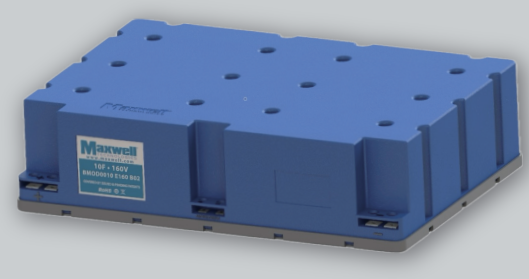
Maxwell TECHNOLOGIES | An UP Company

DATASHEET

160V 10F MODULE

BMOD0010 E160 B02

Wind Pitch Control Energy Storage



Maxwell Technologies' 160V 10F module joins Maxwell's full featured lineup of energy solutions designed to support the latest trends in renewable energy and provide energy storage for emergency pitch control systems. Based on ultracapacitor technology, the 160V 10F module boasts the longest lifetime and greatest energy content out of Maxwell's wind module product portfolio, thereby reducing turbine maintenance and life cycle costs while improving overall system reliability. Scalable in series and parallel configurations, the product can meet many new and existing pitch power delivery requirements.

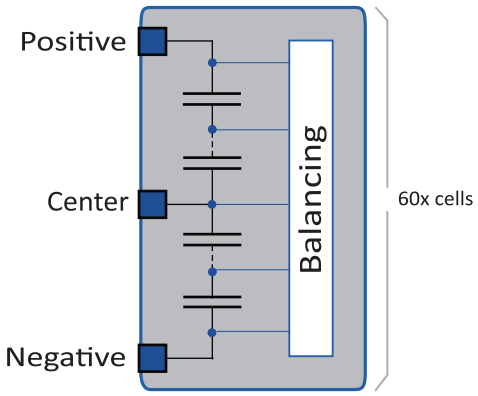
Ultracapacitor technology is preferred for electric pitch control systems because of its longer operating lifetime, low maintenance requirements, and superior cold weather performance when compared to batteries.

FEATURES AND BENEFITS

- Rated at 160V, 10F
- 3,000 hour DC life at maximum operating temperature and voltage*
- Designed for up to 500,000 duty cycles*
- Turnkey solution with passive cell balancing
- Compact and lightweight package
- Screw terminals and center voltage tap

TYPICAL APPLICATIONS

- Wind turbine pitch control
- Small UPS systems
- Industrial applications



ORDERING INFORMATION

Model Number	Part Number	Packaging Quantity(MOQ)
BMOD0010 E160 B02	135929	3

*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 = 160V 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						
C_R	Initial Capacitance	Note 1	10.0	10.6	12	F
R_S	Initial Equivalent Series Resistance (ESR)	Note 1	—	160	230	mΩ
V_R	Rated Voltage		—	—	160	V
V_{MAX}	Absolute Maximum Voltage	Non-repeated. Not to exceed 1 second	—	—	171	V
V_{STRING}	Maximum String Voltage	For series of modules	—	—	1000	V
I_{DCMAX}	Maximum Continuous Current	$\Delta T_{CELL} = I_{RMS}^2 \times R_S \times R_{th}$ - T = 15°C - T = 40°C	—	—	7 12	A_{RMS}
I_{PEAK}	Maximum Peak Current	$I_{PEAK} = \frac{1/2\ V_R}{\Delta t/C_R + R_S}$ (Note 3)	—	—	240	A
I_{LEAK}	Leakage Current	After 72 hours at 25°C	—	—	25	mA
LIFE						
t_{AGING}	Accelerated Aging	V_R= 160V and T_A = 65°C (Note 1) - Capacitance change ΔC from Min C_R - Resistance change ΔR from Max R_S	— — —	3,000 -20 +100	— — —	hours % %
t_{LIFE}	Projected DC Life	V_R= 160V and T_A = 25°C (Note 1) - Capacitance change ΔC from Min C_R - Resistance change ΔR from Max R_S	— — —	10 -20 +100	— — —	years % %
n_{LIFE}	Projected Cycle Life	V_R= 160V and T_A = 25°C (Note 2) - 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%	—	4	—	years
POWER & ENERGY						
P_d	Usable Specific Power	Per IEC 62576, $P_d = \frac{0.12 \times V_R^2}{R_S \times m}$	1.8	2.6	—	kW/Kg
P_{MAX}	Impedance Match Specific Power	$P_{MAX} = \frac{0.25 \times V_R^2}{R_S \times m}$	3.8	5.4	—	kW/Kg
E_{MAX}	Gravimetric Specific Energy	$E_{max} = \frac{E_{MAX}}{m}$	4.8	5.1	—	Wh/Kg
E_d	Stored Energy	$E_{stored} = \frac{½C_R \times V_R^2}{3{,}600}$ (Note 2)	35.6	37.7	—	Wh

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Symbol	Parameter	Conditions	Min	Typical	Max	Unit
TEMPERATURE & THERMAL						
T_A	Operating Temperature	Cell case Temperature	-40	25	65	˚C
R_{th}	Thermal Resistance	All cell case to ambient (with convection)	—	1.5		˚C/W
C_{th}	Thermal Capacitance		—	5,500	—	J/˚C
—	Cooling		Natural Convection			—
PHYSICAL						
m	Mass		—	7.4	—	Kg
TM5	Recommended Torque on Power Terminals	M5 thread	—	2.2	4.0	Nm
TM4	Recommended Torque on Monitoring Terminals	M4 thread	—	1.2	2.0	Nm
—	Vibration		IEC 60068-2-6			
—	Shock		IEC 60068-2-27			
	Environmental Protection	Inpress Protection		IP20		
	Insulation Resistance	Per IEC60068-2-78 At T_A=40˚C and 90% RH (DC 500 or 1000V)		400		MΩ
CELL VOLTAGE MANAGEMENT						
—	Cell Voltage Monitoring		At Voltage Center Tap — 2 Monitoring Terminals			—
—	Cell Voltage Management		Passive			—
SAFETY						
—	Certifications		RoHS, UL810A			
V_{HP}	High-Pot Capability	Duration = 60 seconds Not intended as an operating parameter	5,600	—	—	VDC

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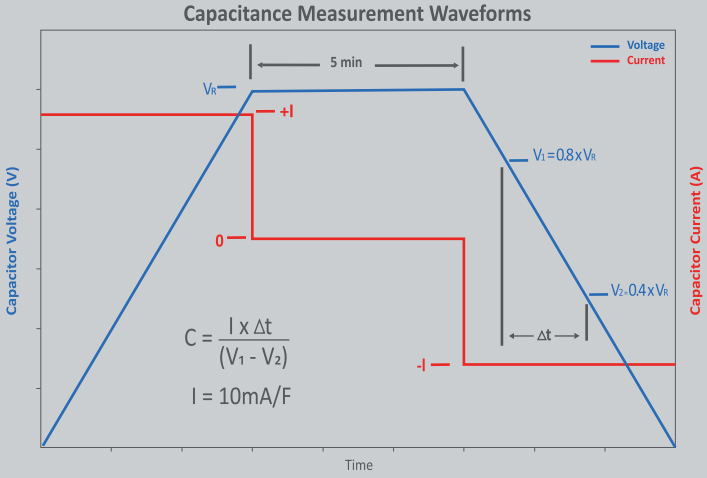
TEST PROCEDURES

NOTES

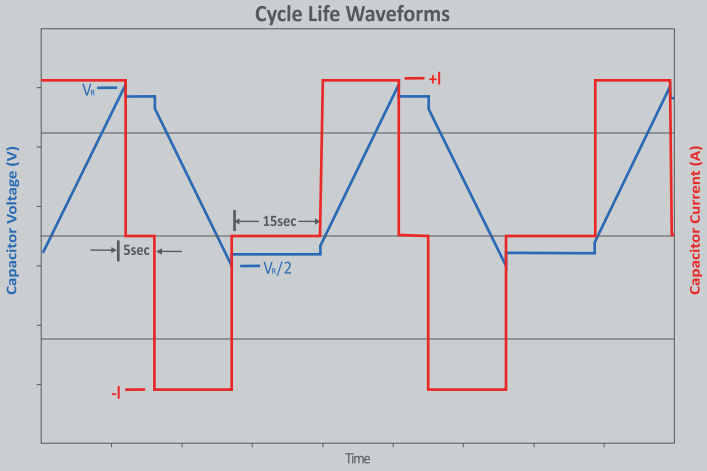
1. Capacitance and ESR measured...

Capacitance Measurement Waveforms

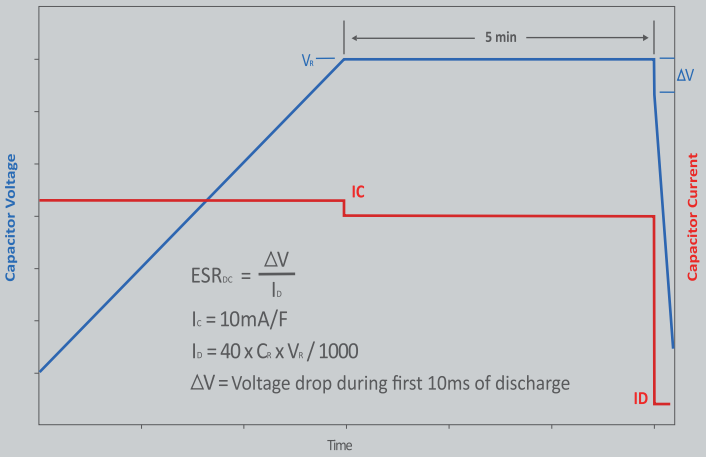


2. Projected Cycle Life determined at 25℃ per waveforms below.
Cycle life is dependent upon application-speciic characteristics.
Actual results will vary.

Cycle Life Waveforms



ESR Measurement Waveforms



3. Peak Current

- Current needed to discharge cell or module from VR to 1/2VR 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 in this case;
C_R is the rated BOL capacitance (F);
R_S is the maximum BOL ESRDC (Ω)

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

TYPICAL PERFORMANCE

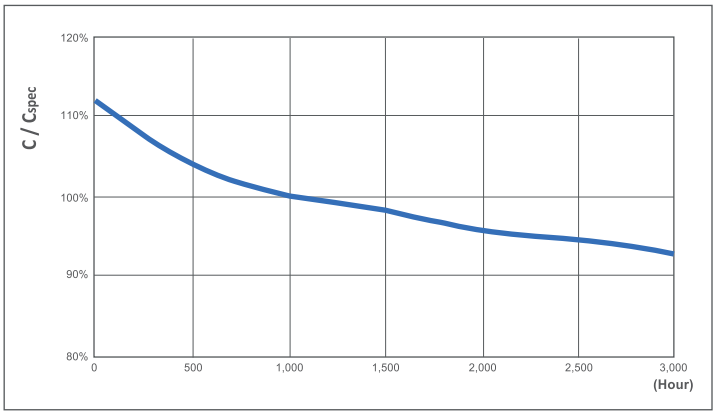


Figure 3: Accelerated Aging Capacitance Performance
V_R = 160V, T_A = 65℃

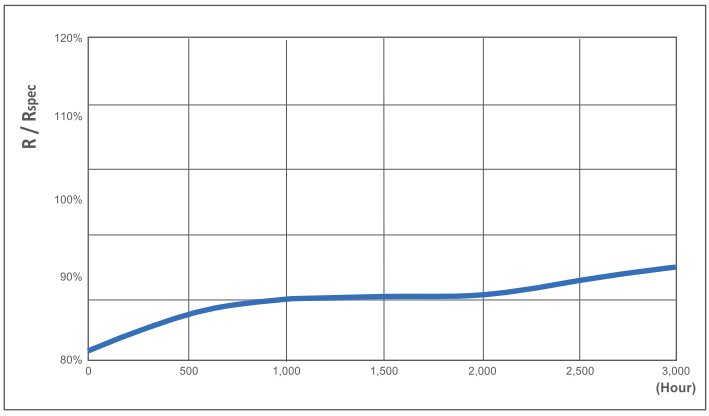


Figure 4: Accelerated Aging ESR Performance
V_R = 160V, T_A = 65℃

DETAILED PRODUCT DESCRIPTION

Introduction

The BMOD0010 E160 B02 energy storage module is built with sixty (60) ultracapacitor cells in series; these board-mounted cells are passively balanced and the entire assembly is packaged into a rigid plastic enclosure.

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 several hundred thousand 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 >1500m²/g) with extremely small charge separation (Angstroms) that results in high capacitance.

Ultracapacitor Cell Description

Rated at 2.7V, the 600F ultracapacitor cell in the module integrates Maxwell's most advanced electrode formulation in a compact and reliable cylindrical form factor, with outstanding electrical parameters and life performance. This ultracapacitor cell, with 4 radial snap-in terminals, is board mountable to achieve reliable and robust electrical and mechanical connectivity which maintains its integrity in high vibration applications.

Module Configuration

The BMOD0010 E160 B02 module integrates a total of sixty (60) ultracapacitor cells connected in series to achieve the desired electrical characteristics of the module.
This can be calculated using the following formulas:

$$C_R = C_{CELL} \times \frac{\#parallel}{\#series}$$

$$R_S = R_{CELL} \times \frac{\#series}{\#parallel} + R_{ACCESS}$$

Where:

- C_R = module rated capacitance (F)
- C_{CELL} = cell capacitance
- R_S = module serial resistance (mΩ)
- R_{CELL} = cell equivalent series resistance
- R_{ACCESS} = module access resistance
- # parallel = number of parallel strings = 1
- # series = number of cells in series = 60

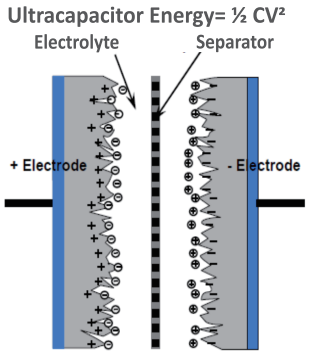


Figure 5: Ultracapacitor Structure Diagram

Cell Balancing

To provide an equal voltage distribution among all sixty ultracapacitor cells, the BMOD0010 E160 B02 features integrated passive balancing circuitry. Sized to accommodate the slight tolerance in capacitance and leakage current of each individual ultracapacitor cell in the design, the integrated passive balancing circuit ensures that each cell will operate within its normal operating conditions and therefore ensure the longest lifetime of the product.

The passive balancing circuit of the BMOD0010 E160 B02 is optimized for stationary, low duty cycle applications. Should there be an interest in higher cycling applications, please consult Maxwell Technologies Applications Engineering.

Mechanical Housing

The module packaging is a rigid plastic enclosure rated for the following stress and environmental conditions:

- Vibration per IEC 60068-2-6
- Shock per IEC 60068-2-27

Electrical Terminals

The BMOD0010 E160 B02 module offers four power terminals (two positive, two negative) and two voltage center taps for monitoring purposes.

Mounting Points

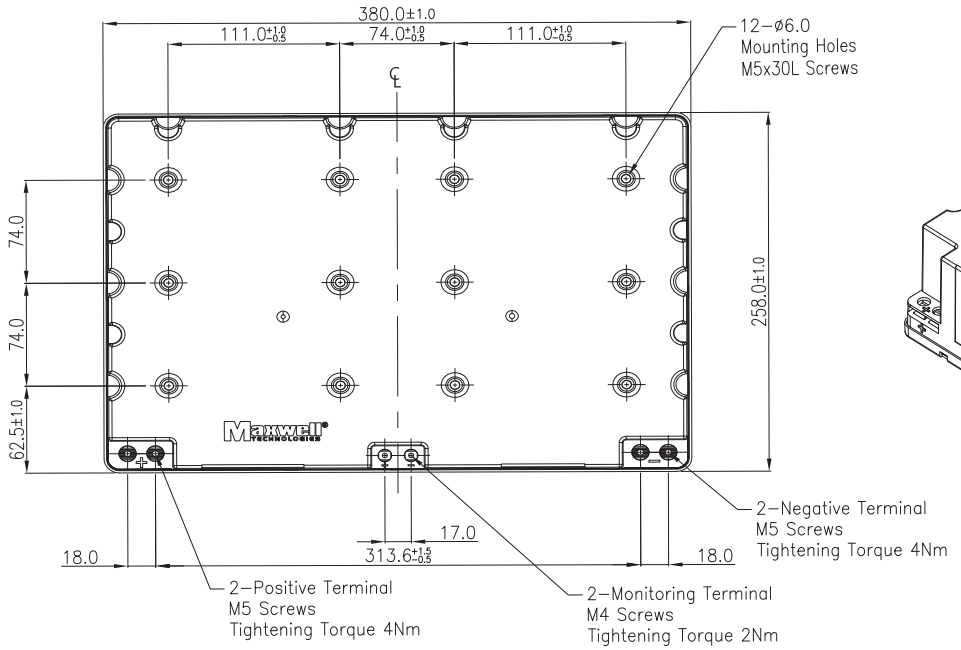
The BMOD0010 E160 B02 module offers twelve mounting points for securing the module in the application.

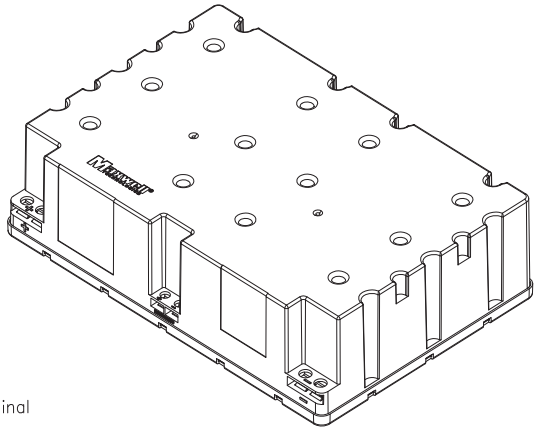
WARNING

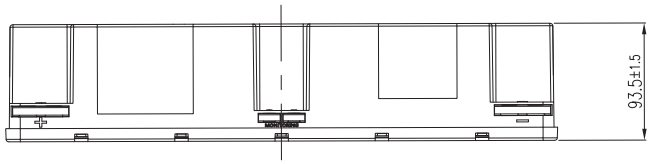
A fully discharged module may "bounce back" if it is stored without a shorting wire connected to the + and - terminals. This bounce back can be as much as 20V for the BMOD0010. When used in series strings this has the potential to cause dangerous electrical shocks.

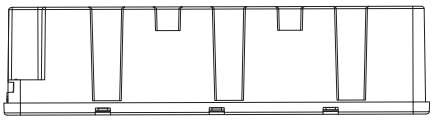
MECHANICAL DRAWINGS

BMOD0010 E160 B02









DIMENSIONS	MIN	TYP	MAX	UNIT
Length (L)	379.0	380.0	381.0	mm
Width (W)	257.0	258.0	259.0	mm
Height (H)	92.0	93.5	95	mm

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