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THE SHIFT TO CLEAN ENERGY NEEDS BETTER BATTERIES NOW:

New 60140 cells – Preliminary data

- **Benefits:**
 - **High energy density**
 - **Very High power**
 - **Very robust housing and screwed contacts**
 - **Easier to assemble**



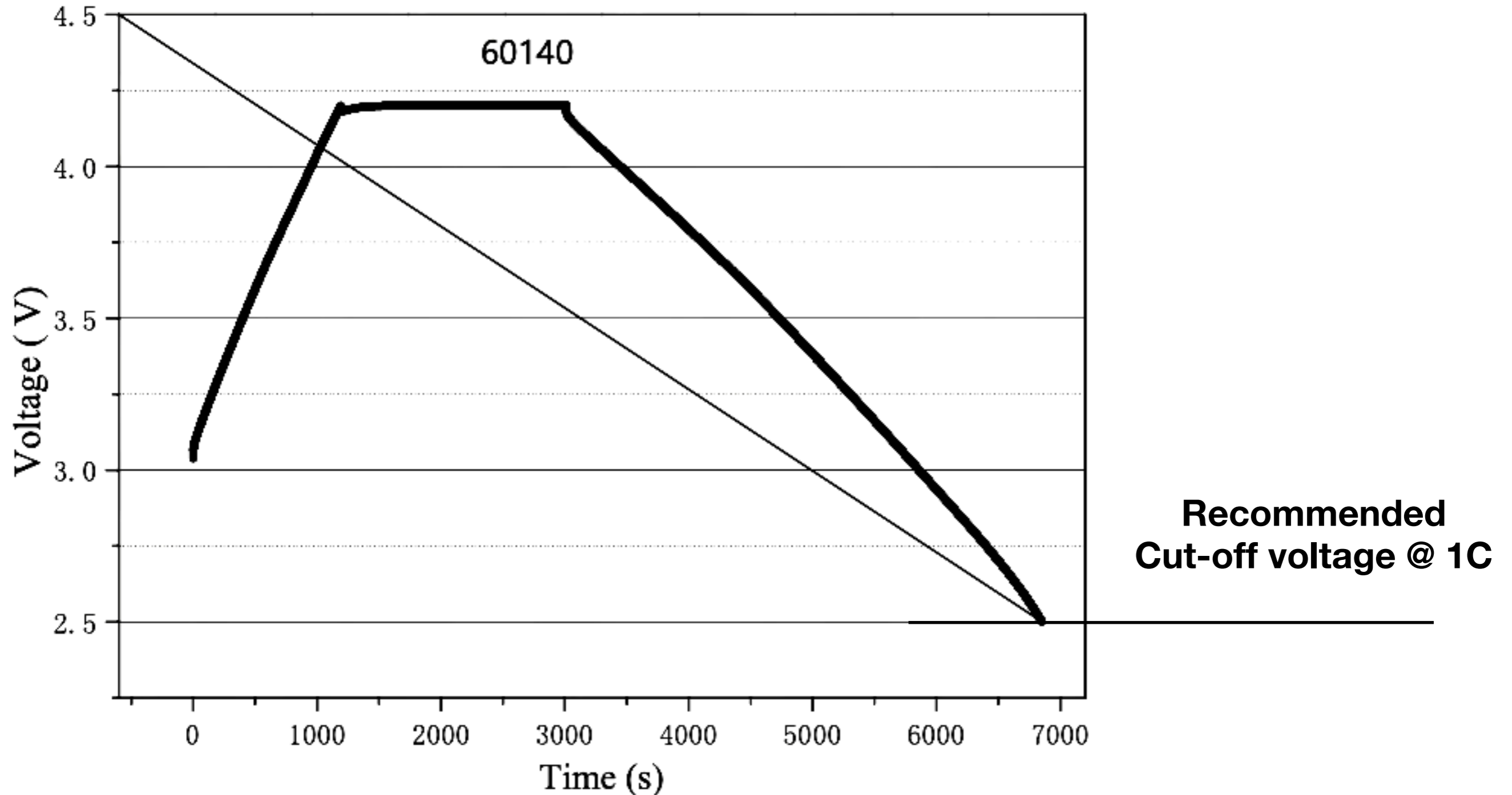
New 60140 cells – Preliminary data

- Upto 88 Wh/kg
- 4.0V nominal
- 18 to 19 Ah
- 30C sustained capable
- Upto 2200 A
- 100C, pulse power
- Very fast charging
- Lower resistance (< 1 mOhm)
- Passive cooling
- > 20000 cycles



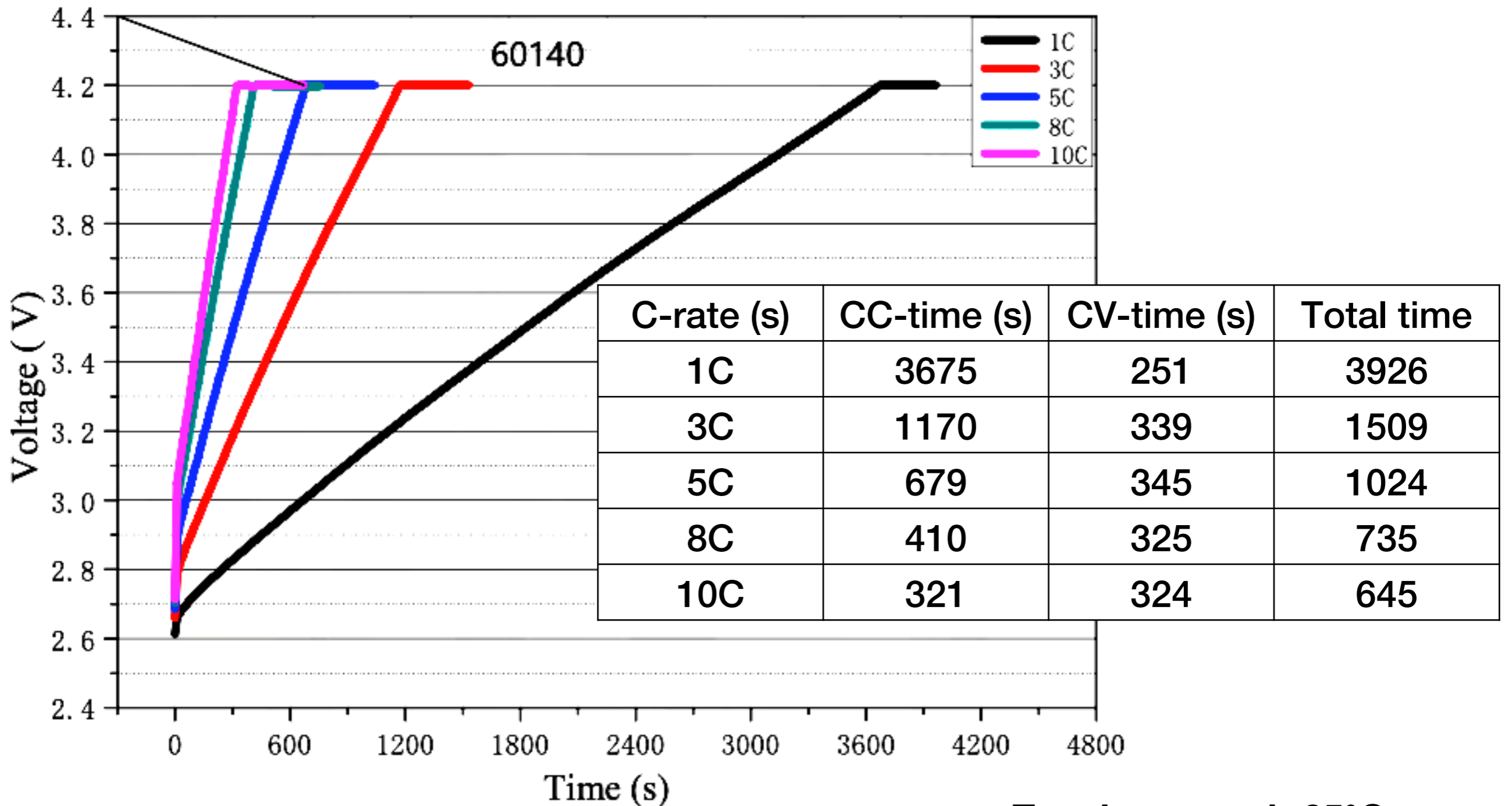
60140 vs 21700

1C capacity test: 18.5 Ah / 80 Wh



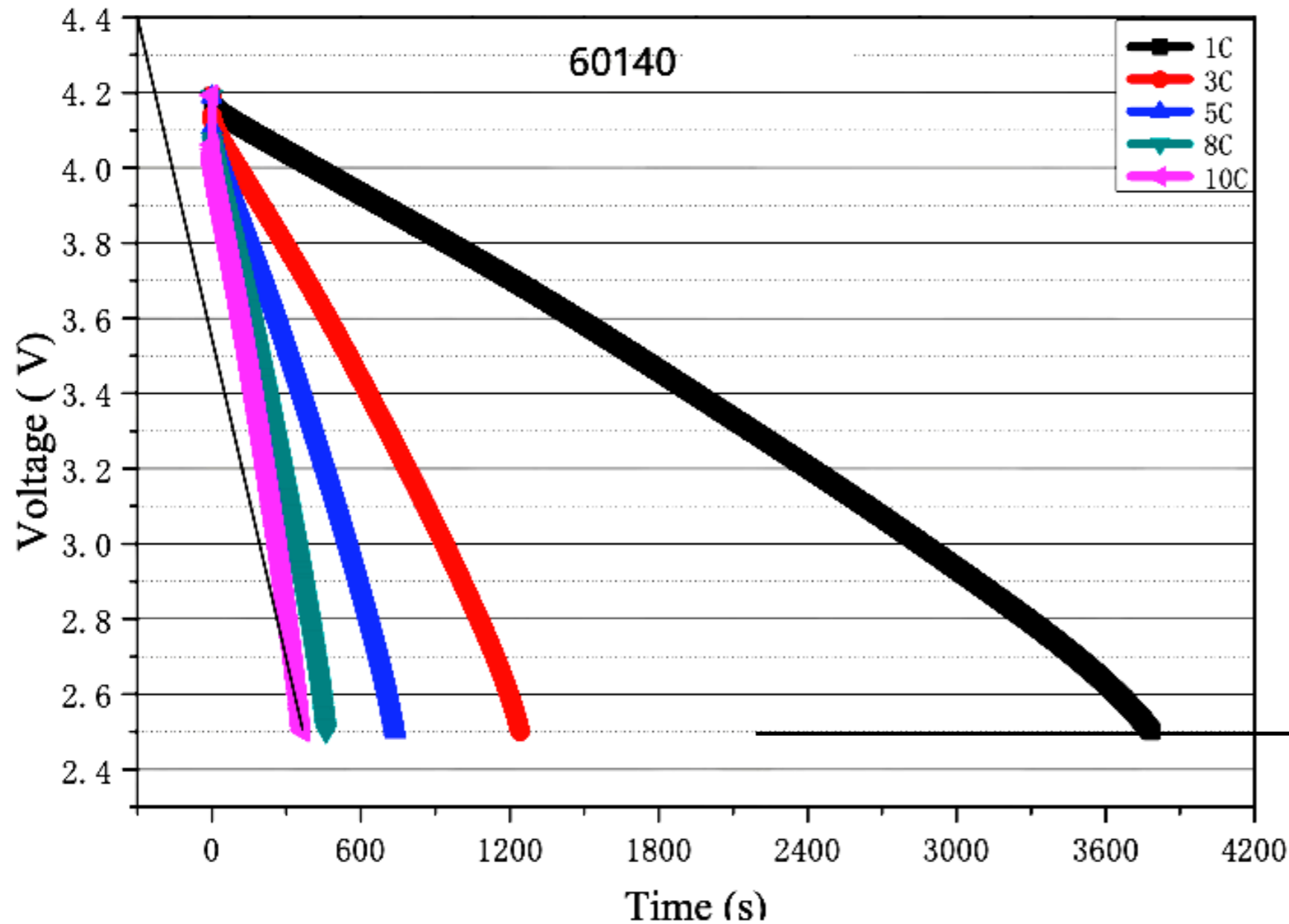
**Test in room air
22 – 25°C air temp.**

1C – 10C charging test



Test in room air 25°C

1C – 10C discharging tests



Leakage current

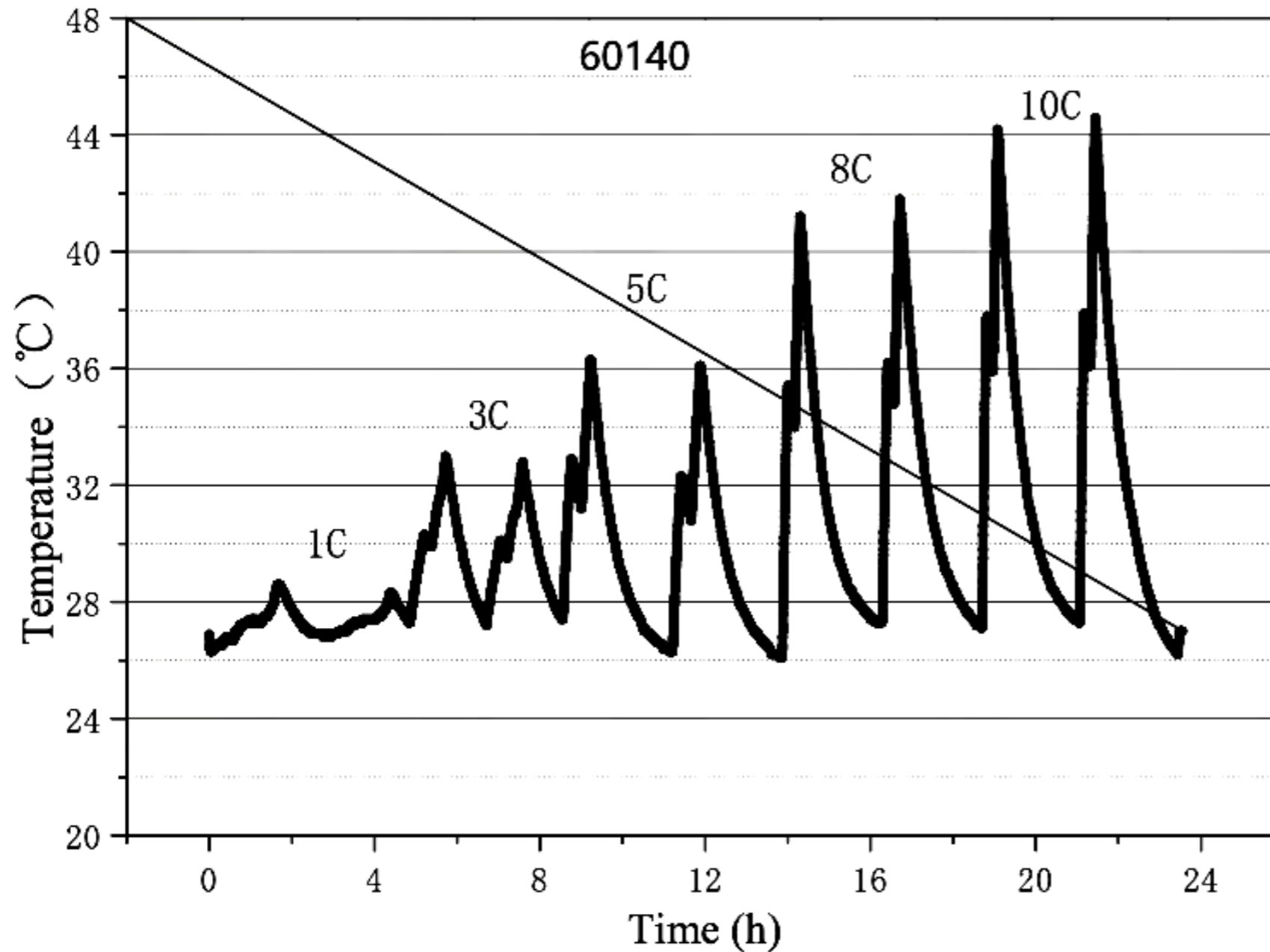
Volt	mA
4.2	15.6
4.0	5.2
3.6	1.96
3.0V	0.0

**Recommended
Cut-off voltage @ 1C**

**30C test (30 seconds)
with adapted interconnect**

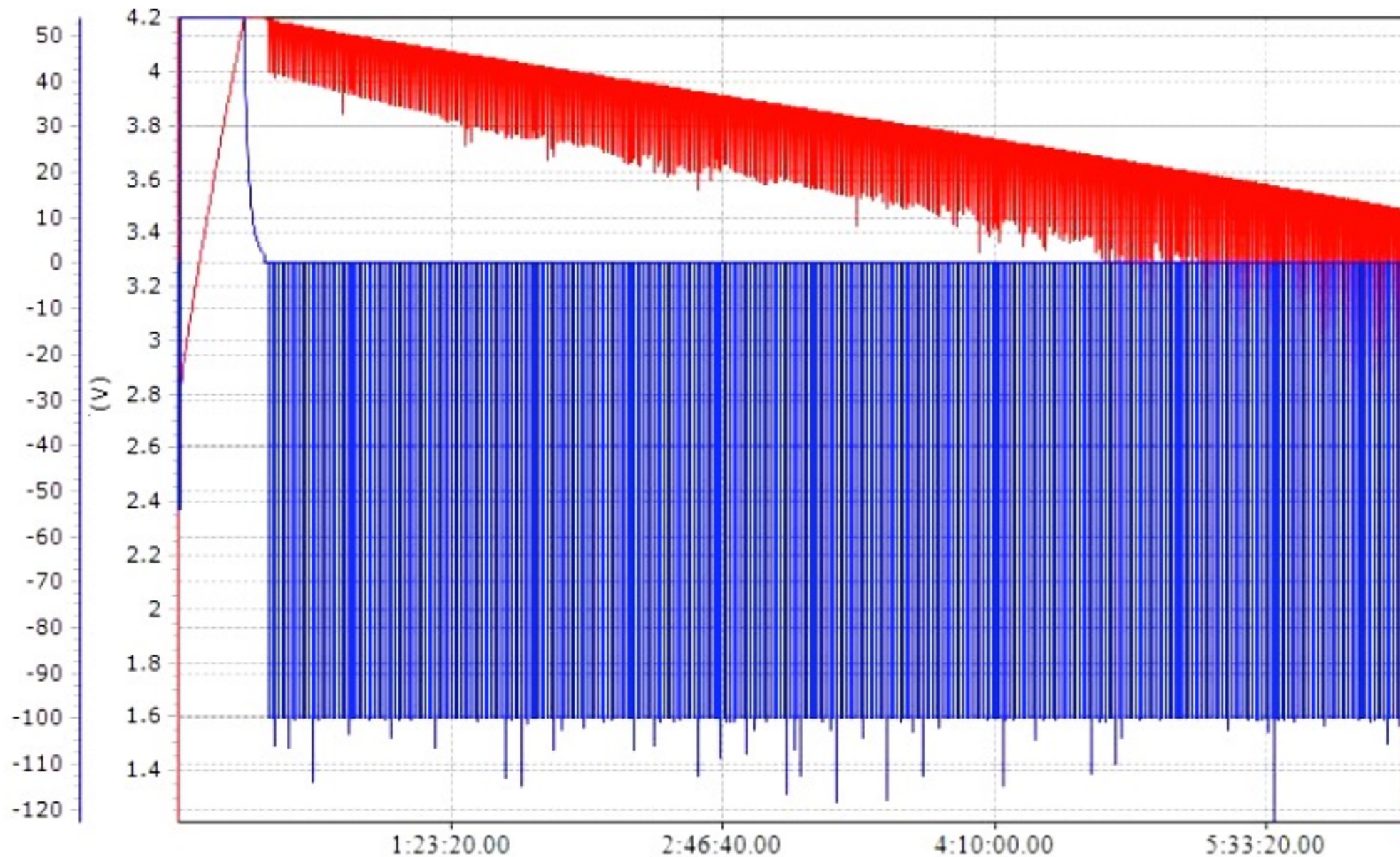
**Test in ventilated room air
At 22 – 25°C air temp.
41°C on skin at end of 10C test**

1C – 10C Charge/discharge temperature tests



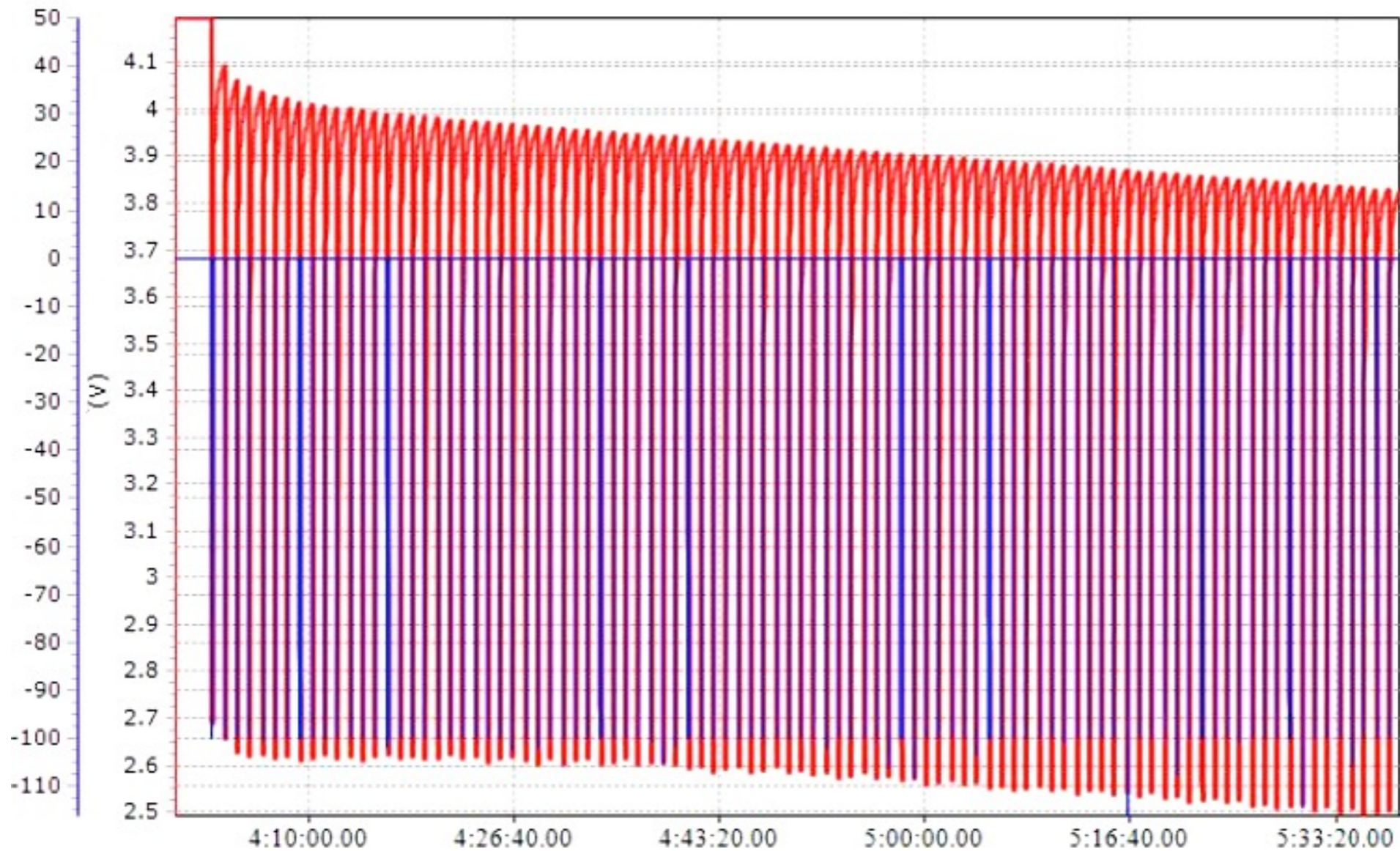
20°C increase @ 10C

100A 1 sec pulse discharging @ 25°C



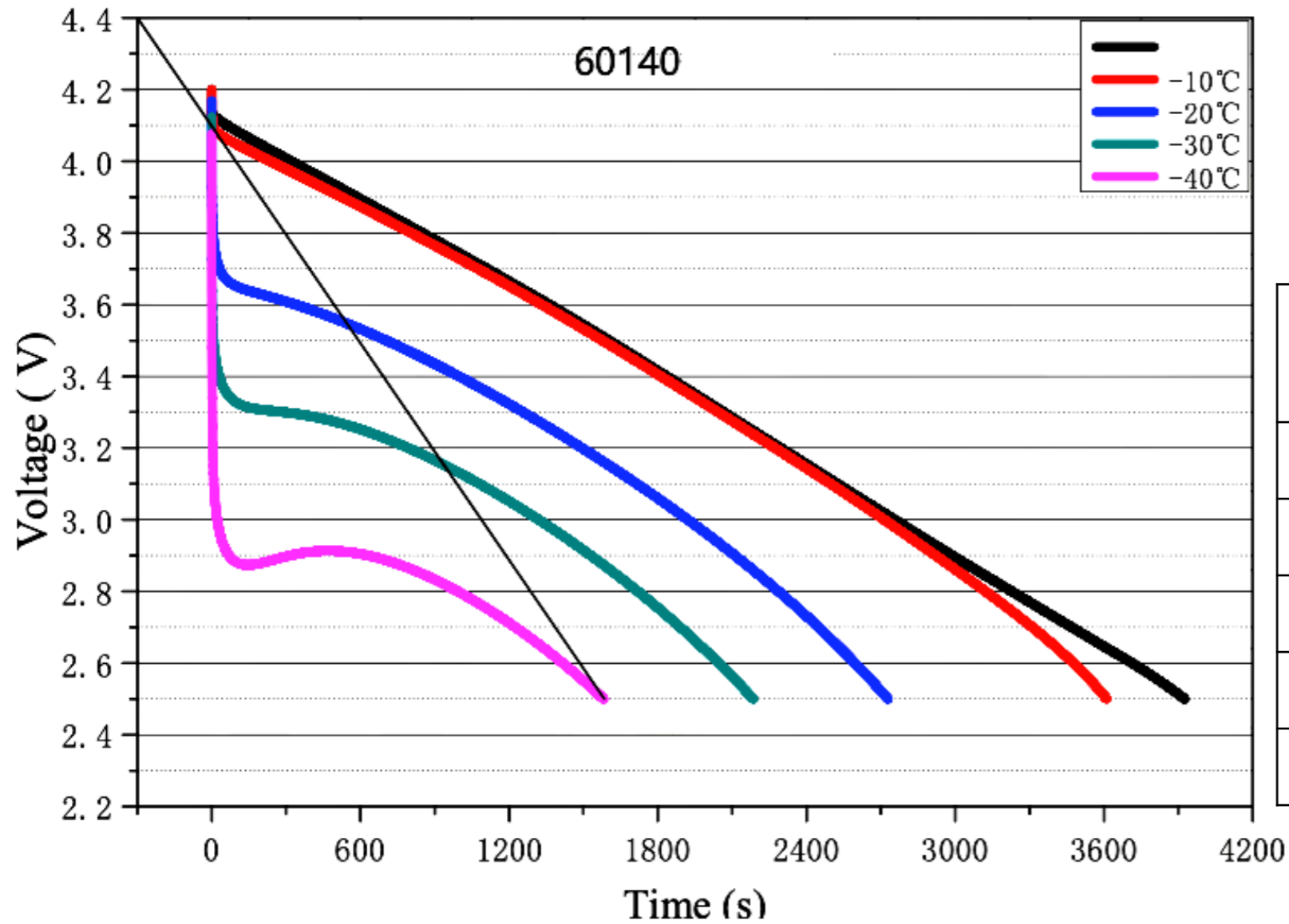
Capacity sufficient for 345 discharge pulses till cut-off Voltage

100A 1 sec pulse discharging @ -40°C



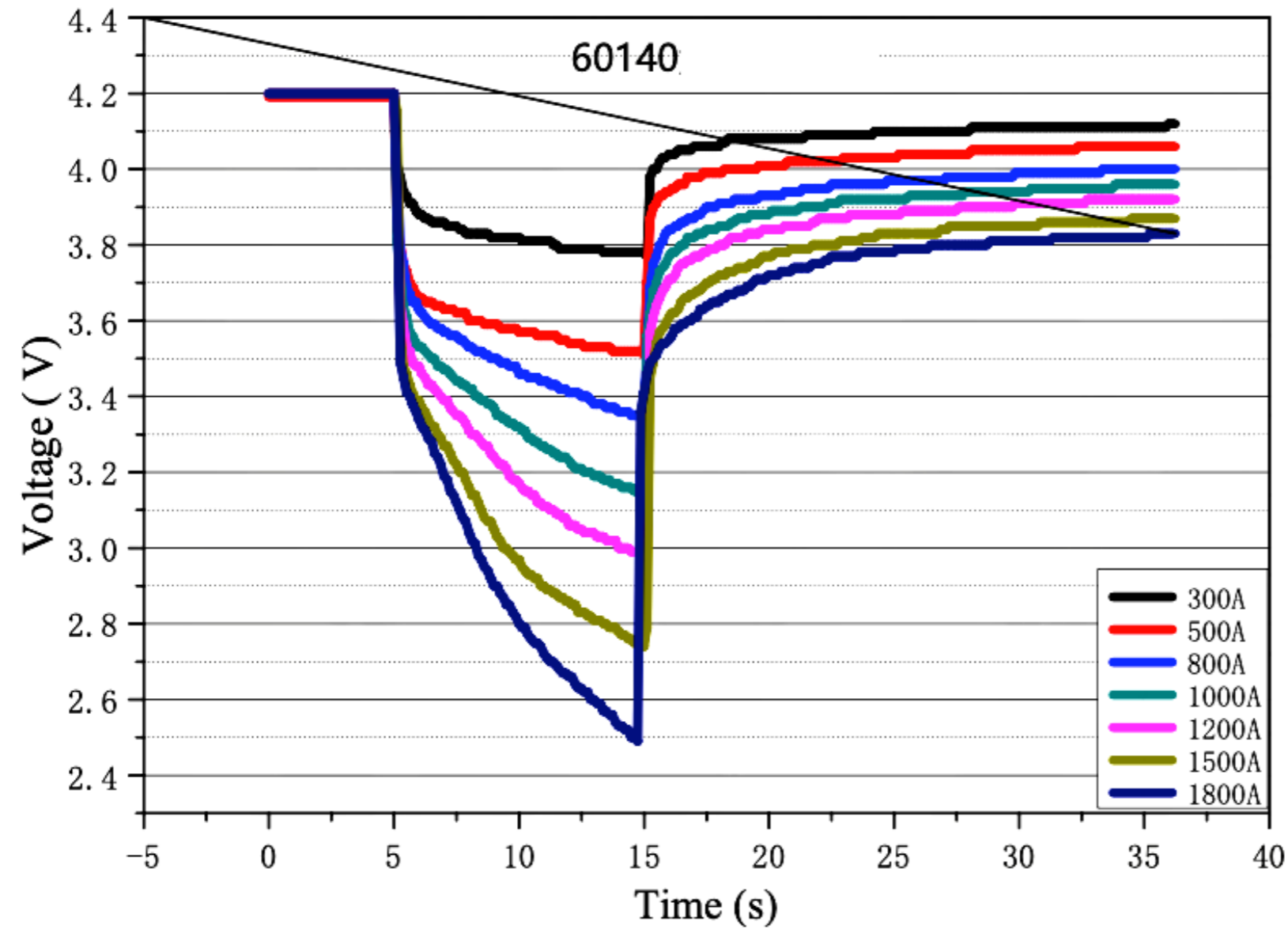
Capacity sufficient for 94 discharge pulses till cut-off Voltage

Low temperature discharging



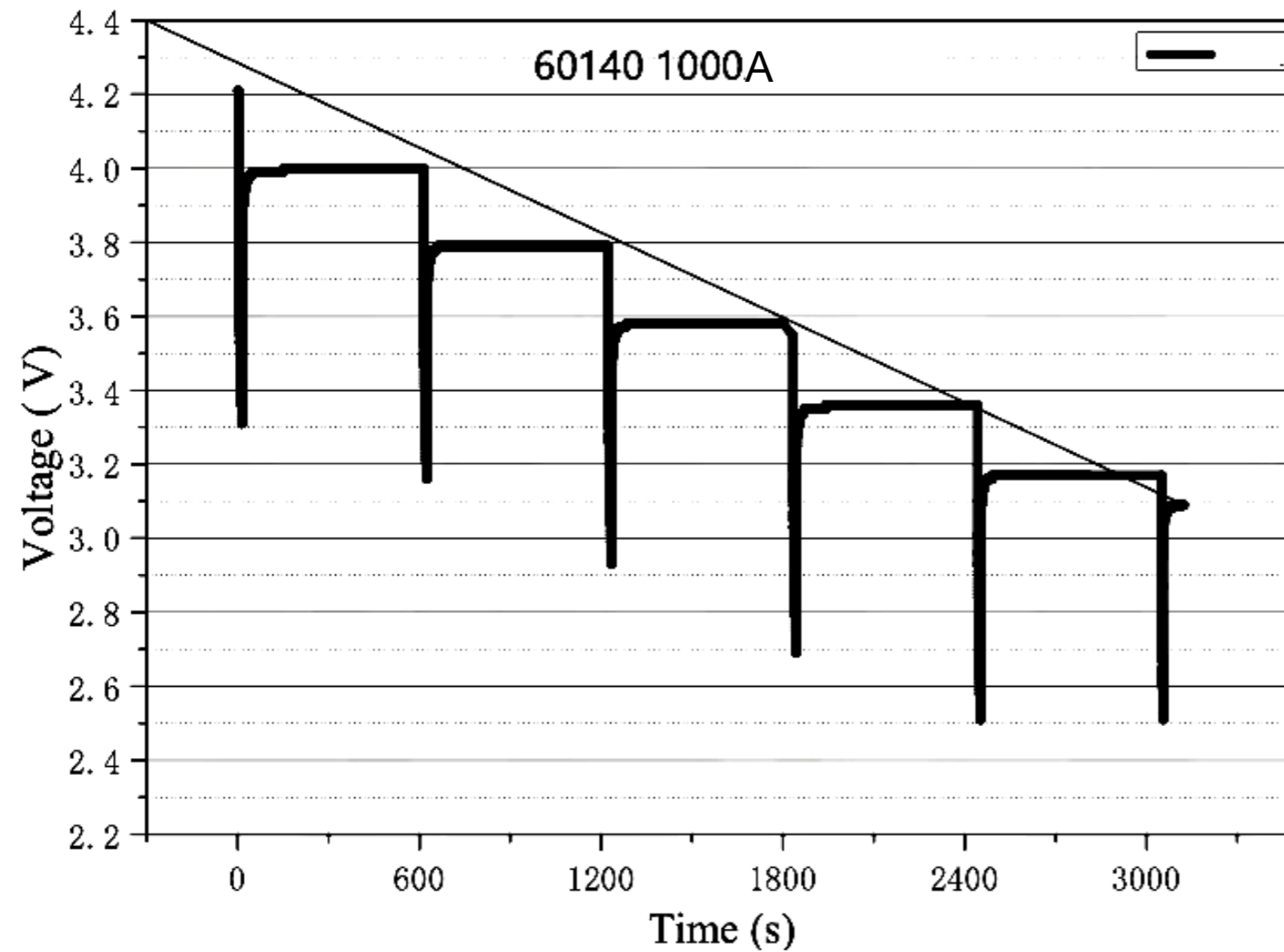
T (°C)	Capacity (Ah)	%
25	19.56	--
-10	17.94	92
-20	13.37	68
-30	10.72	55
-40	7.77	39

High current discharging tests (10 s)



**1800 A (100C) for 10 s
limit to cut-off voltage**

1000A/10 sec pulse discharging tests



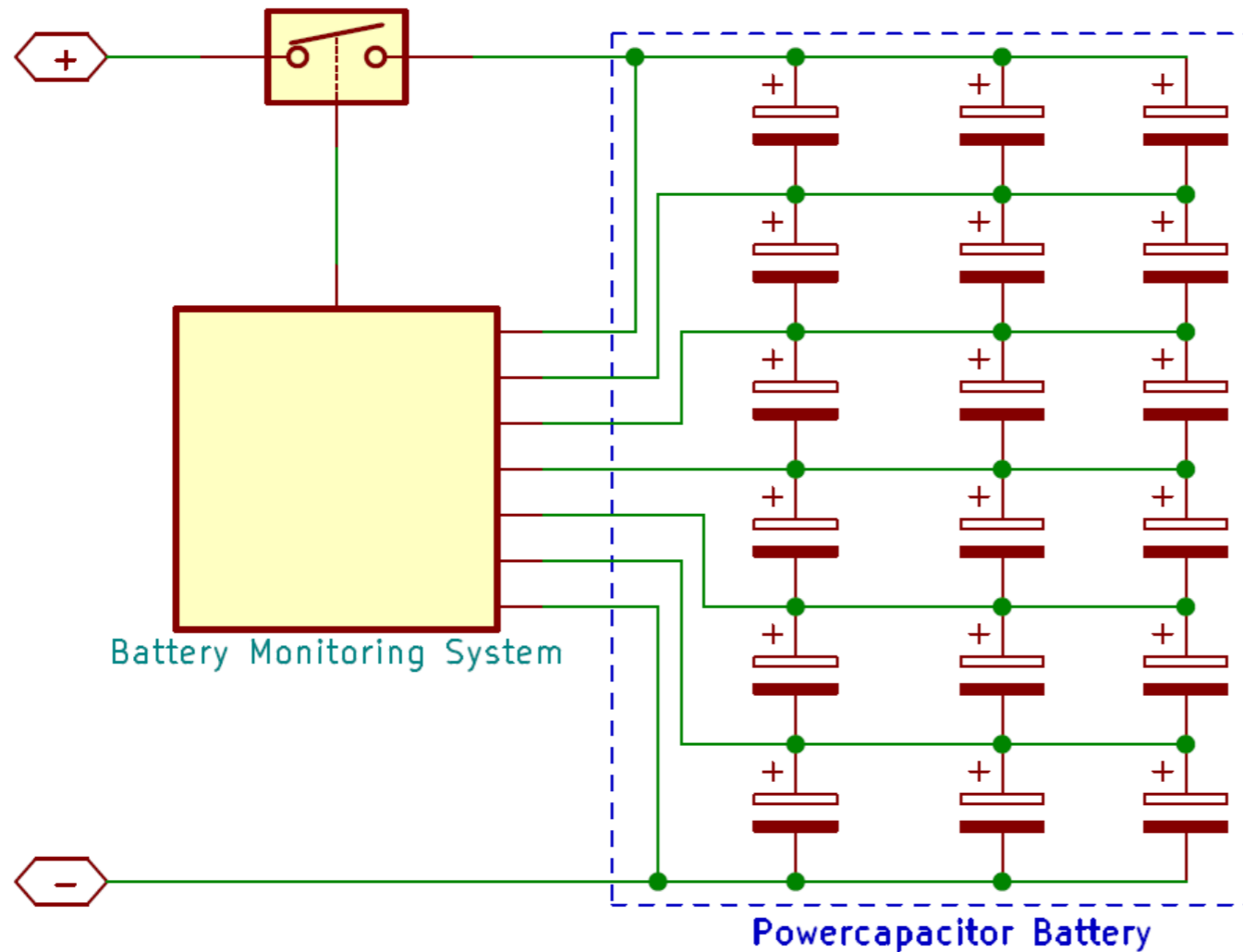
Application domains

- **Very high current and high energy: sustained high power**
- **Advantage in volume, small penalty in weight**
- **Safety, long life, extreme temperatures**
 - **Grid stabilisation**
 - **High speed energy buffering**
 - **Racing vehicles**
 - **E-VTOL**

Comparison 21700-2.5 Ah vs 60140-18.5 Ah

Main datasheet 60140 cell			21700-2.5Ah	60140/21700 factor	Comparison for > 340 A		Legend
Parameters	Values	Unit			14*10*21700	14*60140	
Nominal capacity	19,50	Ah	2,50	7,8	350	273	Better
Rated capacity	18,50	Ah	2,4	7,5	336	259	Worse
Maximum voltage	4.2	V	4,2				
Cut-off voltage	2,5	V	2,5				
DC internal resistance (10ms)	≤ 0.25	mOhm	8				
Nominal charging current	≤ 54A (3C)	A	7.5 (3C)	7,2	75	54	
Recommend max. charging current	≤ 180A (10C)	A	25A (10C)	7,2	250	180	
Recommend max. discharge current	≤ 180A (10C)	A	25A (10C)	7,2			
Maximum continuous discharge current	≤ 540A (30C)	A	34A (14C)	15,9	340	540	
Maximum pulse current	≤ 2200	A	< 75A	29,3	750	2200	
Maximum temperature rise	55 ±5	°C	55 ±5				
Charge discharge temperature range	-40 +85	°C	-40 +85				
Storage temperature range	-40 +55	°C	-40 +55				
Fast charging cycle life (@ 25 ± 2 °C)	≥ 8000 (@10C)	cycles	10000				
Slow charging cycle life	≥ 10000 (@1C)	cycles	20000				
Weight	880	g	70	15,9	9800	12320	
Dimension (diameter d) x Height (H)	Φ60mm x 140mm	mm	Φ21mm x 70mm				
Volume	26,4	dm ³	4,6	5,7	646	369	
Nominal energy	78,0	Wh	9,1	8,6	1274	1092	
Rated energy	72,0	Wh	8,3	8,7	1156	1008	
Nominal Energy density (gravimetric)	88,6	Wh/kg	140,0	0,6			
Nominal energy density (volumetric)	29572,3	Wh/dm ³	19714,9	1,5			
Nominal Power density (continuous)	818,2	W/kg	1428,6	0,6			
Peak Power density (continuous)	2454,5	W/kg	1942,9	1,3			
Pulse power density	10000,0	W/kg	4285,7	2,3			

Battery construction



Parallel first, then serial with matched cells

BMS:

- **Battery management (active balancing) optional**
- **Battery Monitoring sufficient**
- **Monitors S-layer voltages for overvoltage and undervoltage**



For illustration only

Process flow for customer specific solutions

1. Requirements collection:

- Understanding the application and the system
- Understanding the boundary conditions

2. Feasibility study:

- Selecting powercapacitor cell types
- Initial battery configuration: (S xP), multi-module, ...

3. Load profile simulations

- Beginning of Life – End of Life
- Calendar lifetime calculations

4. CAD design

- Enclosure, safety devices, etc.

5. Assembly and test

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Questions?

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