

## Karma Chickens Power System

In previous years, had small 200W-400W 12v system.

New system target is green, quiet power for shared camp infrastructure

- Estimated camp loads
  - Dome light (20W for 4 hours)
  - Freezer (170W 24/7)
  - Sleep apnea machine (270W for 7 hours)
  - Sound system (300W for 2 hours)
  - Dome swamp cooler (350W for 5 hours)
  - Graywater evaporator (30W about 15 minutes of every hour)
- **Switch on solar input to avoid sparking**
- **Switch and fuse on battery system**
- **Heavy busbars, 6AWG wire**
- Electronics cabinet is enclosed, raised for ease of access, has external weather-resistant outlets for camp "grid"
- Batteries are on tray with cleats for stability, a lid on top protects from shorts
- Lots of marine gear (e.g. Blue Sea switches, fuse, busbars)

**1500W of panels** (6x ET Solar 250W) in 2 strings of 96v nominal, connected to a Morningstar Tristar TS-MPPT-60 60-amp solar charge controller

Racked on ProSolar "Rooftrac" rails with plain 1-1/2" galvanized schedule 40 pipe and Hollaender pipe fittings

**48v system using 6v 220Ah flooded lead-acid (golf cart) deep-cycle batteries** from CostCo

- AGMs are low maintenance, but flooded batteries are **cheap!**
- more than 10kWh of gross capacity, but discharging lead-acid batteries past 50% reduces their lifetime and battery's rating is usually for 20-hour discharge
- we targeted 50% max discharge and subtracted charge and discharge inefficiencies
- **4kWh of expected charge/discharge every day**

**2000W 48v "pure sine" inverter** by Samlex, well-conditioned power to avoid buzz in sound system and avoid burnout in CPAP motor (and other motors)

13A PowerStream charger from AC to charge batteries from generator in evening if necessary, then batteries provide power quietly when camp is sleeping

a Pandaboard ARM computer stores various statistics from solar charging, inverter discharge, battery state and makes 1-hour and 24-hour graphs

Pentametric charge and battery monitor from Bogart Engineering

<http://karmachickens.org/>

- [http://www.scubaengineer.com/documents/lead\\_acid\\_battery\\_charging\\_graphs.pdf](http://www.scubaengineer.com/documents/lead_acid_battery_charging_graphs.pdf)
- [http://batteryuniversity.com/learn/article/how\\_to\\_measure\\_state\\_of\\_charge](http://batteryuniversity.com/learn/article/how_to_measure_state_of_charge)
- [http://www.cartsunlimited.net/Battery\\_Break-in\\_Methods.html](http://www.cartsunlimited.net/Battery_Break-in_Methods.html) - breaking in batteries
- <http://www.nooutage.com/vdrop.htm> - Voltage drop calculator
- <http://www.solar-facts.com/batteries/battery-charging.php>
- [http://www.progressivedyn.com/battery\\_basics.html](http://www.progressivedyn.com/battery_basics.html)
- [http://www.cartsunlimited.net/BatteryCharging\\_Tutorial.html](http://www.cartsunlimited.net/BatteryCharging_Tutorial.html)
- [http://www.cartsunlimited.net/How\\_Batteries\\_Work.html](http://www.cartsunlimited.net/How_Batteries_Work.html) and the rest of the site, too.
- <http://forums.goodsamclub.com/Index.cfm/fuseaction/thread/tid/24318006.cfm>
- charging AGMs (versus flooded):  
<http://www.advrider.com/forums/showthread.php?t=738369>
- wire capacity notes: <http://www.rowand.net/Shop/Tech/WireCapacityChart.htm>
- better wire capacity chart: <http://www.btc-bci.com/~billben/maxwire.pdf>
- <http://www.survivalunlimited.com/batteries/batteryblunders.htm>
- [http://www.windsun.com/Batteries/Battery\\_FAQ.htm](http://www.windsun.com/Batteries/Battery_FAQ.htm)
- <http://www.batteryfaq.org/>
- <http://www.windsun.com/Batteries/AgmTech.htm>
  - internal losses for AGM are 12%-15%, so only get 85% of charge current (<http://www.windsun.com/Batteries/AgmTech.htm>) - they recommend Concorde AGM batteries for their low resistance more like 2%
- MorningStar TriStar charge controller manual
  - recommends AGMs are best suited for low-discharge apps than for daily cycling
  - and "AGM batteries are affected by heat, and can lose 50% of their service life for every 8°C (15°F) over 25°C (77°F)." !!!
  - and "Flooded (vented) batteries are preferred for larger cycling solar systems."
- <http://www.batterydirect.co.nz/serv01.htm>
  - Mixing AGM and flooded may be possible
- <http://www.yandina.com/combInfo.htm#Q31>
- <http://www.thehulltruth.com/forums/thread-view.asp?tid=22865&start=1&highlight=agm+charging&highlightmode=1>
- <http://www.lifelinebatteries.com/rvfaq.php>
  - Says don't discharge below 50% to maximize lifetime versus capacity
- <http://www.bethandevans.com/pdf/Batterydata.pdf>
- <http://www.nzmotorhome.co.nz/NZMotorhomeForum/viewtopic.php?f=55&t=4594>
- <http://www.morganscloud.com/2010/08/10/agm-battery-test-2/>
- <http://www.redrivertriumphclub.org/batteries.htm>
- <http://www.vonwentzel.net/Battery/01.Type/index.html>
- <http://www.batteriesinaflash.com/specs/floodedleadacid/RETrojanSpecs/Deep%20Cycle%20Battery%20FAQ.pdf>
- Sizing a circuit breaker - <http://ecmweb.com/content/sizing-circuit-breaker>