

# 2.7V 5F ULTRACAPACITOR CELL

BCAP0005 P270 S01  
ESH5R-0005C0-002R7

## 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

|  |               |
|--|---------------|
| Rated Voltage, $V_R$                               | 2.7 VDC       |
| Surge Voltage <sup>1</sup>                         | 2.85 VDC      |
| Rated Capacitance, $C^3$                           | 5 F           |
| Min. / Max. Capacitance, Initial                   | 4.5 F / 6.0 F |
| Typical Capacitance, Initial <sup>2,3</sup>        | 5.17 F        |
| Rated (Max.) $ESR_{DC}$ , Initial <sup>3</sup>     | 45 m $\Omega$ |
| Typical $ESR_{DC}$ , Initial <sup>2,3</sup>        | 36 m $\Omega$ |
| Typical $ESR_{DC}$ , Initial, 5 sec <sup>2,3</sup> | 70 m $\Omega$ |
| Maximum Leakage Current <sup>4</sup>               | 8 $\mu$ A     |
| Maximum Peak Current, Non-repetitive <sup>5</sup>  | 5.5 A         |

### PHYSICAL

|              |       |
|--------------|-------|
| Nominal Mass | 2.1 g |
|--------------|-------|

### POWER & ENERGY

| Operating Temp. Range                           | Standard (-40°C to 65°C) at 2.7 V | Extended (-40°C to 85°C) at 2.3 V |
|---|-----------------------------------|-----------------------------------|
| Maximum Stored Energy, $E_{max}$ <sup>6,9</sup> | 5.0 mWh                           | 3.6 mWh                           |
| Gravimetric Specific Energy <sup>6</sup>        | 2.4 Wh/kg                         | 1.7 Wh/kg                         |
| Usable Specific Power <sup>6</sup>              | 9.2 kW/kg                         | 6.7 kW/kg                         |
| Impedance Match Specific Power <sup>6</sup>     | 19.2 kW/kg                        | 14.0 kW/kg                        |

### SAFETY

|                |                      |
|----------------|----------------------|
| Certifications | RoHS, REACH, UL 810A |
|----------------|----------------------|

## TYPICAL CHARACTERISTICS

### THERMAL

|   |          |
|---|----------|
| Typical Thermal Resistance ( $R_{th}$ , Housing) <sup>8</sup>         | 60°C/W   |
| Typical Thermal Capacitance ( $C_{th}$ )                              | 2.0 J/°C |
| Usable Continuous Current (BOL) ( $\Delta T = 15$ °C) <sup>8,10</sup> | 2.3 A    |
| Usable Continuous Current (BOL) ( $\Delta T = 40$ °C) <sup>8,10</sup> | 3.8 A    |

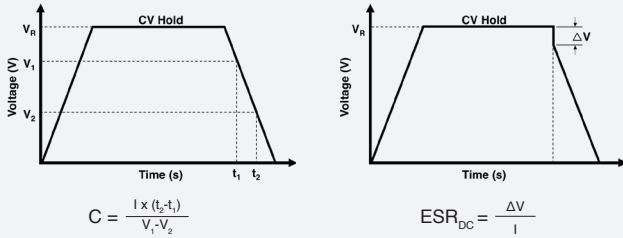
### LIFE\*

|  |                |
|--|----------------|
| Projected DC Life at Room Temperature (At rated voltage and 25°C, EOL <sup>10</sup> )  | 10 years       |
| DC Life at High Temperature (At rated voltage and 65°C, EOL <sup>10</sup> )  | 1,500 hours    |
| DC Life at De-rated Voltage & Higher Temperature (At 2.3V and 85°C, EOL <sup>10</sup> )  | 1,500 hours    |
| Projected Cycle Life at Room Temperature <sup>7</sup> (Constant current charge-discharge from $V_R$ to $1/2V_R$ at 25°C, EOL <sup>10</sup> ) | 500,000 cycles |
| Shelf Life (Stored uncharged at 25°C, $\leq 50\%$ RH)  | 4 years        |

\*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.

# Datasheet: 2.7V 5F ULTRACAPACITOR CELL

- Surge Voltage**  
Absolute maximum voltage, non-repetitive. Duration not to exceed 1 second.
- "Typical" values represent mean values of production sample.
- Rated Capacitance & ESR<sub>DC</sub> (measure method)**
  - Capacitance: Constant current charge (10 mA/F) to V<sub>R</sub>, 5 min hold at V<sub>R</sub>, constant current discharge 10 mA/F to 0.1V.  
e.g. in case of 2.7V 5F cell, 10 \* 5 = 50 mA
  - ESR<sub>DC</sub>: Constant current charge (10 mA/F) to V<sub>R</sub>, 5 min hold at V<sub>R</sub>, constant current discharge (40 \* C \* V<sub>R</sub>[mA]) to 0.1 V.  
e.g. in case of 2.7V 5F cell, charge with 10 \* 5 = 50 mA and discharge with 40 \* 5 \* 2.7 = 540 mA



where C is the capacitance (F);  
I is the absolute value of the discharge current (A);  
V<sub>R</sub> is the rated voltage (V);  
V<sub>1</sub> is the measurement start voltage, 0.8xV<sub>R</sub> (V);  
V<sub>2</sub> is the measurement end voltage, 0.4xV<sub>R</sub> (V);  
t<sub>1</sub> is the time from start of discharge to reach V<sub>1</sub> (s);  
t<sub>2</sub> is the time from start of discharge to reach V<sub>2</sub> (s);  
ESR<sub>DC</sub> is the DC-ESR (Ω);  
ΔV is the voltage drop during first 10ms of discharge (V).

Typical ESR<sub>DC</sub>, Initial, 5 sec tested per Maxwell Application Note, "Test Procedures for Capacitance, ESR, Leakage Current and Self-Discharge Characterizations of Ultracapacitors" available at [www.maxwell.com](http://www.maxwell.com).

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

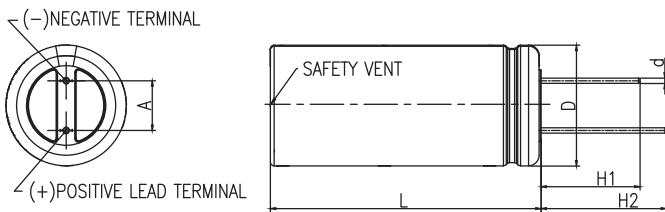
$$I = \frac{\frac{1}{2}V_R}{\Delta t / C + ESR_{DC}}$$

where Δt is the discharge time (sec); Δt = 1 sec in this case.

- The stated maximum peak current should not be used in normal operation and is only provided as a reference value.
- Energy & Power (Based on IEC 62391-2)**
    - Maximum Stored Energy, E<sub>max</sub>(Wh) =  $\frac{1}{2}CV_R^2 / 3,600$
    - Gravimetric Specific Energy (Wh/kg) =  $\frac{E_{max}}{mass}$
    - Usable Specific Power (W/kg) =  $\frac{0.12V_R^2}{ESR_{DC} \times mass}$
    - Impedance Match Specific Power (W/kg) =  $\frac{0.25V_R^2}{ESR_{DC} \times mass}$
  - Cycle Life Test Profile**  
Cycle life varies depending upon application-specific characteristics. Actual results will vary.
  - Temperature Rise at Constant Current**
    - ΔT = I<sub>RMS</sub><sup>2</sup> x ESR<sub>DC</sub> x R<sub>th</sub>

where ΔT: Temperature rise over ambient (°C)  
I<sub>RMS</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.)
  - 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.
  - 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

## BCAP0005 P270 S01



When ordering, please reference the Maxwell Model Number below.

**Maxwell Model Number:** BCAP0005 P270 S01  
**Maxwell Part Number:** 133514  
**Alternate Model Number:** ESHSR-0005C0-002R7

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