DATASHEET

7.5V 1F ULTRACAPACITOR MODULE

BMOD0001 P007 B02

High Power Energy Solution in Compact Form Factor

Maxwell Technologies' 7.5V 1F ultracapacitor module is the latest addition to Maxwell's full featured lineup of energy storage solutions designed to provide support of the latest trends in automotive applications, backup and UPS systems, AMR devices, and security equipment. Comprised of three 2.7V 3F cells in series connection and equipped with passive balancing, the 7.5V 1F ultracapacitor module is designed for performance and system optimization in a long life, small form factor. Whether used alone, integrated into a sub-system assembly, or in a hybrid configuration, Maxwell's ultracapacitor products will help reduce the overall cost and size of the system while improving return on investments for the customer.

Ultracapacitors are the technology of choice for long life and high power applications because of their longer operating lifetime, low maintenance requirements, and superior cold weather performance when compared to batteries.

FEATURES AND BENEFITS

- High power and energy product with low ESR
- 3.000 hour DC life at rated voltage and maximum operating temperature*
- Designed for up to 1 million duty cycles*
- Exceptional shock and vibration resistance
- Passive cell voltage balancing
- Compliant with RoHS and REACH requirements

TYPICAL APPLICATIONS

- Automotive
- Backup and UPS System
- Actuators
- Emergency Lighting
- Telematics
- Security Equipment
- Smoke Detectors
- Advanced Metering

ORDERING INFORMATION

Model Number	Part Number	Package Quantity (MOQ)
BMOD0001 P007 B02	**136244**	**2,000**

* 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.

PRODUCT SPECIFICATIONS & CHARACTERISTICS

Values are referenced at T_A = room temperature and V_R = 7.5V 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	Typical	Max	Unit
ELECTRICAL						
V_R	Rated Voltage		–	–	7.5	V
V_{SURGE}	Surge Voltage	Note 1	–	–	8.5	V
C_R	Rated Capacitance	BOL, Note 2,8	0.9	1.0	1.2	F
R_S	Equivalent Series Resistance (ESR_{DC})	BOL, Note 2,8	–	140	190	mΩ
I_{LEAK}	Leakage Current	Note 3	–	55	75	µA
I_{PEAK}	Peak Current	BOL, Note 4,8	–	–	2.8	A
I_{MAX}	Continuous Current	BOL, Note 7,8 - ΔT = 15°C - ΔT = 40°C	 – –	 – –	 1.3 2.1	A_{RMS}
LIFE						
t_{65C}	High Temperature Life	V_R = 7.5V and T_A = 65°C, EOL, Note 8 - Capacitance change ΔC from min C_R - Resistance change ΔR from max R_S	– – –	3,000 -20 +100	– – –	hours % %
t_{85C}	De-rated Voltage & Higher Temperature Life	V_R = 6.9V 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 Life Time	V_R = 7.5V 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	– – –	1,000,000 -20 +100	– – –	cycles % %
t_{SHELF}	Shelf Life	Stored uncharged, T_A = 25°C and RH ≤ 50% - Capacitance ≥ min. BOL C_R - Resistance ≤ max. BOL R_S	–	4	–	years

PRODUCT SPECIFICATIONS & CHARACTERISTICS

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Symbol	Parameter	Conditions	Min	Typical	Max	Unit
POWER & ENERGY						
P_d	Usable Specific Power	BOL, Note 5,8	7.5	10.8	–	kW/kg
P_{MAX}	Impedance Match Specific Power	BOL, Note 5,8	15.6	22.6	–	kW/kg
E_d	Gravimetric Specific Energy	BOL, Note 5,8	1.6	1.8	–	Wh/kg
E_{MAX}	Stored Energy	BOL, Note 5,8,9	7.0	7.8	–	mWh
TEMPERATURE						
T_A	Operating Temperature	Cell case temperature	-40	25	65	°C
R_{th}	Thermal Resistance	Case to ambient, Note 7	–	45	–	°C/W
C_{th}	Thermal Capacitance		–	5.1	–	J/°C
PHYSICAL						
m	Mass		–	4.3	–	g
–	Vibration – Sine Wave		IEC 60068-2-6			–
–	Shock		IEC 60068-2-27			–
CELL VOLTAGE MANAGEMENT						
–	Cell Voltage Balancing		Passive			
SAFETY						
-	Certifications		UL810A (Cell-level compliant) RoHS, REACH			

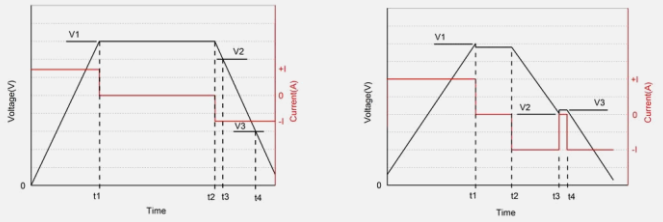
NOTES

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

2. Rated Capacitance & ESR_{DC} (Measurement Method)

V1 = V_R V3 = 0.4 x V_R **C_R = I x (t4 – t3) / (V2 – V3)**
V2 = 0.8 x V_R t2 – t1 = 5 min

V1 = V_R t2 – t1 = 15 sec **R_S = (V3 – V2) / I**
V2 = 0.5 x V_R t4 – t3 = 100 msec



where V_R is the rated voltage (V);
C_R is the capacitance (F);
I is the absolute value of the discharge current (A);
R_S is the DC equivalent series resistance (Ω);

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 1/2V_R in 1 second.

$$I_{PEAK} = \frac{1/2\, V_R}{\Delta t / C_R + R_S}$$

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

5. Energy & Power (Based on IEC 62576)
- Usable Specific Power, Pd (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) = $\frac{E_{MAX}}{m}$
- Store Energy, E_{MAX} (Wh) = $\frac{1/2 C_R \times V_R^2}{3600}$

where V_R is the rated voltage (V);
R_S is the typical 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);
△T 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 BMOD0001 P007 B02 energy storage module is a robust ultracapacitor solution in a cylindrical style can with wire 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

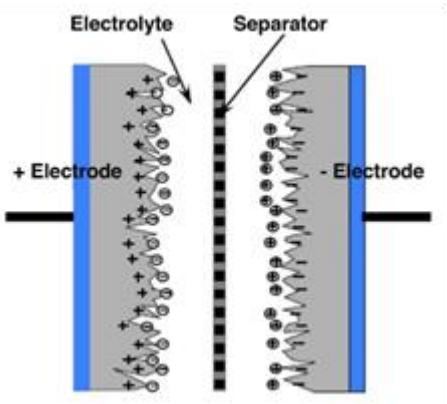


Figure 1: Ultracapacitor Structure Diagram

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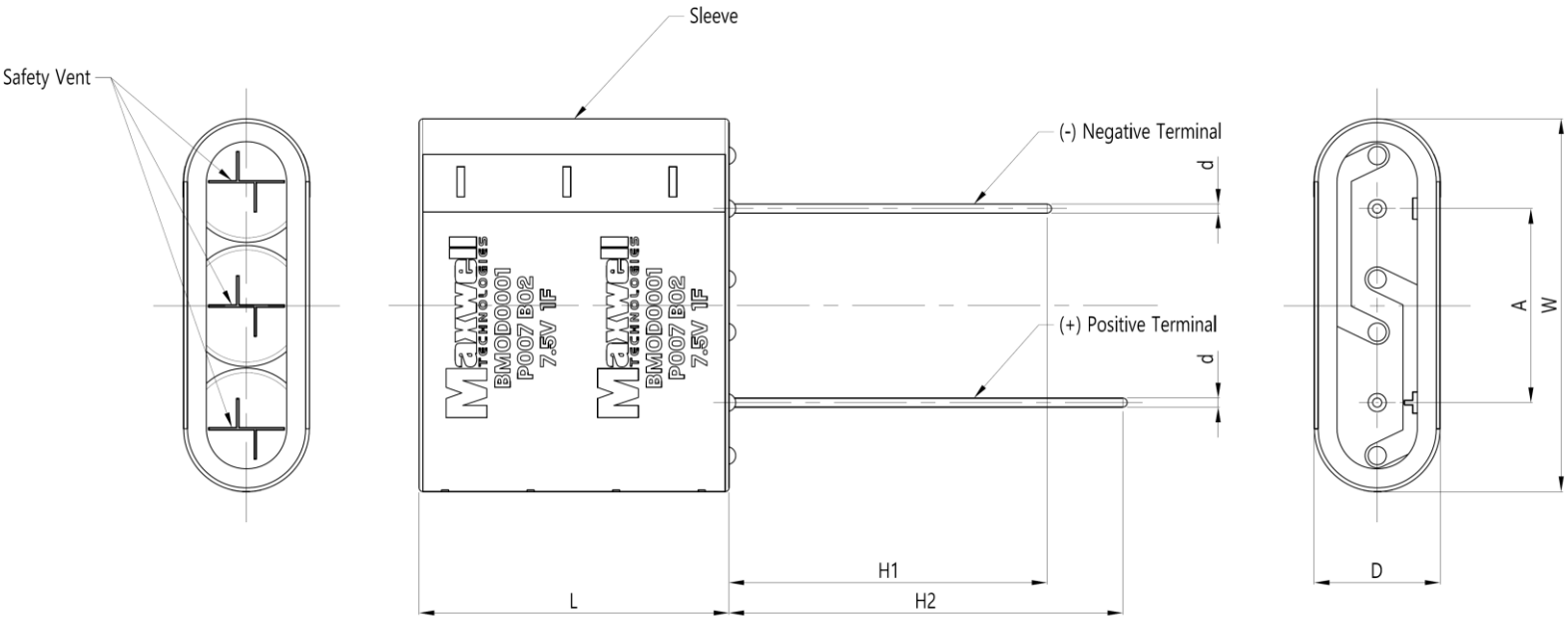
MECHANICAL DRAWINGS

BMOD0001 P007 B02



Dimension (Tolerance)	D (±1.0)	W (±1.0)	L (±2.0)	A (±0.5)	d (±0.05)	H1 (min.)	H2 (min.)	Unit
BMOD0001 P007 B02	8.0	24.0	22.0	12.8	0.60	15.0	19.0	mm

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