

Hybrid Carbon-based Supercapacitor Cell Specifications

1. Application Scope

This specification applies to hybrid carbon-based Supercapacitor cells produced by Shenzhen Toomen New Energy Co., Ltd. Represented by Altreonic NV, Gemeentestraat 61A B1, 3200 Linden, Belgium

- TMDD1.0/3.2
- TMDD1.3/2.7
- TMMD4.0/4.0

2. Product Type

2.1. Product Type: Hybrid Carbon-based Supercapacitor Cell.

Further referred to as "Supercapacitor cell" or "cell".

2.2. Product Specifications:

- 1.0Ah/2000F/3.2VDC
- 1.3Ah/3300F/2.7VDC
- 4.0Ah/5000F/4.0VDC

3. Basic Parameters

			TMDD1.0/3.2/18500	TMDD1.3/2.7/18650	TMMD4.0/4.0/23680
			1.0Ah/2000F/3.2VDC	1.3Ah/3300F/2.7VDC	4.0Ah/5000F/4.0VDC
	Item	Unit	Value	Value	Value
1	Nominal capacity	Ah	1,00	1,30	4,00
		F	2000	3300	5000
	Tolerance	%	5,00	5,00	5,00
2	Rated Voltage	V	3,20	2,70	4,00
2B	Rated Energy/cell	Wh	3,00	3,00	12,50
2C	Nominal Energy/cell	Wh	3,20	3,51	16,00
3	Charge mode		Constant potential	Constant potential	Constant potential
4	Maximum charging voltage	V	3,40	2,75	4,20
5	Final discharging voltage	V	2,00	1,60	2,50
6	Max. continuous charging current	A	10,00	19,50	4,00
7	Max. continuous discharging current	A	10,00	19,50	4,00
7B	Allowable pulse discharge current (< 200 ms)	A	80	100	10
8	Max. Internal Resistance	mOhm	20	13	20
9	Weight	g	30,00	39,00	60,00

	Weight tolerance	%	1,00	1,00	1,00
10	Diameter	mm	18,0	18,0	23,0
11	Height	mm	50,0	65,0	68,0
	Volume single cell	mm ³	12723	16540	28252
	Volume packed cell	mm ³	16200	21060	16200
12	Transportation Voltage +/- 0,1V	V	3,10	2,40	3,50
13	Storage Voltage +/- 0,1V	V	3,10	2,40	3,50
14	Min. Operation Temperature	°C	-20	-40	-40
	Max. Operation Temperature	°C	70	80	80
15	Min storage Temperature	°C	-5	-5	-5
	Max. Storage Temperature	°C	35	35	35
16	Max. storage humidity	RH %	85	85	85
18	Energy Density	Wh/kg	100	80	200
19	Power density	W/kg	1500	1500	300-500
20	Instantaneous Power Density (200 ms)	W/kg	4000	4000	500
21	Residual energy after discharging @ XX A				
	XX = 15 (15C)	%	--	80	--
	XX = 20 (20C)	%	--	75	
	XX = 18 (15C)	%	80	--	
	XX = 25 (20C)	%	75	--	--
22	Lifetime charge/discharge cycle till 75%		20000	50000	10000
23	Energy holding after 28 days	%	95	95	95
24	Short circuit temperature	°C	150	150	150
25	Guarantee period	months	12	12	12
26	Fire Hazardous substances		The cells do not contain any substances that pose a fire or explosion risk.		

4. Appearance

There must be no serious visual defects (damage, deformation, leakage, etc.) on the outer surface of the Supercapacitor cell, even when it does not affect the normal use of the cell.

5. Technical Requirements

5.1. Test Conditions

Unless specifically requested, the experiments shall be carried out under standard atmospheric conditions.

- Standard Temperature : $25 \pm 3^{\circ}\text{C}$
- Standard Humidity : $65 \pm 20\%$
- Atmospheric Pressure : 86 kPa~106 kPa

5.2. Standard Charge Profile

Under the condition of ambient temperature ($25 \pm 3^{\circ}\text{C}$), charge the Supercapacitor cell with the maximum charging voltage under a 0.5A limited constant current until the charging current is less than or equal to 0.02A, then stop charging.

6. Performance Measurement

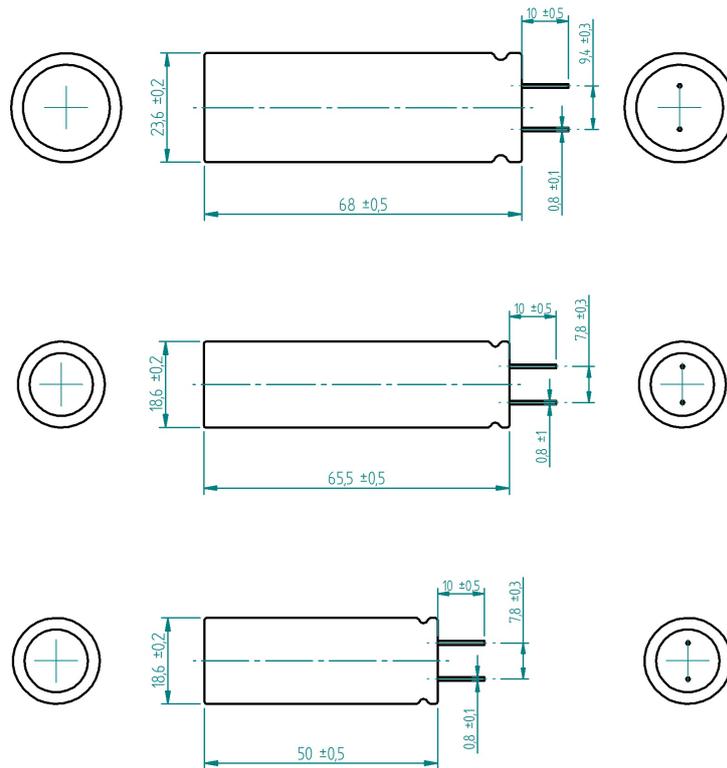
No	Item	Test Method	Required Result
1	Discharge characteristics	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), discharge to the final discharging voltage under the specified current at the ambient temperature of the ($25 \pm 3^{\circ}\text{C}$)	Capacity: $\geq 90\% @ 10\text{C}$ $\geq 75\% @ 20\text{C}$
2	Cycle characteristic	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), hold it for 5 minutes, then discharge to the final discharging voltage under 0.2A at the ambient temperature of the ($25 \pm 3^{\circ}\text{C}$) counting as 1 cycle. If after two consecutive discharge cycles the capacity is lower than 75% of the initial capacity, the cell is considered to be end of life.	No less than 20000 times
3	Energy Holding characteristic	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), keep the cell in storage for 28 days, then measure the discharging capacity of the Supercapacitor cell by discharging it to the final discharging voltage under 0.2A at the ambient temperature of ($25 \pm 3^{\circ}\text{C}$). The recoverable capacity of the Supercapacitor cell is then tested according to the standard charge and discharge condition	Capacity: $\geq 95\%$

7. Safety and Environmental Specifications

No	Item	Test Method	Required Result
1	Short Circuit	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), hold it for 24 hrs, then short circuit the positive and negative electrodes and monitor the temperature variation. When the temperature drops to 10°C below the peak, end the experiment and check the appearance and temperature of the cell under test.	No fire, No explosion. The surface temperature of the cell is less than 150°C .
2	Overcharge	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), keep charging the cell voltage at 10V under 1A, then switch to constant voltage charging until the charging current drop to 5 mA and check the visual appearance.	No fire, No explosion
3	Hammer	The cell is placed on the impact table and a 10kg hammer	No fire,

	Impact	drops freely from a height of 1m impacting the cell under test that has been fixed in the fixture.	No explosion. Deformation is allowed.
4	High Temperature Performance	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), hold it for 2 hrs at the ambient temperature of $(55\pm 2)^{\circ}\text{C}$, then discharge to the final discharging voltage under 0.8A, measure the discharging time; after that hold it for 2 hrs at the ambient temperature of $(25\pm 3)^{\circ}\text{C}$, and check the visual appearance.	No obvious deformation, no burst; Discharging time: $\geq 51\text{min}$
5	Low Temperature Performance	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), hold it for 16~24 hrs at the ambient temperature of $(-20 \pm 2)^{\circ}\text{C}$, then discharge to the final discharging voltage under 0.2A and measure the discharging time. After that hold it for 2 hrs at the ambient temperature of the $(25\pm 3)^{\circ}\text{C}$, and check the visual appearance.	No obvious deformation, no burst. Discharging time: $\geq 180\text{min}$
6	Vibration	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), fix the cell by fixture on the shaking table, adjust the vibration frequency and corresponding amplitude, along X, Y, Z three mutually perpendicular directions under 10 Hz ~ 55 Hz vibration frequency; vibration current I: 60%; vibration time T: 30 minutes.	No fire; No liquid leakage; No obvious damage or explosion
7	Drop	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), it is dropped from 10.0m height onto a 20 mm thick hardwood plate, in each of X, Y and Z directions of the cell.	No fire; No liquid leakage; No rupture or explosion
8	Acupuncture	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), quickly pierce the longitudinal axis of the cell by a steel needle of $\Phi 2.5\text{mm}\sim 5\text{mm}$, and leave the steel needle in the cell for 6hrs.	No fire, No explosion, Leakage and exhaust is allowed.
9	Constant Humidity and Heat	After the Supercapacitor cell is charged according to the standard charge profile (see 5.2), shelve it for 48 hrs in a constant temperature and humidity box with a temperature of $(40 \pm 2)^{\circ}\text{C}$ and relative humidity of (90% ~ 95%), take it out and hold it at the ambient temperature of $(25\pm 3)^{\circ}\text{C}$. Check the visual appearance; then discharge to the final discharging voltage under 1A.	No apparent deformation, no smoke or explosion; Discharging time: $\geq 36\text{min}$

8. Dimensions of the Hybrid carbon based Supercapacitor Cells



9. Guarantee Period

The expiration date of the guarantee period is 12 months from the production data at the factory.

10. Capacitor pin soldering process requirements

Short circuit of the positive and negative electrodes while the cells are in use or during the welding process is to be avoided. The temperature of the soldering station must be set at $300 \sim 320$ °C. The welding time must be less than 3 seconds. Avoid unnecessary movements of the electrode contacts.

11. Disclaimer

11.1. The company shall not be liable for any problems arising from the use of the hybrid carbon-based Supercapacitor cell outside its specifications.

11.2 The company does not assume any responsibility for products beyond the quality guarantee period.

11.3. The company is not responsible for the damage caused by the customer's acceptance tests or during damage caused by any assembly process.

12. Packaging

Carbon-based Supercapacitor cells should be in a 30 to 50% charge state when packaged. The packaged products should be placed in a dry, dust-free and moisture-free box. The batch number, specifications and models, nominal voltage and quantity should be marked on the outside the packing box.

13. Transportation

Carbon-based Supercapacitor cells should be packed in boxes for transportation. During transportation, they should be protected from violent vibrations, shocks or extrusion, sunshine and rain. They can be transported by vehicles, trains, ships and airplanes.

14. Storage

Carbon-based Supercapacitor cells should be stored in clean, dry and ventilated rooms with an ambient temperature as stipulated in item 5.1 and a relative humidity not exceeding 75%. Contact with corrosive substances is to be avoided and cells have to be kept away from fire and heat sources. In addition, the Supercapacitor cell must be stored in a half charge state to prevent over-discharge caused by self-discharge and potentially resulting in irreversible capacity loss.

15. Safety points of attention.

15.1. Never reverse the polarity when charging.

15.2. Never cause a direct short circuit between the positive and negative electrodes of the Supercapacitor cell.

15.3. When a Supercapacitor cell is not used or stored for a long time, charge the Supercapacitor cell before use.

15.4. Before testing or using the Supercapacitor cell, please read this specification carefully to prevent improper operation of the Supercapacitor cell resulting in failure, loss of function, heating, leakage, fire or even explosion.

15.5. When charging and discharging the Supercapacitor cell, only use adequate testing equipment. In particular, it is strictly forbidden to use standard constant-current constant-voltage sources and other equipment that cannot limit the voltage and current when charging and discharging the Supercapacitor cell, to avoid overcharging and over discharging of the Supercapacitor cell that can cause malfunction, failure or can result in a safety hazard.

15.6. When charging and discharging the cell or assembling it into the equipment, be careful not to reverse the positive and negative electrodes of the cell, otherwise the cell will instantaneously overcharge and over discharge, leading to serious failure of the cell.

15.7. Do not directly weld onto the cell body, do not dissect the cell.

15.8. Do not put cell in a pocket or bag with necklaces, hairpins, coins, screws or other metal objects. Do not store cells with any of the above items. Do not use metal or other conductive materials to directly connect the positive and negative electrodes of cell, resulting in a short circuit of cell. If needed, use an insulator to prevent accidental contact with the cell electrodes.

15.9. Do not knock, throw or step on a cell, nor put the cell into washing machine or high pressure equipment.

15.10. Do not place the Supercapacitor cell close to a heat source, such as a fire, heater, etc. Do not use or store the Supercapacitor cell in the hot sun or under the condition of ambient temperature exceeding 60°C. Otherwise, it may cause the Supercapacitor cell to heat, fire and malfunction.

15.11. Do not put the Supercapacitor cell into water or humid environment. When not in use for the time being, please put it in a low temperature and dry environment.

15.12. When it is observed that cell during use, testing when in storage, are hot, give off a smell, are discoloured, are deformed or look out of the ordinary, then the cell should be isolated immediately, disconnected if needed and if possible removed to a safe area.

15.13 If the electrolyte of a cell leaks and accidentally splashes into the eyes, do not rub the eyes, and immediately wash with clean water. If needed, go to a medical facility. When skin or clothing is contaminated with electrolyte, immediately wash away with clean water.

16. Contact point

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17. Manufacturer

Shenzhen Toomen New Energy Co., Ltd