2.1	Requirements for the BMS		P
	The safety integrity level (SIL) target of the BMS		P
	The charge control evaluated by tests in clauses 8.2.2 to 8.2.4		P
8.2.2	Overcharge control of voltage (battery system)		P
	The exceeded charging voltage applied to the whole battery system		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 interrupted the overcharging before reaching 110% of 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	No cooling system	N/A
	Elevated temperature for charging, 5 °C above maximum operating temperature..... :	65 °C applied	P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	Results: no fire, no explosion.....:	See Table 9.2.5	P
	The BMS detected the overheat temperature and terminated charging		P
	The battery system operated as designed during test		P
9	**INFORMATION FOR SAFETY**		**P**
	The cell manufacturer provides information about current, voltage and temperature limits of their products		P
	The battery system manufacturer provides information regarding how to mitigate hazards to equipment manufacturers or end-users.		P
10	**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.		P
	Cell or battery system has clear and durable markings		P
	Cell designation	Final product is battery	N/A
	Battery designation		P
	Battery structure formulation		P
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		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
A.8	Example of operating region		P
ANNEX B	**PROCEDURE OF 7.3.3 PROPAGATION TEST**		N/A
B.1	General		N/A
B.2	Test conditions:		N/A
	– The battery fully charged according to the manufacturer recommended conditions.....:		—

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	– 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.....:		—
B.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.....:		—

ANNEX C	**PACKAGING**		P
	The materials and pack design chosen in such a way as to prevent the development of unintentional electrical conduction, corrosion of the terminals and ingress of environmental contaminants		P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

5.1	TABLE: Critical components information				NA
Object/part no.	**Manufacturer/ trademark**	**Type/model**	**Technical data**	**Standard**	**Mark(s) of conformity [1)]**
cell	-	FP45173209A	3.2V, 150Ah, 480Wh	IEC 62619	Report NO.: RESS 4788 997198-001
Plastic	-	D-1200	ABS V-0 130℃	-	UL E194560
Wire	-	1015/3135	12AWG,105℃ 600v, Horizontal flame	-	UL E355578
IC (U1)	-	H367007X: TSSOP-28	Over charge protection voltage: 3.650V±0.050V, Over charge release voltage:3.500 V±0.050V ,Over Discharge protection voltage: 2.500V±0.10V, Over discharge release voltage:2.800V±0.10V Discharge over current detection voltage:100mV ±10mV,	-	Tested with appliance
MOSEFET (MC1, MC2, MC4, MC7, MC8, MD1, MD2, MD4, MD7, MD8)	-	CRSS052N08N:TO-263	VDSS: 85V, VGS: ±20V, ID: 120A, Tstg: -55°C ~150°C	-	Tested with appliance
NTC	DONG GUAN SENSICOM ELECTRONICS TECHNOLOGY LTD	-	R_{25}: 10K±1%, $B_{25/50}$=3950K±1%	-	UL E318986
PCB	SHEN ZHEN TIE FA TECHNOLOGY LTD	-	-	-	UL E346897

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):___

7.2.2	TABLE: Impact test (cell or cell block)			N/A
Sample No.	**OCV at start of test, (Vdc)**	**Impact location**	**Maximum case temperature, (°C)**	**Results**

Supplementary information:

- No fire or explosion

7.2.4	TABLE: Thermal abuse (cell or cell block)	N/A
Sample No.	**OCV at start of test, (Vdc)**	**Results**

Supplementary information:

- No fire or explosion

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

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): _____

7.2.6	TABLE: Forced discharge test (cell or cell block)				N/A
Sample No.	**OCV before applying reverse charge, (V dc)**	**Measured Reverse charge It, (A)**	**Maximum discharge voltage, (Vdc)**	**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**

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**

Method of cell failure [1)]	Location of target cell	Area for fire protection (m^2)

Supplementary information:

1) Cell can be failed through 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#	2.9	30	29.0	3.7	A、D、F

	Charge Voltage Applied Battery System: 1)	
	Whole	**Part**
	31.9V	--

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**
B3#	23.6	36	29.0	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**
B4#	26.6	30	26.6*
Maximum Specified Temperature of Battery System, °C		**Maximum Measured Cell Case Temperature, °C**	**Results**
60		65.5	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): ____

* The overheating protection worked immediately when charging at 55°C began. The data monitoring continued for one hour, the cell temperature increased to 65.5°C due to the ambient change.

Product photo:

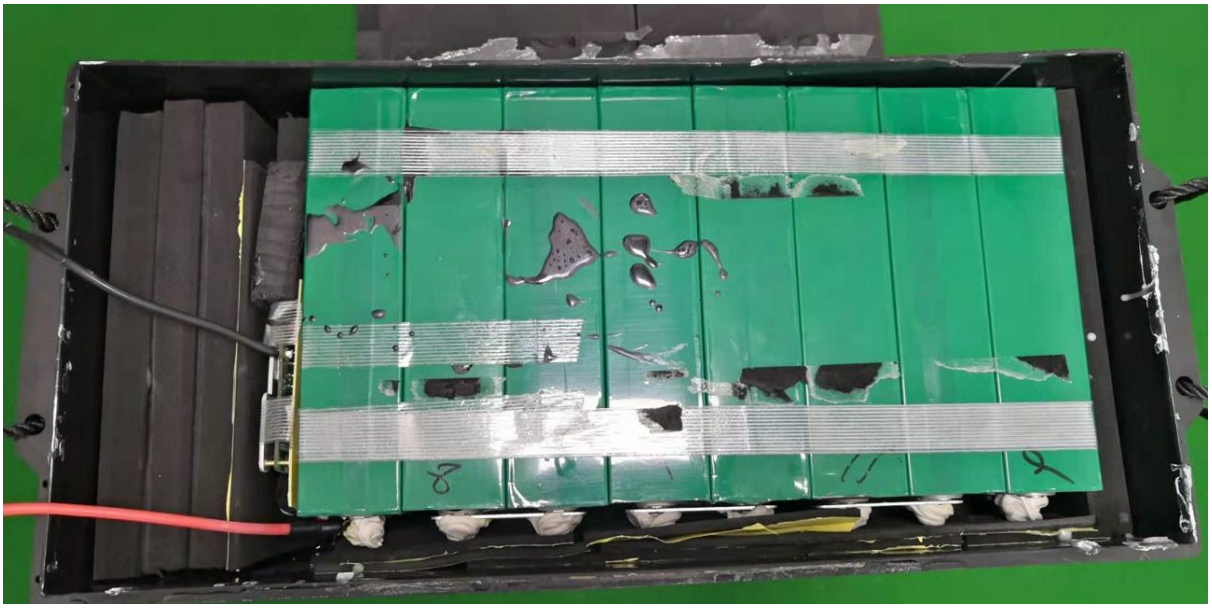
Pic.1 General View of Battery

Pic.2 General View of Battery

Product photo:

Pic.3 Front Terminal View of Battery

Pic.4 Internal View of Battery



Product photo:

Pic.5 Front View of BMS

Pic.6 Rear View of BMS