DATASHEET

2.7V 5F ULTRACAPACITOR CELL

BCAP0005 P270 S01
BCAP0005 P270 S12

High Power Energy Solution in Compact Form Factor

Maxwell Technologies' 2.7V 5F ultracapacitor cells are part of Maxwell's Standard Series of full featured 2.7V products.

Maxwell's Standard Series spans a spectrum of form factors, and our strong cell design engineering experience enables us to produce cells with very low equivalent series resistance (ESR). This translates into increased power density and a small system footprint to meet the specific requirements of your solution. The Standard Series is specialized for systems operating in normal ambient environments and provides system designers with the advantages of significantly more reliable performance under a wider temperature range than most other energy storage options available. Standard Series cells are customizable for a variety of applications that need fast charge/discharge capability and long life.

Whether used alone, integrated into a module assembly, or in a hybrid configuration, Maxwell's 2.7V products will help reduce the overall cost and size of the system while improving return on investment for the customer. Ultracapacitors are the technology of choice for long life and high-power applications because of their durability, low maintenance requirements, and superior cold weather performance when compared to batteries.

FEATURES & 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

ORDERING INFORMATION

Model Number	Part Number	Package Quantity (MOQ)
BCAP0005 P270 S01	133514	4,000
BCAP0005 P270 S12	135966	2,520

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

PRODUCT SPECIFICATIONS & CHARACTERISTICS

Values are referenced at T_A = room temperature and V_R = 2.7V rated voltage (unless otherwise noted). Min and Max values indicate product specifications. Typical results will vary and are provided for reference only. Additional terms and conditions, including the limited warranty, apply at the time of purchase. See the warranty details for applicable operating and use requirements.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
INITIAL						
V_R	Rated Voltage		-	-	2.7	V_{DC}
V_{SURGE}	Surge Voltage	Note 1	-	-	2.85	V_{DC}
C_R	Rated Capacitance	BOL, Note 2,8	4.5	5.0	6.0	F
R_S	Equivalent Series Resistance (ESR_{DC})	BOL, Note 2,8	-	36	45	mΩ
I_{LEAK}	Leakage Current	Note 3	-	5	8	µA
I_{PEAK}	Peak Current	BOL, Note 4,8	-	-	5.1	A
I_{MAX}	Continuous Current	BOL, Note 7,8 - ΔT = 15°C - ΔT = 40°C	- -	- -	2.4 3.8	A_{RMS}
LIFE						
t_{65C}	High Temperature Life	V_R = 2.7V and T_A = 65°C, EOL, Note 8 - Capacitance change ΔC from min C_R - Resistance change ΔR from max R_S	- - -	1,500 -20 +100	- - -	hours % %
t_{85C}	De-rated Voltage & Higher Temperature Life	V_R = 2.3V and T_A = 85°C, EOL, Note 8 - Capacitance change ΔC from min C_R - Resistance change ΔR from max R_S	- - -	1,500 -20 +100	- - -	hours % %
t_{25C}	Projected Lifetime	V_R = 2.7V and T_A = 25°C, EOL, Note 8 - Capacitance change ΔC from min C_R - Resistance change ΔR from max R_S	- - -	10 -20 +100	- - -	years % %
n_{cycle}	Projected Cycle Life	T_A = 25°C, EOL, Note 6,8 - Capacitance change ΔC from min C_R - Resistance change ΔR from max R_S	- - -	500,000 -20 +100	- - -	cycles % %
t_{SHELF}	Shelf Life	Stored uncharged, T_A = 25°C and RH ≤ 50%, Note 8 - Capacitance ≥ min. BOL C_R - Resistance ≤ max. BOL R_S	-	4	-	years

PRODUCT SPECIFICATIONS & CHARACTERISTICS

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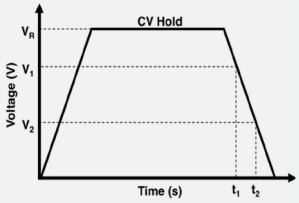
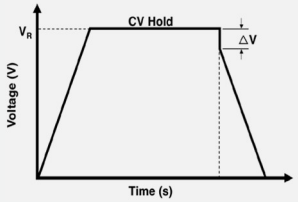
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
POWER & ENERGY						
P_d	Usable Specific Power	BOL, Note 5,8	9.3	11.6	-	kW/kg
P_{MAX}	Impedance Match Specific Power	BOL, Note 5,8	19.3	24.1	-	kW/kg
E_d	Gravimetric Specific Energy	BOL, Note 5,8	2.2	2.4	-	Wh/kg
E_{MAX}	Stored Energy	BOL, Note 5,8,9	4.6	5.1	-	mWh
TEMPERATURE & THERMAL						
T_A	Operating Temperature	Cell case temperature @ 2.7V	-40	-	65	°C
		Cell case temperature @ 2.3V	-40	-	85	°C
R_{th}	Thermal Resistance	Case to ambient, Note 7	-	60	-	°C/W
C_{th}	Thermal Capacitance		-	2.0	-	J/°C
PHYSICAL						
m	Mass		-	2.1	-	g
-	Vibration – Sine Wave		IEC 60068-2-6			-
-	Shock		IEC 60068-2-27			-
SAFETY						
-	Certifications		UL810A, RoHS, REACH			-

NOTES

1. Surge Voltage
   Absolute maximum voltage, non-repetitive. The duration must not exceed 1 second.

2. Rated Capacitance & ESR_{DC} (Measurement 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.
   - 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.





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

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 starting voltage, 0.8 x V_R (V).
V_2 is the measurement end voltage, 0.4 x V_R (V).
t_1 is the time from discharge start to reach V_1 (s).
t_2 is the time from discharge start to reach V_2 (s).
R_S is the DC equivalent series resistance (Ω).
ΔV is the voltage drop during first 10ms of discharge (V).

3. Leakage Current (Measurement Method)
   - Current measured after 72 hours of constant voltage hold at V_R and 25°C. Initial leakage current can be higher.
   - If applicable, module leakage current is the sum of cell leakage current and bypass current created by balancing circuit.

4. Peak Current
   - Current needed to discharge cell or module from V_R to 1/2 V_R in 1 second.

$$I_{PEAK} = \frac{½V_R}{\Delta t/C_R + R_S}$$

where I_{PEAK} is the maximum peak current (A).
V_R is the rated voltage (V).
Δt is the discharge time (sec); Δt = 1 sec in this case.
C_R is the rated BOL capacitance (F).
R_S is the maximum BOL ESR_{DC} (Ω).

   - The stated maximum peak current should not be used in normal operation and is provided as a reference value only.

5. Energy & Power (Based on IEC 62391-2 & IEC 62576)

   - Usable Specific Power, P_d (W/kg) = $\frac{0.12V_R^2}{R_S \times m}$
   - Impedance Match Specific Power, P_{MAX} (W/kg) = $\frac{0.25V_R^2}{R_S \times m}$
   - Gravimetric Specific Energy, E_d (Wh/kg) = $\frac{E_{MAX}}{m}$
   - Stored Energy, E_{MAX} (Wh) = $\frac{½C \times V_R^2}{3{,}600}$

where V_R is the rated voltage (V);
R_S is the rated BOL ESR_{DC} (Ω);
m is the typical mass (kg);
C_R is the rated BOL capacitance (F).

6. Projected Cycle Life
   - Constant current charge-discharge cycle from V_R to 1/2V_R at 25°C.
   - Cycle life is dependent upon application-specific characteristics. Actual results will vary.

7. Continuous Current & Thermal Resistance
   - Maximum current which can be used continuously within the allowed temperature range.

$$I_{MAX} = \sqrt{\frac{\Delta T}{R_{th} \times R_S}}$$

where I_{MAX} is the maximum continuous current (A).
ΔT is the change in temperature (°C).
R_{th} is the typical thermal resistance (°C/W).
R_S is the maximum BOL ESR_{DC} (Ω).

8. BOL & EOL Conditions
   - BOL (Beginning of Life): Rated/Initial product performance.
   - EOL (End of Life):
     - Capacitance: 80% of min. BOL rating (0.8 x min. C_R)
     - ESR_{DC}: 200% of max. BOL rating (2 x max. R_S)

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

DETAILED PRODUCT DESCRIPTION

Introduction

The BCAP0005 P270 S01 / S12 energy storage cell is a robust ultracapacitor solution in a cylindrical style can with radial lead terminals.

Technology Overview

Ultracapacitors, also known as supercapacitors or electric double layer capacitors (EDLC), deliver energy at relatively high rates (beyond those accessible with batteries). Ultracapacitors store charge electrostatically (non-Faradaic) by reversible adsorption of the electrolyte onto electrochemically stable high surface area carbon electrodes. Charge separation occurs on polarization at the electrode/electrolyte interface, producing a double layer. This mechanism is highly reversible, allowing the ultracapacitor to be charged and discharged hundreds of thousands of times. *

Ultracapacitor Construction

An ultracapacitor is constructed with symmetric carbon positive and negative electrodes separated by an insulating ion-permeable separator and packaged into a container filled with organic electrolyte (salt/solvent) designed to maximize ionic conductivity and electrode wetting. It is the combination of high surface-area activated carbon electrodes (typically >1500m^2/g) with extremely small charge separation (Angstroms) that results in high capacitance.

Ultracapacitor Energy = ½ CV^2

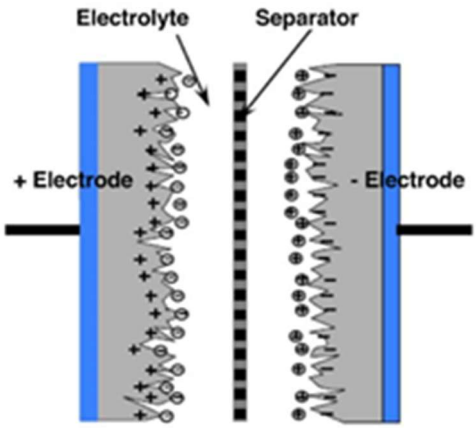


Figure 1: Ultracapacitor Structure Diagram

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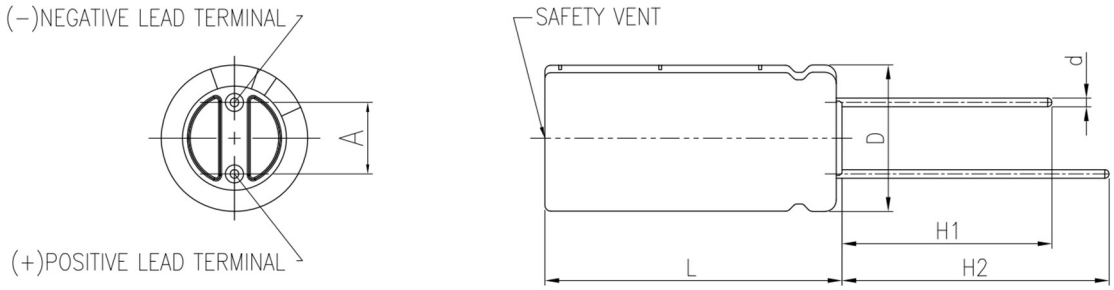
MECHANICAL DRAWINGS

BCAP0005 P270 S01



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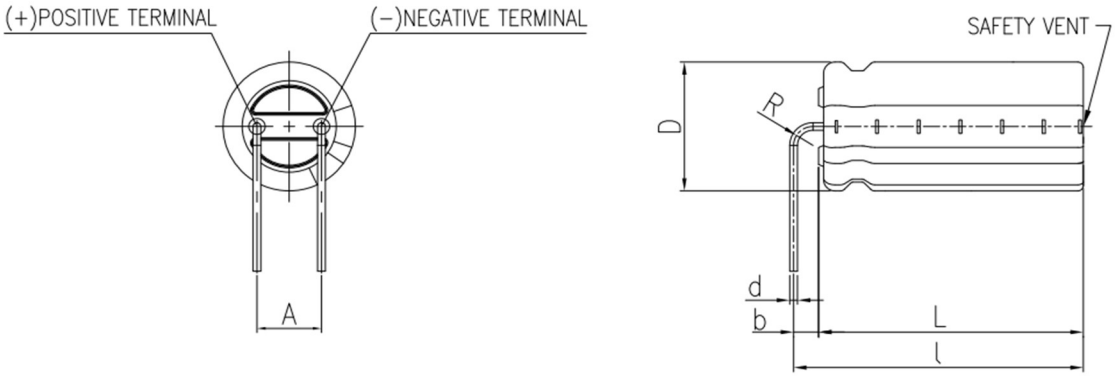

Part Description	Dimensions (mm)									
	L	D	d	A	H1	H2	R	a	b	l
	(±1.0)	(±0.5)	(+0.05)	(±0.5)	(min.)	(min.)	(min.)	(±0.5)	(±0.3)	(max.)
BCAP0005 P270 S01	20.5	10.0	0.60	5.0	15.0	19.0	-	-	-	-
BCAP0005 P270 S12	20.5	10.0	0.60	5.0	-	-	2.0	11.5	1.9	23.5

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