

Chip-Type Ceramic Rechargeable Battery

“EnerCera[®] battery” For Powered Smart Card Application



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NGK INSULATORS, LTD

Next-Generation Cards 2020

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- **Overview**
- **Characteristics of EnerCera Pouch battery**
- **Reference Design & Current Status**

Overview: What is EnerCera Battery ?

Compact and thin Li-ion rechargeable battery suitable for SmartCards

- ✓ With the use of NGK's proprietary Crystal Oriented Ceramic Electrode Plate, EnerCera battery is small, thin, high capacity, high power, and mountable by high temperature processes.
- ✓ EnerCera battery can output high current of several 10 mA to several 100 mA required for operating ICs, sensor devices and wireless communication.



EnerCera Pouch Type

- Ultra thin and bendable pouch type cell (0.45mm thick)
- Can be embedded in IC cards by hot lamination

EnerCera Coin Type

- Heat resistant coin type cell (1mm thick)
- Can be mounted on board by Reflow Soldering

EnerCera Pouch & Coin are the CES 2019 Innovation Awards Winners !!

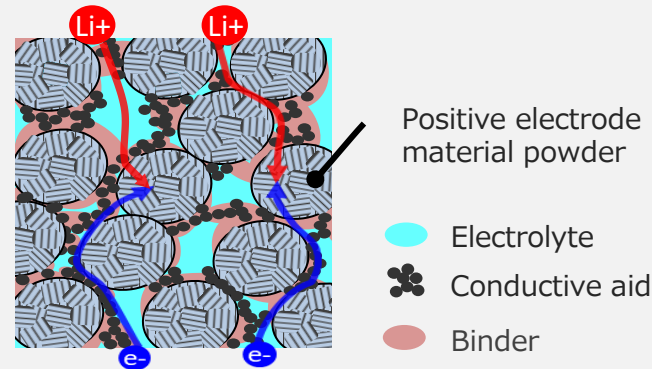
Overview: Ceramic Electrode Plate

Powder Coating Type (Conventional)

Bonding of active material powder and conductive aid with binder

- ✓ Limited improvement in energy density
- ✓ High internal resistance
- ✓ Cannot be mounted at high temperatures

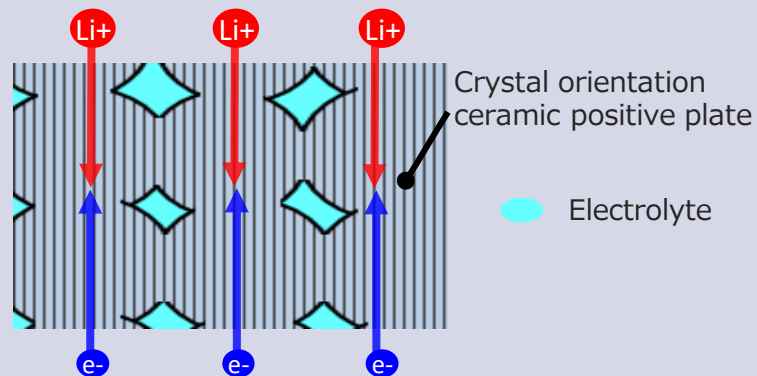
Cross-sectional view of positive electrode



NGK Ceramic Electrode Plate

Formed only with active material by sintering







- ✓ High energy density
- ✓ Low internal resistance
- ✓ Can be mounted at high temperatures
ex. Hot lamination and solder reflow



EnerCera Pouch Lineup



NGK INSULATORS, LTD.

	High Power	High Capacity			Heat Resistant	Fast Charging
Appearance	 0.7g	 0.8g	 0.6g		 0.8g	 0.3g
Model Number	EC382504P-P	EC382704P-C	EC382204P-C	EC302304P-C	EC382704P-H	ET271704P-H
Dimensions [mm]	38 x 25 x 0.45t	38 x 27 x 0.45t	38 x 22 x 0.45t	30 x 23 x 0.45t	38 x 27 x 0.45t	27 x 17 x 0.45t
Capacity [mAh] (Charging voltage)	20 (4.2V)	27 (4.3V) 24 (4.2V)	20 (4.3V) 18 (4.2V)	15 (4.3V) 14 (4.2V)	20 (4.2V)	5 (2.7V)
Nominal Voltage [V]	3.8	3.8	3.8	3.8	3.8	2.3
Energy Density [mWh/cc]	180 (4.2V)	220 (4.3V) 200 (4.2V)	200 (4.3V) 180 (4.2V)	180 (4.3V) 170 (4.2V)	170 (4.2V)	60 (2.7V)
CV Charging	N/A	N/A	N/A	N/A	N/A	OK (80% in 10min.)
Peak Discharge Current ※ [mA]	500	170	140	(100)	125	100
Operating Temp. (recommended)	0°C ~ 45°C					-40°C ~ 60°C
Heatproof Temp. (in process)	80°C (Only cold lamination applicable)				135°C (@ 3 MPa) (Hot lamination applicable)	
Status	Commercial production			Preparation		

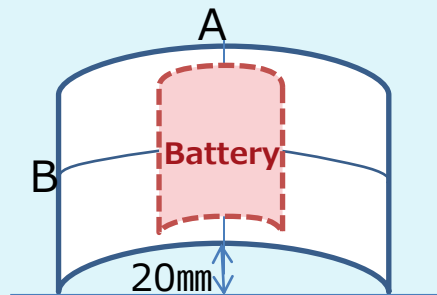
※Voltage drop within 0.5 V @1sec. (@25°C)

Specifications may be changed without notice.

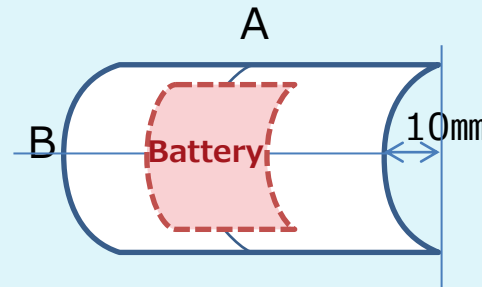
Characteristic: EnerCera Pouch Bendability



Test was performed compliance to *ISO/IEC14443-1 "physical characteristics of IC cards".



**B-axis direction
500 times**



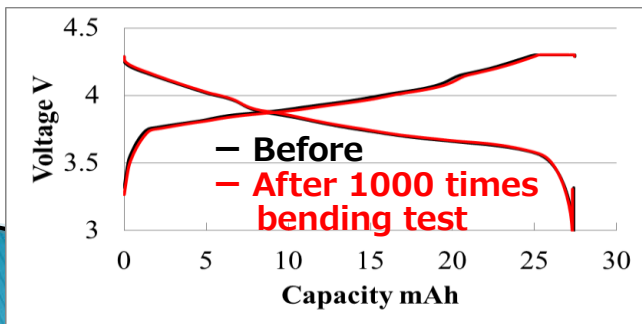
**A-axis direction
500 times**

**Total
1,000 times**

**ISO/IEC14443-1 "IDENTIFICATION CARDS-CONTACTLESS INTEGRATED CIRCUIT CARDS-PROXIMITY CARDS-PART1-PHYSICAL CHARACTERISTICS"*

After bending test (1,000 + 5,000 times), all properties are not changed.

Charge/Discharge performance









Battery Type: EC382704P-C

- Appearance: No change
- Discharge capacity : No change
- Internal Resistance : No change
- Rate performance: No change
- Cycle performance: No change

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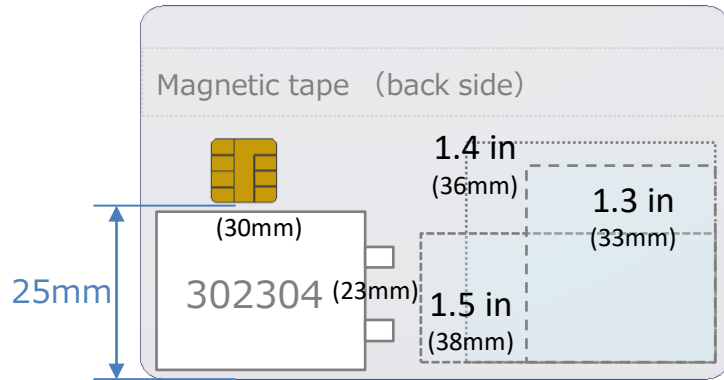
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Specifications may be changed without notice.

New Lineup! - High Capacity Type EC302304P-C -



NGK INSULATORS, LTD.



<https://fuzecard.com/products/fuzecard>



<https://authentrend.com/at-wallet/>

- Ideal for **display cards** such as All-In-One Card and one card and cryptocurrency card
 - Small foot print (30mm x 23mm) which enables to adopt large display for cards
- ⇒ Small foot print pouch type battery supports high value cards

Characteristic: Heat Resistance (Hot Lamination)

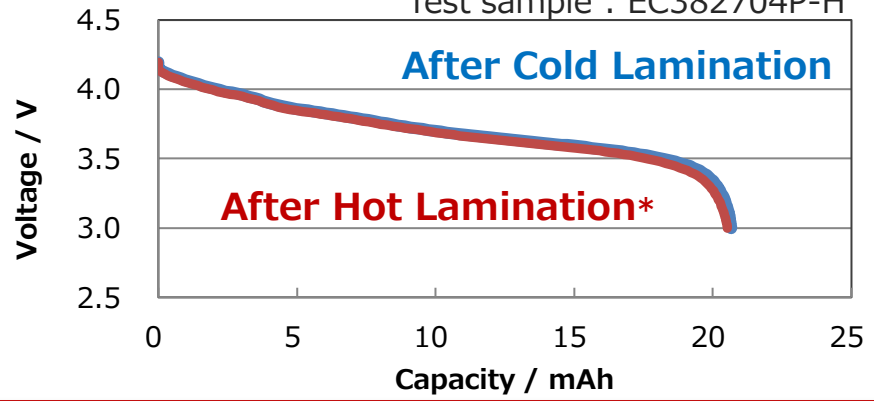
- High Heat Resistance Type -

EnerCera Pouch can be embedded in cards by hot lamination due to the following designs:

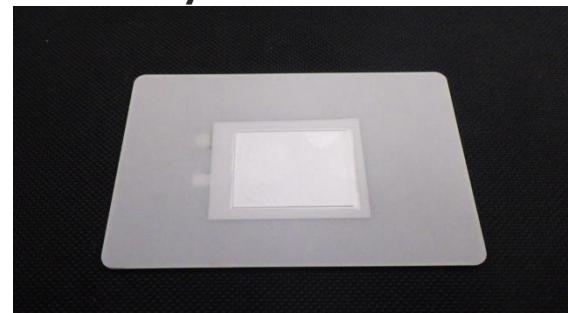
- ✓ Original Ceramic Electrode Plate formed only active material by sintering
- ✓ Unique organic liquid electrolyte with high boiling point
- ✓ Improved pouch sealing design and precise control of amount of liquid electrolyte to avoid leakage at hot lamination process

Discharge Performance after Lamination process

Test sample : EC382704P-H



Appearance of card sample with EnerCera pouch embedded by Hot Lamination









* 135°C x 10 min, pressure 3 MPa

EnerCera Pouch is the world 1st Hot Lamination compatible Li-ion rechargeable battery

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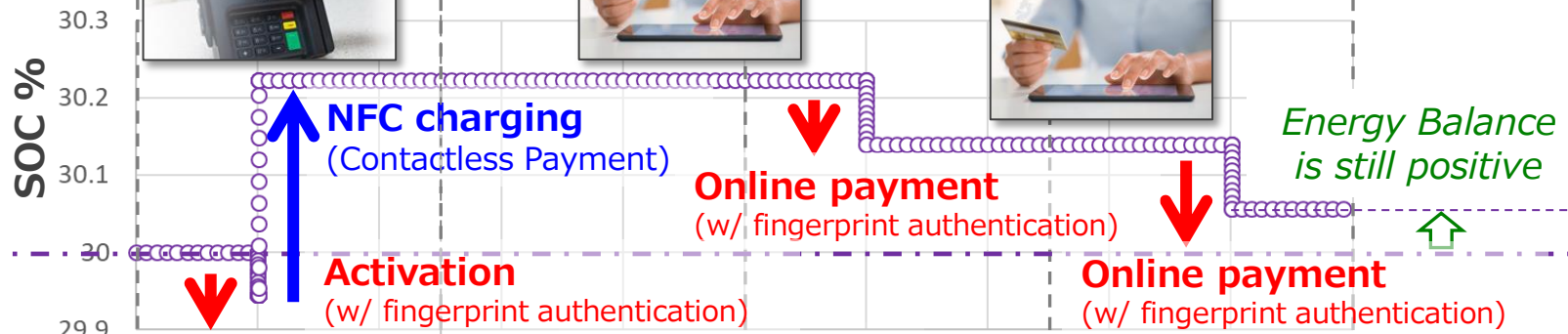
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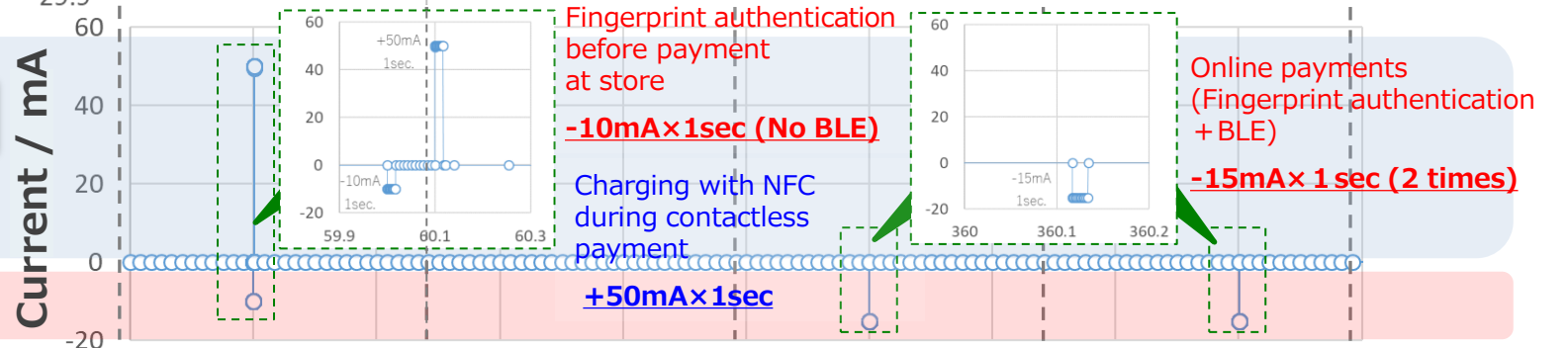
Characteristic: Smart Card Case Study -Fast Charging Type-



Energy Balance



Operation

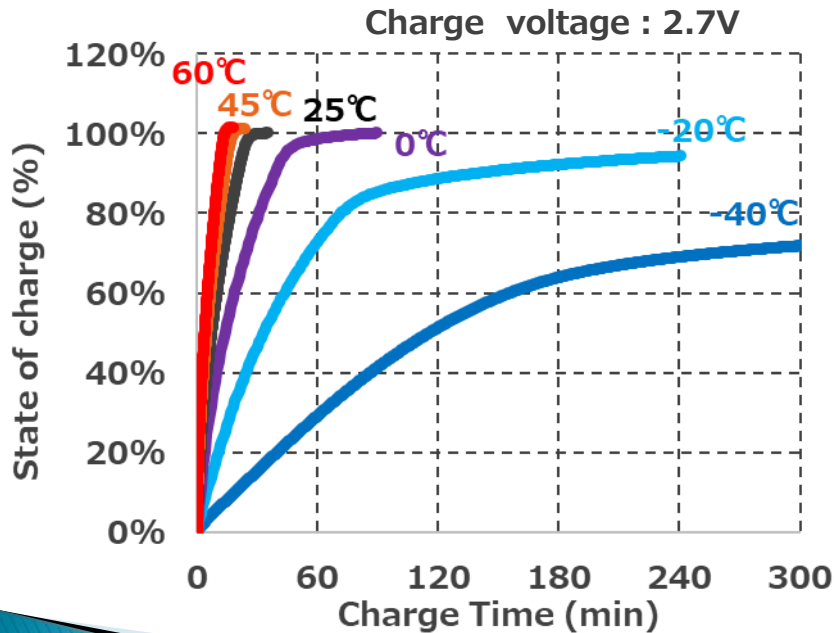


Smart card with EnerCera enables the continuous usage without customized charging !!

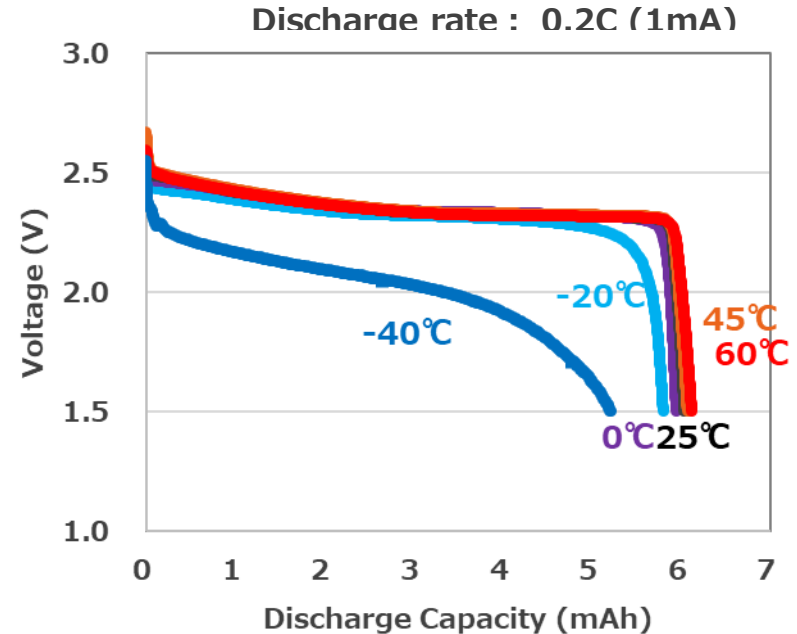
Characteristic: Temperature Dependency - Fast Charging Type

Test sample: ET271704P-H

CV charge performance



Discharge performance

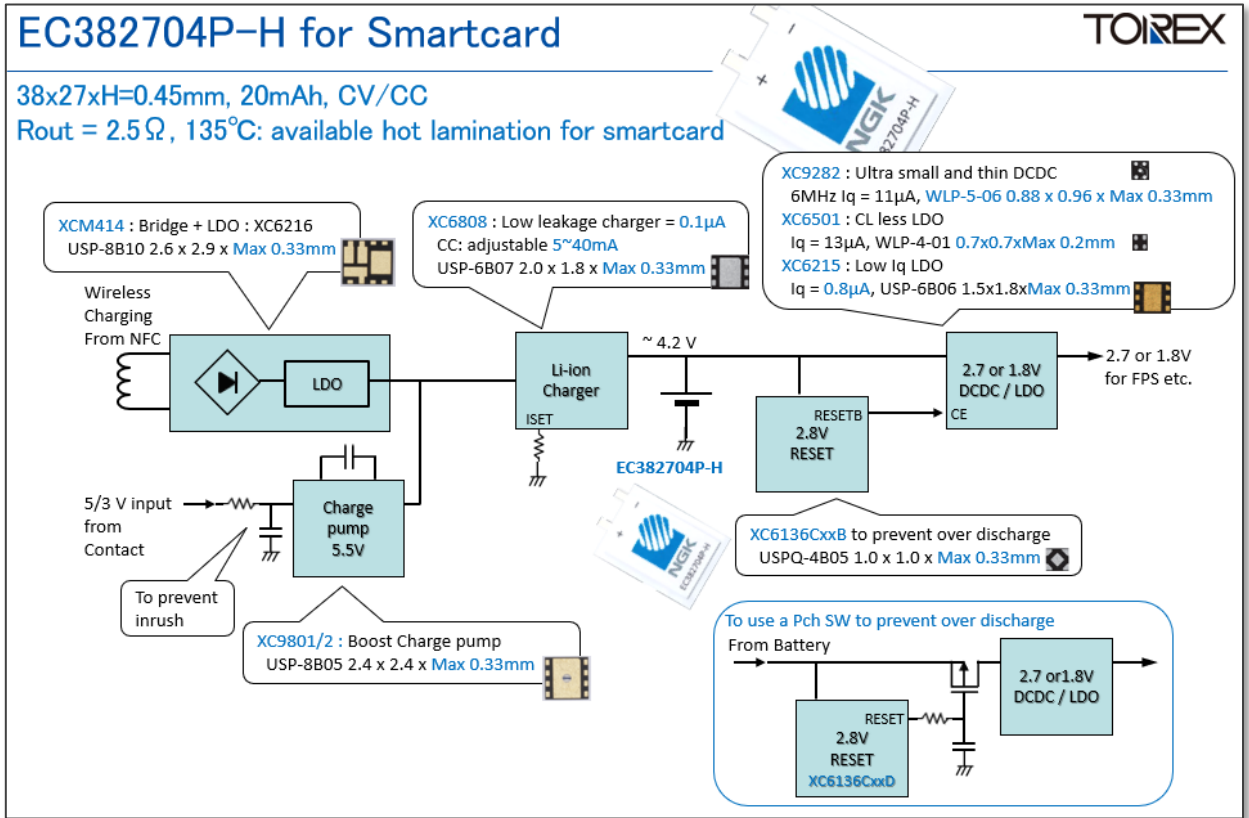


Reference Design: Recommended Charge/Discharge Circuit



- High Capacity, High Power and High Heat Resistance Type -

➤ Charger IC required



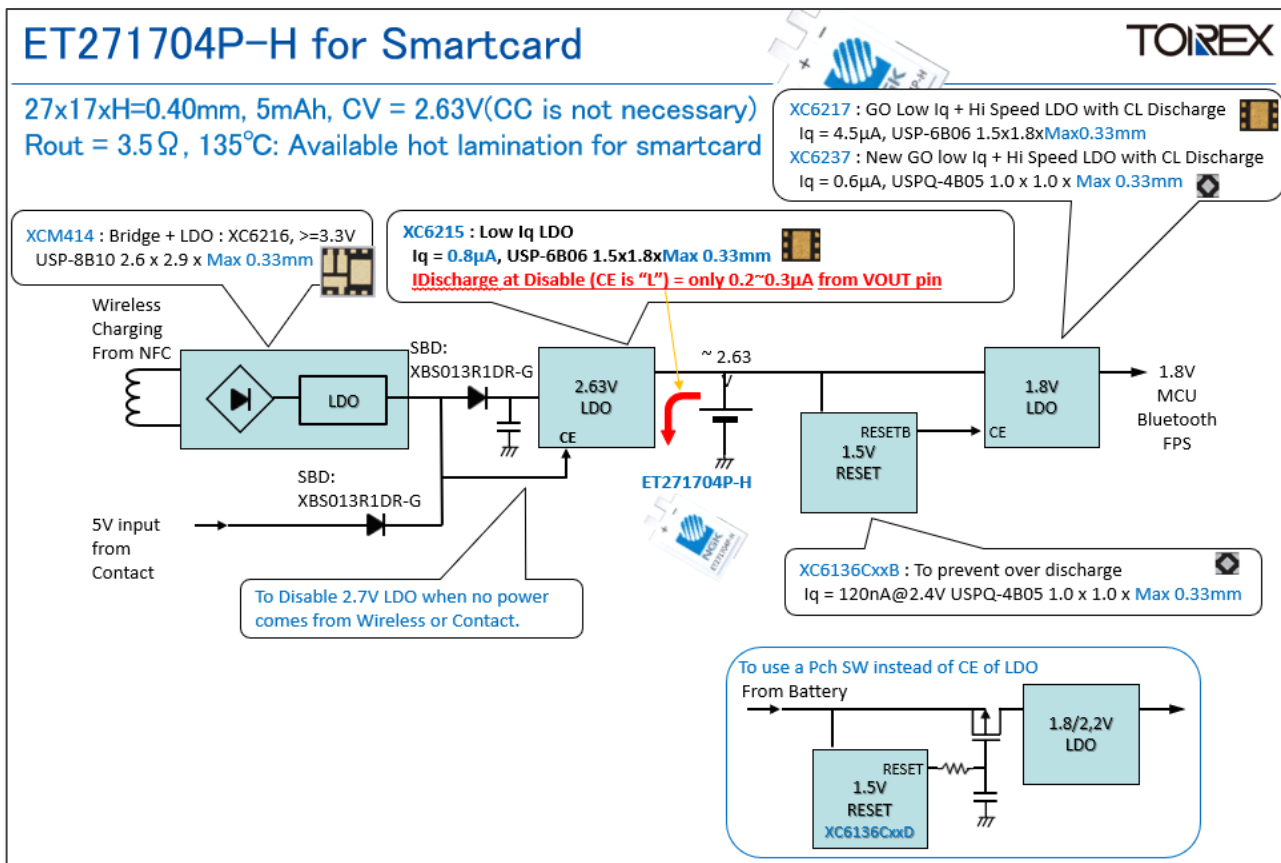
Collaboration with TOREX SEMICONDUCTOR LTD

Reference Design: Recommended Charge/Discharge Circuit



- Fast Charging Type -

➤ **Charger IC is NOT required**



Collaboration with TOREX SEMICONDUCTOR LTD

Production Status of EnerCera Batteries and Smart Cards / Reference Designs with Partners



Site Area : 21,100 m²
Cell production Area : 1,500 m²

NGK Ceramic Device Co., Ltd. Yamanashi Factory

- ✓ The production lines with 1 million units per month capability at NGK's Yamanashi factory
- ✓ Commercial production started in April 2019
- ✓ Many smart card manufacturers are adopting EnerCera Pouch worldwide



Digital Identification (KONA I)



NFC charging card (FUJIKURA, TOREX)



Display ID card (MIRAI BAR, pict leap)

Partners

- APS Card
- KONA I
- FUJIKURA
- TOREX
- MIRAI BAR
- pict leap
- Shoei Printing
- Rohm
- Lapis Semiconductor and more

Thank you

<https://www.ngk-insulators.com/en/product/electron/enercera/index.html>