

おっ! と驚く、セラミックス。

Surprising Ceramics.



©NGK-kero/dwarf

小さな一枚に夢がつまっているね

エナセラ®
EnerCera

December 16th 2021 Flex Japan

Ultra-compact and thin rechargeable battery that contributes to FHE
FHEに貢献する超小型・薄型2次電池

NGK INSULATORS,LTD.

EnerCera Marketing Team Group Manager

Ritsu Tanaka 田中立

➤ About EnerCera®

- Outline of products
- Application of FHE devices
- Deployment to maintenance-free IoT devices

➤ Closing



➤ About EnerCera®

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What is EnerCera Battery ?

EnerCera battery has the unique characteristics of both Lithium-ion rechargeable battery and capacitor

EnerCera battery series is a semi solid-state* rechargeable battery which incorporates NGK's proprietary crystal-oriented ceramic electrodes.

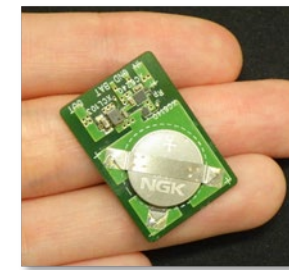
※A solid, multi-layered structure incorporating a crystal-oriented cathode active material sintered which infused with a small amount of liquid electrolyte



EnerCera Pouch



EnerCera Coin



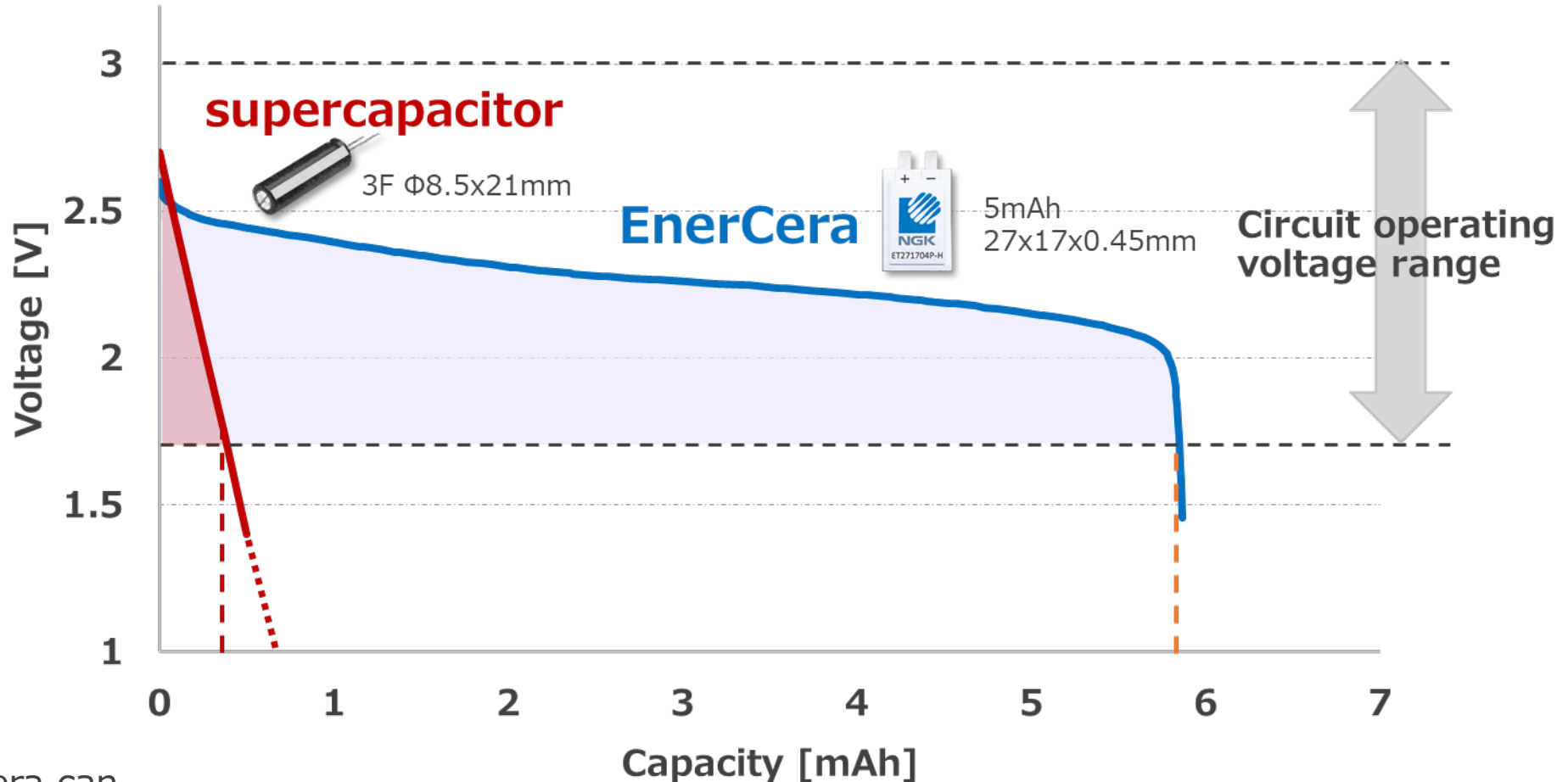
Application: Card type devices, RFID Tags
Wearable devices, ESL, etc.

Features: Ultra-thin (0.45mm), Bending resistance,
High-speed charging

Application: Small sensor devices, industrial equipment
/in-vehicle products, backup power supplies, etc.

Features: High heat resistance (~ 105 °C),
reflow solder mounting, constant voltage

Comparison with EnerCera and capacitor



EnerCera can

- ✓ output much higher energy at stable voltage between circuit operating voltage 1.8~3.0V than capacitor.
- ✓ output high current suitable for wireless communication of BLE etc. due to the low internal resistance compared to other small batteries(primary, rechargeable).

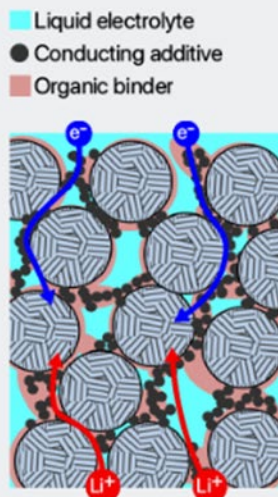
⇒ **EnerCera can output high current such as capacitor and is a new storage device that is able to discharge at stable voltage, not capacitor.**

Conventional Lithium-ion Batteries

Coated-Powder Electrode

Electrode active material is bound with conducting additives and organic binders.

At high temperatures, the organic binder reacts with the liquid electrolyte causing a reduction in binding strength.



Features

- ✓ Low energy density
- ✓ High electrical resistance
- ✓ Low thermal resistance

NGK EnerCera Coin

Proprietary Crystal-Oriented Ceramic Electrode

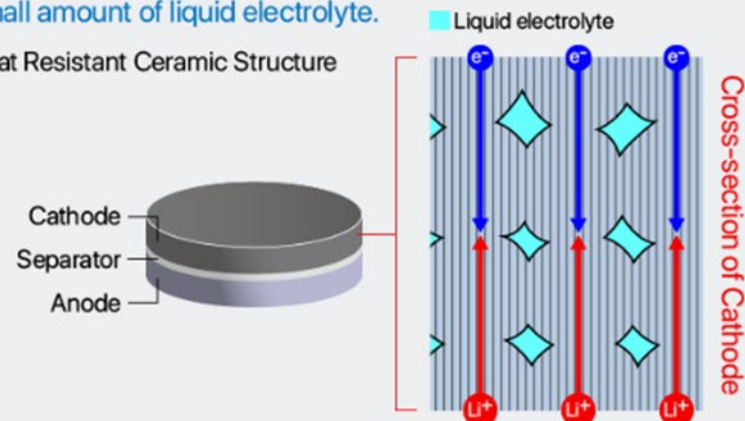
Cathode active material comprises crystal-oriented sintered ceramic.

- Lithium-ions and electrons travel rapidly through active material
- No organic binders or conducting additives

Proprietary Semi Solid-State Battery Technology

Multi-layered structures incorporates sintered ceramic infused with a small amount of liquid electrolyte.

- Heat Resistant Ceramic Structure



Features

- ✓ High energy density
- ✓ Low electrical resistance
- ✓ High thermal resistance
- ✓ Long life expectancy

EnerCera Lineup

New number under development

Model Number	EC382704P-T	EC382504P-P	EC382704P-C	EC382204P-C	EC302304P-C	EC382704P-H	ET271704P-H
Appearance							
Dimensions	38 x 27mm	38 x 25mm	38 x 27mm	38 x 22mm	30 x 23mm	38 x 27mm	27 x 17mm
Thickness	0.45mm						
Nominal Capacity (Charging Voltage)	27mAh (4.3V) 24mAh (4.2V)	20mAh (4.2V)	27mAh (4.3V) 24mAh (4.2V)	20mAh (4.3V) 18mAh (4.2V)	15mAh (4.3V) 14mAh (4.2V)	20mAh (4.2V)	5mAh (2.7V)
Nominal Voltage	3.8V						2.3V
Charging Condition	Constant current (CC) - Constant Voltage (CV) charging						CV charging
(Ref.) Peak Discharge Current*1	560mA	500mA	260mA	200mA	130mA	130mA	100mA
Bendability	Conforming to ISO 14443-1 standard No deterioration after bending and torsion tests						
Operation Temp.	Discharge : -20°C ~ 45°C (Charge : 0°C~45°C)					Discharge : 20°C~60°C (Charge : 0°C ~ 60°C)	-40 ~ 70°C
Heatproof Temp. (in process)	80°C					135°C	
Features	High Power		High capacity			High heat resistance	Fast charging*2

*1 Voltage drop is less than 0.5V with continuous discharge for 0.1 sec. (at 25°C)

*2 Can be charged from 0% to 80% capacity in 14min.

IEC62133 certified

Contents may be changed without notice.

Model Number	ET2016C-R	ET1210C-H	ET2016C-H
Appearance			
Size	Φ20 x 1.6mm	Φ12.5 x 1.0mm	Φ20 x 1.6mm
Nominal Capacity (2.7V charge)	25mAh	4mAh	20mAh
Nominal Voltage	2.3V		
Charging Condition	Constant Voltage (CV) charging (No current control required)		
(Ref.) Peak Discharge Current*1	60mA	20mA	45mA
Operation Temp.	-40°C ~ 60°C	-20°C*2 ~ 105°C	125°C type Under development
Implementation specifications	Reflow soldering applicable*3		

*1 Voltage drop is less than 0.5V with continuous discharge for 0.1 sec. (at 25°C)

*2 -40°C to 105°C for RTC backup applications.

*3 Please check with us for the conditions.


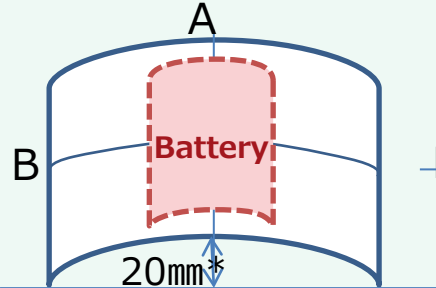
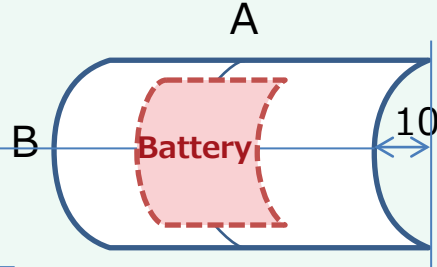
IEC62133 certified

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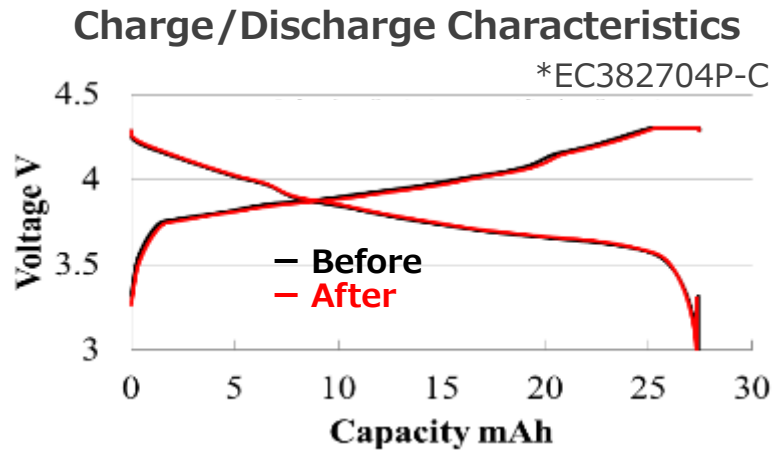
We have a wide lineup of EnerCera pouches and coins such as high-power type, high-capacity type and heat-resistant type.

Bending Resistance of EnerCera Pouch

Compliant with ISO14443-1 "Physical Characteristics of IC cards"

* Radius of curvature 40mm
Total 1000 times



- Appearance (wrinkles, etc.) : No change
- Charge/Discharge characteristics : No change
- Battery resistance : No change
- Cycle characteristics : No change

No change in characteristics after bending test (1000 + 5000 times)

※This data in this material is for reference only and NGK makes no warranty.

EnerCera Pouch mounting support

The following two methods are recommended for joining the tabs of the EnerCera pouch.

■ Solder for Al terminal

	Solder alloy	Flux	Method	Temp.	Result
Ref.	General	No	General	330°C ^{※1} (Pb) 370°C ^{※1} (Pb free)	NG
①	For Al use ^{※2}	Yes ^{※3}	General	400°C	OK
②	For Al use ^{※2}	No	Ultrasonic soldering ^{※4}	—	OK

※1) Quoted from Marutsuelec Co., Ltd. HP

※2) lead-free solder alloy (Sn-Ag-Cu system) with electrolytic corrosion resistance

※3) ALUSAC-35 to be used with Flux (Nihon superior No.1261)

※4) The cavitation effects surface cleaning as flux usage

⇒NGK recommends ① or ②.

* Please note that it cannot be mounted with general solder.

■ ICF bonding

Company		Showa Denko Materials
ICF type		IC-01A
Thickness		25μm
Condition	Temp.	144°C
	Pressure	2.5MPa
	Time	10sec

⇒144°C×2.5MPa×10sec

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The future that EnerCera can realize

Feature of EnerCera



High heat resistance
& High durability



High capacity

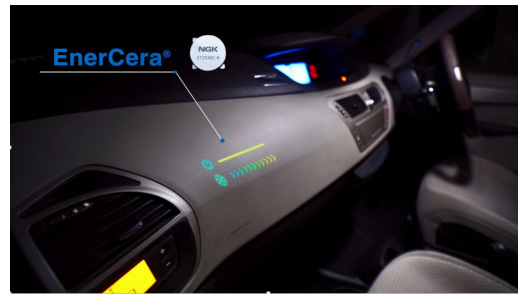


High power

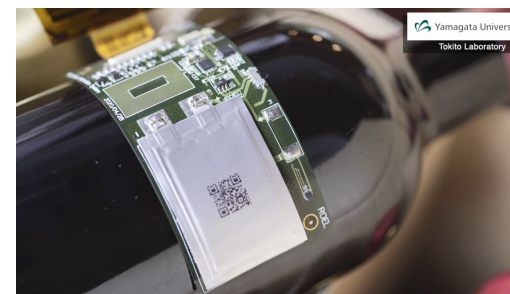
It is possible to add new functions to small and thin devices.
Free design is possible, and the range of applications is infinite.



Smart card



Distributed power supply
for automobiles

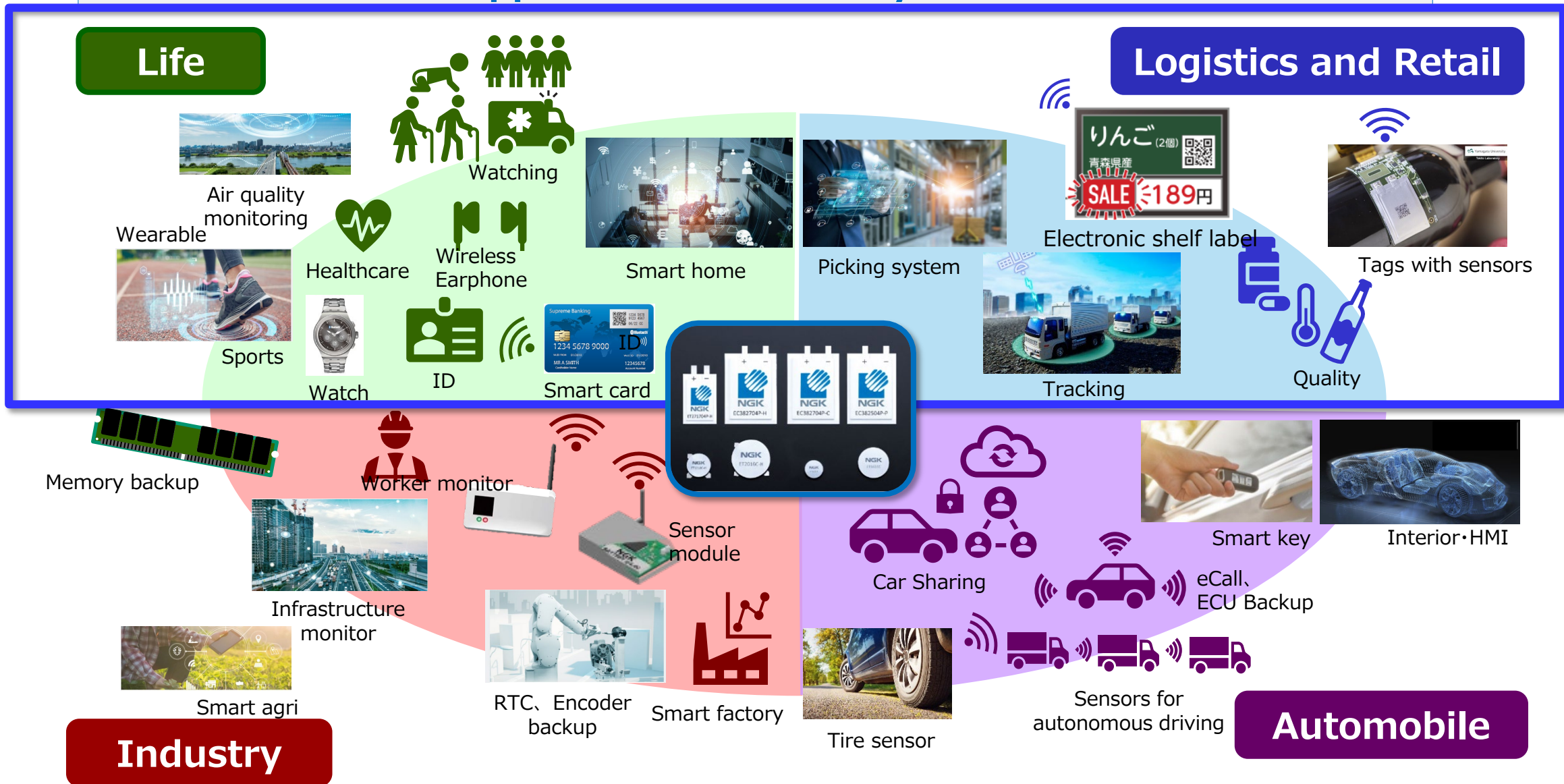


Position tracker
Logistics tag



Maintenance-free
IoT devices

The world of applications enabled by the EnerCera series



NFC charging smart card board

Cooperation: Fujikura Co., Ltd.
Torex Semiconductor Co., Ltd.



Non-contact and instant wireless charging Next-generation smart cards

A card board that supports short-range wireless communication standard "NFC" charging.

When a board incorporating **EnerCera** is used for an IC card, **charging is possible instantly while payment is made.**

It greatly improves the convenience of next-generation smart cards.



Maintenance-free battery solution
that can be quickly charged by NFC

Charging circuit
(power supply controlled
rectifier circuit)

NFC powered coil

NFC powered LED
(flashing while receiving)

Storage of electricity

EnerCera[®] Pouch

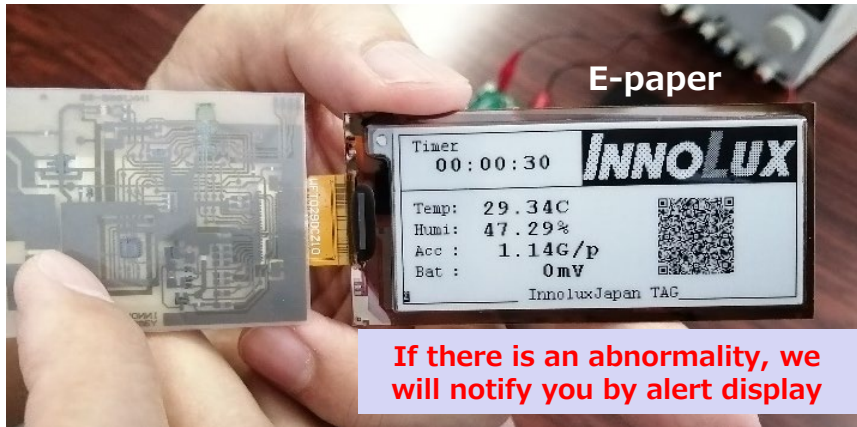
Fast charging type ET271704P-H
27mm x 17mm x 0.45mm

Switch

Flexible Sensor Tag

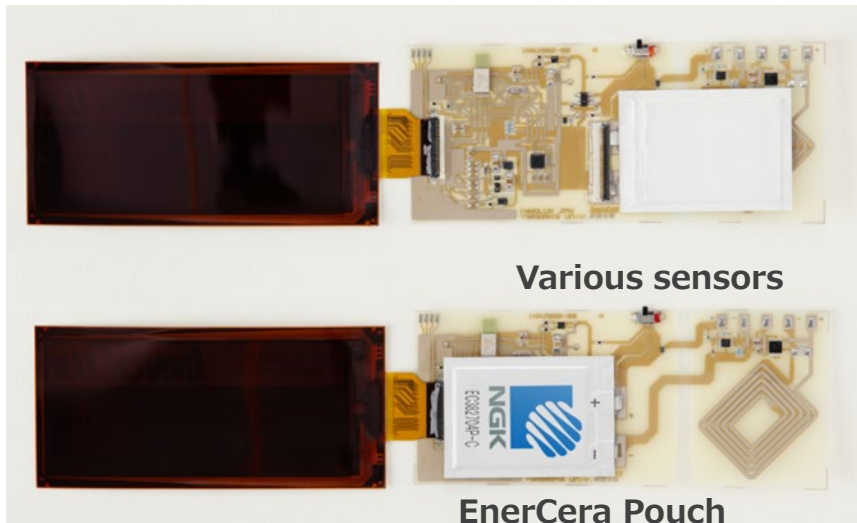
Cooperation: Innolux Japan Co.,Ltd.
Tokito Laboratory, Yamagata University

- 1.The thin and flexible EnerCera battery can be attached to curved surfaces.
2. Durable and reliable EnerCera battery can be used even in harsh environments
- 3.Maintenance-free is possible in combination with wireless power supply and energy harvesting technology



HACCP, towards GDP
Real-time monitoring of transported goods

Product	Flexible logistics tags
Size	40mm×80mm
Charging	Near field wireless charging
Communication	BLE
Sensing function	Temperature, humidity and impact sensing
Use Case	<ul style="list-style-type: none"> ▸ Cargo management during transportation, factories and warehouses ▸ cold chain
Adopted part number	EC382704P-C EC382704P-H



Flexible Sensor Tag for curved surfaces

Cooperation: Innolux Japan Co.,Ltd.
Tokito Laboratory, Yamagata University



For tracking and quality control Ultra-thin and smart electronic tags

The ultra-thin, bend-resistant **EnerCera Pouch** provides a flexible center tag for curved surfaces.

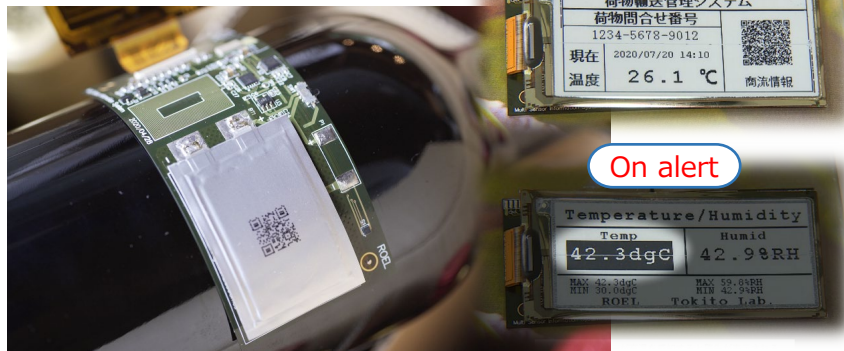
"Maintenance-free" by eliminating the need for battery replacement.

For tracking, temperature and humidity monitoring, impact detection and wireless data communication.

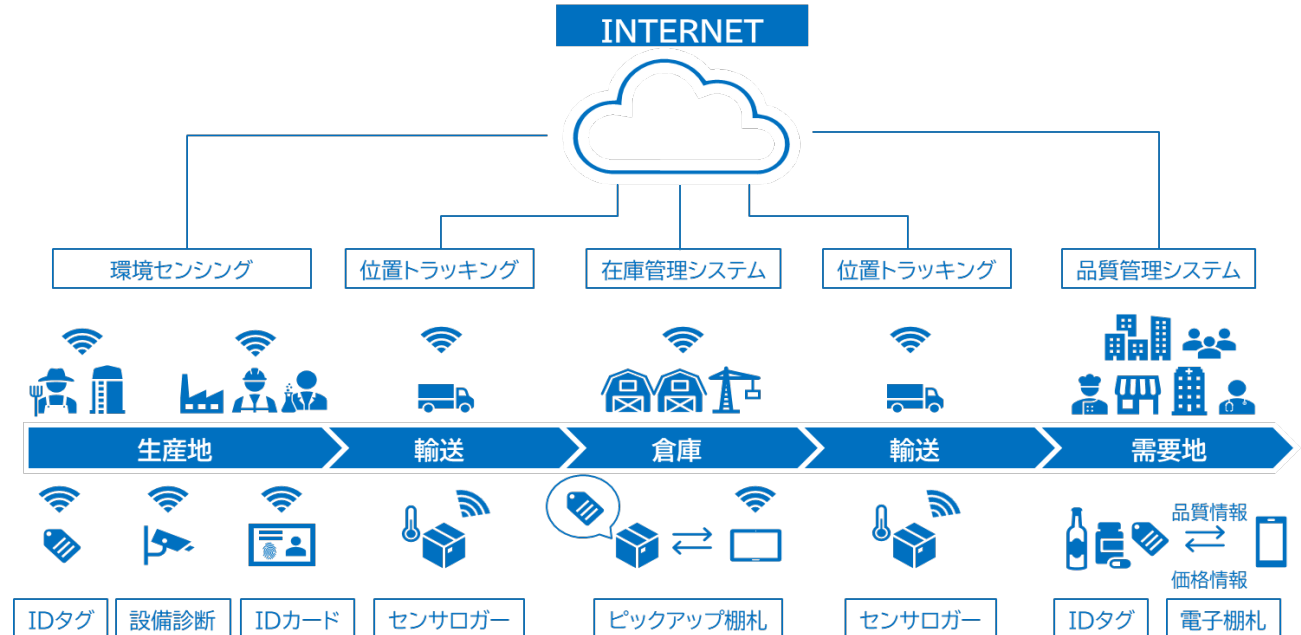
Storage of electricity

EnerCera® Pouch

0.45mm thin



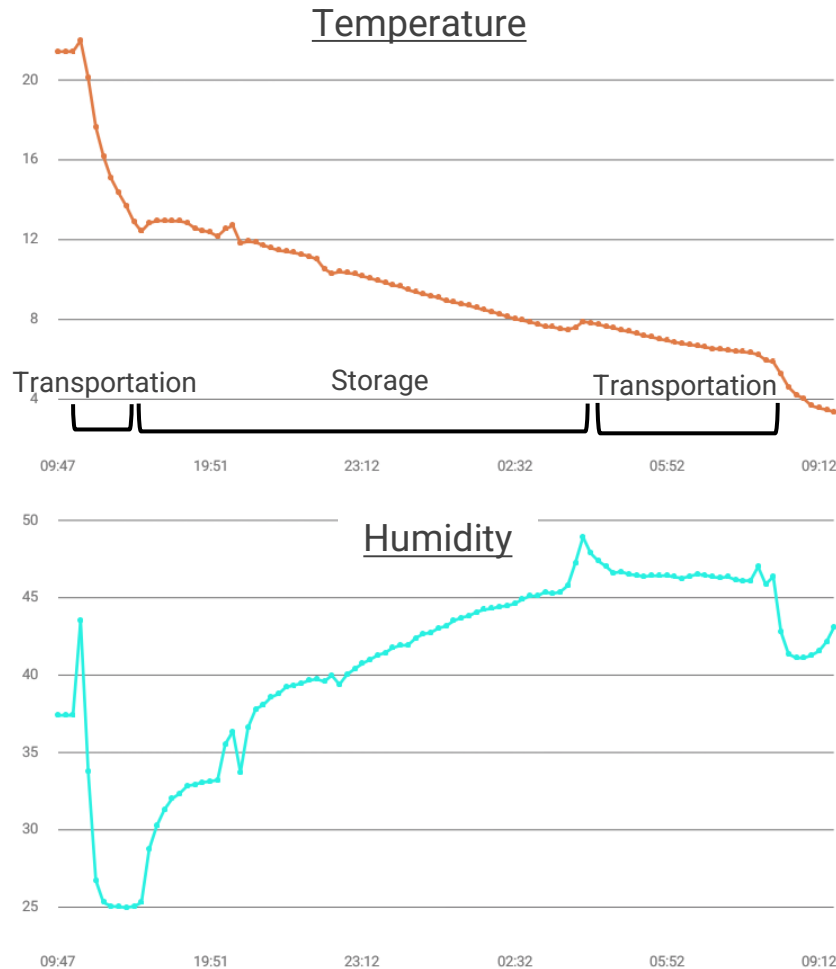
A warning is displayed when the temperature sensor senses a high temperature



Flexible Sensor Tag for curved surfaces

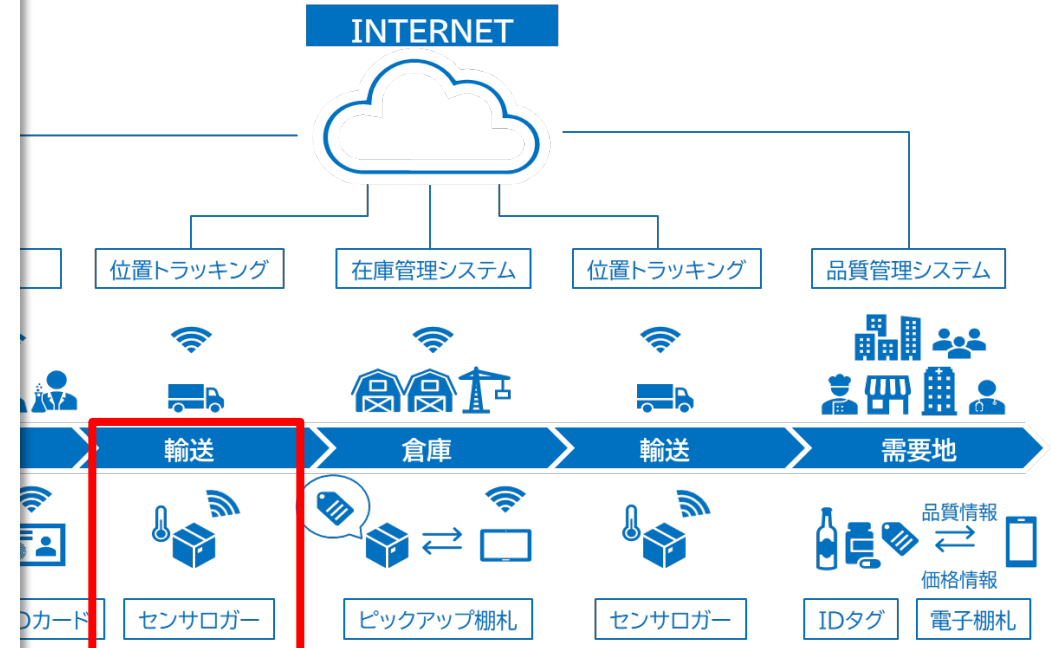
Cooperation: Innolux Japan Co.,Ltd.
Tokito Laboratory, Yamagata University

Actual measurement data during refrigerated transportation



and quality control and smart electronic tags

end-resistant **EnerCera Pouch** provides a flexible curved surfaces.
 "e" by eliminating the need for battery replacement.
 temperature and humidity monitoring, impact detection and communication.



Storage

Medical patches

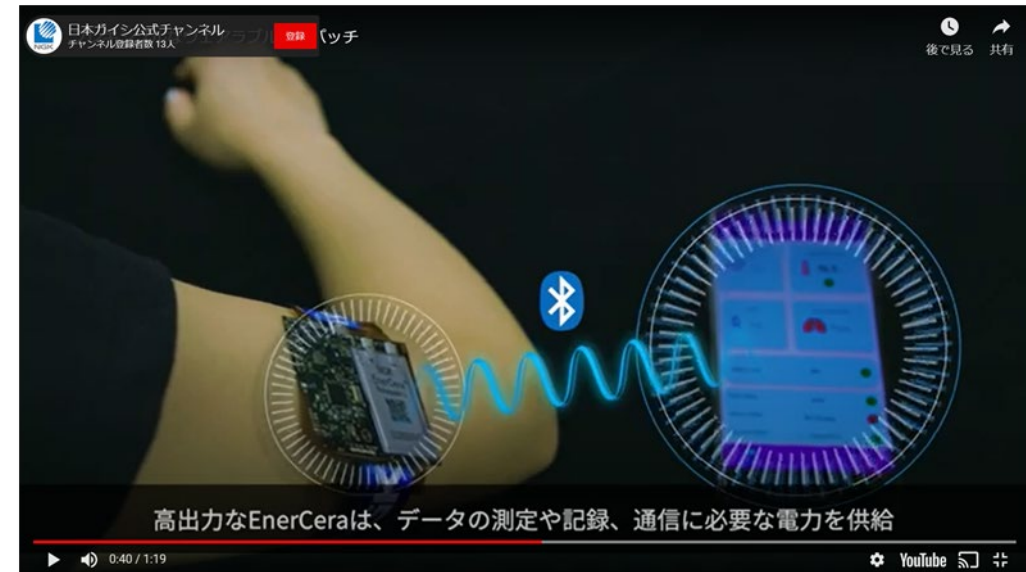
Cooperation: Renesas Electronics Co., Ltd.

1. Ultra-compact and thin with a thickness of only 0.45 mm, and has bending resistance, making it ideal as a power source for wearable medical patches.
2. EnerCera Pouch battery has high output and can drive BLE etc.
3. Devices are reusable because it uses battery that can be recharged repeatedly



Rechargeable
battery
EnerCera®

<https://www.renesas.com/jp/ja/application/healthcare/medical-patch>

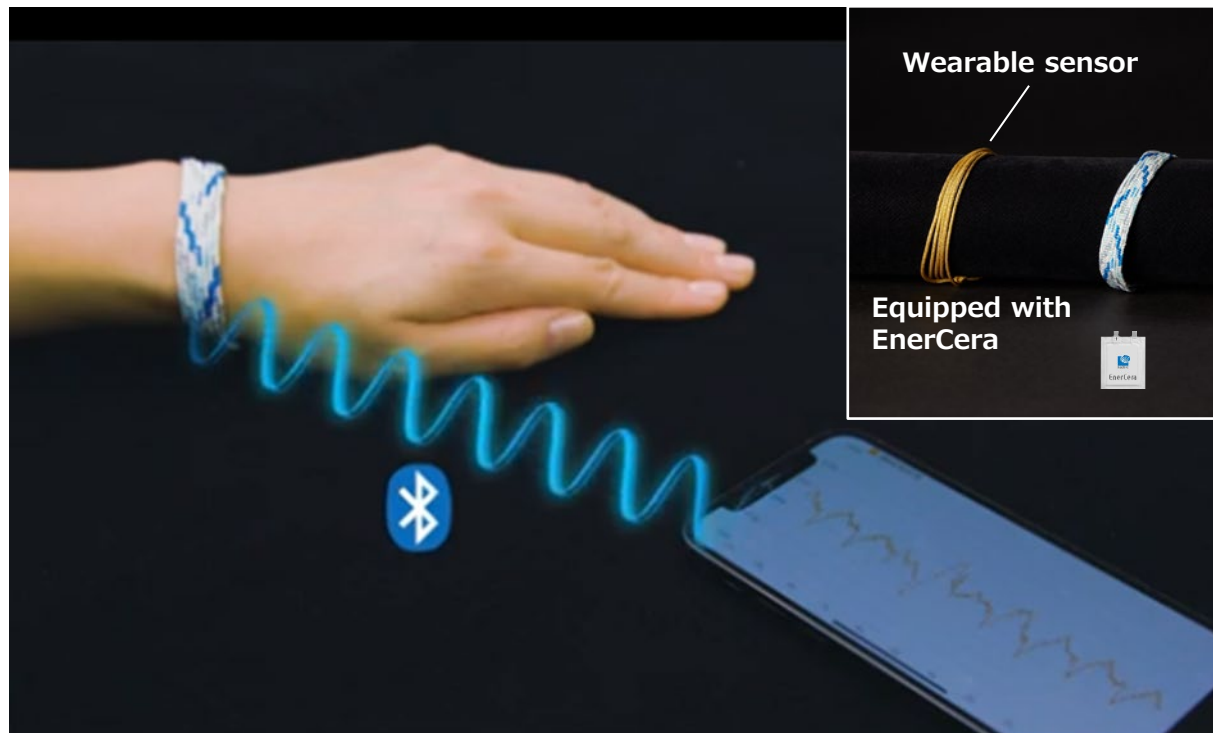


- Highly accurate monitoring of biological data such as heart rate, respiration rate, and oxygen saturation (SpO2)
- Low-profile, bendable, low-resistance EnerCera Pouch for low power consumption and a good fit medical patch
- Renesas RX MCU enables secure BLE communication of sensing data

Piezoelectric braid type wearable sensor

Cooperation: Kansai Univ./ TACHIBANA ELECTRONIC SOLUTIONS
/SHINSEI DENSHI/TEIJIN FRONTIER/Renesas Electronics

1. Using ultra-compact EnerCera Coin battery, sensor module can be miniaturized.
2. Although it is small and thin, EnerCera battery has a high capacity and high power that supports sensing and data communication.
3. Highly durable and highly reliable semi-solid-state battery, ideal for wearable applications.



Product	Piezoelectric braid sensor
Charging	USB
Communication	BLE
Sensing function	Biosensor
Use Case	Vital monitor, Sleep monitor, Pet monitor
Product number	EC302304P-C

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- **Deployment to maintenance-free IoT devices**

➤ Closing



Maintenance-free IoT device with EnerCera Batteries

Charging EnerCera constantly and discharge at high power when needed
➔ Practical maintenance-free IoT device becomes feasible



Maintenance-free IoT device

IoT Society

- Infrastructure
- Logistics/Retail
- Automobile
- Healthcare/Medical
- Construction
- Security/monitoring
- Livestock
- Manufacture
- Smart home
- Data security

Power Generator or Power Supply

- Wireless Power Supply
- Energy Harvesting (PV, Vibration, etc.)

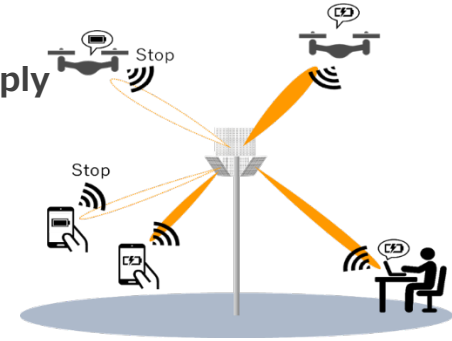


Image: Wireless power supply in the city
source : SoftBank News 2020.9.10

Depending on the environmental conditions

Inoperable or unstable !

IoT device

Various sensors, CPU, memory, communication modules, etc.

Maintenance-free IoT device with EnerCera Batteries

Charging EnerCera constantly and discharge at high power when needed
 → Practical maintenance-free IoT device becomes feasible



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Power Generator or Power Supply

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Constant charging with μW level power

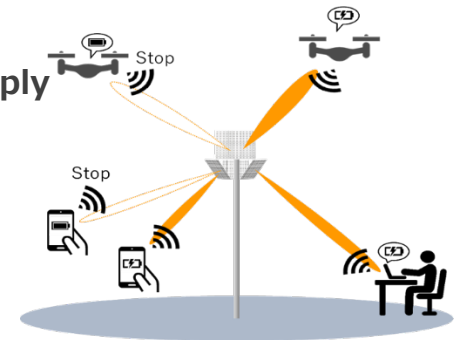


Image: Wireless power supply in the city
 source : SoftBank News 2020.9.10

Energy Storage device
 EnerCera Battery

EnerCera[®]

Superior Battery feature

Capacitor like feature

- Small, High Capacity
- Constant voltage output (keep the voltage for IC)
- Low self-discharge
- High Power
- Constant voltage charging
- Long life
- Reflowable

Discharging Intermittently with large current, several 10mW level

IoT device

Various sensors, CPU, memory, communication modules, etc.

Partnerships in maintenance-free IoT devices

Power generation / power supply		Items	Partner
Energy harvesting	Solar cell	Position tracker	Renesas electronics/SEMTECH
		Smart agricultural sensor	Renesas electronics/SEMTECH
		Various IoT devices	RICOH
Wireless power transfer	920MHz	Logistics sensor tag	Panasonic
		Smart remote control	SMK
	2.4GHz	Logistics IoT devices	Marubun/JAE
	5.7GHz	Failure prediction device	Toshiba/Tokai electronics
EnerCera evaluation board		Evaluation board	Torex semiconductor
		power storage unit	Rohm
		maintenance-free power supplies	Fujikura/e-peas

**DSSC : Dye-Sensitized Solar Cell

Examples of cooperative partners for maintenance-free IoT devices

Always powering EnerCera, outputting the power needed from EnerCera
 → To realize practical maintenance-free IoT devices!!



Maintenance-free IoT device

IoT Society

- Infrastructure
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- Smart home
- Data security

Power Generation and Power Supply Dept.



Constant charging with μW level micro power

Energy Storage Device Dept.



Intermittent discharge at high power levels of several tens of mW

IoT Function Dept.

Environmental power generation	Photoelectric Ricoh Mechanical Exeger/SB Energy Thermoelectric Kanazawa University
Wireless power supply	Ricoh Canon E Thermogentech
	Panasonic Sonic Energy Toshiba Ossia/Marubun Powercast

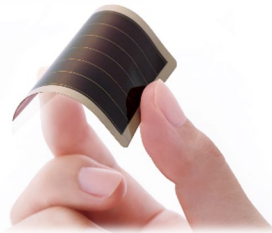
Power SUPPLY IC	TOREX Ricoh Electronic Devices Ricoh ROHM
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Device IC	Renesas Electronics Ricoh ROHM/Lapis Semiconductor Seiko Epson Ablic
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Flexible power supply device that combines solar cells and EnerCera

A thin, light and bendable solar cell that can generate electricity efficiently indoors and in the shade.

OPV



Compact, thin and high-capacity power storage device.

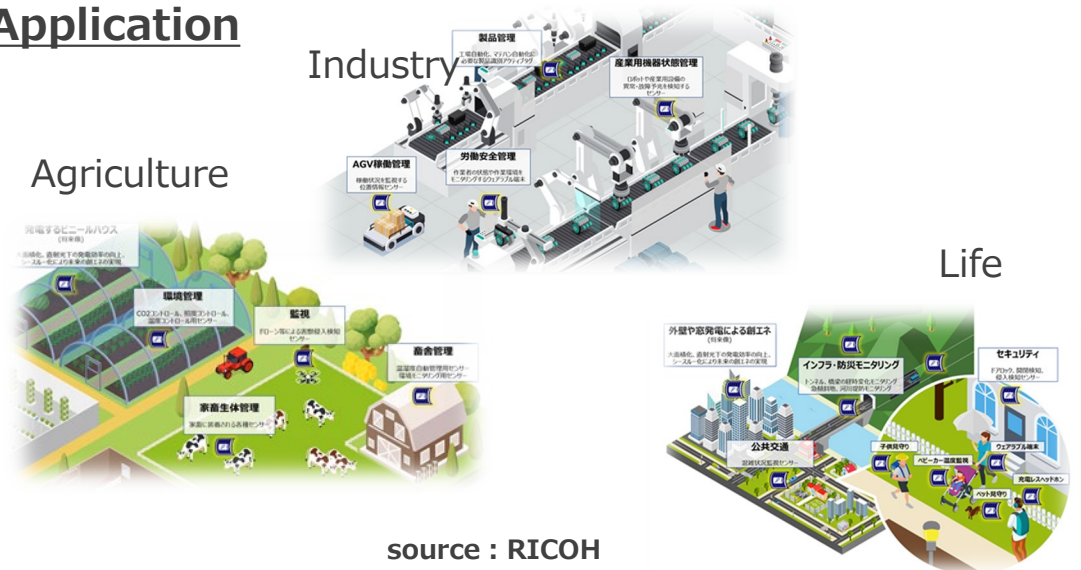
EnerCera



Flexible power supply device



Application



source : RICOH

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Contribute to the promotion of carbon neutral and digital society

Carbon Neutrality

- **Waste reduction**

Aiming for the phasing out of primary batteries

- Circular Economy Action Plan (EU)
- New batteries Regulations (EU)

- **Utilization of energy harvesting technology**

Combination with solar cells, vibration power generation, etc.



EnerCera[®]

Digital Society

- **Popularization of IoT**

- **Advances of communication technology**
5G, 6G communication

- **Higher security**

Personal information protection

Realization of a truly maintenance-free IoT device

- ✓ **EnerCera is a new power storage device that combines the features of batteries and capacitors.**
- ✓ **The EnerCera pouch is thin and easy to bend, making it ideal for flexible devices such as smart cards, logistics tags, and medical wearables.**
- ✓ **In combination with Energy Harvesting and WPT, IoT devices can be made maintenance-free and contribute to the reduction of primary battery waste.**



**Please feel free to contact us for demonstrations
using EnerCera or inquiries about EnerCera.**

Thank you



Contact

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