SPEL
SUPERCAPACITOR

PB & NPB Series For Power Backup Applications

Inventing Green Solutions

www.supercapacitor.in
Email: spel@supercapacitor.in

Introduction: Temporary backup power is a common requirement for a wide range of applications whenever the main power source is suddenly unavailable. Examples include data as well as power backup applications ranging from servers to solid-state drives, power fail alarms in industrial, medical, power stations, smart grid, etc applications, and a host of other “dying gasp” functions where orderly power-down must be assured and system status communicated to a powered host.

In the past, these types of high reliability systems used batteries to provide an uninterrupted power source whenever the main supply of power was inadequate or unavailable. However, many trade-offs accompany battery backup, including long charge times, limited battery lifetime and cycle life, safety and reliability concerns, and large physical size. With the advent of supercapacitors, alternate backup architectures may be employed which eliminate many of these trade-offs.

Batteries vs. Supercapacitors

Systems with batteries for backup power requires a fully charged battery all times with suitable capacity to keep volatile memory alive or alarms sounding until power is restored. Typically, systems employing battery backup enter a low power standby state whenever the main power fails, and only the critical volatile memory or alarm sections of the systems remain powered. Since power failure duration is impossible to predict, such systems require oversized batteries to avoid the possibility of data loss during a lengthy outage.

Supercapacitor based backup systems use a different methodology. Unlike battery based systems which provide continuous power during the entire backup time, Supercapacitor based systems require only short-term backup power to transfer volatile data into flash memory or provide “dying gasp” alarm operation for a minimum necessary amount of time. Once the required data has been saved and the power fail alarms have been properly issued, the power restoration time is unimportant.

To ensure reliable and safe operation of the electrical pitch control systems, SPEL ***WP Series Supercapacitors*** provide the necessary backup power to orient the rotor blades in a fail-safe position in the event of a power loss.

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Advantage of Using Supercapacitor for Power Back-up: Supercapacitors scores over battery for this critical application as they are lightweight and nearly solid state devices. In cold weather the higher power capability of supercapacitors compared to batteries translates to faster response time for similarly designed systems. The transition from battery to supercapacitor based designs improves economics of operations and simplifies design of circuit. Due to longer life span (more than 10years) and practically no maintenance required. Also there is also no longer a need to oversize the energy storage elements for a worst-case backup duration. While the backup power requirements of a Supercapacitor based system is typically much higher than those of a battery based system, the backup energy requirements are generally much lower. Since the cost and size of a backup solution is usually dominated by the storage element, SPEL PB Series Supercapacitor solutions are often smaller and cheaper. With the emergence of small, relatively inexpensive supercapacitors capable of storing numerous Joules of energy, the number of backup applications that can be satisfied with SPEL PB Series Supercapacitors instead of batteries has grown considerably.

SPEL NPB Series: Safe and economic operation of a nuclear power plant (NPP) requires the plant to be connected to an electrical grid system that has adequate capacity for exporting the power from the NPP, and for providing a reliable electrical supply to the NPP for safe startup, operation and normal or emergency shutdown of the plant. SPEL PB Series Supercapacitors are specially designed for critical and special applications, like for use in **Nuclear Power Plant applications**, for complying with various regulations and standards required for electrical power system of the NPP to be reliable, redundant, diverse, independent and provide sufficient capacity for all safety related equipment to operate properly and can fulfill its intended purpose.

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Power Back-up Series NPB048R08F *for Special purpose Application*

Dimensions: Diameter: 230mm, Length: 170mm (*Tol. +/- 0.5mm***)**

Basic Specifications

Capacitance	Capacitance Tolerance	Working Voltage DC	Surge Voltage DC	Termination	Balancing	Typical Mass	Operating Temperature Range	Typical Cycle Life (25 °C)
8.0 F	0% to 20%	48.0V	52.2	Screw M10	Resistor	18.0 Kg	-40~ 65 °C	500,000 cycles

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Electrical Specifications

Rated Capacitance [1]	8.0 Farads
Initial Minimum Capacitance	8.0 Farads
Initial Maximum Capacitance	9.6 Farads
Rated Voltage	48.0 VDC
Absolute Maximum Voltage [2]	52.2 VDC
Absolute Maximum Current	40.0 Amps
Initial Maximum ESR (DC) [3]	252.0 milli-ohms
Test Current for Capacitance and ESR (DC) [3]	15.0 Amps
Maximum Leakage Current [4]	0.500 mA
Maximum Continuous Current	7.0 A
Stored Energy (E_{stored}) [5]	2.56 Wh
Operating Temperature Range	-40°C to 65°C
Storage Temperature Range	-40°C to 70°C

Note: *Capacitance, ESR and Leakage current are all measured according to IEC 62391-1*

* *If required then Leakage current can be altered/changed by Balancing Method.*

\+ *Results may vary. Additional terms & Conditions including limited warranty apply at the time of purchase.*

++ *Product dimensions are for reference only unless otherwise identified, Product dimensions & Specifications may change without Notice.*

Physical Specifications

Physical Dimension (D x L) in mm +/- 0.5mm	230 x 170
Approximate Mass of Module	18.0 Kg.
Connection Terminals	Female M10 Thread
Recommended Torque - Terminal	4 Nm
Environmental Protection	IP54
Vibration Specification	IEC60068-2-6
Shock Specification	IEC60068-2-2,-29
Cooling	Natural Convection
Package Quantity	Single

Monitoring/Cell Management

Internal Temperature Sensor	N/A
Temperature Interface	N/A
Cell Voltage Management	Passive
Cell Voltage Monitoring	N/A
Connector	N/A

SPEL SUPERCAPACITOR

Safety

Maximum Current, Non-repetitive (I_{max}) [6]	198.0 Amps
Short Circuit Current (Typical)	300 Amps**
High Potential Capability	5600VDC for 60 seconds
Max Stored Energy [5]	3.633 Wh****
CAUTION: *Please do not discharge Capacitor directly.*	*Please do not Reverse Polarity*

Note:

** *Current possible with short circuit from rated voltage. It should not be mistaken for operating current.*

*****As per United Nations material classification UN3499 device should have less than 10Wh capacity to meet the Requirement of Special Provisions 361 for transporting without being treated as dangerous goods (hazardous material) Under Transport Regulations.*

Life

Endurance (at V_R and 65 °C) [7] [8]	1500 Hrs.
Room Temperature (at V_R and 25 °C) [7]	10 Years
Cycle Life (at 25 °C) [7]	1,000,000 cycles (Estimated value when cycled from V_R to ½ V_R using constant current of 7 Amps with 10 second rest between charge and discharge steps)
Shelf Life	4 Years (Stored Uncharged at 25°C) 2 Years (Stored Uncharged at 70°C & under 40% RH)

Thermal Characteristics

Typical Thermal Resistance, R_{th} (Housing)	2.2 °C/W
Maximum Continuous Current ΔT = 30 °C [9]	7.36 A_{RMS}
Maximum Continuous Current ΔT = 45 °C [9]	9.0 A_{RMS}

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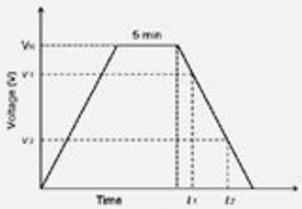
Notes

1 **Rated Capacitance**

> Constant Current charge with 10mA/F to VR
> Constant Voltage charge at VR for 5 minutes.
> Constant Current discharge with 10mA/F to 0.1V

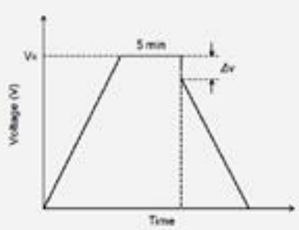


$$C = \frac{I \times (t_2 - t_1)}{v_1 - v_2}$$

Where
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);
I is the absolute value of the discharging current (A);

2 **Surge Voltage / Absolute Maximum Voltage**
> Absolute maximum voltage, not repeated and for no longer than 1 second.

3 **ESR** *(Equivalent Series Resistance)*
> ESR_{DC}
- Constant current charge to VR
- Constant voltage charge at VR for 5min
- Constant current discharge to 0.1V



$$R_d = \frac{\Delta v}{I}$$

Where
R_d is the ESR_{DC} (Ω);
Δv is the voltage drop for 10ms (V);
I is the discharge current (A).

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

5 **Energy & Power**
> Max. Stored Energy at V_R = $\frac{½ C V_R^2}{3600}$

Where C is the Capacitance (F);
V_R is the rated voltage (V).

> Usable Specific Power, IEC 62391-2 (W/kg) = $\frac{0.12 \cdot V^2}{ESR_{DC} \cdot Mass}$

> Impedance Match Specific Power (W/kg) = $\frac{0.25 \cdot V^2}{ESR_{DC} \cdot Mass}$

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

6 **Max. Current**
> Current for 1sec discharging from rated voltage to half Rated voltage under constant current discharging mode.

$$I_{Max.}\ (A) = \frac{½ V_R}{\Delta t / C + R_d}$$

Where
Δt is the discharge time (sec) and Δt is 1 sec in this case;
C is the capacitance (F);
R_d is the ESR_{DC} (Ω);
V_R is the rated voltage (V)

7 **Lifetime**
> End-of-Life Conditions
- Capacitance: -30% from rated min. value
- ESR: +100% from max. ESR value

8 **Endurance**
> Conditions
- Temperature: 65 ± 2°C
- Test duration : 1500 (+48/-0) h
- Applied voltage: V_R ± 0.02V
- Capacitance and ESR measurement are made at 25°C

9 $\Delta T = I_{RMS} . I_{RMS} . ESR . R_{th}$

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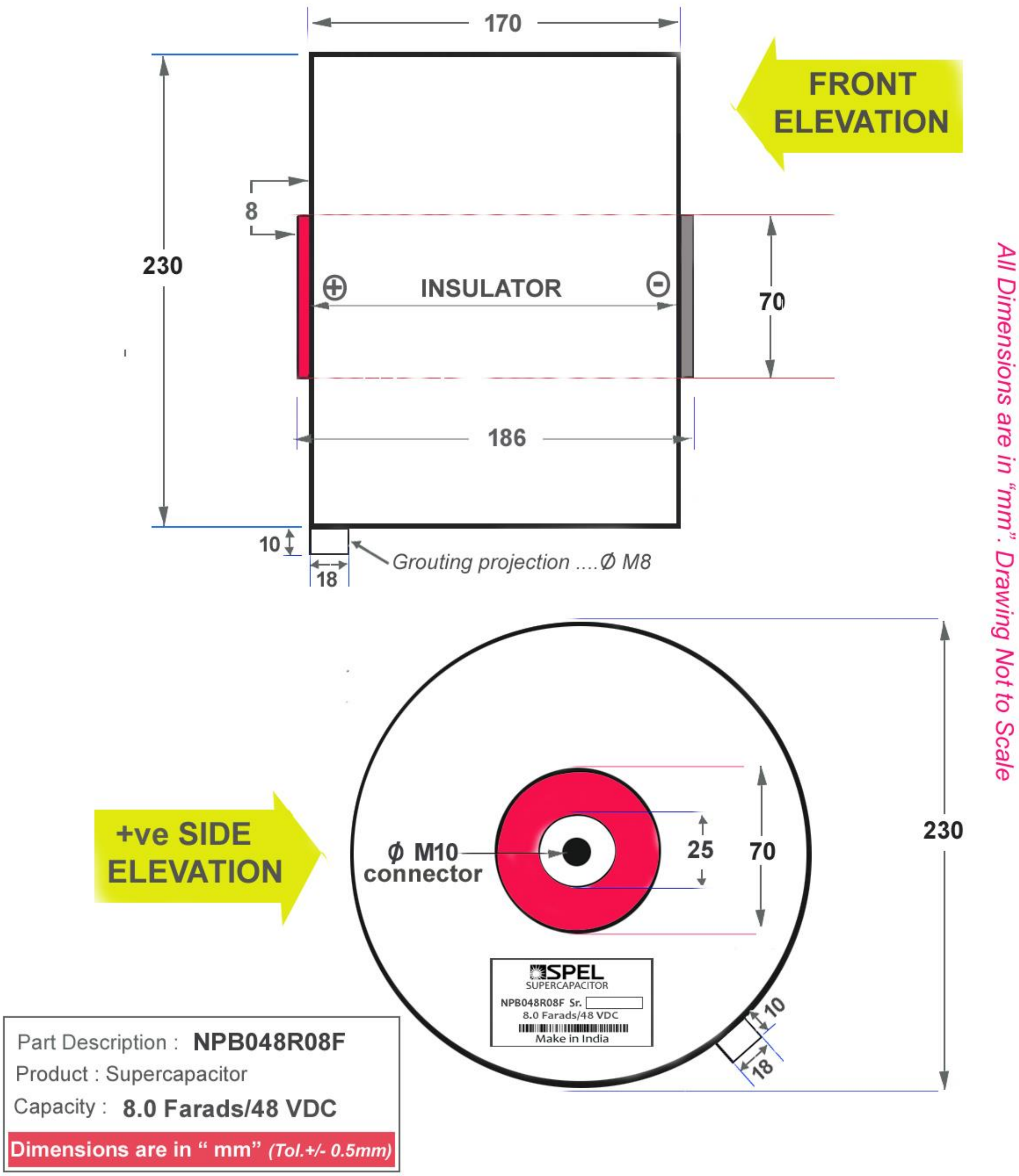
Product Dimensions/Drawing



Note : Product dimensions are for reference only unless otherwise identified. Product dimensions and specifictions may change without notice.. Please contact Surya Powerfarad Energies Limited directly for any technical assistance.

Installation/ Mounting Notes/ Instructions

Mounting Recommendations

Use compatible mounting Clamps. Maximum allowable torque on Mounting Clamp Nuts not to exceed 4Nm. Use dual mounting clamp to meet vibration specifications.

Markings

Products are marked with the following information: Capacitance (F), Nominal Working Voltage (V), Series Code (or part No.), Polarity, Serial Number and name of Manufacturer.

Packaging information

Each Module of NPB048R08F is packed individually in a box.

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