CeraCharge®

World’s first rechargeable solid-state SMT battery

TDK Electronics AG
Piezo & Protection Devices Business Group
Multilayer Technology
Munich, Germany
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Demand for a new battery technology

Billions of devices / Sensors everywhere

INTERNET OF EVERYTHING

- Healthcare
- Wearables
- Energy harvesting
- Smart home

New application fields drive the demand for compact, safe, rechargeable energy sources
CeraCharge®: World’s first solid-state SMT-compatible Li-ion battery

CeraCharge® combines the advantages of Li-ion batteries with the safety and manufacturing benefits of ceramic multilayer components.

CeraCharge® includes:
- High safety
- SMT-compatible
- Suitable for reflow soldering

**Li-ion battery**
- Gas relief valve
- Electrode terminal
- Negative electrode
- Separator
- Positive electrode
- Organic electrolyte (Li-ion)

**Multilayer ceramic**
- Inner electrode
- Dielectric
- External electrode

**CeraCharge®**

**All-ceramic multilayer battery**
- Electrolyte: Li-based ceramic oxide
- Inner electrode: Li-based ceramic oxide
- Charge collector: Cu

**High-energy Li-ion battery technology**

**All solid-state**
- High-volume production process

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Comparison of energy storage devices

<table>
<thead>
<tr>
<th>Capacity [mAh]</th>
<th>Volume [mm$^3$]</th>
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<tbody>
<tr>
<td>$10^{-6}$</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td>$10^{-5}$</td>
<td>$10^{-2}$</td>
</tr>
<tr>
<td>$10^{-4}$</td>
<td>$10^{-1}$</td>
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<tr>
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<td>$10^{1}$</td>
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<tr>
<td>$10^{1}$</td>
<td>$10^{5}$</td>
</tr>
<tr>
<td>$10^{2}$</td>
<td>$10^{6}$</td>
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</tbody>
</table>

(100 mF ≈ 100 μAh)
Unique features

All-ceramic structure
- Cannot leak
- Cannot burn
- Cannot explode

SMT-compatible
- World’s smallest
- Safe
- Rechargeable
- Easy to assemble
- Reflow solderable
- Embeddable
- No need to change battery
- Available in EIA case sizes

Robust design
- Wide temperature range
- Suitable for vacuum applications
### Key figures

#### Size 1812

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit(s)</th>
<th>Value(s)</th>
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<tbody>
<tr>
<td>Nominal voltage</td>
<td>[V]</td>
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<tr>
<td>Operating voltage</td>
<td>[V&lt;sub&gt;op&lt;/sub&gt;]</td>
<td>0 to 1.6</td>
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<tr>
<td>Nominal capacity</td>
<td>[µAh]</td>
<td>100</td>
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<tr>
<td>Nominal discharge current</td>
<td>[µA]</td>
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<tr>
<td>Operating temperature</td>
<td>[°C]</td>
<td>–20 to +80</td>
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<td>Case size</td>
<td>[EIA]</td>
<td>1812</td>
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<tr>
<td>Dimensions</td>
<td>[mm]</td>
<td>4.4 x 3.0 x 1.1</td>
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<tr>
<td>Weight</td>
<td>[g]</td>
<td>0.04</td>
</tr>
</tbody>
</table>

*CeraCharge® offers 1000 times the capacity of a capacitor in the same case size*
Main applications

Real-time clock
Backup battery

- MCU
- LCD
- RTC
- CeraCharge®

Energy harvesting
Energy storage

- Energy harvesting unit
- EN threshold control
- Capacitor
- CeraCharge®

Internet of Things: Beacon
Energy storage (battery)

- Solar cell
- PMIC (CV output)
- CeraCharge®

Wearables
Sub-battery for voltage and current smoothing

- Energy source
- PMIC (CV output)
- Li battery (main battery)
- CeraCharge®