

**From Niche to Mainstream – Expanding the Performance
of Silicon Anodes on All Performance Metrics**



Ionel Stefan

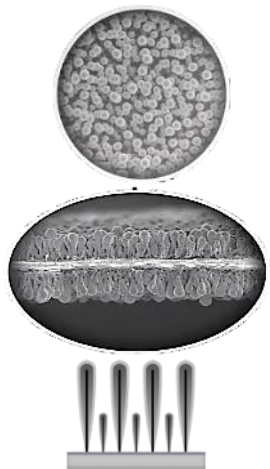
CTO, Amprius Technologies, Inc.
1180 Page Ave., Fremont, CA
NASA Workshop 2025, Jan 20, '26

AMPRIUS – THE SILICON PIONEER

A History of Innovation and Achievements

- Headquarters and prototyping line in Fremont, CA
- Contract manufacturing in China and South Korea
- Highest available energy density in commercial products
- Organic growth into electric flight markets


Founded in **2008**
Fully Operational
in **2010**



**Silicon Nanowire
Design Finalized**



**kWh Scale
Manufacturing**



**Customer Orders
& Commercial
Sales**



**GWh Scale Project
Development
Initiated**

NYSE
IPO- AMPX is
traded on NYSE



**500 Wh/kg
platform validated**

**Factory site in
Brighton Colorado**



2024

**Contract
manufacturing
00' MWh Scale
Expansion
Achieved**

2023

**4000 W/kg High Power
Density Commercial
Product**

2022

**450 Wh/kg Commercial
Product**

2021

**Extreme Fast Charge
Commercial Product
(0-80% in 6 minutes)**

2018

**400 Wh/kg Commercial
Product**

2016

2014

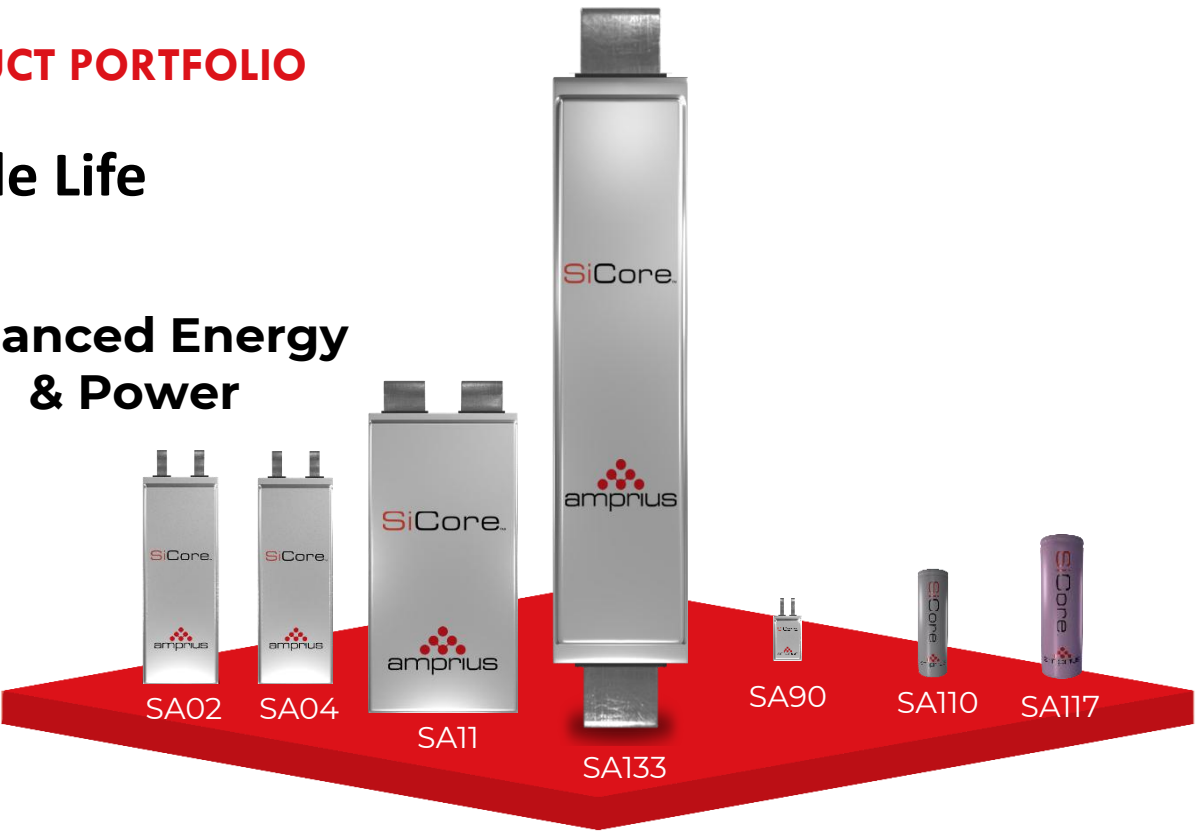
**Other silicon
materials initiated**

2008

COMPREHENSIVE PRODUCT PORTFOLIO

Power-Energy-Cycle Life

Balanced Energy
& Power



High Energy



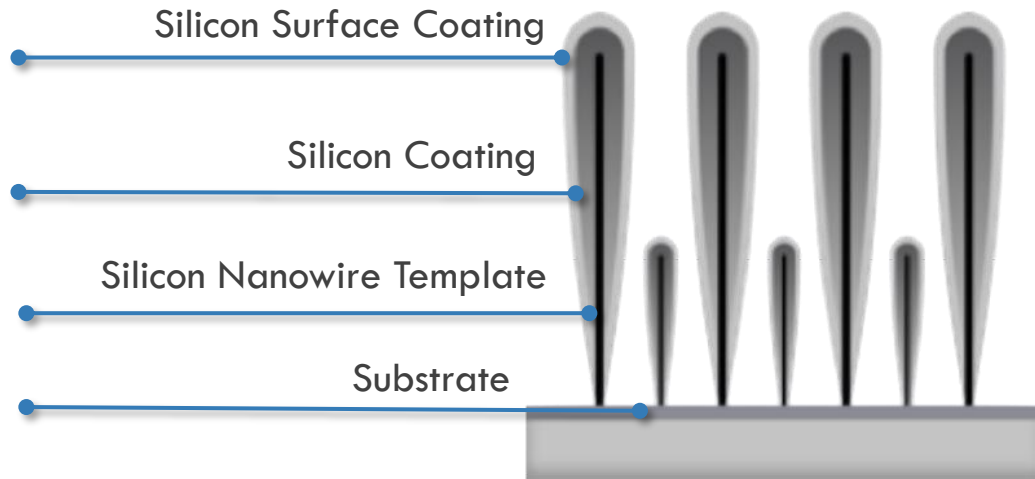
High Power



Commercial Anode Platforms

SiMaxx™

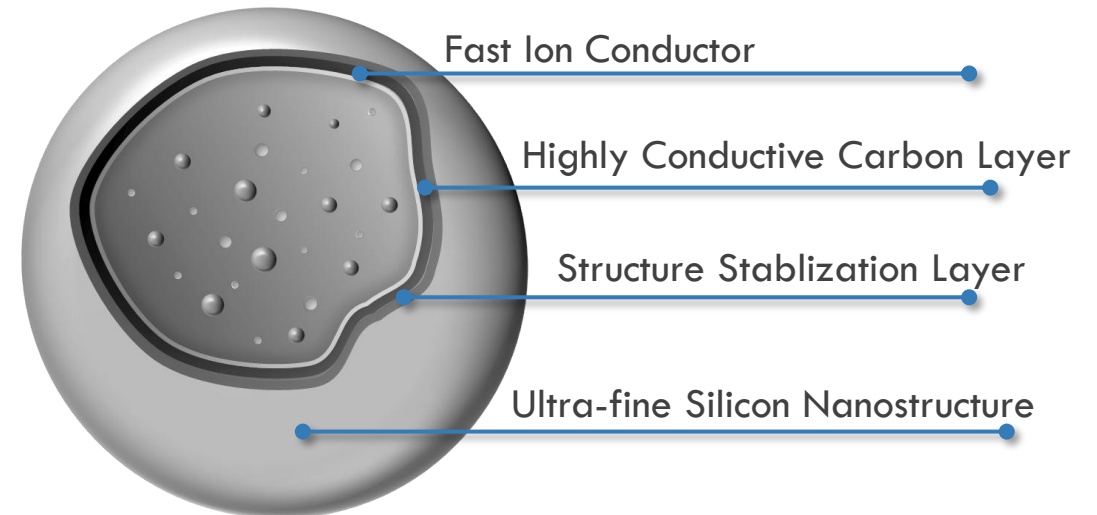
100% Silicon Anode Technology



100% Silicon without
Other Active or Inactive Anode Material

SiCore™

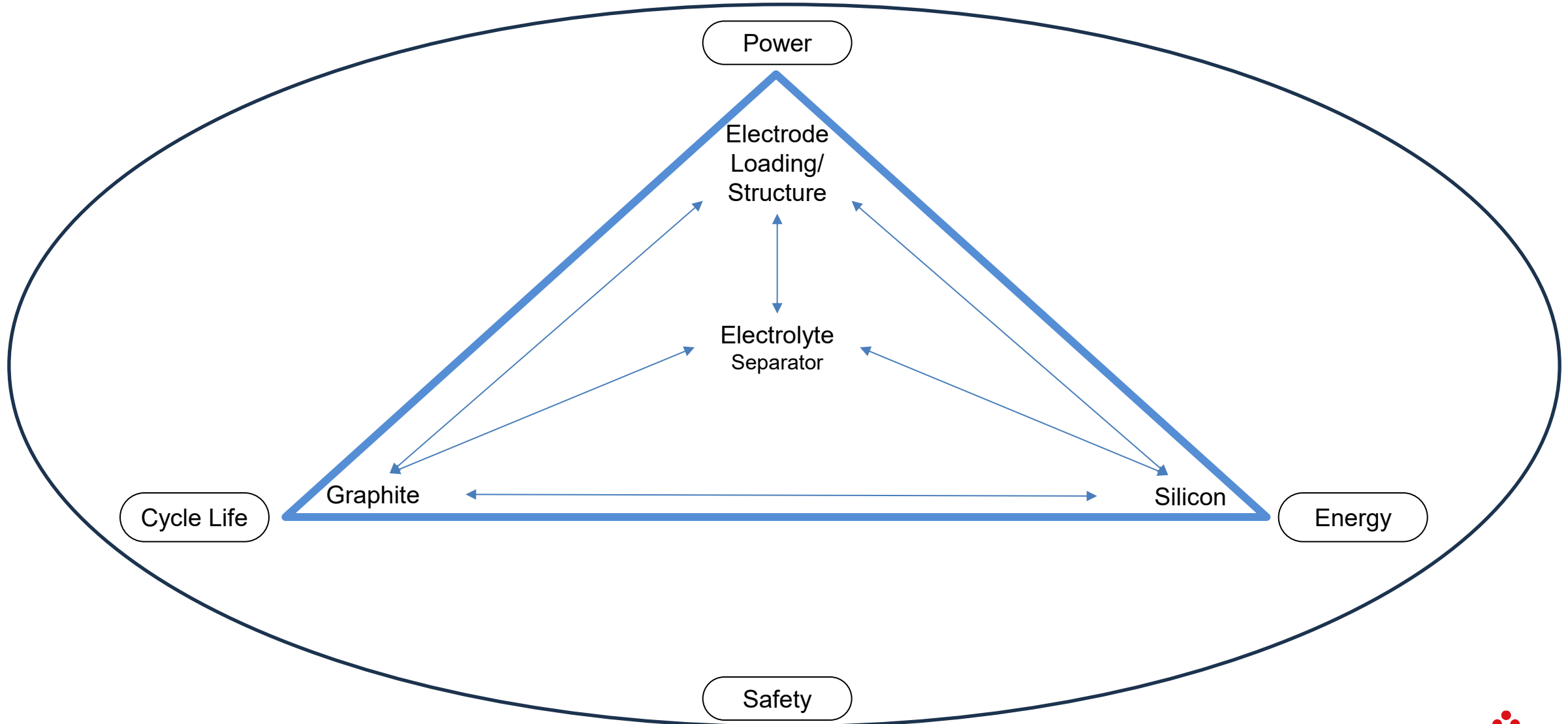
Silicon Oxide Anode Technology



Up to 100% Silicon without
Other Active Anode Material
(can be mixed with other active materials)

THE ENERGY-POWER-CYCLE LIFE TRIANGLE

Trade-offs and Opportunities in Cell Design



Amprius batteries and applications

★ ★

= Pre-Production Cells

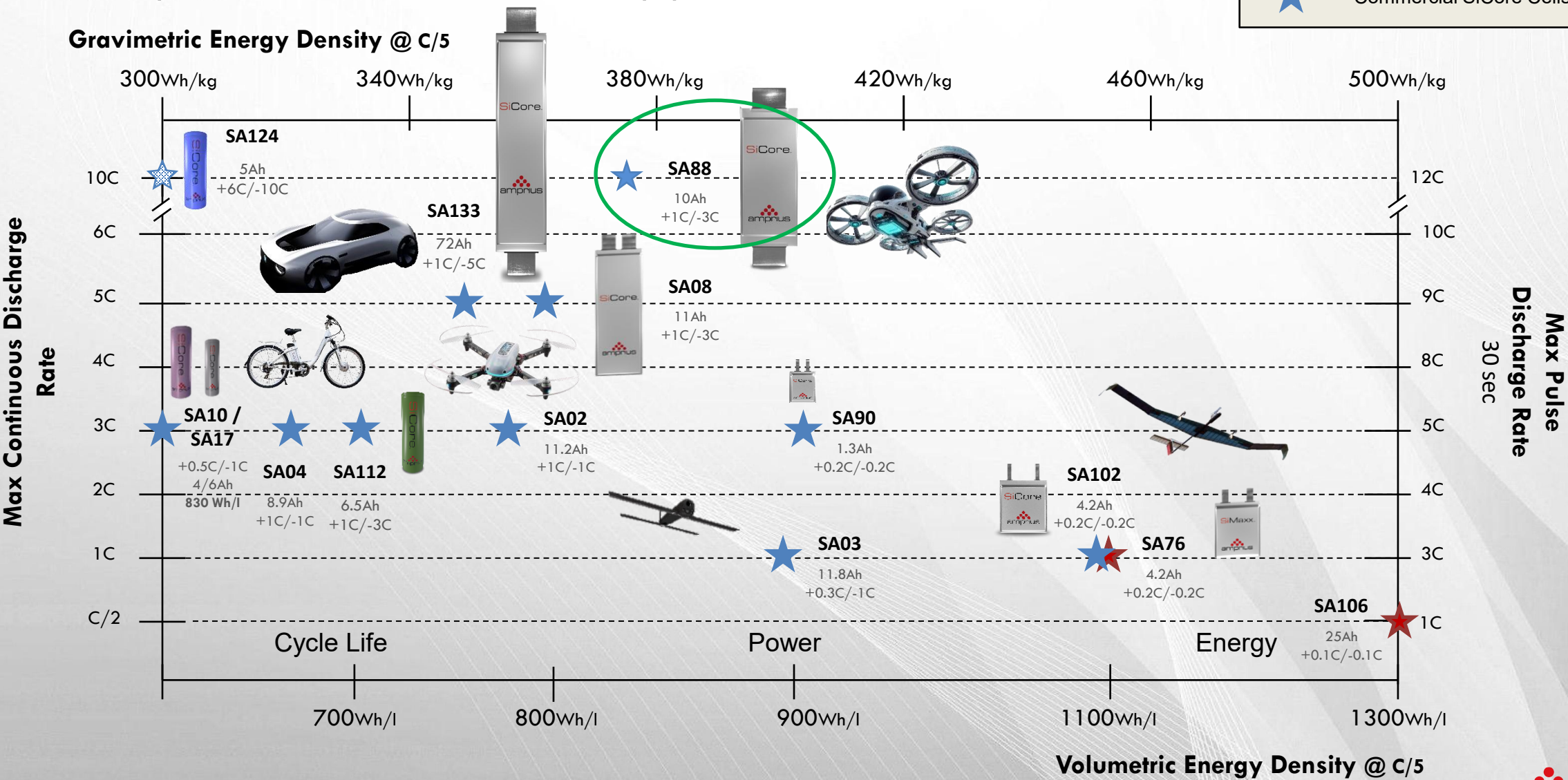
★

= Commercial SiMaxx Cells

★

= Commercial SiCore Cells

Multiple form factors and applications



Exact performance is provided on technical data sheets, visit Booth 305

EXTREME FAST CHARGING, HIGH POWER AND HIGH ENERGY- ALL IN ONE CELL

100% active silicon anode, optimized electrical and chemical design for high power



Size: 5.2x60x145mm

10.5 Ah

36.2 Wh

375 Wh/kg @C/5

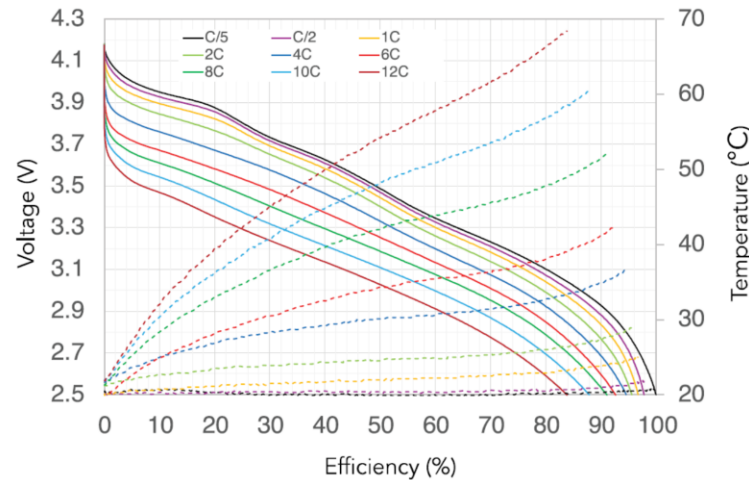
300 Wh/kg @ 10C

ACIR $\leq 2 \text{ m}\Omega$ @ 30%SOC

DCIR $\leq 4 \text{ m}\Omega$ @ 30%SOC

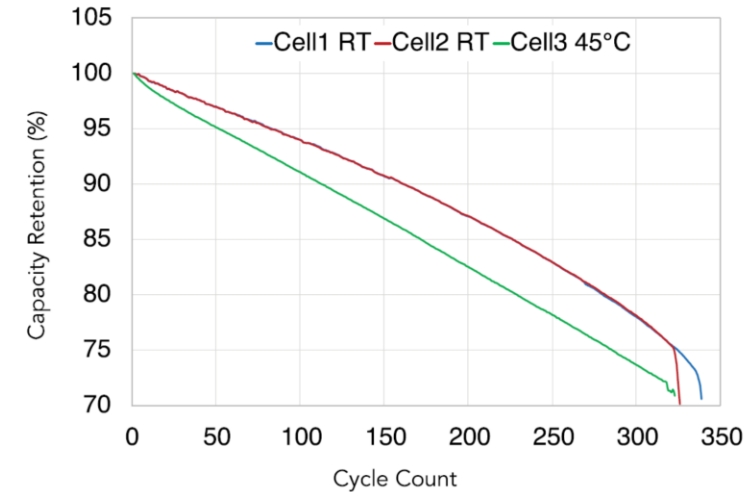
Discharge Rate Capability

0.2C, 0.5C, 1C, 2C, 4C, 6C, 8C, 10C, 12C at Room Temperature



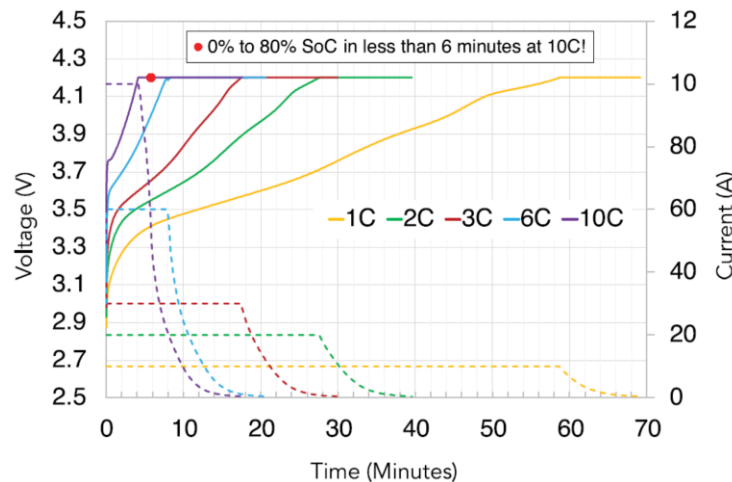
Cycle Life Performance

+1C/-3C, 100% DoD at 45°C and Room Temperature with Compression



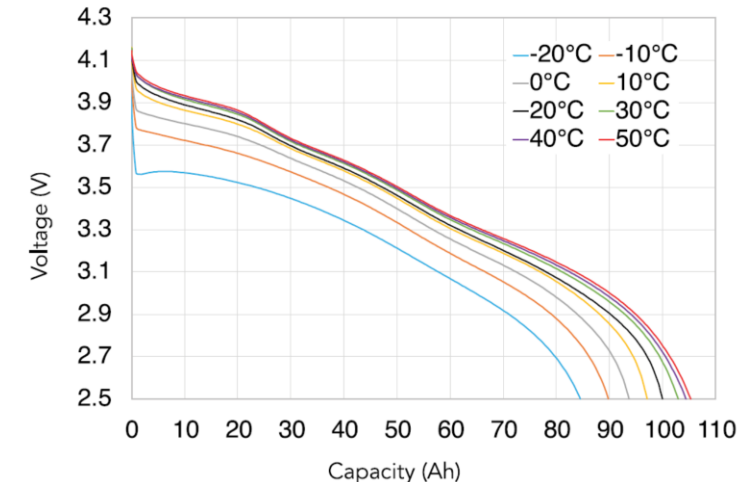
Charge Rate Profiles

0.5C, 1C at Room Temperature



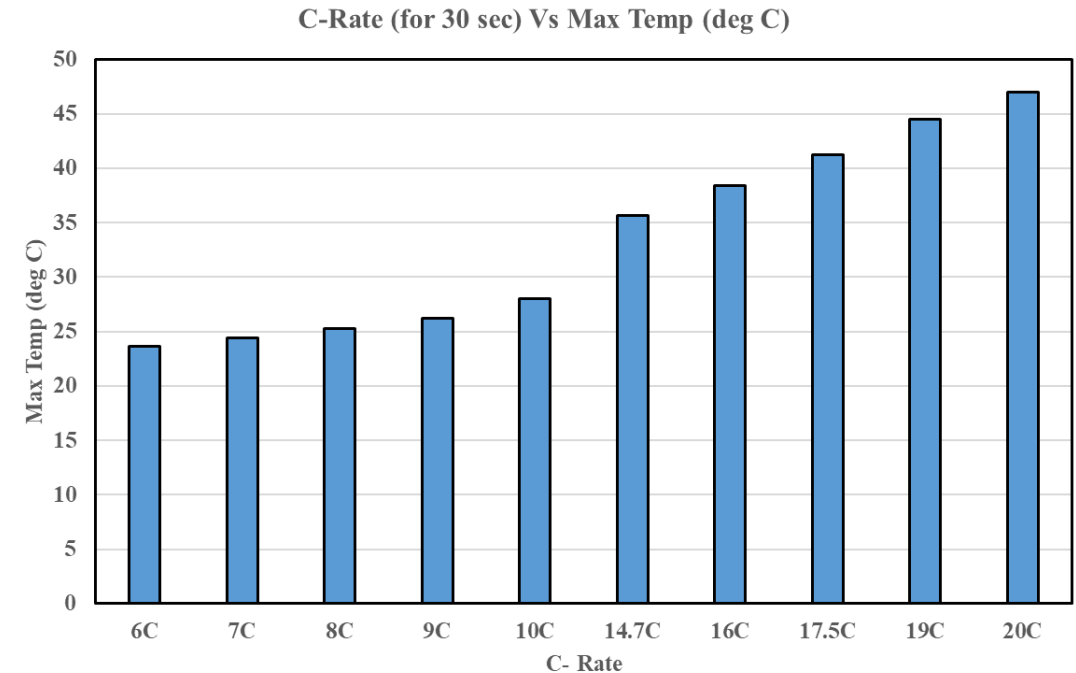
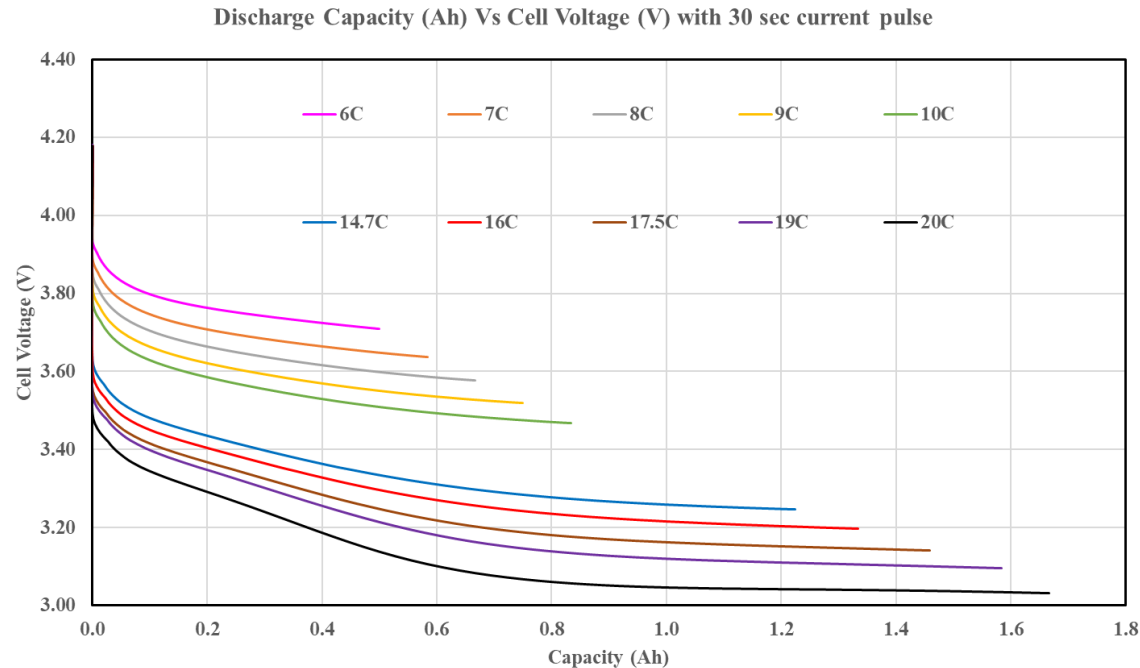
High/Low Temperature Discharge Performance

Discharge Capacity at 1C at Various Temperatures



EXTREME FAST CHARGING, HIGH POWER AND HIGH ENERGY- ALL IN ONE CELL

100% active silicon anode, optimized electrical and chemical design for high power



Key takeaways:

- Tab sizing and low resistance electrical path is critical to high power cell designs
- Low DCIR is even more important in high energy density cells because the available mass for heat dissipation is significantly lower (50-100%)
- Tab cooling becomes possible in specific pack design configurations

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= Pre-Production Cells

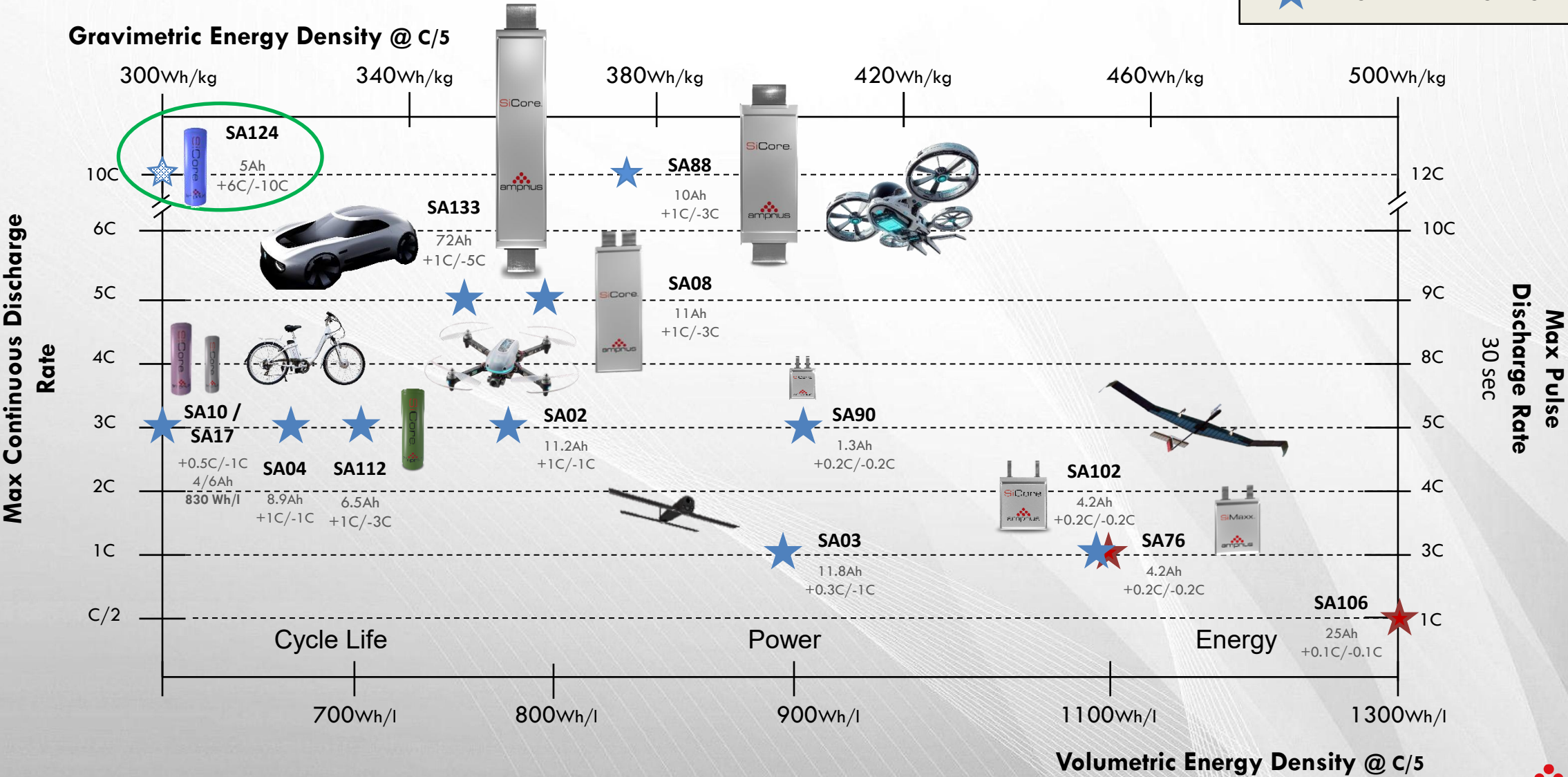
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= Commercial SiMaxx Cells

★

= Commercial SiCore Cells

Multiple form factors and applications



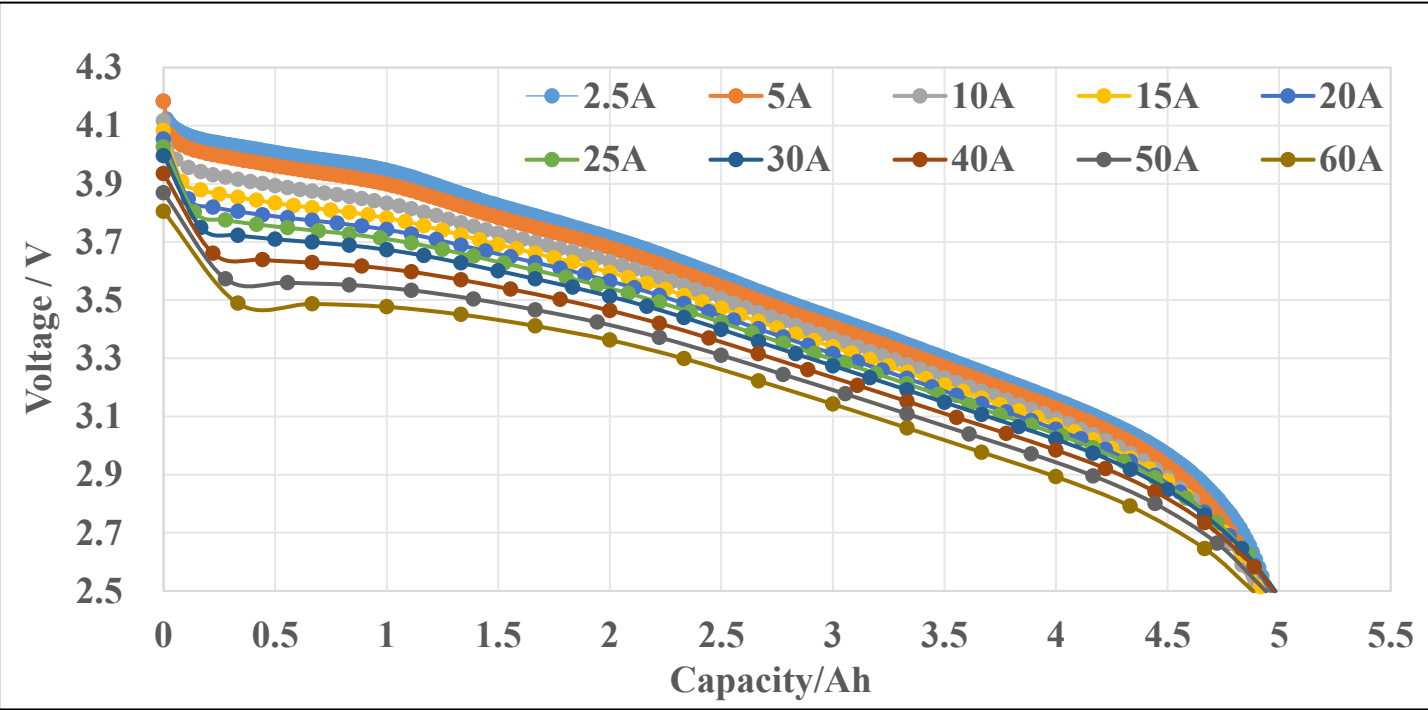
Exact performance is provided on technical data sheets, visit Booth 305

HIGH POWER CYLINDRICAL CELL

Tabless design for minimum internal resistance



Current	2.5A	5A	10A	15A	20A	25A	30A	40A	50A	60A
Rate	0.5C	1C	2C	3C	4C	5C	6C	8C	10C	12C
Capacity/Ah	5003.8	4960.3	4946	4986.6	5021.6	5042.4	5043.8	5036.3	5001.2	4944.7
Capacity retention/%	100.00%	99.12%	98.83%	99.65%	100.36%	100.78%	100.81%	100.66%	99.95%	98.80%
Max.Temp/°C	28.5	30.2	35.6	40.8	44.6	50.9	53.4	60.7	66.2	71.8
Temp. rise/°C	3.5	5.2	10.6	15.8	19.6	25.9	28.4	35.7	41.2	46.8



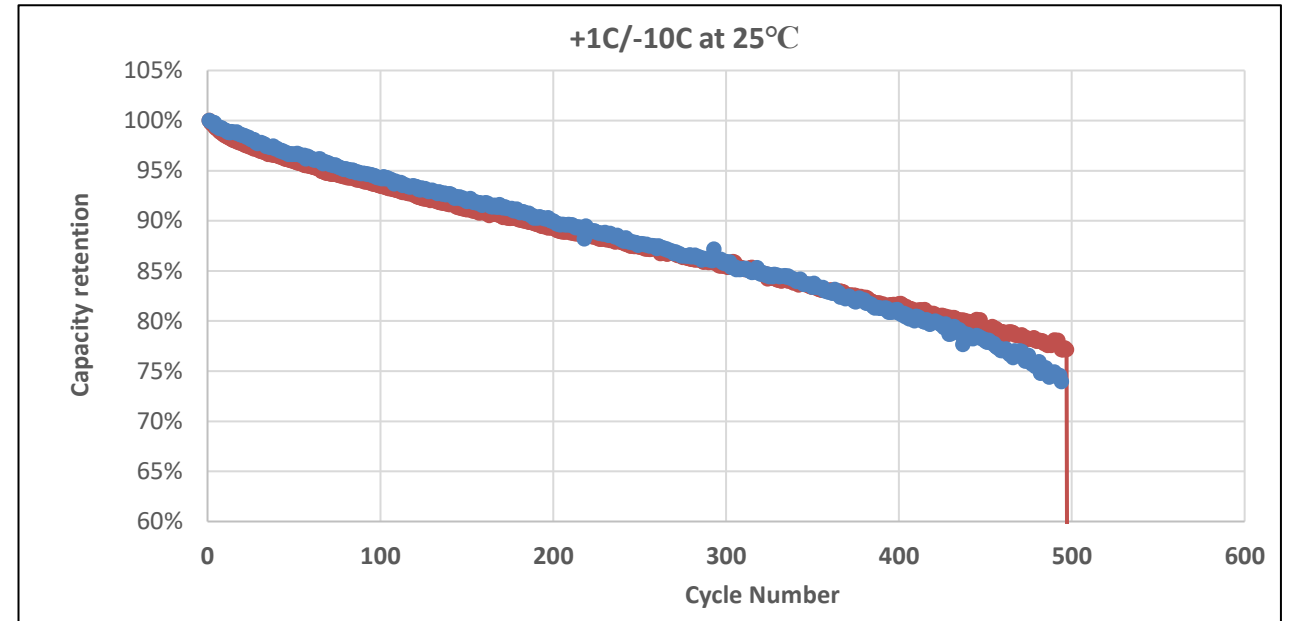
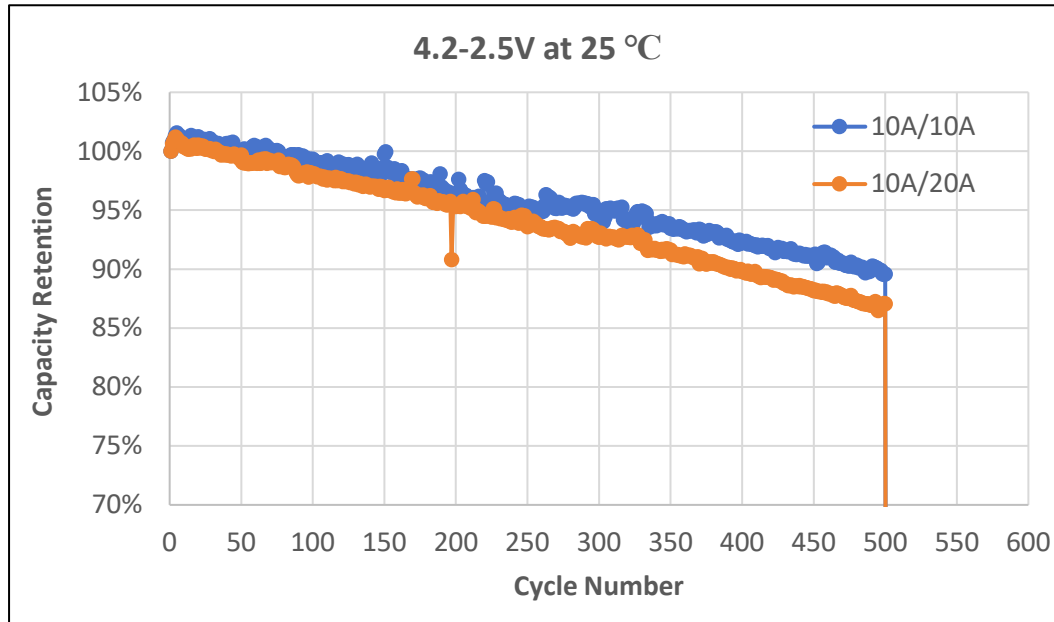
ACIR ~4 mΩ
DCIR ~9 mΩ

Very low difference
from 0.5C to 10C;
limited by temperature,
not by diffusion

Format: 21700
5 Ah
18 Wh
260 Wh/kg @C/5
255 Wh/kg @ 10C
ACIR ≤ 4 mΩ @ 30%SOC
DCIR ≤ 9 mΩ @ 30%SOC

HIGH POWER CYLINDRICAL CELL

~500 cycles at 10C discharge



Key takeaways:

- Cycle life of 1000 cycles at +2C/-2C
- High temperature and electrolyte displacement affects cycle life at 10C discharge
- UN38.3 certified
- Transferred to manufacturing

★ ★

= Pre-Production Cells

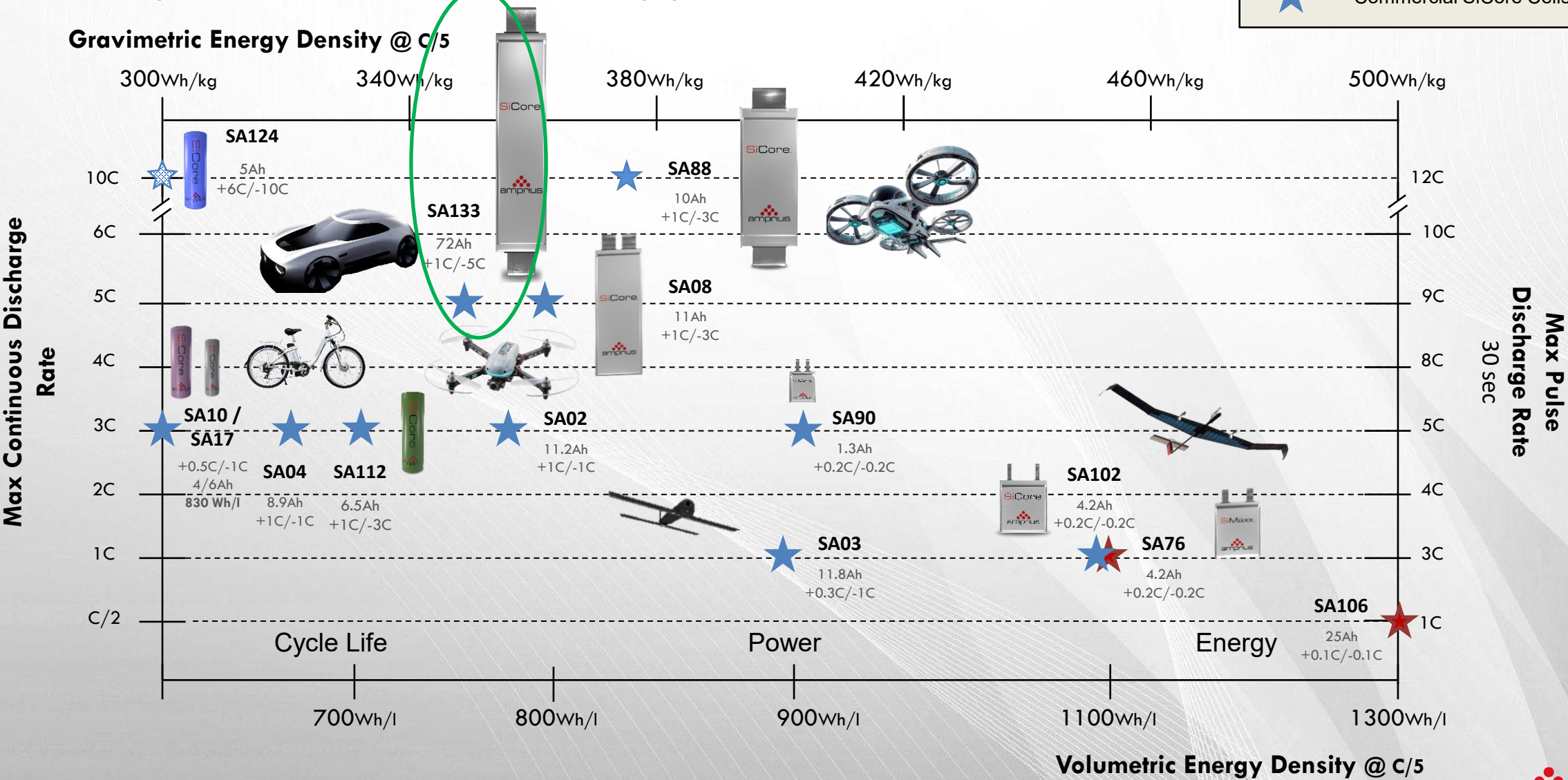
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Multiple form factors and applications



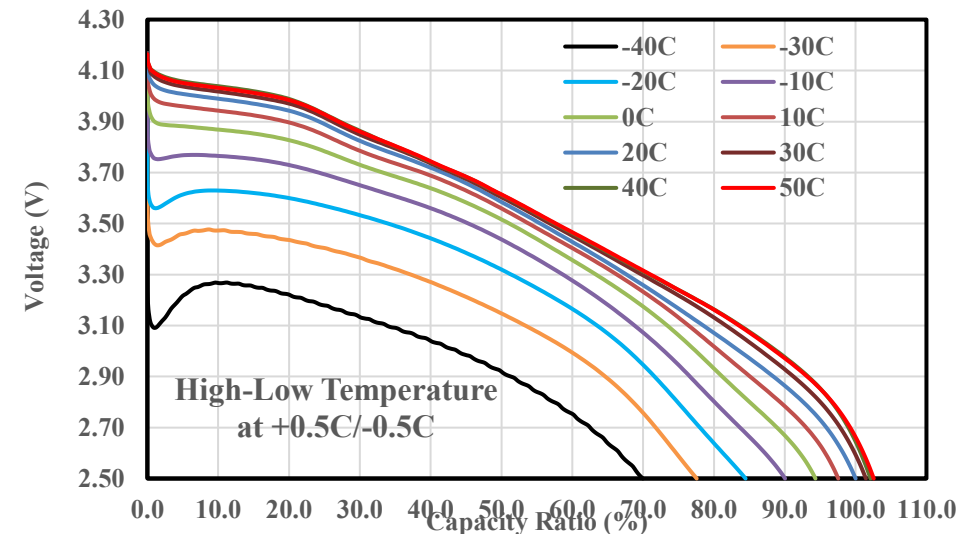
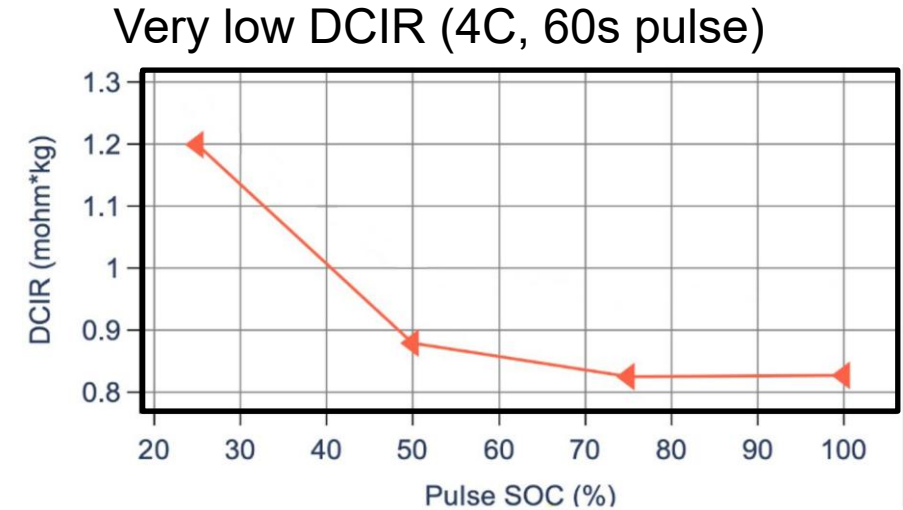
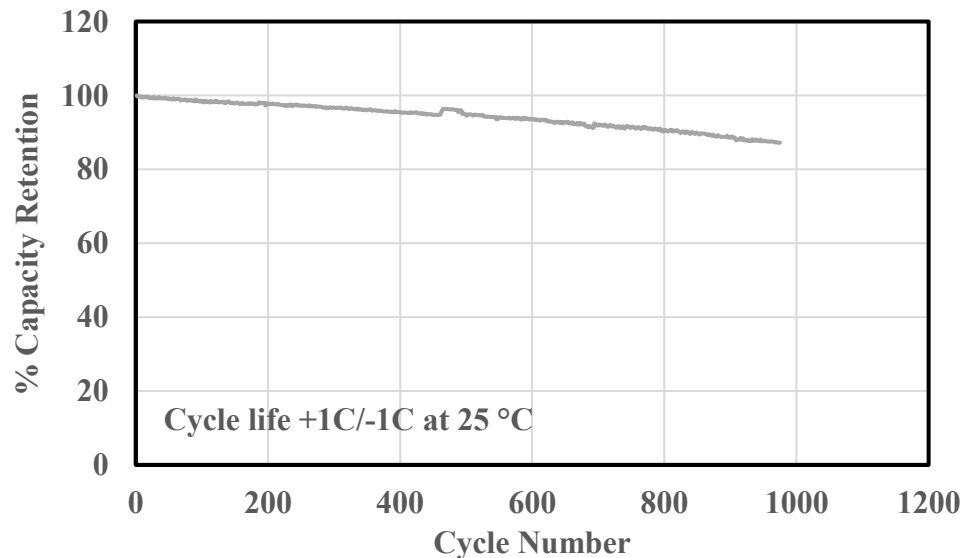
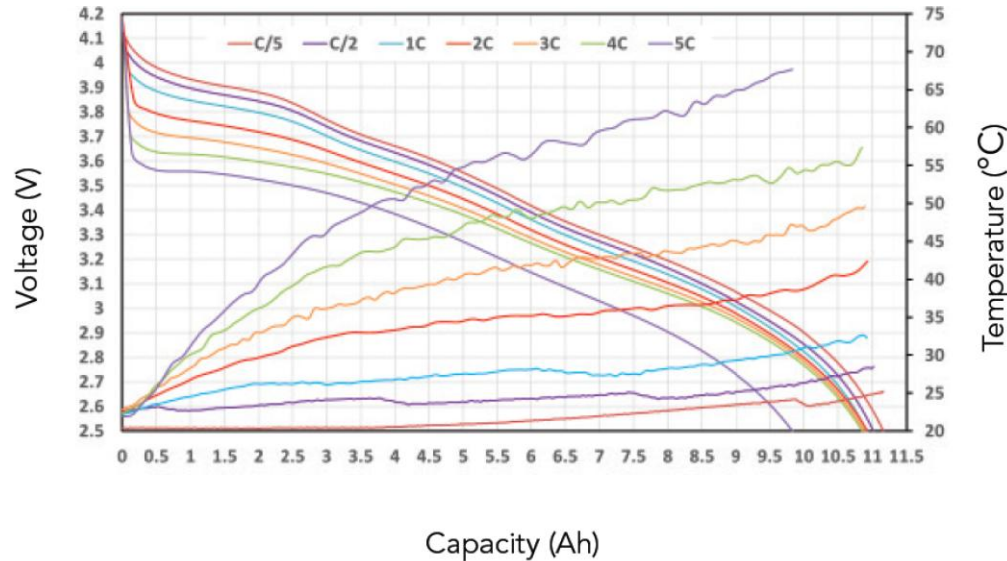
Exact performance is provided on technical data sheets, visit Booth 305

LARGE FORM FACTOR CELL DESIGN, BALANCED POWER-ENERGY, LONG CYCLE LIFE

Designed for eVTOL and high-power EV



14x80x295 mm
72 Ah
350 Wh/kg



★ ★

= Pre-Production Cells

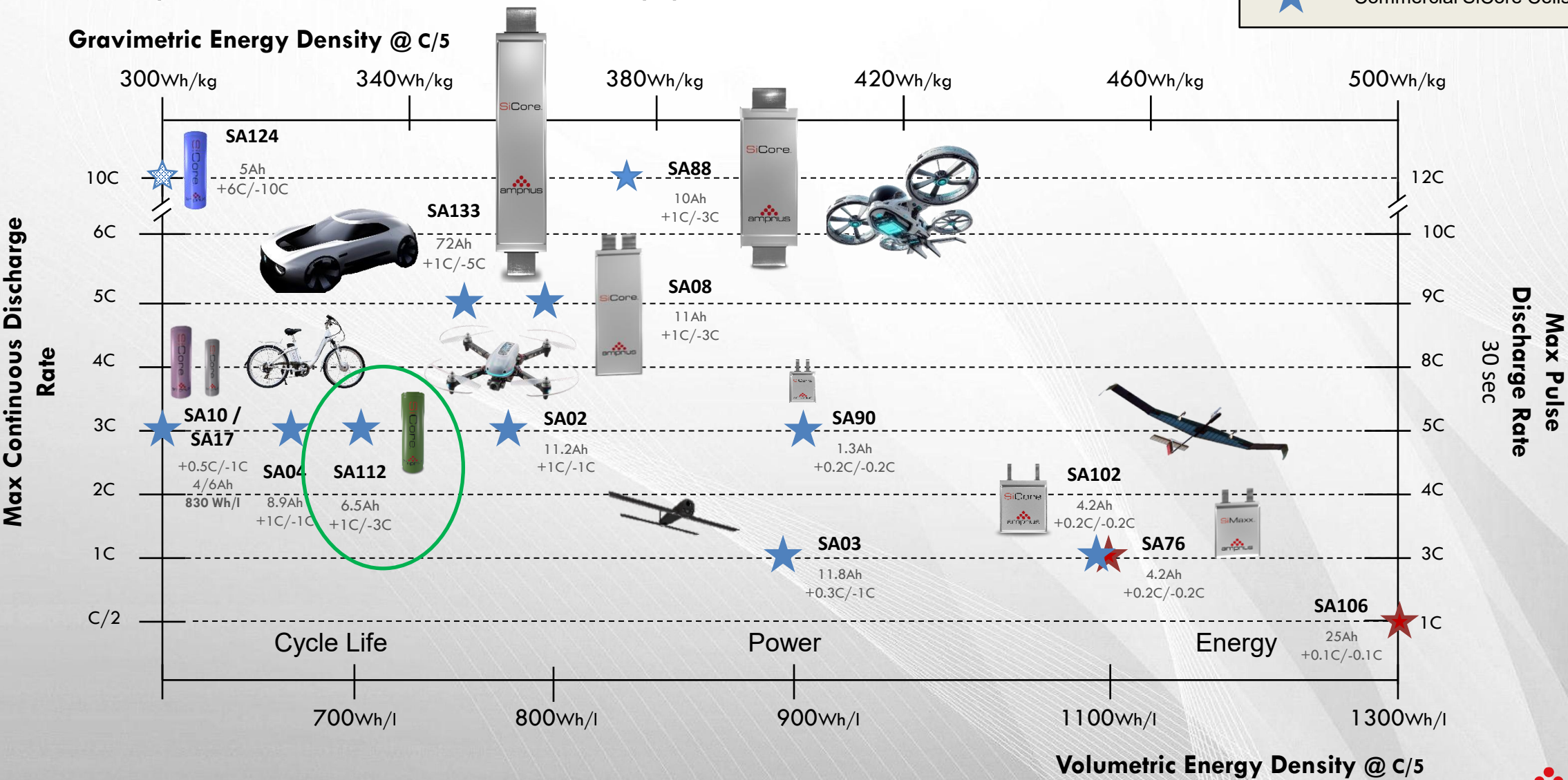
★

= Commercial SiMaxx Cells

★

= Commercial SiCore Cells

Multiple form factors and applications



Exact performance is provided on technical data sheets, visit Booth 305

HIGH ENERGY CYLINDRICAL CELL

High silicon content and electrode loadings for increased energy density



Format: 21700

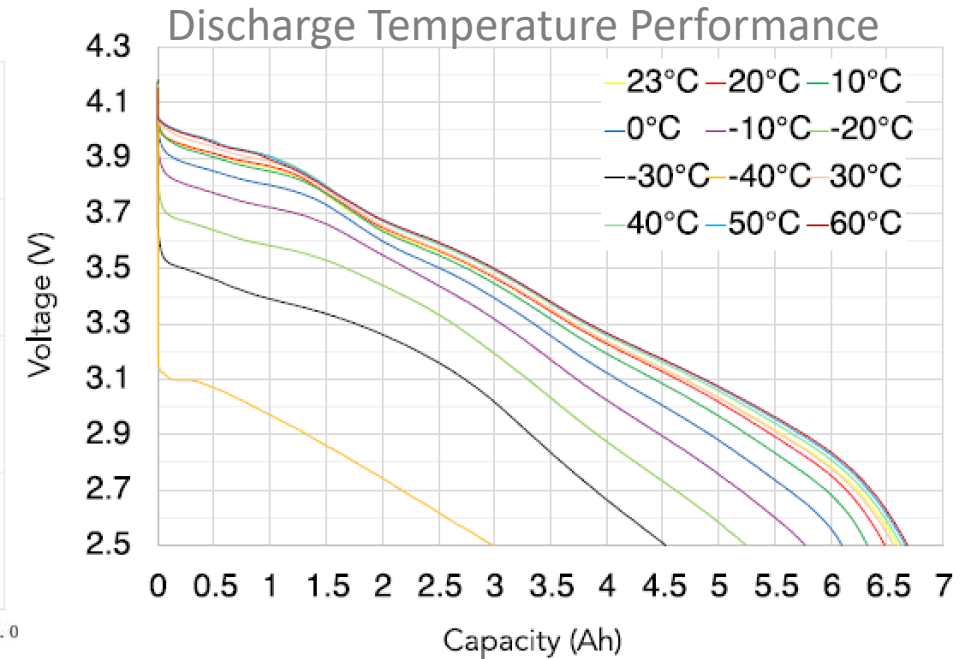
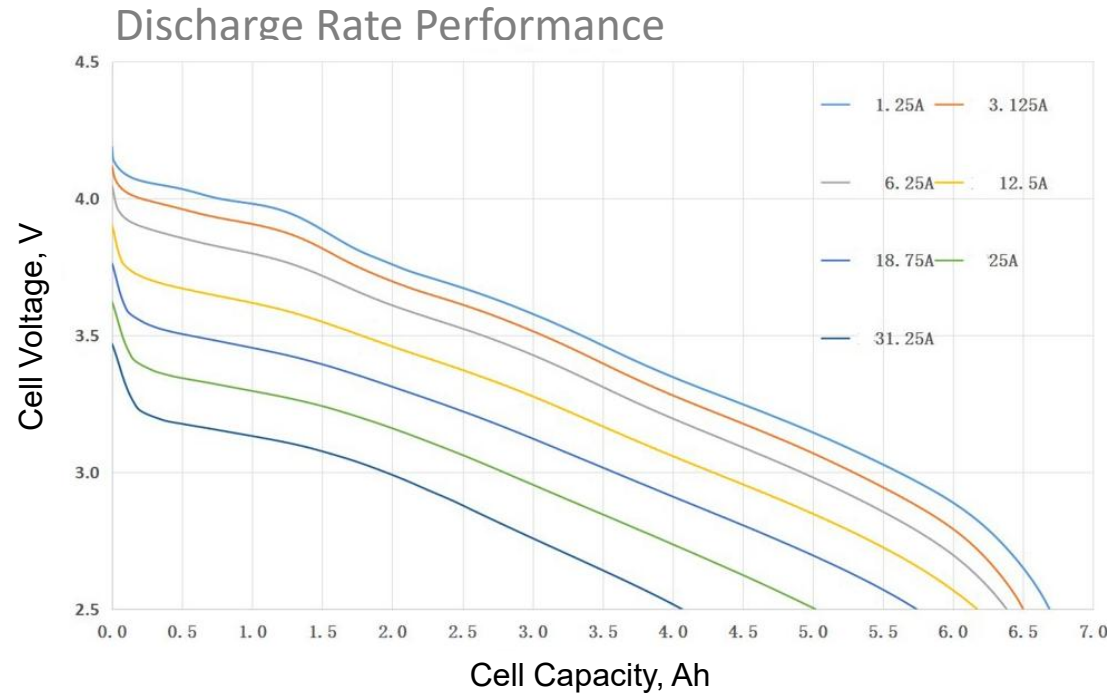
6.5 Ah

22.5 Wh

315 Wh/kg @C/5

ACIR $\leq 16 \text{ m}\Omega$ @ 30%SOC

DCIR $\leq 22 \text{ m}\Omega$ @ 30%SOC

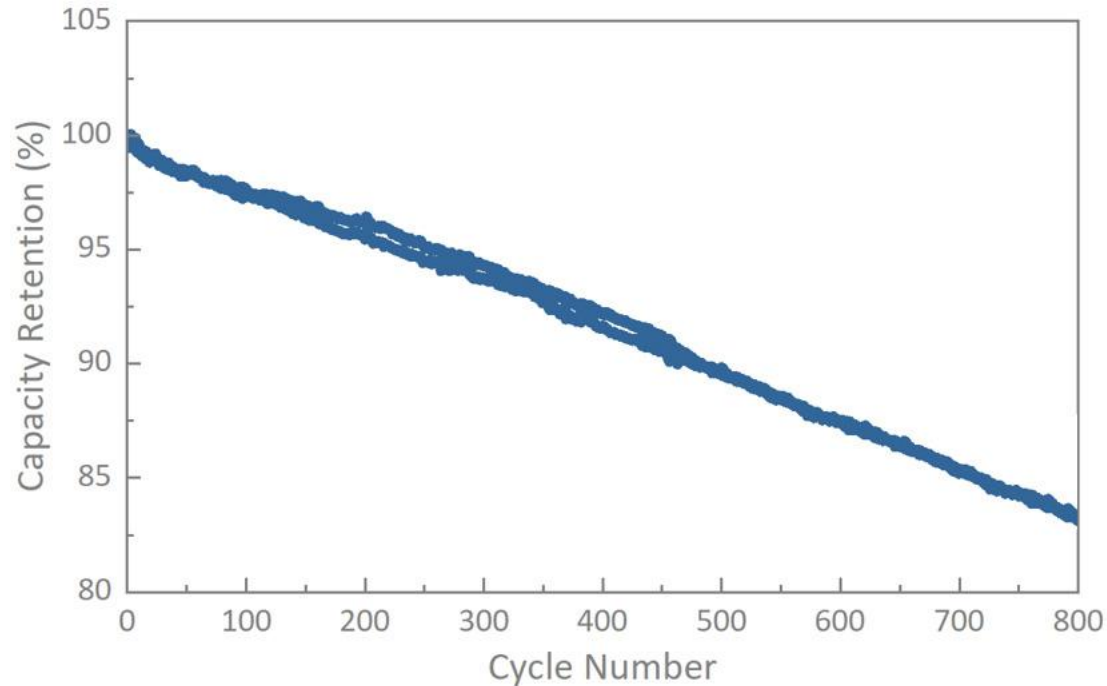


~6.6Ah typical, with up to 3C continuous discharge capability and >80% capacity at -20°C

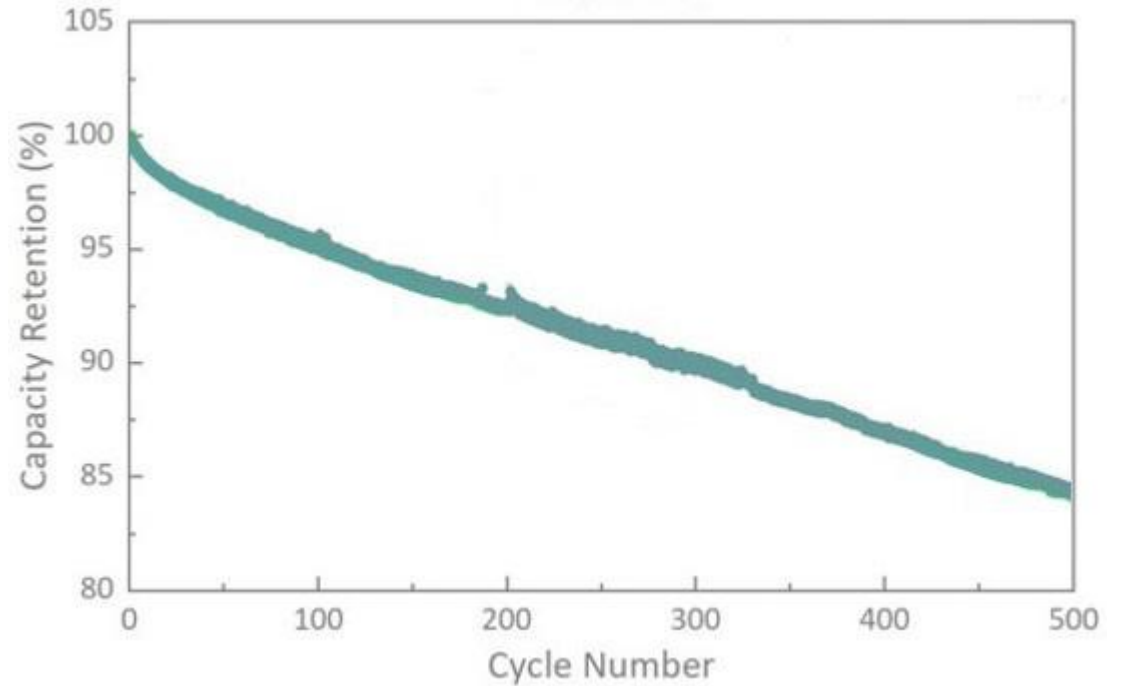
HIGH ENERGY CYLINDRICAL CELL

Prototypes

+1C/-2C, 100% DOD, 25°C



+1C/-2C, 100% DOD, 45°C



- Increased cycle life compared to the previous 6Ah cell design due to cell design optimization
- UN38.3 certified and in large volume manufacturing

★ ★

= Pre-Production Cells

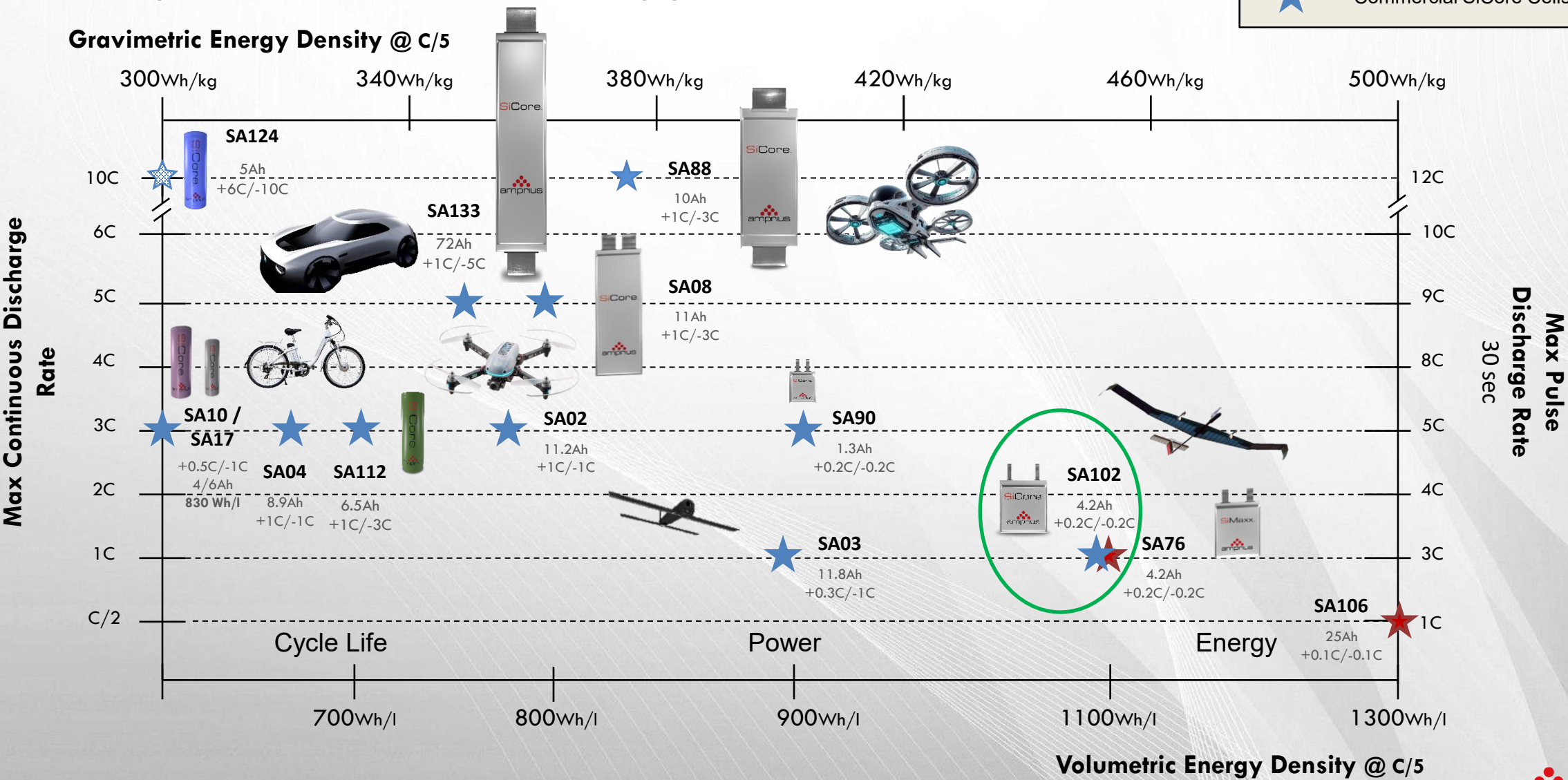
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= Commercial SiMaxx Cells

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= Commercial SiCore Cells

Multiple form factors and applications



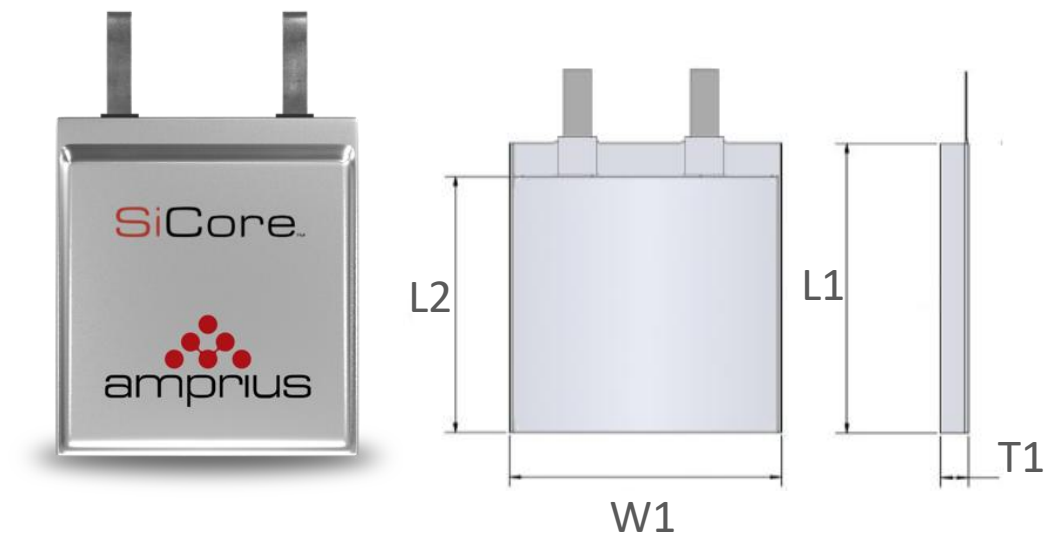
Exact performance is provided on technical data sheets, visit Booth 305

NEW 450 Wh/kg CELL DESIGN CHEMISTRY

High efficiency materials and electrodes

Specifications

Capacity	Typical @ C/10	4390mAh
		14.9Wh
Cell Voltage	Nominal	3.40V
	Charge	4.25V
	Discharge	2.20V
Discharge Current	Max Continuous	4.39A (2C)
	Max Pulse (≤ 30 seconds)	13.17A (3C)
Charge Current	Typical	0.439A (C/10)
	Maximum (0% to 100% SOC)	2.2A (0.5C)
Temperature Range Ambient	Discharge	-10 to 50°C
	Charge	0 to 50°C
	Storage	-20 to 45°C
Internal Resistance	ACIR, 1 kHz @ 30% SOC	≤ 25 mΩ
	DCIR @ 30% SOC, 1C	≤ 67 mΩ
Cycle Life	+0.2C/-0.2C, to 80% SOH	200 cycles
Weight		33.2 ± 0.8g
Packaging		Pouch
Cathode		NMCA
Energy Density Including packaging	Nominal Gravimetric	449 Wh/kg
	Minimum Gravimetric	441 Wh/kg
	Volumetric (@ 30% SOC)	940 Wh/L 5
Special Note	Cell requires external clamping of 30 PSI	
Certifications	UN 38.3	

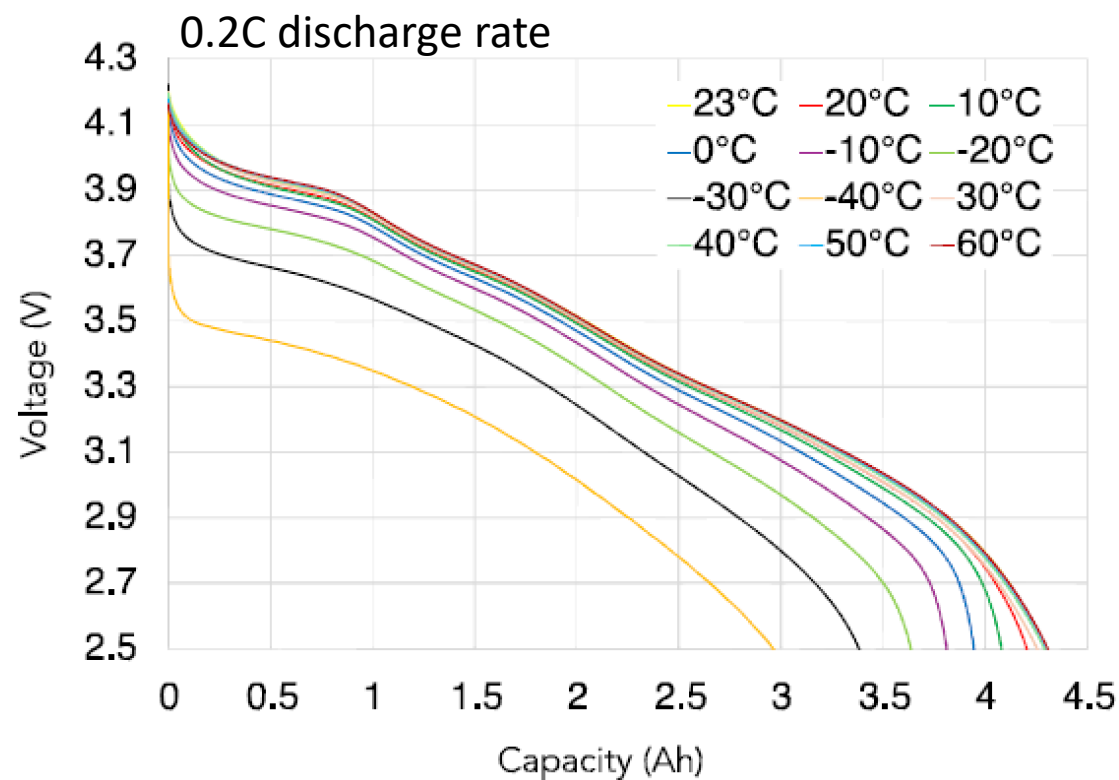
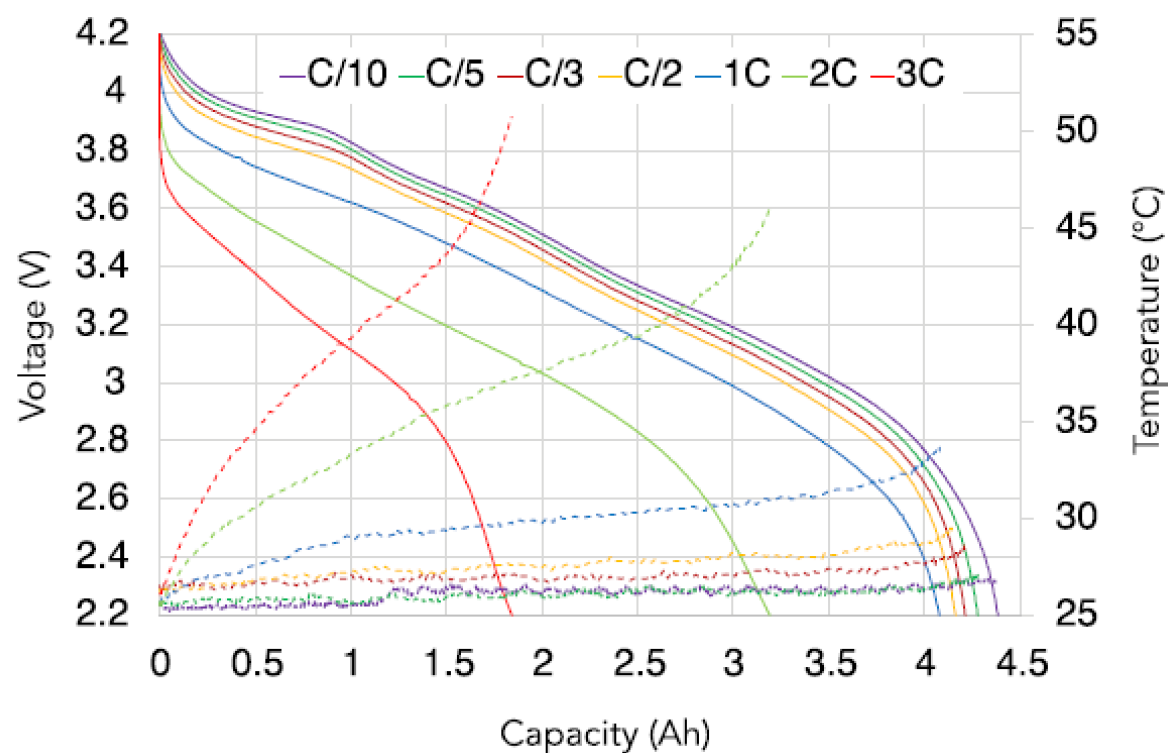


Dimensions

Size	L1	56.5 ±1.5mm
	L2	53.0 ±1.5mm
	W1	49.5 ±1.5mm
	T1 (@ 30% SOC, Fresh)	5.5 ±0.4mm

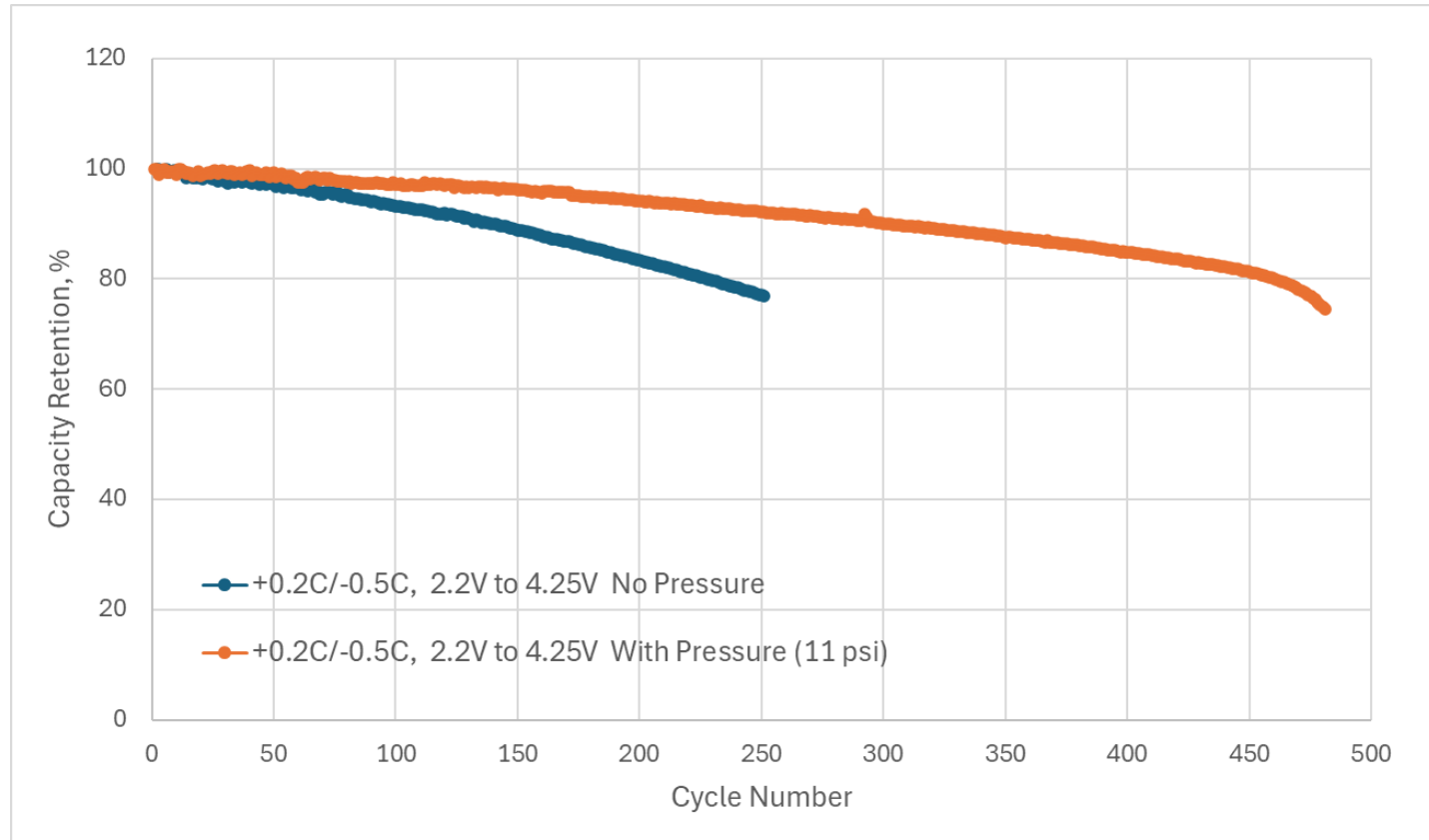
Additional form factors in development

Discharge Rate and Temperature Capability



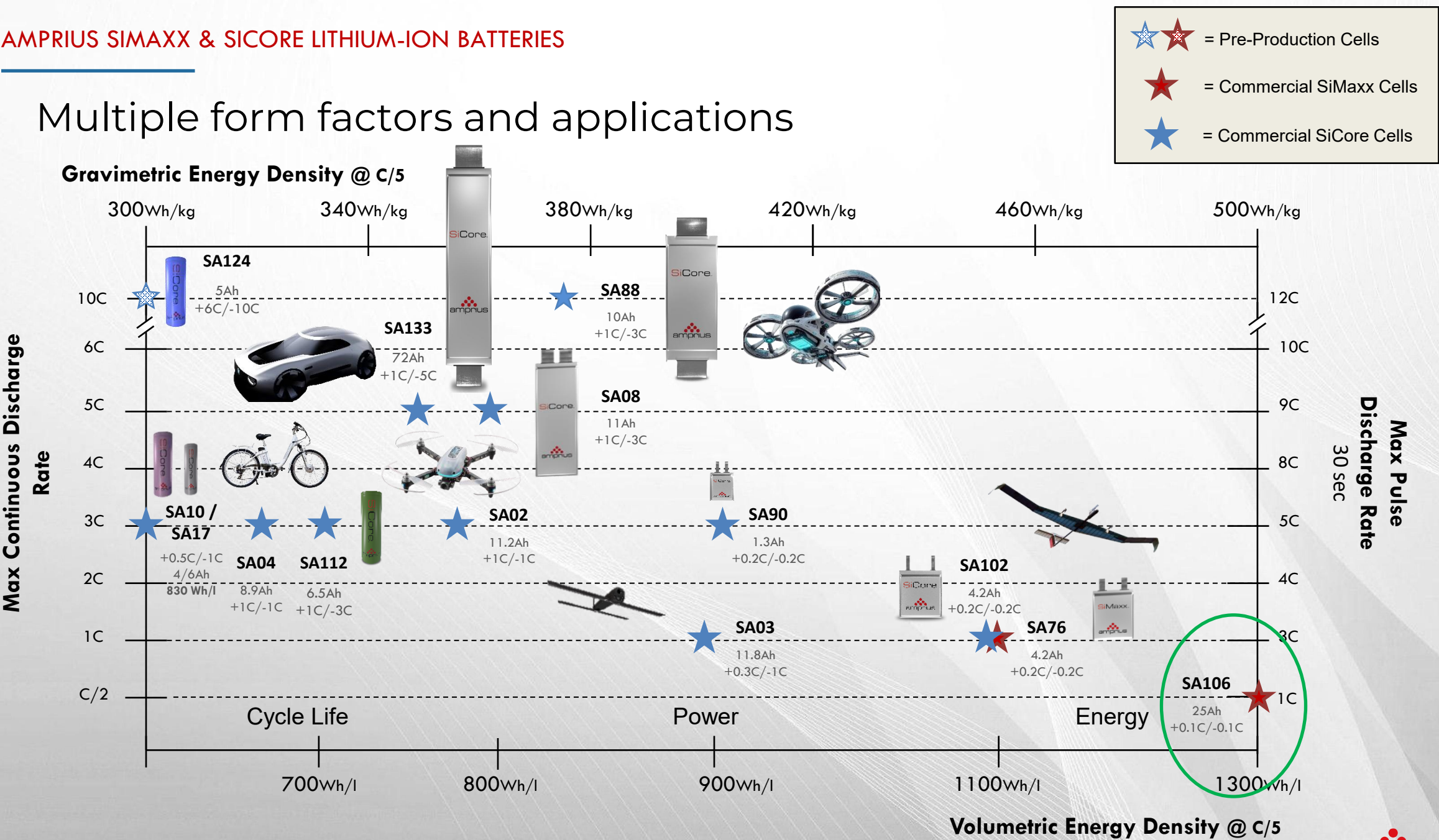
- Rated for continuous discharge up to 2C
- Very good discharge capacity at -40°C (~70%)

Cycle life



- ▶ Tested at 100% depth of discharge
- ▶ Less than 100% SOC discharge likely to increase cycle life further
- ▶ Stratospheric operation requires light pressure, easy to achieve with elastomer materials

Multiple form factors and applications



Exact performance is provided on technical data sheets, visit Booth 305

HIGHEST ENERGY DENSITY DELIVERD TO CUSTOMERS: 515 Wh/kg in 25 Ah CELL

Pure Si anode

iPhone 17 Pro

SA106: 25Ah



Size: 12.7 x 57 x 95 mm

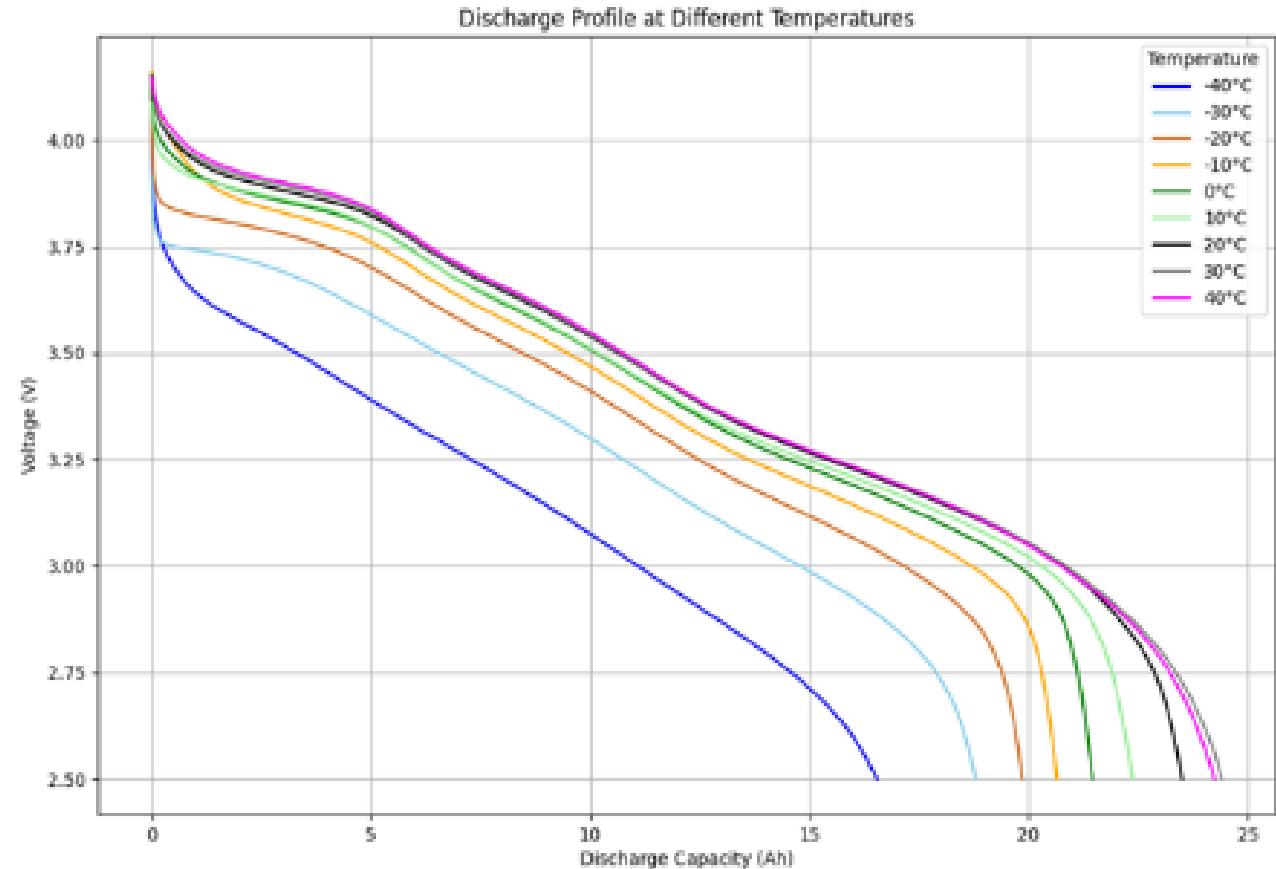
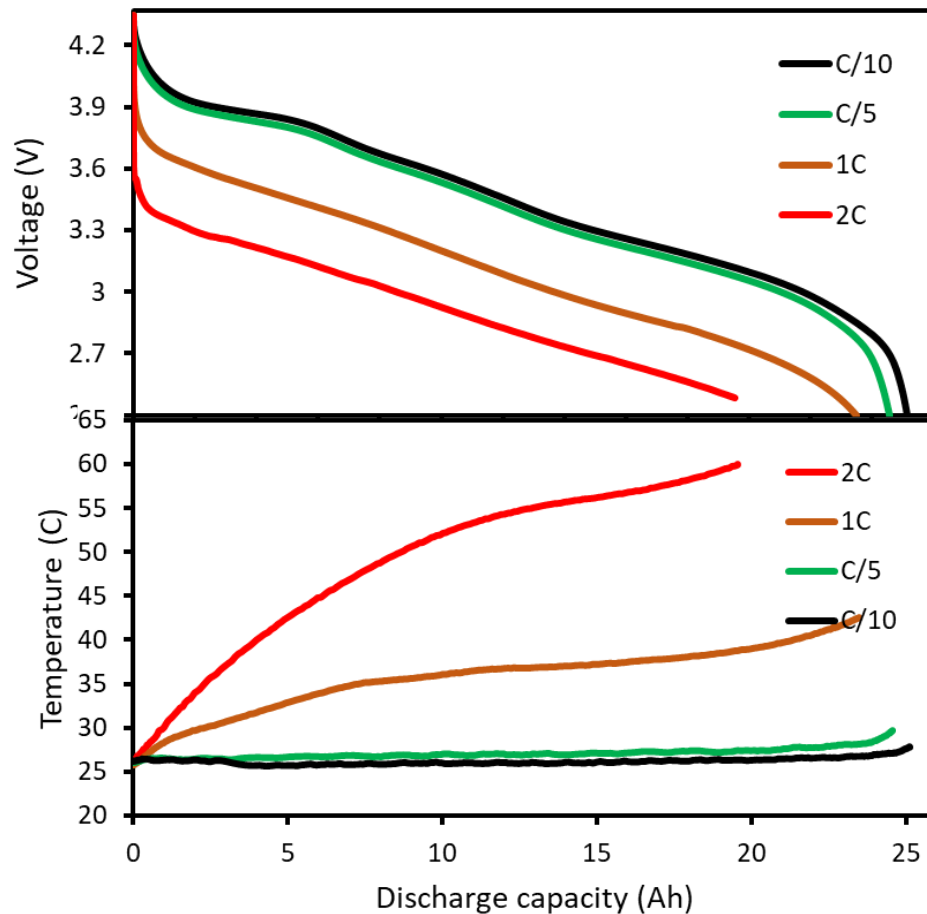
8.8 x 72 x 150 mm

The smallest 25Ah cell !!!

Specifications

Capacity	Typical @ C/10	25 Ah
		86 Wh
	Minimum	24 Ah
		83 Wh
Cell Voltage	Nominal	3.43 V
	Charge	4.35V
	Discharge	2.50 V
Discharge Current	Max Continuous	25 A
	Max Pulse (≤ 30 seconds)	TBD
Charge Current	Typical	2.5 A (C/10)
	Maximum (0% to 100% SOC)	25
Temperature Range	Discharge	-10 to 40°C
	Charge	-10 to 40°C
	Storage	0 to 30°C
Internal Resistance	ACIR (1 kHz @ 30% SOC)	6 mΩ
	DCIR	N/A
Cycle Life	+C/5/-C/5, to 80% SOH	100 cycles
Weight		167.0 ± 1g
Packaging		Pouch
Cathode		NCMA
Energy Density	Gravimetric	515 Wh/kg
	Including packaging	Volumetric (@ 30% SOC)
		1150 Wh/l

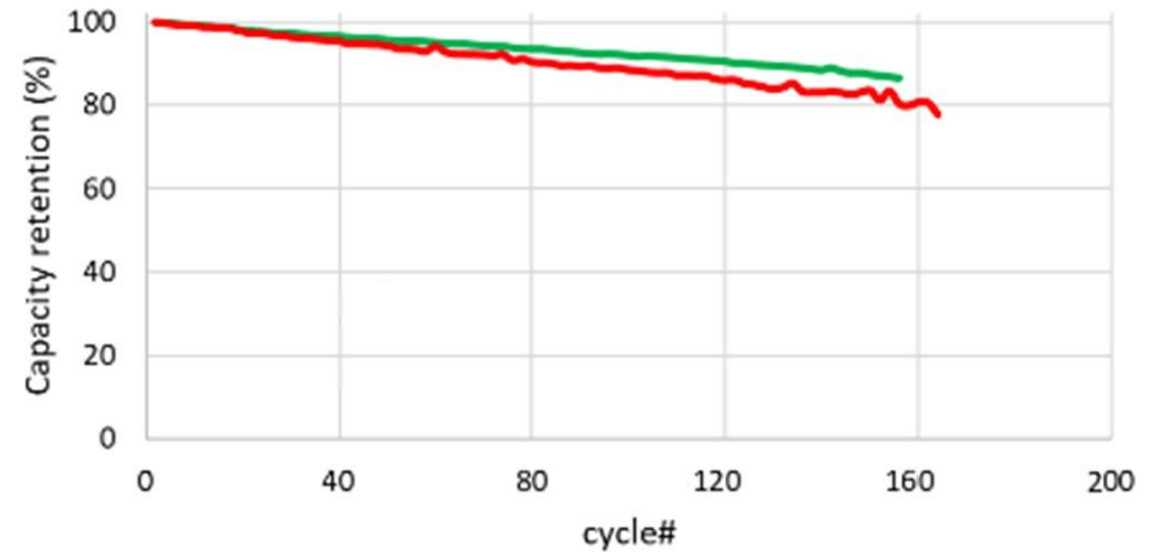
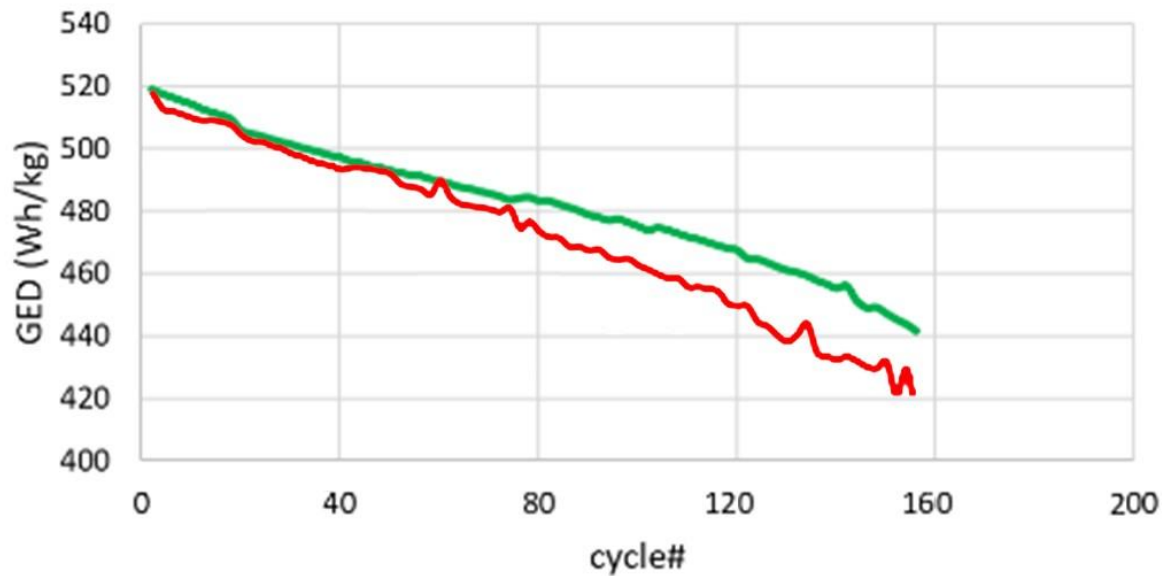
Discharge Rate and Temperature Capability



- Rated for continuous discharge up to 1C for mild temperature increase
- 80% capacity retention at -30°C → 400 Wh/kg delivered at -30°C

515 Wh/kg in 25 Ah CELL

Cycle life at room temperature



KEY TAKEAWAYS

- ▶ 25 Ah, >515 Wh/kg, 1150 Wh/L in 12.7(T) x 57(W) x 95(L) mm format (including tab terrace)
- ▶ ~150 cycles at full depth of discharge, expected >300 with 70% depth of discharge
- ▶ Developed for HAPS customer with support from xTechPrime

415 Wh/kg semi-solid-state electrolyte

Optimized for long mission endurance

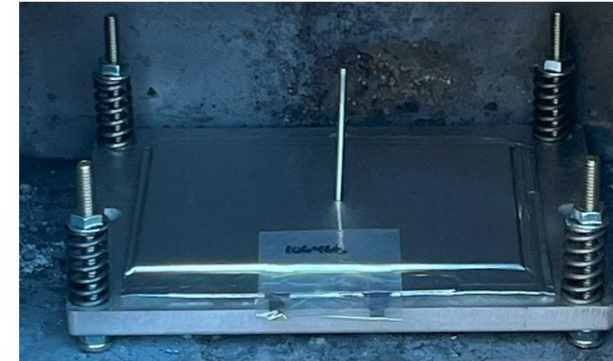
SA89



Size: 2.9 x 99 x 150 mm
12.4 Ah, 42 Wh
415 Wh/kg @C/5



Before Penetration



Right After Penetration

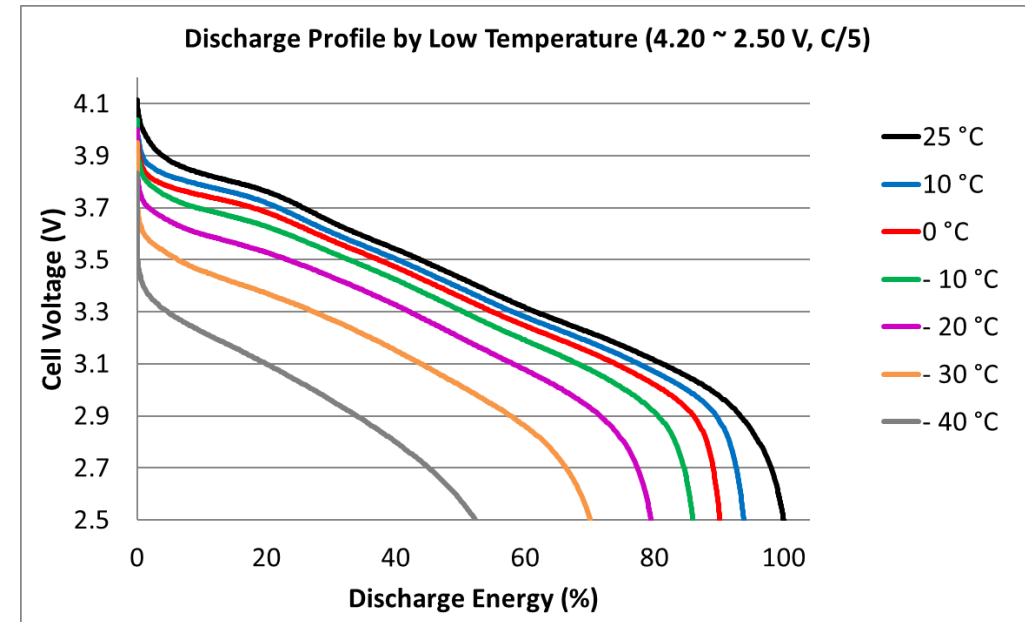
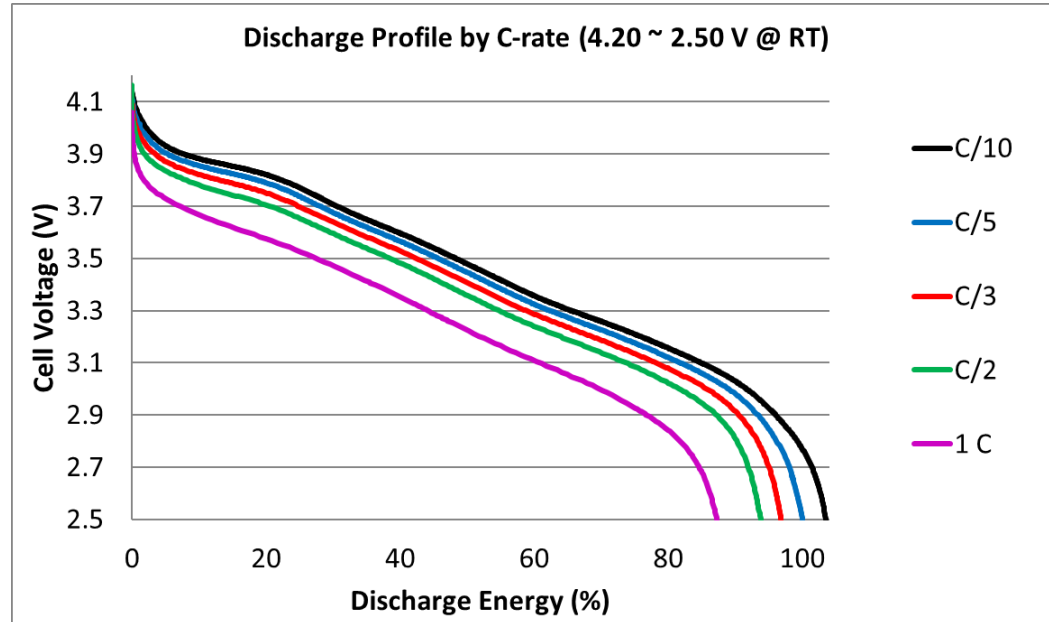


One Day After Penetration

Nail penetration safe

415 Wh/kg semi-solid state electrolyte

Optimized for long mission endurance



KEY TAKEAWAYS

- ▶ High capacity, high energy density cell passes nail penetration by preventing short circuit during the event
- ▶ Nail insulation is complete, cell voltage is stable
- ▶ Developed for wearable battery applications

Electric Flight Applications Enabled by Amprius' Batteries

	Unmanned Aerial Systems (Drones)	High Altitude Pseudo Satellites	Air Transportation	Fixed-wing Electric Aircraft
Product				
Application	Recon Drone	Stratospheric Satellite	eVTOL	Small Passenger Plane
Amprius Product	Balanced Energy/Power	High Energy	High Power	Balanced Energy/Power
Performance Specification	1.4 Ah, 390 Wh/kg at C/5	5.8 Ah, 450 Wh/kg at C/10	10 Ah, 350 Wh/kg at 1C with 20C max pulse	30 Ah, 350 Wh/kg at C/5
End User Benefit	Long endurance and increased capacity with no increase in weight or volume	Ultra long sustained flight at high altitude with max payload	eVTOL with extreme-fast charge and greatly extended service radius	Very long endurance and increased capacity with no increase in weight or volume

Electric Flight Applications Enabled by Amprius' Batteries

E-Bikes

Electric Scooters

Electric Motorcycles

Product			
Amprius Product	High Energy	Balanced Energy/Power	High Power
Performance Specification	6.3 Ah, 315 Wh/kg at C/5	11 Ah, 345 Wh/kg at 1C	10 Ah, 350 Wh/kg at 1C with 20C max pulse
End User Benefit	Ultra long range with no increase in weight or volume	Very long range and high performance with no increase in weight or volume	Ultra high performance with long range and no increase in weight or volume

Thank you !

Amprius Technologies

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