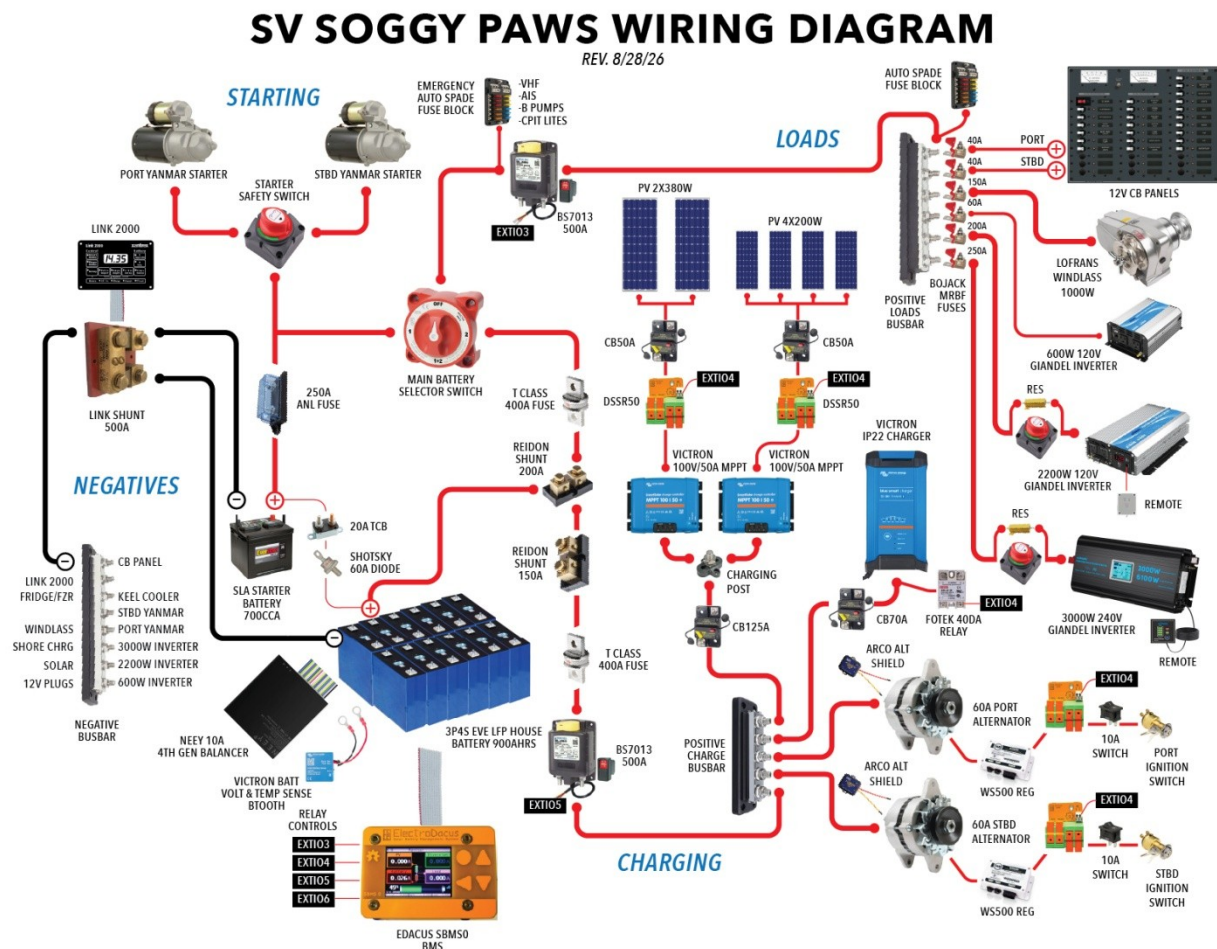


What we have done to make our LifePO4 Battery System

Compliant with ABYC and ISO Standards

Rev 8: 07-Oct-2026

- Purpose:** This document is intended to provide information regarding the electrical system aboard SV Soggy Paws for a new owner, an insurance adjuster, or marine electrician needing system information. The wiring diagram above represents how the boat was wired as of the date of revision. The diagram will be updated later this year as additional upgrades are in progress. *Wiring changes not currently reflected on the above diagram: HVD Alarm, HF radio 30a*

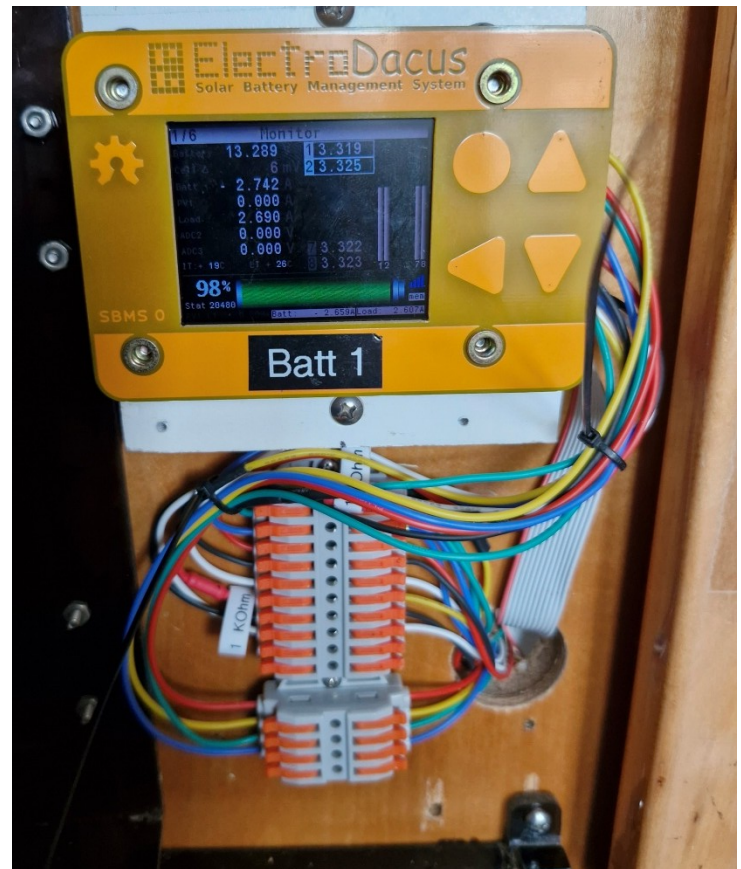


- Basics.** This electrical system has been researched, designed, and installed on our St Francis 44 catamaran not by marine electricians, but by us the boat's owners. Much of the design came from advice gathered from trusted websites and other groups on the internet. It is a significant upgrade to our older lead acid battery system. It is a relatively simple, but very powerful lithium system, consisting of a single large house battery, a separate starter battery, and a BMS that has on-off control over external relays or devices directly. It uses proven, quality equipment and wiring techniques, adhering whenever possible to ABYC/ISO standards. It is not technically difficult to build, but requires basic electrical wiring skills and

tools, attention to detail, and significant study before proceeding. The biggest advantage for this DIY approach is knowing your electrical system so that you do not need help from others.

- 3 **House Bank:** Our Lithium Iron Phosphate (LFP) single house battery consists of 12 good quality LF280K Eve prismatic cells, arranged 3P4S, for a total of 840 aHrs (advertised) but 900 aHrs (measured useable). They are housed in a covered fiberglass compression box with nonconductive separation sheets between cells and cushioning under and along the sides. Cell connecting bars are made of layered, tinned copper with an oversized cross sectional area of 60 mm². They have a very useful small extra threaded hole for monitor and balance wiring. The box is secured under the main cabin settee, such that it cannot move even if the boat is inverted.

- 4 **BMS.** The single BMS is a Canadian made ElectroDacus SBMS0 v3, an external relay type of BMS that has on-off control of relays or equipment directly. It is not an internal MOSFET type, set in main battery wiring that disconnects the battery in case of a problem. It currently has four external relay outputs (soon to be six with future software upgrade) that use two levels of voltage on-off control of equipment in case of a problem. It controls High Voltage Disconnect (HVD) and HVD Lock at two different voltages for all charge devices, and currently Low Voltage Disconnect (LVD) for **all** loads. These controls can be executed six different ways. All parameters are adjustable, and it also has on-off control for high and low temperature and high current. See Electrodacus.com for more details.



- 5 **Monitor Display.** All the SBMS0's monitoring data is routed to our navigation computer and other devices via Wi-Fi using an open source, custom, single-page Node Red display. This display shows all the various system parameters, including charge, load, cell balance, faults, and BMS and battery status. When connected to the internet, all this data is available to us from anywhere in the world.



- 6 **Charging.** The three charge source regulators for solar, alternators, and shore power are all set to normally terminate their daily charging at 14.0 V total battery voltage. If this fails or a single cell voltage goes high prematurely, the BMS HVD is set to deactivate charging via solid state relays (SSR) in the charge source wiring. This occurs at 3.55 Vpc with a loud audible alarm, alerting us to a problem. The BMS also has an upper voltage disconnect safety feature called HVD Lock. This uses the Blue Seas 7713 charge buss relay to disconnect the charge buss from the battery, in case of a major fault, if any cell reaches 3.75 Vpc. The BMS LVD for the load bus BS 7713 relay is currently set at 2.8 Vpc.
- 7 **Balancer.** Because the SBMS0 only has a 500 mV passive balancer, we use a NEEY 10 A active balancer when necessary to keep all cells balanced to within 5 mV delta, both at rest and full-charge voltage. This allows daily charging termination to work well without interference from the BMS HVD. However, because our EVE cells have very tight internal resistance deltas, we rarely need the NEEY.
- 8 **Solar Panels.** The primary charging source is 1560 watts of solar mounted on our hardtop in two arrays with minimal shading:
 - a. Four 200 watt panels in parallel at 24v nominal, totaling 800W.
 - b. Two 380 watt panels in parallel at 24v nominal, totaling 760W.

Even though the maximum output through the controllers is held at 50 A for each array, we rarely see over 42 A due to losses from wiring, panel surface temperature, and conversion.

- 9 **Solar System.** Each array has its own Victron 100/50 SmartSolar MPPT, set to the charging profile described above. Normal daily charging termination from the solar is controlled by the Victron MPPTs, with the BMS providing HVD at two higher voltage levels if there is a

problem. The audible alarm also alerts us if the BMS executes a HVD. This should only happen if the cell voltages develop a large delta with one cell going high very early. There are appropriate circuit breakers before and after each MPPT; one to disconnect each panel array from its MPPT, and one to disconnect both MPPTs at once from the battery. The four 200 watt panels have appropriate MC4 fuses at the parallel juncture as required by ABYC. There is a Victron Battery Voltage and Temperature Sense module mounted on the battery which provides accurate battery information by Bluetooth to the MPPTs.

- 10 **Alternators.** Two 60 amp externally-regulated P type alternators (one on each engine) are each controlled by Wakespeed WS500 charge regulators. The WS500 regulators are set to the same conservative LifePO4 charging profiles described above. They also have high voltage disconnect protection (monitored by the BMS) using the DSSR 20s in their ignition wires. They are protected from voltage spikes by Sterling Alternator Protection Modules (APMs). Also, alternator charging can be manually disabled by an on-off switch in the ignition wire for each alternator. Alternators are normally not engaged while underway unless we need the extra charging.
- 11 **Shore Charger.** Shore charging is controlled by a Victron IP-22 12v 30a battery charger with the same conservative LifePO4 charging profile as above. The IP-22 charging parameters are fully adjustable and suitable for LFP battery charging. There is a Fotek DA-40 solid state relay in its AC shore wiring, controlled by the BMS, that shuts off charging should there be a HVD situation. The shore charger is almost never used, is not often left on “automatic”, and is always monitored.
- 12 **Fuses.** House battery positive wiring is routed first to two Reidon shunts then a 400 A Class T fuse in both Charge and Load circuits, as required by ABYC for LFP batteries over 200 Ahr. Also, as required by ABYC, fire resistant sheathing is installed in the wiring between the battery and the Class T fuses, as they are located further apart than the seven inch basic requirement.
- 13 **Buss Relays.** The large charge and load main buss bars are protected by 500 A Blue Seas 7713 SSR relays, controlled by the BMS. The BMS is currently set to disconnect the charge buss at 3.75 Vpc HVD Lock and the load buss at 2.80 Vpc LVD in case a cell goes too high or low. In the future, after SSRs are added for the inverters to disconnect at 2.8 Vpc, this will be modified to disconnect the entire load buss, in case of a major fault, at 2.5 Vpc LVD Lock.
- 14 **Load Buss Branch Fusing.** The load buss uses appropriate MRBF fuses mounted on the buss bar for branch circuit over current protection (OCP). These fuses are very convenient and have a significant Amperage Interrupt Capacity (AIC) rating of 10K A. Ampacity tables have been used to determine suitability of all branch wires for current carrying capability and fusing requirements.
- 15 **Wire Terminations.** All large circuit wire terminations use high quality end fittings, properly crimped, with colored heat shrink. Smaller wiring terminations use a mix of original

terminations and newer properly-crimped Ancor fittings. Replacement is in progress as time permits.

- 16 **Temperature Sensing.** All charge controllers/regulators use temperature sensors on the batteries that will automatically shut off charging at low and high temperature levels. The WS500s also have high temperature sensors on the alternators that will reduce charging at any temperature over the high temperature set point. The WS500s also have an output reduction feature set point, currently set to 65%, to keep the alternators from ever reaching the high temperature set point. The Victron shore charger also uses the Victron temperature sensor on the house bank.
- 17 **Fire Suppression.** ABYC and others have proven that LFP cells do not spontaneously catch fire, but can enter thermal runaway if over charged. In this situation it is best to rapidly remove the charge current and evacuate the space. If there is an electrical fire in the wiring or other system components, there are three temperature sensitive, automatic Aerosol Fire Suppression Devices strategically located in the electrical spaces at the batteries and electrical wiring area behind the main circuit breaker panel. Close by there are also two large Solkaflam (Halon equivalent) fire extinguishers suitable for all types of common fires.
- 18 **Start Battery Charging.** The 700 CCA Sealed Lead Acid starter battery is isolated from the house bank through a Battery Selector Switch, thus it can be paralleled with the house bank in an emergency. It is trickle charged from the LFP house bank through a thermal circuit breaker and Shottky diode when the voltages differ by more than .5 V. No isolators, eliminators, DC-to-DC devices, or other equipment are needed. Its output cable runs through an ANL fuse and Starter Safety Switch where it splits to each starter motor. It is under the main settee and enclosed in a standard plastic case suitable for this type of battery.
- 19 **Inverters.** There are 3 Giandel brand Pure Sine Wave inverters mounted under the navigation station:
 - a. One 240 V, 3000 W, 50 Hz is under the navigation station, with onboard display and remote in the Galley
 - b. One 120 V, 2200 W, 60 Hz is similarly located, with remote in the Galley
 - c. One 120 V, 600 W, 60 Hz is similarly located, used mainly for daily charging of mobile devices and other small loads
- 20 **Inverter Wiring.** DC 12v wiring to these inverters is protected at the Load buss by appropriate MRBF fuses and there are easily accessible shutoff switches in the larger two inverters' DC cables. The 240 v / 3000 W inverter's output runs to a 3 way rotary switch (inverter, shore, off) and then through the AC circuit breaker panel to outlets throughout the boat. The 120v/2200 inverter's output runs direct to its dedicated outlet in the galley. The 120v/600w inverter has a dedicated multi outlet unit plugged into it under the navigation station. Some of this wiring will change if we return to US AC dockage.

- 21 **Shore Power.** The shore power circuit includes a standard 30 A inlet at the back of the boat starboard side, a 30 A AC circuit breaker inside nearby, an AC circuit breaker for the water heater under the starboard settee in the main cabin, and an AC circuit breaker panel at the navigation station. The AC water heater is included and switched on at this panel. There is a 30 A ProSafe FailSafe galvanic isolator installed in the shore power green ground wiring. As recommended, the AC green earth buss is wired to the DC ground buss at only one point.
- 22 **Small Loads.** Smaller switched DC loads such as fans, refrigeration, interior and navigation lights, various pumps, and other small loads are wired off a BEP DC main circuit breaker panel. A separate small fuse block for up to 12 small unswitched loads with spade fuses is wired off a circuit breaker on the main circuit breaker panel. It is located behind the electrical wall at the navigation station.
- 23 **Emergency Buss.** An Emergency fuse block for bilge pumps, VHF radio, cockpit lights, AIS and VHF antenna splitter is wired to the Blue Seas 7013 load relay on the battery side. Equipment on this buss is spade fused and will not be disconnected due to any BMS action, thus it could be in use until all batteries are depleted.
- 24 Recent upgrades not currently reflected on the above wiring diagram are:
- *Icom 802 HF radio- to be added to the load buss as a major current user*
 - *Basic AC wiring*

Currently our electrical system is working exceptionally well, much better than our original system with the earlier, lower quality RJ cells and older charging equipment. Modern technology is continuing to provide us better electrical equipment, testing and installation tools.

Our solar panel output is sized to recharge our normal daily 180-200 Ah load by around noon, if a reasonably sunny day. On our boat major contributors to that load are big refrigeration and freezer units, multiple computers, fans and lights, Starlink, and now the wonderful world of electric cooking. The bank size is such that it can hold over for more than 4 days, even if there is no charging available. Alternators, a portable generator and shore charging are available as backup, but are rarely used. Solar charging, which is automatic, silent, and effective, especially in the tropics, is by far our preferred battery charging method.

Additional information that we have found on evolving LFP technology, various modern equipment options, and much more on our system details is available on our website

<https://svsoggypaws.com/electricalsystems.htm>