Maxwell TECHNOLOGIES
Enabling Energy's Future™

DATASHEET

2.7V 3F ULTRACAPACITOR CELL

BCAP0003 P270 S01 (ESHSR-0003C0-002R7)
BCAP0003 P270 S12 I BCAP0003 P270 S1B

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[1]	2.85 VDC
Rated Capacitance, C[3]	3 F
Min. / Max. Capacitance, Initial	2.7 F / 3.6 F
Typical Capacitance, Initial[2,3]	3.04 F
Rated (Max.) ESR_{DC}, Initial[3]	70 mΩ
Typical ESR_{DC}, Initial[2,3]	55 mΩ
Typical ESR_{DC}, Initial, 5 sec[2,3]	129 mΩ
Maximum Leakage Current[4]	5 µA
Maximum Peak Current, Non-repetitive[5]	3.3 A

PHYSICAL

Nominal Mass	1.4 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]	3.0 mWh	2.2 mWh
Gravimetric Specific Energy[6]	2.1 Wh/kg	1.5 Wh/kg
Usable Specific Power[6]	8.9 kW/kg	6.4 kW/kg
Impedance Match Specific Power[6]	18.6 kW/kg	13.4 kW/kg

SAFETY

Certifications	RoHS, REACH, UL 810A

TYPICAL CHARACTERISTICS

THERMAL

Typical Thermal Resistance (R_{th}, Housing)[8]	67°C/W
Typical Thermal Capacitance (C_{th})	1.3 J/°C
Usable Continuous Current (BOL) (ΔT = 15 °C)[8,10]	1.8 A
Usable Continuous Current (BOL) (ΔT = 40 °C)[8,10]	2.9 A

LIFE*

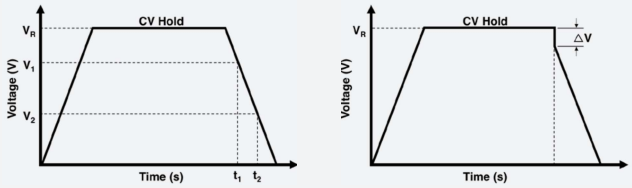
Projected DC Life at Room Temperature (At rated voltage and 25°C, EOL[10])	10 years
DC Life at High Temperature (At rated voltage and 65°C, EOL[10])	1,500 hours
DC Life at De-rated Voltage & Higher Temperature (At 2.3V and 85°C, EOL[10])	1,500 hours
Projected Cycle Life at Room Temperature[7] (Constant current charge-discharge from V_R to $1/2V_R$ at 25°C, EOL[10])	500,000 cycles
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 3F cell, 10 * 3 = 30 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 3F cell, charge with 10 * 3 = 30 mA and discharge with 40 * 3 * 2.7 = 324 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.

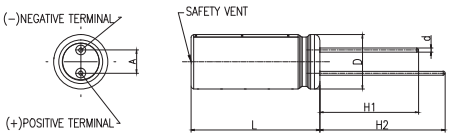
8. Temperature Rise at Constant Current
   - $\Delta T = I_{RMS}^2 \times ESR_{DC} \times R_{th}$

   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.)

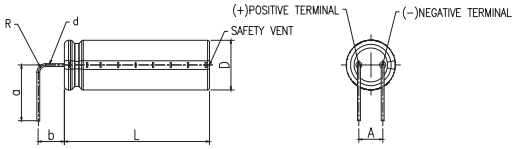
9. Per United Nations material classification UN3499, all Maxwell ultracapacitors have less than 10 Wh capacity to meet the requirements of Special Provisions 361. Both individual ultracapacitors and modules composed of those ultracapacitors shipped by Maxwell can be transported without being treated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

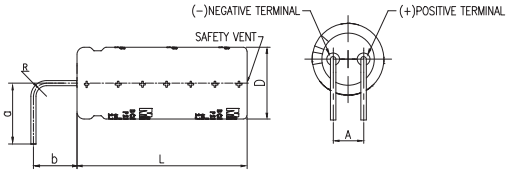
BCAP0003 P270 S01



BCAP0003 P270 S12



BCAP0003 P270 S1B



When ordering, please reference the Maxwell Model Number below.

Maxwell Model Number:	Maxwell Part Number:	Alternate Model Number:
BCAP0003 P270 S01	133512	ESHSR-0003C0-002R7
BCAP0003 P270 S12	134378	-
BCAP0003 P270 S1B	135520	-

Part Description	Dimensions (mm)								
	L (±1.0)	D (+0.5)	d (±0.05)	A (±0.5)	H1 (min.)	H2 (min.)	R (min.)	a (±0.5)	b (±0.5)
BCAP0003 P270 S01	19.5	8.0	0.60	3.5	15.0	19.0	-	-	-
BCAP0003 P270 S12 / S1B	19.5	8.0	0.60	3.5	-	-	1.5	7.0	5.0

Maxwell Technologies, Inc.
Global Headquarters
3888 Calle Fortunada
San Diego, CA 92123
USA
Tel: +1 (858) 503-3300
Fax: +1 (858) 503-3301

Maxwell Technologies, GmbH
Leopoldstrasse 244
80807 Munich
Germany
Tel: +49 (0)89 4161403 0
Fax: +49 (0)89 4161403 99

Maxwell Technologies
Shanghai Trading Co., Ltd.
Room 1005, 1006, and 1007
No. 1898, Gonghexin Road,
Jin An District, Shanghai 2000072,
P.R. China
Tel: +86 21 3852 4000
Fax: +82 21 3852 4099

Maxwell Technologies
Korea Co., Ltd.
17, Dongtangiheung-ro
681 Beon-gil, Giheung-gu,
Yongin-si, Gyeonggi-do 17102
Republic of Korea
Tel: +82 31 289 0721
Fax: +82 31 286 6767

Maxwell TECHNOLOGIES
Enabling Energy's Future™