Model	INP42P	Specification code	RD-EVE M22-S02-LF	Edition	E

Product Delivery Specification

Square Aluminum-Coated Lithium-Ion Battery

Model: INP42P

Authorized strength	Examine and verify	Ratify
Han Suiwu	Tan Mingsheng	He Wei

Customer Inbox
Corporate name：
Ratify：
Date：

August 2020

Hubei Yiwai Power Co., Ltd.

Model	INP42P	Specification code	RD-EVE M22-S02-LF	Edition	E

Change Resume

Edition	Date	Change content	Confirm
A	2019/3/27	New release version	Pei Tingting
B	2019/06/04	Adjust the cell internal resistance to match the shipment state, i.e., 30% SOC.	Pei Tingting
C	2020/03/20	Change version format and add power, DCIR, SOC/OCV, and high/low temperature capacity data	Pei Tingting
D	2020/06/15	Safety test conditions for overcharge and compression based on GB38031-2020 revision	Tan Mingsheng
E	2020/08/04	Add recommendations for BMS design parameters and module design parameters	Tan Mingsheng

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1. Essential Information

1.1. scope of application

This product specification applies to the square aluminum-shell lithium-ion batteries manufactured by Hubei EVE Energy Co., Ltd.

1.2. Product Type: Square Aluminum-Cased Lithium-Ion Battery

1.3. Product name: INP42P

2. Battery Specifications

2.1. Basic Battery Parameters

Project		Standard	Remarks
Minimum capacity		42.0Ah	1C，25±2℃，3.0-4.2V
Least energy		153.0Wh	1C，25±2℃，3.0-4.2V
Initial internal resistance		0.6±0.1mΩ	AC，1kHz，30%SOC
Nominal voltage		3.65V	1/3C，3.0-4.2V
Battery weight		820±20g	
Charging limit voltage (U_{max})		4.2V	
Discharge cutoff voltage (U_{min})		3.0V(>0℃)， 2. 5V （ 0℃≤T<-20℃ ）， 2.2V(≤-20℃)	
Charge	Standard charging current	42.0A	1C
Discharge	Standard discharge current	42.0A	1C
Cycling performance	25°C standard cycle	4000 weeks	1C/1C,3.5~4.05V, capacity retention rate ≥80%
	45°C standard cycle	2200 weeks	1C/1C,3.5~4.05V, capacity retention rate ≥80%
Battery size	Height 1 (H)	96.7±0.3mm	Contains pole columns, see Figure 1
	Height 2 (h)	91.6±0.3mm	Excluding the pole column, see Figure 1
	Width (L1)	148.0±0.3mm	See Figure 1
	Width (L2)	148.6±0.3mm	See Figure 1
	Thickness （T)	26.7±0.3mm	Maximum thickness at 30% SOC and 100 kgf pressure
Working temperature	Charging temperature	0~50℃	
	Discharge temperature	-30~55℃	
Storage temperature	1 year	0~25℃	Ship SOC status
	3 month	0~45℃	
	1 month	0~60℃	

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2.2. size of product

2.2.1. Size and weight specifications

Order number	Project		Standard	Testing Methodology Chapter
1	Size	Height 1 (H)	96.7±0.3mm	3.8.1
		Height 2 (h)	91.6±0.3mm	
		Width (L1)	148.0±0.3mm	
		Width (L2)	148.6±0.3mm	
		Thickness （T)	26.7±0.3mm	
2	Weight	Weight (including blue film and top patch)	820±20g	3.8.2

2.2.2. Electrical performance indicators

Order number	Project		Standard	Testing Methodology Chapter
1	Capacity	1/3C capacity	≥42.5Ah	3.8.3.1
		1C capacity	≥42.0Ah	3.8.3.2
2	Energy	1/3C energy	≥160.0Wh	3.8.3.1
		1C energy	≥153.0Wh	3.8.3.2
3	Discharge performance	-30℃ capacity retention rate	≥70%	3.8.3.3
		-20°C capacity retention rate	≥75%	3.8.3.4
		-10℃ capacity retention rate	≥80%	3.8.3.5
		0°C capacity retention rate	≥85%	3.8.3.6
		25°C capacity retention rate	100%	/
		55℃ capacity retention rate	≥99%	3.8.3.7
4	DCR	25℃，50%SOC，1C，10sec	≤1.6mΩ	3.8.3.8
5	Recurrence	25℃ recurrence	4000 weeks, capacity retention rate ≥80%	3.8.3.9
		45°C standard cycle	2200 weeks, with a capacity retention rate ≥80%	3.8.3.10
6	Charge retention and capacity recovery	25°C, 28 days	Volume retention rate ≥96%	3.8.3.12
			Capacity recovery rate ≥99%	
		45°C, 28 days	Volume retention rate ≥93%	3.8.3.13
			Capacity recovery rate ≥98%	

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2.2.3. Safety performance indicators

Order number	Project	Standard	Testing Methodology Chapter
1	Overdischarge	Non-flammable and non-explosive	3.8.4.1
2	Over-charging	Non-flammable and non-explosive	3.8.4.2
3	Short circuit test	Non-flammable and non-explosive	3.8.4.3
4	Heat	Non-flammable and non-explosive	3.8.4.4
5	Extrusion test	Non-flammable and non-explosive	3.8.4.5
6	Temperature cycle	Non-flammable and non-explosive	3.8.4.6

2.3. Battery drawing

See Figure 1.

2.4. surface

The battery should not have obvious scratches, cracks, rust stains, discoloration, or electrolyte leakage, which may affect its commercial value.

3. Condition of Experiment

3.1. ambient condition

Unless otherwise specified, the test shall be conducted in an environment with a temperature of 25±2°C, relative humidity below 65% RH, and atmospheric pressure ranging from 86 kPa to 106 kPa. The room temperature mentioned in this specification refers to 25±2°C.

3.2. measuring equipment

The accuracy of measuring instruments and meters shall meet the following requirements:

(1) Voltage measurement device: ±0.1%;

(2) Current measurement device: ±0.1%;

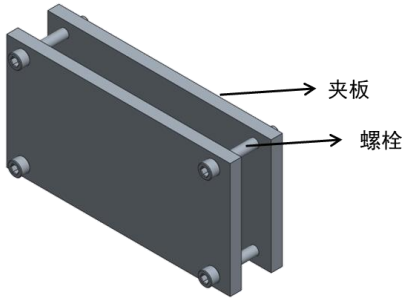
(3) Temperature measurement device: ±0.5т;

(4) Dimension measurement device: ±0.01 mm;

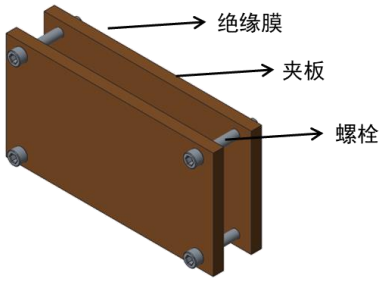
(5) The weight measurement device is ±0.1g.

3.3. Test fixture preparation

The monomer battery must be secured using clamps (material: aluminum, thickness: 10mm), which should fully cover the battery surface. The clamps are fastened with four M6 bolts, and all surfaces of the clamps must be coated with an insulating film with a minimum thickness of 0.1mm. The fixture assembly is shown in the following figure:



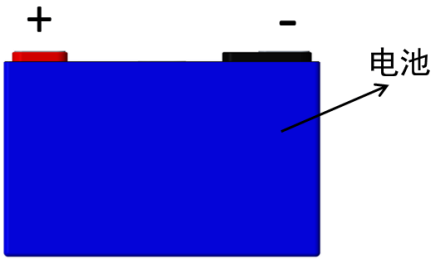
Schematic diagram of battery fixture



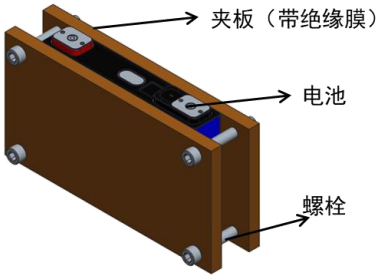
Battery fixture package insulation film diagram

3.4. Installation of test fixture

Place the battery (approximately 30% SOC) coated with a blue film (material: PET, thickness 0.11 mm) and a top patch (material: PC, thickness 0.3 mm) into the center of the fixture, and secure each bolt with a torque of 1.3 N·m.



Battery front view



axiogram of battery

3.5. Standard charging method

Standard charging is performed under ambient temperature conditions of 25±2°C, where the battery is charged at a constant current of 42.0A until reaching 4.2V, followed by switching to constant voltage charging at 4.2V until the charging current decreases to ≤2.1A. The battery is then left to rest for 30 minutes.

3.6. Standard discharge method

The standard discharge was performed at ambient temperature of 25±2°C, with the battery discharging at a constant current of 42.0A until the voltage reached 3.0V, followed by a 30-minute rest period.

3.7. capacity calibration and energy calibration

Capacity calibration is performed under ambient temperature conditions of 25±2°C. The battery is charged according to Standard 3.5 charging method, followed by discharge according to Standard 3.6 discharge method. After resting for 30 minutes, the standard charging and discharge procedures are repeated three times. The average discharge capacity obtained from these three cycles represents the 1C discharge capacity. The recorded discharge capacity is designated as calibration capacity C_0, while the average discharge energy across three cycles constitutes the 1C discharge energy. The recorded discharge energy is recorded as calibration energy E_0.

3.8. test method

3.8.1. size

Testing equipment: Caliper (length/width/height); Flat plate thickness gauge (thickness*)

experimental method：

a) Measure the battery length, width, and height using a caliper;

b) The thickness of shipped batteries was measured using a flat plate thickness gauge under the following test conditions: 100 kgf pressure maintained for 10 seconds.

*The battery thickness increases with both SOC (State of Charge) and usage time. The specified thickness refers to the cell's physical dimensions at shipment (with SOC around 30%).

3.8.2. weight

Test equipment: Electronic balance; Test method: Measure the weight of the battery using an electronic balance.

3.8.3. Electrical Properties

3.8.3.1. 1C discharge capacity and energy

Under ambient temperature conditions of 25±2°C, the battery was fully charged using standard charging methods (3.5) and then discharged at a constant current of 85.5A to 2.8V. After a 30-minute rest period, the discharge capacity and energy were recorded. The above charging-discharging cycles were repeated three times, with the average discharge capacity from these three cycles representing the 1C discharge capacity, and the average discharge energy from these three cycles representing the 1C discharge energy.

3.8.3.2. -30τ capacity retention rate

Under ambient temperature conditions of 25±2°C, the battery was installed in the test fixture according to Method 3.4, followed by capacity calibration (see Section 3.7 for capacity and energy calibration). The battery was then fully charged using standard charging procedures (Method 3.5) at ambient temperature, stored for 6 hours at-30±2°C, and discharged at a constant current of 42.0A to 2.2V under the same temperature conditions. The discharge capacity C_1，C_1/C_0 was recorded, with C1/C0 representing the capacity retention rate at-30 °C.

3.8.3.3. -20τ capacity retention rate

Under ambient temperature conditions of 25±2°C, the battery was installed with test fixtures according to Method 3.4, followed by capacity calibration (see Section 3.7 for capacity and energy calibration). The battery was then fully charged using standard charging procedures (Method 3.5) at ambient temperature, stored for 6 hours at-20±2°C, and discharged at a constant current of 42.0 A to 2.2V under the same temperature conditions. The discharge capacity C_2，C_2/C_0 representing the capacity retention rate at-20°C.

3.8.3.4. -10τ capacity retention rate

Under ambient temperature conditions of 25±2τ, the battery is installed with the test fixture as specified in Section 3.4, followed by capacity calibration (3.7 Capacity Calibration and Energy Calibration). Under the same ambient temperature conditions, the battery is fully charged using the standard charging method (3.5), then left at-10±2τ for 6 hours. Subsequently, it undergoes constant current discharge at 42.0A to 2.5V under-10±2τ conditions. The discharge capacity C_3，C_3/C_0 representing the capacity retention rate at-10τ.

3.8.3.5. 0% capacity retention rate

Under ambient temperature conditions of 25±2τ, the battery was installed with test fixtures according to Method 3.4, followed by capacity calibration (3.7 Capacity Calibration and Energy Calibration). Under the same ambient temperature conditions, the battery was fully charged using standard charging procedures (3.5), then rested for 6 hours at 0±2τ. A constant current discharge was performed at 42.0A to 2.5V under 0±2τ conditions, with discharge capacity C_4，C_4/C_0 represents the 0τ capacity retention rate.

3.8.3.6. 55℃ capacity retention rate

Under ambient temperature conditions of 25±2°C, the battery was installed with test fixtures according to Method 3.4, followed by capacity calibration (3.7 Capacity Calibration and Energy Calibration). Under the same ambient temperature conditions, the battery was fully charged using standard charging procedures (3.5), then rested at 55±2°C for 3 hours. Subsequently, constant-current discharge was performed at 42.0A to 3.0V under 55±2°C conditions, with discharge capacity C_5 , C_5/C_0 was calculated to determine the 55°C capacity retention rate.

3.8.3.7. internal resistance

a) The shipped batteries were tested at ambient temperature of 25±2°C using an AC frequency of 1 kHz.

b) Under ambient temperature conditions of 25±2°C, perform battery capacity calibration (3.7 Capacity Calibration and Energy Calibration), then charge according to the standard charging method (3.5). Subsequently, discharge at a constant current of $1/3C_0$ for 90 minutes (adjust SOC to 50%) and hold for 2 hours. Record the voltage at the end of the holding period V_1. Then discharge at a constant current of 42.0 A for 10 seconds, record the voltage at the end of the discharge period V_2, and calculate the DCR: DCR = (V_1-V_2)*1000/42.0 mΩ.

3.8.3.8. 25°C standard cycle

Pre-test upper fixture: At 30% SOC (State of Charge) at room temperature, install the test fixture as described in Section 3.4.

Pre-cycle capacity test: The battery is discharged at a constant current of 42.0A to 3.0V at an ambient temperature of 25±2° C, left at rest for 10 minutes, then fully charged according to the standard charging method (3.5), followed by discharge according to the standard discharge method (3.6), and the discharge capacity C_0 is recorded.

Cyclic test: ambient temperature 25±2℃;

a. Charge the battery at a constant current of 42.0A until reaching 4.05V, then switch to constant voltage charging until 2.1A cutoff, followed by a 30-minute rest period.

b. Perform constant current discharge at 42.0 A to 3.5V.

c. Incubate for 30 minutes, then repeat cycles a)–c) for 4000 times.

Cycling capacity test: The battery was discharged at a constant current of 29.0A to 2.8V at an ambient temperature of 25±2°C, followed by a 30-minute rest period. Then, it was fully charged according to the standard charging method (3.5), and subsequently discharged according to the standard discharge method (3.6). The discharge capacity C_6 was recorded, and the capacity retention rate was calculated as C_6/C_0 × 100%.

3.8.3.9. 45°C standard cycle

Pre-test upper fixture: Install the test fixture at 30% SOC under ambient temperature conditions, then proceed according to method 3.4.

Pre-cycle capacity test: The battery is discharged at a constant current of 42.0A to 3.0V at an ambient temperature of 25±2°C, left at rest for 30 minutes, then fully charged according to the standard charging method (3.5), followed by discharge according to the standard discharge method (3.6), and the discharge capacity C_0 is recorded.

Cyclic test: ambient temperature 45±2℃;

a. Charge the battery at a constant current of 42.0A until reaching 4.05V, then switch to constant voltage charging until 2.1A cutoff, followed by a 30-minute rest period.

b. Perform constant current discharge at 42.0A to 3.5V.

c. After a 30-minute incubation period, the a) -c) cycle was repeated 2200 times.

Cycling capacity test: The battery was discharged at a constant current of 21.0A to 3.0V at an ambient temperature of 25±2°C, followed by a 10-minute rest period. Then, it was fully charged according to the standard charging method (3.5), and subsequently discharged according to the standard discharge method (3.6). The discharge capacity C_7 was recorded, and the capacity retention rate was calculated as C_7/C_0 × 100%.

3.8.3.10. Charge retention and capacity recovery at 25℃

Under ambient temperature conditions of 25±2°C, install the test fixture according to method 3.4, then perform battery capacity calibration (3.7 Capacity Calibration and Energy Calibration). Charge the battery using the standard charging method (3.5), followed by a 28-day storage period at ambient temperature 25±2°C. Subsequently, discharge the battery under ambient temperature 25±2°C using the standard discharge method (3.6) (record discharge capacity C_9). After charging using the quasi-charging method (3.5), discharge again with the standard discharge method (3.6) (record discharge capacity C_{10}). Capacity retention rate =C_9/C_0 × 100%, capacity recovery rate =C_{10}/C_0 × 100%.

3.8.3.11. 55т Charge retention and capacity recovery

Under ambient temperature conditions of 25±2т, install the test fixture according to method 3.4, then perform battery capacity calibration (3.7 Capacity Calibration and Energy Calibration). Charge the battery using the standard charging method (3.5), followed by a 7-day storage period at ambient temperature of 55±2т. Subsequently, store the battery at ambient temperature of 25±2т for 6 hours. Then discharge the battery using the standard discharge method (3.6) (record discharge capacity C_{11}), followed by charging using the quasi-charging method (3.5) and discharging again with the standard discharge method (3.6) (record discharge capacity C_{12}). Capacity retention rate =C_{11}/C_0 × 100%, capacity recovery rate =C_{12}/C_0 × 100%.

3.8.3.12. 45т storage

Under ambient temperature conditions of 25±2т, install the test fixture according to method 3.4, then perform battery capacity calibration (3.7 Capacity Calibration and Energy Calibration). Charge the battery using the standard charging method (3.5), followed by storage at ambient temperature 45±2т for 28 days, then at ambient temperature 25±2т for 6 hours. Discharge the battery using the standard discharge method (3.6) (record discharge capacity C_{13}), then charge it again using the quasi-charging method (3.5) and discharge it with the standard discharge method (3.6) (record discharge capacity C_{14}). Capacity retention rate =C_{13}/C0 × 100%, capacity recovery rate =C_{14}/C0 × 100%.

3.8.4. Safety Performance

3.8.4.1. overdischarge

Under ambient temperature conditions of 25±2°C, the battery was fully charged according to the standard charging method (2.4.3), followed by installation of the test fixture as described in Section 3.4. The battery was discharged at a constant current of 42.0 A for 90 minutes under safety test conditions of 25±5°C. Observation was conducted for 1 hour. (Refer to GB 38031-2020 "Batteries for Electric Vehicles") safety requirements)

3.8.4.2. over-charging

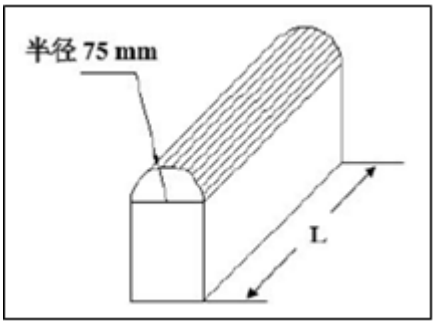
Under ambient temperature conditions of 25±2°C, the battery was fully charged using the standard charging method (2.4.3), followed by installation of the test fixture according to Section 3.4. In the safety test environment with temperature maintained at 25±5°C, the battery was charged at a constant current of 42.0A until reaching 4.62V or 115% State of Charge (SOC), after which charging was terminated. Observation was conducted for 1 hour. (Refer to GB 38031-2020 Safety Requirements for Batteries Used in Electric Vehicles)

3.8.4.3. crimp

The battery was fully charged under standard charging conditions (2.4.3) at an ambient temperature of 25±2°C. The safety test was conducted at an ambient temperature of 25±5°C under the following conditions:

a) Compression direction: Apply pressure perpendicular to the battery cell's electrode plate orientation, or align with the direction where the battery cell is most susceptible to compression in the vehicle's layout.

b) Extrusion plate configuration: a semi-cylindrical body with a radius of 75mm, where the length (L) of the semi-cylinder exceeds the dimensions of the battery cells to be extruded (refer to the figure below).



c) Squeeze speed: no more than 2 mm/s;

d) Compression level: when voltage reaches 0V, deformation reaches 15%, or compression force reaches 100kN, or Stop extrusion after 1000 times the test object weight.

e) Maintain for 10 minutes. Observe for 1 hour. (Refer to GB 38031-2020 Battery for Electric Vehicles-Safety Requirements) All requirements)

3.8.4.4. External short circuit

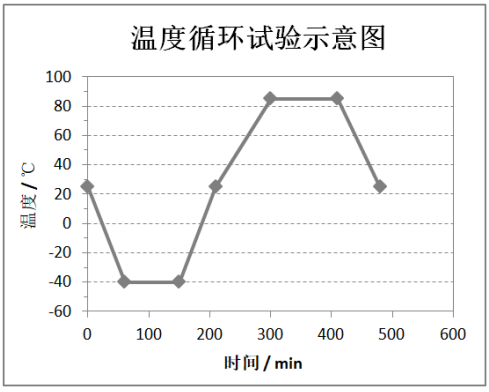
Under ambient temperature conditions of 25±2°C, charge the battery fully using the standard charging method (2.4.3), then install the test fixture according to the procedure in Section 3.4. In the safety test environment with temperature maintained at 25±5 °C, apply external short-circuiting to the battery's positive and negative terminals for 10 minutes. The external circuit resistance should be less than 5mΩ. Monitor the battery for 1 hour. (Refer to GB 38031-2020 Safety Requirements for Batteries Used in Electric Vehicles)

3.8.4.5. Heating (130°C)

Under ambient temperature conditions of 25±2°C, charge the battery fully according to the standard charging method (2.4.3), then install the test fixture as described in Section 3.4. Place the battery in a temperature chamber, which is heated from room temperature to 130°C±2°C at a rate of 5°C/min. Maintain this temperature for 30 minutes before stopping the heating process. Observe the battery for 1 hour. (Refer to GB 38031-2020 Safety Requirements for Batteries Used in Electric Vehicles)

3.8.4.6. temperature cycle

At ambient temperature of 25±2℃, charge the battery to full capacity using the standard charging method (2.4.3), then install the test fixture as specified in 3.4. Place the battery in a temperature chamber and adjust the chamber according to the table and figure below, repeating the cycle 5 times. (Refer to GB 38031-2020 Safety Requirements for Batteries Used in Electric Vehicles)



Temperature (℃)	Time increment (min)	Cumulative time (min)	Temperature change rate (℃/min)
25	0	0	0
-40	60	60	13/12
-40	90	150	0
25	60	210	13/12
85	90	300	2/3
85	110	410	0
25	70	480	6/7

4. Recommended BMS Design Parameters

The following data represents the reference performance parameters of INP42P batteries for BMS design purposes. Actual usage shall comply with the agreed-upon operating methods and conditions between both parties.

4.1. Electrical Performance Data

4.1.1. SOC~OCV

The battery was calibrated at ambient temperature (25±2°C) for both capacity (3.7) and energy (3.5) measurements. After standard charging (3.5), it underwent constant-current discharge at 42.0A with 10% capacity reduction per cycle (10% × C_0). Each discharge was followed by a 60-minute rest period, and the voltage readings were recorded after each cycle to determine the Open-Circuit Voltage (OCV) corresponding to the State of Charge (SOC) in the discharged state.

The battery was subjected to capacity calibration (3.7 capacity calibration and energy calibration) at an ambient temperature of 25±2°C. It was then charged at a constant current of 16.8A with each charge cycle maintaining 10% capacity at C_0. After 60-minute rest periods, the charging process was repeated 10 times. The voltage recorded after each rest period was used to determine the Open Circuit Voltage (OCV) corresponding to the State of Charge (SOC) during charging.

Temperature	OCV (V)										
	SOC%	100	90	80	70	60	50	40	30	20	10	0
25°C	Discharge	4.18	4.05	3.94	3.84	3.76	3.68	3.64	3.61	3.57	3.50	3.43
	Charge	4.17	4.04	3.93	3.83	3.75	3.67	3.63	3.60	3.56	3.49	3.42

4.1.2. Recommended Charging

Conventional charging (10~45т): Constant current and voltage charging at 42.0A until 4.2V, with a cutoff current of 2.1A.

Fast charging (25~35т,10%~80% SOC): Constant current charging at 126A to 3.65V,84A to 3.84V,63A to 4.95V, and 42 A to 4.05V.

Model	INP42P	Specification code	RD-EVE M22-S02-LF	Edition	E

4.1.3. Pulse Discharge and Charging Power

Temperature	Way	Maximum power (W)					
		Time (s)	90% SOC	50% SOC	30% SOC	20% SOC	I_{max} (A)
40℃	Discharge	5	2100	1522	1410	1215	5
		30	1442	1152	1005	866	30
	Charge	5	435	1431	1602	1680	5
		30	299	1052	1131	1161	30
25℃	Discharge	5	1680	1214	1122	1004	5
		30	1126	883	807	703	30
	Charge	5	345	1103	1207	1232	5
		30	232	781	865	864	30
-5℃	Discharge	5	596	430	388	355	5
		30	467	353	321	289	30
	Charge	5	127	371	410	412	5
		30	99	294	336	337	30
-20℃	Discharge	5	181	144	114	91	5
		30	166	131	102	73	30

4.1.4. DCR

Temperature	Way	DCR (mΩ)				
		Time (s)	90% SOC	50% SOC	30% SOC	20% SOC
40℃	Discharge	5	0.89	0.86	0.86	0.91
		30	1.29	1.13	1.20	1.28
	Charge	5	0.88	0.86	0.86	0.90
		30	1.29	1.17	1.21	1.31
25℃	Discharge	5	1.12	1.09	1.09	1.16
		30	1.67	1.49	1.52	1.66
	Charge	5	1.12	1.09	1.12	1.17
		30	1.67	1.55	1.56	1.67
0℃	Discharge	5	3.15	3.14	3.20	3.39
		30	4.02	3.83	3.87	4.17
	Charge	5	3.21	3.19	3.27	3.40
		30	4.13	4.02	4.00	4.17
-20℃	Discharge	5	10.43	9.50	10.75	12.89
		30	11.35	10.38	12.04	15.99

4.1.5. Charging capacity at different temperatures

After standard discharge, the battery was left at the corresponding temperature specified in the table for 4 hours, followed by constant current and constant voltage charging to 4.2 V until the current decreased to 2.1 A (0.05C). The measured capacity represents the charging capacity at the corresponding temperature and current conditions.

Charge rate	Temperature (℃)	Charging capacity (Ah)
42A (1C)	45	45.4
	25	42.9
21A (0.5C)	10	41.1
	5	40.2

4.1.6. Discharge capacity at different temperatures

After standard charging, the battery was left at the corresponding temperature in the table below for 6 hours, followed by constant current discharge at 42.0 A and 84 A respectively until reaching 3.0 V.

(3.0V (>0°C), 2.5V (0°C ≤ T <-20°C), 2.2V (-20°C ≤ 0°C)). The measured capacity represents the discharge capacity at corresponding temperatures and currents.

Discharge rate	Temperature (℃)	Discharge capacity (Ah)	Discharge cutoff voltage (V)
42.0A (1C)	45	45.3	2.8
	25	42.6	2.8
	0	36.8	2.5
	-20	33.5	2.5
	-30	30.8	2.2
84A (2C)	45	45.8	2.8
	25	43.1	2.8
	0	38.9	2.5
	-20	38.1	2.5
	-30	37.1	2.2

4.2. Safety Operation Restrictions for Batteries

4.2.1. current limit

4.2.1.1. Discharge Operating Current Limit:

Temperature （T）	Discharge operating current limit		
	Pulsed current limitation		Current limiting
	$I_{max-peak}$（A）	Time (sec)	$I_{max-continuous}$（A）
52	0	-	0
50	336	180	210
40	336	180	210
35	336	180	210
30	336	180	210
25	336	180	210
20	294	180	168
15	252	180	168
10	168	180	126
5	168	180	126
0	168	180	126
-5	126	180	84
-10	126	180	84
-15	126	180	84
-20	126	180	84
-25	84	180	42
-30	84	180	42
-32	0	-	0

Note: The above $I_{max-peak}$ and $I_{max-continuous}$ refer to the maximum allowable current of the battery at 50%SOC.

Model	INP42P	Specification code	RD-EVE M22-S02-LF	Edition	E

4.2.1.2. Charging Current Limit:

Temperature （τ）	Current limit for charging operation		
	Pulsed current limitation		Current limiting
	$I_{max\text{-}peak}$（A）	Time (sec)	$I_{max\text{-}continuous}$（A）
52	0	-	0
50	210	30	168
40	210	30	168
35	210	30	168
30	210	30	168
25	210	30	168
20	168	30	126
15	168	30	126
10	126	30	84
5	126	30	84
0	84	30	42
-2	0	/	0

Note: The above $I_{max\text{-}peak}$ and $I_{max\text{-}continuous}$ refer to the maximum allowable current of the battery at 50%SOC.

4.2.1.3. Safe current limit:

If the current exceeds $I_{max\text{-}safety}$ within the range of 0msec to 200msec, the battery will not trigger a safety event (EUCAR hazard level ≤L3: battery leakage, and electrolyte loss <50%), but the battery cannot continue charging and discharging and must be replaced.

If used between operating current limit and safety current limit, the battery will experience significantly accelerated degradation without triggering safety events.

In the absence of specified temperature, the safe limit current can be determined through linear interpolation between two adjacent conditions in the table below.

Temperature （T）	Safe current limit			
	Discharge		Charge	
	$I_{max\text{-}safety}$ （A）	Maximum allowed time (ms)	$I_{max\text{-}safety}$ （A）	Maximum allowed time (ms)
55	378	200	252	200
50	378	200	252	200
40	378	200	252	200
35	378	200	252	200
30	378	200	252	200
25	378	200	252	200
20	336	200	210	200
15	294	200	210	200
10	210	200	168	200
5	210	200	168	200
0	210	200	126	200
-5	210	200	84	200
-10	168	200	63	200
-15	168	200	42	200
-20	168	200	42	200
-25	126	200	21	200
-30	126	200	21	200

4.2.2. Voltage Limit:

Charge and discharge voltage limitation			
Class	Project	Numeric value	Remarks
Security restrictions	Charging voltage	4.25V	When the voltage exceeds 4.25V, the sustained charging duration must be less than 2000 milliseconds. When the charging voltage exceeds 4.25V, EVE cannot guarantee battery safety. If the voltage surpasses the safety limit, immediately discharge the battery to bring it within safe limits.
	Discharge voltage	2.7V	When the voltage drops below 3.0V, the sustained discharge duration must remain under 2000 milliseconds. When the discharge voltage falls below 3.0V, EVE cannot guarantee the battery's safety performance. If the voltage exceeds the safety limit, immediately perform constant current and constant voltage charging (charging current not exceeding 42A, charging voltage not exceeding 4.2V, and constant voltage cutoff current not less than 2.1A) to ensure compliance with safety requirements.
Operation restrictions	Charging voltage	4.2V	When the temperature ranges from 0°C to 25°C, the charging cutoff voltage is 4.2V. When the temperature ranges from 25°C to 45°C, the charging cutoff voltage is 4.18V. When the temperature is between 45°C and 55°C, the charging cutoff voltage is 4.15V. Charging is not permitted when T>55°C.
	Discharge voltage	3.0V	When T>0℃, the discharge cutoff voltage is 3.0V. When 0℃ ≤ T <-20℃, the discharge cutoff voltage is 2.5V. When T≤-20°C, the discharge cutoff voltage is 2.2V.

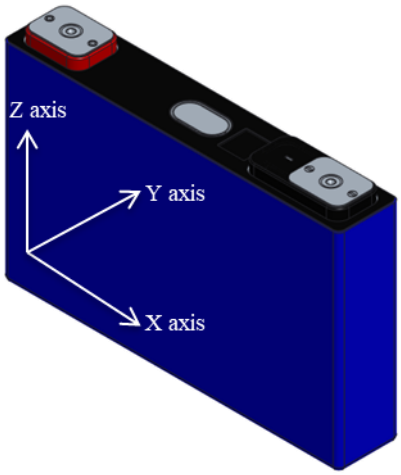
4.2.3. temperature limitation：

Temperature limits for safe operation			
Class	Project	Numeric value	Remarks
Security restrictions	Maximum safe temperature	60℃	If the battery is used at temperatures exceeding the maximum safe limit, irreversible permanent damage may occur. Users must not operate the device above this temperature threshold.
	Minimum safe temperature	-35℃	If the battery is used at temperatures exceeding the minimum safe range, irreversible permanent damage may occur. Users must ensure operating temperatures remain below the minimum safe threshold.
Operation restrictions	Maximum allowable operating temperature	55℃	If the battery operating temperature exceeds the maximum operating temperature, the power must be reduced to 0.
	Recommended operating temperature range	10~45℃	Recommended operating temperature range of the battery.
	Minimum operating temperature	-30 °C	If the battery is used at temperatures exceeding the minimum operating temperature, the power must be

Model	INP42P	Specification code	RD-EVE M22-S02-LF	Edition	E
			To be reduced to 0.		

5. Recommended Module Design Parameters

5.1. Battery direction



5.2. Battery compression force

The safety boundary of the battery under compression force during module assembly. Test conditions:

-Compressed area: 148.3mm × 91.0mm (L × H)

Compression speed: 0.02 mm/sec

Compression direction: Y-axis

- Battery SOC: 100%

Phenomenon	Compressive force
Internal generation of defects	30kN
Weeping	> 100kN

As shown in the table above, the compression force applied to the battery must not exceed 30 kN, as exceeding this limit may cause damage to the battery.

5.3. Expansion Force of Battery

5.3.1. test condition：

Initial battery preload: 3000N

Charge/discharge conditions:

-Charging: Constant current and constant voltage charging at 42.0A to 4.2V, cutoff current 2.1A (0.05C). Left undisturbed for 30 minutes.

-Discharge: Constant current discharge from 42.0A to 3.0V. Hold for 30 minutes.

Perform 2000 cycles under charging and discharging conditions, and record the battery expansion force before and after each cycle.

5.3.2. Test results after 2000 cycles:

Expansibility	BOL	3000N
	EOL	< 20000N

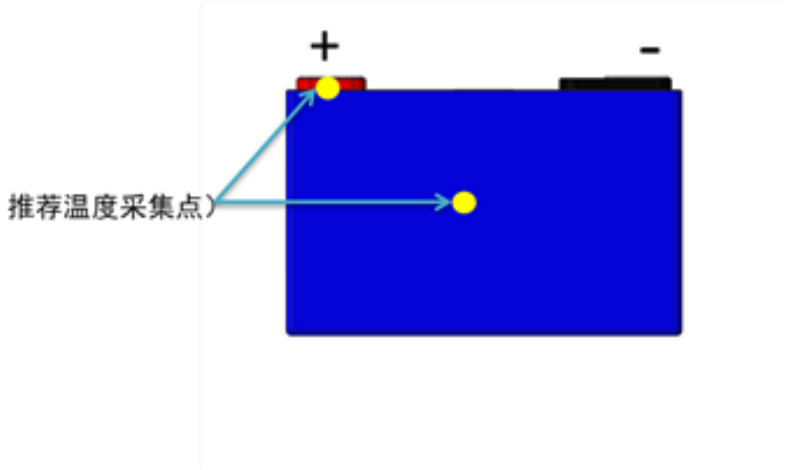
5.4. Thermal Parameters

Testing method: Reference standards: GB/T 10295-2008, ASTM E1269-2011

Mean thermal conductivity	Thermal conductivity (W/mK)	
	X/Z Xiang	Y Xiang
	25~26W/mK	5~7 W/mK
Mean heat capacity	Heat capacity (kJ/(kg·K))	
	0.9~1.2 kJ/(kg·K)	

5.5. Recommended temperature sampling points (battery temperature field distribution)

For temperature measurement on battery surfaces, the optimal locations are the positive electrode terminal and the center of the large surface, as illustrated in the figure below.



6. Battery Operation Instructions and Precautions

6.1. long term storage

After charging, the battery should be used promptly to prevent capacity loss due to self-discharge. If storage is required, the battery must be kept at a low State of Charge (SOC). Recommended storage conditions are: 30%±10% SOC, 0~25°C, and ≤60% RH.

6.2. transport

The product shall be packed in boxes during transportation at a SOC level not exceeding 30%. During transit, vigorous vibration, impact, or compression must be avoided, and exposure to sunlight or rain should be prevented. This method is applicable for transportation via vehicles such as automobiles, trains, ships, and aircraft.

6.3. operation declaration

- Reverse charging is prohibited. Connect the battery terminals correctly and strictly avoid reverse charging.
- Over-discharge is prohibited. During normal battery operation, to prevent over-discharge, the battery should be charged periodically and the voltage maintained above 2.8V.
- Batteries must not be submerged in water. When not in use, they should be stored in a cool and dry environment.
- Batteries must not be placed near heat sources such as fire or heaters for use or storage.
- When charging, use a charger specifically designed for lithium-ion batteries.
- During use, it is strictly prohibited to reverse the positive and negative terminals of the battery.
- Do not leave batteries in fire or heat batteries.
- Do not use metal to directly conduct the positive and negative terminals of the battery.
- Do not transport or store batteries with metals such as hair clips, necklaces, etc.
- It is prohibited to strike, throw, step on, or bend batteries.
- Do not directly weld batteries.
- Do not puncture batteries with nails or other sharp objects.
- Do not use batteries in extremely hot environments, such as direct sunlight or inside a hot car.
- Use is prohibited in areas with strong static electricity and strong magnetic fields.
- If the battery leaks liquid and the electrolyte splashes onto the skin or clothing, immediately wash the affected area with running water.
- Do not use the battery if it exhibits any unusual odors, heating, discoloration, deformation, or abnormalities during use, storage, or charging.

6.4. else

Any matters not mentioned in this specification shall be determined through mutual consultation between both parties.

7. Contact Way

Contact address: No.68, Jingnan Avenue, High-tech Zone, Jingmen Economic Development Zone, Hubei Province, Hubei Yiwei Power Co., LTD.

Contact number: 86-0724-6079699

Fax: 86-0724-6079688

Website:http://www.evejq.com

Model	INP42P	Specification code	RD-EVE M22-S02-LF	Edition	E

Figure 1: INP42P Battery Diagram

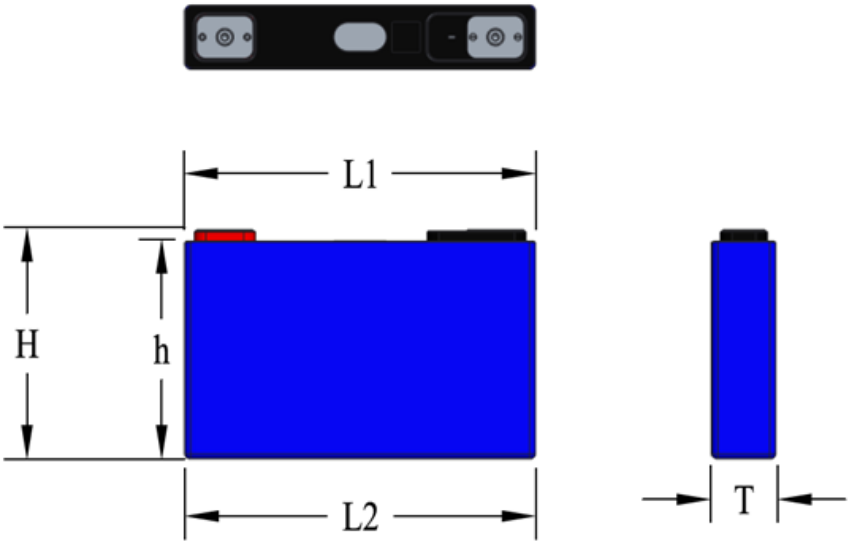


Figure 1. INP42P Battery