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LR1865LE Performance Report

Lishen Battery (Suzhou) Co. Ltd. 2023/9/21

力神电池（苏州）有限公司

Lishen Battery（Suzhou） Co. LTD

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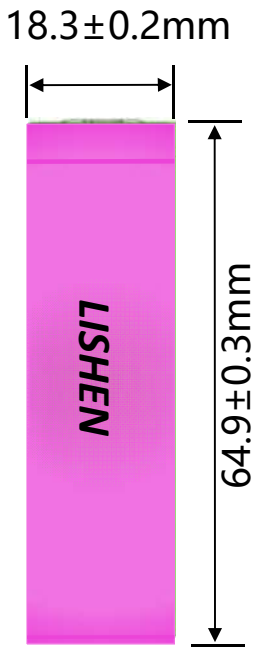
PART 01

Cell Specification

Cell Specification

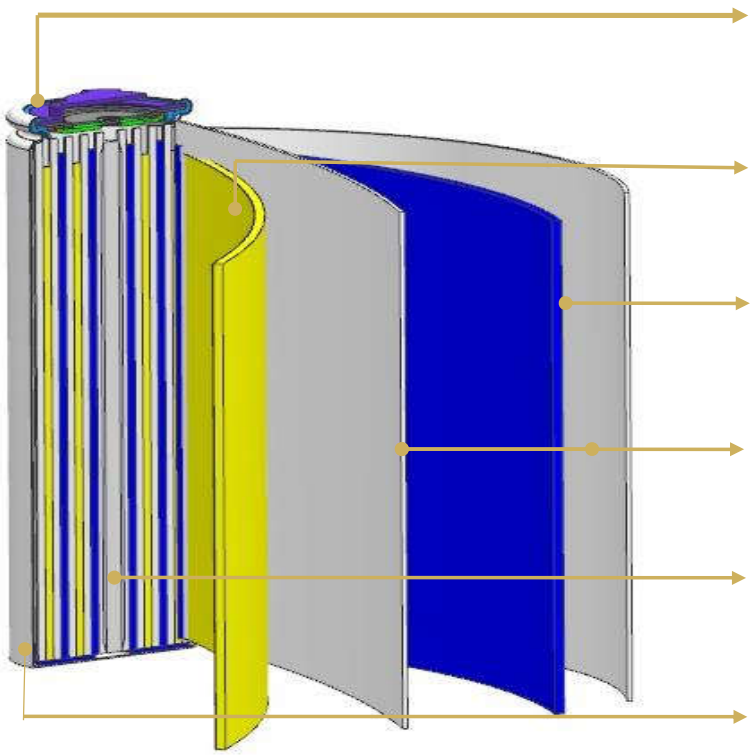


Target Application

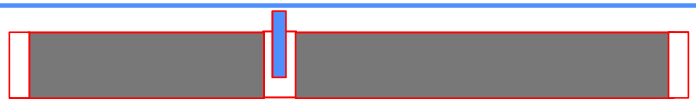
- Power Tool
- Gardening Tool
- Smart-home Devices

Design Capacity(0.2C)	Nominal	3000	mAh
	Min.	2900	mAh
Nominal Voltage	0.2C	3.60	Volt
Charging Current	Standard	0.6	A
	Cycle	3.0	A
Discharging Current	Cycle	20	A
	Max.	30 (75℃ cut-off)	A
Energy Density	Typical	630	Wh/L
	Typical	234	Wh/kg
Safety	Meet UN38.3/CB/UL1642/CCC		
Operating Temperature	Charge 0℃~45℃		
	Discharge -20℃~60℃		

Cell Design Concept



CAP	With CID and Vent
Positive electrode	NCA
Negative electrode	Graphite+Si
Separator	PE+ Ceramic Separator
Electrolyte	EC/EMC/DMC+$LiPF_6$
Can	Nikel-plated steel plate



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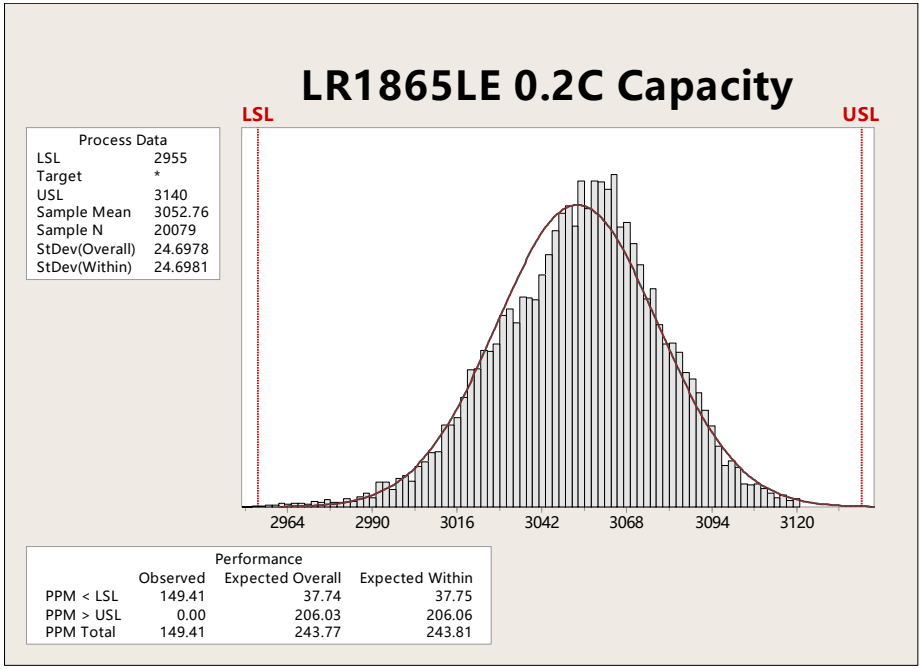
PART 02

Cell Electrical Performance

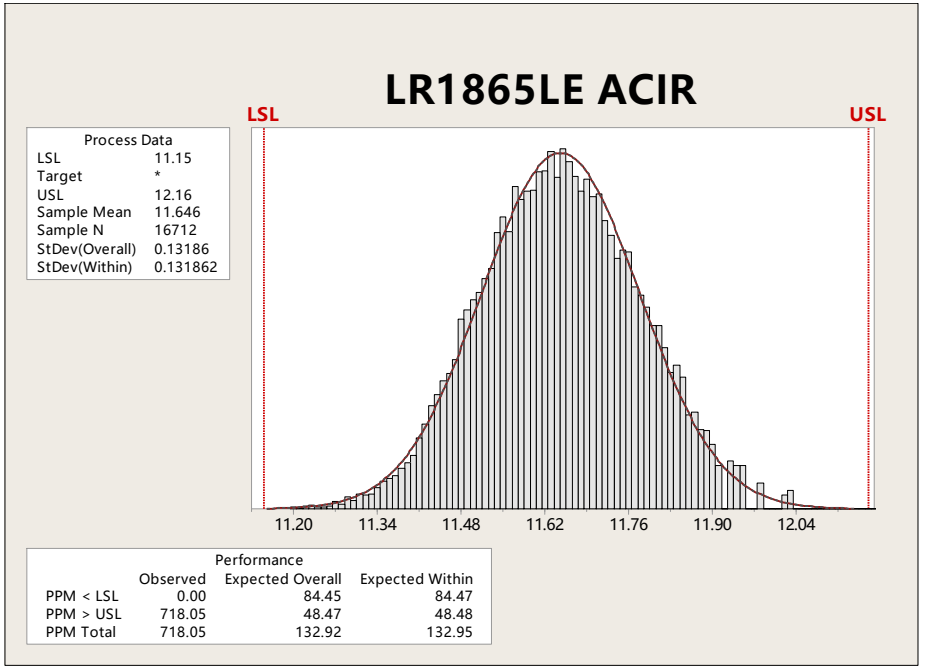
Cell Electrical Performance

- **The standard of capacity and ACIR in product specification:**

Minimum Capacity: 2900mAh



ACIR≤18mΩ

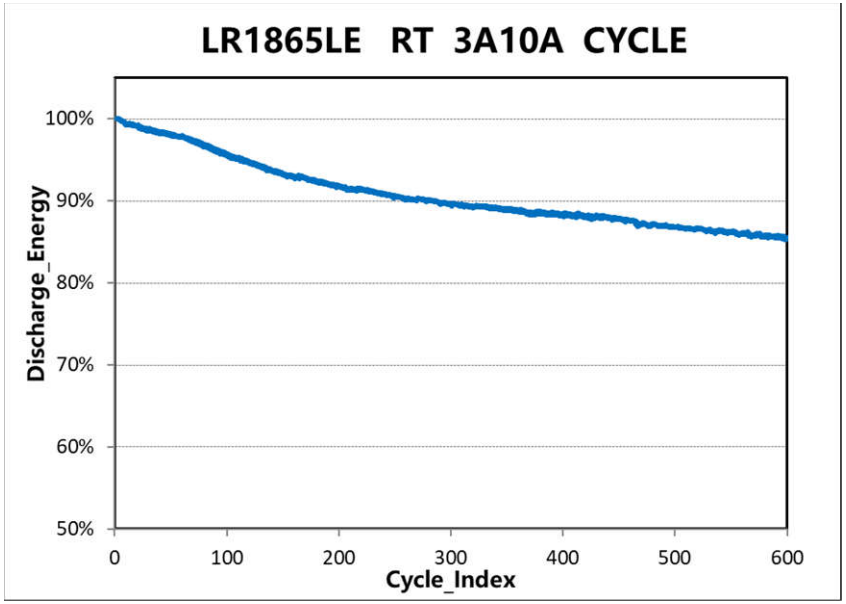


The Capacity and ACIR can meet the requirement of product specification.

Cell Electrical Performance

Cycle Life

1. Test Condition
   - Charge Condition: 3A CCCV 4.2V，cut-off 100mA @ RT;
   - Rest：15min;
   - Discharge Condition: 10A to 2.5V or 75˚C @ RT;
   - Rest：30min;

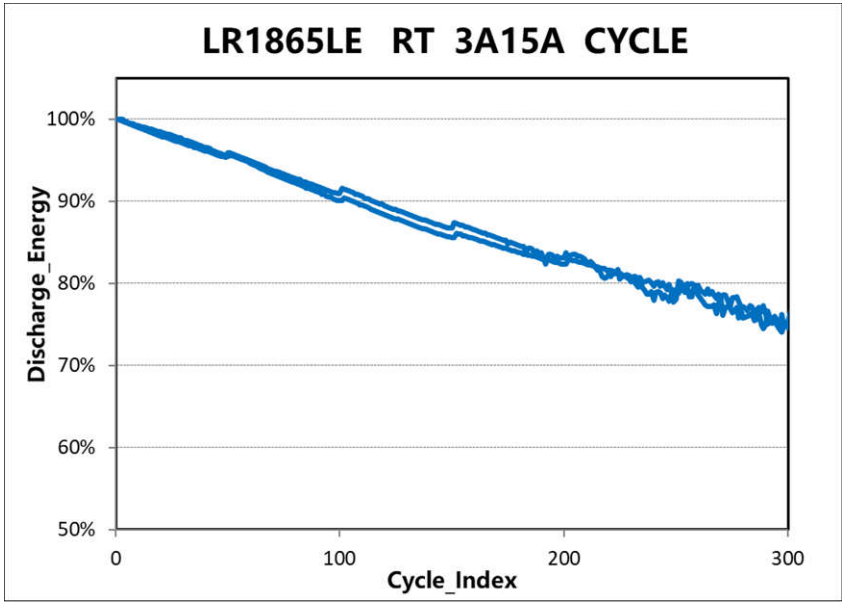


Discharge energy (600th Cycle) ≥80% of 1st Cycle Capacity at 3A10A cycle.

Cell Electrical Performance

● Cycle Life

2. Test Condition
   - Charge Condition: 3A CCCV 4.2V，cut-off 100mA @ RT;
   - Rest：15min;
   - Discharge Condition: 15A to 2.5V or 75˚C @ RT;
   - Rest：30min;

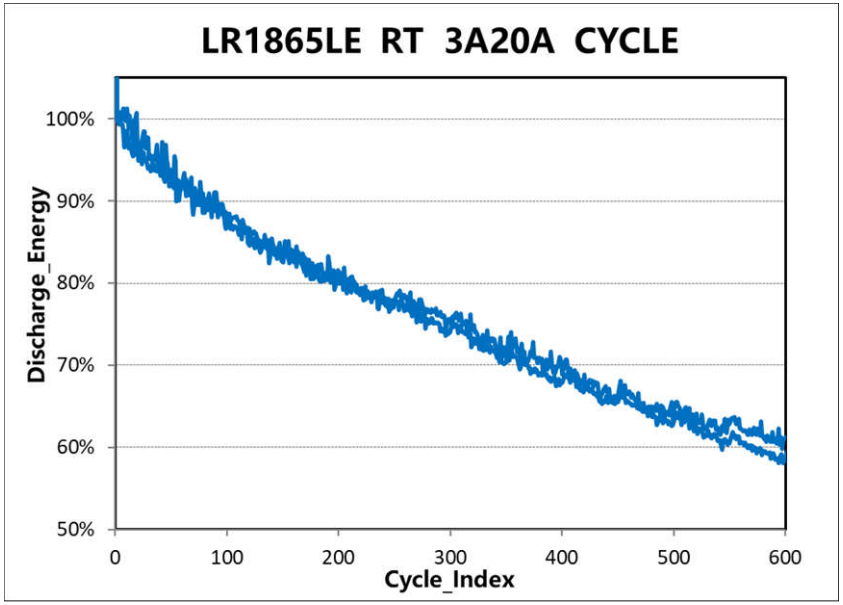


Discharge energy (300th Cycle) ≥60% of 1st Cycle Capacity at 3A15A cycle.

Cell Electrical Performance

Cycle Life

3. Test Condition
   - Charge Condition: 3A CCCV 4.2V，cut-off 100mA @ RT;
   - Rest：15min;
   - Discharge Condition: 20A to 2.5V or 75˚C @ RT;
   - Rest：30min;

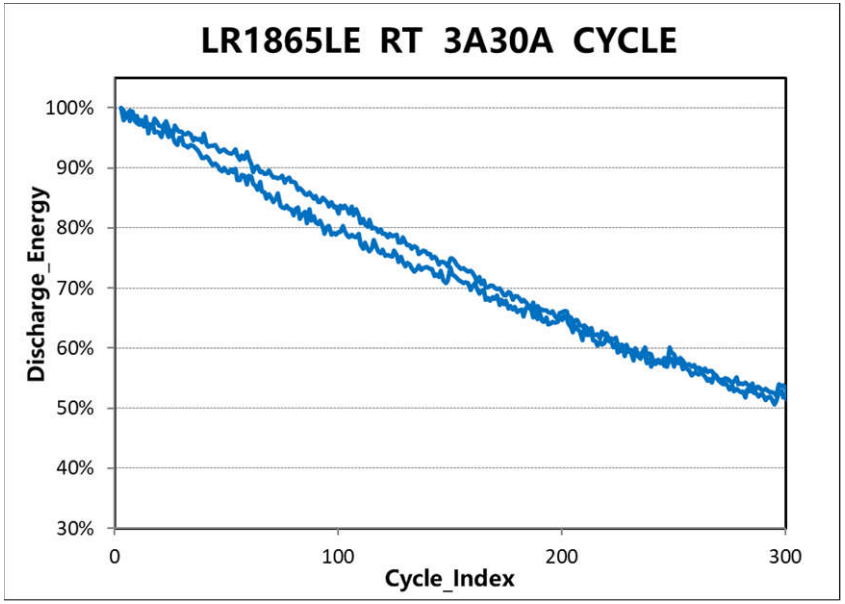


Discharge energy (600th Cycle) ≥50% of 1st Cycle Capacity at 3A20A cycle.

Cell Electrical Performance

Cycle Life

4. Test Condition
   - Charge Condition: 3A CCCV 4.2V，cut-off 100mA @ RT;
   - Rest：15min;
   - Discharge Condition: 30A to 2.5V or 75˚C @ RT;
   - Rest：30min;

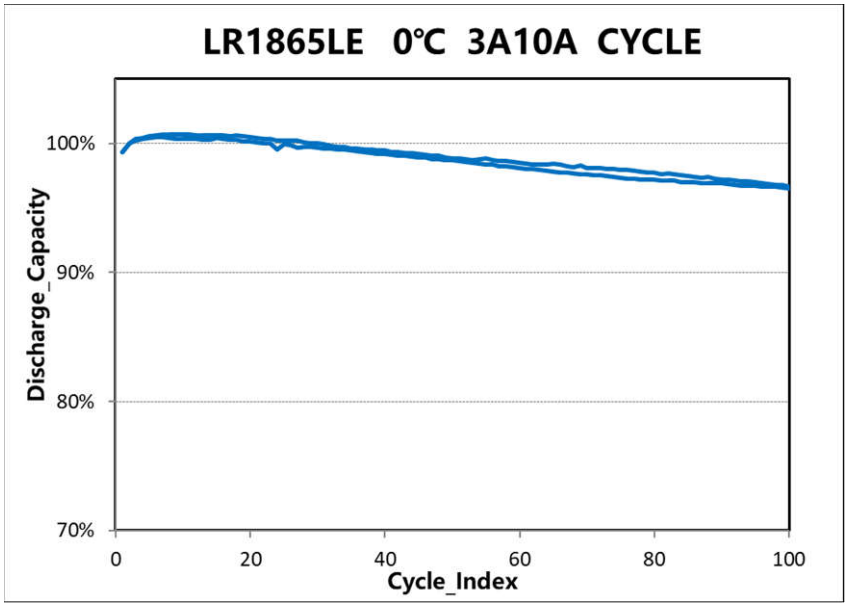


Discharge energy (200th Cycle) ≥60% of 1st Cycle Capacity at 3A30A cycle.

Cell Electrical Performance

Cycle Life

5. Test Condition
   - Charge Condition: 3A CCCV 4.2V，cut-off 100mA @ 0℃;
   - Rest：15min;
   - Discharge Condition: 10A to 2.5V or 75˚C @ 0℃;
   - Rest：30min;



LR1865LE also has excellent cycle performance at 0℃.

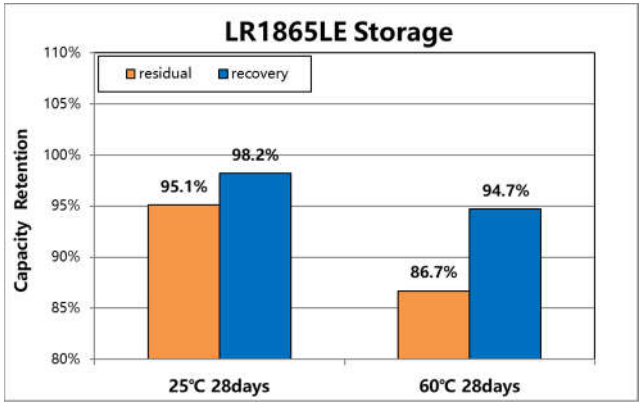
Cell Electrical Performance

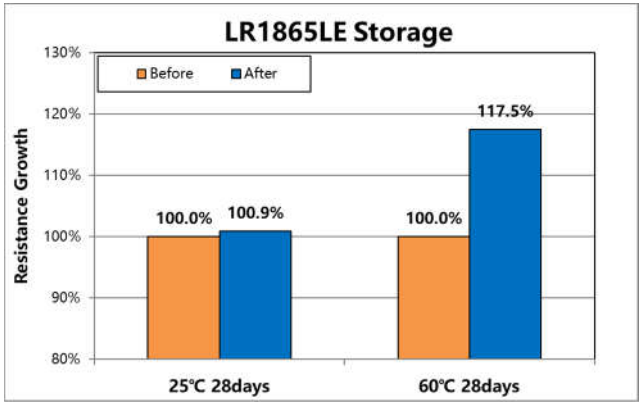
- **Storage-25℃ and 60℃**

  Test Condition

  - Charge Condition : 1.0C CCCV 4.2V，cut-off 100mA ；
  - Storage Condition : 25℃±2ºC & 60℃±2ºC，28days;
  - Discharge Condition : 1.0C CD to 2.5V.

Item	Before Storage			After Storage				Test result		
	Capacity (mAh)	ACR (mΩ)	Voltage (mV)	ACR (mΩ)	Voltage (mV)	Residual (mAh)	Recovery (mAh)	ΔR(%)	Residual (%)	Recovery (%)
25℃ 28D	2965	11.7	4163	11.8	4122	2820	2912	0.9%	95.1%	98.2%
60℃ 28D	2982	12.0	4163	14.1	4075	2586	2825	17.5%	86.7%	94.7%





Recovery discharge capacity ≥90% at 25℃ for 28 days, ≥85% at 60℃ for 28 days, that can meet the requirement of product specification.

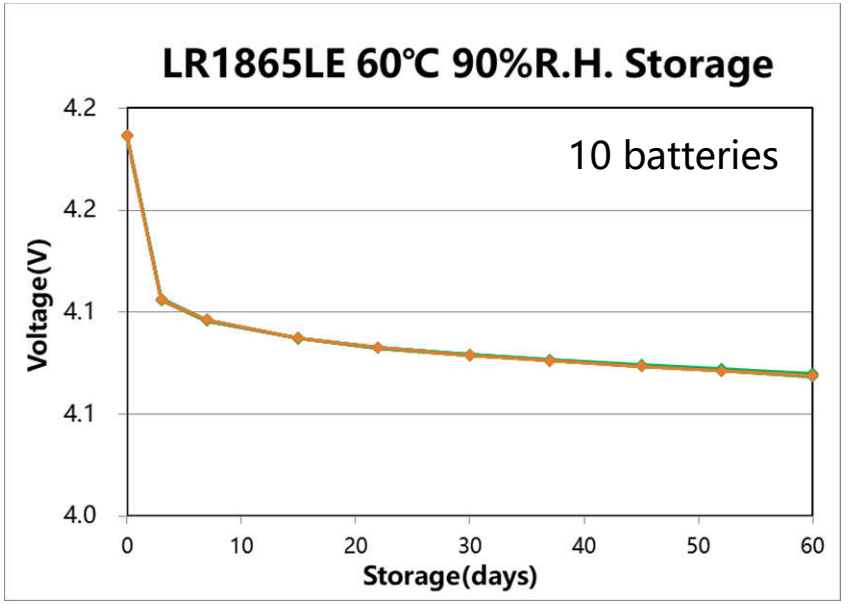
Cell Electrical Performance

- **Storage-60℃ 90%R.H.**

  Test Condition

  - Charge Condition : 1.0C CCCV 4.2V，cut-off 100mA ；
  - Storage Condition : 60℃±2℃，90%R.H.

60℃ 90%RH 42 days (10 pcs)	Before Storage		After Storage	
	Voltage (mV)	ACIR (mΩ)	Voltage (mV)	ACIR (mΩ)
1#	4.186	11.6	4.069	15.0
2#	4.186	11.6	4.069	15.4
3#	4.186	11.6	4.070	15.5
4#	4.187	11.4	4.069	15.0
5#	4.187	11.5	4.069	15.3
6#	4.187	11.6	4.070	15.1
7#	4.187	11.6	4.068	15.5
8#	4.187	11.6	4.070	15.5
9#	4.187	11.5	4.070	15.3
10#	4.187	11.5	4.069	15.1



LR1865LE has excellent stability at high temperature and humidity environments.

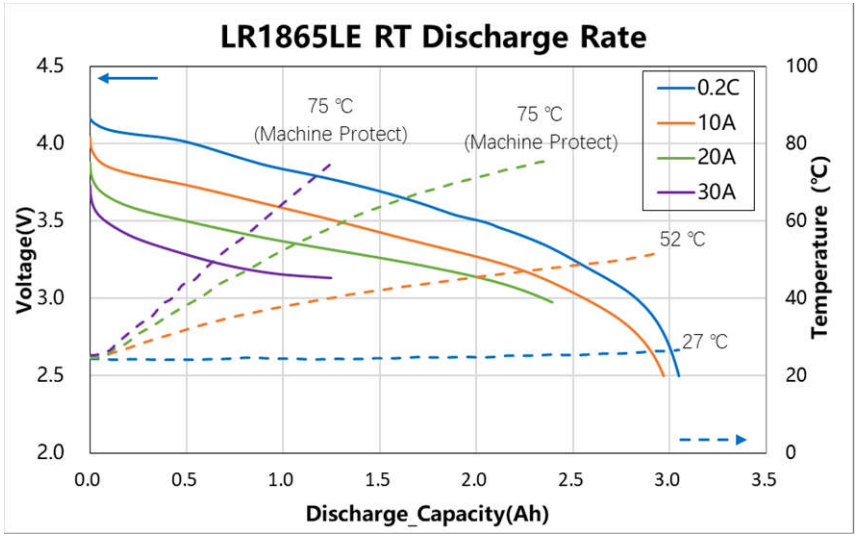
Cell Electrical Performance

Discharge Rate

Test Condition @ 25℃

- Charge Condition： 1C CCCV 4.2V，cut-off 100mA @25℃ rest 30min；
- Discharge Condition ： 0.2C/10A/20A/30A CD to 2.5V (75℃ cut-off).

Discharge Rate	0.2C	10A	20A	30A
Discharge Capacity	3.049	2.970	2.393	1.246
	100.0%	97.4%	78.5%	40.9%
Discharge Energy	11.030	10.088	7.983	4.078
	100.0%	91.5%	72.4%	37.0%
Temp. Rise(℃)	2	27	50	50



LR1865LE has excellent performance at rate discharge.

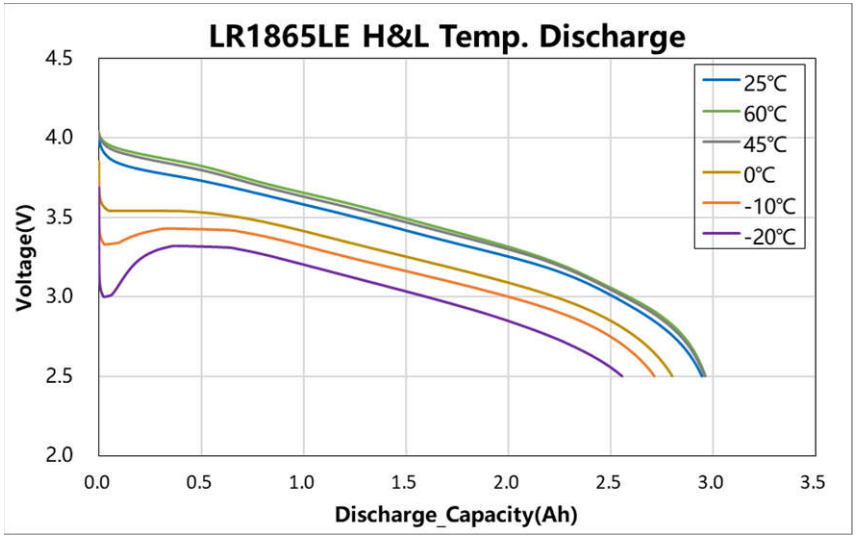
Cell Electrical Performance

Temperature vs. Discharge Capability

Test Condition

- Charge Condition：1C CCCV 4.2V，cut-off 100mA；
- Discharge Temperature Storage Time：25℃，45℃，60℃，0℃，-10℃，-20℃，180min；
- Discharge Condition: 10A CD to 2.5V@ 25℃，45℃，60℃，0℃，-10℃，-20℃。

Temp(℃)	25℃	45℃	60℃	0℃	-10℃	-20℃
Discharge Capacity (Ah)	2.946	2.959	2.962	2.799	2.711	2.555
Discharge Capacity (%)	100.0%	100.5%	100.5%	95.0%	92.0%	86.7%
Discharge Energy (Wh)	9.978	10.163	10.226	9.068	8.560	7.780
Discharge Energy (%)	100.0%	101.9%	102.5%	90.9%	85.8%	78.0%



LR1865LE has excellent performance at High&Low temperature Discharge.

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PART 03

Cell Safety Performance

Cell Safety Performance

Detailed data are available in the appendix

Sort	Item	Test standard	Test result	Judgment
Safety	Overcharge	2.0C，6.0V	No Fire , No Explosion	Pass
	Overdischarge	1.0C，90min	No Fire , No Explosion	Pass
	RT short circuit	5mΩ External Resistance	No Fire , No Explosion	Pass
		10mΩ External Resistance	No Fire , No Explosion	Pass
		20mΩ External Resistance	No Fire , No Explosion	Pass
		40mΩ External Resistance	No Fire , No Explosion	Pass
		60mΩ External Resistance	No Fire , No Explosion	Pass
	Heating	130℃，60min	No Fire , No Explosion	Pass
	Crush	UL1642	No Fire , No Explosion	Pass

LR1865LE has high safety performance，which can meet the requirement of product specification.

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PART 04

Certification

Certification

Item	Process	Expected Completion Date
CB	PASS	May 17, 2023
CCC	PASS	December 5, 2023
UN38.3	Under Certification	December 31, 2023
UL1642	Under Certification	December 31, 2023

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Power Your Life!

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Lishen Battery（Suzhou） Co. LTD

勇挑千斤担，敢啃硬骨头

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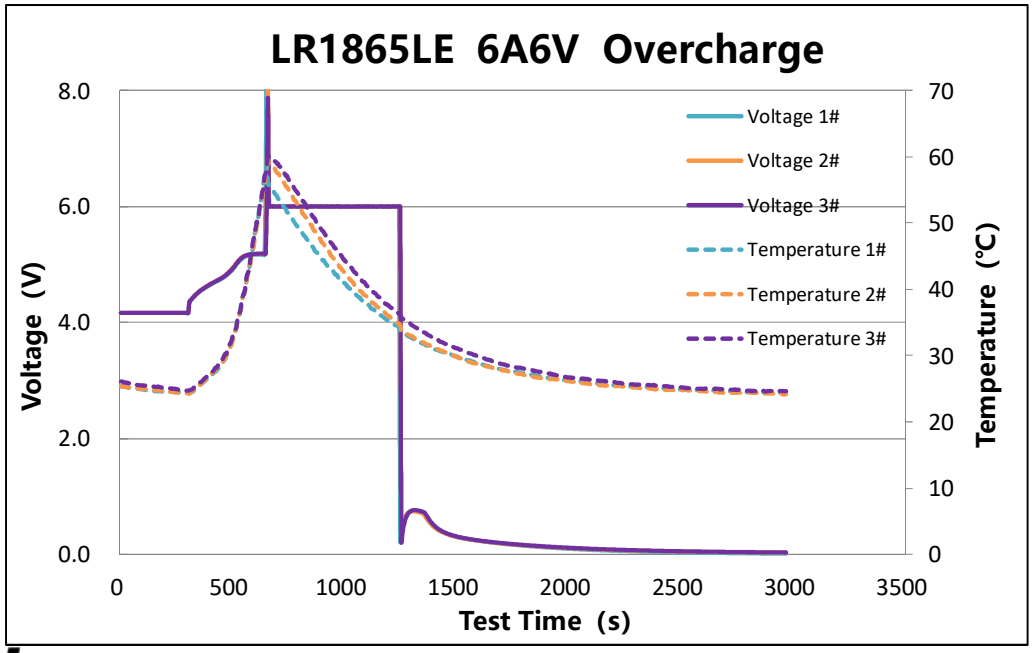
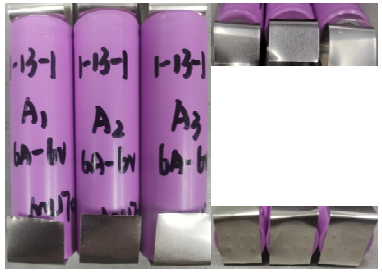
Appendix-Safety Test

Overcharge Cell State:100%SOC					
Test: Charge the test samples at 2C rate to 6.0V.				Criterion: No fire, no explosion	
No.	OCV/V	IR/mΩ	Max. Temp./℃	Result	Judgment
1	4.186	11.7	58.8	No Fire , No Explosion	Pass
2	4.187	11.9	59.5	No Fire , No Explosion	Pass
3	4.187	11.9	60	No Fire , No Explosion	Pass

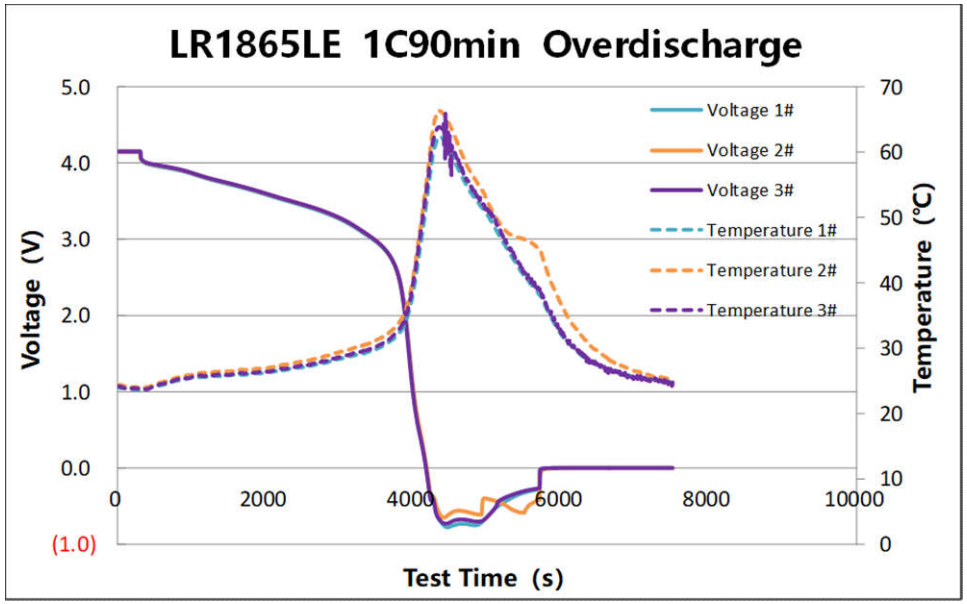


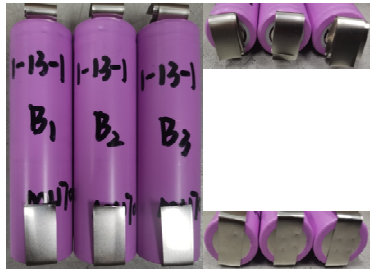


测试后照片

Appendix-Safety Test

Overdischarge Cell State: 100%SOC					
Test: Discharge the test samples at 1C rate for 90min.				Criterion: No fire, no explosion	
No.	OCV/V	IR/mΩ	Max. Temp./℃	Result	Judgment
1	4.162	11.6	62.5	No Fire , No Explosion	Pass
2	4.159	12	66.4	No Fire , No Explosion	Pass
3	4.158	11.8	65.9	No Fire , No Explosion	Pass

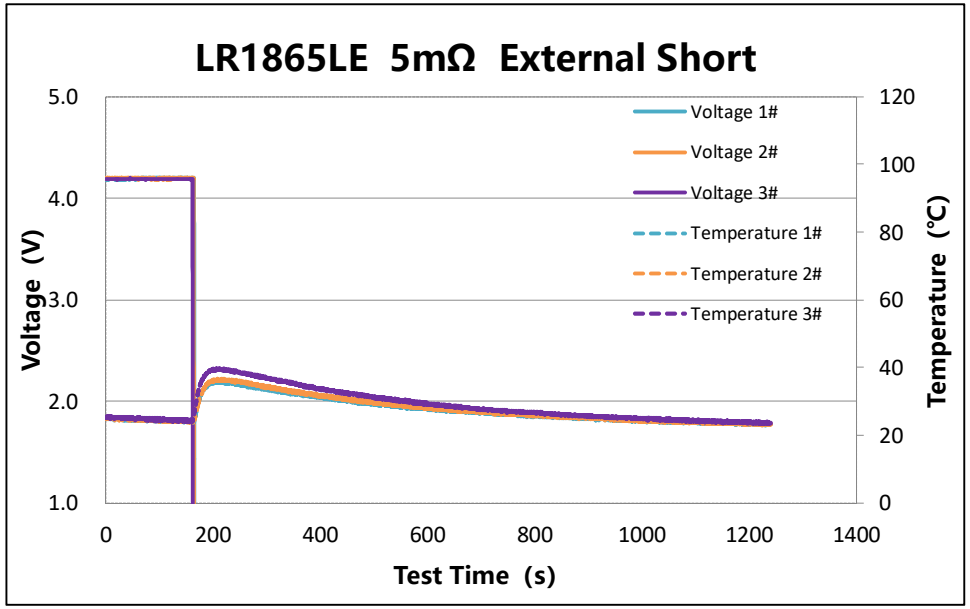




测试后照片

Appendix-Safety Test

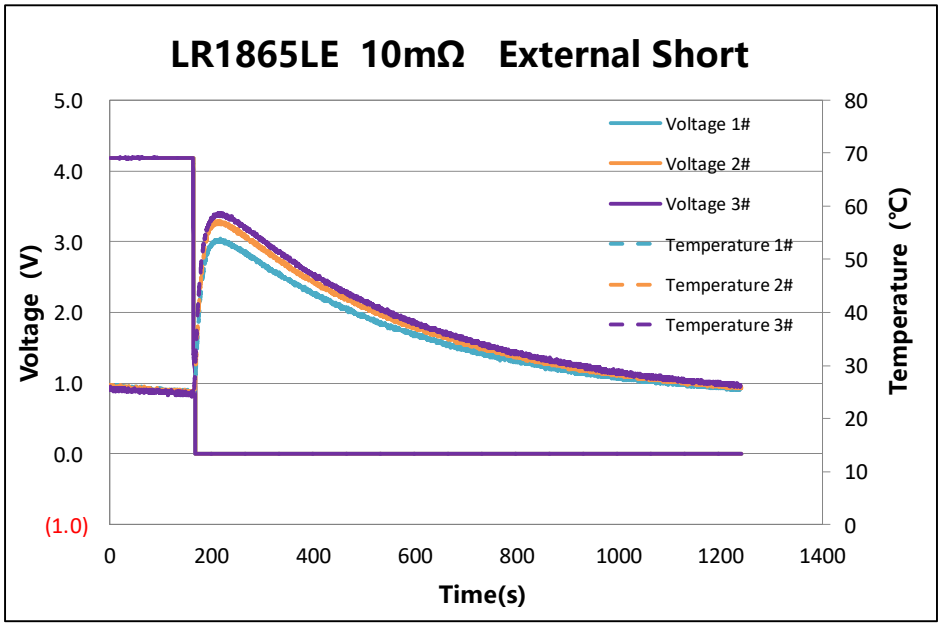
RT 5mΩ Short Circuit Cell State: 100%SOC					
Test: Short-circuited by connecting the positive and negative terminals with a total resistance of 5mΩ at RT.				Criterion: No fire, no explosion	
No.	OCV/V	IR/mΩ	Max. Temp./℃	Result	Judgment
1	4.189	12	36.1	No Fire , No Explosion	Pass
2	4.189	11.9	36.7	No Fire , No Explosion	Pass
3	4.188	11.8	39.7	No Fire , No Explosion	Pass



测试后照片

Appendix-Safety Test

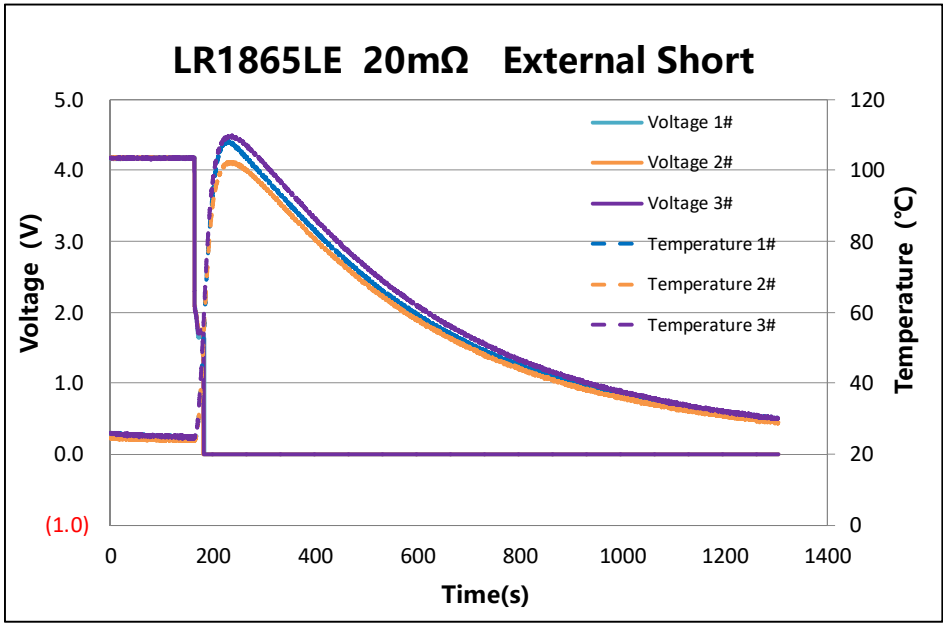
RT 10mΩ Short Circuit Cell State: 100%SOC					
Test: Short-circuited by connecting the positive and negative terminals with a total resistance of 10mΩ at RT.				Criterion: No fire, no explosion	
No.	OCV/V	IR/mΩ	Max. Temp./℃	Result	Judgment
1	4.186	11.9	53.9	No Fire , No Explosion	Pass
2	4.186	11.8	57.2	No Fire , No Explosion	Pass
3	4.187	11.8	58.7	No Fire , No Explosion	Pass



测试后照片

Appendix-Safety Test

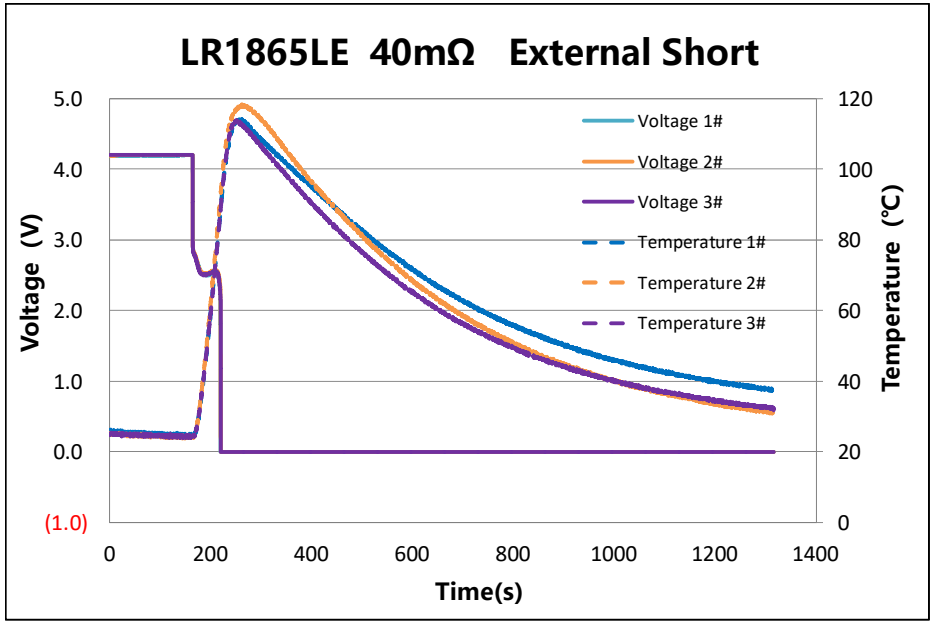
RT 20mΩ Short Circuit Cell State: 100%SOC					
Test: Short-circuited by connecting the positive and negative terminals with a total resistance of 20mΩ at RT.				Criterion: No fire, no explosion	
No.	OCV/V	IR/mΩ	Max. Temp./℃	Result	Judgment
1	4.166	12.0	108.4	No Fire , No Explosion	Pass
2	4.168	12.0	102.6	No Fire , No Explosion	Pass
3	4.164	12.0	109.9	No Fire , No Explosion	Pass



测试后照片

Appendix-Safety Test

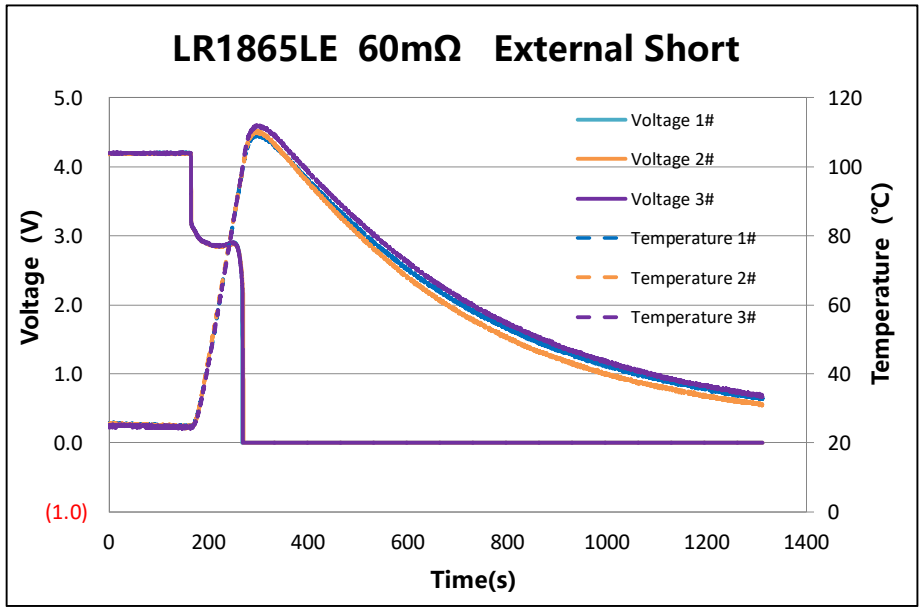
RT 40mΩ Short Circuit	Cell State: 100%SOC				
Test: Short-circuited by connecting the positive and negative terminals with a total resistance of 40mΩ at RT.				Criterion: No fire, no explosion	
No.	OCV/V	IR/mΩ	Max. Temp./℃	Result	Judgment
1	4.192	12.0	114.1	No Fire , No Explosion	Pass
2	4.192	11.9	118.3	No Fire , No Explosion	Pass
3	4.192	12.0	113.8	No Fire , No Explosion	Pass



测试后照片

Appendix-Safety Test

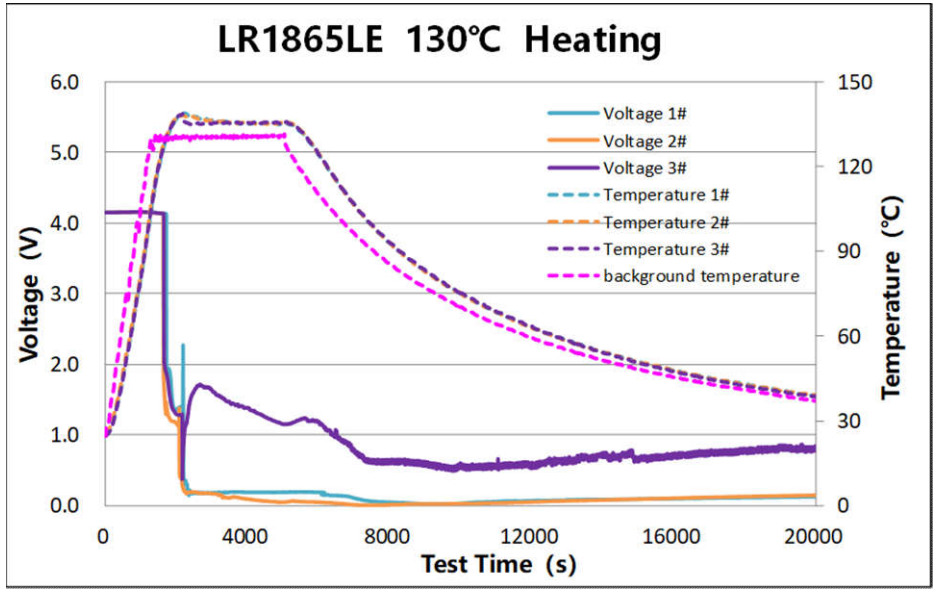
RT 60mΩ Short Circuit Cell State: 100%SOC					
Test: Short-circuited by connecting the positive and negative terminals with a total resistance of 60mΩ at RT.				Criterion: No fire, no explosion	
No.	OCV/V	IR/mΩ	Max. Temp./℃	Result	Judgment
1	4.192	11.9	109.3	No Fire , No Explosion	Pass
2	4.191	11.9	110.5	No Fire , No Explosion	Pass
3	4.192	11.9	112.0	No Fire , No Explosion	Pass



测试后照片

Appendix-Safety Test

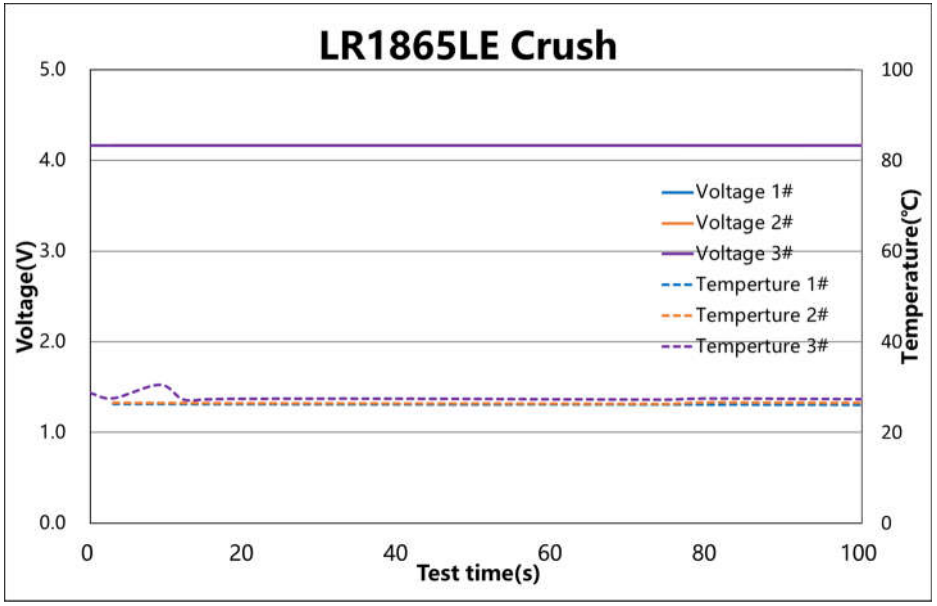
130℃ Heating Cell State: 100%SOC					
Test: Temperature of the chamber is to be raised at a rate of 5±2℃ per minute to a temperature of 130±5℃, monitor the temperature change of the box for 60minutes.				Criterion: No fire, no explosion	
No.	OCV/V	IR/mΩ	Max. Temp./℃	Result	Judgment
1	4.188	11.9	138.4	No Fire , No Explosion	Pass
2	4.188	11.9	138.2	No Fire , No Explosion	Pass
3	4.189	11.8	138.6	No Fire , No Explosion	Pass



测试后照片

Appendix-Safety Test

Crush Cell State: 100%SOC					
Test:13 ±1 kN				Criterion: No fire, no explosion	
No.	OCV/V	IR/mΩ	Max. Temp./℃	Result	Judgment
1	4.167	11.7	26.5	No Fire , No Explosion	Pass
2	4.166	11.8	26.7	No Fire , No Explosion	Pass
3	4.166	11.7	30.5	No Fire , No Explosion	Pass



测试后照片