

# 5.0V 1.5F ULTRACAPACITOR MODULE

BMOD0001 P005 B02  
EMHSR-0001C5-005R0

## 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 RoHS and REACH requirements

## TYPICAL APPLICATIONS

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



## PRODUCT SPECIFICATIONS

### ELECTRICAL

Rated Voltage, $V_R$	5.0 VDC
Surge Voltage <sup>1</sup>	5.4 VDC
Rated Capacitance, $C^3$	1.5 F
Min. / Max. Capacitance, Initial	1.35 F / 1.8 F
Typical Capacitance, Initial <sup>2,3</sup>	1.55 F
Rated (Max.) $ESR_{DC}$ , Initial <sup>3</sup>	130 mΩ
Typical $ESR_{DC}$ , Initial <sup>2,3</sup>	109 mΩ
Maximum Leakage Current <sup>4</sup>	5 μA
Maximum Peak Current, Non-repetitive <sup>5</sup>	3.1 A

### PHYSICAL

Nominal Mass	3.4 g
--------------	-------

### POWER & ENERGY

Operating Temp. Range	Standard (-40°C to 65°C) at 5.0V	Extended (-40°C to 85°C) at 4.6V
Maximum Stored Energy, $E_{max}^{6,9}$	5.2 mWh	4.4 mWh
Gravimetric Specific Energy <sup>6</sup>	1.5 Wh/kg	1.3 Wh/kg
Usable Specific Power <sup>6</sup>	6.7 kW/kg	5.7 kW/kg
Impedance Match Specific Power <sup>6</sup>	14.1 kW/kg	11.9 kW/kg

### SAFETY

Certifications	RoHS, REACH
----------------	-------------

## TYPICAL CHARACTERISTICS

### THERMAL

Typical Thermal Resistance ( $R_{th}$ , Housing) <sup>8</sup>	77°C/W
Typical Thermal Capacitance ( $C_{th}$ )	2.8 J/°C
Usable Continuous Current (BOL) ( $\Delta T = 15^\circ\text{C}$ ) <sup>8,10</sup>	1.2 A
Usable Continuous Current (BOL) ( $\Delta T = 40^\circ\text{C}$ ) <sup>8,10</sup>	2.0 A

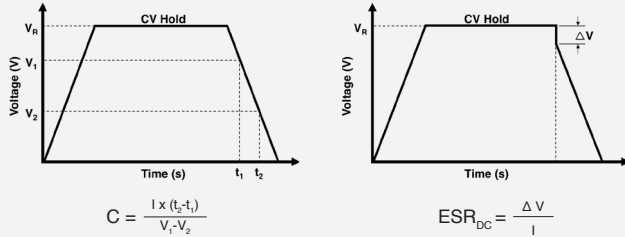
### LIFE\*

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 4.6V 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, ≤ 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: 5.0V 1.5F ULTRACAPACITOR MODULE

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<sub>DC</sub> (measure method)
  - Capacitance: Constant current charge ( $4 \times C \times V_R$ [mA]) to  $V_R$ , 5 min hold at  $V_R$ , constant current discharge ( $4 \times C \times V_R$ [mA]) to 0.1 V.  
e.g. in case of 5.0V 1.5F module,  $4 \times 1.5 \times 5.0 = 30$  mA.
  - ESR<sub>DC</sub>: Constant current charge ( $4 \times C \times V_R$ [mA]) to  $V_R$ , 5 min hold at  $V_R$ , constant current discharge ( $40 \times C \times V_R$ [mA]) to 0.1 V.  
e.g. in case of 5.0V 1.5F module, charge with  $4 \times 1.5 \times 5.0 = 30$  mA and discharge with  $40 \times 1.5 \times 5.0 = 300$ mA.



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,  $0.8 \times V_R$  (V);  
 $V_2$  is the measurement end voltage,  $0.4 \times V_R$  (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<sub>DC</sub> is the DC-ESR (Ω);  
ΔV is the voltage drop during first 10ms of discharge (V).

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.

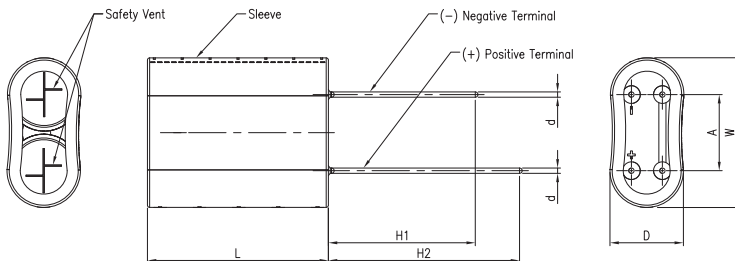
$$I = \frac{\frac{1}{2} V_R}{\Delta t / C + ESR_{DC}}$$

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.
6. Energy & Power (Based on IEC 62391-2)
    - Maximum Stored Energy,  $E_{max}$  (Wh) =  $\frac{\frac{1}{2} C V_R^2}{3,600}$
    - Gravimetric Specific Energy (Wh/kg) =  $\frac{E_{max}}{mass}$
    - Usable Specific Power (W/kg) =  $\frac{0.12 V_R^2}{ESR_{DC} \times mass}$
    - Impedance Match Specific Power (W/kg) =  $\frac{0.25 V_R^2}{ESR_{DC} \times mass}$
    - Presented Power and Energy values are calculated based on Rated Capacitance & Rated (Max.) ESR<sub>DC</sub>, 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<sub>RMS</sub>: Maximum continuous or RMS current (A)  
R<sub>th</sub>: Thermal resistance, module 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.)
  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<sub>DC</sub>: 2x max. BOL rating

## BMOD0001 P005 B02



When ordering, please reference the Maxwell Model Number below.

<b>Maxwell Model Number:</b>	<b>Maxwell Part Number:</b>	<b>Previous Model Number:</b>
BMOD0001 P005 B02	133730	EMHSR-0001C5-005R0

Products and related processes may be covered by one or more U.S. or international patents and pending applications. Please see [www.maxwell.com/patents](http://www.maxwell.com/patents) for more information. Product dimensions are for reference only unless otherwise identified. Maxwell Technologies reserves the right to make changes without further notice to any products herein. "Typical" parameters which may be provided in Maxwell Technologies datasheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Please contact Maxwell Technologies directly for any technical specifications critical to application.

**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: +86 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, MAXWELL, MAXWELL CERTIFIED INTEGRATOR, ENABLING ENERGY'S FUTURE, DURABLU, NESSCAP, XP, BOOSTCAP, D CELL and their respective designs and/or logos are either trademarks or registered trademarks of Maxwell Technologies, Inc., and/or its affiliates, and may not be copied, imitated or used, in whole or in part, without the prior written permission Maxwell Technologies, Inc. All contents copyright © 2020 Maxwell Technologies, Inc. All rights reserved. No portion of these materials may be reproduced in any form, or by any means, without prior written permission from Maxwell Technologies, Inc.

**Maxwell**  
TECHNOLOGIES  
Enabling Energy's Future™