Performance and Safety Testing of Varta Li-ion Polymer Cells

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Outline

- Cell Characteristics
- Performance
- Safety
- Conclusions
Varta Cell Characteristics

Voltage : 3.7 V
Capacity : 1.21 Ah
Dimensions : 5mm X 37mm X 38.5 mm
MOSFET switches for Overvoltage and Undervoltage
# Initial Screening Results

29 Cells delivered: Statistics on Physical Screening

<table>
<thead>
<tr>
<th></th>
<th>Thickness (mm)</th>
<th>Weight (g)</th>
<th>OCV (V)</th>
<th>CCV (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average</strong></td>
<td>5.08</td>
<td>22.8938</td>
<td>3.787</td>
<td>3.491</td>
</tr>
<tr>
<td><strong>Std. Dev.</strong></td>
<td>0.06</td>
<td>0.59</td>
<td>0.11</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>2 x Std Dev</strong></td>
<td>0.11</td>
<td>1.19</td>
<td>0.22</td>
<td>0.10</td>
</tr>
<tr>
<td><strong>COV (%)</strong></td>
<td>1.10</td>
<td>2.59</td>
<td>2.87</td>
<td>1.49</td>
</tr>
</tbody>
</table>
Rate Capability Test for Varta Li-ion Polymer Cells

Average Capacity Loss: First to last Cycle (%)
Cycling under Vacuum Conditions for Varta Li-ion Polymer cells
Discharge at -20 deg C for Varta Li-ion Polymer Cells
Cycling at 22 deg C for Varta Li-ion Polymer Cell

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Internal Resistance Characteristic for the Varta Li-ion Polymer Cell

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Overcharge Test of Varta Li-ion Polymer Cell
Unrestrained

Charge @0.6A to 4.2V, 4.2V to 0.05A
Charge @1.2A w/12V limit for 6hr
Overcharge Test of Varta Li-ion Polymer Cells Restrained

Charge @0.6A to 4.2V, 4.2V to 0.05A
Charge @1.2A w/12V limit for 6hr or until an event stops the test

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Overdischarge of Varta Li-ion Polymer Cell
Unrestrained & Restrained

Charge: 0.60A to 4.2V, 4.2V to 0.05A
Discharges: cyc1-1.2A to 1.0V, cyc2 & 3- 0.6A to 2.7V, 1.2A to 0V.
On final discharge:
an additional 150% capacity after reaching 0V

-4.20V applied

-12.60V applied

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External Short Circuit on Varta Li-ion Polymer Cell:
Unrestrained and Restrained

Figure 16: ES-HEDS-01 Varta Li-Poly Cell Evaluations
External Short Circuit
Charge: 0.60A to 4.2V, 4.2V to 0.05A
Short Circuit through 40 milliohm external circuit

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Simulated Internal Short

Figure 20: ES-HEDS-01 Varta Li-Poly Cell Evaluations
Internal Short Circuit, Crush
Charge: 0.60A to 4.2V, 4.2V to 0.05A
Crush with a 1/4" non-conductive rod

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Heat-to-Vent on Varta Li-ion Polymer Cell
Unrestrained

Figure 24: ES-HEDS-01 Varta Li-Ion Cell Evaluations
Heat-to-Vent: Unrestrained cells
Charge: 0.80A to 4.2V, 4.2V to 0.05A

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Heat-to-Vent Test for Varta Li-ion Polymer Cell
Restrained

Figure 25: ES-HEDS-01 Varta Li-Ion Cell Evaluations
Heat-to-Vent: Restrained cells
Charge: 0.60A to 4.2V, 4.2V to 0.05A

- Cell Voltage (V)
- Temperature (deg C)
- Time (hr)

Legend:
- cell #19 volt
- cell #20 volt
- cell #19 cell temp

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