

### FEATURES

- » **The XP™ product line establishes a new market standard for enhanced performance under adverse environmental conditions**
- » **Patent pending improvements both in structure and in sealing**
- » **Compliant with RoHS, UL, and REACH requirements**
- » **Recommended Applications:**
  - **Actuators, Automotive, Emergency Lighting, Advanced Metering**
  - **Smoke Detectors, Telematics, Backup Systems, etc.**



*\*Image is not to scale*

ELECTRICAL SPECIFICATIONS		
Rated Voltage, $V_R$		<b>2.7 VDC</b>
Surge Voltage <sup>1</sup>		<b>2.85 VDC</b>
Rated Capacitance, $C^2$		<b>5 F</b>
Capacitance Tolerance	Max.	-10% / +20%
	Avg. <sup>4</sup>	+5% / +10%
Initial DC-ESR, $R_{DC}^3$	Max.	35 mΩ
	Avg. <sup>4</sup>	28 mΩ
Maximum Leakage Current <sup>5</sup>		0.008 mA
Maximum Peak Current, Non-repetitive <sup>6</sup>		5.7 A
Maximum Stored Energy, $E_{max}^7$		5.0 mWh
Gravimetric Specific Energy <sup>7</sup>		2.2 Wh/kg
Usable Specific Power <sup>7</sup>		10.8 kW/kg
Impedance Match Specific Power <sup>7</sup>		22.6 kW/kg

TEMPERATURE SPECIFICATIONS	
Operating Temperature Range	-40 ~ 65°C <small>(<math>\Delta CAP &lt; 5\%</math> and <math>\Delta ESR &lt; 300\%</math> of initial values measured at 25°C)</small>
Storage Temperature Range	-40 ~ 70°C (stored fully discharged)

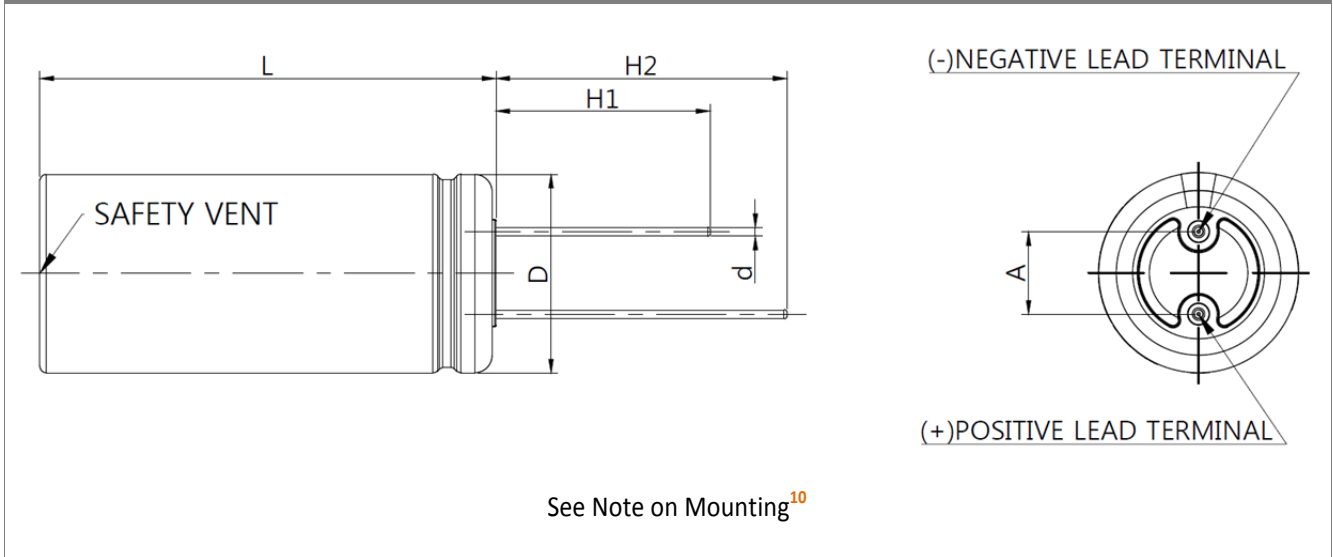
TYPICAL LIFETIME CHARACTERISTICS	
High Temp. Endurance (at $V_R$ and 65°C) <sup>8</sup>	1,500 hours
Projected Room Temp. DC Life (at $V_R$ and 25°C) <sup>8</sup>	10 years
Biased Humidity Test (at $V_R$ , 60°C, and 90% RH)	2,500 hours <small>(Electrical characteristics not considered)</small>
Cycle Life (at 25°C)	500,000 cycles <small>(Cycled from <math>V_R</math> to <math>1/2V_R</math> using 100mA/F constant current with 10 second rest between charge and discharge steps)</small>
Shelf Life	4 years <small>(Stored fully discharged at under 25°C and under 40% RH)</small>

TYPICAL THERMAL CHARACTERISTICS	
Thermal Resistance, $R_{th}$ (Housing)	60 °C/W
Thermal Capacitance, $C_{th}$	2.0 J/°C
Usable Continuous Current ( $\Delta T = 15^\circ C$ ) <sup>9</sup>	2.6 A
Usable Continuous Current ( $\Delta T = 40^\circ C$ ) <sup>9</sup>	4.3 A

**SAFETY & ENVIRONMENTAL**

RoHS	Compliant
REACH	Compliant
UL	Compliant

**DRAWING**



**DIMENSION & WEIGHT**

D (+0.5)	10.0 mm
L (+1.5)	20.0 mm
H1 (Min.)	15.0 mm
H2 (Min.)	19.0 mm
d (±0.05)	0.6 mm
A (±0.5)	5.0 mm
Nominal Weight	2.3 g

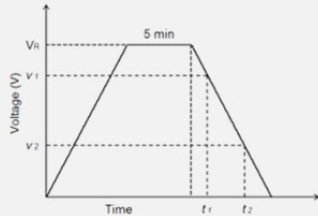
**NOTE**

**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 5F cell,  $4 \times 5 \times 2.7 = 54mA$
- > Constant voltage charge at  $V_R$  for 5min.
- > Constant current discharge with 4CV [mA] to 0.4V.

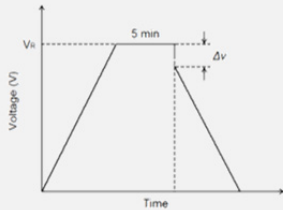


$$C = \frac{I \times (t_2 - t_1)}{v_1 - v_2}$$

where  $C$  is the capacitance (F);  
 $I$  is the absolute value of the discharge current (A);  
 $v_1$  is the measurement starting voltage,  $0.8 \times V_R$  (V);  
 $v_2$  is the measurement end voltage,  $0.4 \times V_R$  (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. DC-ESR (DOE Measurement Method)**

- > Constant current charge with 4CV [mA] to  $V_R$ .
- > Constant voltage charge at  $V_R$  for 5min.
- > Constant current discharge with 40CV [mA] to 2.5V.  
e.g. In case of 5F cell,  $40 \times 5 \times 2.7 = 540mA$



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

where  $ESR_{DC}$  is the DC-ESR ( $\Omega$ );  
 $\Delta v$  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. Maximum Leakage Current (Measurement Method)**

- > The capacitor is charged to the rated voltage at 25°C.
- > Leakage current is the current after 72 hours that is required to keep the capacitor charged at the rated voltage.

**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 discharging mode

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

where  $I$  is the maximum peak current (A);  
 $V_R$  is the rated voltage (V);  
 $\Delta t$  is the discharge time (sec);  $\Delta t = 1$  sec in this case;  
 $C$  is the rated capacitance (F);  
 $ESR_{DC}$  is the maximum DC-ESR ( $\Omega$ )

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

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

- > Maximum Stored Energy,  $E_{max}$  (Wh) =  $\frac{\frac{1}{2}CV_R^2}{3600}$
- > 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. High Temp. Endurance and Room Temperature DC Life**

- > Test Conditions:
  - Temperature:  $65 \pm 2^\circ C, 25 \pm 2^\circ C$
  - Applied Voltage:  $V_R \pm 0.02V$
- > End-of-Life Conditions:
  - Capacitance: -30% from the rated minimum value
  - DC-ESR: +100% from the rated maximum value
- > Capacitance and ESR measurements are taken at 25°C

**9. Maximum Continuous Current**

- > Current which can be used within the allowed temperature range under the constant current discharging mode

$$I = \sqrt{\frac{\Delta T}{R_{th} \times ESR_{DC}}}$$

where  $I$  is the maximum continuous current (A);  
 $\Delta T$  is the change in temperature ( $^\circ C$ );  
 $R_{th}$  is the thermal resistance ( $^\circ C/W$ );  
 $ESR_{DC}$  is the maximum DC-ESR ( $\Omega$ )

**10. Mounting Recommendations**

- > Provide properly spaced holes for mounting according to the cell dimension as to minimize leads being mechanically stressed.
- > Do not place any copper patterns including the ground pattern or through-holes underneath the cell or on the underside of the PCB as the electrolyte inside the cell, if leaked, can corrode and short-circuit the patterns or damage other components nearby. Spacing of at least 1mm should be provided between the footprint of the cell and the nearest copper pattern.
- > Protective coating of components on the PCB is strongly recommended in order to reduce the risk of the components being damaged in an event of electrolyte leakage.
- > The recommended mounting orientation is with the terminal leads pointing upward.
- > Provide at least 2mm clearance from the safety vent and do not position anything near the safety vent that may be damaged by vent rupture.
- > Place cells on the PCB taking into account that the cells may not be completely hermetic during its lifetime. Electrolyte vapor and gases generated during normal operation may escape the package.
- > Soldering recommendations for small and medium size cells are available and can be found on [www.nesscap.com](http://www.nesscap.com) under Support -> Download.

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 <b>Nesscap Energy Inc.</b> Scotia Plaza 40 King Street West, Suite 5800 Toronto, Ontario, M5H 3S1 <b>CANADA</b>	 <b>Nesscap Energy Inc.</b> S24040 Camino Del Avion #A118, Monarch Beach, California, 92629 <b>USA</b>	 <b>Nesscap Co., Ltd.</b> 17, Dongtangiheung-ro 681beon-gil, Giheung-gu, Yongin-si, Gyeonggi-do (17102) <b>REPUBLIC OF KOREA</b>	 <b>Nesscap China</b> Room 1608-09, Anhui Building Chuangzhan Center, No.6007 Shennan Road, Futian District, Shenzhen City <b>CHINA</b>	 <b>Nesscap Energy GmbH</b> Beerengarten 4 D-86938 Schondorf <b>GERMANY</b>
<a href="mailto:marketing@nesscap.com">marketing@nesscap.com</a>				<a href="mailto:info@nesscap-energy.de">info@nesscap-energy.de</a>