

High Heat-resistant Lithium-ion Capacitor

JTEKT

Only One
Technology

Large current

High capacitance

High temperatures

Safety

Durability

Low temperatures

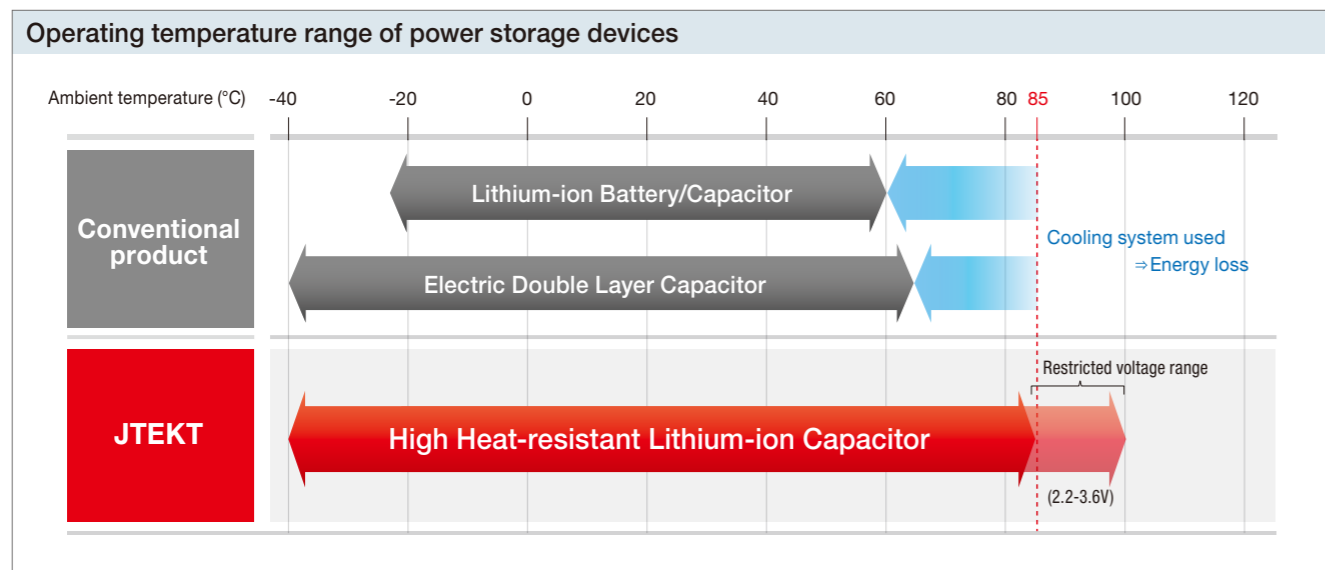
Wide operating temperature range

-40 to 85°C

JTEKT's Proprietary High Heat-resistant Lithium-ion Capacitor Patented Technology Offering the Highest Heat Resistance in the Industry

Wide operating temperature range from -40 to 85°C

The wider operating temperature range enables a lighter and more compact system without additional cooling system. Meets the needs of various industries.



Tremendous output density and increased tolerance against heat generation during large current.

Offers high heat tolerance to avoid irreversible deterioration caused by Resistive heat generation*1 during large current. Maintains higher output density than other storage devices while significantly improving service life.

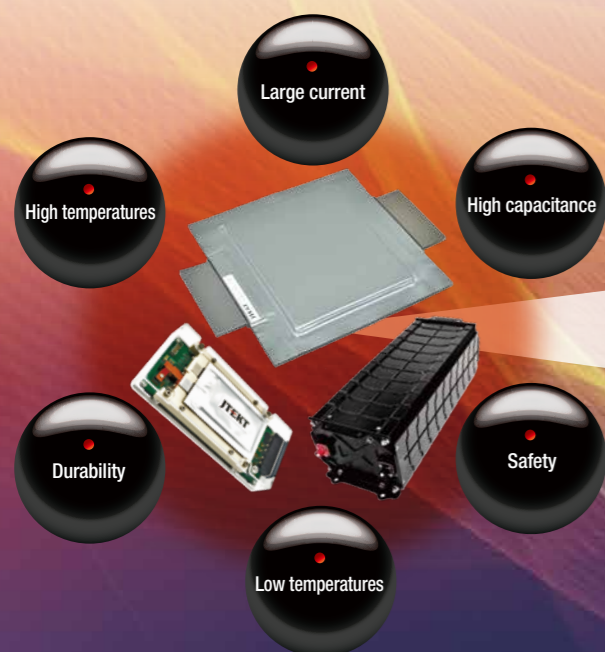
Comparison of energy storage devices

| | Lithium-ion Battery | Electric Double Layer Capacitor | Lithium-ion Capacitor (conventional) | Lithium-ion Capacitor (JTEKT) |
|---|---------------------|---------------------------------|--------------------------------------|-------------------------------|
| Energy density ² | ◎ | △ | ○ | ○ |
| Output density ³ | △ | ○ | ○ | ◎ |
| Service life (number of charges/discharges) | △ | ○ | ○ | ◎ |
| Operating temperature range (°C) | -20 to 60 | -40 to 70 | -30 to 70 | -40 to 85 |
| Operating voltage (V) | 3.6 | 0 to 2.7 | 2.2 to 3.8 | 2.2 to 3.8 |

*1. Resistive heat generation: Heat generated when an electric current flows through a conductor
 *2. Energy density: Electrical energy per unit of volume or mass
 *3. Output density: Electrical energy able to be extracted in one second expressed per unit of volume or mass

Suited to fields where reliability is crucial

The High Heat-resistant Lithium-ion Capacitor can be used for a vast variety of applications due to its wide operating temperature range and significantly longer service life when subjected to large current.



Energy
 Wind power/solar power generators, etc.
 <Application examples>
 • Power storage system for suppressing short-cycle power fluctuations

Logistics equipment
 Automated guided vehicles (AGV)
 <Application examples>
 • Rapid charging power supply

Industrial equipment
 Construction machinery
 <Application examples>
 • Hybrid power supply

Automobiles/mobility
 Automobiles
 <Application examples>
 • Various backup power supply
 • Electric power steering high-output auxiliary power supply
 • Auxiliary equipment power supply

Machine tools/equipment
 <Application examples>
 • Power supply for instantaneous power failure/voltage drop compensating devices (also called Uninterruptible Power Supply)
 • Power supply for conveyance equipment
 • Peak-cut power supply

Railroad
 <Application examples>
 • Multifunctional power supply (for regeneration /emergency use)

Supports the power supply needs of various industries



High temperatures

Highest heat resistance in the industry

Broader range of applications without any cooling.



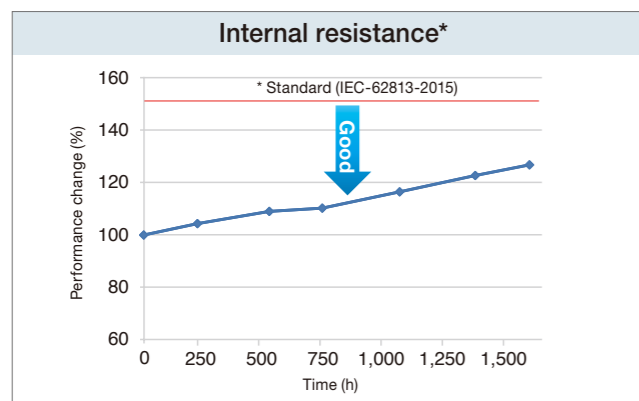
Large current

Tolerates self-heat generation during large current charge/discharge

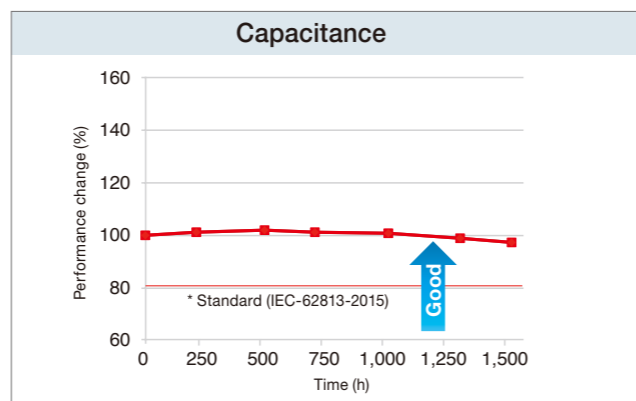
- Shows excellent durability against deterioration caused by self-heat generation during large current charge/discharge.
- Achieves a compact system through elimination of cooling and reduction of cooling space.

Performance change during hightemperature float charging (85°C, 3.8V)

Stable performance at high temperature



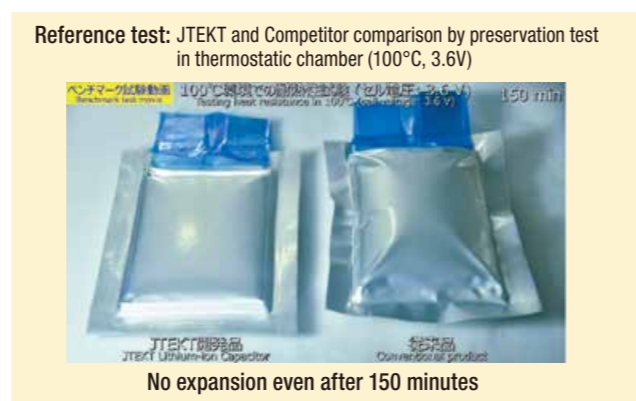
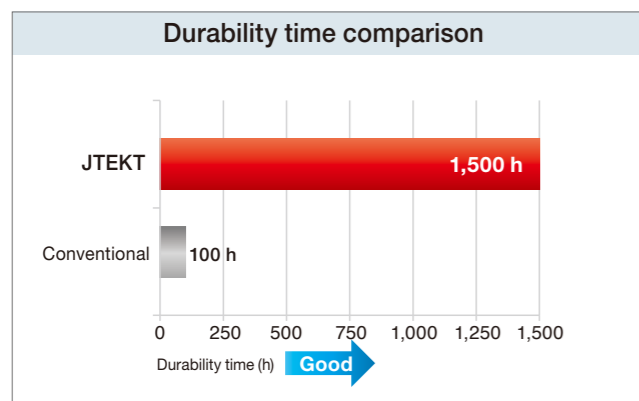
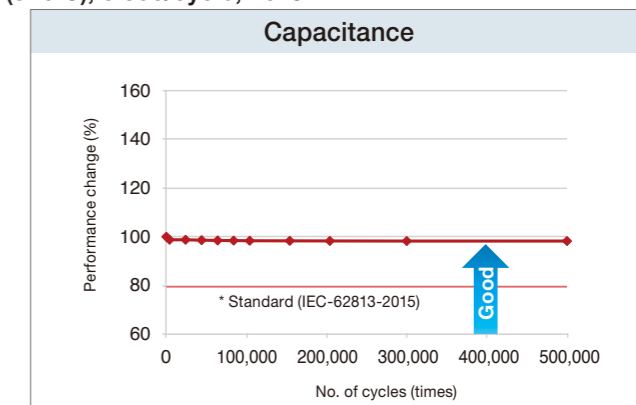
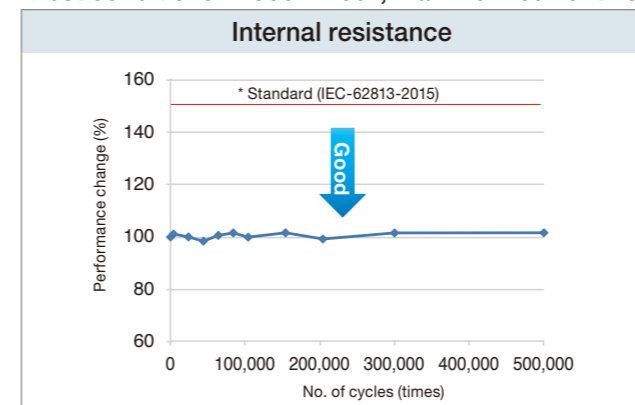
*Increased internal resistance leads to lower output



Performance change with repeated largecurrent charge/discharge

Only slight performance change despite harsh largecurrent charge/discharge cycles

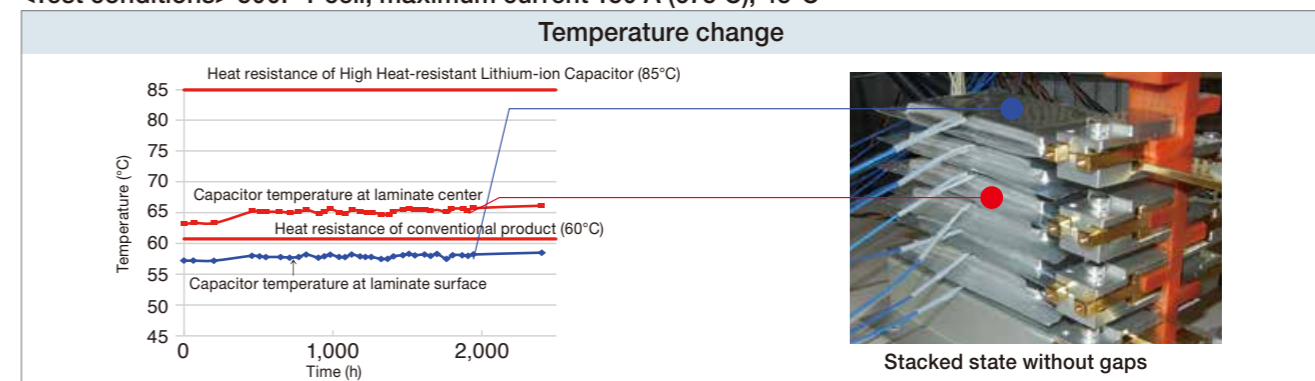
<Test conditions> 2000F 1 cell, maximum current 480 A (540 C), 5 sec/cycle, 25°C



Self-heat generation behavior during large current charge/discharge

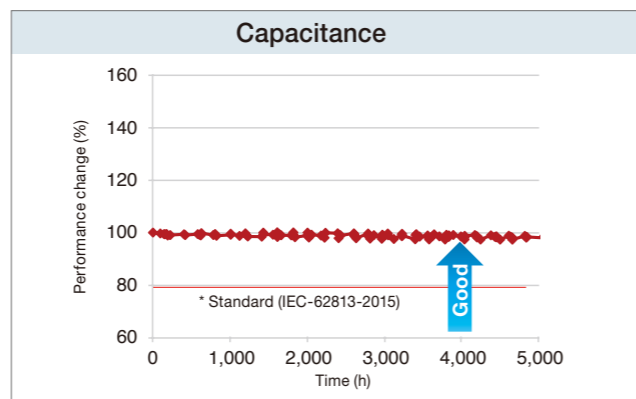
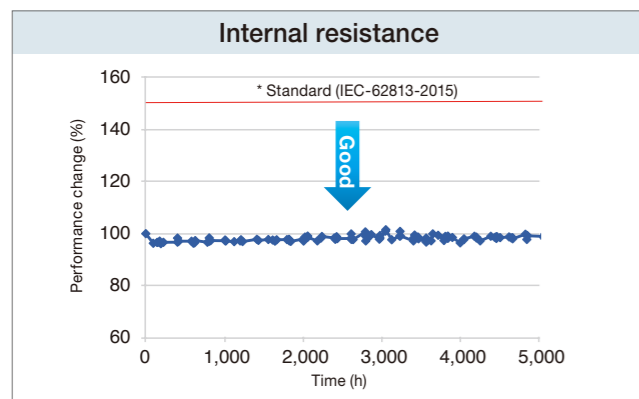
Excellent heat tolerance contributes to high output and downsizing of the system

<Test conditions> 500F 1 cell, maximum current 150 A (675 C), 45°C



Performance change during hightemperature float charging (65°C, 3.6V)

Only slight performance change at 65°C and 3.6V



Test video

Stable operation also possible at 100°C by limiting operating voltage

[Test overview]

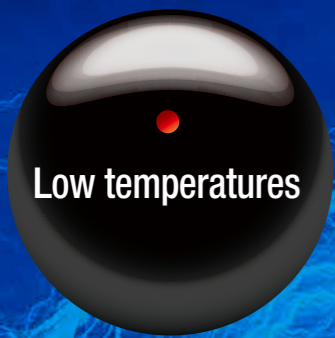
The High Heat-resistant Lithium-ion Capacitor was used as the power source of a toy racing machine, achieving stable current supply even in boiling water.

View video here



<https://www.youtube.com/watch?v=xWFil0BG4os>

* IEC62813-2015: Specifies the electrical characteristics (capacitance, internal resistance, discharge accumulated electric energy, and voltage maintenance rate) test methods of lithium-ion capacitors for electric and electronic equipment.



Offers excellent low temperature performance

- Can be used in extremely low temperatures not previously possible.
- Large electric current can be supplied stably.



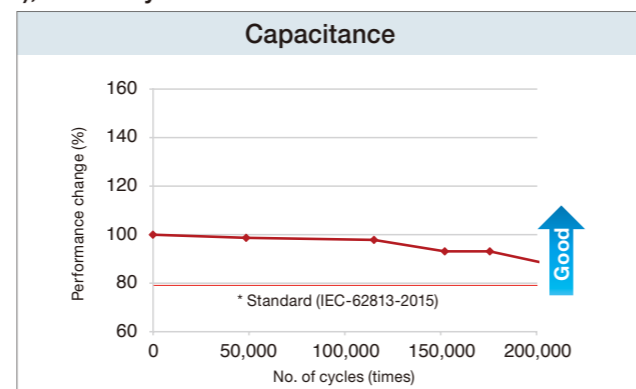
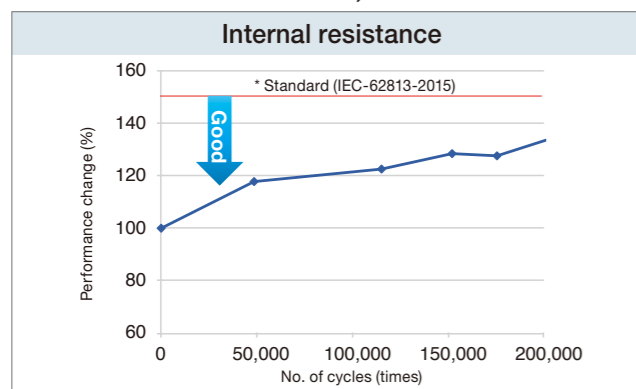
High Safety Level

- Material composition making thermal runaway unlikely.
- Passed strict safety test.

Performance change during repeated charge/discharge at -40°C

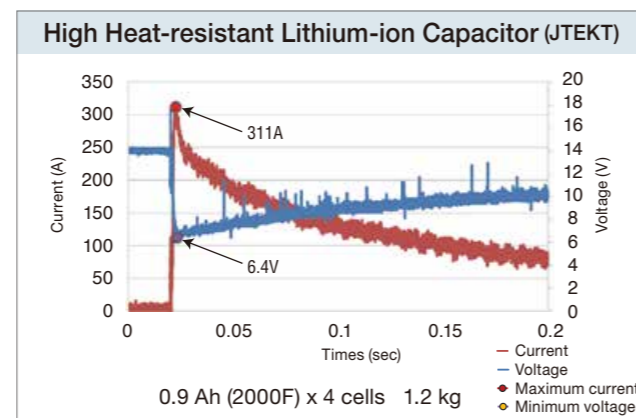
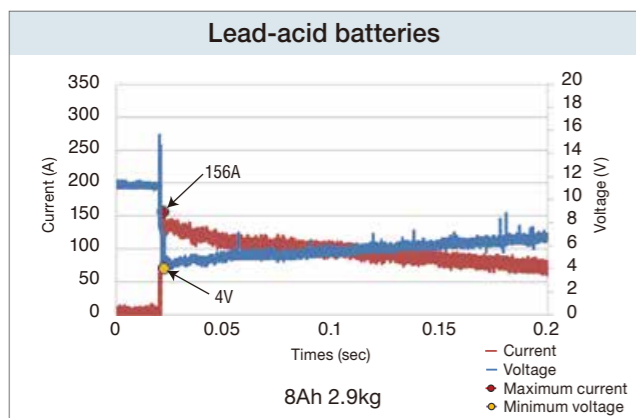
Demonstrated stable performance in low temperatures

<Test conditions> 500F 1 cell, maximum current 20 A (90 C), 85 sec/cycle



Comparison of power waveforms when starting a 250 cc motorcycle at -40°C

Large current output despite low temperatures

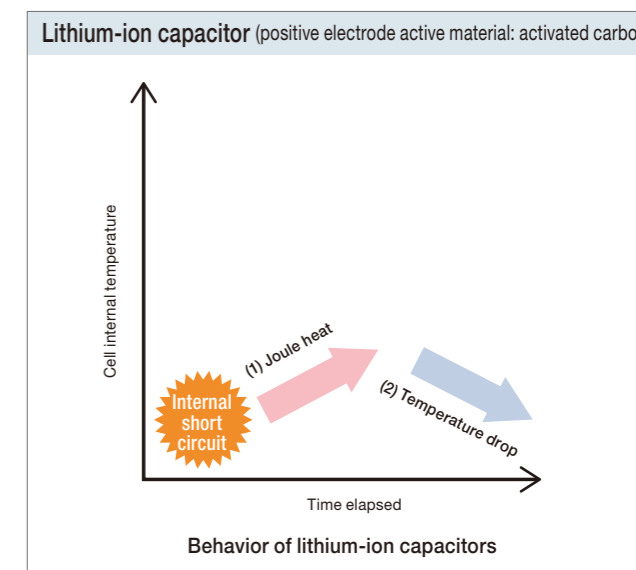
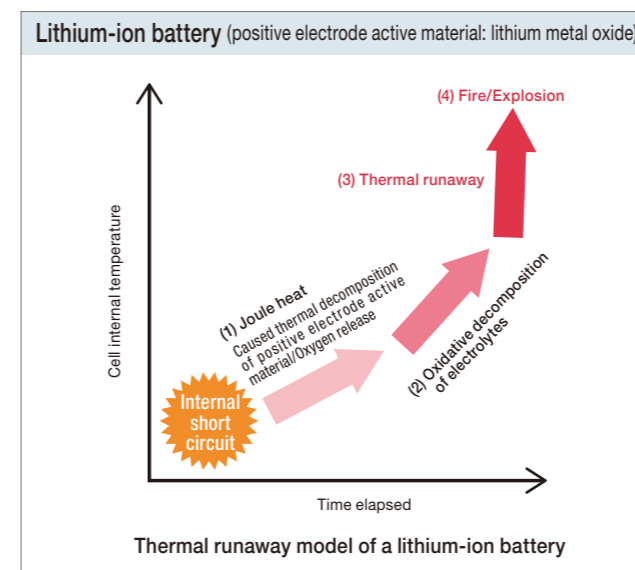


Material composition that is difficult to ignite

Lithium-ion batteries use lithium metal oxide for the positive electrode, which can lead to thermal runaway and ignition when an internal short circuit occurs, however lithium-ion capacitors are safe energy storage devices that are not prone to thermal runaway and ignition due to activated carbon being used as the material for the positive electrode instead of lithium metal oxide.

What is thermal runaway?

An increase in temperature causes an overcurrent or facilitates a reaction, which further increases temperature and makes it uncontrollable



Nail penetration test

Nail penetration test performed according to GB/T31485-2015
No fire on Capacitor



Excerpts of test results from China National Standard (GB/T31485-2015)

| No. | Test name | Hazard level/requirement | | | | | | |
|-----|------------------|--------------------------|--------------------------------------|----------------------|--------------------------|--|-----------|--------------|
| | | 0 No change | 1 Protective mechanism activation | 2 Damage/breakage | 3 Electrolyte leakage | 4 Electrolyte vaporization (fuming) | 5 Fire | 6 Rupture |
| 1 | Overcharging | ← | ← | ○ | ← | ← | ← | ← |
| 3 | Short-circuit | ← | ← | ○ | ← | ← | ← | ← |
| 5 | Heating | ← | ← | ○ | ← | ← | ← | ← |
| 6 | Crushing | ← | ← | ← | ← | ○ | ← | ← |
| 7 | Nail penetration | ← | ← | ← | ← | ○ | ← | ← |

Test video

A stable supply of large current is possible as the electrolyte liquid does not freeze even at -40°C

[Test overview]

Cooling of energy storage device to -40°C.
Conventional energy storage devices cannot start the engine, but JTEKT's product can.



View video here

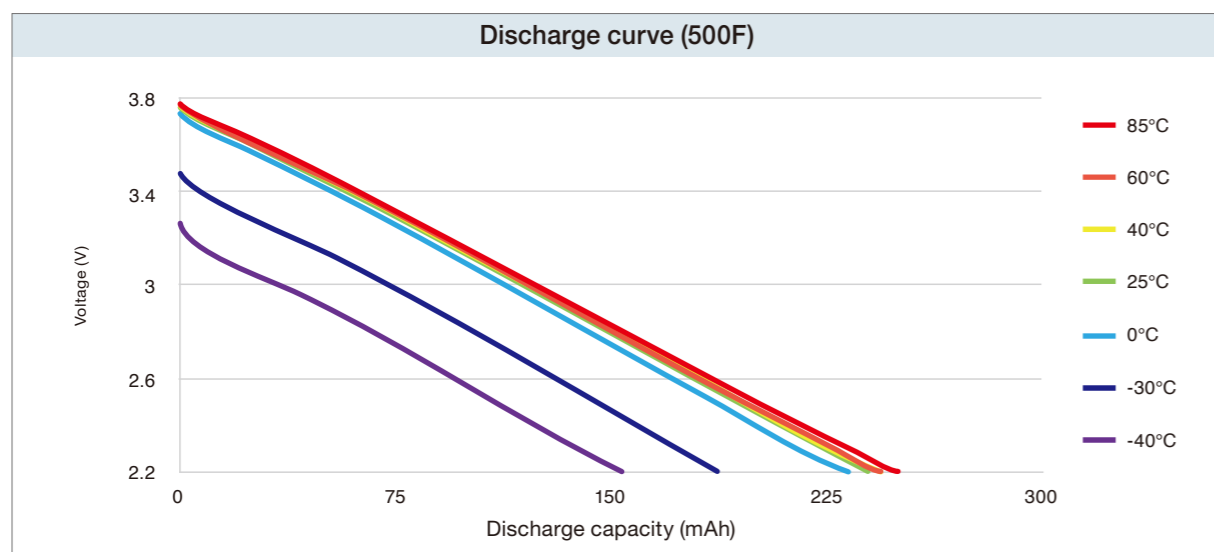
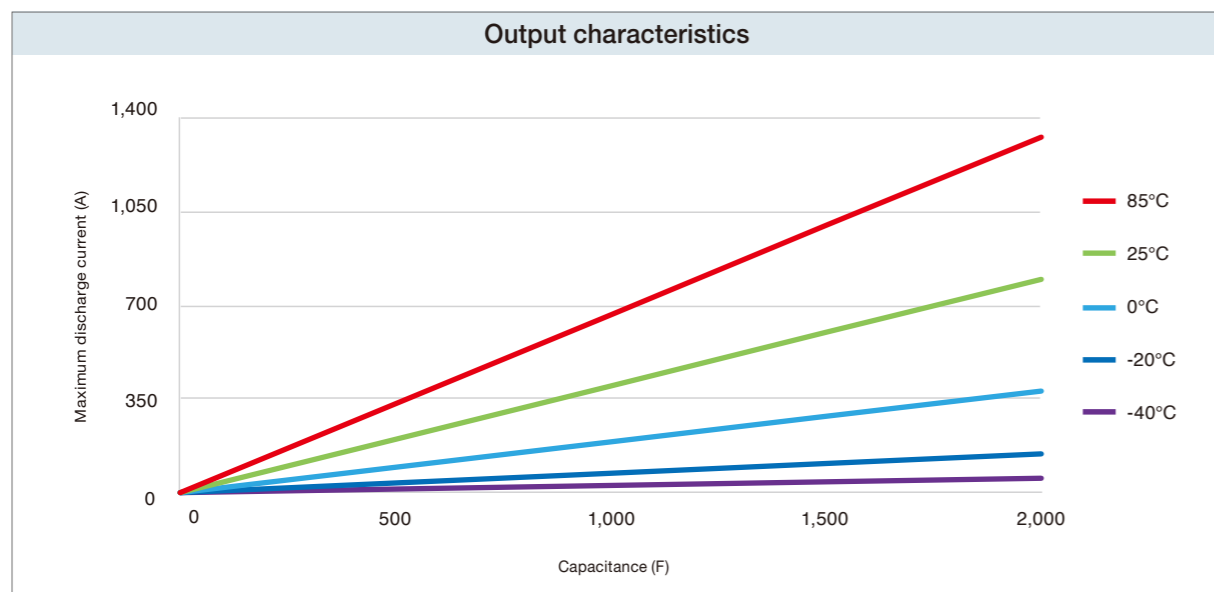
<https://youtu.be/fj37dA3a6LQ>



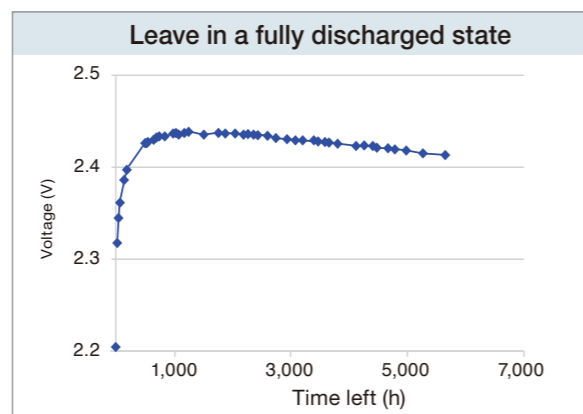
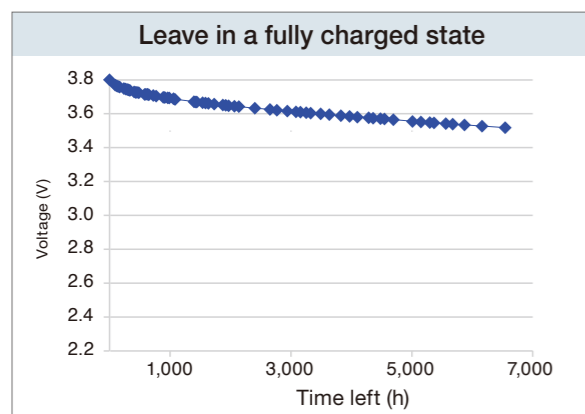
* IEC62813-2015: Specifies the electrical characteristics (capacitance, internal resistance, discharge accumulated electric energy, and voltage maintenance rate) test methods of lithium-ion capacitors for electric and electronic equipment.

Performance test data

Output characteristics and discharge curves at each temperature

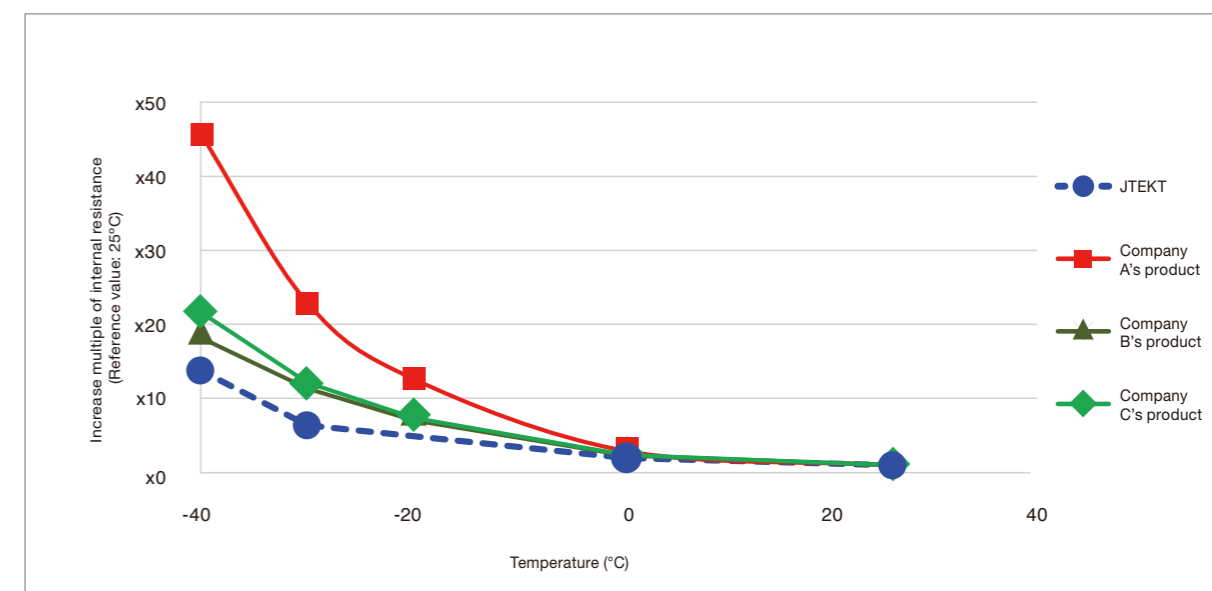


Self-discharging property test



Comparison of internal resistance increase in low temperatures

<Test conditions> Conform to IEC62813-2015

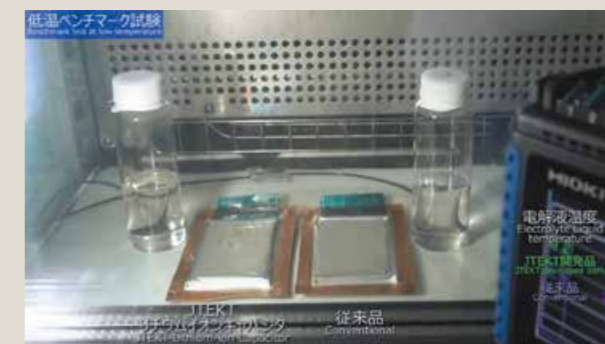


Test video

A stable supply of large current is possible as the electrolyte liquid does not freeze even at -40°C

[Test overview]

Electrolyte liquid was stored in the glass jars on the left and right, and cooled to -40°C. The conventional electrolyte liquid (right) froze, however JTEKT's electrolyte liquid (left) did not.



[View video here](#)

<https://www.youtube.com/watch?v=hmLMzz8c8Ro>

Glossary

| | |
|------------------------------|---|
| Current (A) | The number of electrons flowing per second |
| Voltage (V) | The difference in potential between two points |
| Watt (W) | Amount of electrical energy that can be output per second |
| Watt-hour (Wh) | Total electrical energy |
| Internal resistance (mΩ) | Resistance of power storage devices |
| C-rate (C) | A value that represents the ease of outputting power |
| Joule heat (J) | Heat generated when a current flows through a conductor |
| Primary battery | Batteries that can only be discharged (cannot be charged) |
| Secondary battery | Rechargeable batteries (can be used repeatedly) |
| Float charging | How to charge at a constant voltage |
| Power density (W/L, W/kg) | Power by unit volume or mass |
| Energy density (Wh/L, Wh/kg) | Electric energy by unit volume or mass |

Product Lineup

Capacitor Cell



<Legal compliance>

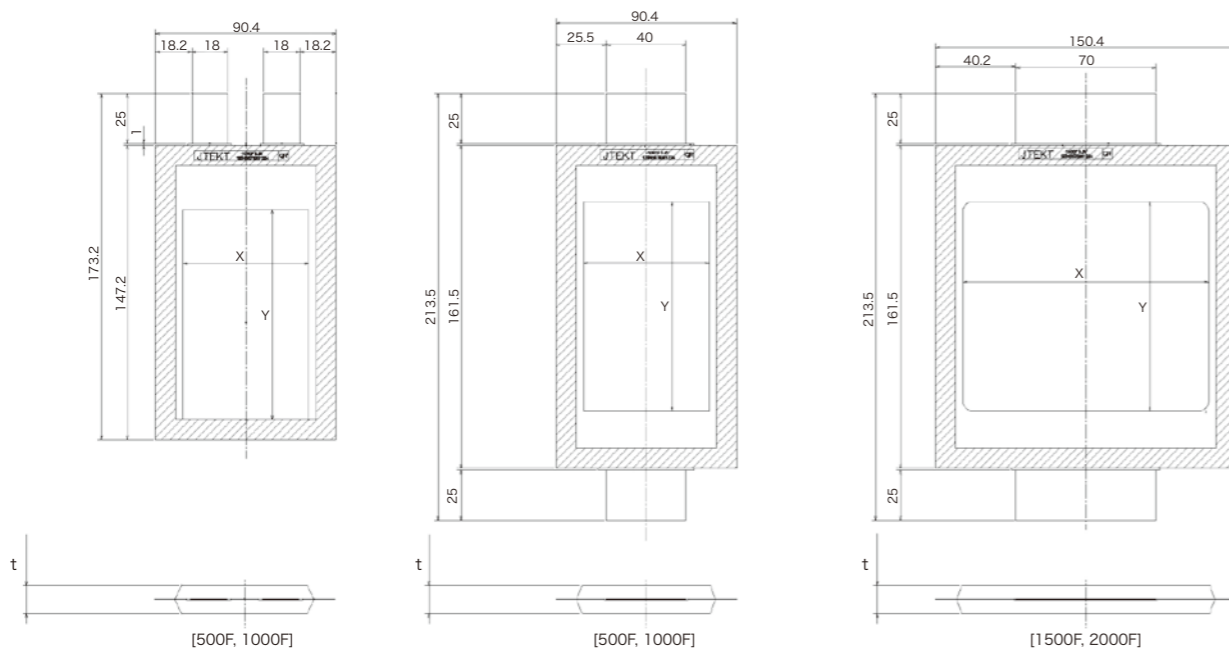
• United Nations Recommended Transport Test (UN3508)

• China National Standard (GB/T31485-2015)

Capacitor Cell Specifications

| | | Capacitance series | | | |
|-----------------------------|--------------------------------|---|-------|-------|-------|
| | | 500F | 1000F | 1500F | 2000F |
| Operating voltage range | (V) | 2.2 to 3.8 | | | |
| Internal resistance | (mΩ) | 4.0 | 2.0 | 1.4 | 1.0 |
| Operating temperature range | Operating voltage: 2.2 to 3.8V | -40 to 85°C After 1,000h float-charging test (85°C, 3.8V) Internal resistance increase rate: 50% or less. Capacitance reduction rate: 20% or less. | | | |
| | Operating voltage: 2.2 to 3.6V | -40 to 100°C After 1,000h float-charging test (100°C, 3.6V) Internal resistance increase rate: 50% or less. Capacitance reduction rate: 20% or less. | | | |
| Energy capacity | (mAh) | 222 | 444 | 666 | 888 |
| Ref.) Cell weight | (g) | 80 | 160 | 240 | 320 |
| Ref.) Cell volume | (cm ³) | 55 | 97 | 135 | 188 |
| Ref.) Cell size | X(mm) | 63 | ← | 123 | ← |
| | Y(mm) | 111 | ← | ← | ← |
| | t(mm) | 7.0 | 13.3 | 9.1 | 13.3 |

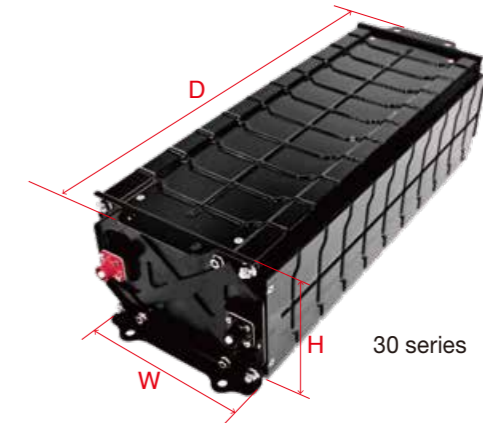
(*Complies with IEC62813-2015)



Modules (for 2000F cell)



4 series



30 series

- A module with multiple cells combined and a balance circuit added
- Supports not only standard cell stacks, but also customized cell stacks (up to 36) specified by customers
- Compact specifications (low cost/lightweight) are also achieved
- Plan to obtain UL810A

- Obtained JIS E4031 (Rolling Stock Equipment - Vibration And Shock Test standards)
- Voltage and capacitance can be adjusted by connecting modules
- Modules other than 2000F cell are also available

Module Specifications

| | | 4 series | 8 series | 16 series | 30 series |
|----------------------------------|-------|-------------|--------------|--------------|-----------|
| Voltage range ^{*1} | (V) | 8.8 to 15.2 | 17.6 to 30.4 | 35.2 to 60.8 | 66 to 114 |
| Synthetic electrostatic capacity | (F) | 500 | 250 | 125 | 66 |
| Electric energy | (Wh) | 11 | 21 | 43 | 80 |
| Mass | (kg) | 5.7 | 7.6 | 11.5 | 18.0 |
| Size ^{*2} | D(mm) | 173 | 239 | 370 | 602 |
| | W(mm) | 222 | | | |
| | H(mm) | 172 | | | |

*1 The upper limit of the voltage range is displayed at the absolute maximum rating. *2 Size includes mounting bracket.

List of features

| | |
|--------------------------------|---|
| Information and communications | CAN/RS-485 communication used to notify user of individual cell voltage |
| Cell monitoring | Enables monitoring of individual cell voltage and temperature (module center/exterior) |
| Automatic voltage equalization | Enables cell voltage equalization and inter-module voltage equalization |
| Error detection | CAN communication/RS-485 communication: Notification of overcharge state, overdischarge state, and cell balance function error I/O (High/Low) overcharge state, overdischarge state, cell balance function error "High" output |
| Other | Service plug: Optional; Power supply: Internal and external options available |

Power supply unit



Power supply unit combining a High Heat-resistant Lithium-ion Capacitor cell with a balance circuit and a charge/discharge controller (complies with ISO26262)
Please contact us regarding order-made products

Global Network

<https://www.jtekt.co.jp/e/company/global.html>



Capacitor Inquiry Desk

info_capacitor@jtekt.co.jp



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