

# Supercapacitor to replace starting battery

For high reliability in any environment select a **Supercapacitor based starting system**

**Eliminate the starting battery, the weakest link in a generator system**

- Environmentally safe
- No toxic chemicals
- Virtually maintenance free
- Service life 15 – 20 years
- Operating range -40°C to +65°C
- High cranking amps
- Resists shock and vibration
- Multiple mounting options
- Lightweight

## Features

In very cold climates the Supercapacitor will deliver up to 3 times the cranking amps of any lead acid battery. In hot desert climates our Supercapacitor starter provides up to 6 times the service life of a lead acid battery.

Polar strongly recommends using Supercaps in extreme weather installations, helicopter and remote access sites, and where battery theft is a problem. The cost to replace a single lead acid starting battery at helicopter access or a remote site grossly outweighs the procurement cost of a Supercapacitor. The configuration of our Supercapacitor starting system makes them impractical for starting automobiles and trucks reducing the theft value.

The long service life of the Supercapacitor solves the problem of maintenance crews frequently installing improper (but convenient) starting batteries that provide poor starting reliability.

Supercaps provide the energy to operate: fuel pumps, glow plugs and crank diesel generators with multiple cranking attempts. It takes only minutes to recharge and continue cranking the engine for those stubborn start situations.



## How it works

A capacitor operates on electrostatic charges over large surface areas. Batteries function on electrochemical reactions. Both batteries and capacitors have a self discharge and require a float charge.

A few milliamps are required to support the active cell to cell balancing circuit within the Supercapacitor. The capacitor maintenance charge is less energy than a lead acid battery.

Whether charging with a lead acid battery or a Supercapacitor, current is required to power the engine's controls and monitoring during standby mode. Polar uses an isolated DC to DC charger to maintain a capacitor's charge.

The DC to DC power supply used to float and recharge the Supercapacitor is powered by a 24 or 48 Vdc load battery bank. The DC to DC charger steps the load battery bank voltage down to a nominal 12 Vdc. Polar's charger is fully isolated, current limited, and introduces very low ripple. The electrical load and effect on the load battery bank is negligible.

The Supercapacitor provides more cranking cycles in a shorter period of time than the lead acid battery. It takes only minutes to recharge the Supercapacitor from the load battery bank as opposed to much longer charging times for the lead acid battery. Fast charging a lead acid battery can damage it. The Supercapacitor is the best product for hard to start situations.

## Efficient, Economical, and Environmentally Friendly

### Very High Efficiency

Supercapacitors are highly efficient technology. Their coulombic efficiency (defined as the total charge removed divided by the total charge added to replenish the charge removed) is greater than 98% even at very high currents. This means that little energy is lost when charging and discharging the Supercapacitor. Round-trip efficiency is also very high, due to the low equivalent series resistance (ESR). At a 5 second rate, round-trip efficiency is greater than 70%. At a 10 second rate, RTE is greater than 80%.

### Lightweight and Compact

The standard lead acid starting battery weights more than 20 kg, and our Supercapacitor weights 5.5 kg. The volume of the lead acid battery is 9050 cc and the volume of the supercapacitor is 4900 cc. The Supercapacitor being smaller in size and lighter in weight outperforms the lead acid battery.

### High Current Capability

You can charge the Supercapacitor as quickly as the DC to DC charger will allow. Cold cranking amps are limited by the impedance of the circuit; we have measured up to 2000 amps.

### Wide Voltage Range

For nominal 12 Vdc systems voltage range is 12 to 15 Vdc. In most applications we set the DC to DC charger to 14.1 - 14.4 Vdc.

### Wide Temperature Range

Because Supercapacitors operate without relying on chemical reactions, they can withstand a wide range of temperatures. They can operate environments up to 65°C and withstand storage up to 85°C, without risk of thermal runaway. At cold temperatures they can deliver charging power as cold as -40°C, well below the cold performance threshold of batteries. Many batteries fail to perform as temperatures drop below -10C and typically battery heaters (not fuel efficient or friendly to solar hybrid systems) are used.

### Long Cycle Life

The energy storage mechanism of a Supercapacitor is a highly reversible process. The process moves charge and ions only; it does not make or break chemical bonds. It is therefore capable of hundreds of thousands of complete cycles with minimal change in performance. Cycle depth is also not an issue, Supercapacitors can be micro-cycled (cycled less than 5% of their total energy) or full cycled (cycled greater than 80% of their total energy) with the same long life.

## Long Operational Life

Since there are no chemical reactions, the energy storage mechanism of a Supercapacitor is a highly stable process. It is therefore capable of many years of continuous duty with minimal change in performance. Long-term storage is not an issue, since the Supercapacitor can (and should) be stored completely discharged. The long cycle life and long operational life make the Supercapacitor a lifetime component. The service life of the capacitor is based on its ability to hold a charge; capacitors do degrade over time with respect to their ability to hold a charge. To provide an estimated 20+ years of service life we oversize the capacitor to compensate for its loss charge capacity. Typically 300 to 400 Farads is sufficient to start up to 1.5 liters diesels or 2 liter LPG / Natural Gas engines under all weather conditions. One 500 Farad rated capacitor compensates for aging thereby providing over 20 years of service. When was the last time you remember replacing a capacitor in a motor or appliance versus a battery?

## Ease of Maintenance

Supercapacitors are virtually maintenance free. They have no memory effects, cannot be over-discharged, and can be held at any voltage at or below their rating. If kept within their wide operating ranges of voltage and temperature, there is no recommended maintenance.

## Safety

**Do not jumper a battery to a supercap. The current flow will be too high for either the cable, point of connection, or the battery.**

## Specifications

### Supercapacitor P/N: 20-16-0001

Storage rating: 500 Farads  
Max capacitor voltage: 16 Vdc  
Weight: 5.5 kg

### 24 and 48 Vdc chargers

Charger output voltage: 14 - 14.4 Vdc  
Max charger output current at 14 Vdc: 23 A  
Recharge time from 0 Vdc: 10 minutes  
Recharge time from 8 Vdc: 2 minutes  
Weight: 1 kg

### 48 Vdc charger P/N: 00-10-0015

Charger input voltage: 28.8 - 60 Vdc  
Idle current at 54 Vdc: 0.08 A  
Max input current at 48 Vdc: 8.7 A

### 24 Vdc charger P/N: 00-10-0016

Charger input voltage: 19.2 - 45 Vdc  
Idle current at 28 Vdc: 0.2 A  
Max input current at 24 Vdc: 17.4 A

