ActiveLED® White Paper Series

ActiveLED® Solar and DC Systems

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ActiveLED®
Energy Efficient Lighting and Controls

Rationale

ActiveLED®, a division of Ringdale Instruments®, has a uniquely modular approach to providing solar applications for lighting that is scalable from the smallest to the largest systems.

With the exception of the Solar Panels or Wind Generators themselves, ActiveLED provides the components for every aspect of the system, including any mechanical mounting hardware for solar panels, battery boxes and electrical cabinets.

ActiveLED Solar and DC-Systems Components are exceptional in performance and longevity

Local DC systems are safer at lower voltages, this is why Ringdale/ActiveLED adopted its 48 System Voltage strategy in early 2004 when its DC only and POE devices first were made available. In the meantime (since 2014) Schneider Electric and GE have both adopted 48V-DC for their DC low voltage systems.

Very high voltage DC systems in a home or factory are so dangerous that ActiveLED believes they should not be recommended. Very high voltage (100..1000V-DC) power electronic devices are by their nature also more expensive to make.

Electronic Components

LiFePO4 Battery Banks:	12V, 18V, 21V, 24V, 30V, 36V, 42V, 48V, 52V, 58V Useable Initial Capacity: 70Wh, 140Wh, 500Wh, 1000Wh, 5200Wh
Low Loss Bank Separation Diodes:	Continuous forward current: 50A, 100A, 200A, 500A Maximum Loss: less than 0.8%
Battery Fuel Gauges:	50A, 100A, 200A, 500A Maximum Loss: less than 0.8%
Solar or Wind Charger:	up to 800Watt input power from 14..44V input to 48V, 52V or 58V nominal battery voltage LiFePO4 and Lead Acid versions.
Solar Charger and Current Source:	up to 240W Solar Panel input, up to 75 Watt LED driver output
Grid Charger:	up to 1500W Grid Charger, 120V-AC / 60 Hz monitors solar panel input, battery charge and discharge, EDSaP managed.
4 Channel DC Current Source:	Input voltage 44..63V, 4 x 24W max outputs, EDSaP dimmable
DC Motor Variable Control:	Input voltage 24..75V, up to 3hp (2.25 kW), EDSaP speed control for circulation pumps, irrigation pumps, hydraulic pumps etc.
Solid State DC Relays:	Input Voltage 24..75V, output 3.3V, 5V, 12V, 24V, 48V PWM input can be used for ON/OFF or PWM of output voltage EDSaP managed.
Programmable Logic Controller:	16 input channels, 8 dry contact output channels Ethernet, Web Interface, built-in compiler and disassembler.

Mechanical Components

Battery Racking:	Useable Initial Capacity: 5200Wh, 10400Wh, 15600Wh, 20800Wh infinitely expandable systems
Solar Panel Mount (Pole):	60W, 120W, 240W or 2 x240W
Solar Panel Mount (Ground):	60W, 120W, 240W or 2 x240W
Solar Panel Mount (Roof):	240W
Matching Roof Shingles:	Roofing system combines Solar and metal shingled 19° pitched roof.

Product Descriptions and Purpose of Devices

LiFePO4 Battery Banks

ActiveLED no longer recommends using Lead Acid, but LiFePO4 batteries due to their superior energy density per weight, cycle time and discharge ability. When calculating a Lead Acid system considerations have to be given to depth of discharge and the effect on the lifetime of the battery.

Generally Lead Acid batteries that are not discharged more than 50% of capacity will lose 30% of their capacity every 300 charge/discharge cycles, compared to 2500 cycles for a LiFePo4 battery with a 90% discharge per cycle. Lead Acid batteries that are deep cycled to 90% discharge loose 30% of their capacity after 150 cycles.

The consequences are that when properly dimensioned a lead acid system requires twice the capacity, twice the space and 7 times the weight compared to a LiFePO4 system and the LiFePO4 system will still outlive the Lead Acid System 2 times.

The cost of LiFePO4 systems is ~ $0.78 per useable watt hour versus Lead Acid of $0.38 per watt hour. Lead Acid battery manufacturers will claim half that but as you can only discharge the Lead Acid batteries to 50% the system has to be twice the capacity.

There is another aspect which is charge and discharge efficiency, whereby a Lead Acid battery can only be fully charged and discharged with an efficiency of ~70% a LiFePO4 system can be charged and discharged with an efficiency of 90%.

Last not least the operating temperatures while maintaining 90% of capacity of LiFePO4 batteries are from -20° C to +60° C while lead acid batteries should not be charged above 40°C or discharged below -5°C. The capacity of lead acid at -10°C is 1/10th of its nominal capacity at 20°C.

Battery Fuel Gauges

It is a well known fact that in stationary environmentally controlled battery banks most early battery failures or significant loss of capacity is due to over-discharge.

The main purpose of a battery fuel gauges is to monitor and indicate battery availability, for example ActiveLED's Battery Fuel Gauge shows green from full charge to half charge, yellow from half to 10% charge and red when the battery has been turned off. During a charging cycle the indicator shows yellow until a full charge has been reached.

The fuel gauge can turn a 100Ah battery bank (LiFePO4 or Lead Acid) off completely to protect the batteries. It does so at 10% so that sufficient charge is available to sustain the monitoring electronics until a new charge can be received.

In its ON or operational condition the Fuel Gauge has a loss of less than 0.8% meaning in a 52V nominal system at 90A the loss in the fuel gauge is only 0.36V * 90A = 32.4Watt or 0.69% a very low operational cost for the benefit of protecting the investment of the battery bank.

Each Battery Bank requires one fuel gauge.

Bank Separation Diodes

When batteries or battery banks are new and in parallel they have almost the same charging characteristics. However, if one bank has a lower voltage the higher voltage bank will charge the lower voltage bank. The consequences are that if one bank is damaged the other bank will destroy it even faster. Separation diodes completely overcome this issue.

ActiveLED's Separation Diodes have the lowest forward voltage in the industry of 0.36V at 100A reducing the operational cost to less than 0.8% meaning in a 52V nominal system at 90A the loss in the fuel gauge is only 0.36V * 90A = 32.4Watt or 0.69% a very low operational cost for the benefit of protecting the investment of the battery banks.

If you only have one Battery Bank you do not need a separation diode.

If you have a higher capacity system and have multiple banks of batteries, you need to protect the battery banks from each other.

Solar or Wind Charger

This device converts solar power generated by solar panels of up to 800Watt input power from 14..44V input and 0..18A and charges a number of battery systems.

Common battery systems of 48V, 52V or 58V nominal battery voltage LiFePO4 and Lead Acid versions of this device are available. As this is a programmable device other battery system voltages can be accommodated as long as they are in the range of 40..63V and the input voltage does not exceed 5 V below the output voltage.

ActiveLED's Solar or Wind Chargers can be used in conjunction with Fuel Gauge and Separation Diode as well as the ActiveLED 1500W Grid Charger.

Solar Charger and Current Source

This device is an LED current source for light fixtures up to 75 Watts and combines a solar charger for up to 480W in solar panels accommodating Lead Acid or LiFePO4 battery systems.

There are only two pairs of wires to consider, the Battery Wires and the Solar Panel Wires. Multiple devices can be connected to one battery bank in parallel.

All devices have to be connected to at least one solar panel as they use the solar panel also as the daylight sensor. The devices can be put in parallel on the solar panel input when only one solar panel is used in the system with multiple devices.

Depending on the watt hour requirement the battery bank voltage can be programmed from nominal 12V-DC to 58V-DC allowing to select the most cost effective LiFePO4 battery system for the application.

Often in applications like solar billboard, monument signs and the like a compact solution is required.

Grid Charger

This Grid Charger can deliver up to 1500W, 120V-AC / 60 Hz for charging a Battery System or providing backup power for a DC system. The device provides AC to DC conversion at a 96% efficiency and a power factor >0.96 the highest efficiency for such a system.

The supplemental grid power can be used to provide power to DC users directly or to re-charge the batteries.

To optimally apply grid power only when it is needed, the device monitors solar panel input, battery charge and discharge, EDSaP managed.

4 Channel 48V-DC Current Source

This DC current source allows up to 4 LED fixtures without drivers to be driven, it has 4 programmable (90mA .. 900mA) current sources.

The input accommodates Lead Acid as well as LiFePO4 systems with nominal voltages between 44..63V, 4 x 24W max outputs. The total output power should be limited to 96 Watts.

The efficiency of the device is 98% with a maximum loss of ~2Watt at 96 Watt output power.

All 4 outputs are simultaneously dimmable through the EDSaP dimming protocol or a 0..10V dimming input and has optional ports for daylight and motion sensor.

DC Motor Variable Control

When the whole environment needs to run off DC, ActiveLED makes a low cost variable speed motor control for DC motors where the motor can be run at the system DC voltage at full output.

The input voltage range of the variable speed DC controller is 24..75V, the maximum current is 50A. The controller can drive DC motors up to 3hp (2.25 kW) and is controlled via an EDSaP speed controller.

DC motors can be used for variable speed circulation pumps and Fans etc.

High Power Solid State DC Relays

A solid state relay for switching resistive and inductive loads up to 50A (140A peak) with an input voltage range of 24..75V-DC.

The device is EDSaP manageable and can take ON/OFF input through a CMOS or TTL level signal line as well as provide an output that the device has fired/ is on.

The device can be used for irrigation pumps, hydraulic pumps, hydraulic lifts etc.

ActiveLED makes a 48V DC hydraulic boat lift and personal water craft lifts using this device to drive the DC motor to drive the hydraulic pump.

Low Power Solid State DC Relay and Voltage Down Converter
When different voltages are required for different DC controlling devices, this Voltage Converter can be used either as a highly efficient Voltage DC to DC down converter as well as a controllable down converter, used like a solid state relay.

Input Voltage 24..75V, output 3.3V, 5V, 12V, 24V, 48V PWM input can be used for ON/OFF or PWM of output voltage.

Programmable Logic Controller

A simple process controller that allows programs to be downloaded and executed in the device. The unique feature of this PLC is that a program can be loaded in clear text and the device will compile the program. At a later stage the program can be disassembled without the need for a PC.

Communication to the device is via its built-in web server and Ethernet.

The device has 16 input channels, 8 dry contact output channels, Ethernet, Web Interface, built-in compiler and disassembler.

Supply voltage is 12V and requires a *Low Power Solid State DC Relay and Voltage Down Converter* when run from higher voltages. The device is suitable for AC systems as well as any negative grounded DC system.

The device is not suitable for positive grounded battery systems over 28V DC.

Product manufactured in Georgetown, Texas.