NESSCAP ULTRACAPACITORS
A Maxwell Technologies Company

24V 9F Module | Datasheet

FEATURES

- *Rated voltage of 24V and capacitance of 9F*
- *High performance module with low ESR*
- *Designed with compact and light-weight package*
- *Long lifetimes with up to 500,000 duty cycles**
- *Passive cell balancing*
- *Typical applications:*
  - *Backup power for robotics*
  - *Industrial applications*

Image is not to scale.

ELECTRICAL SPECIFICATIONS		BMOD0009 P024 B02 EMHSR-0009C0-024R0
Rated Voltage, V_R		**24 V_{DC}**
Surge Voltage[1]		29.7 V_{DC}
Rated Capacitance, C[2]		**9 F**
Capacitance Tolerance	Min. / Max.	0% / +20%
	Average[4]	+3% / +10%
Initial DC-ESR, R_{DC}[3]	Max.	145 mΩ
	Average[4]	92 mΩ
Typical Leakage Current[5]	At 2.18V per cell	5 mA
Maximum Peak Current, Non-repetitive[6]		45 A
Maximum Stored Energy, E_{max}[7]		0.72 Wh
Gravimetric Specific Energy[7]		1.7 Wh/kg
Usable Specific Power[7]		1.1 kW/kg
Impedance Match Specific Power[7]		2.4 kW/kg

TEMPERATURE SPECIFICATIONS	
Operating Temperature Range	-40 ~ 65°C
Storage Temperature Range (stored without charge)	-40 ~ 70°C

TYPICAL LIFETIME CHARACTERISTICS*	
DC Life at High Temperature[8] (at V_R and 65°C)	1,500 hours
Projected DC Life at Room Temperature[8] (at V_R and 25 ± 10°C)	10 years
Projected Cycle Life[8] (constant current charge-discharge from V_R to $1/2V_R$ at 25 ± 10°C)	500,000 cycles
Shelf Life (stored without charge at 25 ± 10°C)	4 years

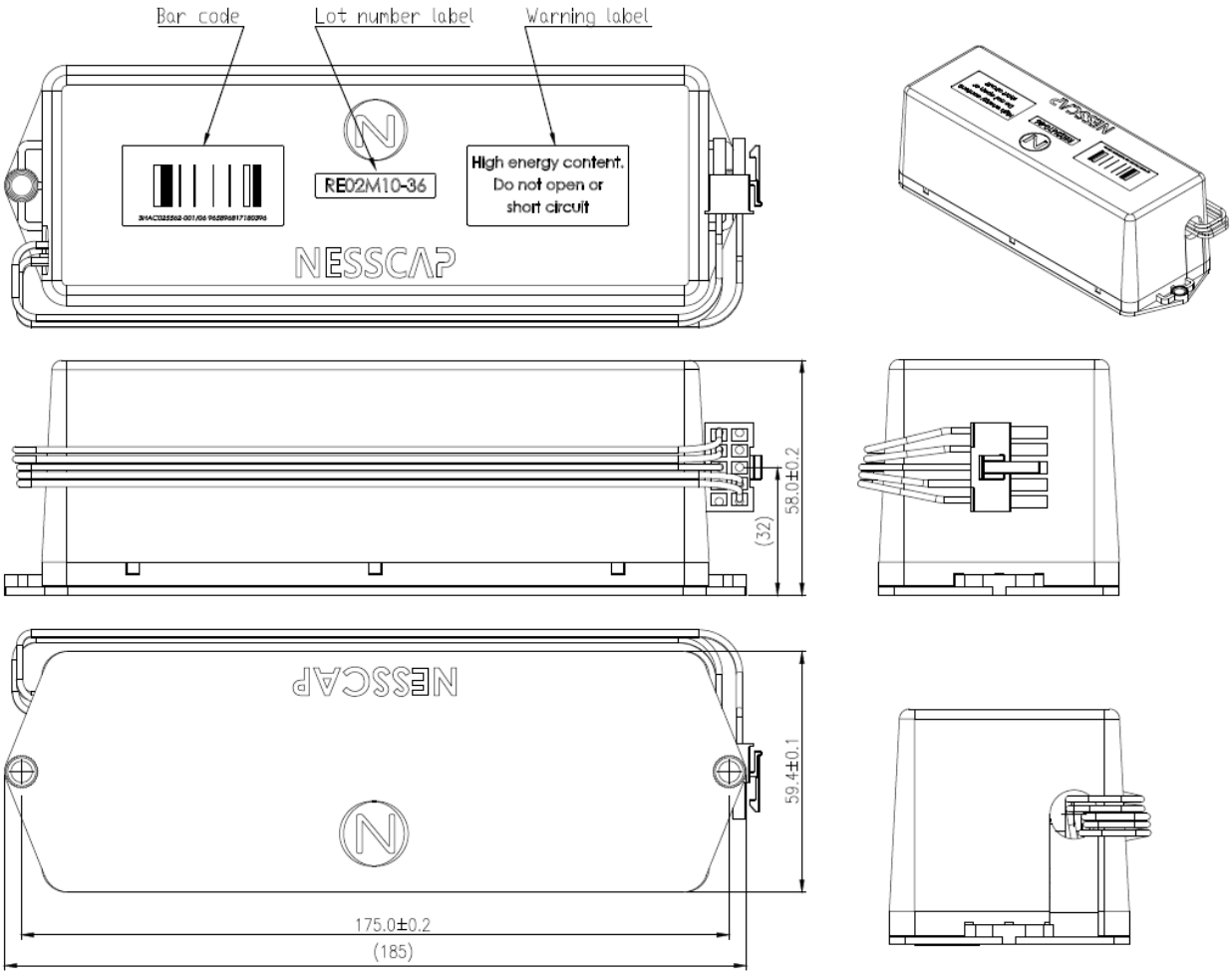
PHYSICAL SPECIFICATIONS	
Output Terminals	2×AWG16 wires (positive) / 2×AWG16 wires (negative)
Insulation Coordination	IEC 61287-1 (Category: OV II) Rated insulation voltage: 1kV DC or 2.8kV AC (at 50Hz, 10 sec) Rated impulse withstand voltage: 4kV DC
Protection Degree	IEC 60529 – IP 20
Vibration	IEC 60068-2-6 Table B-1
Shock	IEC 60068-2-27

*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.

UMU / MONITORING SPECIFICATIONS	
Cell Balancing	Passive single cell balancing
Voltage Monitoring	Voltage check pin
Temperature Monitoring	N/A
Power Terminal	2×AWG16 wires for each terminal (connector type)

SAFETY & ENVIRONMENTAL SPECIFICATIONS	
RoHS	Compliant
REACH	Cell-level compliant
UL	Cell-level compliant

DRAWING



DIMENSION & WEIGHT			
Length (±0.2)	Width (±0.1)	Height (±0.2)	Nominal Weight
185.0 mm	59.4 mm	58.0 mm	410 g

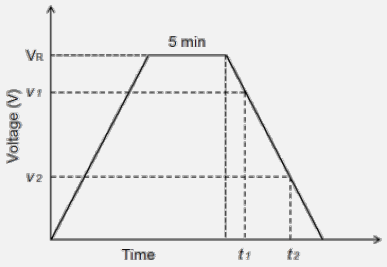
NOTE

1. **Surge Voltage**

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

2. **Rated Capacitance (Measurement Method)**

> Constant current charge with 4CV [mA] to V_R.
e.g. In case of 24V-9F module, 4 x 24 x 9 = 860mA
> Constant voltage charge at V_R for 5 min.
> Constant current discharge with 4CV [mA] to 4V.

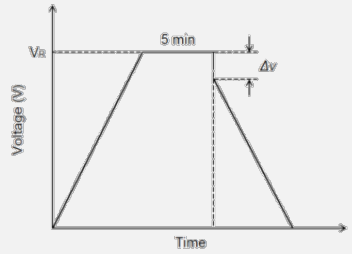


$$C = \frac{I \times (t_2 - t_1)}{v_1 - v_2}$$

where C is the capacitance (F);
I is the absolute value of the discharge current (A);
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);

3. **Initial DC-ESR (Measurement Method)**

> Constant current charge with 4CV [mA] to V_R.
> Constant voltage charge at V_R for 5 min.
> Constant current discharge with 40CV [mA] to 20V.
e.g. In case of 24V-9F module, 40 x 24 x 9 = 8,640mA = 8.6A



$$ESR_{DC} = \frac{\Delta v}{I}$$

where ESR_{DC} is the DC-ESR (Ω);
Δv is the voltage drop during first 10ms of discharge (V);
I is the absolute value of the discharge current (A)

4. **Average**

> Typical value or percentage spread that may be present in one shipment

5. **Typical Leakage Current**

> Typical leakage current of the module is the sum of the leakage current of the cell (measured at the rated voltage and at room temperature after 72 hours) and the bypass current created by the balancing circuit.

6. **Maximum Peak Current**

> Current that can be used for 1-second discharging from the rated voltage to the half-rated voltage under the constant current discharge mode

$$I = \frac{½V_R}{\Delta t / C + ESR_{DC}}$$

where I 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 is the rated capacitance (F);
ESR_{DC} is the maximum DC-ESR (Ω);

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

7. **Energy & Power (Based on IEC 62391-2)**

> Maximum Stored Energy, E_{max} (Wh) = $\frac{½CV_R^2}{3600}$

> Gravimetric Specific Energy (Wh/kg) = $\frac{E_{Max}}{Weight}$

> Usable Specific Power (W/kg) = $\frac{0.12V_R^2}{ESR_{DC} \times Weight}$

> Impedance Match Specific Power (W/kg) = $\frac{0.25V_R^2}{ESR_{DC} \times Weight}$

8. **DC Life and Cycle Life Test**

> End-of-Life Conditions:
- Capacitance: -20% from the minimum rated value
- DC-ESR: +100% from the maximum specified initial value

> Capacitance and ESR measurements are taken at 25 ± 10°C

When ordering, please reference the Maxwell Model Number below.

Maxwell Model Number:	Maxwell Part Number:	Nesscap Model Number:
BMOD0009 P024 B02	133735	EMHSR-0009C0-024R0

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