2016 Singlehanded TransPac Seminar on Power Management

The Scottish CPA’s Guide to Cheap Boat Wiring

Bob Johnston, SHTP Class of 2006
J/92 “Ragtime!”
Yanmar 1GM10 (9 h.p.)
Typical 1-2-Both-Off Rotary Battery Switch

“Make before break”

Must combine (All/Both) for charging from alternator, then remember to isolate one battery after charging

Effectively uses only half your house bank (if two deep-cycles), since one battery is always isolated
Rags’ Main Fuse Panel (Wow)
Alternator w/field wire
External alternator regulator
Regulator installed on Rags
Battery isolator switch/ACR Kit
Battery Monitor (Victron BMV-700/702)

Keeps you aware of your power system:
  Voltage
  Amps + (charging) or – (using)
  Ah Consumed
  State of Charge
  Time to go
  Power consumption in Watts

Great for preparing your load chart

This one is pretty accurate and sells for about $160 on Ebay.
Automatic Charging Relay and Battery Monitor on Rags
Rags’ Solar Charge Controller
Rags’ Auxiliary DC Panel
Aux DC Panel - rear w/cover
Rags’ AC System
Take spare fuses (labeled)
Power requirements per the SHTP Race Rules and Conditions

4.01 All equipment required (incl. electrical) shall function properly and be of a type, size and capacity suitable and adequate for (sailing solo to Hawaii)

4.02 Heavy items such as batteries . . . shall be securely fastened

4.10 A permanently installed 25-watt VHF radio

4.18 Fixed mount electronic depth sounder

4.26 A second bilge pump, which may be manual or electric

4.30 Navigation lights as required by the COLREGS

4.30 All yachts shall have a masthead tricolor light or a strobe able to be hoisted

4.31 A minimum of two batteries with a combined capacity of at least 120 Ah
4.32 A means of charging the batteries at sea at a rate that will allow the running lights to be used from sunset to sunrise each day

4.33 An energy budget that details all the storage, sources and uses of electricity

4.35 Equipment to communicate your position to the Race Committee . . . though a single sideband (SSB) radio transceiver is not required, it is highly recommended

4.38 A depth sounder

4.39 A knotmeter or log

4.45 Automatic Identification System (AIS) receiver or radar with perimeter alarm

17.01 (Penalties) A yacht failing to comply with the position reporting requirements shall receive a 60-minute penalty added to the yacht's corrected time for each calendar day the yacht fails to comply.
Marine Batteries: Types (applications)

- **Starting**
  - High amps for short periods (then quickly recharged)

- **Deep-Cycle**
  - Can be heavily discharged repeatedly (but taking much longer to recharge)

- **Dual-Purpose**
  - Lower storage capacity than deep-cycle batteries of the same size. Not a good compromise for our needs.
Marine Batteries: Chemistry

- **Flooded**
  - Not sealed, must vent hydrogen (explosive) and can spill, must inspect and top off electrolyte, 6-7% per mo. self-discharge.

- **Gel – Sealed (spillproof)**
  - Highest number of lifetime charging cycles, more sensitive to proper charging than AGM’s, 3% self-discharge.

- **AGM – Sealed (spillproof)**
  - More shock/vibration tolerance, lower internal resistance/better charge acceptance, 3% self-discharge.

- **TPPL and Lithium**
  - Can accept high charging amperage for much quicker charging, can be deeply discharged (>80%), monitoring system adds complexity and cost.
Marine Batteries: Key Tips

Don’t mix chemistries – each chemistry charges differently

Don’t mix ages or sizes in one bank – the weaker battery will shorten the life of the stronger battery

A large (200A) battery bank fuse may well save your boat. Mount within 7” of your battery. This Blue Sea fuse holder mounts right on the battery >
Your battery bank as a bucket

- 100% “Full” with solar, hydro, etc.
- 85% “Full” with alternator
- 50% “Empty” (mid-capacity rule)
- <50% “Empty” (shortens batt. life)
Engine as your primary charger

• Clean tank and fuel
• Fuel filter elements – primary and secondary
• Tighten fittings, replace crush washers
• Know how to bleed air out of fuel system
• Carry spare alternator belt(s), bolts, tools/bar
• Check condition and alignment of alt. bracket
• Condition of wires to battery switch (etc.)
• Protect engine switch panel from water
• Increase throttle above idle to charge
Types of Solar Panels

1) Poly (or multi) crystalline – best output
   Ex: Kyocera KC40T: 43W/17.4V/2.48A
   Best if adjustable to face sun/avoid shadow

2) Amorphic (flexible) – Need 2X surface area
   but tolerate minor shading (rigging, etc.)
   Ex: PowerFilm R42: 42W/15.4V/2.7A

3) Semi-Flexible (Ex: Solbian brand) – lighter
   than rigid panels but similar output - $$$
Types of solar charge controllers

- **Shunt/1 or 2 stage**: Uses relays or shunt transistors to control voltage in one or two steps. These short or disconnect the solar panel unless the voltage is within its charging band, making it inefficient for keeping your battery bank “topped off.”

- **PWM/3 stage** (Pulse Width Modulation): Industry standard for smaller panels. Best alternative to MPPT but doesn’t convert excess voltage.

- **Maximum Power Point Tracking** (MPPT): Highly efficient in colder conditions and with larger arrays. Converts excess voltage into additional current. The only brand of MPPT available for smaller panels (below 150W) is Genasun.
SunForce 400 Watt Wind Turbine

 Blades: Carbon fiber for low wind noise
Body material: Cast aluminum
“High wind over speed Technology”
Fully integrated regulator automatically shuts down when the batteries are charged to minimize wear.
Maintenance-free: (2) Moving Parts
3 Year Warranty
Max Power up to 400 Watts or 27 Amps
“In ideal conditions” (i.e. lots of wind!)
Completely weatherproof
Tower kit sold separately (adds ~ $500)
Powder-coated for marine applications
Dimensions: 27" L x 15" W x 9" H
Weight: 19 lbs (plus mast, hdw, etc.)
Cost: About $500 at Defender (plus mast)
Watt & Sea Hydrogenerator

Cruising 300 model includes: Hydrogenerator 300W (fixed blades), Converter 12/24V auto-detected, Three-blade propeller (240mm), Lifting bracket with cam-cleat, Fastening kit for transom
$3,840

610mm (24”) Weight: 17.2#
970mm (38”) Weight: 18.9#

Bruce Schwab:
OceanPlanetEnergy.com
EFOY Fuel Cell

80Ah/40W/3.3A Weighs 15.7#
   $ 3,500
140Ah/72W/6.0A Weighs 17.4#
   $ 5,000
210Ah/105W/8.8A Weighs 18.7#
   $ 7,000
Methanol cartridge Weighs 18.5#
   $ 80
Electrical Budget
(see Excel Spreadsheet)
Blue Sea Wiring Sizing Chart

U.S. Coast Guard regulation requires all ungrounded current carrying conductors (except the starting circuit) to be protected with a circuit breaker or a fuse.

<table>
<thead>
<tr>
<th>CIRCUIT LENGTH</th>
<th>CURRENT FLOW IN AMPS</th>
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<tbody>
<tr>
<td></td>
<td>5A</td>
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<tr>
<td>0 to 20 ft</td>
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<td>120 ft</td>
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<td>130 ft</td>
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Although this process uses information from ABYC E-11 to recommend wire size and circuit protection, it may not cover all of the unique characteristics that may exist on a boat. If you have specific questions about your installation please consult an ABYC certified installer.

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Kynntana’s DC Panel
Kynntana’s AC Panel
Kynntana – Wiring
Kynntana – High-Wattage Panel
Kynntana’s Nav Station