Product Specification

IFP28148115A-52Ah

1. Basic information

1.1 Scope of application

This product specification is provided to customers by Hefei Guoxuan High-tech Power Energy Co., Ltd., describing the performance of its lithium-ion secondary battery.

1.2 Usage: EV

1.3 Product type: lithium ion secondary battery, square, LFP battery

1.4 Model name: IFP28148115A-52Ah

2. Specifications

2.1 Standard technical parameters

project	parameter	Conditions/Notes
2.1.1 Capacity	>53.5Ah	0.33C
	>52Ah	1C
2.1.2 Nominal voltage	3.2V	0.33C
	3.1V	1C
2.1.3 Charge and discharge voltage range	2.0V ~ 3.65V	>0°C
	1.8V ~ 3.65V	<0°C, continuous charging is not allowed
2.1.4 Weight	966g±30g	Without outer film
2.1.5 Mass energy density	>175Wh/kg	0.33C/0.33C
2.1.6 Volume energy density	>350Wh/L	0.33C/0.33C
2.1.7 AC internal resistance	0.5mΩ<R<0.8mΩ	25 °C ±2 °C
2.1.8 DC internal resistance	<2.5mΩ	50%SOC, 25 °C±2°C

2.2 Recommended charging specifications

project	parameter	Conditions/Notes
2.2.1 Regular charging (slow charging)	26A 3.65V 2.6A 10°C<T<45°C	Constant current Constant voltage Cut-off condition (termination) Temperature
2.2.2 Step charge (fast charge)	See Annex A.1	Fast charging strategy at different temperatures

2.3 Operating temperature range

project	parameter	Conditions/Notes
2.3.1 Optimal working temperature	10°C ∽35°C	
2.3.2 Charging temperature range	0°C ∽55°C	Charging current, see Annex A.1
2.3.3 Discharge temperature range	-30°C~60°C	Maximum cell temperature ≤60°C

3. Appearance size

3.1 Appearance

There are no obvious scratches, cracks, rust, discoloration or electrolyte leakage on the outer surface of the battery, and no other appearance defects that affect the normal use of the battery.

3.2 size

Thickness: (28.2±0.5) mm (including outer film, 5% SOC, 10kgf).

Width: (148±0.3)mm.

Height: (118.5±0.3)mm (including pole).

4. Performance test specifications

4.1 Standard test conditions

4.1.1 Single battery charging

At room temperature (25°C+2°C), the single battery is discharged with a current of 52A to a voltage of 2.0V, let stand for 30 minutes, and then charged with a current of 52A to a voltage of 3.65V, then switch to constant voltage charging until the charging current drops to 2.6 Stop charging at A, and let it stand for 30 minutes after charging.

4.1.2 Single battery discharge

At room temperature (25°C+2°C), the single battery is discharged with a current of 52A to a voltage of 2.0V, and it is allowed to stand for 30 minutes.

4.2 Electrical characteristics

project	parameter	Conditions/Notes
4.2.1 Initial capacity	>52Ah	Charge according to 4.1.1 and discharge 4.1.2
4.2.2 The correlation between capacity and temperature	55℃, ≥100% initial capacity 25℃, 100% initial capacity 0℃, ≥85% initial capacity -10℃, ≥75% initial capacity -20℃, ≥70% initial capacity -30℃, ≥55% initial capacity	Charge according to 4.1.1 at 25℃+2℃, and discharge to 2.0V (0℃ and below 1.8V) at 1C under test temperature.
4.2.3 SOC-OCV table	See Annex A.4	Charge according to 4.1.1, then discharge 5% capacity at 1C (this capacity is discharged according to 4.1.2 to the corresponding cut-off voltage ([-30℃~o℃) 2.0V, [0℃~10℃) 2.3V, [10℃~55℃]2.5V)) corresponding capacity), stand for 1h, repeat 20 times, record after standing Voltage data.
4.2.4 Different temperature and different SOC discharge resistance (DCR)	See Annex A.5	Charge according to 4.1.1, then adjust the soC according to 4.2.2 discharge capacity at different temperatures at 1C (refer to 4.2.3 for cut-off voltage), stand for 1h, and test the DCR after 3C discharge for 30s. The discharge resistance is the difference between the open circuit voltage and the discharge end voltage divided by the current. The test sOC is 90%, 80%, 70%, 60%, 50%, 40%, 30%, 20%, 10%.
4.2.5 Different temperature and different SOC charging resistance (DCR)	See Annex A.6	Charge according to 4.1.1, then adjust the soC according to 4.2.2 discharge capacity at different temperatures with lC (refer to 4.2.3 for cut-off voltage), stand for 1h, and test the DCR charged at 2.25C for 15s. The charging resistance is the difference between the charging terminal voltage and the open circuit voltage divided by the current, and the test SOC is 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%.

4.3 Maximum pulse power (limit capacity value)

project	parameter	Conditions/Notes
4.3.1 The peak power of pulse discharge at different temperatures and different SOCs	See Annex A.7	According to the DCR and the maximum pulse discharge current calculated according to the test data in 4.2.4, the pulse discharge power at the lower limit voltage of the discharge specified at different temperatures is calculated.
4.3.2 Different temperature and different SOC pulse feedback peak power	See Annex A.8	According to the DCR and the maximum pulse charging current calculated according to the test data in 4.2.5, the pulse feedback power at the charging upper limit voltage of 3.65V is calculated.

4.4 Maximum allowable pulse power (use allowable value)

project	parameter	Conditions/Notes
4.4.1 Maximum allowable pulse discharge power at different temperatures and different SOCs	See Annex A.9	According to 4.3.1 the maximum pulse discharge rate capability of the cell and the temperature protection during the discharge process, the upper limit of the pulse discharge power of the cell is limited.
4.4.2 Maximum allowable pulse feedback power at different temperatures and different SOCs	See Annex A.10	According to the maximum pulse charging rate capability of the battery cell in 4.3.2, combined with the reliable upper limit voltage of the pulse charging of the battery cell at a large rate and the consideration of the temperature protection during the charging process, the upper limit of the battery pulse feedback power is limited.

4.5 Durability

project	parameter	Conditions/Notes
4.5.1 Room temperature charge retention rate	>95%	25°C, 100%SOC, 28 days
4.5.2 Room temperature capacity recovery rate	>96%	
4.5.3 High temperature charge retention rate	>94%	55°C, IOO%SOC, 7 days
4.5.4 High temperature capacity recovery rate	>95%	
4.5.5 Storage capacity recovery rate	>94%	45°C, 50%SOC, 28 days
4.5.6 High temperature cycle life	800 times	80% capacity retention rate; 55°C, according to 4.1.1 charging method; IC discharged to 2.0V
4.5.7 High temperature cycle life	1000 times	80% capacity retention rate; 45°C, according to 4.1.1 charging method; IC discharged to 2.0V
4.5.8 Cycle life at room temperature	2000 times	80% capacity retention rate: 25°C, according to 4.1.1 charging method; 1C discharge to 2.0V
4.5.9 Calendar life	8 years	80% capacity retention rate, 25°C, 50%SOC

4.6 Safety test specifications

project	Judgment Standard	Test Conditions
4.6.1 Overdischarge	No explosion, no fire, no leakage	The single battery is charged according to the method of 4.1.1, and the single battery is discharged at 1 I (A) for 90 minutes, and observe 1h. (I=52A)
4.6.2 Overcharge	No explosion, no fire	The single battery shall be charged according to the method of 4.1.1, and shall be charged with a constant current of 1 I (A) until the voltage reaches 1.5 times of the charge termination voltage specified in the technical conditions of the enterprise or the charging time shall be 1h, then stop charging, and observe for 1h. (I=52 A)
4.6.3 Short circuit	No explosion, no fire	The single battery is charged according to the method 4.1.1, and the positive and negative electrodes of the single battery are externally short-circuited for 10 minutes, and the external circuit resistance should be less than 5mΩ, and observe for 1h.
4.6.4 Drop	No explosion, no fire, no leakage	The single battery is charged according to the method of 4.1.1, and the positive and negative terminals of the single battery are freely dropped from a height of 1.5m to the concrete floor, and observed for 1h
4.6.5 Heating	No explosion, no fire	The single battery is charged according to the method 4.1.1, the temperature box is raised from room temperature to 130°C ± 2°C at a rate of 5°C/min, and the heating is stopped after the temperature is maintained for 30 minutes, and the observation is made for 1 hour.
4.6.6 Acupuncture	No explosion, no fire	The single battery is charged according to the method of 4.1.1, using a high temperature resistant steel needle with a diameter of 5mm~8mm (the cone angle of the steel needle is 45°~60°), at a speed of (25±5) mm/s, from perpendicular to the battery The direction of the pole plate penetrates, the penetration position should be close to the geometric center of the pierced surface, the steel needle stays in the battery, and observe for 1h
4.6.7 Extrusion	No explosion, no fire	The single battery is charged according to the method 4.1.1; the test is carried out according to the following conditions: a) Squeeze direction: apply pressure perpendicular to the direction of the battery plate; b) Form of extruded plate: a semi-cylinder with a radius of 75mm, the length (L) of the semi-cylinder is greater than the size of the battery to be extruded; c) Extrusion speed: (2±1) mm/s; d) Extrusion degree: stop after the voltage reaches 0V or the deformation reaches 15% or the extrusion force reaches 100KN Squeeze, hold for 10min; and observe for 1h.
4.6.8 Sea water immersion	No explosion, no fire	The single battery is charged according to the method of 4.1.1, and the single battery is immersed in 3.5% NaCI solution (mass fraction, which simulates the composition of seawater at normal temperature) for 2h, and the water depth should completely submerge the single battery.

<table>
<tr>
<td>4.6.9 Temperature cycling</td>
<td>No explosion, no fire, no leakage</td>
<td>The single battery is charged according to the method 4.1.1, and the single battery is placed in the temperature box. The temperature of the temperature box is adjusted according to the following table. The number of cycles is 5 times and the observation is for 1 hour.</td>
<td>
<table>
<tr><th>温度/℃</th><th>时间增量/min</th><th>累计时间/min</th><th>温度变化率/℃/min</th></tr>
<tr><td>25</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>-40</td><td>60</td><td>60</td><td>13/12</td></tr>
<tr><td>-40</td><td>90</td><td>150</td><td>0</td></tr>
<tr><td>25</td><td>60</td><td>210</td><td>13/12</td></tr>
<tr><td>85</td><td>90</td><td>300</td><td>2/3</td></tr>
<tr><td>85</td><td>110</td><td>410</td><td>0</td></tr>
<tr><td>25</td><td>70</td><td>480</td><td>6/7</td></tr>
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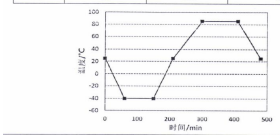


</td>
</tr>
<tr>
<td>4.6.10 Low air pressure</td>
<td>No explosion, no fire, no leakage</td>
<td colspan="2">The single battery is charged according to the method 4.1.1. The single battery is placed in a low-pressure box, the air pressure in the test box is adjusted to 11.6KPa, the temperature is room temperature, and the battery is allowed to stand for 6h and observe for 1h.</td>
</tr>
</table>

5. Precautions for use

Warnings on the use of lithium-ion rechargeable batteries. Improper operation may cause the battery to heat up, catch fire and deteriorate the performance. Be sure to read the following clauses carefully.

Precautions

When using a battery-equipped device, please refer to the user manual before use.

Please check the orientation of the positive and negative terminals before packaging.

The terminals or wires are connected to the battery module, and attention should be paid to insulation to prevent short circuits.

When not in use for a long time, the battery should be stored in a cool and dry place (≤35°℃, 30%~50% SOC, charge and discharge once every 3 months).

Do not place the battery in direct sunlight or a heat source.

Do not wear metal jewelry (such as rings, watches, ornaments, etc.) when handling the battery unit.

Do not place the battery in a place outside the operating temperature range specified in this document.

Prohibited matters

Do not charge beyond the maximum charging rate.

Do not disassemble or modify the battery.

Do not throw or hit the battery.

Do not pierce the battery with sharp objects (such as nails, knives, pens, electric drills). Do not mix with other types of batteries or modular units.

Do not excessively squeeze the battery during use.

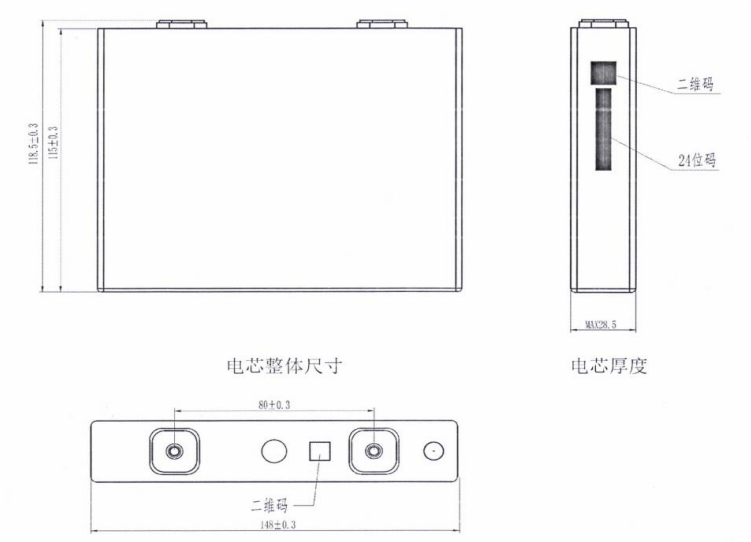
Do not use new and old batteries in the PACK at the same time. Do not place the battery in a high temperature greater than 60°C. Do not put the battery in a microwave oven or high-pressure container.

Do not use conductive materials to connect the positive and negative terminals (such as metals, wires). It is not allowed to get wet or immerse the battery in water or sea water.

Do not use the battery in a manner other than in the written agreement of the manufacturer. Poor insulation between the battery shells in series is prohibited.

The placement direction of the battery in the vehicle must ensure that the height of the battery core is perpendicular to the direction of travel of the vehicle.

6. Outline drawing



Appendix

A.1 Ladder charging matrix table

Step	temperature	<0°C	0°C <T<5°C	5 °C <T<15°C	I5°C <T<25°C	25 °C <T<45°C	45 °C <T<50°C	50 °C <T<55 °C
1	Charging current (C)	Charging is not allowed	0.15	0.33	0.8	1	0.5	0.33
	Jump voltage (V)	/	3.62	3.6	3.51	3.51	3.51	3.6
2	Charging current (C)	/	0.1	0.25	0.5	0.5	0.25	0.1
	Jump voltage (V)	/	3.65	3.62	3.6	3.6	3.62	3.65
3	Charging current (C)	/	/	0.1	0.25	0.25	0.1	
	Jump voltage (V)	/	/	3.65	3.62	3.62	3.65	
4	Charging current (C)	/	/		0.1	0.1		
	Cut-off voltage (V)	/	/		3.65	3.65		

A.2 Single cell failure threshold

A.2.1 Single cell failure threshold

battery model:	Numerical value	explain	refer to
Single overvoltage serious alarm threshold V	3.8	When charging, the overvoltage exceeds the alarm threshold, which will affect the cycle life of the battery, and the user is not allowed to charge more than this voltage value	Must be forced to power off
Monomer overvoltage general alarm threshold V	3.7	Critical value of overvoltage during charging	More than 5s, forced power off
Maximum working voltage V	3.65	Maximum limit value for normal operation	
Monomer undervoltage serious alarm threshold V	[-30℃~0℃)1.8 [0 ℃~55℃]2.0	When the undervoltage exceeds the alarm threshold during discharging, it will affect the cycle life of the battery, and the user is not allowed to exceed this voltage value when discharging	
Monomer undervoltage general alarm threshold V	[-30℃~0℃)1.9 [0 ℃~55℃]2.2	When the undervoltage exceeds the alarm threshold during discharging, it will affect the cycle life of the battery, and the user is not allowed to exceed this voltage value when discharging	
Minimum working voltage V	[-30℃~0℃2.0 [0 ℃~55℃]2.3	Minimum critical value for normal operation	
The battery temperature is too high, the general alarm threshold ℃	55	If the battery working temperature exceeds this temperature, the battery power will be limited	
The battery temperature is too high serious alarm threshold ℃	60	If the battery temperature exceeds this alarm threshold, it will affect the safety performance of the battery. The user should not exceed this temperature when using it.	
The battery temperature is too low, the general alarm threshold ℃	-20	The battery operating temperature is lower than this temperature, will limit the battery power	
Battery temperature is too low serious alarm threshold ℃	-30	If the battery temperature is lower than this alarm threshold, it will affect the battery safety performance. The user should not lower the temperature when using it.	

A.2.2 Battery information provided for Pack design

battery model:	Symbol	Numerical value	opinion	refer to
Maximum allowable pressure	Fmax	TBD		250kgf, 5%SOC
Minimum required pressure	Fmin	TBD		20kgf, 5%SOC

A.3 Cycle life under selected conditions

A.3.1 Room temperature cycle life

Test Conditions

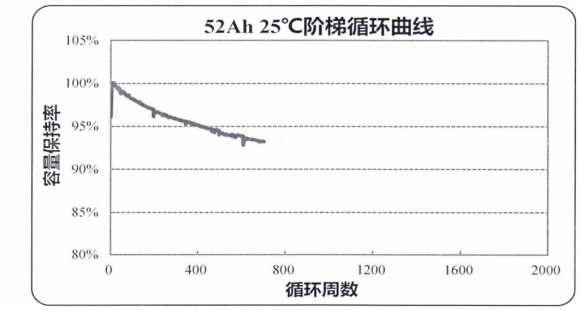
Charging: Stepped constant current charging, 1C charging to 3.51V, 0.5C charging to 3.60V, 0.25C

Charge to 3.62V, 0.1C to 3.65V;

Discharge: 1C discharge to cut-off voltage 2.0V;

Temperature: 25℃;

Standing time: stand for 30min after charging/discharging.



A.4 SOC-OCV table

T	-10℃	0℃	10℃	15℃	25 ℃	35℃	45 ℃
DOD/%	电压/V	电压/V	电压/V	电压/V	电压/V	电压/V	电压/V
0%	3.361	3.335	3.340	3.352	3.375	3.354	3.334
5%	3.320	3.319	3.325	3.326	3.329	3.330	3.331
10%	3.309	3.318	3.324	3.325	3.328	3.329	3.331
15%	3.309	3.318	3.324	3.325	3.328	3.329	3.331
20%	3.309	3.318	3.324	3.325	3.328	3.329	3.331
25%	3.309	3.318	3.324	3.325	3.328	3.329	3.331
30%	3.304	3.314	3.323	3.324	3.327	3.329	3.330
35%	3.293	3.304	3.316	3.319	3.324	3.325	3.327
40%	3.292	3.293	3.298	3.302	3.310	3.306	3.301
45%	3.285	3.285	3.288	3.290	3.294	3.295	3.297
50%	3.280	3.282	3.285	3.287	3.290	3.293	3.296
55%	3.277	3.280	3.284	3.285	3.289	3.292	3.295
60%	3.276	3.279	3.283	3.285	3.288	3.291	3.294
65%	3.274	3.279	3.282	3.284	3.288	3.290	3.293
70%	3.273	3.277	3.280	3.281	3.284	3.280	3.277
75%	3.272	3.273	3.272	3.272	3.272	3.267	3.261
80%	3.270	3.264	3.258	3.256	3.253	3.248	3.242
85%	3.266	3.250	3.236	3.234	3.230	3.223	3.217
90%	3.259	3.230	3.215	3.213	3.210	3.205	3.201
95%	3.246	3.209	3.188	3.186	3.180	3.149	3.117
100%	3.227	3.175	3.072	3.024	2.928	2.830	2.732

A.5 Different temperature and different SOC discharge resistance (DCR)

3C30s discharge DCR/mΩ								
T/SOC	-30°C	-20 °C	-10°C	0°C	10°C	25 °C	45 °C	55°C
10%	/	/	/	10.32	4.81	2.94	1.73	1.61
20%	/	/	/	6.83	3.79	2.35	1.55	1.41
30%	/	16.71	9.46	5.31	3.35	2.13	1.49	1.33
40%	/	14.20	7.40	4.59	3.13	1.98	1.42	1.29
50%	17.82	12.46	6.38	4.24	2.98	1.88	1.33	1.20
60%	16.72	10.99	5.85	4.05	2.92	1.93	1.40	1.25
70%	15.09	10.11	5.56	3.97	2.94	1.89	1.38	1.23
80%	13.97	9.61	5.41	3.91	2.87	1.81	1.32	1.18
90%	13.29	9.32	5.29	3.81	2.79	1.72	1.25	1.11
Note: / means that 30s, -30°C 2C test data, -20°C 2C test data are not supported								

A.6 Different temperature and different SOC charging resistance (DCR)

2.25C 15s charging DCR/mΩ				
T/SOC	10°C	25 °C	45 °C	55°C
10%	2.98	1.91	1.37	1.26
20%	2.92	1.85	1.34	1.20
30%	2.87	1.82	1.29	1.15
40%	2.84	1.77	1.25	1.14
50%	2.80	1.72	1.22	1.08
60%	2.80	1.75	1.22	1.08
70%	2.80	1.74	1.26	1.13
80%	2.77	1.72	1.22	1.08
90%	2.71	1.63	1.15	1.01

A.7 Different temperature and different SOC pulse discharge peak power

30s pulse discharge peak power/W								
T/SOC	-30°C	-20 °C	-10°C	0°C	10°C	25 °C	45°C	55 °C
10%	/	/	/	166.6	358.5	577.4	979.3	1050.1
20%	/	/	/	259.7	471.5	754.5	131.2	1244.2
30%	/	105.8	188.4	337.5	536.2	847.1	215.2	1348.9
40%	/	125.1	241.5	391.3	575.6	911.9	1278.8	1406.9
50%	117.1	143.2	281.3	424.4	606.2	963.9	1363.3	1513.8
60%	124.7	162.9	308.4	447.4	626.8	959.7	1323.3	1485.0
70%	138.3	178.0	326.5	462.1	630.4	985.2	1350.9	1513.8
80%	150.2	188.3	338.4	471.2	646.1	1028.3	1414.2	1585.1
90%	158.4	194.8	346.2	482.4	663.7	1078.4	1489.7	1677.3
Note: / means that 30s, -30°C 2C test data, -20°C 2C test data are not supported								

A.8 Different temperature and different SOC pulse feedback peak power

15s pulse feedback peak power/W				
T/SOC	IO°C	25 °C	45 °C	55°C
10%	440.3	665.2	898.5	975.3
20%	399.7	618.9	839.8	935.1
30%	388.4	585.6	795.4	885.3
40%	384.3	586.1	795.1	857.7
50%	382.5	590.8	791.9	875.8
60%	374.2	563.3	773.1	862.3
70%	368.6	554.1	729.4	799.7
80%	366.1	548.7	728.5	810.4
90%	366.1	564.7	758.3	850.5

A.9 Different temperature and different SOC maximum allowable pulse discharge power/rate

30s maximum allowable pulse discharge power/W								
T/SOC	-30°C	-20 °C	-10°C	0°C	IO°C	25 °C	45°C	55°C
0% ∽10%	6.8	14.0	43.7	75.4	149.5	244.6	301.6	150.8
10% ∽20%	6.8	28.1	58.2	119.9	216.1	348.5	301.6	150.8
20% ∽30%	13.5	75.5	114.6	167.8	265.9	418.3	301.6	150.8
30% ∽40%	13.5	89.4	147.7	196.1	287.6	454.6	301.6	150.8
40% ∽50%	80.5	102.3	172.0	213.4	303.6	481.3	301.6	150.8
50% ∽60%	88.3	119.9	195.3	234.9	325.8	492.8	301.6	150.8
60% ∽70%	100.2	134.0	212.3	249.5	337.0	524.1	301.6	150.8
70% ∽80%	108.4	141.2	218.6	254.0	346.0	548.6	301.6	150.8
80% ∽90%	113.9	145.5	223.6	260.6	355.9	577.3	301.6	150.8

Note: For the range of SOC interval, the left interval is the closed interval, and the right interval is the open interval. For example: 10%~20% is 10%≤SOC<20%

30s maximum allowable pulse discharge rate/C								
T/SOC	-30°C	-20 °C	-10°C	0°C	10°C	25 °C	45 °C	55 °C
0% ∽10%	0.1	0.1	0.3	0.5	1.0	1.6	2.0	1.0
10% ∽20%	0.1	0.2	0.4	0.8	1.4	2.3	2.0	1.0
20% ∽30%	0.1	0.5	0.8	l.l	1.8	2.8	2.0	1.0
30% ∽40%	0.1	0.6	1.0	1.3	1.9	3.0	2.0	1.0
40%~50%	0.6	0.7	1.2	1.4	2.0	3.2	2.0	1.0
50% ∽60%	0.7	0.9	1.3	1.6	2.2	3.3	2.0	1.0
60% ∽70%	0.7	1.0	1.5	1.7	2.2	3.5	2.0	1.0
70% ∽80%	0.8	1.0	1.5	1.7	2.3	3.6	2.0	1.0
80% ∽90%	0.8	1.0	1.5	1.7	2.4	3.8	2.0	1.0

Note: SOC interval range, the left interval is a closed interval, and the right interval is an open interval. For example: 10%~20% is 10%≤SOC<20%

A.10 Different temperature and different SOC maximum allowable pulse feedback power/rate

15s maximum allowable pulse feedback power/W				
T/SOC	10°C	25 °C	45 °C	55°C
0% ∽10%	161.7	252.2	351.6	175.8
10% ∽20%	135.4	213.7	295.1	147.5
20% ∽30%	116.1	183.1	258.3	129.2
30% ∽40%	114.5	183.7	260.1	130.1
40% ∽50%	114.7	186.7	263.2	131.6
50% ∽60%	100.4	160.6	230.3	115.2
60% ∽70%	88.2	141.9	195.9	98.0
70% ∽80%	88.4	142.4	200.7	100.4
80% ∽90%	90.4	150.2	212.9	106.5

Note: SOC interval range, the left interval is a closed interval, and the right interval is an open interval. For example: 10%~20% is 10%≤SOC<20%

15s maximum allowable pulse feedback magnification/C				
T/SOC	10°C	25 °C	45 °C	55°C
0% ∽10%	0.9	1.4	2.0	1.0
10% ∽20%	0.8	1.2	1.6	0.8
20% ∽30%	0.6	1.0	1.4	0.7
30%~40%	0.6	1.0	1.5	0.7
40% ∽50%	0.6	1.0	1.5	0.7
50% ∽60%	0.6	0.9	1.3	0.6
60% ∽70%	0.5	0.8	1.1	0.5
70% ∽80%	0.5	0.8	1.1	0.6
80% ∽90%	0.5	0.8	1.2	0.6

Note: For the range of SOC interval, the left area is the closed area, and the right area is the open area. For example: 10%~20% is 10%≤SOC<20%

Remarks: The magnitude of the pulse feedback current must strictly comply with all the state of charge and cell temperature listed in the following table. Violation of the pulse feedback condition may cause permanent damage to the battery cell and reduce its service life.

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According to European Union (EU) 2015/863 Directive; 2006-66-EC Battery Directive requirements, as shown in the following table, cadmium, lead, mercury, hexavalent chromium, polybrominated biphenyls (PBB), polybrominated diphenyl ethers (PBDE) and phthalates A total of 10 substances of formate esters (PAEs) are included in the list of prohibited substances.

A.11 List of ten prohibited substances

RoHS prohibited substances	Maximum limit (PPM)	instruction
Cadmium (Cd)	20	2006-66-EC Directive Requirements
Lead (Pb)	40	2006-66-EC Directive Requirements
Mercury (Hg)	5	2006-66-EC Directive Requirements
Hexavalent chromium (Cr6+)	1000	RoHS 1.0 restricted substances
Polybromobiphenyl (PBB)	1000	RoHS 1.0 restricted substances
Polybromodibenzoic acid (PBDE)	1000	RoHS 1.0 restricted substances
Di(2-ethylhexyl) Phthalate (DEHP- Di(2-ethylhexyl) Phthalate)	1000	New restricted substances in RoHS 2.0
Benzyl Butyl Phthalate (BBP- Benzyl Butyl Phthalate)	1000	New restricted substances in RoHS 2.0
Dibutyl phthalate (DBP-Di-n-bulyl Phtalale)	1000	New restricted substances in RoHS 2.0
Diisobutyl Phthalate (DIBP-Diiso butyl Phthalate)	1000	New restricted substances in RoHS 2.0