REDHAWK ENERGY

Innovative Solutions for Your Critical Power Needs

Switch Boost™ Systems

120V, 24V, 12V

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RH - Switch Boost™ Systems

Application

Railway Power Switches

A railway power switch application requires an AC or DC power source that can provide a high initial current to meet the in-rush/break-away current demand of the switch or hydraulic motor. This momentary inrush is followed by a lower level current for a longer duration as the switch throws. Finally, a small rise in current towards the end of the operation usually occurs as the switch drives home.

Batteries have long been used for railway power switch applications. Batteries provide an "instantaneous" and generally "reliable" source of power for operating a railway switch when called upon.

Batteries used for railway power switch applications however are selected for reasons other than reliability, performance and life with results being less than satisfactory. Those reasons can be related to cost, physical accommodation, general familarity, or OEM size restrictions (as is the case for switch mounted 12V and 24V batteries). When these factors enter the selection criteria it could be at the sacrifice of dependability and life.

New Technology?

The short-time, high current nature of the load profile of railway power switches are well aligned with the characteristics and capabilities of a relatively new device for energy storage known as an **Ultracapacitor** or **Supercapacitor.**

All-New Switch Boost™ Systems

Our innovative and **patented** Switch Boost™ Systems utilize one or two Ultracapacitor or Hybrid Ultracapaci-tor modules to provide enhanced power for 12V, 24V and 120V railway power switch applications. Taking advantage of the high current and exceptional cycling capability of ultracapacitors and hybrid ultracapacitors, Switch Boost™ Systems can dramatically improve the performance, life and reliability of railway power switches, compared to battery-only systems.

Technology Overview

Ultracapacitors

Ultracapacitors, also known as Supercapacitors or Electric Double Layer Capacitors (ELDC) are a relatively new energy storage device with capabilities that are a cross between a capacitor and a battery. The fundamental difference between an Ultracapacitor and a battery relates to how energy is stored in the device. In a battery, the energy is stored in **electrochemical form** where reactions inside the cell release their charge to create a usable electric current. An Ultracapacitor works on a different principal. Ultracapacitors store energy in **electrostatic form** where an electric field is created when opposite charges are held seperated from each other. Once the field reaches its maximum voltage the Ultracapacitor is charged. When a conductive path is established, electric current flows and the device begins to discharge.

Short Duration High Power

Ultracapacitors are well suited for short duration high power demands and can be combined with the primary energy source (batteries) and sized to handle peak power demands.

Exceptional Charge Efficiency

An Ultracapacitor is up to 98%+ efficient on charging throughout its life. By comparison, the charge acceptance efficiency of lead acid batteries is typically in the 70% to 85% range and is based on state of charge, charge rates and plate construction. Charge efficiency also decreases as the battery ages.

Rapid Recharge Time

Ultracapacitors can be recharged extremely fast - from seconds to just a few minutes. Comparatively lead acid batteries take between 4 and 7 hours with a "sufficient" charging source to recharge from 10% SOC to 100% SOC.

Wide Operating Temperature Range

Ultracapacitors are capable of delivering energy down to **-40°C and even -50°C** with minimal impact on performance and efficiency. While batteries may struggle to perform as temperatures dip below 0°C, Ultracapacitors will be negligibly impacted even under the coldest conditions.

Cycle Life

Ultracapacitors = 1,000,000 Cycles

- When operated between full rated voltage and 50% voltage at constant current.
- End-of-Life (EOL) is measurable and predictable compared to lead acid batteries.

VRLA Batteries = 300-1,200 Cycles

- "Depth of Discharge" dependent - the deeper discharge - the shorter cycle life.

Hybrid Ultracapacitors (HCAP)

Hybrid Ultracapacitors (HCAP) combined with Lithium Ion are an emerging technology for energy storage. HCAPs can replace traditional batteries and offer a more reliable, cost-efficient solution for 12V and 24V railway power switches. The hybrid technology provides a source of short duration power and energy for long duration backup. HCAPs are an environmentally friendly power source which do not contain heavy metals (RoHS Compliant), is non-flammable, and poses no risk of explosion or thermal runaway.

Switch Boost™ 120V

Overview

Our all-new and **patented** Switch Boost™ 120V System utilizes one or two Ultracapacitor modules to provide enhanced power for high voltage railway power switches. Taking advantage of the high current and exceptional cycling capability of ultracapacitors, the Switch Boost™ 120V System can dramatically improve the performance, life and reliability of railway power switches, compared to battery-only systems.

When the Switch Boost™ 120V System is combined with a battery for "charging", the Switch Boost™ provides the necessary current to throw the switch while the Battery recharges the Switch Boost™ and is preserved for outage situations. The Switch Boost™ 120V System offers built-in safety & security and plug & play integration for rapid field deployment.

Features & Benefits

Integrated NEMA 1 Rated Enclosure
Electrical components are internally mounted for operator safety.

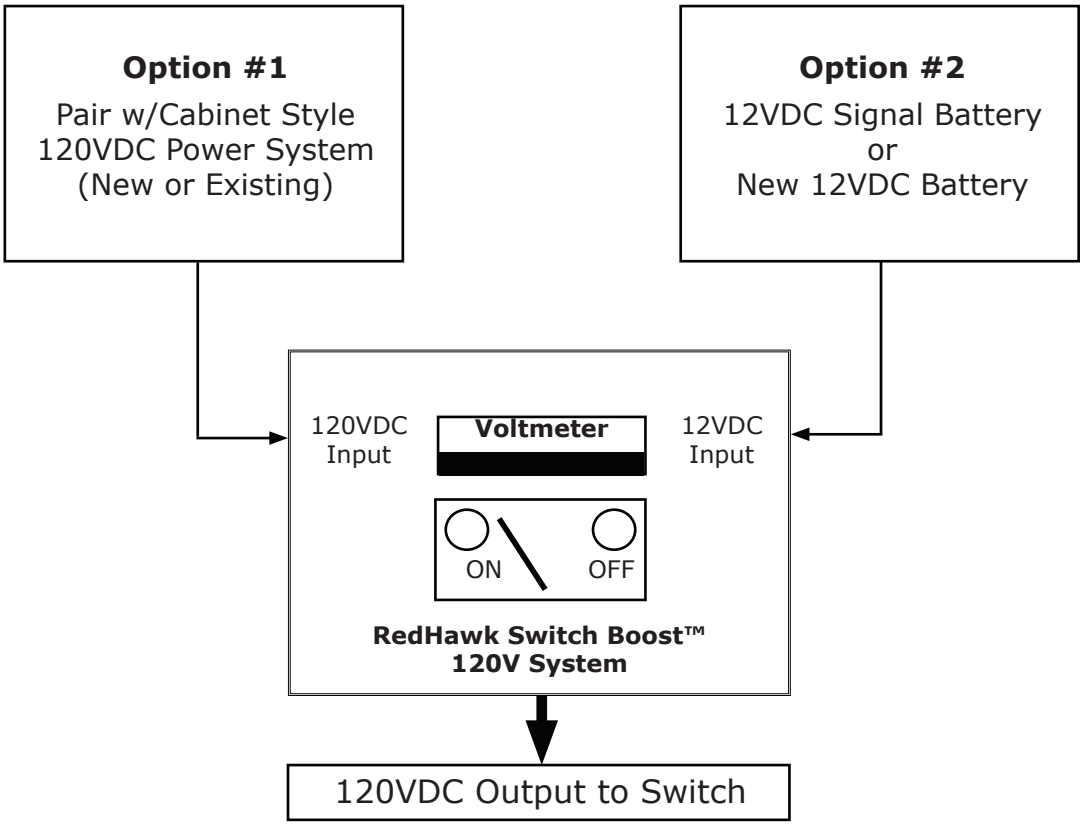
Front Mounted Analog Meter
Ability to safely monitor ultracapacitor voltage condition without needing to open the cabinet door.

Front Mounted On/Off Switch
Allows operator to discharge the ultracapacitor module(s) down to a safe voltage for module maintenance, troubleshooting or replacement.

Minimal Maintenance Needs
Recommended yearly inspection - check cabinet, clean debris/dirt and check terminal tightness and integrity.

Long Life Design
Provides **10+ years** of service when operated under nominal voltage at 25°C (77°F).

Switch Boost™ 120V



Models:

UCS-1001 & UCS-1002
25.5"W x 24"H x 12"D
68 lbs

UCS-1001 G5 & UCS-1002 G5
21.5"W x 21.25"H x 10.25"D
48.5 lbs

Ultracapacitor Specifications:		
Capacitance	Rated	6F
	Tolerance	-0/+20%
Voltage	Rated	150 VDC
	Surge	171 VDC
ESR	ESR (DC) - maximum initial	200mΩ
Current	Maximum leakage	0.7mA
	Maximum peak	214A
Energy Storage	Maximum energy	18.8Wh
	Usable energy	14.1Wh
Power	Power density	2596W/kg
Temperature Characteristics	Operating temperature range	-40°C to +65°C
	Storage temperature range	-40°C to +70°C
Safety	Short circuit current	750A
	Environmental ingress protection	IP54
DC Life	Life (projected)	10+ Years
Cycle Life	Life (projected)	1,000,000 Cycles
Storage	Storage life	4 Years

System Options:

Dual Ultracapacitor Modules

12V to 125V DC-DC Converter

12V Battery & Charger

Spare Parts Kit

*Specifications subject to change

Switch Boost™ 24V

Overview

Our Switch Boost™ 24V System utilizes one or two Hybrid Ultracapacitor (HCAP) modules to provide enhanced power and energy for 24V railway power switches. The Switch Boost™ 24V System can replace traditional 24V batteries and offer a more reliable, cost-effective solution. The Switch Boost™ 24V System can also be paired with a new or existing 24V battery for increased backup.

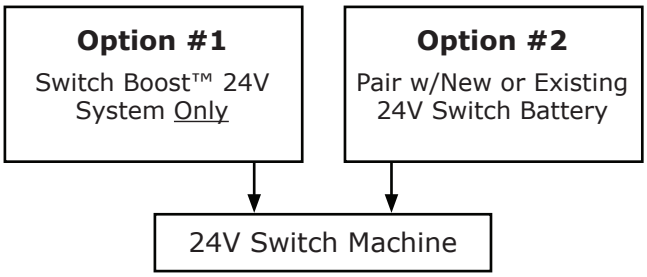
HCAP 24V Module

Customization Available

Integrated cabinet, charger, battery backup and other accessories available.

Safety

Environmentally friendly power source which does not contain heavy metals (RoHS Compliant), is non-flammable, and poses no risk of explosion or thermal runaway.



HCAP Specifications:		
Model	**HCAP-27V-10-600**	**HCAP-27V-25-900**
Rated Capacity	10Ah	25Ah
Cranking Amps	600A	900A
Total Energy	250 Wh	600 Wh
Charging Voltage	27V	27V
Rated Voltage	24V	24V
Max Voltage	27V	27V
Min. Voltage	17V	17V
Module Capacitance	3,000F	10,000F
ESR	15 mΩ	12 mΩ
Max. Continuous Current	100A	150A
Self Discharge (T=25°C)	180 days	180 days
Dielectric Strength	2,500 VDC	2,500 VDC
Compliance	RoHS	RoHS
Terminals	SAE 3/8”-16 UNC	SAE 3/8”-16 UNC
Dimensions (W x D x H)	10”W x 6.5”D x 8.5”H	12.75”W x 6.5”D x 8.5”H
Weight	15 lbs	24.25 lbs
Operating Temperature	-40°C to +65°C	-40°C to +65°C
Storage Temperature	-40°C to +70°C	-40°C to +70°C

*Specifications subject to change

Switch Boost™ 12V

Overview

Our Switch Boost™ 12V System utilizes one or two Hybrid Ultracapacitor (HCAP) modules to provide enhanced power and energy for 12V railway power switches. The Switch Boost™ 12V System can replace traditional 12V batteries and offer a more reliable, cost-effective solution in virtually the same footprint. HCAP modules can be mounted horizontally or vertically to match any new or existing integrated switch-mount requirement. If desired the Switch Boost™ 12V System can also be paired with 12V battery for increased backup.

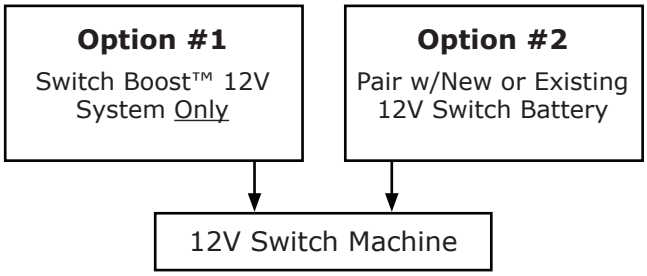
HCAP 12V Module

Customization Available

Integrated cabinet, charger, battery backup and other accessories available.

Safety

Environmentally friendly power source which does not contain heavy metals (RoHS Compliant), is non-flammable, and poses no risk of explosion or thermal runaway.



HCAP Specifications:			
Model	**HCAP-13.5-17-200**	**HCAP-13.5-10-600**	**HCAP-13.5-25-900**
Rated Capacity	17Ah	10Ah	25Ah
Cranking Amps	200A	600A	900A
Total Energy	210 Wh	125 Wh	280 Wh
Charging Voltage	13.5V	13.5V	13.5V
Rated Voltage	12V	12V	12V
Max Voltage	13.5V	13.5V	13.5V
Min. Voltage	9V	9V	9V
Module Capacitance	1,000 F	6,000 F	10,000 F
ESR	12 mΩ	10 mΩ	6 mΩ
Max. Continuous Current	70A	100A	150A
Self Discharge (T=25°C)	180 days	180 days	180 days
Dielectric Strength	2,500 VDC	2,500 VDC	2,500 VDC
Compliance	RoHS	RoHS	RoHS
Terminals	SAE 3/8”-16 UNC	SAE 3/8”-16 UNC	SAE 3/8”-16 UNC
Dimensions (W x D x H)	10”W x 6.5”D x 8.5”H	10”W x 6.5”D x 8.5”H	10”W x 6.5”D x 8.5”H
Weight	12.45 lbs	10 lbs	15.8 lbs
Operating Temperature	-40°C to +65°C	-40°C to +65°C	-40°C to +65°C
Storage Temperature	-40°C to +70°C	-40°C to +70°C	-40°C to +70°C

*Specifications subject to change

About Us

RedHawk Energy Systems, LLC is a value-added manufacturing subsidiary of the Arthur N. Ulrich Company. Since the early 1980's we've been a leader in the design, development and deployment of advanced energy systems (solar & wind, fuel cells, thermoelectric generators, stirling engines, ultracapacitors and more) for critical prime and backup power requirements.

- **Solar & Wind Power Systems**
- **Solid Oxide Fuel Cells**
- **Free-Piston Stirling Engines**
- **RP Series Retractable Mast**
- **Hybrid Power Systems**
- **Batteries**
- **Battery Boxes & Enclosures**
- **Switch Boost™ Systems**

Visit **www.redhawkenergy.net** for more information on our innovative power solutions.

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