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CNAS L5138

<b>TEST REPORT</b> <b>IEC 62619</b> <b>Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications</b>		
<b>Report Number</b> .....	TSZ23080483-P02-R01	
<b>Date of issue</b> .....	2023-09-27	
<b>Total number of pages</b> .....	21 Pages	
<b>Applicant's name</b> .....	AMPS MIDDLE EAST FZ-LLC	
<b>Address</b> .....	B03-314, BUSINESS CENTER 02 RAKEZ BUSINESS ZONE-FZ RAK, UNITED ARAB EMIRATES	
<b>Test specification:</b>		
<b>Standard</b> .....	IEC 62619:2022	
<b>General disclaimer:</b>		
The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing laboratory.		
<b>Test item description</b> .....	LiFePO4 Li-ion Battery	
<b>Trade Mark(s)</b> .....	Eastman Solar	
<b>Manufacturer</b> .....	AMPS MIDDLE EAST FZ-LLC B03-314, BUSINESS CENTER 02 RAKEZ BUSINESS ZONE-FZ RAK, UNITED ARAB EMIRATES	
<b>Model/Type reference</b> .....	ES51.2-200LP	
<b>Ratings</b> .....	51.2V, 200Ah, 10240Wh	
<b>Testing Laboratory:</b>	Shenzhen Tiansu Calibration and Testing Co., Ltd	
<b>Testing location/ address</b> .....	No.2, Jinlong Avenue, Longgang District, Shenzhen, Guangdong, China	
<b>Tested by (name, function, signature) .....</b>	Joshua mo /Test engineer	
<b>Reviewed by (name, function, signature) .. :</b>	Davis Ding /Reviewer	
<b>Approved by (name, function, signature) .. :</b>	Duan jiangtao /Approved	

<b>Summary of testing:</b>	
<b>Tests performed (name of test and test clause):</b> 7.2.3 Drop test (cell or cell block, and battery system) 8.2.2 Overcharge control of voltage (battery system) 8.2.3 Overcharge control of current (battery system) 8.2.4 Overheating control (battery system)  Cell (Model: LF100LA) has been evaluated according to IEC 62619:2022, Certificate No.: SG PSB-BT-03455, Report No.: 085-282260325-000	<b>Testing location:</b> Shenzhen Tiansu Calibration and Testing Co., Ltd. No.2, Jinlong Avenue, Longgang District, Shenzhen, Guangdong, China
<b>The product fulfils the requirements of EN IEC 62619:2022.</b>	

**Copy of marking plate:****The artwork below may be only a draft.**

Product Name: LiFePO4 Lithium-ion Battery

+ Mode Name: ES51.2-200LP IFpP/51/161/120/[2P16S]E/-20+40/90

51.2V, 200Ah, 10240Wh

YYYYMMDD0001 Made in China

- Manufacturer: AMPS MIDDLE EAST FZ-LLC

CC/CV 58.4V 40A, CV 58.4V to 10.2A

Caution: Risk of fire and burns, follow manufacturer's instructions, disposal of batteries should follow local regulations.

**Remark:**

**1:** The date code "YYYYMMDD0001"

1.1: YYYY stands for year.

1.2: MM stands for month.

1.3: DD stands for date.

1.4: 0001 represents the flow code

<b>Test item particulars.....:</b>		
<b>Classification of installation and use.....:</b> To be defined in final product		
<b>Supply Connection .....</b> DC connector		
<b>Recommend charging method declared by the manufacturer.....:</b> Charging the battery with 40A constant current until 58.4V, then constant voltage until charging current reduces to 5.1A.		
<b>Possible test case verdicts:</b>		
- 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)		
<b>Testing.....:</b>		
<b>Date of receipt of test item .....</b> 2023-08-28		
<b>Date (s) of performance of tests .....</b> 2023-08-28 to 2023-09-08		
<b>General remarks:</b>		
"(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 <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.		
<b>Name and address of factory (ies) .....</b> : GUANGDONG NPP NEW ENERGY CO.,LTD No.3 LiaoBianHongLi Road, Liaobu Town, Dongguan City, Guangdong Province		
<b>General product information and other remarks:</b>		
The battery of model is composed of thirty-two lithium-ion cells (16S2P), and equipped with overcharge, overdischarge, overcurrent, and short circuit protection circuits.		
	Cell	Battery
Model	LF100LA	ES51.2-200LP
Rated capacity(Ah)	102	200
Nominal voltage(V)	3.2	51.2
Recommended Charge Current(A)	50	40
Maximum Charge Current(A)	100	100
Recommended Discharge Current(A)	50	100
Maximum Discharge Current(A)	250	100
Maximum Charge Voltage(V)	3.9	59.2
End-of-discharge Voltage(V)	1.9	44.8
Charge temperature Range(°C)	0 to 65	0 to 45
Discharge temperature Range(°C)	-30 to 65	-20 to 60
Nominal mass(kg)	1.98±0.1	93±3
External dimensions(mm)	49.9±1.0*160±1.0*118.5± 1.0	500±2*160±2*850±2

错误!未找到引用源。

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
<b>4</b>	<b>PARAMETER MEASUREMENT TOLERANCES</b>		P
	Parameter measurement tolerances		P
<b>5</b>	<b>GENERAL SAFETY CONSIDERATIONS</b>		P
<b>5.1</b>	<b>General</b>		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
<b>5.2</b>	<b>Insulation and wiring</b>		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		P
<b>5.3</b>	<b>Venting</b>		P
	Pressure relief function		P
	Encapsulation used to support cells within an outer casing		P
<b>5.4</b>	<b>Temperature/voltage/current management</b>		P
	The design prevents abnormal temperature-rise		P
	Voltage, current, and temperature limits of the cells		P
	Specifications and charging instructions for equipment manufacturers	Charging instructions included in the product specification.	P
<b>5.5</b>	<b>Terminal contacts of the battery pack and/or battery system</b>		P
	Polarity marking(s)		P
	Polarity marking not provided for keyed external connector		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
<b>5.6</b>	<b>Assembly of cells, modules, or battery packs into battery systems</b>		P
5.6.1	General		P

错误!未找到引用源。

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	Independent control and protection method(s)		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 <sup>1</sup>		P
	The voltage control function		P
	Maximum charging/discharging current of the cell are not exceeded		P
<b>5.7</b>	<b>Operating region of lithium cells and battery systems for safe use</b>		P
	The cell operating region..... :	Upper limit charge voltage: 3.90V; Cut off discharge Voltage: 1.90V	P
	Designation of battery system to comply with the cell operating region		P
<b>5.8</b>	<b>System lock (or system lock function)</b>		N/A
	Non-resettable function to stop battery operation		N/A <sup>i</sup>
	Manual with procedure for resetting of battery operation		N/A
	Emergency battery final discharge		N/A
<b>5.9</b>	<b>Quality plan</b>		P
	Manufacturing quality plan (for example: ISO9001, etc.) prepared and implemented..... :	The manufacturer supplies a self-declaration document.	P
	The process capabilities and the process controls		P

<b>6</b>	<b>TYPE TEST CONDITIONS</b>		P
<b>6.1</b>	<b>General</b>		P
<b>6.2</b>	<b>Test items</b>		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		P

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IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

<b>7</b>	<b>SPECIFIC REQUIREMENTS AND TESTS</b>		P
<b>7.1</b>	<b>Charging procedure for test purposes</b>		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..... :	The method mentioned in manufacturer's specifications	P
<b>7.2</b>	<b>Reasonably foreseeable misuse</b>		P
7.2.1	External short-circuit test (cell or cell block)	CB approval cell	N/A
	Short circuit with total resistance of 30 m ± 10 m 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	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	CB approval cell	N/A
7.2.3.2	Whole drop test (cell or cell block, and battery system)		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)		P
	Description of the Test Unit..... :	Battery system	—
	Mass of the test unit (kg)..... :	93.3	—
	Height of drop (m)..... :	0.05	—
	Results: no fire, no explosion		P
7.2.4	Thermal abuse test (cell or cell block)	CB approval cell	N/A
	Results: no fire, no explosion		N/A
7.2.5	Overcharge test (cell or cell block)		N/A

错误!未找到引用源。

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	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	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, $t = (1 \text{ It} / I_m) \times 90$ (min.) .....		N/A
	Results: no fire, no explosion .....		N/A
<b>7.3</b>	<b>Considerations for internal short-circuit – Design evaluation</b>		N/A
7.3.1	General	CB approval cell	N/A
7.3.2	Internal short-circuit test (cell)		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 $25 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ .		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

<b>8</b>	<b>BATTERY SYSTEM SAFETY (CONSIDERING FUNCTIONAL SAFETY)</b>		P
<b>8.1</b>	<b>General requirements</b>		N/A
	Functional safety analysis for critical controls		N/A



错误!未找到引用源。

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	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		N/A
<b>8.2</b>	<b>Battery management system (or battery management unit)</b>		P
8.2.1	Requirements for the BMS		P
	The safety integrity level (SIL) target of the BMS		N/A
	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 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		N/A
	Elevated temperature for charging, 5 °C above maximum operating temperature..... :	50°C	P
	Results: no fire, no explosion..... :	See Table 8.2.4	P
	The BMS detected the overheat temperature and terminated charging		P
	The battery system operated as designed during test		P
<b>9</b>	<b>EMC</b>		N/A
	Battery system fulfil EMC requirements of the end-device application..... :		N/A
<b>10</b>	<b>INFORMATION FOR SAFETY</b>		P

错误!未找到引用源。

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	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

11	<b>MARKING AND DESIGNATION (REFER TO CLAUSE 5 OF IEC 62620)</b>		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		N/A
	Battery designation		P
	Battery structure formulation		P

12	<b>PACKAGING AND TRANSPORT</b>		N/A
	Refer to Annex D		N/A

ANNEX A	<b>OPERATING REGION OF CELLS FOR SAFE USE</b>		N/A
A.1	General		N/A
A.2	Charging conditions for safe use		N/A
A.3	Consideration on charging voltage		N/A
A.4	Consideration on temperature		N/A
A.5	High temperature range		N/A
A.6	Low temperature range		N/A
A.7	Discharging conditions for safe use		N/A
A.8	Example of operating region		N/A

ANNEX B	<b>PROCEDURE OF 7.3.3 PROPAGATION TEST BY LASER IRRADIATION</b>		N/A
B.1	<b>General</b>		N/A
B.2	<b>Test conditions</b>		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..... :		—

错误!未找到引用源。

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

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

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IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

5.1	TABLE: Critical components information					N/A
Object / part No.	Manufacturer/ trademark	Type / model	Technical data	Standard	Mark(s) of conformity1)	
Cell	EVE Power Co., Ltd.	LF100LA	3.2V, 102Ah	IEC 62619:2022	Certificate No.: SG PSB-BT-03455, Report No.: 085-282260325-000	
IC	--	--	--	--	--	
MOSFET	--	--	--	--	--	
PCB	--	--	--	--	--	
Supplementary information: Due to customer confidential information not being reflected.						

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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): \_\_\_\_

Remark: Maximum charge voltage of the cell is 3.65V. The customer requires to use the maximum charge voltage of 110% for the test as the tightening test condition

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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): \_\_\_\_

错误!未找到引用源。

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 <sup>1)</sup>	Maximum applied pressure, (N)	Results	
--	--	--	--	--	
--	--	--	--	--	
--	--	--	--	--	
--	--	--	--	--	
--	--	--	--	--	

**Supplementary information:**  
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 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): \_\_\_

错误!未找到引用源。

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 <sup>1)</sup>		Location of target cell		Area for fire protection (m <sup>2</sup> )		
--		--		--		
--		--		--		
--		--		--		
<b>Supplementary information:</b>						
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): ___						



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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	
B01#	46.85	100	56.21	3.701	A, D, F	
			<b>Charge Voltage Applied Battery System: 1)</b>			
			<b>Whole</b>	<b>Part</b>		
			68.64V	--		
<b>Supplementary information:</b>						
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	
B01#	46.97	120	48.37	A, D, F	
<b>Supplementary information:</b>					
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): ____					

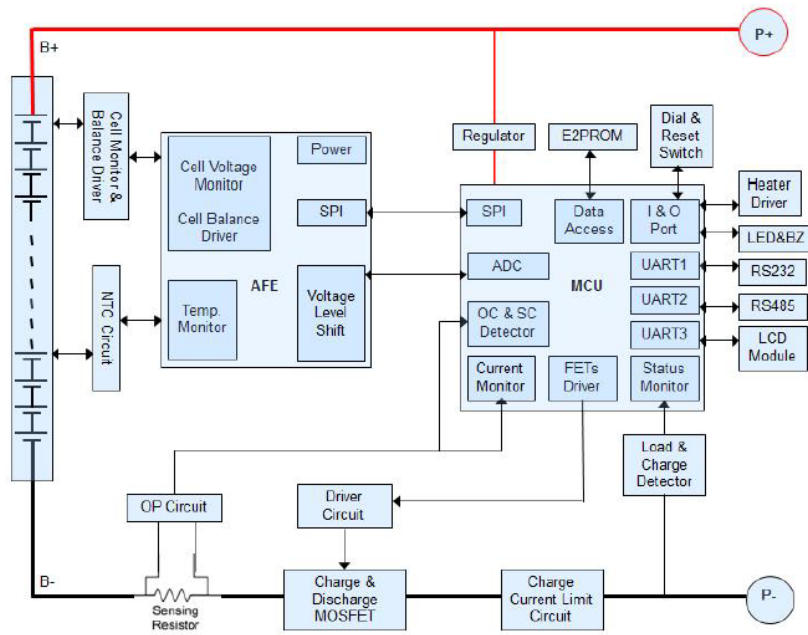
错误!未找到引用源。

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	
B01#	51.57	100	54.33	
Maximum Specified Temperature of Battery System, °C		Maximum Measured Cell Case Temperature, °C	Results	
45		48.9	A, D, F	
<b>Supplementary information:</b> 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): ____				

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### Circuit Diagram



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Product Photo



Figure 1 Front view of battery

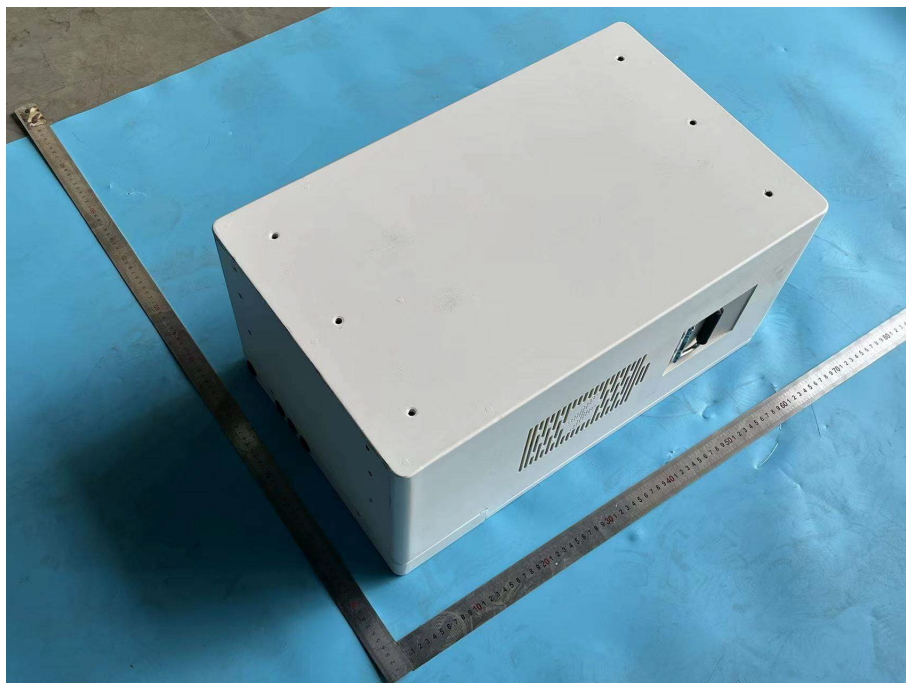


Figure 2 Back view of battery

错误!未找到引用源。

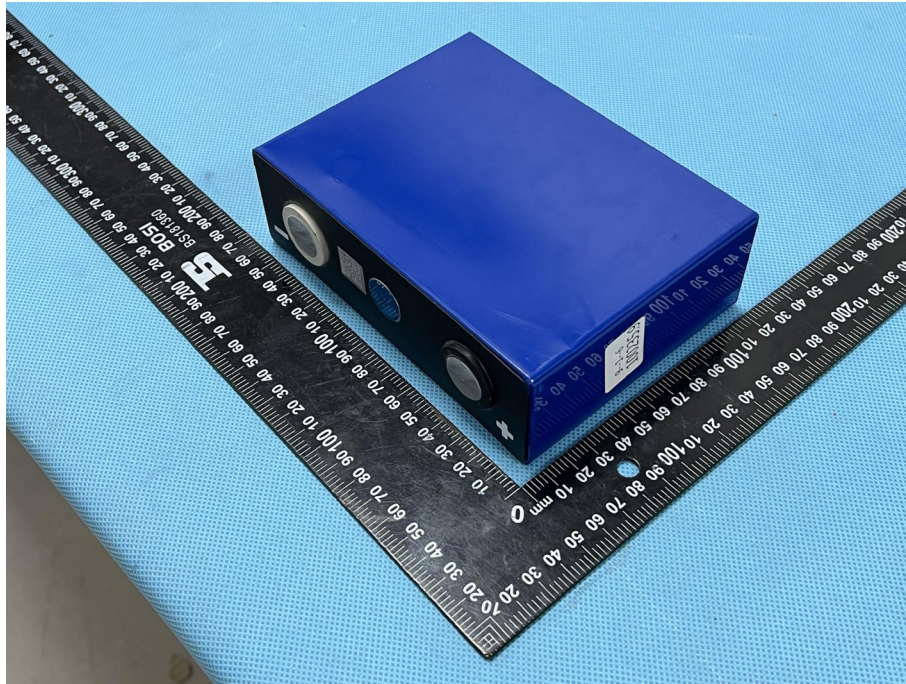


Figure 3 Front view of cell

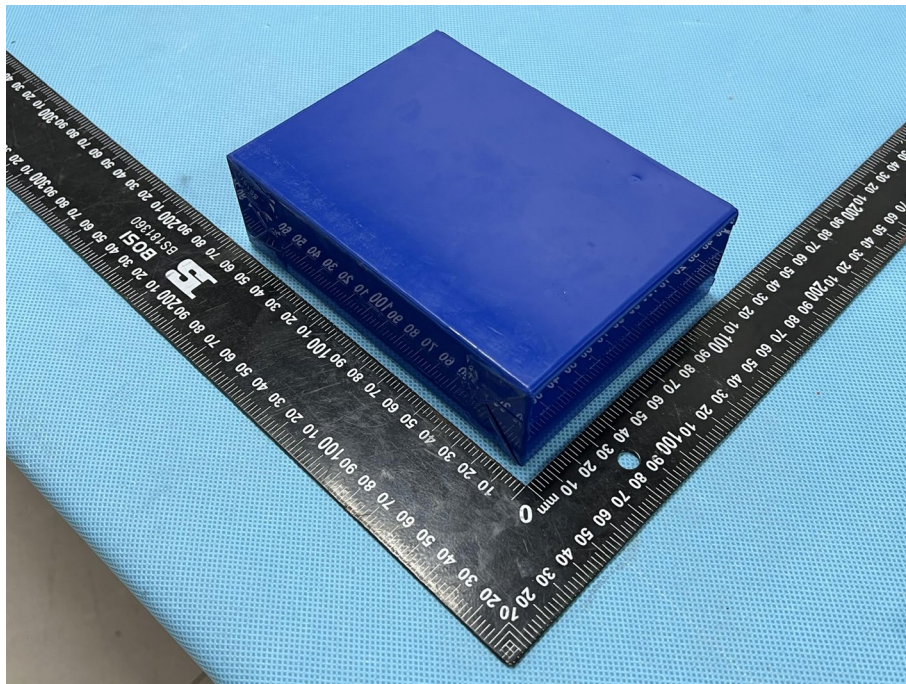


Figure 4 Back view of cell