TECHNICAL SPECIFICATION

Lithium-ion Battery-Capacitor

Model: G0016-LF（SPC1520）

Approved	Checked	Draft

Customer signature
Company name: **Approved by:** **Signature date：**

Document Revision Record

Mark	Edit Date	Edition	Edit Page	Edit Cause
0	2012.8.20	1.0		Formulated first edition
1	2014.3.16	1.1	10	Add drawing
2	2016.8	2		The name changed to “Lithium-ion battery-capacitor”

1 Scope of application

The specification can applied in G0016-LF lithium-ion super-capacitor, specifying the property index, test method, quality control and points for attention etc.

2 Product type

Lithium -ion super-capacitor.

3 Properties

No.	Item	General Parameter		Remark
1	Capacity	Typical	45mAh	20mA discharge at room temperature (23±5) °C measured capacity value will be changed by discharge current, temperature and cut-off voltage).
		Minimal	38mAh	
2	Nominal voltage	≥3.60V		20mA discharge within 50% capacity at (23±5) ℃.
3	Internal Impedance	≤160mΩ		Internal resistance measured at AC 1 kHz within 50% capacity at (23±5) ℃.
4	End Voltage	2.5V		Usually, EVE would recommend the end voltage is 3.0V.
5	Standard Charge Voltage	3.67V		/
6	Max. Charge Voltage	3.95V		/
7	Standard Charge Current	20mA		/
8	Max. Charge Current	50mA		Prefer 0℃~+50℃when charge.
9	Min. Charge Current	0.1mA		
10	Standard Charge Process	CCCV(Constant current/ Constant voltage) End Charge current: ≤5mA		Standard charge test at (23±5)℃.
11	Max. Continuous Discharge Current	500mA		(23±5)℃, Voltage ≥ 2.5V.
12	Max. Pulse Discharge Current	2.0A		Pulse 1S (23±5)℃, Voltage ≥ 2.5V.
13	Weight	About 7.5g		
14	Operation Temperature Range	-40℃~+85℃		Operation under higher temperature than ambient temperature may lead to reduced capacity and lower voltage. If continuous high temperature over +40 °C -20 °C usa consult EVE. 60±25%RH
15	Storage Temperature Range	-30℃~+60℃		EVE recommend temperature (20±5) °C
16	Dimension	Diameter： 15.1mm max		
		Height： 21.0mm max		

4 Appearance

When using, the G0016-LF capacitor shall be no flaw, inflate, out of shape, corrosion and leakage.

5 Performance And Test Conditions

5.1 Standard Test Conditions

Test should be conducted with new lithium-ion super-capacitor within 10 days after shipment from our factory. All tests stated in this product specification are conducted at temperature 20℃±5℃ and humidity 65%±20% RH.

5.2 Measuring instrument or Apparatus

5.2.1 Measuring instrument or Apparatus

The dimension measurement shall be implemented by vernier micrometer with equal or more precision scale of 0.01mm.

5.2.2 Weighting instrument or Apparatus

The weight of the cell capacitor shall be implemented by electronic scale with equal or more precision scale of 0.05g.

5.2.3 Voltmeter

According to GB*, the voltage of the cell capacitor shall be implemented by voltmeter with equal or more precision level of 0.5 and more resistance of 10kΩ/V.

5.2.4 Ammeter

According to GB*, the current of the cell capacitor shall be implemented by ammeter with equal or more precision level of 0.5.

5.2.5 Impedance meter

Impedance shall be measured by a sinusoidal alternating current method (1kHz LCR meter).

5.3 Initial performance test

No.	Item	Test Method and Condition	Requirements
1	Open-circuit Voltage	The open-circuit voltage shall be measured within 24 hours after standard charge.	≥3.60V
2	AC impedance	Internal impedance shall be measured under the standard charging condition.	≤160mΩ
3	Minimal Capacity	The minimal capacity shall be measured by a standard charge G0016-LF after 30 min rest, and 20mA discharge till the voltage tapered to 3.0V.	C_5≥38mAh

5.4 Temperature dependence of discharge capacity

G0016-LF lithium-ion super-capacitor shall be charged by standard charge process, then discharged at temperatures listed in below table. For -10℃ test, lithium-ion super-capacitor shall be stored at -10℃ temperature for 16 hours before discharging, and then discharge at the same test temperature. For 23℃ and 55℃ test, lithium-ion super-capacitor shall be stored at the test temperature for 8 hours before discharging, and then discharge at the same test temperature. Each G0016-LF shall meet or exceed the requirements listed below.

No.	Item	Temperature & 0.2C5A Capacity		
1	Discharge Temperature	-10℃(20mA)	23℃(20mA)	55℃(20mA)
2	Discharge Capacity	60%	100%	95%

5.5 Charge retention and recovery

Test Item		Test Conditions	Criteria
RT	1	After standard charge, the G0016-LF stored at RT for 30 days. Use 20mA current to discharge and mark the capacity as capacity retention.	Capacity Retention≥85% C5
	2	After the test of capacity retention, G0016-LF charge/discharge at 20mA for 3cycles, the maximum capacity chose as capacity recovery.	Capacity Recovery≥90% C5

6 Cycle Life

Number of charge-discharge cycles to 85%of the initial capacity.

No.	100% DOD	10% DOD	1% DOD
Charge to 3.67V in standard mode	Carry out 800 cycles 800 次	Carry out 8000 cycles 8000 次	Carry out 80000 cycles 80000 次

notes：DOD (depth of discharge)

7 Safety and environmental adaptability

7.1 Environmental adaptability

7.1.1 Temperature Cycling Test

According to the requirements of UL*, the lithium-ion super-capacitor is to be placed in a test chamber and subjected to the following cycles:

a) Raising the chamber-temperature to 70 ±3°C (158 ±5°F) within 30 minutes and maintaining this temperature for 4 hours.

b) Reducing the chamber temperature to 20 ±3°C (68 ±5°F) within 30 minutes and maintaining this temperature for 2 hours.

c) Reducing the chamber temperature to minus 40 ±3°C (minus 40 ±5°F) within 30 minutes and maintaining this temperature for 4 hours.

d) Raising the chamber temperature to 20 ±3°C (68 ±5°F) within 30 minutes.

e) Repeating the sequence for a further 9 cycles.

f) After the 10th cycle, storing the capacitors for a minimum of 24 hours, at a temperature of 20±

Criteria：The samples shall not explode, catch fire or leak.

7.1.2 Low Pressure (Altitude Simulation) Test

According to the requirements pointed in UL*, lithium-ion super-capacitor are to be stored for 6 hours at an absolute pressure of 11.6 kPa (1.68 psi) and a temperature of 20 ± 3°C (68 ± 5°F).

Criteria：The samples shall not explode, catch fire or leak.

7.1.3 Free-fall test

According to the requirements pointed in IEC62133-2002, lithium-ion super-capacitor are to be dropped from a height of 1 meter 3 times onto concrete ground.

Criteria：The samples shall not explode or catch fire.

7.1.4 Vibration test

According to the requirements pointed in UL*, lithium-ion super-capacitor are installed onto the vibration desk with clamps. The frequency is to be varied at the rate of 1 Hz /min between 10 and 55 Hz, and repeat vibration for 95±5min.The lithium-ion super-capacitor are to be tested in three mutually perpendicular directions), for which has only two axis of symmetry could conduct vibration test with two vertical directions.

Criteria：The samples shall not explode, catch fire or leak.

Warning: The description of the following abuse tests is for demonstration purposes only. During handling and application of capacitor, abusive conditions must be avoided. Any application or test requiring performance beyond the limits given hereby must be approved by the manufacturer.

7.2 Safety

7.2.1 Heating Test

According to the requirement pointed in UL*, a cell capacitor is to be heated in a gravity convection or circulating air oven with an initial temperature of 20±5°C (68 ±9°F). The temperature of the oven is to be raised at a rate of 5 ±2°C (9 ±3.6°F) per minute to a temperature of 130±2°C (266 ±3.6°F) and remain for 10 minutes. The sample shall return to room temperature (20 ±5°C) and then be examined.

Criteria：Discharge from the relief valve is allowed, but the samples shall not explode or catch fire.

7.2.2 Impact Test

According to the requirement pointed in UL*, a test sample cell capacitor is to be placed on a flat surface. A 15.8 ±0.1 mm (5/8 ±0.004 inch) diameter bar is to be placed across the center of the sample. A 9.1 ±0.46 kg (20 ± 1 pound) weight is to be dropped from a height of 610 ±25 mm (24 ±1 inch) onto the sample.

Criteria：The samples shall not explode or catch fire.

7.2.3 Crush Test

According to the requirement pointed in UL*, a cell capacitor is to be crushed between two flat surfaces. The force for the crushing is to be applied by a hydraulic ram or similar force mechanism. The flat surfaces are to be brought in contact with the lithium-ion super-capacitor and the crushing is

to be continued until an applied force of 13±0.78kN (3000 ±224 pounds) is reached. Once the maximum force has been obtained it is to be released.

Criteria：The samples shall not explode or catch fire;

7.2.4 Short-Circuit Test

According to the UL* test requirement, each test sample, in turn, was short-circuited by connecting the positive and negative terminals of the sample with a circuit load having a maximum resistance ＜0.1 ohm. The sample was discharged until a fire or explosion was obtained, or until it had reached a completely discharged state of less than 0.2 volts and the cell case temperature had returned to +10ºC (+18ºF) of ambient temperature.

Criteria：The samples shall not explode or catch fire.

7.2.5 Forced-Discharge Test

According to the requirement pointed in GB/T*, and at ambient temperature (20 ± 5 ℃), capacitor discharge to the termination voltage by 0.2C5 current, and then reverse charging by 1C5 current，the charging time is more than 90min.

Criteria： The samples shall not explode or catch fire;

References to safety standards

****UL: Underwriters Laboratories "Standard Lithium Battery"***

*****IEC: Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications***

GB：General specification of lithinum-ion battery for cellular phone

Note: This specification use the latest release version of the standard documents above as the criterion.

8 Incoming inspection

Before shipping, the factory wills 100% check open circuit voltage of the Lithium-ion super-capacitor (OCV) and the load voltage. Also EVE will sampling tests the battery capacity, visual appearance and size.

As for the customer's incoming inspection, the factory recommended sampling according to GB2828.1-2003, GB2829-2002 standard.

Table 1 Acceptability quality leve

No.	Item	Technical equest	Check level	AQL
1	Dimension	3.16	S-3	0.65
2	Appearance	4	Ⅱ	0.65
3	Open circuit voltage	3.2	Ⅱ	0.4

4	Internal Impedance	3.3	Ⅱ	0.4

Table 2 Sampling amoun

Lot size	sampling amount
≤3200	32
3200~10 000	50
＞10 000	80

9 Product mark

9.1 The Capacitor's label specification：

① type

② positive and negative electrode mark

③ date code

④ safety warning

9.2 Date code：

Date code will be marked on the sleeve of battery.

Method：XX MM YY, "XX" stand for：date"MM", stand for：month,"YY"stand for: year.

10 Storage

Lithium -ion Super-Capacitor should be stored in a cool, clean, dry environment, the recommended temperature is ≤+30℃, rela

from fire and heat.

We recommend that the battery capacitors shouldn't be stored over six months before used.

11 Safety

We propose to use lithium-ion super-capacitor process, need to comply with the following provisions:

- Before use, do not remove the capacitor from the original packaging.
- Do not scattered placed the capacitor together in order to avoid accidental short circuit.
- Do not heat the capacitor above 100 ℃ or incinerated.
- Do not recharge the capacitor more than 3.95V.
- Do not weld or solder directly to capacitor, should use the capacitor with terminals or wires.

- Do not mix the new and used capacitors or different brand capacitor.
- Do not disassembly or open capacitor.
- Do not short circuit the battery or reversely contact the positive and negative terminals.
- G0016-LF and power supply could use in parallel, but the protection measure must equip to prevent G0016-LF from charging.

12 Transportation

According to PACKING INSTRUCTION PI965Ⅱ~ PI967Ⅱ of IATA DGR 57st Edition for transportation, or the special provision 188 of IMDG. More information concerning shipping,testing, marking and packaging can be obtained from Label master at http://www.labelmaster.com.

The products meet all the requirements of the IATA DGR 57th edition, under special provisions A164 including UN 38.3 test and 1.2m drop test. They can be shipped as "Not Restricted" cargo in accordance with IATA Dangerous Good Regulations Section II of Packing Instruction 967 of IATA DGR item UN3481.

Separate battery when shipping to prevent short-circuiting. They should be packed in strong packaging for support during transport. Take in a cargo of them without falling, dropping, and breakage. Prevent collapse of cargo piles and wet by rain.

Transport Fashion: By air, by sea.

Packaging Information: Packaging paper+ Plastic tray.

13 Important notes

1） The warranty period is limited to one year from date of shipment. EVE will replace batteries if it is clear that there was a defect in EVE's manufacturing process and that the battery was not misused. EVE will replace the batteries for free.

2）Customers are responsible to confirm and assure the matching and reliability of batteries under actual application.

3） EVE shall not warrant or be responsible in any case where customers fail to carry out proper handing,

operating, installation, testing and maintaining batteries, or don't follow the instruction, cautions, warnings,

notes provided in this specification and other EVE's reasonable instructions or advises.

4） This product specification will be validated assuming that it is accepted when it is not returned within six

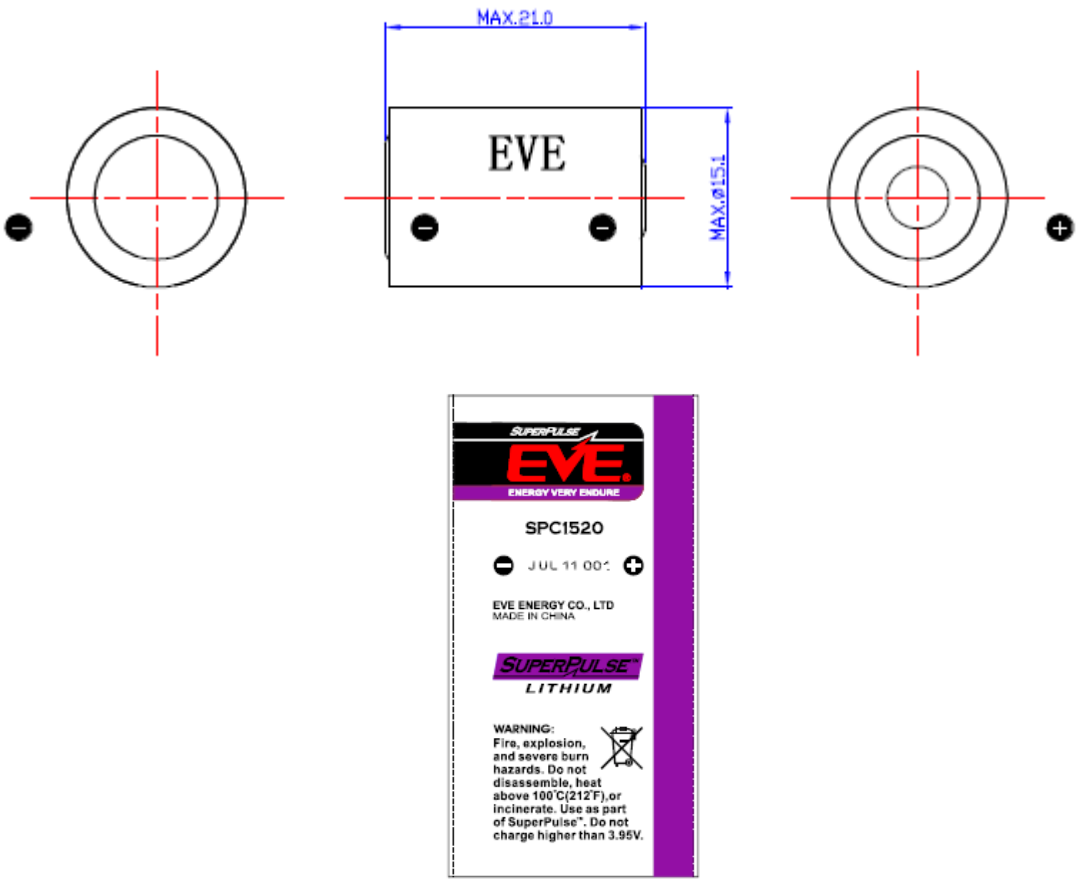
months from the date of issue.

14 Remark of production duty

Customers must strictly operate according to specification and advises of the technical specification. Operation at temperature different from ambient may lead to reduced capacity and lower voltage reading

at the beginning of pulses. The company will be exemption from liability if the lithium-ion super-capacitor are improper used or abused and then cause fire, explosion, the human body or property damage.

15 Drawing (unit of size： mm)



16. Note

Any other items which are not covered in this specification shall be agreed by both parties.