# 2.7V 3F ULTRACAPACITOR CELL

## FEATURES AND BENEFITS
- High performance product with low ESR
- Exceptional shock and vibration resistance
- Long lifetimes with up to 500,000 duty cycles*
- Compliant with UL, RoHS and REACH requirements

## TYPICAL APPLICATIONS
- Actuators
- Emergency Lighting
- Telematics
- Automotive
- Security Equipment
- Backup System
- Smoke Detectors
- Advanced Metering

## PRODUCT SPECIFICATIONS

### ELECTRICAL

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Voltage, $V_r$</td>
<td>2.7 VDC</td>
</tr>
<tr>
<td>Surge Voltage</td>
<td>2.85 VDC</td>
</tr>
<tr>
<td>Rated Capacitance, $C$</td>
<td>3 F</td>
</tr>
<tr>
<td>Min. / Max. Capacitance, Initial</td>
<td>2.7 F / 3.6 F</td>
</tr>
<tr>
<td>Typical Capacitance, Initial$^{2,3}$</td>
<td>3.04 F</td>
</tr>
<tr>
<td>Rated (Max.) ESR$_{DC}$, Initial$^3$</td>
<td>70 mΩ</td>
</tr>
<tr>
<td>Typical ESR$_{DC}$, Initial$^{2,3}$</td>
<td>55 mΩ</td>
</tr>
<tr>
<td>Typical ESR$_{DC}$, Initial, 5 sec$^{2,3}$</td>
<td>129 mΩ</td>
</tr>
<tr>
<td>Maximum Leakage Current$^4$</td>
<td>5 μA</td>
</tr>
<tr>
<td>Maximum Peak Current, Non-repetitive$^6$</td>
<td>3.3 A</td>
</tr>
</tbody>
</table>

### PHYSICAL

Nominal Mass: 1.4 g

### POWER & ENERGY

<table>
<thead>
<tr>
<th>Operating Temp. Range</th>
<th>Standard (-40°C to 65°C) at 2.7 V</th>
<th>Extended (-40°C to 85°C) at 2.3 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Stored Energy, $E_{max}^{6,9}$</td>
<td>3.0 mWh</td>
<td>2.2 mWh</td>
</tr>
<tr>
<td>Gravimetric Specific Energy$^6$</td>
<td>2.1 Wh/kg</td>
<td>1.5 Wh/kg</td>
</tr>
<tr>
<td>Usable Specific Power$^8$</td>
<td>8.9 kW/kg</td>
<td>6.4 kW/kg</td>
</tr>
<tr>
<td>Impedance Match Specific Power$^6$</td>
<td>18.6 kW/kg</td>
<td>13.4 kW/kg</td>
</tr>
</tbody>
</table>

### SAFETY

Certifications: RoHS, REACH, UL 810A

*Results may vary. Additional terms and conditions, including the limited warranty, apply at the time of purchase. See the warranty details for applicable operating and use requirements.*

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**TYPICAL CHARACTERISTICS**

### THERMAL

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Thermal Resistance $^{8}$ ($R_{in, Housing}$)</td>
<td>67°C/W</td>
</tr>
<tr>
<td>Typical Thermal Capacitance $^{C_{in}}$</td>
<td>1.3 J°C</td>
</tr>
<tr>
<td>Usable Continuous Current (BOL) $^{(\Delta T = 15 , ^\circ\text{C})^{8,10}}$</td>
<td>1.8 A</td>
</tr>
<tr>
<td>Usable Continuous Current (BOL) $^{(\Delta T = 40 , ^\circ\text{C})^{8,10}}$</td>
<td>2.9 A</td>
</tr>
</tbody>
</table>

### LIFE*

- Projected DC Life at Room Temperature
  - At rated voltage and 25°C, EOL$^{10}$: 10 years
  - At rated voltage and 65°C, EOL$^{10}$: 1,500 hours
  - At 2.3V and 85°C, EOL$^{10}$: 1,500 hours
- Projected Cycle Life at Room Temperature
  - (Constant current charge-discharge from $V_r$ to $1/2V_r$ at 25°C, EOL$^{10}$): 500,000 cycles
- Shelf Life
  - (Stored uncharged at 25°C, ≤ 50% RH): 4 years

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1. Surge Voltage
   Absolute maximum voltage, non-repetitive. Duration not to exceed 1 second.

2. “Typical” values represent mean values of production sample.

3. Rated Capacitance & ESR
   Capacitance: Constant current charge (10 mA/F) to V<sub>s</sub>, 5 min hold at V<sub>s</sub>, constant current discharge 10 mA to 0.1V.
   e.g. in case of 2.7V 3F cell, 10 * 3 = 30 mA
   ESR<sub>DC</sub>: Constant current charge (10 mA/F) to V<sub>s</sub>, 5 min hold at V<sub>s</sub>, constant current discharge (40 * C * V<sub>s</sub>/mA) to 0.1 V.
   e.g. in case of 2.7V 3F cell, charge with 10 * 3 = 30 mA and discharge with 40 * 3 * 2.7 = 324 mA

   ![Diagram of Capacitance and ESR](image)

   
   \[ C = \frac{I \times (t_1 + t_2)}{V_s} \]
   \[ ESR_{DC} = \frac{\Delta V}{I} \]

   where C is the capacitance (F);
   I is the absolute value of the discharge current (A);
   V<sub>s</sub> is the rated voltage (V);
   t is the time from start of discharge to reach V<sub>1</sub> (s);
   t is the time from start of discharge to reach V<sub>2</sub> (s);
   ESR<sub>DC</sub> is the DC-ESR (Ω);
   ∆V is the voltage drop during first 10ms of discharge (V).


4. Maximum Leakage Current
   • Current measured after 72 hrs at rated voltage and 25°C. Initial leakage current can be higher.
   • If applicable, module leakage current is the sum of cell and balancing circuit leakage currents.

5. Maximum Peak Current
   • Current needed to discharge cell/module from rated voltage to half-rated voltage in 1 second.

6. Energy & Power (Based on IEC 62391-2)
   • Maximum Stored Energy, E<sub>max</sub> (Wh) = \[ \frac{C \times V_s^2}{2} \]
   • Gravimetric Specific Energy (Wh/kg) = \[ \frac{E_{max}}{mass} \]
   • Usable Specific Power (W/kg) = \[ \frac{impulse~power~rate}{ESR_{DC} \times max} \]
   • Impedance Match Specific Power (W/kg) = \[ \frac{ESR_{DC} \times max}{0.25 \times V_s^2} \]
   • Presented Power and Energy values are calculated based on Rated Capacitance & Rated (Max.) ESR<sub>DC</sub> Initial values.

7. Cycle Life Test Profile
   Cycle life varies depending upon application-specific characteristics. Actual results will vary.

8. Temperature Rise at Constant Current
   • ΔT=\[\frac{I \times \frac{R_{th}}{I}}{ESR_{DC} \times R_{th}}\]
     where ΔT: Temperature rise over ambient (°C)
     I<sub>max</sub>: Maximum continuous or RMS current (A)
     R<sub>th</sub>: Thermal resistance, cell to ambient (°C/W)
     ESR<sub>DC</sub>: Rated (Max.) ESR<sub>DC</sub> (Ω).
     (Note: Design should consider EOL ESR<sub>DC</sub> for application temperature rise evaluation.)

9. Per United Nations material classification UN3499, all Maxwell ultracapacitors have less than 10 Wh capacity to meet the requirements of Special Provisions 361. Both individual ultracapacitors and modules composed of those ultracapacitors shipped by Maxwell can be transported without being treated as dangerous goods (hazardous materials) under transportation regulations.

10. BOL: Beginning of Life, rated initial product performance
    EOL: End of Life criteria.
    • Capacitance: 80% of min. BOL rating
    • ESR<sub>DC</sub>: 2x max. BOL rating

When ordering, please reference the Maxwell Model Number below.

<table>
<thead>
<tr>
<th>Maxwell Model Number:</th>
<th>Maxwell Part Number:</th>
<th>Alternate Model Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCAP0003 P270 S01</td>
<td>133512</td>
<td>ESHSR-0003C0-002R7</td>
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<tr>
<td>BCAP0003 P270 S12</td>
<td>134378</td>
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<tr>
<td>BCAP0003 P270 S1B</td>
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