

**LiTE*STAR™**

**THE SOLID STATE, THIN-FILM, LITHIUM BATTERY**

- Taking the next step with thin-film flexible energy storage
- Going where no other battery is able
- Inside the product for life

Product development specialists across many industries are finding innovative ways to exploit the performance life in the **LiTE*STAR™** Battery. Life cycle testing has exceeded 60,000 full depth of discharge cycles and an end of life limit has yet to be reached.

As a result, the **LiTE*STAR™** Battery can be engineered inside the product for life as a fully integrated device within the electronic circuitry. In many applications, a micro-amp-hr battery is sufficient where an internal or external source (i.e. RF Energy) is present for recharging the battery.

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**Features:**
- Reversible, High Energy Density Cell Chemistry
- Superior Cycle Life (Rechargeability)
- High Voltage Cell Chemistry
- Thin-Film Flexible Form Factor (<15μm)
- Intrinsically Stable, All solid state construction
- No Memory Effects
- Able to charge from low (<1) to high (>50) C rates
- In-Situ Compatibility with manufacturing processes

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**Engineered Performance Options:**

<table>
<thead>
<tr>
<th>OPTIONS</th>
<th>APPLICATION CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrates</td>
<td>Ceramic Al₂O₃ Thin (5mil) where flexible form not required.</td>
</tr>
<tr>
<td>Metal Foil</td>
<td>Thin (1mil) where planar flexibility or conformal packaging required</td>
</tr>
<tr>
<td>Cathodes</td>
<td>LiCoO₂ Engineered capacities up to ~.2 mAh/cm², 0°C, 4.2-3.0V range</td>
</tr>
<tr>
<td>MnO₂</td>
<td>Engineered capacities up to ~.2 mAh/cm², ~15°C low operating limit, 4.5-1.5V range</td>
</tr>
<tr>
<td>V₂O₅</td>
<td>Engineered capacities up to ~.3 mAh/cm², 0°C low operating limit, 4.0-1.0V range</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Patterns/Packaging Conformal cell patterns and packaging tailored to form, fit and function requirements</td>
</tr>
</tbody>
</table>

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**Performance Comparisons:**

<table>
<thead>
<tr>
<th>Battery System</th>
<th>Anode</th>
<th>Voltage Nominal, V</th>
<th>Energy Density, Wh/kg</th>
<th>Cycle Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>LiTE<em>STAR</em></td>
<td>Li</td>
<td>LiCoO₂*</td>
<td>4.0</td>
<td>200°</td>
</tr>
<tr>
<td>Lead-acid</td>
<td>Pb</td>
<td>PbO₂</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>Nickel-Cadmium</td>
<td>Cd</td>
<td>Ni oxide</td>
<td>2.2</td>
<td>35</td>
</tr>
<tr>
<td>Nickel-M-Hydride</td>
<td>Ni</td>
<td>Ni oxide</td>
<td>2.2</td>
<td>35</td>
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<tr>
<td>Lithium-ion</td>
<td>Li</td>
<td>LiCoO₂</td>
<td>4</td>
<td>90</td>
</tr>
<tr>
<td>Lithium-organic</td>
<td>Li</td>
<td>MnO₂</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Lithium-Polymer</td>
<td>Li</td>
<td>PO₅</td>
<td>3</td>
<td>200</td>
</tr>
<tr>
<td>Edison</td>
<td>Fe</td>
<td>NiO oxide</td>
<td>2.2</td>
<td>30</td>
</tr>
<tr>
<td>Silver-zinc</td>
<td>Zn</td>
<td>AgO</td>
<td>1.5</td>
<td>90</td>
</tr>
<tr>
<td>Nickel-zinc</td>
<td>Zn</td>
<td>Ni oxide</td>
<td>1.6</td>
<td>60</td>
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<tr>
<td>Nickel-hydrogen</td>
<td>H₂</td>
<td>NiO oxide</td>
<td>2.2</td>
<td>55</td>
</tr>
<tr>
<td>Silver-Cadmium</td>
<td>Cd</td>
<td>AgO</td>
<td>1.1</td>
<td>55</td>
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<tr>
<td>Zinc-air</td>
<td>Zn</td>
<td>O₂ (Air)</td>
<td>1.5</td>
<td>100</td>
</tr>
<tr>
<td>Zinc-Bromine</td>
<td>Zn</td>
<td>Br₂</td>
<td>1.6</td>
<td>70</td>
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<tr>
<td>High-Temperature</td>
<td>Li(Na)</td>
<td>FeO</td>
<td>1.7</td>
<td>180</td>
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<tr>
<td>High-temperature</td>
<td>Ni</td>
<td>SrO</td>
<td>5</td>
<td>210</td>
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</tbody>
</table>

* For a 1 mil titanium foil substrate

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**Comparative Performance of Typical Secondary Batteries**

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**LiTE*STAR™ is available in flexible or rigid formats and can be engineered to specific patterns, shapes, and sizes.**

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**www.InfinitePowerSolutions.com**
PRELIMINARY PERFORMANCE SPECIFICATIONS

**BATTERY TYPE**
- **Makeup:** Solid State Rechargeable Microbattery
- **Electrolyte:** All Solid State (LiPON, Lithium Phosphorus Oxynitride)
- **Anode:** Lithium
- **Cathode:** LiCoO₂
- **Form:** Thin Film
- **Substrate:** Metal Foil or Rigid Ceramic
- **Encapsulant:** Fully encapsulated in thin membrane

**VOLTAGE (V) Nominal**
- 4.0 V Open Circuit

**CAPACITY**
- Up to: ~0.2mAhr/cm²
- Can be increased by surface area or parallel cell stacks

**OPERATING RANGE**
- Sustained Operation
- Can be engineered to higher temperatures

**CHARGING**
- >85% Charging efficiency
- Capability to charge at C rates greater than 50 at lower efficiencies

**ENERGY DENSITY**
- Wh/kg (gravimetric): 200
- Wh/l (volumetric): 450

**LIFE**
- Cycle Life: >60,000 charge/discharge cycles
- Shelf Life: Infinite prior to activation
- Quiescent Storage Life: <1% total energy loss per year after initial activation

**MECHANICAL**
- Designed to Application Specific Form Factor Requirements

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*Note: All tests results are based on a 1.2µm cathode thickness and 1.0 cm² area.
Production batteries available in 3.0µ thicknesses for capacities up to 0.2 mAhr/cm²
1: Discharge Capacity based upon 1.2µ thick cathode
2: Internal Resistance Measured at Various voltages during discharge cycle
3: Cycling: Charged @ 500µA to 4.2V then discharged @ 500µA to 3.0V
4: Thermal Cycle Testing Using 100µA discharge current