Supercapacitors

—— Electric Double Layer Capacitors (EDLC)

—— Lithium-ion Capacitors (LIC)

PART NUMBER SYSTEM

Part Number System for EDLC and LIC (Radial Type)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SC		C	D	P	R	2	R	7	1	0	5	S	R	H	0	8	0	0	1	2	E	*	*
Capacitor Type Code			supercapacito Type	Series Code		Rated Voltage Code (V)			Capacitance Code (F)			Capacitance Tolerance Code (%)	Lead Form Code		Dimension Code						Sleeve Code		Customer Special Requirement	

SC= Super capacitor	C	Cell	D	EDLC	SCV	VC	2.7	2R7	0.5	504	+80 -20	Z	VC	8×14	080014	E	PET						
	M	Module	H	Hybrid	SVQ	VQ	3	3R0	1	105	+10 -10	K	VH	8×20	080020	V	PVC						
					SVT	VT	3.8	3R8	2	205	+30 -10	Q	VV	8×25	080025								
					SRP	PR	5.5	5R5	3	305	+20 -20	M	RH	10×20	100020								
					SRE	ER			3.3	335	+20 -10	V	RL	10×25	100025								
					SSP	PS			5	505	+5 -5	B	RX	11.5×4.5	115004								
					SSE	ES			7	705	+20 0	R	RY	13.5*7	135007								
					HBR	BR			10	106			RZ	12.5×6.5	125006								
					HBRL	BL			15	156			SA	12.5×25	125025								
									20	206			SB	12.5×30	125030								
									25	256			SC	16×25	160025								
									50	506			SD	16×30	160030								
									70	706			SL	18×40	180040								
									100	107			SV	18×50	180050								
									120	127				19×4.5	190004								
									150	157				20.5×7.5	205007								
									200	207				22×45	220045								
									220	227				25×50	250050								
									350	357				35×50	350050								
									400	407				35×60	350060								
									470	477				8.5×17×17	081717								
														8.5×17×23	081723								
														11×21×23	112123								
														11×21×27	112127								
														13×26×27	132627								

Large LIC Cell and Supercapacitor Module

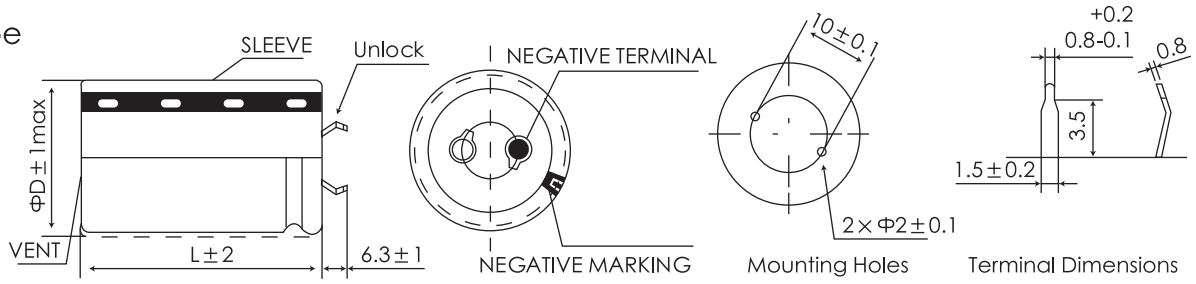
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SC	C		D	A	A	2	R	7	1	0	5	S	*	*
Capacitor Type Code			Supercapacitor Type	Series Code		Rated Voltage Code (F)			Capacitance Code (F)			Capacitance Tolerance Code (%)	Internal code	

SC= Super Capacitor	C	Cell	D	EDLC	HAA	AA	3.8	3R8	9.6	965	+10/-10	K		
	D	Module	H	Hybrid	HCC	CC	4	4R0	11.1	116	+30/-10	Q		
					SRM	MR	32	032	13	136	+20/-20	M		
					SSM	PS	48	048	19.4	196	+20/-10	V		
					HMAA	AA	64	064	21.7	216	+5/-5	B		
							80	080	1000	108	+20/0	R		
							90	090	2000	208				
							136	136	3000	308				
									3400	348				
									5000	508				
									6000	608				
									10000	109				
									16000	169				

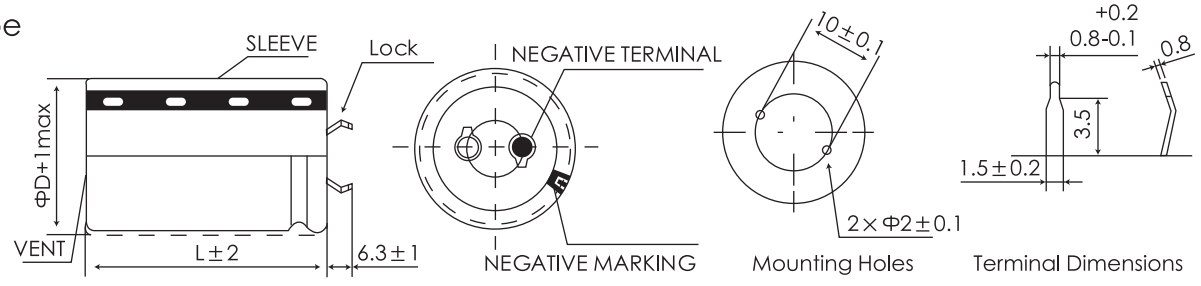
Lug/Snap-in Terminal Code

Unit:mm

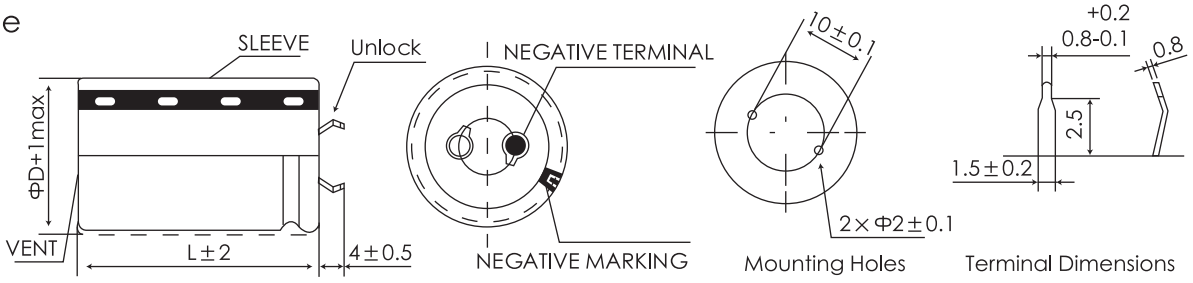
SA-Type



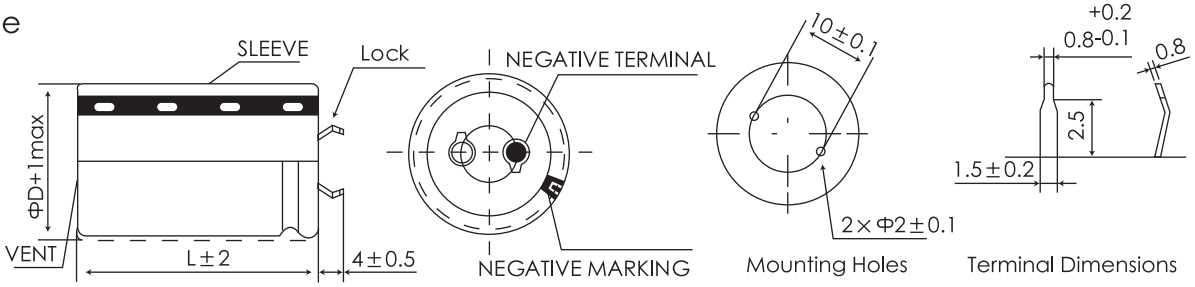
SB-Type



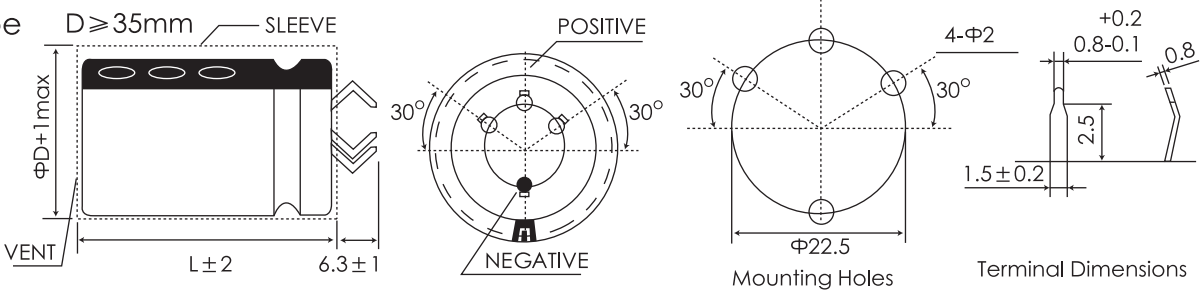
SC-Type



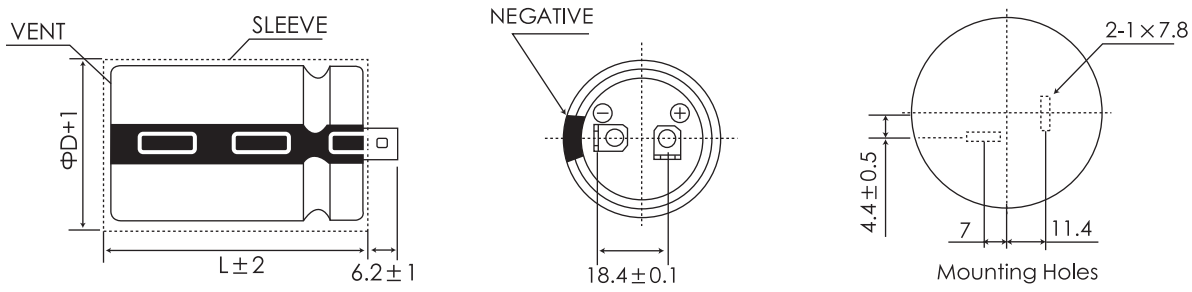
SD-Type



SV-Type



SL-Type



■ TECHNICAL NOTES of EDLC

1. General Description of Electric Double Layer Capacitors

1-1. Operating Principle

By externally applying a voltage below a certain voltage to the boundary, higher charges can be accumulated. Charge and discharge of capacitor utilize adsorption and desorption of ions to the ionic adsorption layer (electric double layer) formed on the electrode surface of the activated carbon used for electrodes. The capacitors have electric charges oriented at the very short distance on boundary of electrolyte and electrodes what is called the "electric double layer capacitor."

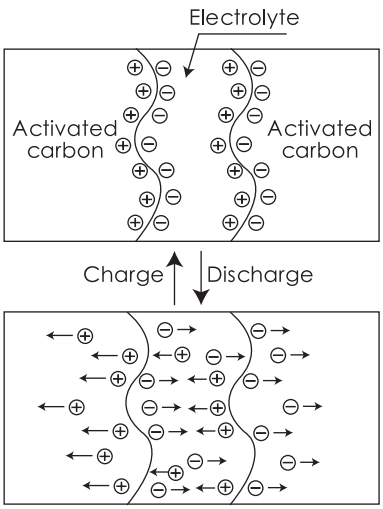


Fig. 1

1-2. Advantages and Disadvantages of Electric Double Layer Capacitor

EDLC differs from rechargeable batteries, not causing chemical reaction, with surface of activated carbon with energy accumulation by ionic physical attachment only, therefore it holds the characteristics stated below:

■Advantages

(1) Small size and capacitance in farads (F) available by utilizing the activated carbon electrode with a large surface area

(2) With low degradation, million cycles of charge-discharge and long life is possible

(3) With a high power density, rapid (high current) charge-discharge is possible

(4) Ease of maintenance

(5) Environment-friendly without using heavy metal for its structure material

■Disadvantages

(1) Low energy density

(2) Series connection is required when used with a low resistance of voltage at a high voltage

(3) Cannot be used in AC circuits

1、双电层电容器的基本概要

1-1、工作原理

在额定电压范围内，通过外部施加电压使得电荷在界面积聚。电容的充放电通过在活性炭电极表面形成的离子吸附界面（双电层）处离子的吸附和脱附来实现。利用电解液和电极的界面之间相隔的距离极其短，电荷在界面处集中排列从而形成物理储电的电容，称为“双电层电容”。

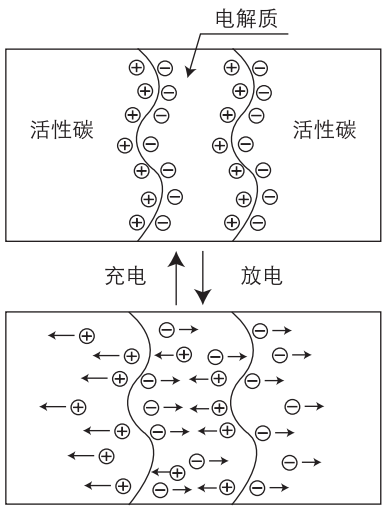


图. 1

1-2、EDLC的特点

EDLC不同于二次电池，不发生化学反应，利用活性炭表面离子的物理吸附实现储能，因此具有以下特征：

■优势：

（1）利用活性炭的比表面获得小体积和大容量

（2）EDLC劣化缓慢，具有长寿命和上百万次的循环寿命

（3）具有高输出功率特性，实现快速充放电

（4）易于维护

（5）构成材料中没有使用重金属元素，环境友好

■劣势：

（1）低能量密度

（2）由于单体电压低，在高电压使用时需要多只串联。

（3）不能使用在AC电路中。

2. Description of life expectancy

Generally, the life of Electric Double Layer Capacitors is largely affected by the ambient temperature. The expected life is approximated by the equation as shown below:

$$L = L_0 \times 2^{(\frac{T_0 - T}{10})}$$

Where:

L : Expected lifetime at temperature T

L_0 : Lifetime at temperature T0

T : Expected working temperature

T_0 : Upper category temperature

Note that the above equation does not cover charge and discharge. In the case of charge and discharge, heat generation occurs inside a capacitor; the temperature rise by this heat generation must also be considered

3. Handling Precautions and Guidelines

For safety application, please contact company directly for any technical specifications, handling precautions and guidelines critical to application.

3-1. Precautions

(1) Prohibition of disassembly

The disassembling may generate internal short circuit in the cell, which may cause gassing, leakage, explosion, or other problems. Electrolyte is harmful: In case the electrolyte comes into contact with the skin, or eyes, physicians shall flush the electrolyte immediately with fresh water and medical advice is to be sought.

(2) Prohibition of dumping of cells into fire

These may cause explosion of the cells, which is very dangerous and is prohibited.

(3) Prohibition of cells immersion into liquid.

The cells shall never be soaked with liquids such as water, seawater, drinks such as juices, coffee or others.

(4) Prohibition of use of damaged cells.

The cells might be damaged during shipping by shock. If any abnormal features of the cells are found such as damages in the cell package, smelling of an electrolyte, an electrolyte leakage and others, the cells shall never be used any more. The Cells with a smell of the electrolyte or a leakage shall be placed away from fire to avoid firing or explosion.

2、寿命估算

一般来说,环境温度对EDLC的寿命影响很大。其理论估算寿命的计算公式参照如下:

$$L = L_0 \times 2^{(\frac{T_0 - T}{10})}$$

其中:

L：T温度下理论寿命

L_0：最高额定工作温度的工作寿命

T：实际工作温度

T_0：最高额定工作温度

以上公式未考虑电容的充放电的情况。电容充放电产生会在电容内部热产生热量，这就需要考虑电容内部的温升。

3、使用注意事项和使用手册

为了确保安全，当设计的设备需使用电容时，请与公司联系咨询电容的技术规格以及使用要求。

3-1、注意事项

（1）禁止拆卸

拆卸电容器可能产生内部短路，导致产气，电解液泄漏。电解液有害，如果电解液接触皮肤或者眼睛，应该立即用清水冲洗并且寻求医生的治疗。

（2）禁止将电容器投入火中

将电容器投入火中可能导致爆炸，这种行为是非常危险，是被禁止的。

（3）禁止将电容器浸没于液体中

电容器不允许被浸泡在液体中，例如水，盐水，饮料例如果汁，咖啡或者其它。

（4）禁止使用已经损坏的电容器

如果使用前发现电容的外包装破裂，闻到电解液的气味，电解液泄漏或者其它非正常情况，请勿继续使用。

3-2. Handling Guidelines

(1) It is not suitable that cell is used under such conditions: AC circuit and wave filtering.

(2) Voltage

Work voltage of cell should not exceed Max. work voltage of cell during using. Otherwise, will shorten shelf life, even cause swelling, leakage or crack.

(3) Polarity

Please check the polarity before using. If working under reverse polarity, cell will not only shorten shelf life, but also heavy damage, such as swelling, electrolyte leakage etc.

(4) Environment

Work temperature will have an influence on life of cell. As usual, higher work temperature will shorten life. So, it is better that cell works under as possible as low environmental temperature.

Work temperature of cell should consider internal environmental temperature in the unit and temperature rise when cell works.

(5) IR drop

When main power sources shut down, cell will change into work mode from failure mode, at the same time, OCV will decrease due to IR drop. So please choose proper product type according to impedance specified in product datasheet and applied current.

(6) Cells in series connection

When cells in series connection for higher work voltage, it should be assured that work voltage of any single cell must not exceed Max. work voltage of single cell, otherwise, will shorten shelf life, even cause swelling, leakage or crack.

(7) Soldering

Heat shock will decrease electric performance of cell, even cause swelling, leakage or crack.

Manual soldering temperature should not exceed 350℃, soldering time should not exceed 4s. Wave soldering temperature should not exceed 260℃, soldering time should not exceed 5s, while preheating temperature should be limited to less than 100℃ and maximum preheating time of 60 seconds for PC boards 0.8mm or thicker.

Unless the EDLC is specifically rated to withstand reflow soldering temperature, please don't use reflow soldering , infrared heating and air heating methods on the EDLC.

3-2、使用指导

（1）不可用于以下场合：不能用于交流线路中；不能用于滤波。

（2）电压

使用过程中，电容器的工作电压不能超过其最大工作电压。否则，将缩短其使用寿命，甚至导致气胀，泄露，或者开裂。

（3）极性

使用前一定要检查电容器的极性，电容长时间在相反的极性下工作，不仅会缩短其使用寿命，而且可能导致严重的损毁，例如导致气胀，电解液泄漏等。

（4）环境

电容的寿命会受到工作温度的影响，一般而言，电容的工作环境温度越高，其寿命越短。因此，应使电容的工作温度在最大容许温度下尽可能地降低。

工作温度应该同时考虑工作环境温度以及工作时电容内部产生的温升。

（5）IR压降

在主电源关闭时，电容将从电源失效检验模式转为后备电源工作模式，此时由于瞬间启动电流及电容内阻将导致开路电压下降。请根据相关产品介绍中所列出的阻抗和使用电流确定正确的产品型号。

（6）电容串联

当多个单体电容串联使用以提高工作电压时，必须确保每只单体电容两端的电压不超过其最大工作电压，否则，将缩短其使用寿命，甚至导致气胀，泄露，或者开裂。

（7）焊接

热冲击会影响电容的电性能，甚至会导致电容的鼓气、漏液以及开裂。

手工焊的温度建议低于350℃，焊接持续时间少于4s。波峰焊的温度建议低于260℃，焊接持续时间少于5s，其中预热温度应低于100℃，最多给PCB预热60s，浸锡达0.8mm或更厚。

除非EDLC有明确的额定耐回流焊接温度，否则不应对EDLC使用回流焊，而应使用红外线或空气加热方式。

TECHNICAL NOTES OF LIC

1. Operating Principle

As a new system in the super capacitor field, the lithium-ion capacitor is based on the adoption of the new & advanced material technology, and uses the hybrid electrode material according to the design to realize the combination of principle & technology of the lithium-ion battery and super capacitor in one electrolytic cell by electrochemical calculation. In this way, the features of high specific power, long lifetime and fast charging of the super capacitor can be well maintained, and meanwhile the specific energy will be greatly enhanced with the performance blank between the double layer capacitor and lithium-ion battery effectively filled up, showing excellent application prospect.Lithium Ion Capacitors are hybrid capacitors that use a carbon-based material as the negative electrode. Just as in a conventional EDLC, they use activated carbon for the positive electrode.

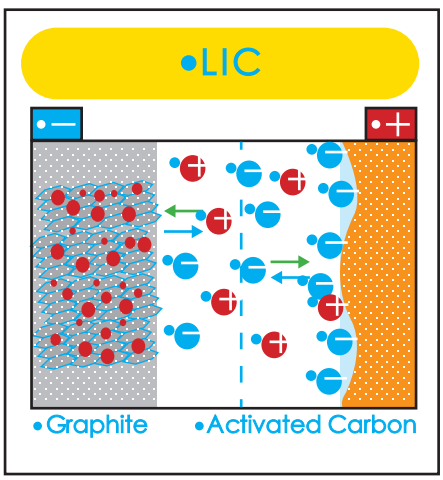


Fig. 1

2. Features

(1)High working voltage:3.8V
(2)High energy density: 10~20Wh/Kg
(3)Fast charge/discharge at high current
(4)Low self discharge:≤5%/3 months
(5)Long life:≥100,000 charge/discharge cycles
(6)Wide operation temperature range: -25~55℃（Soft pack）/70℃（Al can）
(7)High safety/reliability

3. Application

(1) Electric Vehicle

The lithium-ion capacitor is of tremendous market values in the area of hybrid power cars & coaches and pure electric buses. Some well-known car manufacturers have already conducted systematic testing and evaluation on the lithium-ion capacitor products. The conclusion they have drawn shows that to compare with the present batteries in use, the lithium-ion capacitor possesses significant performance advantages, and will have a bright future in the follow-up development of hybrid power cars and take up an important market share.

1、工作原理

锂离子电容器作为超级电容器领域中的一种新体系，以采用新型先进材料技术为基础，通过电化学计算，按照设计使用混合电极材料，在一个电解池中实现了锂离子电池和双电层电容器的原理和技术的结合，使其在保持双电层电容器高比功率、长寿命和快速充电特性的同时，大幅度提高了比能量，有效的填补了双电层超级电容器和锂离子电池之间的性能空白，表现出了良好的应用前景。锂离子电容器是一种混合型电容器，其使用碳基材料为负极，而正极与普通的双电层电容器一样，使用活性炭材料。

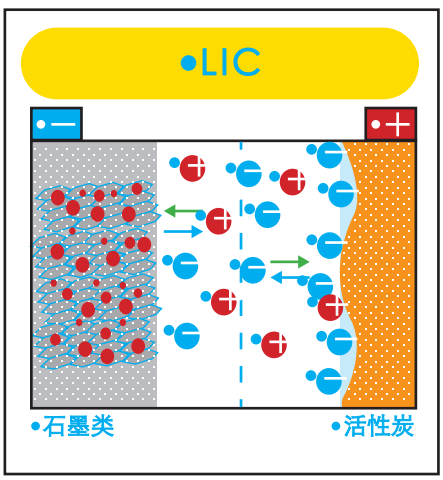


图. 1

2、特点

（1）高工作电压：3.8V
（2）高能量密度：10~20Wh/Kg
（3）大电流快速充放电：3~6min
（4）低自放电：≤5%/3个月
（5）长寿命：≥10万次充放电循环
（6）宽工作温度范围：-25~55℃（软包）/70℃（铝壳）
（7）高安全性与高可靠性

3、应用

（1）电动汽车

锂离子电容器在混合动力轿车和大客车，以及纯电动公交车等电动汽车领域中具有巨大的市场价值。众多知名汽车公司都对锂离子电容器产品进行了系统的检测和评估，认为与目前使用的电池相比，锂离子电容器具有显著的性能优势，非常看好锂离子电容器在混合动力轿车后续开发中的应用前景，未来将占据重要的市场份额。

(2) Rail Transit

Off-line operation is one of the technical development directions of the modern tram, and enterprises both at home and abroad highly value this point. Under the premise of keeping the reasonable weight and cost, the adoption of the lithium-ion capacitors can satisfy the off-line operation requirement for the whole journey after a fast charging at the terminal station. Thus a great amount of infrastructure expenditure can be saved, and the remarkable cost/performance advantage demonstrated.

(3) Hybrid power driven engineering machinery and harbor machinery

The engineering machinery and harbor machinery have the common problem of low engine energy efficiency, and are unable to recover the regenerated energy. The hybrid power driven engineering machinery and harbor machinery using the lithium-ion capacitors take the full advantage of the characteristics of the lithium-ion capacitor, and are of very high energy-saving rate and excellent cost performance.

(4) Energy-saving elevator

The adoption of the Li-ion capacitors can recycle the stored potential energy into electricity to be firstly used in the next operation cycle. Thus, the energy-saving is realized. Meanwhile, it can also be used as an emergency back-up power supply of the elevator to greatly improve its safety performance.

(5) Golf Cart and AGV

The golf cart and AGV using the lithium-ion capacitors make the power supply smaller in size, light in weight, lower in cost, longer in lifetime and easy to use. It is a brand new application model worthy to be developed.

(6) Electric Tools

The fast charging electric tools need the combination of high power and energy, long lifetime, excellent safety performance and consistency. The adoption of the lithium-ion capacitor will further improve the performance of the fast charging electric tools, and prolong the lifetime and reduce the cost. It is of a very broad market prospect.

(7) DC Circuit and Smart Meters

Compared with EDLC, the lithium-ion capacitor can offer much higher capacitance. Therefore, it will have a very bright future, and be widely used in electric appliances such as smart meter, mobile DVR, tachograph, hand-held GPRS equipment, and ETC etc.

4. Handling Precautions and Guidelines

For safety application, please contact company directly for any technical specifications, handling precautions and guidelines critical to application.

4.1 Precautions

(1) Prohibition of disassembly

The disassembling may generate internal short circuit in the cell, which may cause gassing, leakage, explosion, or other problems. Electrolyte is harmful: In case the electrolyte comes into contact with the skin, or eyes, physicians shall flush the electrolyte immediately with fresh water and medical advice is to be sought.

(2) Prohibition of dumping of cells into fire

These may cause explosion of the cells, which is very dangerous and is prohibited.

(3) Prohibition of cells immersion into liquid.

The cells shall never be soaked with liquids such as water, seawater, drinks such as juices, coffee or others.

(4) Prohibition of use of damaged cells.

The cells might be damaged during shipping by shock. If any abnormal features of the cells are found such as damages in the cell package, smelling of an electrolyte, an electrolyte leakage and others, the cells shall never be used any more. The Cells with a smell of the electrolyte or a leakage shall be placed away from fire to avoid firing or explosion.

（2）轨道交通

脱线运行是现代有轨电车的技术发展方向之一，国内外企业对此均予以高度重视。应用锂离子电容器作为电源，在保持合理重量和成本的前提下，在终点站一次快速充电即可满足全程脱线运营的要求，节约了大量的基建费用，具有显著的成本和性能优势。

（3）混合动力工程机械及港口机械

工程机械和港口机械普遍出现发动机能量效率低下，具备能量回收的条件。混合动力工程机械及港口机械充分利用了锂离子电容器的特性，具有优秀的节能效率和高性价比。

（4）节能电梯

使用锂离子电容器，回收储存势能所转化的电能，下一工作循环时优先使用，实现节能；同时用作为电梯应急后备电源，能够大幅度提高电梯使用的安全性。

（5）高乐夫球车及AGV

高尔夫球车和AGV使用锂离子电容器，电源体积、重量和成本更低，寿命更长，使用更方便，能够开拓崭新的应用模式。

（6）电动工具

快充式电动工具需要电源兼顾高功率和高能量、长寿命、高安全性和高一致性等，使用超级电容器能进一步提高快充式电动工具使用性能、延长寿命、降低成本，具有非常广阔的市场前景。

（7）直流电路和智能仪表

相比双电层电容器，锂离子电容器能提供更高的容量。因此，它具有更广阔的应用前景，如智能仪表、车载DVR，行驶记录仪、手持GPRS设备、ETC等电器。

4、使用注意事项和使用指导

为了确保安全，当设计的设备需使用电容时，请与公司联系咨询电容的技术规格以及使用要求。

4-1、注意事项

（1）禁止拆卸

拆卸电容器可能产生内部短路，导致产气，电解液泄漏。电解液有害，如果电解液接触皮肤或者眼睛，应该立即用清水冲洗并且寻求医生的治疗。

（2）禁止将电容器投入火中

将电容器投入火中可能导致爆炸，这种行为是非常危险，是被禁止的。

（3）禁止将电容器浸没于液体中

电容器不允许被浸泡在液体中，例如水，盐水，饮料例如果汁，咖啡或者其它。

（4）禁止使用已经损坏的电容器

如果使用前发现电容的外包装破裂，闻到电解液的气味，电解液泄漏或者其它非正常情况，请勿继续使用。