



TEST REPORT

Applicant : Guangzhou Felicity Solar Technology Co., Ltd
Address : No.23 Xingfu street, Donghua Industrial Zone, Renhe Town, Baiyun District, Guangzhou, 510445 Guangdong, P.R. China

Manufacturer : Guangzhou Felicity Solar Technology Co., Ltd
Address : No.23 Xingfu street, Donghua Industrial Zone, Renhe Town, Baiyun District, Guangzhou, 510445 Guangdong, P.R. China

Product Name : LiFePO4 Battery System
Brand Name : felicitysolar
Model No. : LPBF48250
Ratings : 51.2V, 250Ah, 12.5kWh

Standard : Secondary cells and batteries containing alkaline or other non-acid electrolytes
- Safety requirements for secondary lithium cells and batteries, for use in industrial applications
EN / IEC 62619: 2017

Date of Receiver : May 13, 2022
Date of Test : May 14, 2022 to June 07, 2022
Date of Issue : June 08, 2022
Test Report Form No : NTCS-IEC 62619: 2017
Test Result : Pass *

This Test Report is Issued Under the Authority of :

Compiled by

Leo Xia / Engineer

Approved by



Han Song / Manager

***Remarks:**

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of Shenzhen Nore Testing Center Co., Ltd. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

List of Attachments (including a total number of pages in each attachment):

Attachment 1: Photo documentation (5 pages).

Summary of testing:

Factory : Guangzhou Felicity Solar Technology Co., Ltd

Address : No.23 Xingfu street, Donghua Industrial Zone, Renhe Town, Baiyun District, Guangzhou,
510445 Guangdong, P.R. China

Tests performed (name of test and test clause):

cl.7.2.3 Drop test (cells 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)

The samples comply with the requirement of IEC 62619: 2017.

Testing location:

ATS Electronic Technology Co., Ltd.

3/F, Building A, No. 1 Hedong Three Road, Jinxia Community, Changan Town, Dongguan City, Guangdong, China

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

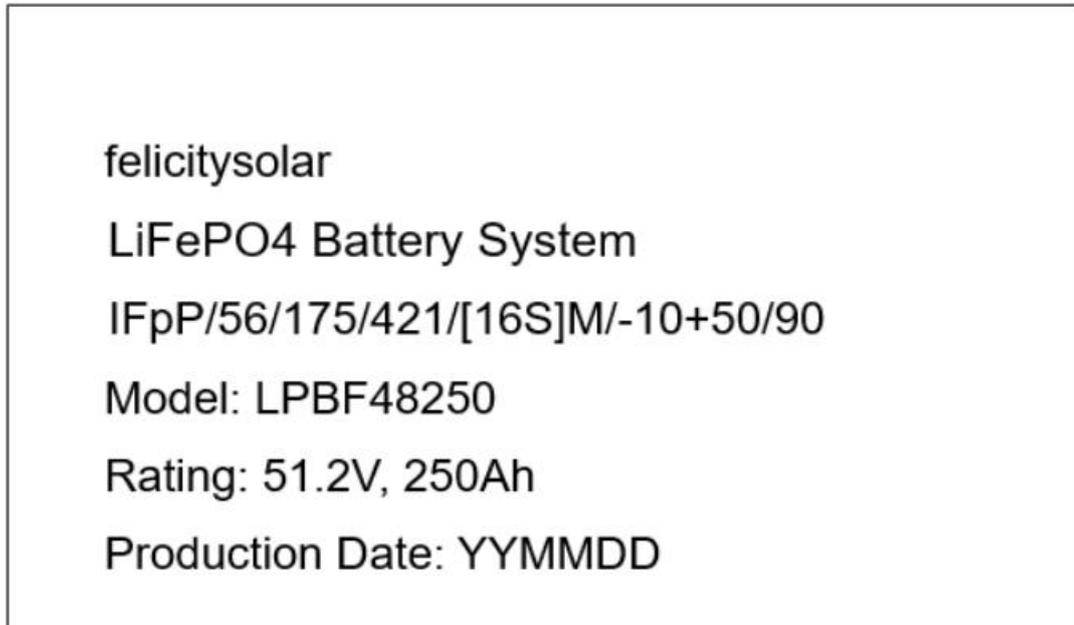
N/A

The product fulfils the requirement of EN / IEC 62619:2017

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:



The others required marking items are indicated in the battery manual.

Remark:

1. Date of manufacture:

YYMMDD:

YY: Year the battery manufactured

MM: Month the battery manufactured

DD: Day the battery manufactured

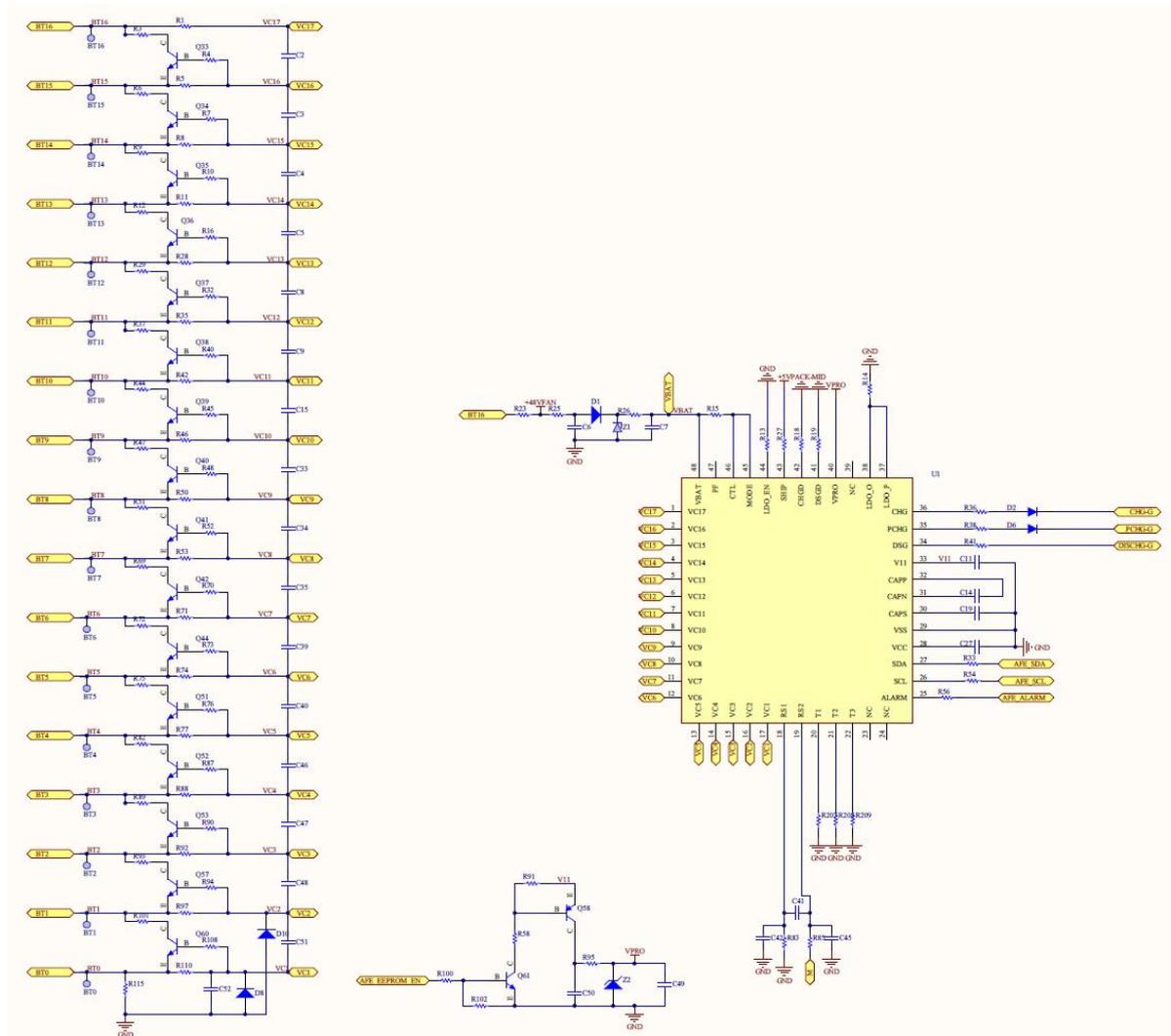
Test item particulars :	
Classification of installation and use :	To be defined in final product
Supply Connection	Not directly connected to mains
Possible test case verdicts:	
- test case does not apply to the test object.....: N/A	
- test object does meet the requirement.....: P (Pass)	
- test object does not meet the requirement.....: F (Fail)	
Testing:	
Date of receipt of test item	2022-05-13
Date (s) of performance of tests	2022-05-14 to 2022-06-07

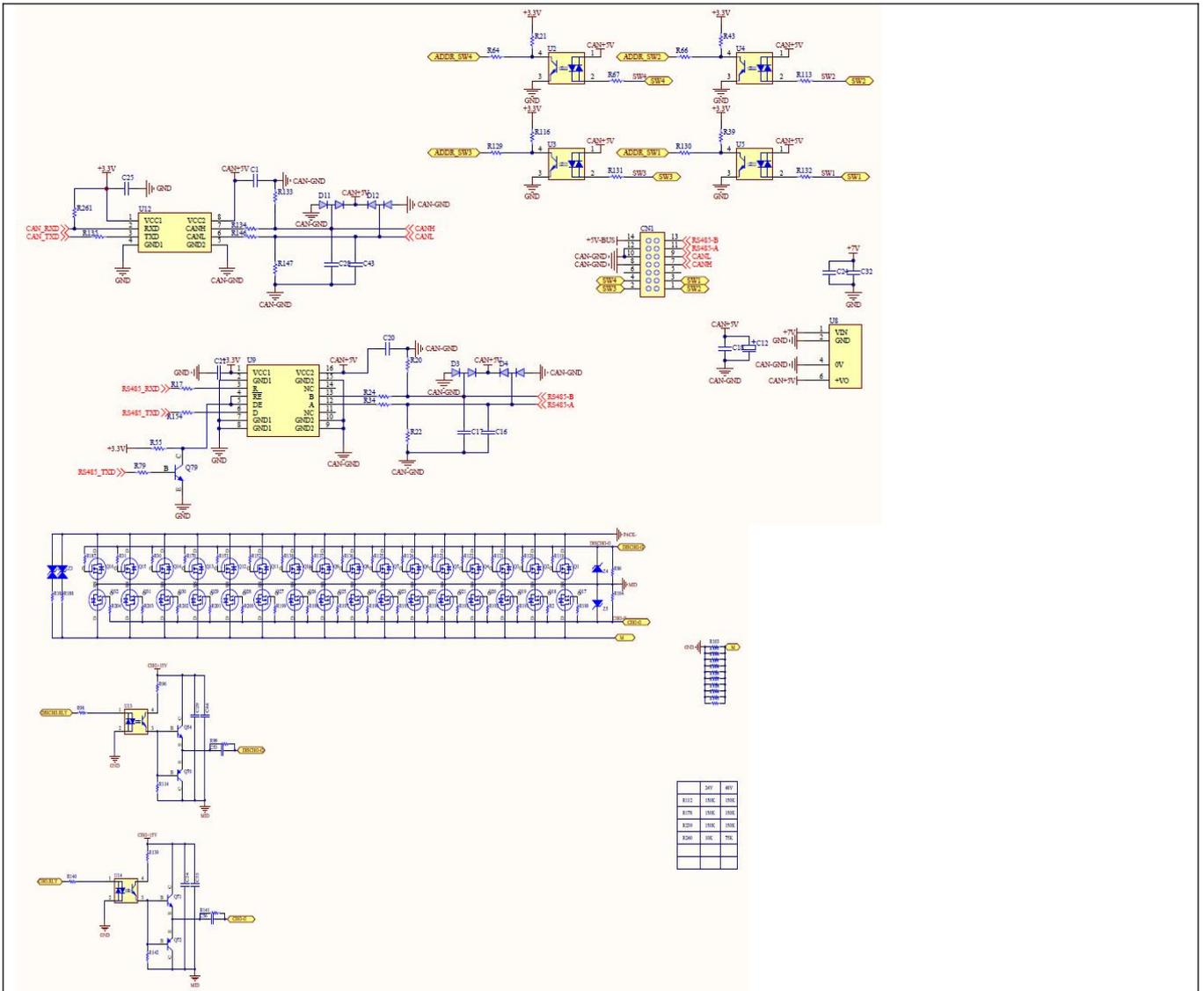
GENERAL PRODUCT INFORMATION AND OTHER REMARKS:

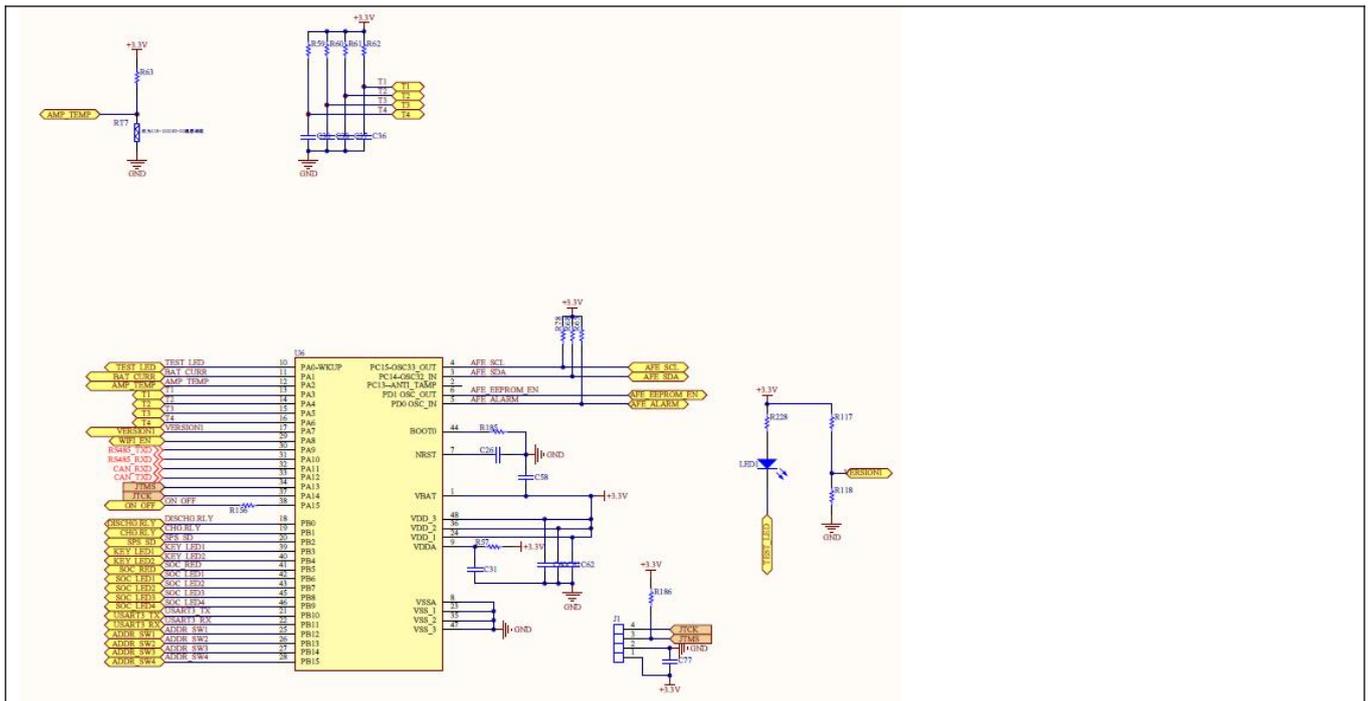
The electric, electronic and software controls and systems for critical safety was subjected to analysis for functional safety according to IEC 60730-1 Annex H.

It contains a BMS board, relay, fuse and 16 cells with 1P16S configuration.

The topology diagram as followed:







The main features of the cell are shown as below:

Product name	LiFePO4 Battery System
Model	LPBF48250
Nominal capacity	250Ah
Nominal voltage	51.2V
Maximum Charge Current	200A
Maximum Discharge Current	200A
Maximum Charge Voltage	57.6V
Cut-off Voltage	48V
Charge temperature Range	0°C~50°C
Discharge temperature Range	-20°C~55°C
Weight	Approx. 183kg
Designation	IFpP/56/175/421/[1P16S]M/-10+50/90
Connecting type	1P16S
Recommend charging method declared by the manufacturer	Charge the battery at constant current 120A until the voltage of battery reaches 57.6V, then charge at constant voltage 57.6V till charge current is 5A
Recommend discharging method declared by the manufacturer	Discharging the battery with 120A constant current to discharge cut off voltage 48V.
External dimension (mm) (±2mm)	615 x 350 x 955 (Length x Width x Height)

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	Venting design in the cell.	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	Overcharge, over discharge, over current and short-circuit proof circuit used in this battery.	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)		N/A
	Recommendations of cell operating limits by the cell manufacturer		P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	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
	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..... :	Listed in the specification of cell.	P
	Designation of battery system to comply with the cell operating region	Information mentioned in manufacturer's specifications.	P
5.8	Quality plan		N/A
	Manufacturing quality plan (for example: ISO9001, etc.) prepared and implemented..... :	Not requested by client.	N/A
	The process capabilities and the process controls		N/A

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	Tests were carried out in an ambient temperature of 25±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..... :	The method mentioned in manufacturer's specifications.	P
7.2	Reasonably foreseeable misuse		P
7.2.1	External short-circuit test (cell or cell block)	Certified cell used.	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

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
7.2.2	Impact test (cell or cell block)	Certified 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		P
7.2.3.2	Whole drop test (cell or cell block, and battery system)	The mass of battery system is more than 20 kg.	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)	Tested complied.	P
	Description of the Test Unit..... :	Battery system	—
	Mass of the test unit (kg)..... :		—
	Height of drop (m)..... :	0.01	—
	Results: no fire, no explosion		P
7.2.4	Thermal abuse test (cell or cell block)	Certified cell used.	N/A
	Results: no fire, no explosion		N/A
7.2.5	Overcharge test (cell or cell block)	Certified 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)	Certified cell used.	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, $t = (1 It / I_m) \times 90$ (min.)..... :		N/A

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	Results: no fire, no explosion..... :		N/A
7.3	Considerations for internal short-circuit – Design evaluation		N/A
7.3.1	General	Certified cell used.	N/A
7.3.2	Internal short-circuit test (cell)		N/A
	Samples preparation procedure: a), in accordance with 8.3.9 of IEC 62133:2012; 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
	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, no explosion..... :		N/A
7.3.3	Propagation test (battery system)	7.3.2 for cell have tested.	N/A
	Method to create a thermal runaway in one cell ... :		N/A
	Results: No external fire from the battery system or no battery case rupture..... :		N/A

8	BATTERY SYSTEM SAFETY (CONSIDERING FUNCTIONAL SAFETY)		P
8.1	General requirements		P
	Functional safety analysis for critical controls	Evaluated according to IEC 60730-1 Annex H.	P
	Conduct of a process hazard, risk assessment and mitigation of the battery system	FMEA document were provided.	P
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



IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	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		N/A
	Elevated temperature for charging, 5 °C above maximum operating temperature..... :		P
	Results: no fire, no explosion..... :		P
	The BMS detected the overheat temperature and terminated charging	See Table 8.2.4	P
	The battery system operated as designed during test		P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

9	INFORMATION FOR SAFETY		P
	The cell manufacturer provides information about current, voltage and temperature limits of their products	Certified cell used.	N/A
	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.	See page 3	P
	Cell or battery system has clear and durable markings		P
	Cell designation		N/A
	Battery designation	IFpP/63/281/83/[1P16S]E/-10+50/90	P
	Battery structure formulation	1P16S	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		—
	– Target cell forced into thermal runaway		—



IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	– 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					P
Object/part no.	Manufacturer/ trademark	Type/model	Technical data	Standard	Mark(s) of conformity ¹⁾	
Cell	Guangzhou Felicity Solar Technology Co., Ltd	FLS-LFP58420145-250Ah	3.2V, 250Ah	IEC 62619: 2017	ATS report no.: ATSR220413521	
BMS (Main board)	HUIZHOU KINGSUM ELECTRONICS CO LTD	KSE-D	V-0, 130°C	UL 94 UL 796	UL E345887	
BMS (Main board)	Interchangeable	Interchangeable	V-0, 130°C	UL 94 UL 796	UL approved	
IC (U1)	Maxim integrated	MAX14920	Supply voltage: 6V~65V, T _{OPR} : -40°C~85°C	IEC 62619: 2017	Tested with appliance	
IC (U6)	Freescalse semiconductor	MC9S08DZ60	Operating voltage: 2.7V~5.5V, T _A : -40°C~85°C	IEC 62619: 2017	Tested with appliance	
IC (U9)	TEXAS INSTRUMENTS	ISO3080	Supply voltage: 3.15V~5.5V, T _J : -40°C~85°C	IEC 62619: 2017	Tested with appliance	
IC (U12)	Maxim integrated	IS1050	Supply voltage: 3V~5.5V, T _J : -40°C~125°C	IEC 62619: 2017	Tested with appliance	
MOSFET (Q1~Q32)	infineon	IPB042N10N3 G	V _{DS} : 100V, V _{GS} : ±20V, I _D : 137A	IEC 62619: 2017	Tested with appliance	
Fuse	Adler	AEY3250900	70VDC, 250A	IEC 62619: 2017	Tested with appliance	

Supplementary information:

¹⁾ Provided evidence ensures the agreed level of compliance.

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 (m Ω)	Maximum Case Temperature Rise—T (°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): ____

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 I _t , (A)	Total Time for Reversed Charge Application (min)	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):____

7.3.2	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):

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):					

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
Battery #1					A, D, F
			Charge Voltage Applied Battery System: 1)		
			Whole	Part	
				N/A	
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
Battery #1				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): ____				

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	
Battery #1				
Maximum Specified Temperature of Battery System, C		Maximum Measured Cell Case Temperature, C	Results	
			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): ____				

Photo documentation
Photo 1



Photo 2



Photo 3



Photo 4



Photo 5

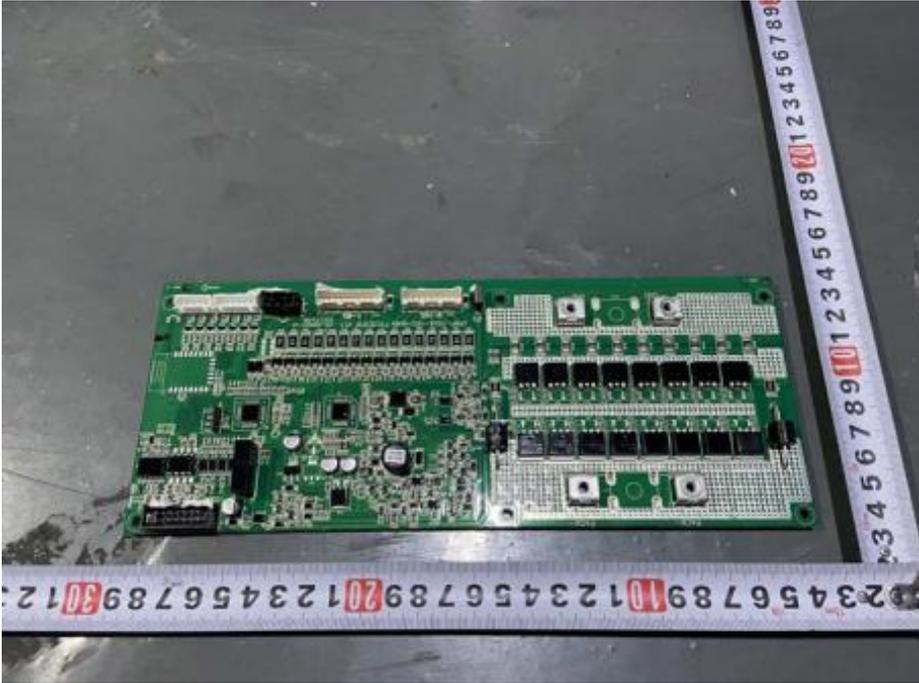


Photo 6

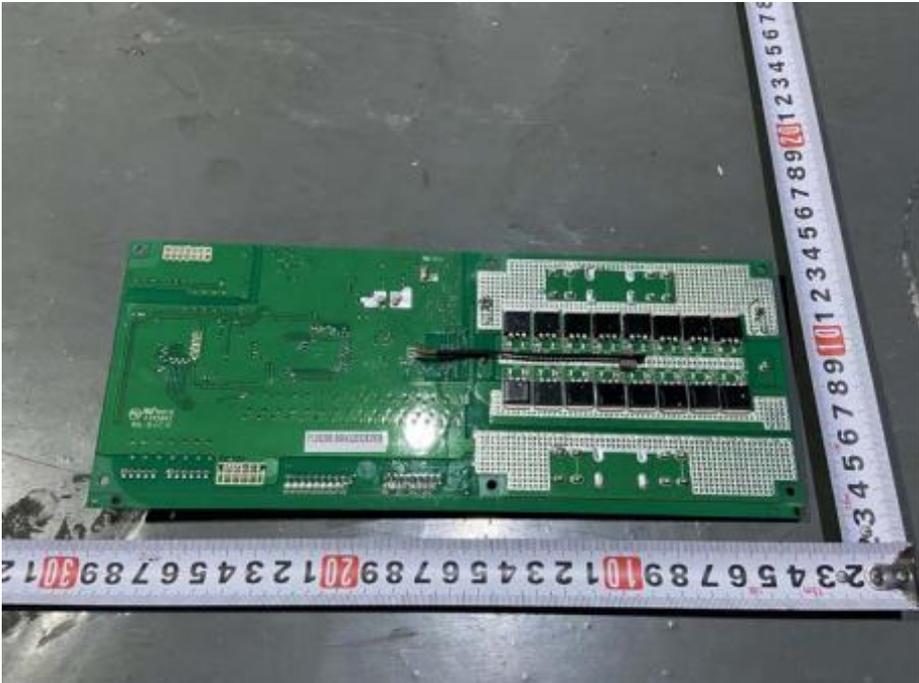


Photo 7

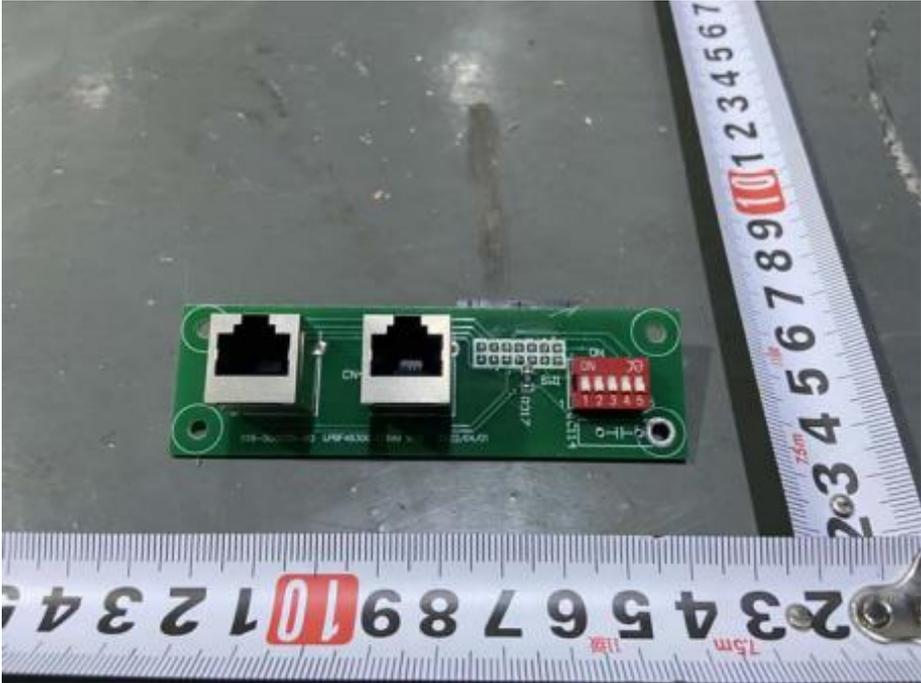


Photo 8



Photo 9

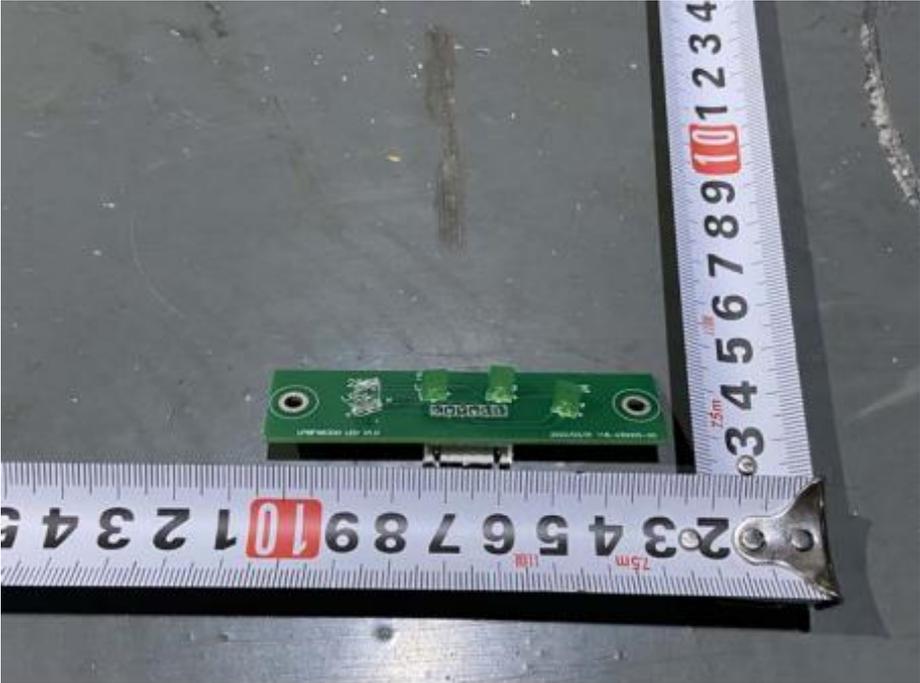
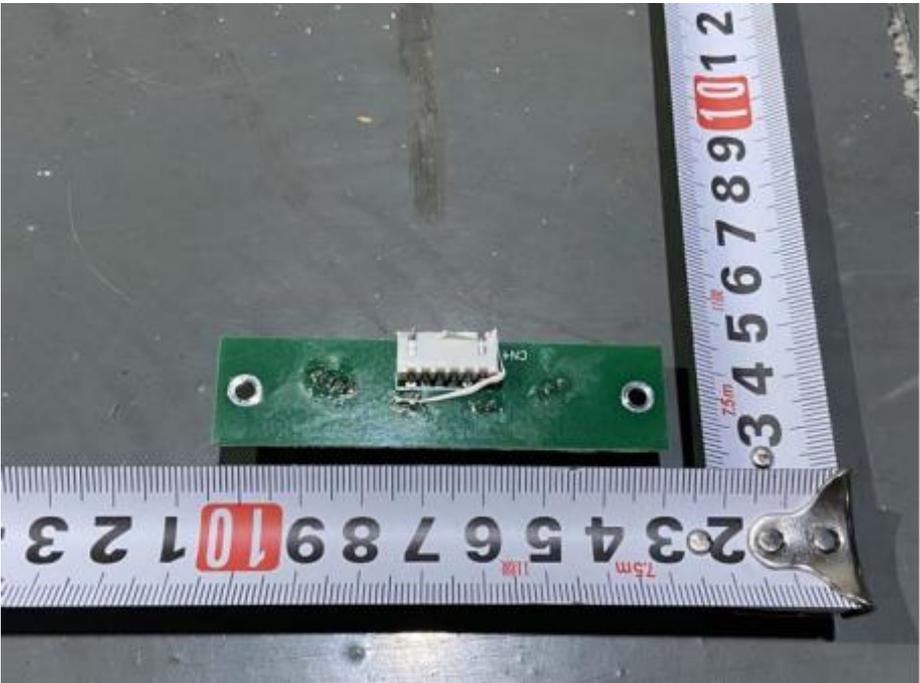


Photo 10



----- END OF THIS REPORT -----