What we have done to make our LifePO4 Battery System Compliant with ABYC and ISO Standards

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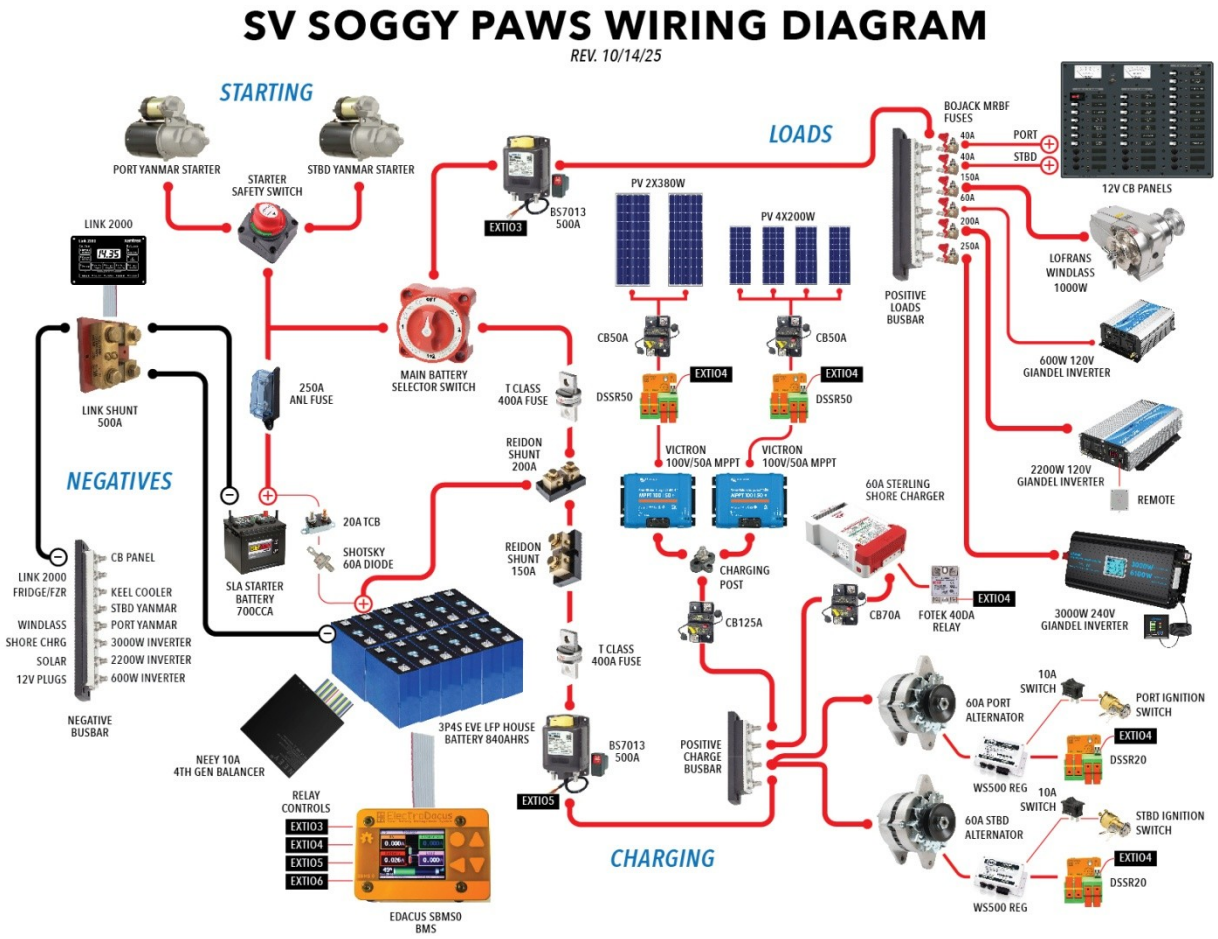

1 This document is intended to provide information regarding the electrical system aboard SV Soggy Paws for a new owner, an insurance adjuster, or marine electrician needing system information. The wiring diagram above represents how the boat was wired as of the date of revision. The diagram will be updated later this year as additional upgrades are in progress. *Wiring changes not currently reflected on the above diagram: Schottky Diode, Auto Buss, Emergency Buss, Giandel 3000 remote, HVD alarm, EXTIO #s, MPPT Batt V sensor, HF radio 30a*

2 Our Lithium Iron Phosphate (LFP) single house battery consists of 12 LF280K Eve prismatic cells, arranged 3P4S, for a total of 840 aHrs (advertised) but 900 aHrs (measured useable), in a covered fiberglass compression box.

3 The BMS is an Electrodacus SBMS0 which has four external relay outputs that control High Voltage Disconnect (HVD) and HVD Lock for solar, alternator and shore charging, and Low Voltage Disconnect (LVD) for Loads. All parameters are adjustable and it also has control for high and low temperature and high current. Its monitor output is routed to our navigation computer and other devices via Wifi using a custom Node Red display.

4 The three charge source regulators for solar, alternators, and shore power are set to terminate their daily charging at 14.0v. If this fails, the BMS HVD is set to deactivate relays in the charge source wiring at 3.55vpc with a loud audible alarm. The BMS LVD for Loads is set at 2.8vpc. The BMS has a

final charging disconnect safety feature called HVD Lock. This uses the BS 7713 relay to disconnect the Charge Buss from the battery, in case of a major fault, if any cell reaches 3.75vpc.

5 The primary charging source is 1560 watts of solar mounted on our hardtop in two arrays:
   a. Four 200 watt panels in parallel at 24v nominal, totaling 800W.
   b. Two 380 watt panels in parallel at 24v nominal, totaling 760W.

6 Each array has its own Victron 100/50 SmartSolar MPPT, set to the charging profile described above. Daily charging termination from the solar is controlled by the Victron MPPT's, with the BMS providing HVD at two higher voltage levels. There are appropriate circuit breakers before and after each MPPT; one to disconnect the panels from the MPPT input, and one to disconnect the MPPT output from the battery. The four 200 watt panels have 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 to the MPPTs by Bluetooth.

7 Two 60 amp externally-regulated P type alternators (one on each engine) are each protected by Balmar Alternator Protection Devices, and are controlled by Wakespeed WS500 charge regulators. The WS500 regulators are set to the same conservative LifePO4 charging profiles described above. 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.

8 Shore charging is controlled by a Sterling Power Products Pro Charge Ultra 60a battery charger with the same conservative LifePO4 charging profile as above. The shore charger is almost never used, is never on left on "automatic", and is always managed manually. It is not suitable for automatic LFP use, as the absorption cannot be set to less than one hour.

9 House battery positive wiring is routed first to two Reidon shunts then a 400a Class T fuse in both Charge and Load circuits as required by ABYC for LFP batteries over 200 ahr. Also required by ABYC, fire resistant sheathing is installed in the wiring between the battery and the Class T fuses, as they are located approximately 30 inches apart.

10 Charge and Load main buss bars are protected by 500a Blue Seas 7713 Relays, controlled by the BMS, set at 3.75vpc HVD Lock and 2.50vpc LVD Lock.

11 The Load buss uses appropriate MRBF fuses for branch circuits for over current protection (OCP). Ampacity tables have been used to determine suitability of all branch wires for current carrying capability.

12 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.

13 All charge controllers/regulators have 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 Sterling shore charger is almost never used, and is only manually engaged when necessary.

14 There are 3 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.

15 The 700 CCA Sealed Lead Acid starter battery is isolated from the house bank through a Battery Selector Switch and trickle charged through a thermal circuit breaker and Shotsky diode. Its output cable runs through an ANL fuse and Starter Safety Switch where it splits to each starter motor.

16 There are 3 Giandel brand Pure Sine Wave inverters mounted under the navigation station:
   a. One 240v 3000 watt with onboard display and remote in the Galley

b. One 120v 2200 watt with remote in the Galley
c. One 120v 600 watt used mainly for daily charging of mobile devices and other small loads

17 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' 12 volt wiring. The 240v/3000w 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.

18 The shore power circuit includes a standard 30 amp inlet at the back of the boat starboard side, a 30 amp AC circuit breaker inside nearby, and an AC circuit breaker panel at the navigation station. An AC water heater is included and switched on at this panel. There is a Pro Fail Safe galvanic isolator installed in the shore power green ground wiring. The AC green ground buss is wired to the DC ground buss with one wire.

19 Smaller DC loads such as the HF radio, refrigeration, interior and navigation lights, fans, and other small loads are wired off a BEP DC main circuit breaker panel. A separate Auto Buss for up to 12 small loads with spade fuses is wired off a circuit breaker on the main circuit breaker panel.

20 An Emergency Buss for bilge pumps, VHF radio, cockpit lights, AIS and VHF antenna splitter is wired to the Blue Seas 7013 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.