

Eric Verhulst, CEO/CTO

THE SHIFT TO CLEAN ENERGY NEEDS BETTER BATTERIES NOW:

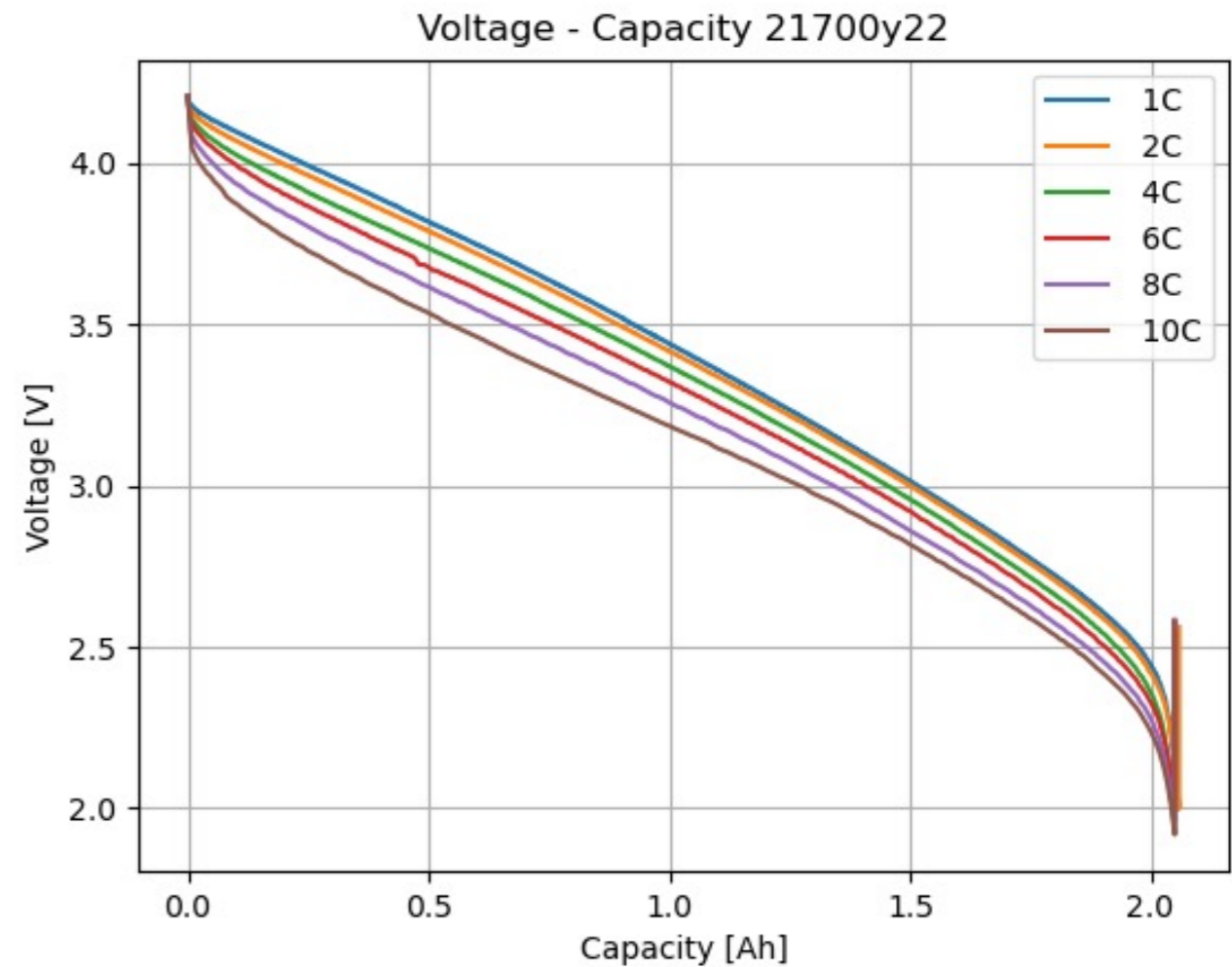
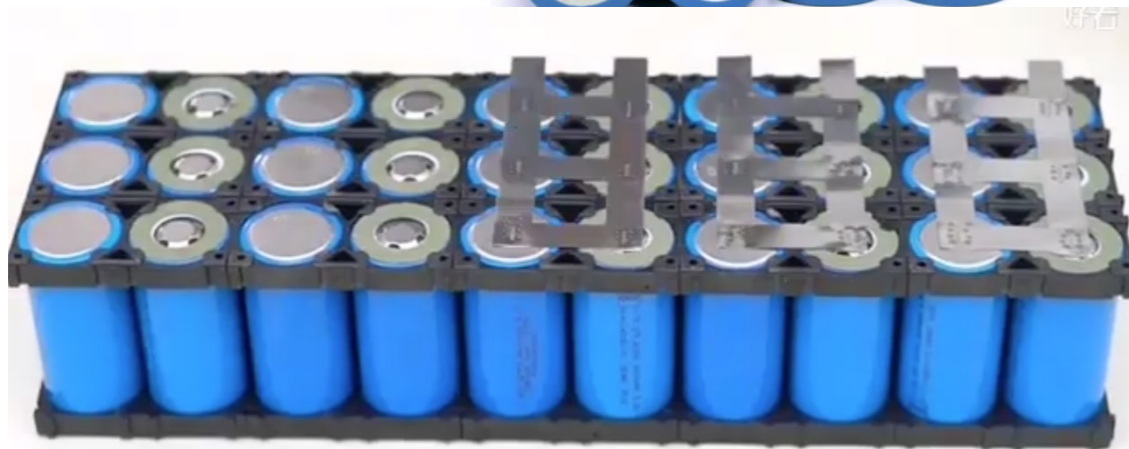
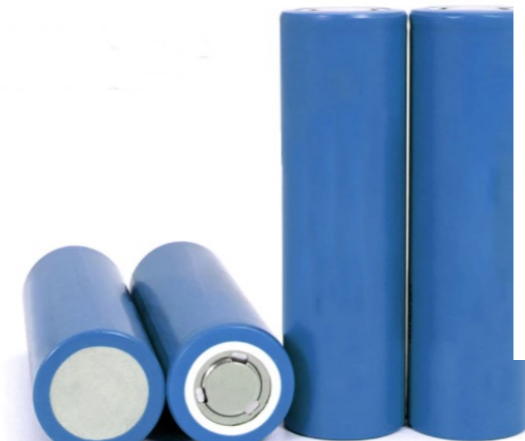
New 21700 cells

- **Benefits:**
 - **Higher energy density**
 - **High power**
 - **Very robust steel housing**
 - **Easier to assemble**
 - **Internal safety CID disconnects positive terminal upon high pressure (10 kPa)**



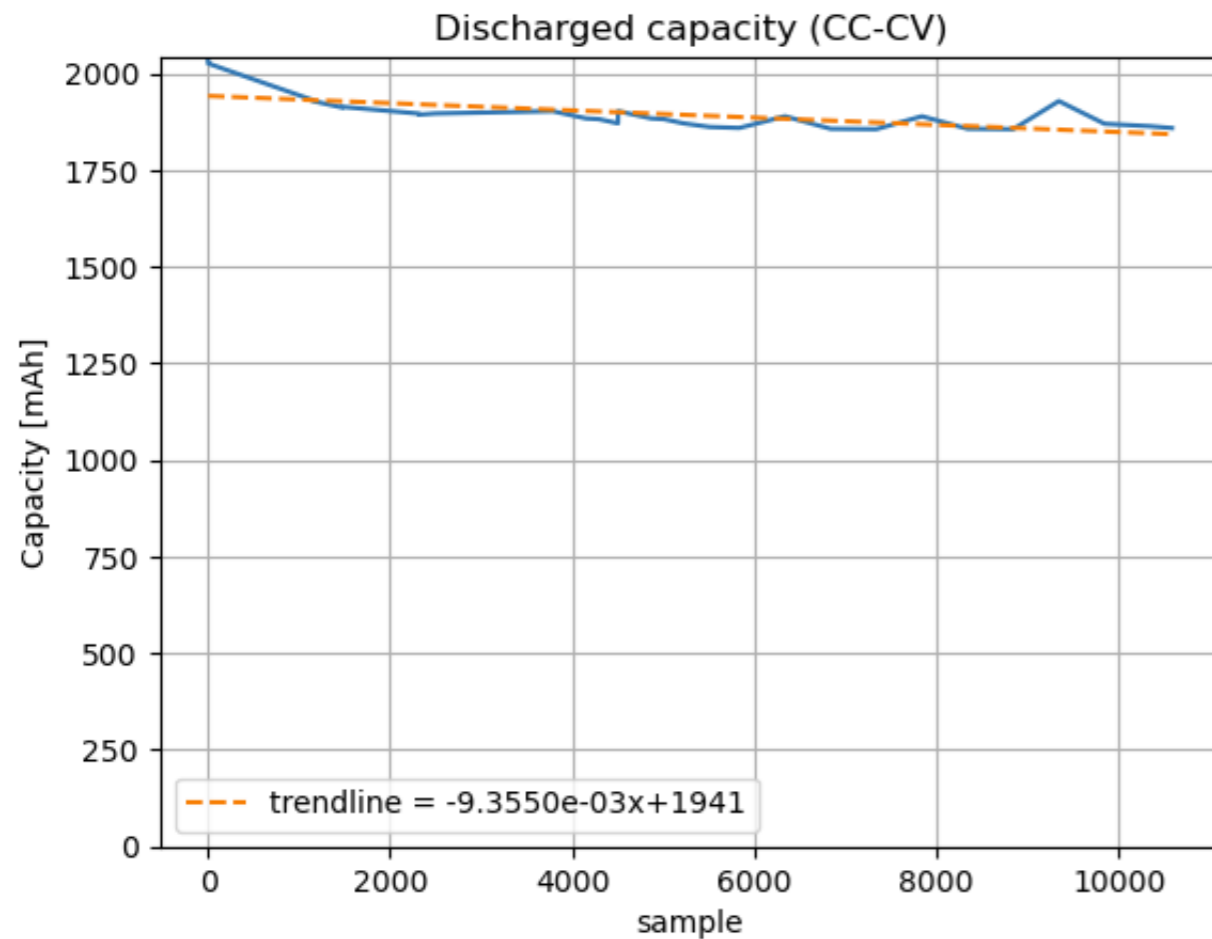
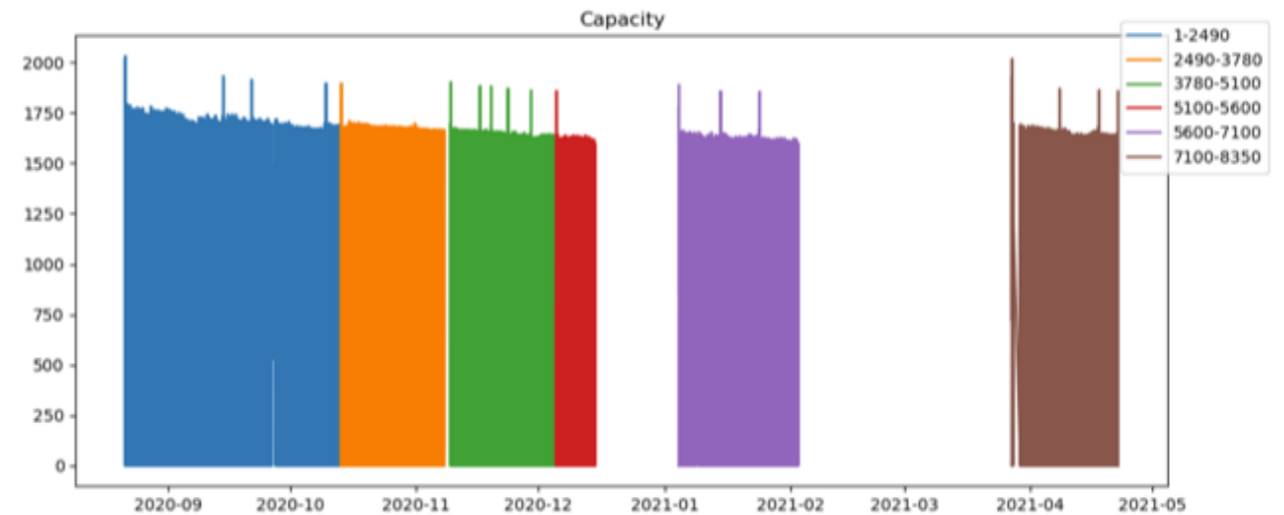
New 21700 cells

- Upto 140 – 150 Wh/kg
- 4.0V – 1900 to 2500 mAh
- 10C sustained capable
- > 10C – upto 30C (30 seconds)
- Very fast charging
- Lower resistance (10 mOhm)
- Passive cooling
- Hard short-circuit tested
- Overcharging tested
- > 20000 cycles

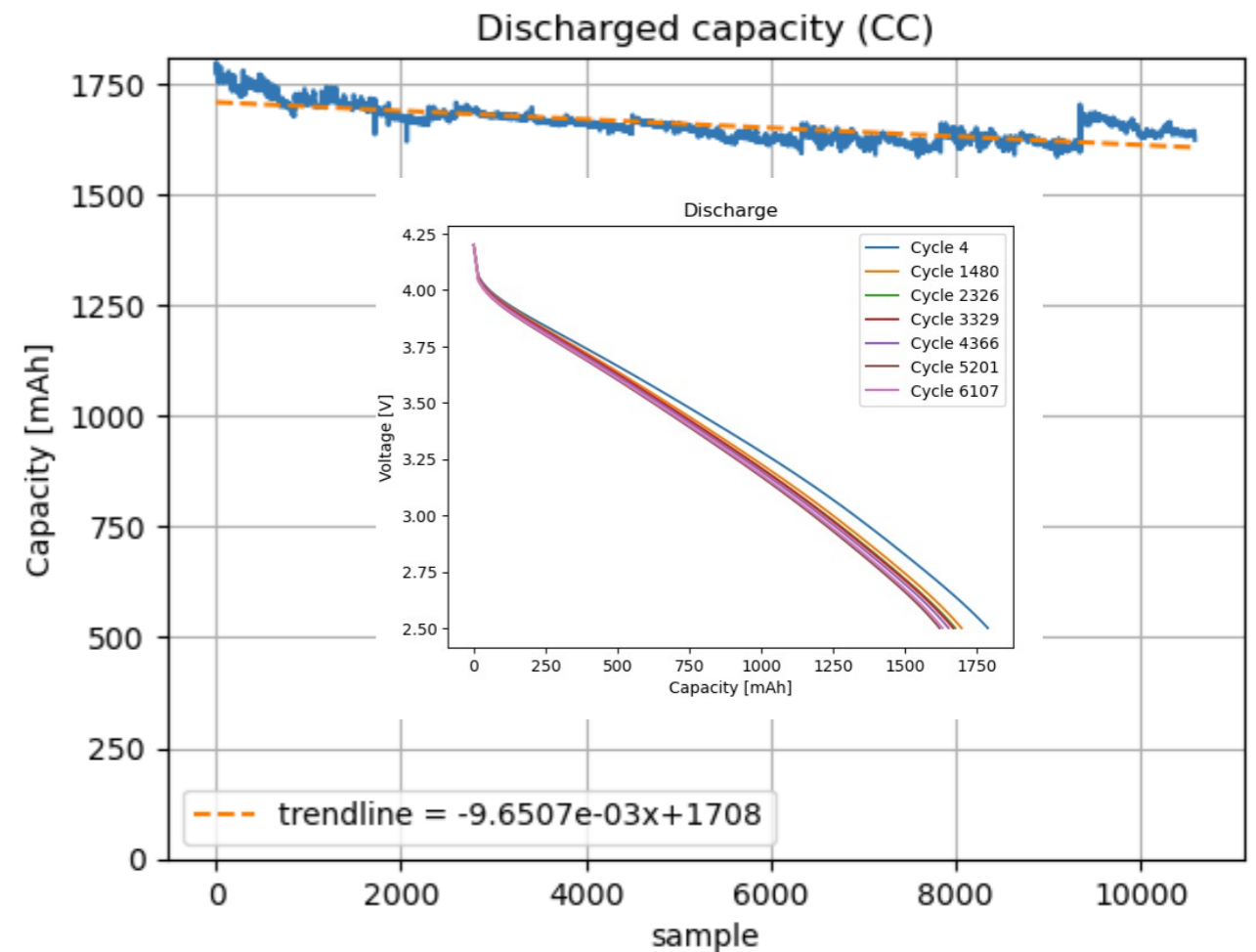


New 21700 cells, proven > 10000 cycles

- Tests > 1 year
- Shows some recovery due to rest time

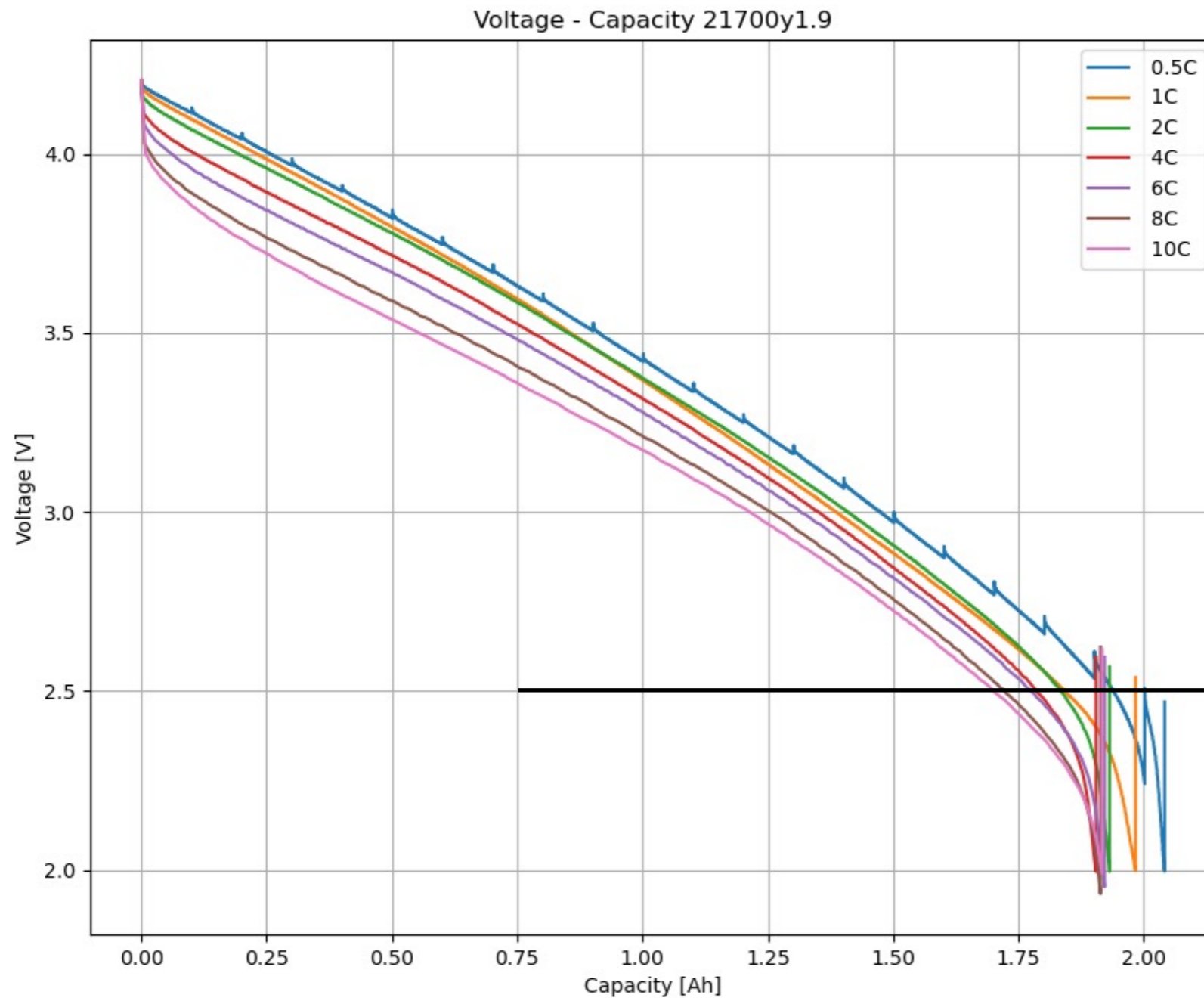


**3C charging, 1C discharging
with CV phase**



**5C charging, 3C discharging
without CV phase**

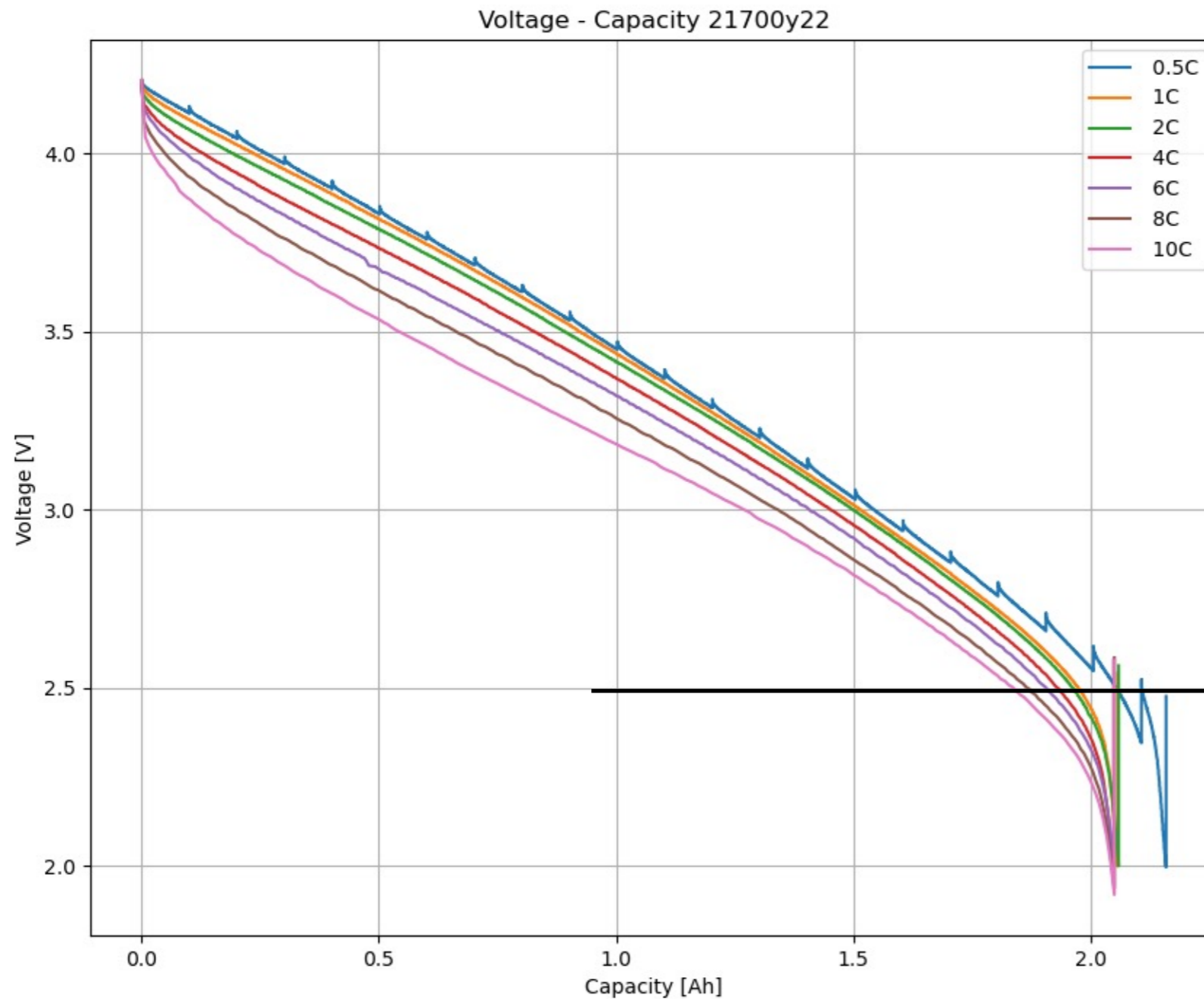
1C – 10C discharging tests – 1.9 Ah cell



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

**Test with ventilated room air
At 22 – 25°C air temp.
35°C on skin at end of 10C test**

1C – 10C discharging tests 2.2 Ah cell

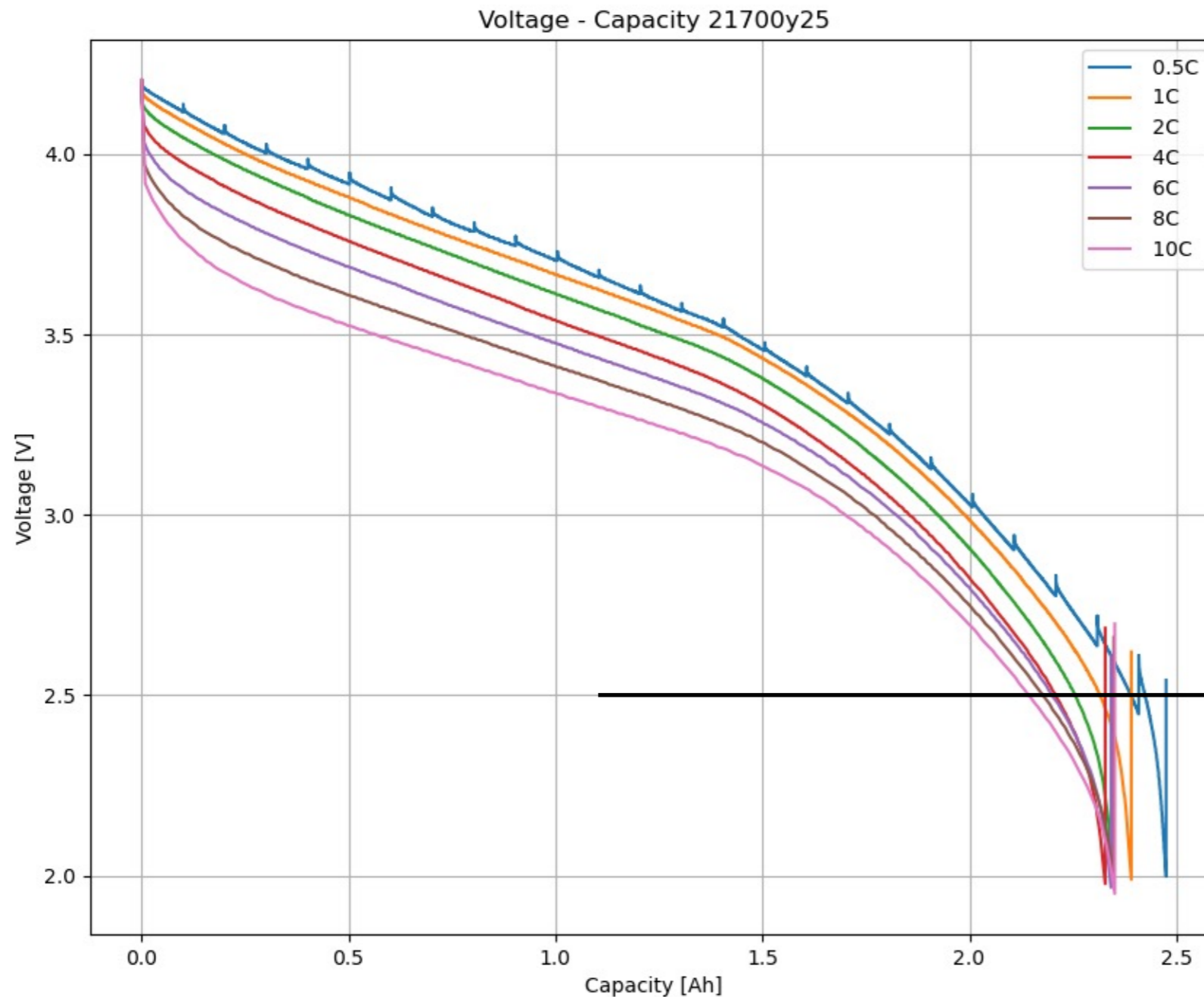


**0.5C in steps
with relaxation**

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

**Test with ventilated room air
At 22 – 25°C air temp.
35°C on skin at end of 10C test**

1C – 10C discharging tests 2.4 Ah cell



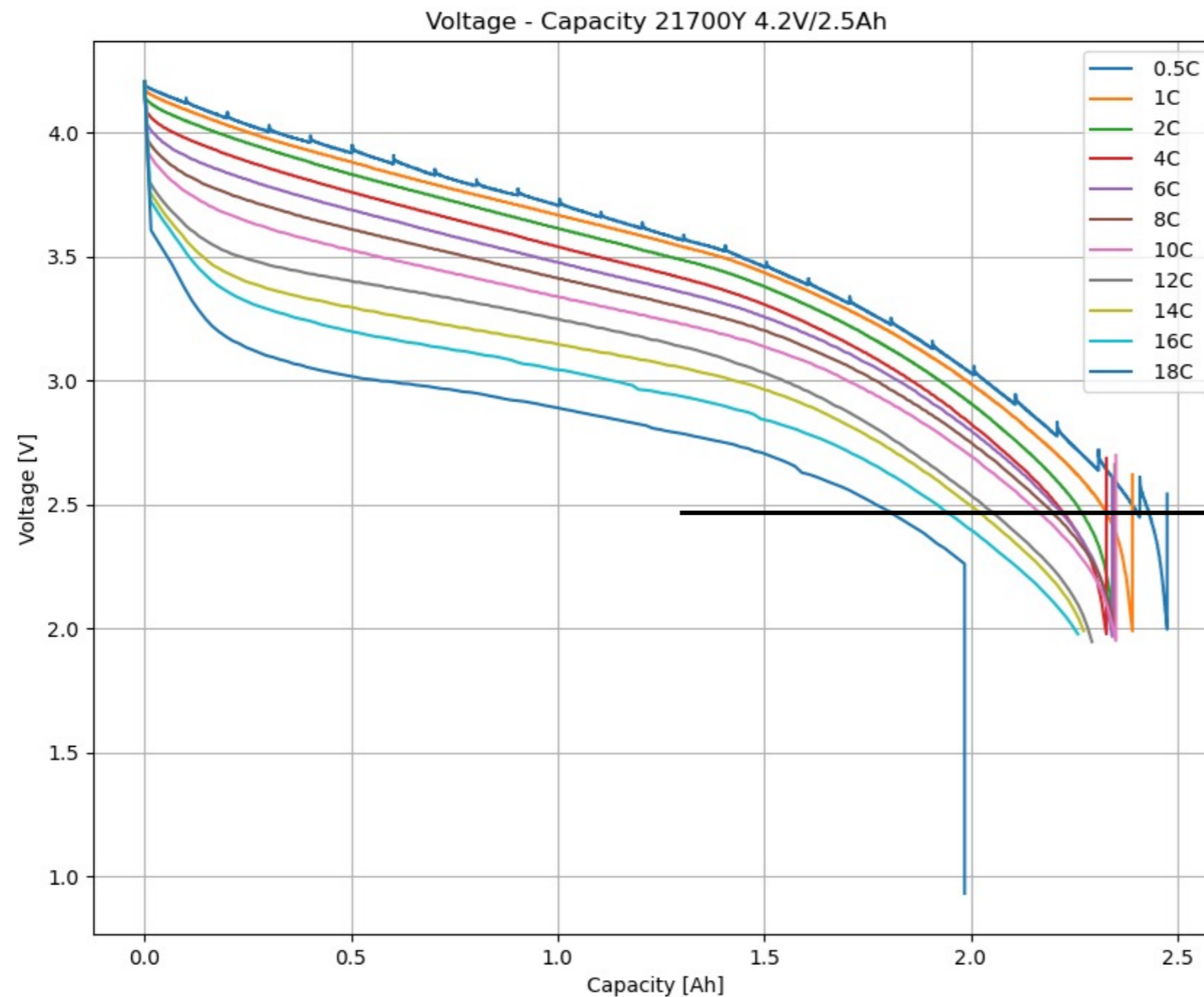
**0.5C in steps
with relaxation**

**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**

Stress discharging tests (> 10C) 2.4 Ah cell



**0.5C in steps
with relaxation**

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

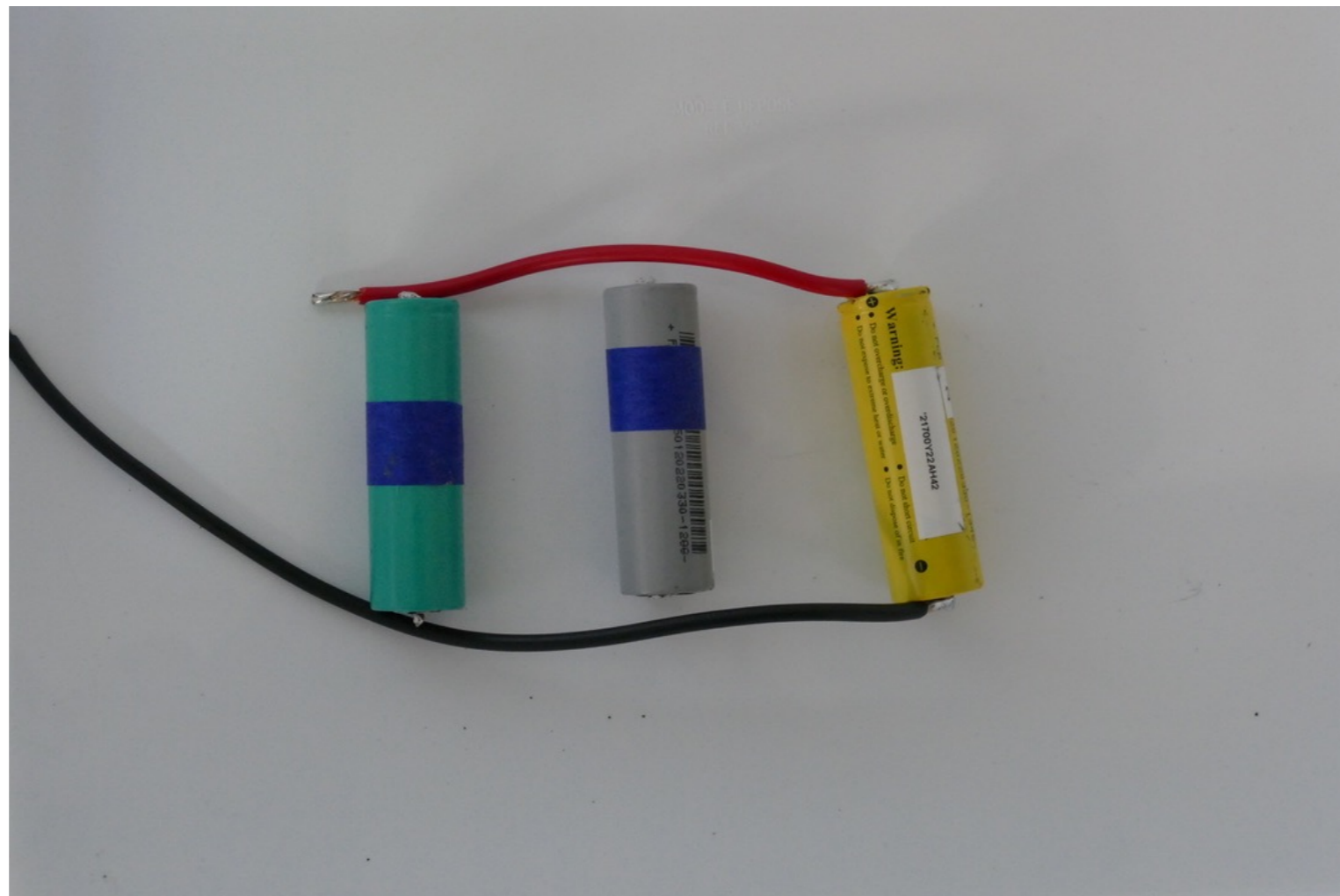
**Test in ventilated room air
At 22 – 25°C air temp.
18C test terminates with CID activation**

Abuse tests 2.4 Ah cell

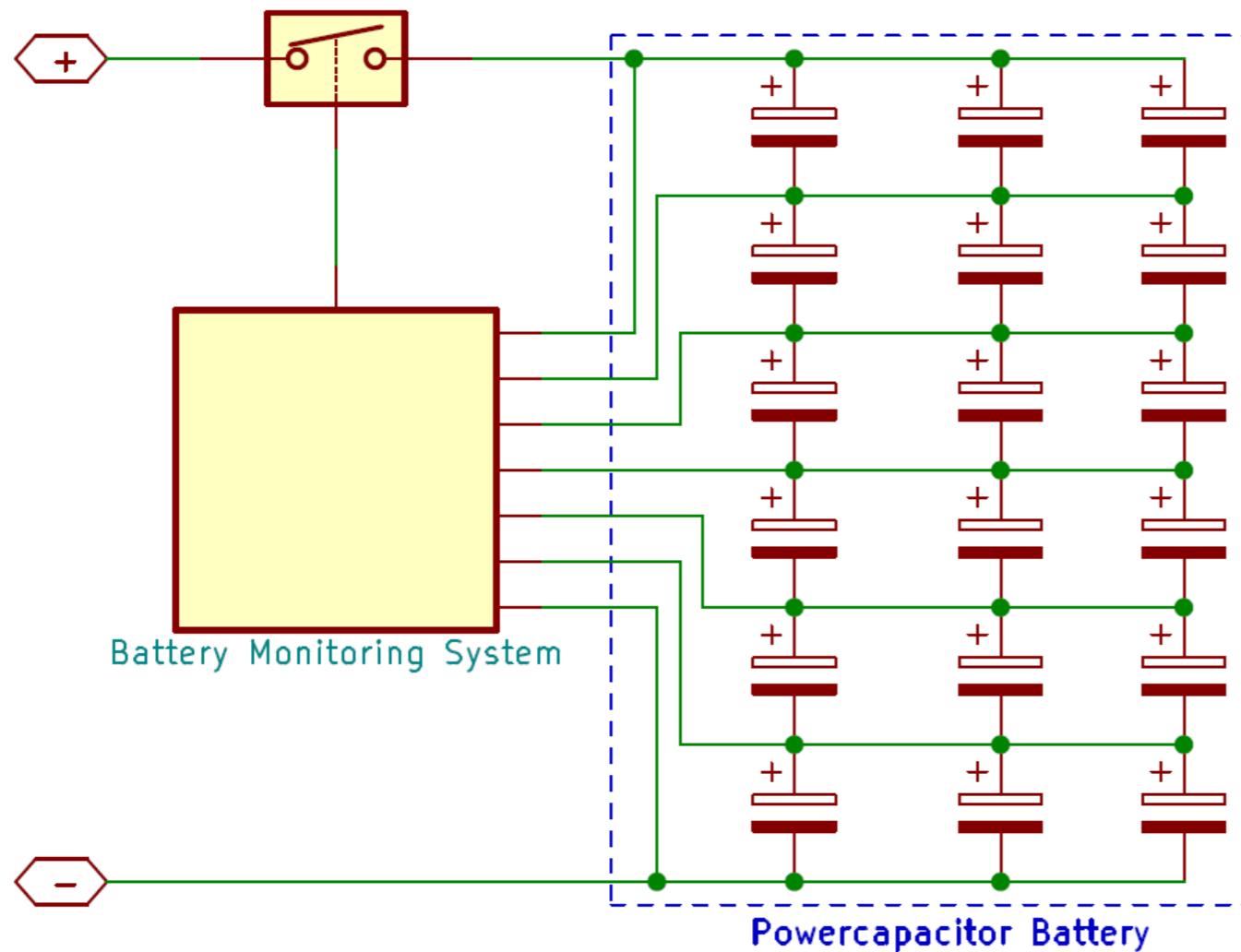
- Hard short-circuit test ($> 300\text{A}$)
- Overcharging (8V, 10A)

RESULT:

- CID activates and disconnect positive contact
- **NO FIRE, NO EXPLOSION**



Battery construction



**Parallel first, then serial
with matched cells**

**Battery filled with heat absorbing
silicon gel (+ protects against
vibrations, shocks, leaks, water
penetration)**

BMS: (optional)

- **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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