



**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.....: 5061921007801-00

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Name of Testing Laboratory preparing the Report.....: TÜV SÜD New Energy Vehicle Testing (Jiangsu) Co., Ltd.

Applicant's name: Suzhou Stealth Energy Technology Co., Ltd

Address: 8th Floor,Zhenghe Building ,No.198 Jinfeng Road,Science and Technology City,Huqiu District,Suzhou,Jiangsu Province,PEOPLE'S REPUBLIC OF CHINA

Test specification:

Standard.....: IEC 62619: 2017

Test procedure.....: TÜV Mark

Non-standard test method.....: N/A

Test Report Form No.: IEC 62619A

Test Report Form(s) Originator....: UL (Demko)

Master TRF.....: Dated 2018-06-07

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Test item description:	Rechargeable Li-ion Battery System
Trade Mark:	 S T E A L T H E N E R G Y
Manufacturer	Suzhou Stealth Energy Technology Co., Ltd 8th Floor,Zhenghe Building ,No.198 Jinfeng Road,Sience and Technology City,Huqiu District,Suzhou,Jiangsu Province,PEOPLE'S REPUBLIC OF CHINA
Model/Type reference:	SP-HE10227-H, SP-HE20427-H, SP-HE30727-H, SP-HE40927- H, SP-HE51227-H
Ratings:	SP-HE10227-H: 102.4Vd.c., 27Ah; SP-HE20427-H: 204.8Vd.c., 27Ah; SP-HE30727-H: 307.2Vd.c., 27Ah; SP-HE40927-H: 409.2Vd.c., 27Ah; SP-HE51227-H: 512Vd.c., 27Ah;

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):	
Testing Laboratory:	TÜV SÜD New Energy Vehicle Testing (Jiangsu) Co., Ltd.
Testing location/ address:	No.15 Factory Building A, Jintong International Industrial Park, No.8 Xihu Road, Changzhou, Jiangsu, 213164, P. R. China
Tested by (name, function, signature) ..	Xiaohang Chen (Project Handler) 
Approved by (name, function, signature):	Haiyang Liu (Designated Reviewer)

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

Summary of testing:	
Tests performed (name of test and test clause): In section 7, clause 7.2.3.3 was performed with battery model SP-HE10227. -Cl. 7.2.3.3 Edge or corner drop test (cell or cell block, and battery system) In section 8, tests of clause 8.2.2, 8.2.3 and 8.2.4 were performed with a battery system SP-HE10227-H: - 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 above requirements of IEC 62619:2017 (First Edition).	Testing location: TÜV SÜD New Energy Vehicle Testing (Jiangsu) Co., Ltd. No.15 Factory Building A, Jintong International Industrial Park, No.8 Xihu Road, Changzhou, Jiangsu, 213164, P. R. China

Summary of compliance with National Differences: N/A
List of countries addressed: N/A

Copy of marking plate:

Below marking plates will be pasted on the surface of the battery

Rechargeable Li-ion Battery System				-Do not disassemble the battery pack. -Do not immerse the battery pack in water. -Do not short-circuit the battery. -Do not place at a children or pet touchable area. -Do not place near open flame or flammable material.			
Product Name: SP-HEHV27		Rate Capacity: 27Ah		Emergency Situations -If leaking, fire, wet or damaged, switch off the breaker and go away from the battery. -Do not touch the leaking liquid. -Do not use water. Use sand or dry powder extinguisher. -Contact your supplier as soon as possible if anything failure happens.			
System Model	Nominal Voltage	Operating Voltage	Rate Energy	Emergency Situations -If leaking, fire, wet or damaged, switch off the breaker and go away from the battery. -Do not touch the leaking liquid. -Do not use water. Use sand or dry powder extinguisher. -Contact your supplier as soon as possible if anything failure happens.			
□SP-HE10227-H	102.4Vdc	80-115.2Vdc	2.76kWh	Emergency Situations -If leaking, fire, wet or damaged, switch off the breaker and go away from the battery. -Do not touch the leaking liquid. -Do not use water. Use sand or dry powder extinguisher. -Contact your supplier as soon as possible if anything failure happens.			
□SP-HE20427-H	204.8Vdc	160-230.4Vdc	5.53kWh	Emergency Situations -If leaking, fire, wet or damaged, switch off the breaker and go away from the battery. -Do not touch the leaking liquid. -Do not use water. Use sand or dry powder extinguisher. -Contact your supplier as soon as possible if anything failure happens.			
□SP-HE30727-H	307.2Vdc	240-345.6Vdc	8.29kWh	Emergency Situations -If leaking, fire, wet or damaged, switch off the breaker and go away from the battery. -Do not touch the leaking liquid. -Do not use water. Use sand or dry powder extinguisher. -Contact your supplier as soon as possible if anything failure happens.			
□SP-HE40927-H	409.6Vdc	320-460.8Vdc	11.05kWh	Emergency Situations -If leaking, fire, wet or damaged, switch off the breaker and go away from the battery. -Do not touch the leaking liquid. -Do not use water. Use sand or dry powder extinguisher. -Contact your supplier as soon as possible if anything failure happens.			
□SP-HE51227-H	512Vdc	400-576Vdc	13.82kWh	Emergency Situations -If leaking, fire, wet or damaged, switch off the breaker and go away from the battery. -Do not touch the leaking liquid. -Do not use water. Use sand or dry powder extinguisher. -Contact your supplier as soon as possible if anything failure happens.			
Nominal Charge/Discharge Current: 27A		Available SOC range: 10%~100%		Emergency Situations -If leaking, fire, wet or damaged, switch off the breaker and go away from the battery. -Do not touch the leaking liquid. -Do not use water. Use sand or dry powder extinguisher. -Contact your supplier as soon as possible if anything failure happens.			
Max. Charge/Discharge Current: 30A		Storage Temperature: -10~30℃		Emergency Situations -If leaking, fire, wet or damaged, switch off the breaker and go away from the battery. -Do not touch the leaking liquid. -Do not use water. Use sand or dry powder extinguisher. -Contact your supplier as soon as possible if anything failure happens.			
S/N		Operating Temperature: 0~45℃		Emergency Situations -If leaking, fire, wet or damaged, switch off the breaker and go away from the battery. -Do not touch the leaking liquid. -Do not use water. Use sand or dry powder extinguisher. -Contact your supplier as soon as possible if anything failure happens.			
SPHE51227BD0328001				Made in China			
Suzhou Stealth Energy Technology Co., Ltd							

system:

Remark:

This is not the actual code and only for example.

1. SPHE51227BD03280001:

- SPHE: product type;
- 51227: Voltage & Capacity;
- B: cell manufacture, "B" stand for GUOXUAN;
- D: year, "D" stand for 2022;
- 03: month;
- 28: date;
- 0001: Product Serial Number.

Year	Corresponding code	Month	Corresponding code	Day	Corresponding code	Day	Corresponding code
2019	A	1	01	1	01	17	17
2020	B	2	02	2	02	18	18
2021	C	3	03	3	03	19	19
2022	D	4	04	4	04	20	20
2023	E	5	05	5	05	21	21
2024	F	6	06	6	06	22	22
2025	G	7	07	7	07	23	23
2026	H	8	08	8	08	24	24
2027	I	9	09	9	09	25	25
2028	J	10	10	10	10	26	26
2029	K	11	11	11	11	27	27
2030	L	12	12	12	12	28	28
2031	M			13	13	29	29
2032	N			14	14	30	30
2033	O			15	15	31	31
2034	P			16	16		

- 2. "P+", "P-" are marked near the polarity of the battery system, "P+" positive electrode ; "P-" negative electrode.
- 3. "BAT+", "BAT-" are marked near the polarity of the battery module, "BAT+" positive electrode ; "BAT-" negative electrode.



Test item particulars	
Classification of installation and use: Use in industrial application	
Supply Connection	
Supply by terminals	
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 : 2022-03-28	
Date (s) of performance of tests	
2022-03-30 to 2022-04-07	
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 <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.	
Remark: Photo Documentation: 25 pages	
Manufacturer's Declaration per sub-clause 4.2.5 of IEC 61851-2:	
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.....:	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> Not applicable
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies) :	Suzhou Stealth Energy Technology Co., Ltd 8th Floor,Zhenghe Building ,No.198 Jinfeng Road,Sience and Technology City,Huqiu District,Suzhou,Jiangsu Province,PEOPLE'S REPUBLIC OF CHINA

General product information and other remarks:

The Rechargeable Li-ion Battery System, 5 models: SP-HE10227-H, SP-HE20427-H, SP-HE30727-H, SP-HE40927-H, SP-HE51227-H are used in industrial appliance. The Battery system consists of one controller box and different number of Rechargeable Li-ion Battery modules with model SP-HE10227 connected in series, 1 module for SP-HE10227-H, 2 modules for SP-HE20427-H, 3 modules for SP-HE30727-H, 4 modules for SP-HE40927-H, 5 modules for SP-HE51227-H.

The Battery module SP-HE10227 consists of 32 Rechargeable Li-ion Cell with model No. IFP20100140A-27Ah connected in series.

Additionally, details information of the battery and the built-in cell are shown in following table:

Product name	Rechargeable Li-ion Battery Cell	Rechargeable Li-ion Battery Module	Rechargeable Li-ion Battery System
Type/model	IFP20100140A-27Ah	SP-HE10227	SP-HE10227-H SP-HE20427-H SP-HE30727-H SP-HE40927-H SP-HE51227-H
Nominal voltage	3.2V	102.4V	SP-HE10227-H:102.4V SP-HE20427-H:204.8V SP-HE30727-H:307.2V SP-HE40927-H:409.6V SP-HE51227-H:512V
Rated capacity	27Ah	27Ah	27Ah
Charging voltage declared by manufacturer	3.65V	115.2V	SP-HE10227-H:115.2V SP-HE20427-H:230.4V SP-HE30727-H:345.6V SP-HE40927-H:460.8V SP-HE51227-H:576V
Upper limit charging voltage	3.85V	123.2V	SP-HE10227-H:123.2V SP-HE20427-H:246.4V SP-HE30727-H:369.6V SP-HE40927-H:492.8V SP-HE51227-H:616V
Charging current declared by manufacturer	27A	27A	27A
Maximum continuous charging current	54A	30A	30A
Discharging current declared by manufacturer	27A	27A	27A
Maximum continuous discharging current	67.5A	30A	30A
Discharge cut-off voltage	2.0V for cell	2.5V for cell or 80V for model	SP-HE10227-H:80V SP-HE20427-H:160V SP-HE30727-H:240V SP-HE40927-H:320V SP-HE51227-H:400V

Standard temperature range for charging	-10°C to 55°C	0~45°C	0°C to 45°C
Standard temperature range for discharging	-30°C to 60°C	0~45°C	0°C to 45°C
Standard charging method by manufacturer	Charge at constant current 27A until voltage reaches 3.65V, then charge at constant voltage 3.65V till current is 1.35A.	Charge at constant current 27A until voltage reaches 3.6*32*N V, then charge at constant voltage 3.6*32*N V till current is 1.35A.	Charge at constant current 27A until voltage reaches 3.6*32*N V, then charge at constant voltage 3.6*32*N V till current is 1.35A. (N=1~5 battery modules)
Charging method for internal short-circuit test	Charge at constant current 27A until voltage reaches 3.85 V, then charge at constant voltage 3.85V till current is 1.35A	-	-
Dimension	Thickness: (20.5±0.1)mm Height: (140.5+0-0.2)mm Width: (100.0±0.1)mm	W*D*H: 640±5*220±5*280±5 mm	W*D*H SP-HE10227-H: 640±5*220±5*380±5 mm SP-HE20427-H: 640±5*220±5*660±5 mm SP-HE30727-H: 640±5*220±5*940±5 mm SP-HE40927-H: 640±5*220±5*1220±10 mm SP-HE51227-H: 640±5*220±5*1500±10 mm
Weight	611±5g	30.5±0.5kg	SP-HE10227-H:35±1KG SP-HE20427-H:66±1KG SP-HE30727-H:96±1KG SP-HE40927-H:127±1KG SP-HE51227-H:157±1KG
Configuration	-	32S	SP-HE10227-H: (1P16S)2S*1 SP-HE20427-H: (1P16S)2S*2 SP-HE30727-H: (1P16S)2S*3 SP-HE40927-H: (1P16S)2S*4 SP-HE51227-H: (1P16S)2S*5

Information for testing sample:

Sample Type	Test Item
SP-HE10227	tests of clause 8.2.4
SP-HE10227-H	test of clause 7.2.3.3, 8.2.2, 8.2.3

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...		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		P
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		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.....:	See page 5 & 6	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.....:	Manufacturing quality plan was 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	See page 5 & 6	P
7.2	Reasonably foreseeable misuse		P
7.2.1	External short-circuit test (cell or cell block)		N/A
	Short circuit with total resistance of 30 mW± 10 mW at 25 °C ± 5 °C		N/A
	Results: no fire, no explosion		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.		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)		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..... :	model: Battery Model SP-HE10227	—
	Mass of the test unit (kg)..... :	Measured: 31.593kg	—
	Height of drop (m)..... :	0.10m	—
	Results: no fire, no explosion		P
7.2.4	Thermal abuse test (cell or cell block)		N/A
	Results: no fire, no explosion		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		—
	Results: no fire, no explosion		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, $t = (1 It / I_m) \times 90$ (min.)..... :		N/A
	Results: no fire, no explosion		N/A
7.3	Considerations for internal short-circuit – Design evaluation		N/A
7.3.1	General		N/A
7.3.2	Internal short-circuit test (cell)		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 $25\text{ °C} \pm 5\text{ °C}$.		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, no explosion		N/A
7.3.3	Propagation test (battery system)	Test of clause 7.3.2 was performed in the approved cell report	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	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, risk assessment and mitigation of the battery system		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		N/A
	The exceeded charging voltage applied to only a part of the battery system, such as the cell(s)		P
	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.....:	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

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		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		N/A
A.6	Low temperature range		N/A
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		—
	– 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

5.1					
TABLE: Critical components information					
Object/part No.	Manufacturer/trademark	Type/Model	Technical Data	Standard	Marks of Conformity
1-Cell	Hefei Guoxuan High-Tech Power Energy Co., Ltd	IFP20100140A-27Ah	3.2Vd.c., 27Ah	IEC 62619: 2017	CB Certificate No. DK-82517-UL
For Battery Module: contain BMU, balance board and indicators devices					
2-IC for MCU (U8)	TI	MSP430F248TPMR	1.8V-3.6V -40°C ~ 105°C	-	-
3-IC for Op (U11)	TI	OPA2335AIDR	SOP-8 -40°C ~ 85°C	-	-
4-IC for isolated (U2 U14)	TI	ISO7731DW	2.25V-5.5V -55°C ~ 125°C	-	-
5-LDO (U12)	Linear Technology Corporation	LTC3639IMSE	150V/100Ma -40°C ~ 125°C	-	-
6.MOS (QB2)	MCC	MCT04N15	VDS:150V VGS:±20V ID:4A (TA=25°C) TJ: -55°C ~ 150°C	-	-
7-MOS (Q17)	ON	NTR4101PT1G	VDS:-20V VGS:±8V ID:-2.4A (TA=25°C) TJ: -55°C ~ 150°C	-	-
8-MOS (QB3)	VISHAY	SI4455DY	VDS:150V VGS:±20V ID:-2.8A (TA=25°C) TJ: -55°C ~ 150°C	-	-
9-SHUNT (RB1)	ISABELLENHUTTE	BVR-Z-R0002	0.2mΩ±1% 3W -55°C ~ 150°C	-	-
10-Resistor (NTC1 NTCB1 NTCB4 NTCB2 NTCB3)	THINKING	TSM1C103F34D1R	R25=10KΩ±1% B25/85=3435K±1% -50°C ~ 150°C	-	-
11-Resistor (R20 R28 R89 R98 R121 R138 R155 R174 R176 R178 R180 R186 R206)	YAGEO	RC0603FR-07100KL	1/10W 100kΩ ±1 -55°C ~ 155°C	-	-

5.1					
TABLE: Critical components information					
Object/part No.	Manufacturer/trademark	Type/Model	Technical Data	Standard	Marks of Conformity
12-Capacitor (CY1 CY2 CY3 CY4 CY5)	TDK	CD45-B2GA471K-NKA	470pF 400VAC	-	-
13-Capacitor (C7 C11 C13 C14 C46 C47...)	YAGEO	CC0603JRNPO9BN330	33pF 50V ±5% -55°C ~ 125°C	-	-
14-Diode (D23)	ON	MMSZ4678T1G	1.8V -55°C ~ 150°C	-	-
15-Diodo (DB35 DB37 DB39 DB41 DB43 DB45...)	Yangzhou Yangjie Electronic Technology Co., Ltd.	SS220A	200V,2A -55°C ~ 150°C	-	-
16-Diodo (D1)	BRIGHTTEK	1SA1206G71C0CA06	25Ma -40°C ~ 85°C	-	-
17-Inductor (L2 L10 L11 L12 L20 L28 L47 L55 L56 L57 L58)	WURTH	74279266	1000ohm,100MHz ±25% -55°C ~ 125°C	-	-
18-Inductor (L30)	COMPON	CLH7060N-302M	3mH/0.9A/125Vac,-40°C ~ 105°C	-	-
19-Transient Voltage Suppressors (D4 D6)	BrightKing	SMBJ6.5CA	6.5V 4A -65°C ~ 150°C	-	-
20-Crystal (Y1)	TXC	9C-3.6864MAAJ-T	18pF ±30ppm -40°C ~ 85°C	-	-
21-FUSE (F1)	LF	0466.375NRHF	50A/125V AC/DC	-	E10480
22-General Purpose Transistor (Q10)	ON	MMBT5551LT1G	160V 0.6A -55°C ~ 150°C	-	-
23-Optocoupler (OP1)	Toshiba	TLP387	300V/150mA -55°C ~ 110°C	-	-
For BMS part					

5.1					
TABLE: Critical components information					
Object/part No.	Manufacturer/trademark	Type/Model	Technical Data	Standard	Marks of Conformity
24-BMS (Main board, bottom board)	Suzhou Sanbess Technology Co.,Ltd	Model:MC0600 27 Hardware version: P- HV-27AH-V1.0 Software version: BCMU-HV-27AH-V1.0	Overcharge detection voltage for each cell: 3.7V, Overdischarge detection voltage for each cell: 2.00V±0.062V, Charge overcurrent detection current: 33A, Discharge overcurrent detection current: 33A, High temperature protection: 48°C ±1°C, Low temperature protection: 1°C ±1°C,	-	-
- PCB material	GUANG DE ZT TECHNOLOGY	M0408888	Tg=130°C, V-0	-	E501786
25-IC- MU (U9)	TI	MSP430F6736AIPZ	1.8V-3,6V -40°C ~ 85°C	-	-
26-IC for PMIC (U6)	TI	TL431AIPK	2.495V-36v -40°C ~ 85°C	-	-
27-IC for CAN control (U23)	MC	MCP2515I/SO	2.7V-5.5V -40°C ~ 85°C	-	-
28-IC for Flash (U11)	SST	SST25VF016B-75-4I- S2AF	2.7V-3.6V -40°C ~ 85°C	-	-
29-IC for isolated RS485 (U15,U20)	TI	ISO3082DWG4	-0.3V-6V -40°C ~ 85°C	-	-
30-IC for RS485 (U1,U7)	TI3	MSP430F248TPMR	1.8V-3.6V -40°C ~ 105°C	-	-
31-IC for isolated CAN Transceiver (U22)	TI	ISO1050DUBR	3V-5.5V -55°C ~ 105°C	-	-
32-IC for Power Switch (U3)	INFINEON	ICE3BR0680JZ	-0.3V-25V -25°C ~ 130°C	-	-
33-IC for ESD Protection (U30 U31)	ST	USBLC6-4 SC6	130W -40°C ~ 125°C	-	-

5.1					
TABLE: Critical components information					
Object/part No.	Manufacturer/trademark	Type/Model	Technical Data	Standard	Marks of Conformity
34-IC for isolated (U2 U14)	TI	ISO7731DW	2.25V-5.5V -55°C ~ 125°C	-	-
35-Relay	Xiamen Hongfa	HFD3-V/5-S	4A, 400VAC/600VDC -40°C ~ 85°C	-	E133481
36-LDO Regulator (U1)	TI	LP5907MFX-3.3/NOPB	2.2V-5.5V -40°C ~ 125°C	-	-
37-LDO Regulator (U12)	TI	TPS7A2601DRVPR	2.4V-18V -40°C ~ 125°C	-	-
38-Operational Amplifier (U18 U19)	TI	LM321MF/NOPB	3V-32V -40°C ~ 85°C	-	-
39.MOS (MCU)	ON	2N7002ET1G	VDS:60V VGS:±20V ID:260mA (TA=25°C) TJ:-55°C ~ 150°C	-	-
40-MOS (44pcs, Q12 Q17 Q18 Q20 Q24 Q29 Q31)	INFINEON	BSS806NE	VDS:20V VGS:±8V ID:6.9A (TA=25°C) TJ: -55°C ~ 150°C	-	-
41-MOS (Q26 Q30)	ALPHA&OMEGA	AO6400	VDS:30V VGS:±12V ID:2.3A (TA=25°C) TJ: -55°C ~ 150°C	-	-
42-MOS (Q4)	ON	BSS84LT1G	VDS:50V VGS:±20V ID:130mA (TA=25°C) TJ: -55°C ~ 150°C	-	-
43-MOS (Q15 Q23)	ON	CPH6350-TL-W	VDS:-30V VGS:±20V ID:-6A (TA=25°C) TJ: -55°C ~ 150°C	-	-
44-Transformer (TX1)	KUNSHAN POWER ELECTRONICS TECHNOLOGY CO.,LTD.	EC2825	8+8 21:21/9:4:3:3:3 0.4mH±10%	-	-
45.Resistor (NTC1)	TDK	B57236S0100M000	2.1W 10Ω ±20%	-	-

5.1 TABLE: Critical components information					
Object/part No.	Manufacturer/trademark	Type/Model	Technical Data	Standard	Marks of Conformity
46-Resistor (NTC1 NTCB1 NTCB4)	THINKING	TSM1C103F34D1R	R25=10KΩ±1% B25/50=3435K±1% Topr: -50°C ~ 150°C	-	-
47-Resistor (R37 R94 R95 R96 R202 R203 R207 R209 R210 R211 R212 R213 R214 R221 R222 R224)	YAGEO	RC0603FR-0710RL	1/10W -55°C ~ 150°C	-	-
48.Capacitor (C27)	CARLI	PB105J3AF2QH050D9R	1uF/1000VDC ±20%	-	-
49-Capacitor (C33 C111 C114 C116 C118 C120 C122 C127)	YAGEO	CC1206KKX7R9BB475	4.7uF 50V ±10% -55°C ~ 125°C	-	-
50-Capacitor (C33 C111 C114 C116 C118 C120 C122 C127)	NCC	EKY-160ETD471MH15D	470uF 16V ±20%	-	-
51-Capacitor (C6 C83)	SAMXON	EGT108M1CG16RRS0P	1000uF 16V ±20%	-	-
52.Diode (ZD1)	JCET	BZT52C5V1	4.8V-5.4V	-	-
53-Diode (D4 D7)	DIODES	DFLS1100-7	100V 1A 55°C ~ 175°C	-	-
54-Diode (D2)	ON	MM5Z18VT1G	18V 200mW -55°C ~ 150°C	-	-
55-Diode (D5)	BRIGHTTEK	1SA1206G71C0CA06	25mA -40°C ~ 85°C	-	-
56.Inductor (L2 L3)	WE	744232222	CM Choke 2*2.2k 200mA 1206 SMD	-	-

5.1					
TABLE: Critical components information					
Object/part No.	Manufacturer/trademark	Type/Model	Technical Data	Standard	Marks of Conformity
57-Inductor (L2 L3)	WE	744778122	22uH 0.119Ω 1.38A 7.3×7.3×3.2mm -40 to +125	-	-
58-DIP Switch	TACLEX ELECTRONICS CO.,LTD	NDS-V(01,03,01B,03B)	Blue or red, general tolerances 10mm over ±0.20mm, 10mm below ±0.10mm	-	-
59-Transient Voltage Suppressors (D3)	BrightKing	P6KE200A	200V/600W -55°C ~ 150°C	-	-
60-Crystal (Y1)	CITIZEN	CM200C32768HZFT	32.768K ±20ppm -40°C ~ 85°C	-	-
61-Fuse (F2 F3 F4)	LF	0466.375NRHF	50A/125V AC/DC	-	E10480
62-General Purpose Transistor (Q8 Q9 Q11 Q12 Q15 Q16)	ON	MMBT3904LT1G	200mA/40V -55°C ~ 150°C	-	-
63-Optocoupler (U2 U4 U5 U8 U14 U16 U17 U21 U24 U26 U27 U41)	AVAGO	HCPL-817-50BE	50mA/6V -30°C ~ 100°C	-	-
64-Buzzer (U25)	Changzhou Cre-sound electronics co.,ltd	LEB9055B-05B-2.7-5.0-R.	3V-6.5V -40°C ~ 85°C	-	-
Electrical components					
65-Connector	MELOX	1716920106 1716920102 1054110106 1054110102	23A,600V,-40°C ~105°C	-	E29179
		901420020 901420018 901420006 901301320 901301318 901301306	3A,350V,-55°C~105°C		
		513531000 513530800 559171010 559170810	3A,250V,-40°C ~105°C		

5.1 TABLE: Critical components information					
Object/part No.	Manufacturer/trademark	Type/Model	Technical Data	Standard	Marks of Conformity
		511631200 511630900 511630800 511630600 511630400 511630300 511630200 533751210 533750910 533750810 533750610 533750410 533750310 533750210	3.5A,250V,-40~105°C		
		436450400 436450300 436450200 436500418 436500318 436500218	2.5A,250V,-40~105°C		
66-Relay	Bussmann	EVC-HBANB-100S-E	100A/750VDC -40~85°C	-	E521360
67-Break	PROJOY	PEBS-H	750VDC/40A -30~70°C	EN60947-2:2017	No.R50426346
68-Fuse	ADLER Elektrotechnik Leipzig GmbH	AE3 EV	50A,850V	-	E506668
69-B+,B-Cable	3Q WIRE & CABLE CO LTD	UL10269,10AWG	1000V,105°C	-	E341104
70-Voltage sampling line	3Q WIRE & CABLE CO LTD	UL1569,24AWG	300V,105°C	-	E341104
71-Wiring for connecting	3Q WIRE & CABLE CO LTD	UL1569,16AWG,24AWG	300V,105°C	-	E341104
72-HV connector (plug)	Amphenol Technology(Zhuhai) Co., Ltd.	3.6mm SURLOK PLUS PLUG	50A,1500VDC -40°C ~125°C	-	TÜV Rheinland Certificate NO.R50481661
73-HV connector (socket)	Amphenol Technology(Zhuhai) Co., Ltd.	3.6mm SURLOK PLUS RECEPTACLE	50A,1500VDC -40°C ~125°C	-	
74-RJ45	Amphenol LTW	SPRJS-5EPFFJ-TC7002	300V,105°C	-	-

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 (mW)	Maximum Case Temperature Rise DT (K)	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 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):

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 of Battery System, (V dc)	Max. Voltage of Cell/Cell Blocks, (V dc)	Results
SP-HE10227-H	2.866	30	114.57	3.658	A, D, F
			Charge Voltage Applied Battery System: 1)		
			Whole	Part	
			128.48	-	

Supplementary information:

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)	120% of Max. Charging Current, (A)	Max. Charging Voltage, (V dc)	Results
SP-HE10227-H	93.30	36	97.439	A, D, F
SP-HE10227-H	93.21	64.8	100.553	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
Sample No.	OCV at start (SOC 50%) of test, V dc	Recommended Charging Current, A	Maximum Charging Voltage, V dc	
SP-HE10227-H	107.302	27	110.465	
Maximum Specified Temperature of Battery System, °C		Maximum Measured Battery Case Temperature, °C	Results	
45.0		49.6	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):				

TABLE H.1—MEASURES TO ADDRESS FAULT / ERRORS (Software Class B)			
Component	Fault	Declared measures	Verdict
1.CPU	-	-	-
1.1 Register	Stuck at	Periodic self-test using static memory test: Such as SR test, DR test and SP test.	P
1.3 Programme counter	Stuck at	Periodic self-test using stack overflow test.	P
2. Interrupt handling and execution	No interrupt	Time-slot monitoring: Timer B is checked by Timer A.	P
	Too frequency interrupt	Time-slot monitoring: Timer B is checked by Timer A.	P
3. Clock	Wrong frequency (for quartz synchronized clock: harmonics / sub-harmonics only)	Frequency monitoring.	P
4. Memory	-	-	-
4.1 Invariable memory	All single bit faults	CRC (Cyclic Redundancy Check)	P
4.2 Variable memory	DC fault	March c	P
4.3 Addressing (relevant to variable and in variable memory)	Stuck at	CRC for invariable memory; March c for variable memory;	P
5. Internal data path	-	-	P

5.1 Data	Stuck at	Periodic self-test using static memory test: such as SR test, DR test and SP test.	P
5.2 Addressing	Wrong address	Periodic self-test using stack overflow test.	P
6. External communication	-	-	-
6.1 Data	Hamming distance 3	CRC (Cyclic Redundancy Check)	P
6.2 Addressing	Wrong address	CRC (Cyclic Redundancy Check)	P
6.3 Timing	Wrong point in time	Time-slot monitoring	P
	Wrong sequence	Time-slot monitoring	P
7. Input/output periphery	-	-	-
7.1 Digital I/O	Fault conditions specified in Clause H.27.1	Plausibility check	P
7.2 Analog I/O	-	-	-
7.2.1 A/D- and D/A converter	Fault conditions specified in Clause H.27.1	Plausibility check	P
7.2.2 Analog multiplexer	Wrong addressing	Plausibility check	P
9. Customer chips, eg. ASIC, GAL, Gate array	Any output outside the static dynamic functional specification	No such chip used.	N/A

H27.1		TABLE: Electrical / electronic component fault modes											
Component	short circuiting	open circuit	a) No flames	b) 1.5 x max temp. of Cl. 14	c) as declared (H57)	d) protect. against el. shock	d) electric strength, basic insulation	e) creepage and clearance	f) no rupture of ext. fuses or	f) complies with a), b) and d)	g) as declared in H58	Observations	
DC OUT (P+) on the power board		x	P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.	
DC OUT (P+) and DC OUT (P-) on the power board	Reverse		P	P	P	P	P	P	N/A	N/A	N/A	The system doesn't work. No hazard.	
P5V		x	P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.	

P5V	x		P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
P3V3	x		P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
P3V3		x	P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
P5V5	x		P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
P5V5		x	P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
P5VS	x	x	P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
P5VS		x	P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
P3V3S_AD		x	P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
P3V3S_AD	x		P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
Current sense line	x		P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
Current sense line		x	P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
RS485-A of U1 and U7	x		P	P	P	P	P	P	N/A	N/A	N/A	Communication time out. The power DC Contactor switched off. No hazard.

RS485-A of U1 and U7		x	P	P	P	P	P	P	N/A	N/A	N/A	Communication time out. The power DC Contactor switched off. No hazard.
CAN of U22	x		P	P	P	P	P	P	N/A	N/A	N/A	Communication time out. The power DC Contactor switched off. No hazard.
CAN of U22		x	P	P	P	P	P	P	N/A	N/A	N/A	Communication time out. The power DC Contactor switched off. No hazard.
Cell voltage sense line	x		P	P	P	P	P	P	N/A	N/A	N/A	The voltage value is abnormal. Communication time out. The power DC Contactor switched off. No hazard.
Cell voltage sense line		x	P	P	P	P	P	P	N/A	N/A	N/A	The voltage value is abnormal. Communication time out. The power DC Contactor switched off. No hazard.
NTC resistor	x		P	P	P	P	P	P	N/A	N/A	N/A	The temperature value is abnormal. The power DC Contactor switched off. No hazard.
NTC resistor		x	P	P	P	P	P	P	N/A	N/A	N/A	The temperature value is abnormal. The power DC Contactor switched off. No hazard.
TVS	x		P	P	P	P	P	P	N/A	N/A	N/A	The power DC Contactor switched off. Cease to output. No hazard.
Fuse		x	P	P	P	P	P	P	N/A	N/A	N/A	The system doesn't work. The power DC Contactor switched off. Cease to output. No hazard.
Supplementary information: N/A												

Table: Manufacturer's Documentation

Documentation Title	Revision	Issuing Date
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System Requirements Specification (SRS)	SDE/QP-JS-009, A01	2022-02-15
User manual	SDE/QP-JS-001, A01	2022-02-15
Safety architecture	SDE/QP-JS-009, A01	2022-02-15
Code standard	SDE/QP-JS-009, A01	2022-02-15
Hardware Specification	HV-SCH001, V0.1	2021-08-01
Software system design Specification	SDE/QP-JS-009, A01	2022-02-15
Component single fault analysis	SDE/QP-JS-007, A01	2022-02-15
Hazard analyses and risk assessment for system	SDE/QP-JS-008, A01	2022-03-15
FEMA for Hardware	SDE/QP-JS-005, A01	2022-03-15
Fault insert test record	SDE/QP-JS-009, A01	2022-03-15
Cell test report	Model No. IFP20100140A=27A Report No: RESS-4788914086-002	2019-04-11
Battery system safety test report	Report No: 5061921007801-00	2022-05-06
Battery system EMC test report	Report No:4861921208600	2022-05-06

--- End of test report ---