Maxwell TECHNOLOGIES
Enabling Energy's Future™

DATASHEET

XP™ 2.7V 50F ULTRACAPACITOR CELL

BCAP0050 P270 X01
ESHSR-0050C0-002R7UC

FEATURES AND BENEFITS

- Enhanced performance under adverse environmental conditions
- Patented improvements both in structure and in sealing
- 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[1]	2.85 VDC
Rated Capacitance, C[3]	50 F
Min. / Max. Capacitance, Initial	45 F / 60 F
Typical Capacitance, Initial[2,3]	54.5 F
Rated (Max.) ESR_{DC}, Initial[3]	16 mΩ
Typical ESR_{DC}, Initial[2,3]	10 mΩ
Typical ESR_{DC}, Initial, 5 sec[2,3]	16 mΩ
Maximum Leakage Current[4]	73 µA
Maximum Peak Current, Non-repetitive[5]	37 A

PHYSICAL

Nominal Mass	12.4 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}[6,9]	50.6 mWh	36.7 mWh
Gravimetric Specific Energy[6]	4.0 Wh/kg	2.9 Wh/kg
Usable Specific Power[6]	4.4 kW/kg	3.2 kW/kg
Impedance Match Specific Power[6]	9.1 kW/kg	6.6 kW/kg

SAFETY

Certifications	RoHS, REACH, UL 810A

TYPICAL CHARACTERISTICS

THERMAL

Typical Thermal Resistance (R_{th}, Housing)[8]	25°C/W
Typical Thermal Capacitance (C_{th})	11 J/°C
Usable Continuous Current (BOL) (ΔT = 15 °C)[8,10]	6.1 A
Usable Continuous Current (BOL) (ΔT = 40 °C)[8,10]	10.0 A

LIFE*

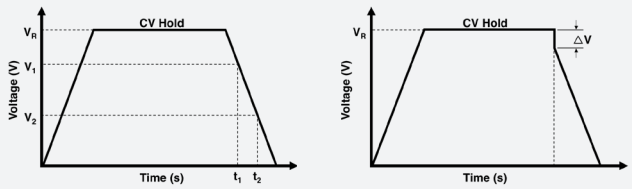
Projected DC Life at Room Temperature (At rated voltage and 25°C, EOL[10])	10 years
DC Life at High Temperature (At rated voltage and 65°C, EOL[10])	1,500 hours
DC Life at De-rated Voltage & Higher Temperature (At 2.3V and 85°C, EOL[10])	1,500 hours
Projected Cycle Life at Room Temperature[7] (Constant current charge-discharge from V_R to $1/2V_R$ at 25°C, EOL[10])	500,000 cycles
Biased Humidity Life (At rated voltage, 60°C, and 90% RH)	3,000 hours
Shelf Life (Stored uncharged at 25°C, ≤ 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.

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_{DC} (measure method)
   - Capacitance: Constant current charge (10 mA/F) to V_R, 5 min hold at V_R, constant current discharge 10 mA/F to 0.1V.
     e.g. in case of 2.7V 50F cell, 10 * 50 = 500 mA
   - ESR_{DC}: Constant current charge (10 mA/F) to V_R, 5 min hold at V_R, constant current discharge (40 * C * V_R[mA]) to 0.1 V.
     e.g. in case of 2.7V 50F cell, charge with 10 * 50 = 500 mA and discharge with 40 * 50 * 2.7 = 5,400 mA



$$C = \frac{I \times (t_2 - t_1)}{V_1 - V_2} \qquad ESR_{DC} = \frac{\Delta V}{I}$$

where C is the capacitance (F);
I is the absolute value of the discharge current (A);
V_R is the rated voltage (V);
V_1 is the measurement start voltage, 0.8xV_R (V);
V_2 is the measurement end voltage, 0.4xV_R (V);
t_1 is the time from start of discharge to reach V_1 (s);
t_2 is the time from start of discharge to reach V_2 (s);
ESR_{DC} is the DC-ESR (Ω);
ΔV is the voltage drop during first 10ms of discharge (V).

Typical ESR_{DC}, 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.

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.

$$I = \frac{½V_R}{\Delta t / C + ESR_{DC}}$$

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.

6. Energy & Power (Based on IEC 62391-2)
   - Maximum Stored Energy, E_{max}(Wh) = $\frac{½CV_R^2}{3{,}600}$
   - 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) = $\frac{0.25V_R^2}{ESR_{DC} \times mass}$
   - Presented Power and Energy values are calculated based on Rated Capacitance & Rated (Max.) ESR_{DC}, 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
   - $\Delta T = I_{RMS}^2 \times ESR_{DC} \times R_{th}$

   where ΔT: Temperature rise over ambient (°C)
   I_{RMS}: Maximum continuous or RMS current (A)
   R_{th}: Thermal resistance, cell to ambient (°C/W)
   ESR_{DC}: Rated (Max.) ESR_{DC}(Ω).
   (Note: Design should consider EOL ESR_{DC} 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_{DC}: 2x max. BOL rating

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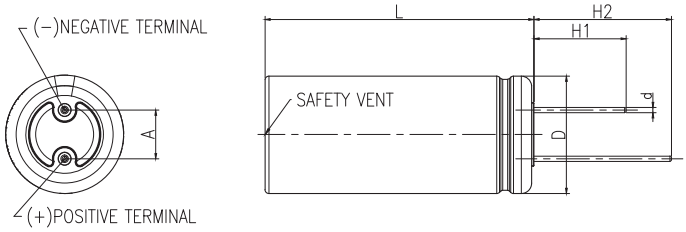

Part Description	Dimensions (mm)					
	L (±1.0)	D (+0.5)	d (±0.05)	H1 (min.)	H2 (min.)	A (±0.5)
BCAP0050 P270 X01	41.0	18.0	0.80	15.0	19.0	7.5

When ordering, please reference the Maxwell Model Number below.

Maxwell Model Number:	Maxwell Part Number:	Alternate Model Number:
BCAP0050 P270 X01	133521	ESHSR-0050C0-002R7UC

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