

SAMXON[®]
Aluminum Electrolytic Capacitors

X-CON[®]
Conductive Polymer
Aluminum Solid Capacitors

XLPC[®]
Aluminum Multilayer Polymer Capacitors

ANGA POW[®]

THE BATTERY-FREE REVOLUTION

LCC LITHIUM CARBON CAPACITOR

*ADVANCEMENTS IN ENERGY
STORAGE AND POWER SOLUTIONS*



MAN YUE TECH
萬 裕 科 技

Any Battery-Free Solutions?

LCC
is the answer!



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What is LCC - Lithium Carbon Capacitor?

LCC is a type of asymmetric super capacitor. Its negative electrode uses activated carbon same as EDLC. Its positive electrode uses activated carbon and metallic element.

Achieving the **highest energy-density among all kind of capacitors**, LCC combines perfectly the advantages of a battery (high energy density and high voltage) and a capacitor (quick charge/discharge, wide operating-temperature range, high power density, long lifetime, low self-discharge, safe & eco friendly).

What is LCC - Lithium Carbon Capacitor?

What is LCC

- Asymmetric supercapacitor
- Combines features of a battery and capacitor
- Offers superior energy-density

LCC Electrodes

- Negative electrode: Activated carbon (similar to EDLC)
- Positive electrode: Activated carbon and metallic element

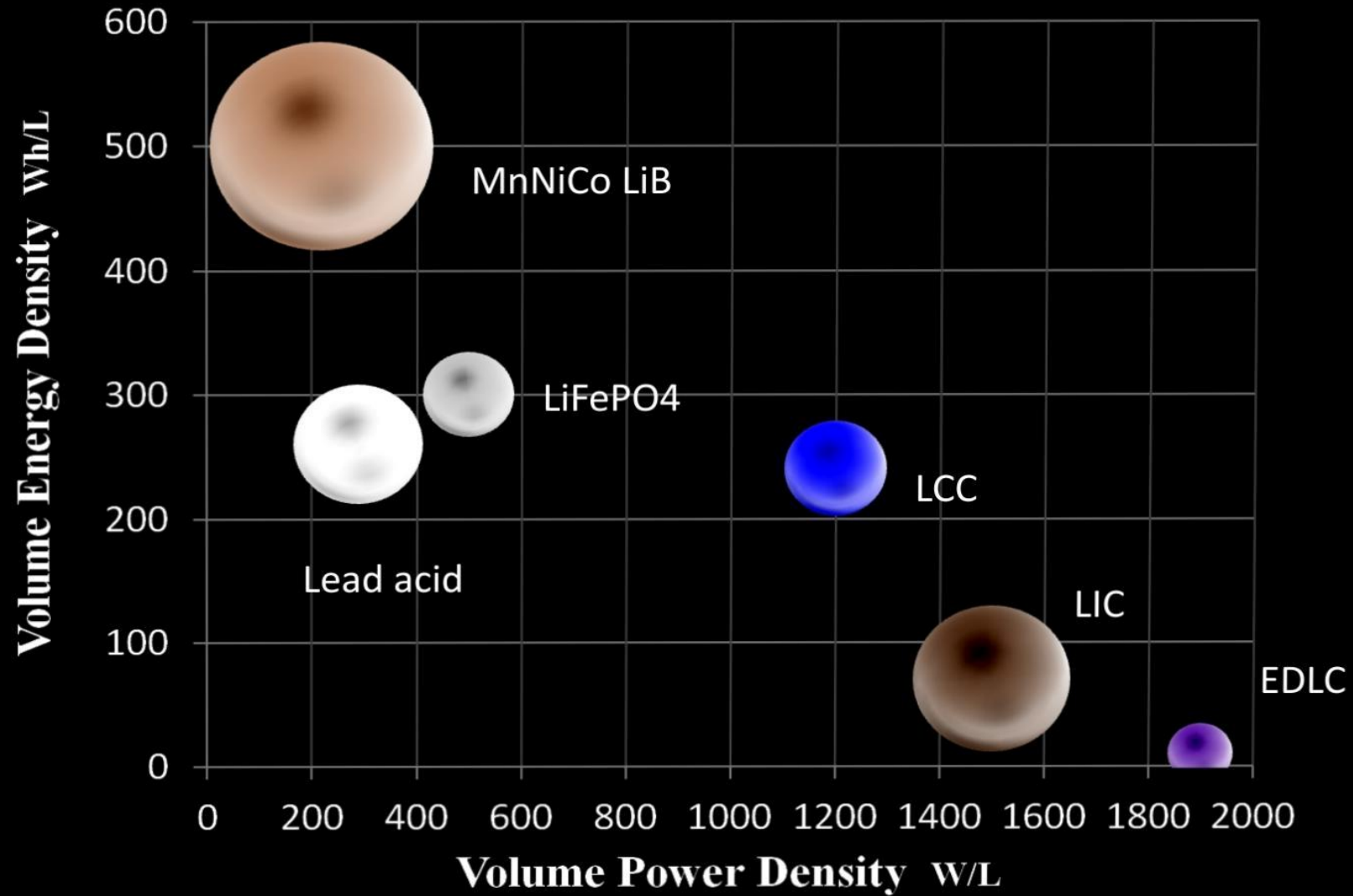
LCC Advantages

- Combines the advantages of a battery and a capacitor
- High energy density
- High voltage
- Quick charge/discharge
- Wide operating-temperature range
- High power density
- Long lifetime
- Low self-discharge
- Safe & eco-friendly

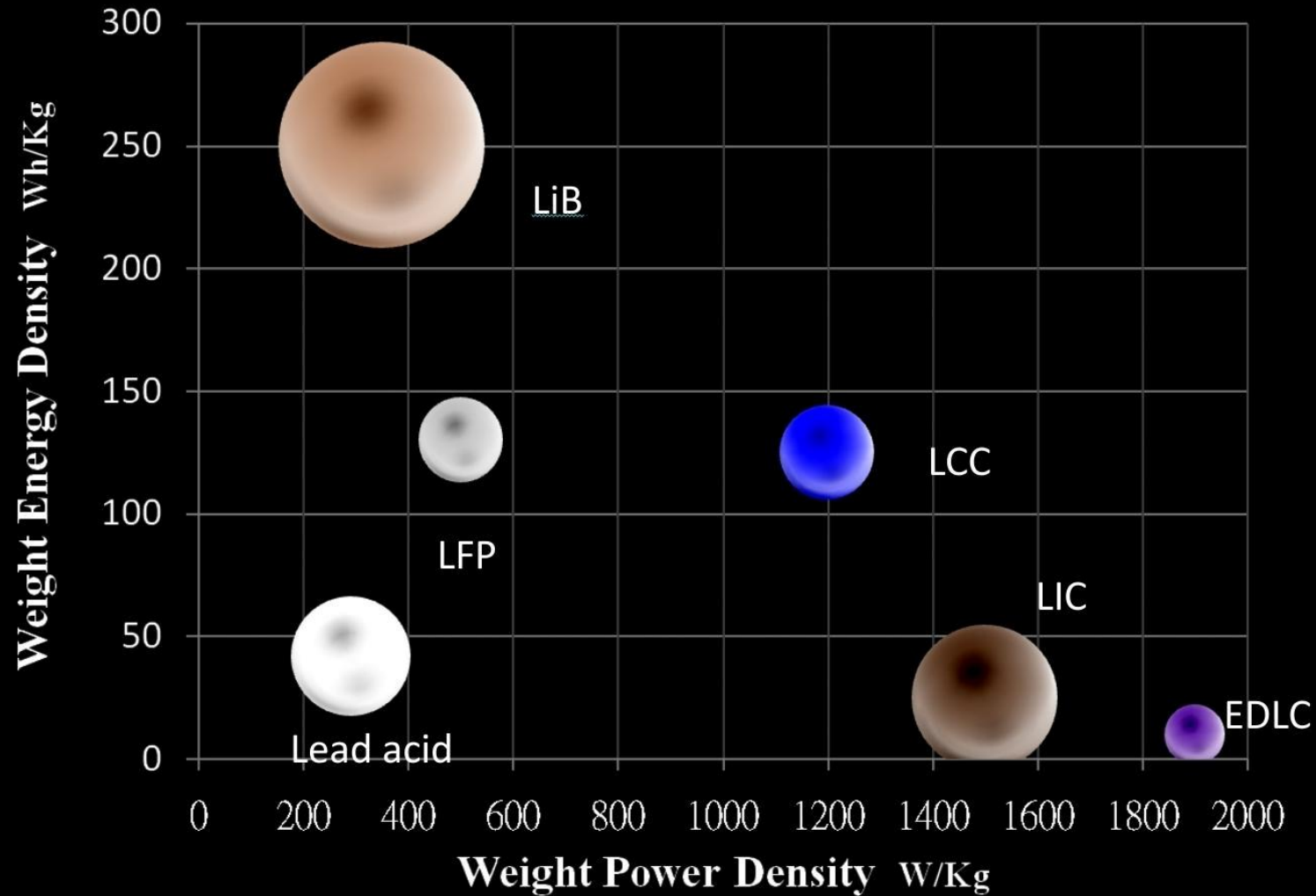
Performance Comparison

Item	Batteries			Capacitors		
	LIB MnNiCo	LFP LiFePO4	Lead Acid	LCC	LIC	EDLC
Energy Density (Wh/kg)	200-250	120-150	40	80-120	25	5
Safety	Extremely Low	Low	Commonly	High	High	Extremely High
Life Cycle	500	3,000-4,000	500	50,000	500,000	1,000,000
Voltage Range	3.0-4.2V	3.0-4.2V	1.7-2.1V	2.5-4.2V	2.2-3.8V	0-2.7V
Charging Current	1C	1C	0.2C	20-30C	50-100C	100-200C
Discharge Current	1C	1-2C	1C	20-30C	50-100C	100-200C
Peak Current	2C	5C	5-8C	50C	100C	500C
Charging Temperature	+5-+45°C	+5-+45°C	+5-+45°C	-40-+70°C	-30-+70°C	-40-+70°C
Operating Temperature	-20-+60°C	-20-+60°C	-20-+60°C	-40-+70°C	-30-+70°C	-40-+70°C

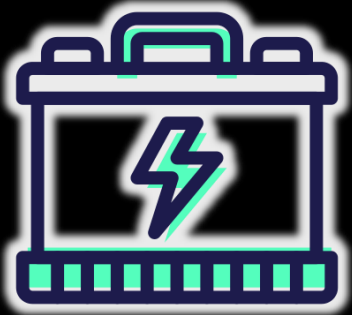
Comparison LCC with other batteries and capacitors



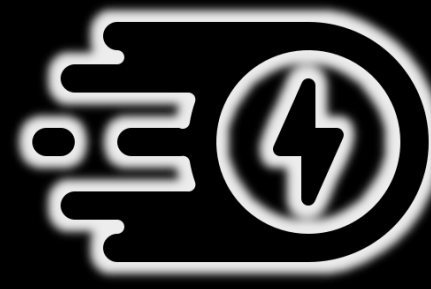
Comparison LCC with other batteries and capacitors



Excellent Performance of LCC



Excellent Energy Storage Device



Quick Charge

50 times quicker than Li-ion Battery & *250 times quicker* than Lead Acid Battery



High Standard of Safety

Non-Flammable and *no explosion* during puncture & short-circuit



Long Lifespan

Can be fully charged & discharged for *50,000 times*.
Used over 10 years possible

Excellent Performance of LCC



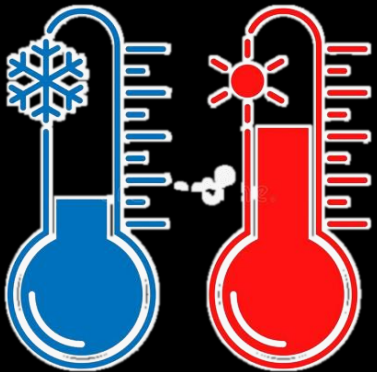
High Torque & High Power Output

Guarantee **powerful acceleration** & uphill performance



Low Cost

Insignificant degradation
Low maintenance Cost
Low total cost



Wide Operating Temp Range

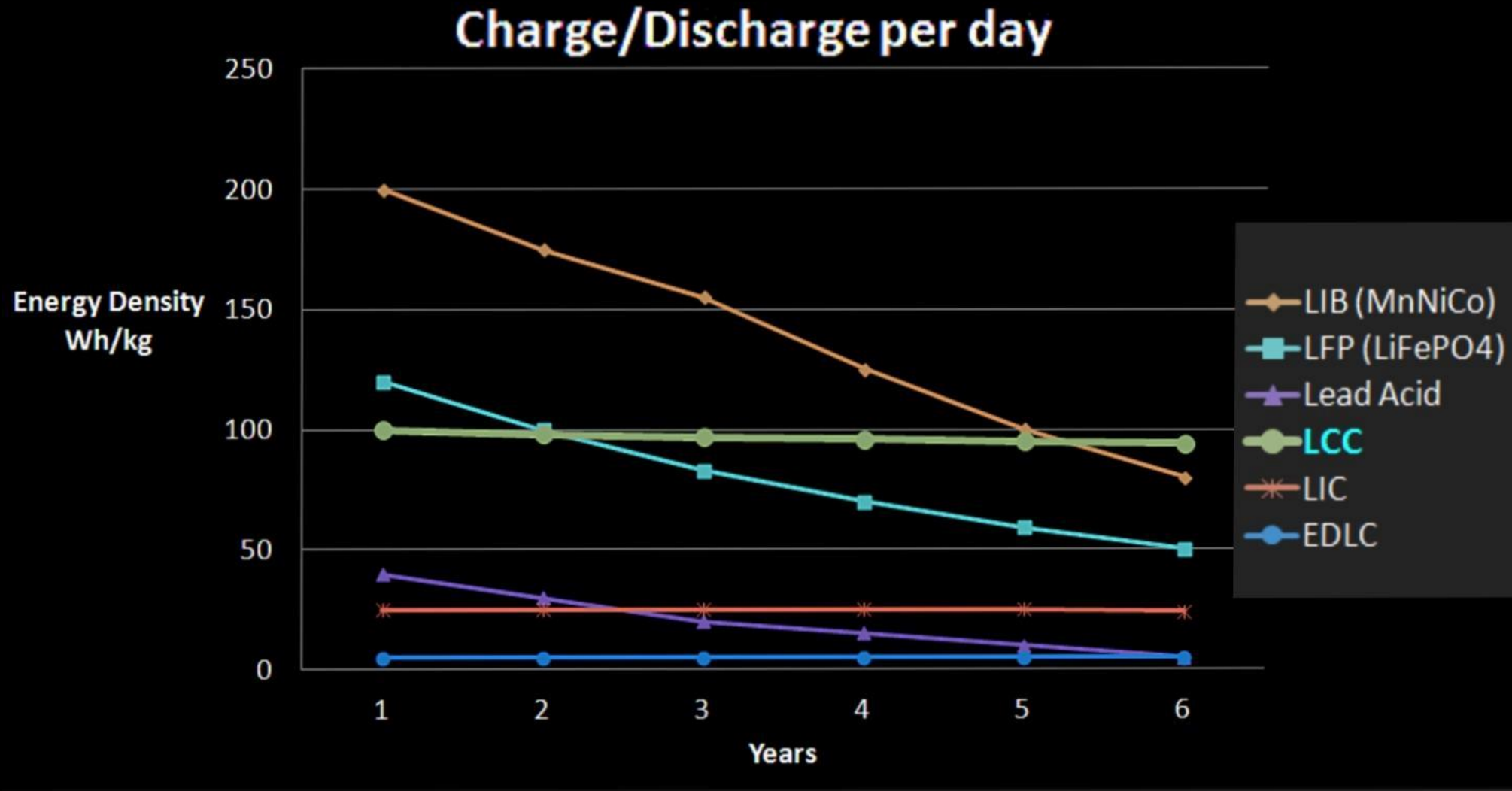
Normal operation under very **Low/high temp.** (-40~+70°C)



Green Energy

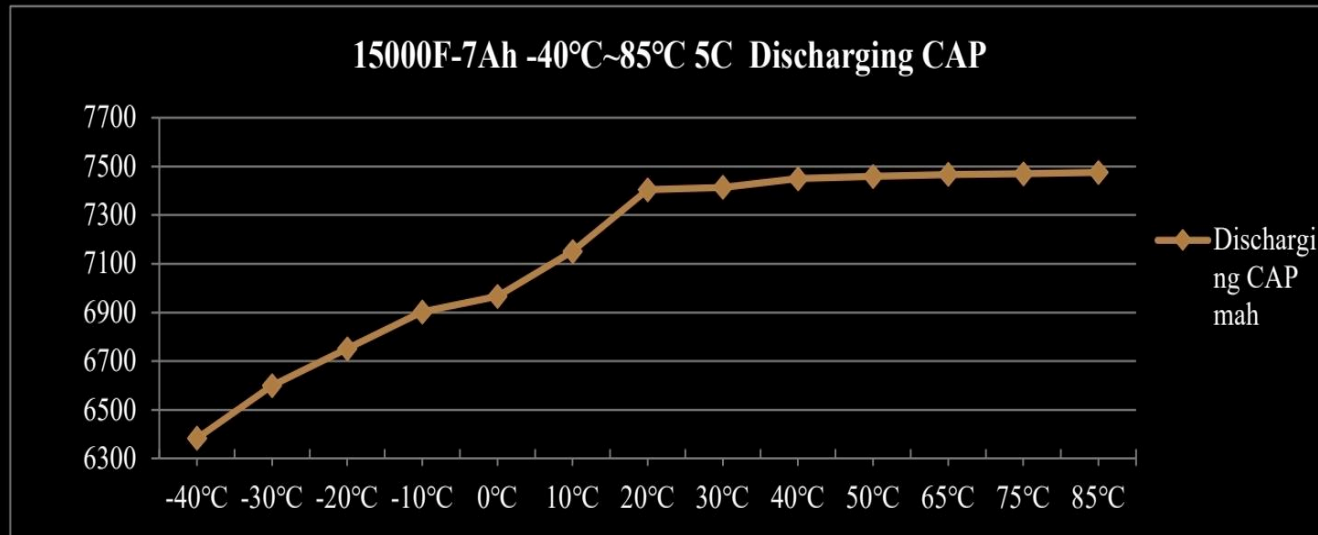
No toxic heavy metals
e.g. Pb, Cd, Hg
RoHS Compliant

Degradation of Different Types of Battery vs LCC



15000F-7Ah Different Temperature Test Report

Test purpose	Test the discharging characteristics in high & low temperatures														
Test No.	ZHD	Spec	15000F-7Ah	Size	130*65*13	Test date	2024.2.26	Test instruments	Capacitance tester, high & low temperature test box						
Batch #	/	Temperature	-40~85°C	test voltage	4.2V	Test item	characteristics test at high & low temperatures	Test ratio, current	5C 35A						
Method	First, test the discharge capacitance of the product at room temperature, and then let it stand for 12 hours at the set temperature before testing the discharge capacitance of the product (test conditions: charging 4.2V, constant voltage for 30 minutes, discharging 2.5V, charging and discharging current 35A)														
temp		Initial CAP	-40°C CAP	-30°C CAP	-20°C CAP	-10°C CAP	-0°C CAP	10°C CAP	20°C CAP	30°C CAP	40°C CAP	50°C CAP	65°C CAP	75°C CAP	85°C CAP
ZHD-450	Discharging CAP(F)	7405.3	6383.2	6600.2	6750.7	6902.7	6966.6	7150.9	7405.3	7414.8	7450.5	7459.4	7468.1	7471.2	7475.5
	Discharging efficiency	100%	86.20%	89.10%	91.20%	93.20%	94.10%	96.60%	100%	100.10%	100.60%	100.70%	100.80%	100.89%	100.95%



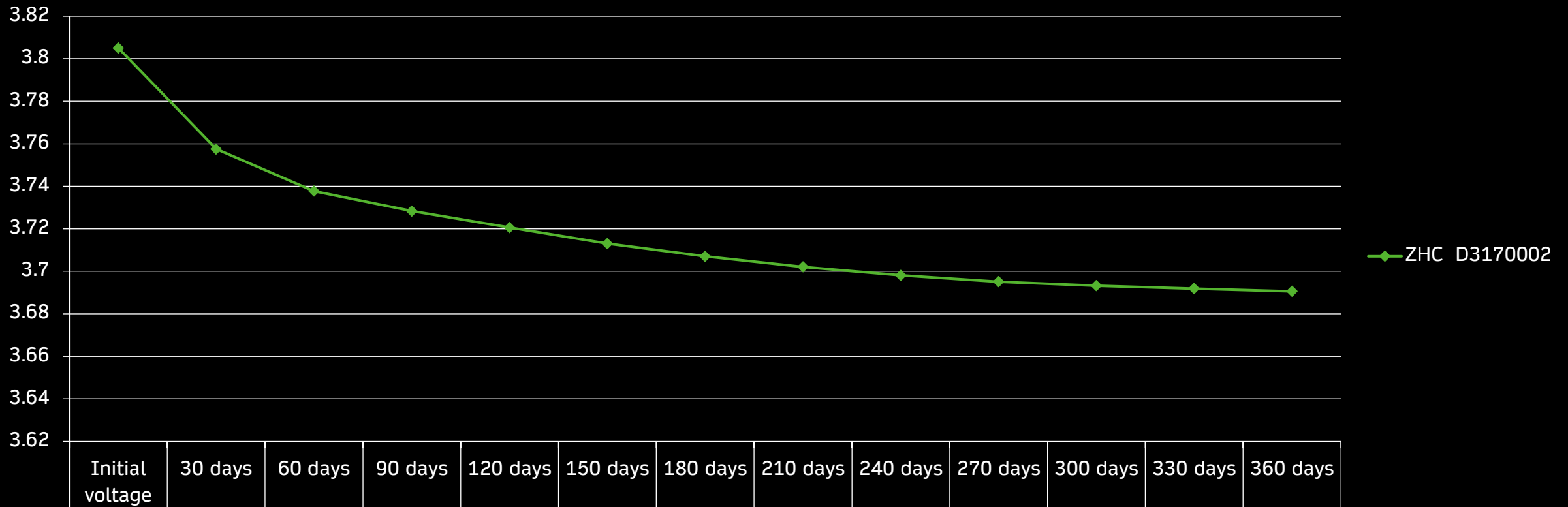
Judgement: OK

Measured By: HZhao

Checked By: ZYChen

Self-discharge voltage test data													
	Initial voltage	30 days	60 days	90 days	120 days	150 days	180 days	210 days	240 days	270 days	300 days	330 days	360 days
ZHC D3170002	3.805	3.75751	3.73771	3.72834	3.72061	3.71304	3.70705	3.70207	3.69809	3.69512	3.69326	3.69189	3.69057

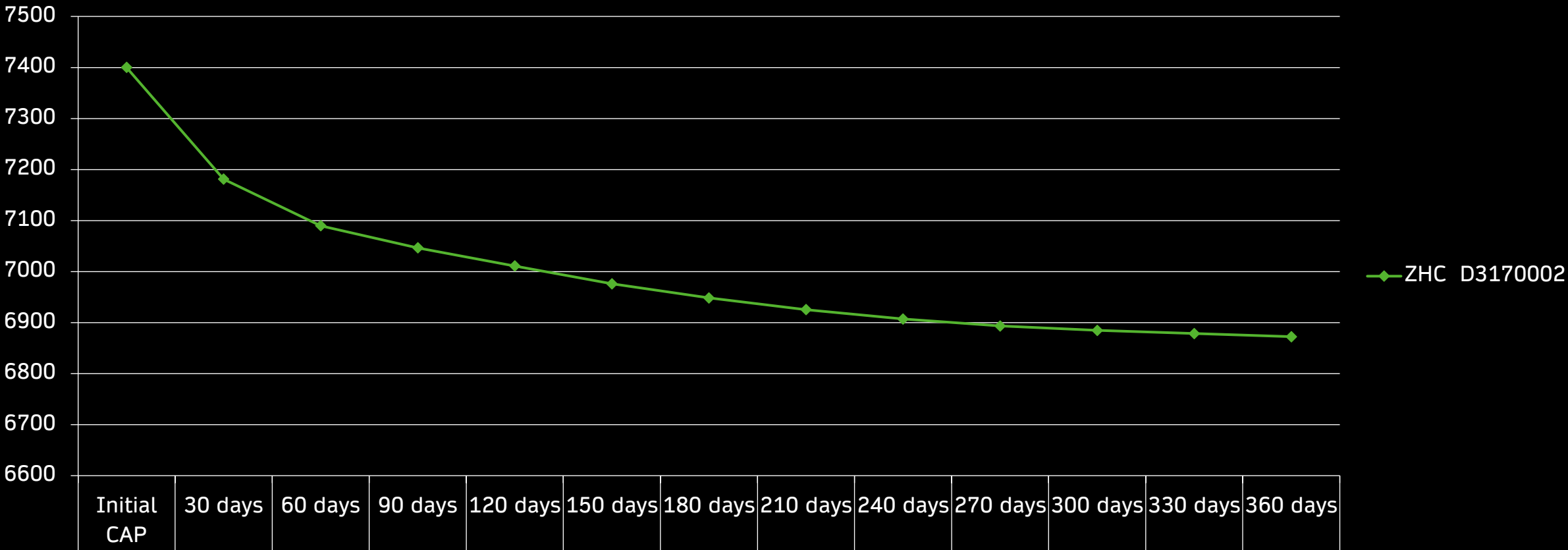
ZHC 7000F Self-discharge voltage data



Storage capacitance retention data

mAh	Initial CAP	30 days	60 days	90 days	120 days	150 days	180 days	210 days	240 days	270 days	300 days	330 days	360 days
ZHC D3170002	7400.1	7181.1	7089.8	7046.6	7010.9	6976.1	6948.4	6925.5	6907	6893.4	6884.8	6878.5	6872.4

ZHC 7000F Storage capacitance retention rate



Safety Performance



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Available Form Factors



Cell Type



Pouch Pack



**Tailor-made
Modules**

LCC Applications: Battery-Free Keyboard and Mouse

Advantages:

- Long life time, no more battery replacement
- Eco-friendly
- Up to 3 months usage duration without degraation
- Super Quick Charge in less than 10mins
- Low Long-term cost



LCC Applications: E-Bike

Advantages:

- Super Quick Charge
- High power for acceleration or hill climbing
- Applying Kinetic Energy Recovery System by excellent recharge
- Possibility reduce 48V motor to lower voltage i.e. 24V by increase output current
- High Standard of Safety



產品規格

容量：

250WH

放電倍率：

10C

充電時間：

10分鐘



LCC Applications: Low speed Vehicles/robotic vehicles

Advantages:

- High Standard of Safety
- Super Quick Charge
- High Power Output (Max. 50C)
- Long Lifetime
- Eco-friendly



Golf Car



Sightseeing Car

AGV/RGV

Comparison between LIB/LFP to LCC



LIB/LFP

- e.g. Charging 2H working 10H
- Working time 20H in 24hours
- More charger, more spare AGV, more spare battery for end of life
- Lower initial cost higher maintenance cost

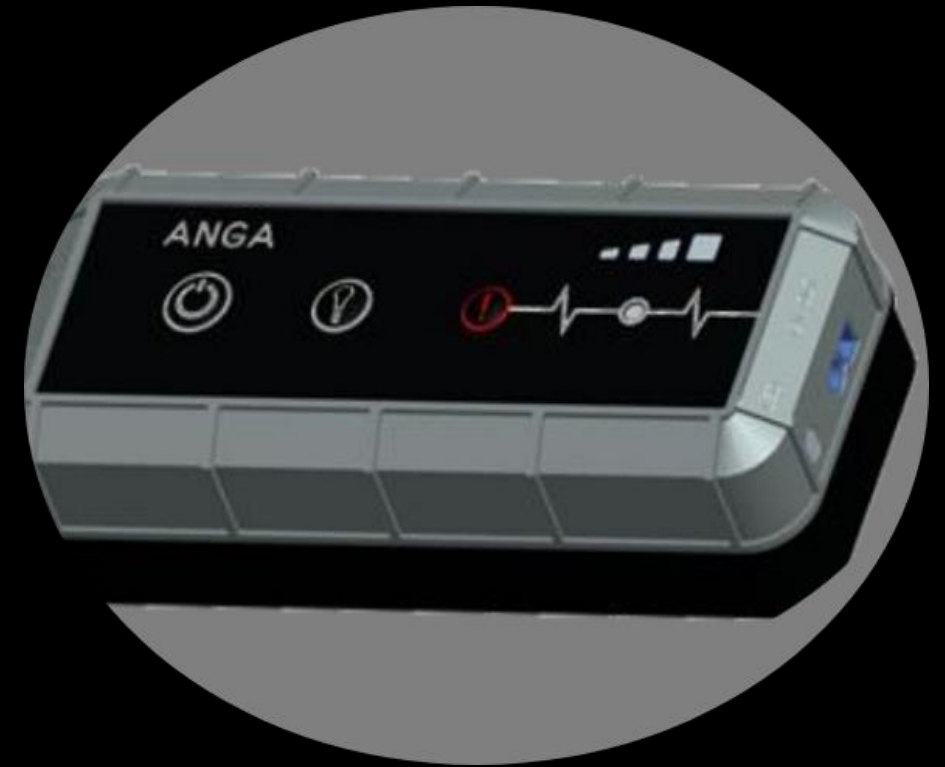
LCC

- e.g. charging 5mins, working 3H
- Working time 23 hours, only less than 40mins charging in 24 hours
- Less charger required
- Longer life time > lower cost
- Able to work under low temperature
- Safe

LCC Applications: Engine/motor starter

Advantages:

- High Standard of Safety
- High power output(up to 1000A)
- High power density > small in size
- Super quick charge
- Long Lifetime
- Eco-friendly



LCC Applications: New Energy Vehicles

Advantages:

- Green Technology Adoption
- Energy Efficiency
- Innovative Charging System
- Powerful Performance
- Longer Cycle Life
- Safety Measures



New Energy Ferry

LCC Applications: New Energy Vehicles

Advantages:

- Energy Efficiency and Recovery
- Reduced Emissions
- Longer lifespan and better reliability
- Safety and Environmental Friendliness



Locomotive

LCC Applications: Elevator Automatic Rescue & Energy Saving Device

Advantages:

- Energy Saving (~40%)
- Emergency Backup Power upon Power System Failure
- Emergency Level (go to the nearest level when power shut down)



LCC Applications: Backup Power

Applications

- UPS
- Telecommunication & Communication Base Station

Advantages:

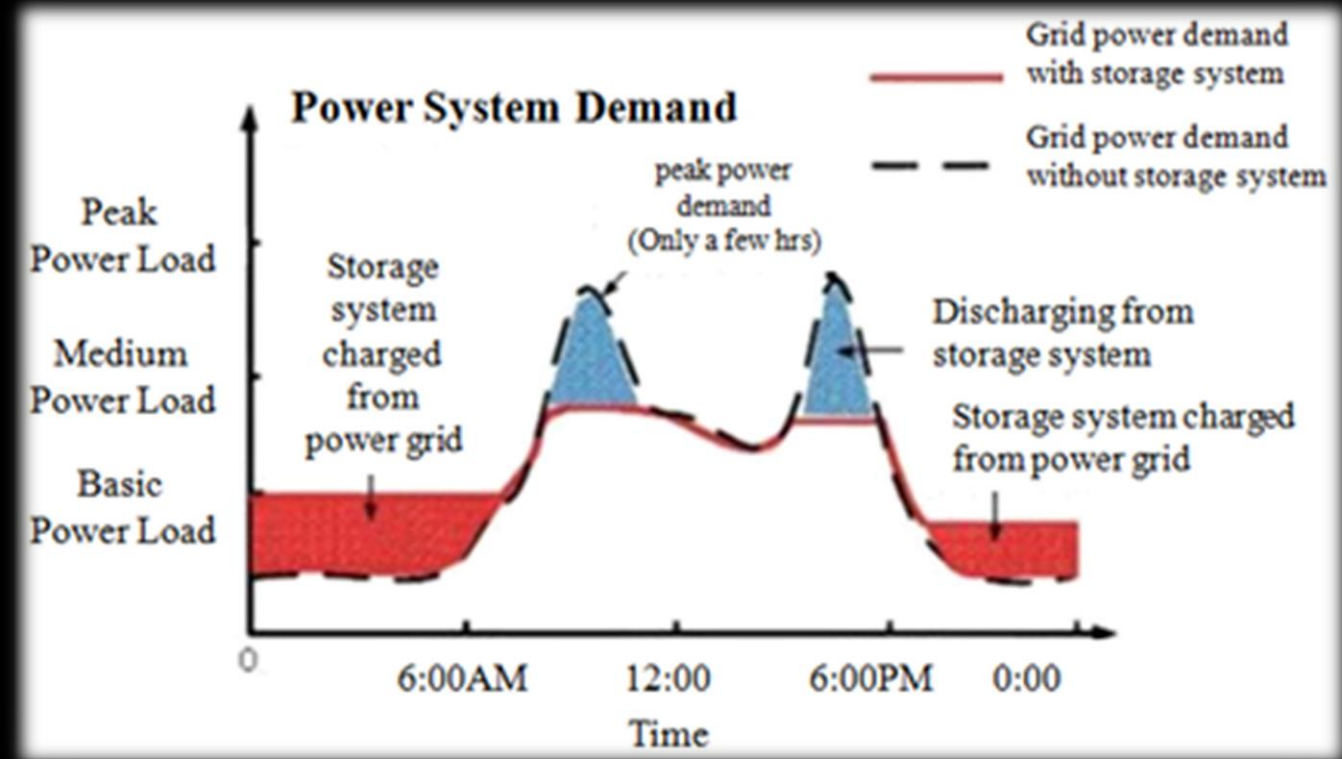
- High Standard of Safety
- Fast reaction in minutes with high power
- Quick charge
- Significant Reduction of Maintenance cost
- Long Lifetime



LCC Applications: Energy storage in Peak assist grid system

Advantages:

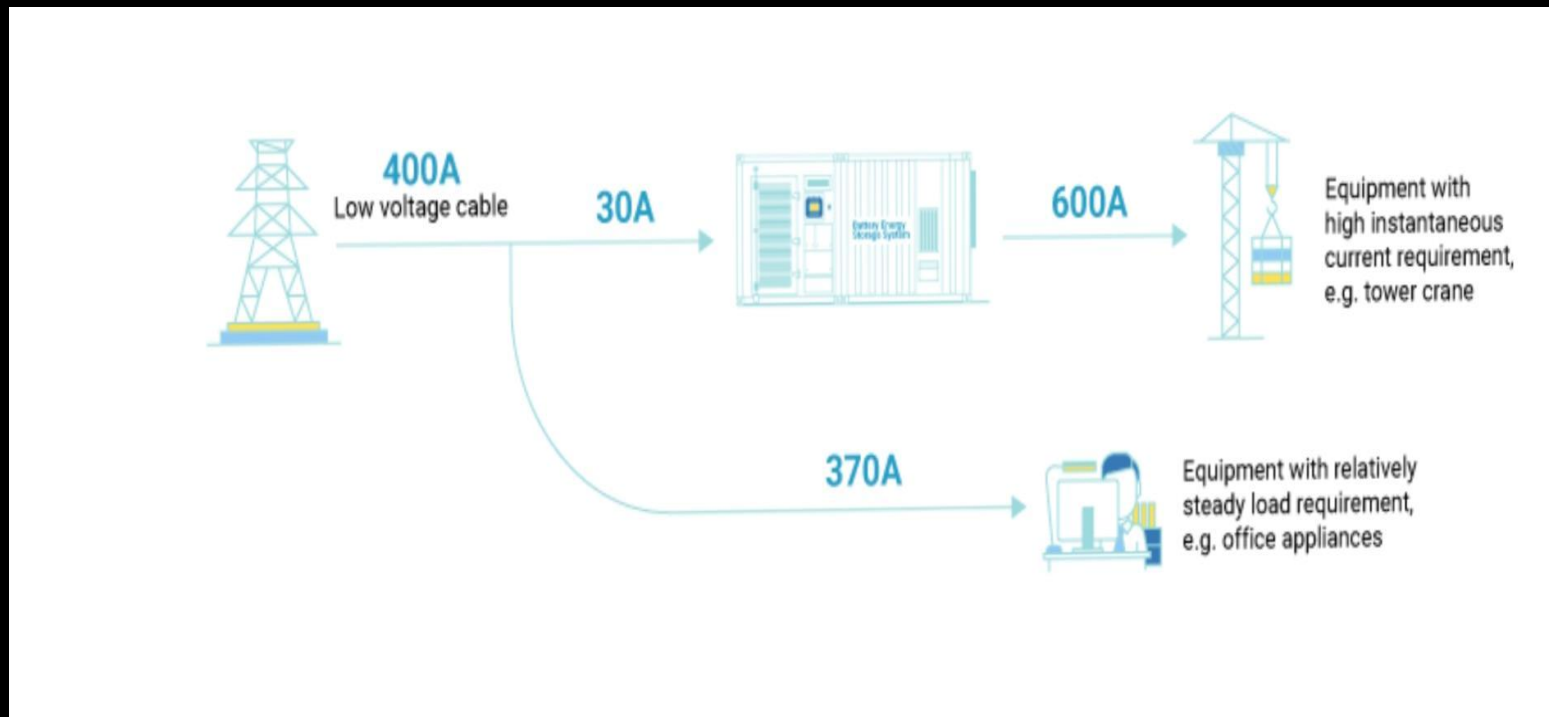
- High Standard of Safety
- High Power Output
- Long Lifetime
- No Degradation
- Peak Shaving in minutes with high power
- Significant Reduction of Maintenance Cost



LCC Applications: Power amplifier for heavy duty equipment

Advantages:

- Significant cost reduction
- Replacing Diesel Generator
- High Power Output
- Long Lifetime without degradation
- KERS efficient



Passenger/Material Hoists



Tower Cranes

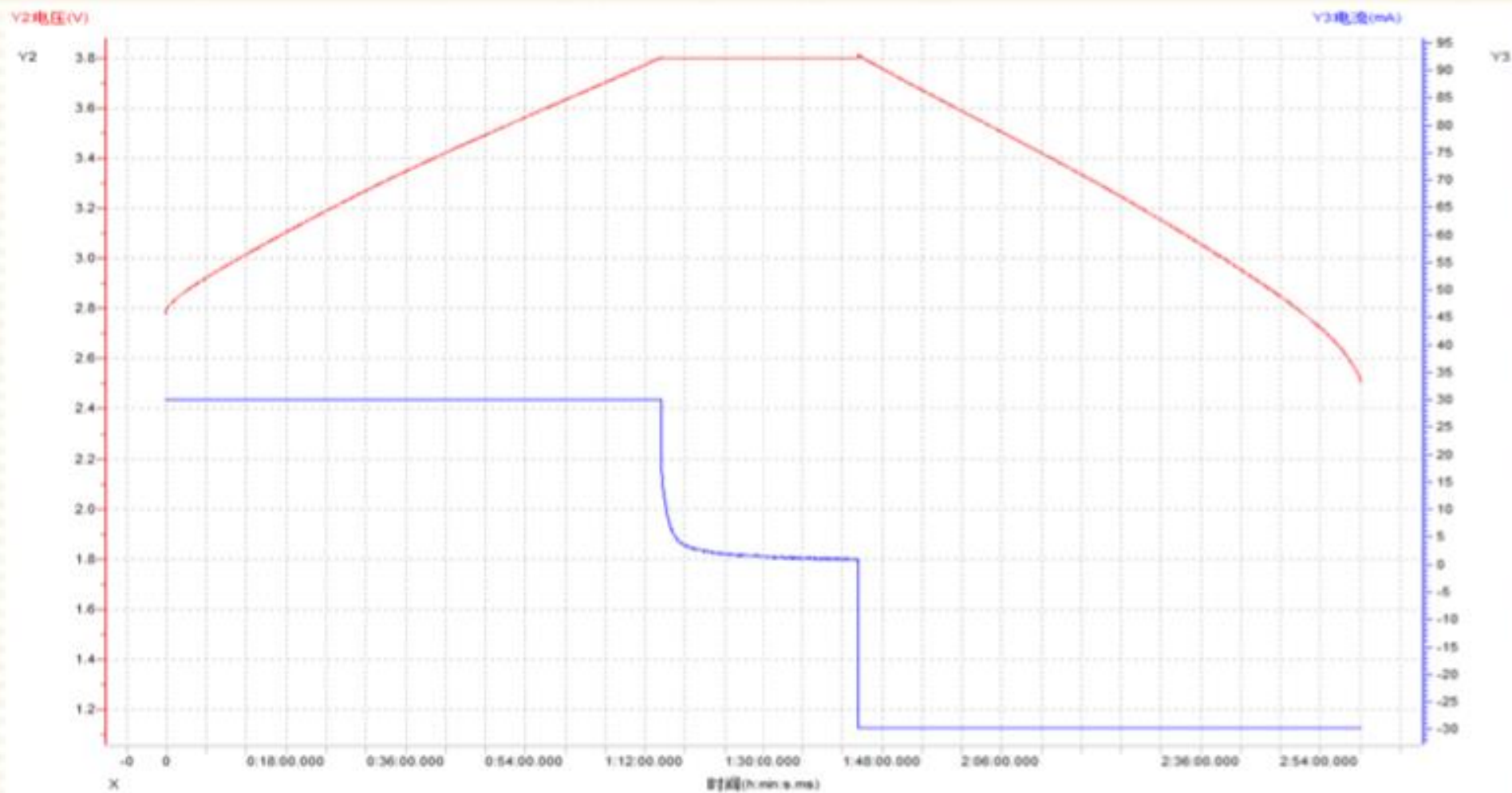


Welders

Cycle life vs SOC example

	A	B	C	D
1	Max voltage	Min voltage	SOC	Cycles
2	29.0	17.5	100%	10K
3	29.0	18.7	90%	40K
4	29.0	19.8	80%	70K
5	29.0	21.0	70%	100K
6	29.0	22.1	60%	130K
7	29.0	23.3	50%	170K
8	29.0	24.4	40%	200K
9	29.0	25.6	30%	230K
10	29.0	26.7	20%	250K
11	29.0	27.9	10%	300K
12	25.0	23.0		1000K

LCC charge & discharge curve



Endurance & ESR

Endurance @3.8V 65°C

