

No.	B1901WT8888-00148-Y
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中国认可  
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检测  
TESTING  
CNAS L0462

# TEST REPORT

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Product Name :	Super Capacitors
Type and Specification :	4.2V 21000F (Rated Capacity: 20000mAh, Limited Charging Voltage:4.2Vdc)
Test Category :	Entrusted Test
Factory :	DONGGUAN CITY GONGHE ELECTRONICS CO.,LTD
Client:	DONGGUAN CITY GONGHE ELECTRONICS CO.,LTD



China Electronic Product Reliability And  
Environmental Testing Research Institute

China CEPREI Laboratory

# TEST REPORT

Report reference No .	: B1901WT8888-00148-Y
Total number of pages	: 11
Test item description	: Super Capacitors
Trademark	: /
Model and/or type reference	: 4.2V 21000F
Factory's Name	: DONGGUAN CITY GONGHE ELECTRONICS CO.,LTD
Address	: 506 Factory, No.64, Dezheng Middle Road, ChangAn Town, DongGuan city, Guangdong province ,CHINA
Client's Name	: DONGGUAN CITY GONGHE ELECTRONICS CO.,LTD
Address	: 506 Factory, No.64, Dezheng Middle Road, ChangAn Town, DongGuan city, Guangdong province ,CHINA
Testing Laboratory Name	: China CEPREI Laboratory/ China Electronic Product Reliability and Environmental Testing Research Institute
Address	: No. 46 Tianhui Road, Tianhe District, Guangzhou, Guangdong, 510663, China
Testing location	: China CEPREI Laboratory
Test specification	
Standard	: 1. IEC 61960: 2011 (Edition 2.0) —Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications. 2. Testing technologic requirement offered by the client*.
Test category	: Entrusted Test
Number of test item	: 20 pieces
Date of receipt of test item	: 2019.01.16
Date(s) of performance of test	: 2019.01.16-2019.02.22
Ambient Condition	: (15~35)°C, (25~75) % RH, (86~106) kPa
Test Instruments and Equipment	: See Equipment List of This Report.
<b>Summary of Testing and Conclusions</b>  The test results of subclause 7.3 and 7.4 fulfill the requirements of the standard IEC61960: 2011. The test results of subclauses 7.5 and 7.6 were not given a verdict(because the test period offered by the client can not meet the requirements of the standard IEC61960: 2011). The test item of "Cycle number calculation" requested by the client was not given a verdict.  Item "*" not included in accredited CNAS and CMA scope of the laboratory.	
Tested by (printed name and signature)	: Mei Ziqiang (梅自强)
Reviewed by (printed name and signature)	: Ye Yaoliang (叶耀良)
Approved by (printed name and signature)	: Zhang Yuanqin (张元钦)
Date of issue	: 2019.02.25

**Test case verdicts**

Test case does not apply to the test object .....	N
Test item does meet the requirement(Pass) .....	P
Test item does not meet the requirement(Fail) .....	F
Test item does not need to be given a verdict.....	—

**General remarks**

1. Report without “specific stamp” of inspection organization or the authority will be regarded as invalid.
2. Duplicated report without original “specific stamp” of inspection organization or the authority will be regarded as invalid.
3. Report without the signatures of Tester, Reviewer or Approval will be regarded as invalid.
4. Test report if altered will be regarded as invalid.
5. Any dispute about the report must be submitted to inspection organization within 15 days upon report received, it will be rejected if out of the period.
6. Generally, the entrusted test only responsible for the samples.

**General product information:**

Charging procedure for test purposes:

Prior to charging, the specimen shall be discharged at  $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  at a constant current of  $0.2\text{ }I_t\text{ A}$  (4.0A), down to the end-of-discharge voltage (2.7V). Then, the specimen shall be charged at  $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  by using the limited charging voltage (4.2V) and standard charging current  $0.2\text{ }I_t\text{ A}$  (4.0A), until the charging current is reduced to  $0.02\text{ }I_t\text{ A}$  (400mA), using a constant voltage charging method.

**Testing Laboratory Contact Info:**

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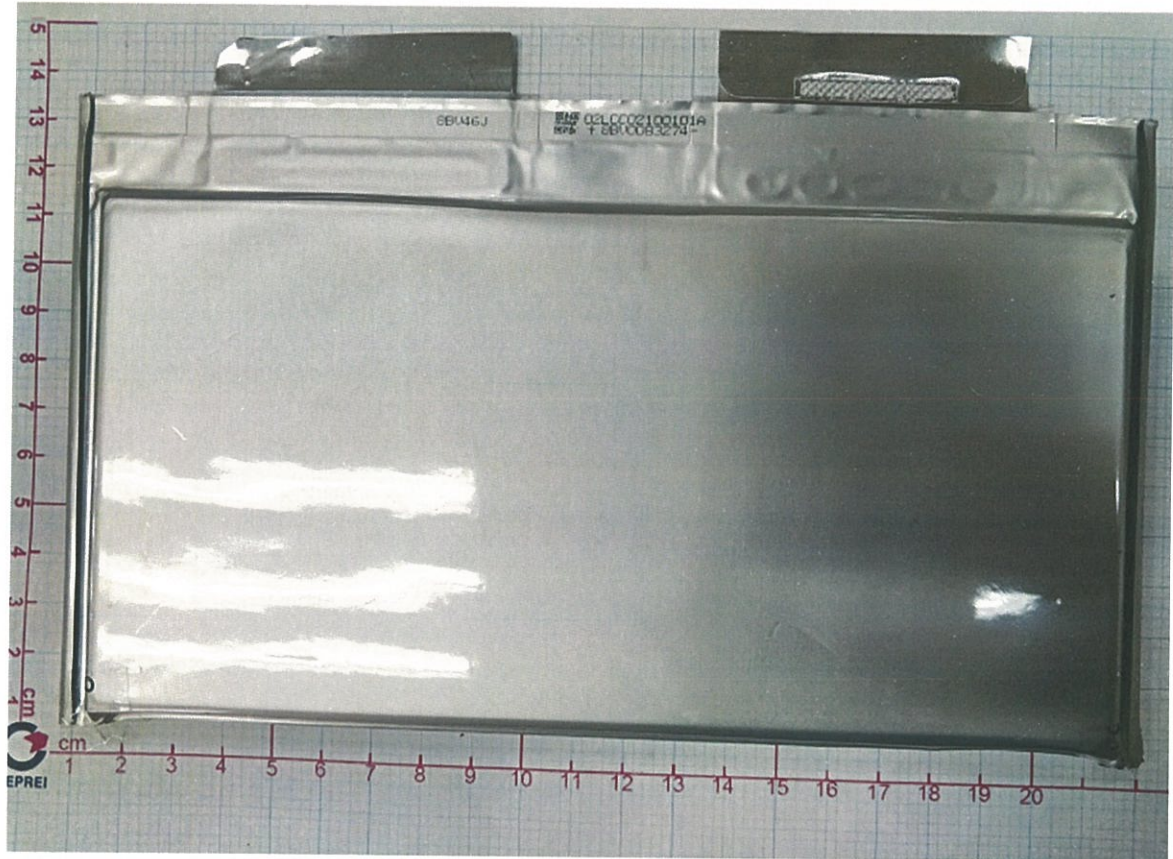
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## Specimen



## IEC 61960

Clause	Requirement + Test	Result - Remark	Verdict
7.1	General	See below.	P
	Tests in this clause conducted in still air, except as specified	Tests conducted in still air.	P
	Charge and discharge currents for tests were based on the rated capacity (C5 Ah), and expressed as a multiple of $I_t$ A, where: $I_t \text{ A} = C_n \text{ Ah}/1 \text{ h}$		P
	Minimum values required for each electrical test were based on Table 5		P
	Sample sizes and sequence of tests were in accordance with Table 4		P
7.2	Charging procedure for test purposes	See below.	P
	The cell or battery discharged at $20^\circ\text{C} \pm 5^\circ\text{C}$ at a constant current of $0,2 I_t$ A down to a specified end-of-discharge voltage prior to charging	Discharge condition: $20^\circ\text{C} \pm 5^\circ\text{C}$ , 4.0A to 2.7V.	P
	Cell or battery charged in an ambient temperature of $20^\circ\text{C} \pm 5^\circ\text{C}$ using the method declared by the manufacturer, except as stated in this standard :	Charging condition: $20^\circ\text{C} \pm 5^\circ\text{C}$ , 4.2V/4.0A, 400mA.	P
7.3	Discharge performance	See below.	P
7.3.1	Discharge performance at $20^\circ\text{C}$ (rated capacity)	Test samples:C1~C20	P
	Cell or battery charged in accordance with 7.2, and stored in an ambient of $20^\circ\text{C} \pm 5^\circ\text{C}$ for 1 h to 4 h (h) .....	Charging condition: $20^\circ\text{C} \pm 5^\circ\text{C}$ , 4.2V/4.0A, 400mA. The samples were stored in an ambient of $20^\circ\text{C} \pm 5^\circ\text{C}$ for 2 h.	P
	Cell or battery discharged in an ambient of $20^\circ\text{C} \pm 5^\circ\text{C}$ , at a constant current of $0,2 I_t$ A until its voltage increased to specified end-of-discharge voltage (A) (V) .....	Discharge condition: $20^\circ\text{C} \pm 5^\circ\text{C}$ , 4.0A to 2.7V.	P
	The capacity (Ah) delivered above was not less than 100 % of the rated capacity declared by the manufacturer (Ah) .....	(See Table 7.3.1)	P
	The above two steps repeated up to four additional times, as necessary to meet this requirement (No. of tests).....		N
7.3.2	Discharge performance at $-20^\circ\text{C}$	Test samples:C1~C5	P
	Cell or battery charged in accordance with 7.2, and stored in an ambient of $-20^\circ\text{C} \pm 2^\circ\text{C}$ for 16 h to 24 h (h) .....	Charging condition: $20^\circ\text{C} \pm 5^\circ\text{C}$ , 4.2V/4.0A, 400mA. The samples were stored in an ambient of $-20^\circ\text{C} \pm 2^\circ\text{C}$ for 16 h.	P
	Cell or battery discharged in an ambient of $-20^\circ\text{C} \pm 2^\circ\text{C}$ , at a constant current of $0,2 I_t$ A until its voltage increased to specified end-of-discharge voltage	Discharge condition: $-20^\circ\text{C} \pm 2^\circ\text{C}$ , 4.0A to 2.7V.	P
	Capacity (Ah) delivered during discharge performance test at $-20^\circ\text{C} \pm 2^\circ\text{C}$ .....	(See Table 7.3.2)	P

IEC 61960			
Clause	Requirement + Test	Result - Remark	Verdict
7.3.3	High rate discharge performance at 20 °C	Test samples:C6~C10	P
	Cell or battery charged in accordance with 7.2, and stored in an ambient of 20 °C ± 5 °C for 1 h to 4 h (h) .....	Charging condition: 20°C ± 5°C, 4.2V/4.0A, 400mA. The samples were stored in an ambient of 20 °C ± 5 °C for 2 h.	P
	Cell or battery discharged in an ambient of 20 °C ± 5 °C, at a constant current of 1,0 I <sub>t</sub> A until its voltage increased to specified end-of-discharge voltage (A) (V) .....	Discharge condition: -20°C ± 2°C, 4.0A to 2.7V.	P
	Capacity (Ah) delivered during high rate discharge performance at 20 °C ± 5 °C .....	(See Table 7.3.3)	P
7.4	Charge (capacity) retention and recovery	Test samples:C11~C15	P
	Cell or battery charged in accordance with 7.2, and stored in an ambient of 20 °C ± 5 °C for 28 days	Charging condition: 20°C ± 5°C, 4.2V/4.0A, 400mA. The samples were stored in an ambient of 20 °C ± 5 °C for 28 days.	P
	Cell or battery discharged in an ambient of 20 °C ± 5 °C, at a constant current of 0,2 I <sub>t</sub> A until its voltage increased to specified end-of-discharge voltage (A) (V) .....	Discharge condition: 20°C ± 5°C, 4.0A to 2.7V.	P
	Retained capacity (Ah) after 28 days of storage according to Table 5 .....	(See Table 7.4)	P
	Cell or battery was then charged in accordance with 7.2 within 24 h following the above discharge test, and stored in an ambient of 20 °C ± 5 °C for 1 to 4 h (h) .....	Charging condition: 20°C ± 5°C, 4.2V/4.0A, 400mA. The samples were stored in an ambient of 20 °C ± 5 °C for 2 h.	P
	Cell or battery discharged in an ambient of 20 °C ± 5 °C, at a constant current of 0,2 I <sub>t</sub> A until its voltage increased to specified end-of-discharge voltage	Discharge condition: 20°C ± 5°C, 4.0A to 2.7V.	P
	Recovery capacity according to Table 5 (Ah) ...	(See Table 7.4)	P
7.5	Charge (capacity) recovery after long term storage	Test samples:C6~C10	—
	Cell or battery charged in accordance with 7.2, and discharged in an ambient of 20 °C ± 5 °C, at a constant current of 0,2 I <sub>t</sub> A until its voltage increased to specified end-of-discharge voltage (A) (V) .....	Charging condition: 20°C ± 5°C, 4.2V/4.0A, 400mA. Discharge condition: 20°C ± 5°C, 4.0A to 2.7V.	—
	Cell or battery stored in an ambient temperature of 40 °C ± 2 °C, for 90 days	Storage condition: 40 °C ± 2 °C, for 639h (by the client's request).	—
	Cell or battery charged in an ambient of 20 °C ± 5 °C, using manufacturer's method	Charging condition: 20°C ± 5°C, 4.2V/4.0A, 400mA.	—
	Cell or battery stored in an ambient of 20 °C ± 5 °C for 1 h to 4 h (h) .....	The samples were stored in an ambient of 20 °C ± 5 °C for 2 h.	—

## IEC 61960

Clause	Requirement + Test	Result - Remark	Verdict
	Cell or battery discharged in an ambient of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ , at a constant current of $0,2\text{ }I_t\text{ A}$ until its voltage increased to specified end-of-discharge voltage(A) (V) .....	Discharge condition: $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ , 4.0A to 2.7V.	—
	Capacity (Ah) delivered after long term storage according to Table 5 .....	(See Table 7.5)	—
	The charging and storage steps, optionally, repeated up to four additional times as necessary to satisfy this requirement		N
7.6	Endurance in cycles	Test samples: C16~C18 (by the client's request)	—
7.6.1	General	See below	—
	Prior to charging, the cell or battery shall be discharged at $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ at a constant current of $0,2\text{ }I_t\text{ A}$ , down to a specified end-of-discharge voltage	Discharge condition: $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ , 4.0A to 2.7V.	—
	The following endurance test shall then be carried out, irrespective of cell designation, in an ambient temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ . Charge and discharge shall be carried out in accordance with the conditions specified in either Tables 2 or 3	See 7.6.3	—
7.6.2	Endurance in cycles at a rate of $0,2\text{ }I_t\text{ A}$		N
	The total number of cycles obtained when the test is completed shall be not less than that specified for this characteristic in Table 5		N
7.6.3	Endurance in cycles at a rate of $0,5\text{ }I_t\text{ A}$ (accelerated test procedure)	Method of endurance test is offered by the client as follows: Step 1—Charge as follows: $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ , 4.2V/20A, 2.0A. Step 2—The charged samples stored in an ambient of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 5 min. Step 3—Discharge as follows: $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ , 20A to 2.7V. Step 4—Step 1 to 3 repeated at least 300 times(one time defined as one cycle). Step 5—Discharge capacity test in accordance with 7.3.1.	—
	The following alternative procedures may be carried out as an alternative to 7.6.2. The remaining capacity obtained when the test is completed shall be not less than that specified for this characteristic in Table 5	(See Table 7.6)	—

## IEC 61960

Clause	Requirement + Test	Result - Remark	Verdict
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7.3.1	TABLE: Discharge performance at 20 °C (rated capacity: 20Ah)					P
Sample number	Discharge capacity(Ah)	Sample number	Discharge capacity(Ah)	Sample number	Discharge capacity(Ah)	
C1	21.424	C8	21.611	C15	21.798	
C2	21.276	C9	21.506	C16	21.605	
C3	21.629	C10	21.687	C17	21.656	
C4	21.899	C11	21.898	C18	21.788	
C5	22.010	C12	21.695	C19	21.485	
C6	21.621	C13	21.620	C20	21.341	
C7	21.838	C14	21.565	/	/	

7.3.2	TABLE: Discharge performance at -20 °C					P
Sample number	Discharge capacity(Cells)		Sample number	Discharge capacity(Batteries)		Note
	Acceptance criteria	Measurement results		Acceptance criteria	Measurement results	
C1	≥6.0 Ah (30% $C_5$ Ah)	17.278 Ah	/	/	/	/
C2		17.682 Ah	/		/	/
C3		17.421 Ah	/		/	/
C4		17.745 Ah	/		/	/
C5		17.221 Ah	/		/	/

7.3.3	TABLE: High rate discharge capacity at 20 °C ± 5 °C					P
Sample number	Discharge capacity(Cells)		Sample number	Discharge capacity(Batteries)		Note
	Acceptance criteria	Measurement results		Acceptance criteria	Measurement results	
C6	≥14.0 Ah (70% $C_5$ Ah)	20.540 Ah	/	/	/	/
C7		20.355 Ah	/		/	/
C8		20.605 Ah	/		/	/
C9		20.804 Ah	/		/	/
C10		20.415 Ah	/		/	/

7.4	TABLE: Charge (capacity) retention and recovery					P
Sample number	Charge (capacity) retention		Charge (capacity) recovery		Note	
	Acceptance criteria	Measurement results	Acceptance criteria	Measurement results		
C11	≥14.0 Ah (70%C <sub>5</sub> Ah)	21.394 Ah	≥17.0 Ah (85%C <sub>5</sub> Ah)	21.798 Ah	Storage time: 20°C ± 5°C, for 28 days	
C12		21.245 Ah		21.654 Ah		
C13		21.615 Ah		21.560 Ah		
C14		21.089 Ah		21.480 Ah		
C15		21.059 Ah		21.789 Ah		

## IEC 61960

Clause	Requirement + Test	Result - Remark	Verdict
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7.5	TABLE: Charge (capacity) recovery after long term storage					—
Sample number	Discharge capacity(Cells)		Sample number	Discharge capacity(Batteries)		Note
	Acceptance criteria	Measurement results		Acceptance criteria	Measurement results	
C6	≥10.0 Ah (50% $C_5$ Ah)	21.606 Ah	/	/	/	Storage time: 40°C ± 2°C, for 639 h (by the client's request)
C7		21.680 Ah	/		/	
C8		21.508 Ah	/		/	
C9		21.467 Ah	/		/	
C10		21.630 Ah	/		/	

7.6	TABLE: Endurance in cycles(Cells)				—
Sample number	Acceptance criteria	Initial discharge capacity( $C_0$ )	Completed cycle number(n)	Remaining discharge capacity ( $C_n$ ,after cycle test)	
C16	≥12.0 Ah (60% $C_5$ Ah)	21.605 Ah	322	21.125 Ah	
C17		21.656 Ah	323	21.129 Ah	
C18		21.788 Ah	323	21.276 Ah	
Note:					
1. Method of endurance test is offered by the client, see subclause 7.6.1.					
2. Method of the initial discharge capacity test and remaining discharge capacityis test is in accordance with 7.3.1.					

## Test Items and Test Results

Test Items	Requirement + Test	Result - Remark	Verdict
Cycle number calculation	<p>According to <b>table 7.6</b>, total cycle number, N, is calculated using the following:</p> $N = \frac{C_0}{C_0 - C_n} \times n \times \left(\frac{I}{10}\right)^2 \times 80\%$ <p>where  <math>C_0</math> is the initial discharge capacity;  <math>C_n</math> is the remaining discharge capacity after cycle test;  n is the completed cycle number;  I is the constant discharge current in the cycle test, I=20 A.</p>	<p><b>Total cycle number, N:</b>  C16: 46378  C17: 42473  C18: 43984</p>	—

## Instrument used for the purpose of this test

No.	Designation	Type	Serial Number	Calibration Due Date
1	Digital multimeter	2000	7521060023	2019.05.18
2	Battery performance testing system	CT-3008W-10V6A-A	T1509-085965	2019.12.09
3	High temperature test chamber	SPH-201	06102392	2019.07.10
4	High-low temperature testing chamber	MC-710P	6534070011	2020.01.06
5	Battery performance testing system	CT-4004-5V200A-4CH	7539990120	2019.11.29
6	Battery performance testing system	CT-4002-60V60A-2CH	7539990119	2019.12.20

## Environmental conditions

Field	Temperature(°C)	RH(%)	Atm. (kPa)
For testing	15~35	25~75	86~106