

Boating with Lithium Batteries

LiFePO₄

An Introduction to:

- Chemistry
- Construction
- Installation
- Charging
- Maintenance





A Bit About Me

- Lifetime in the Boating World
- SAMS® Surveyor Associate
- ABYC® Certified Master Technician
- 40 Years of Battery Sales & Service
- Cruising Editor of Waterway Guide™
- Past President of SSCA
- USCG Licensed Deck & Engine Room

What IS a Battery??

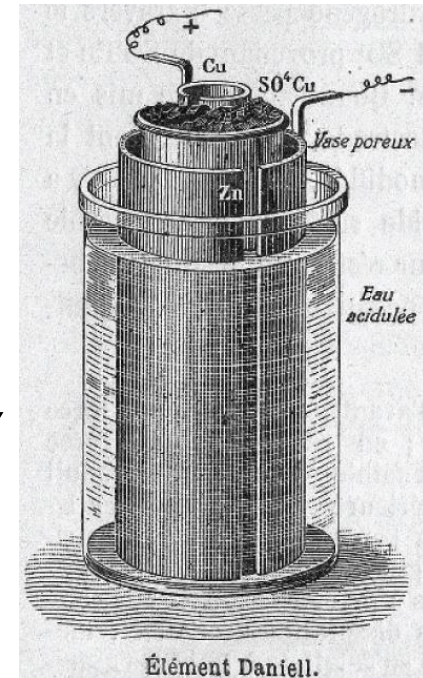
A collection of one or more cells in which:

Potential ENERGY

is stored **CHEMICALLY**,

and converted to,

ELECTRICAL ENERGY



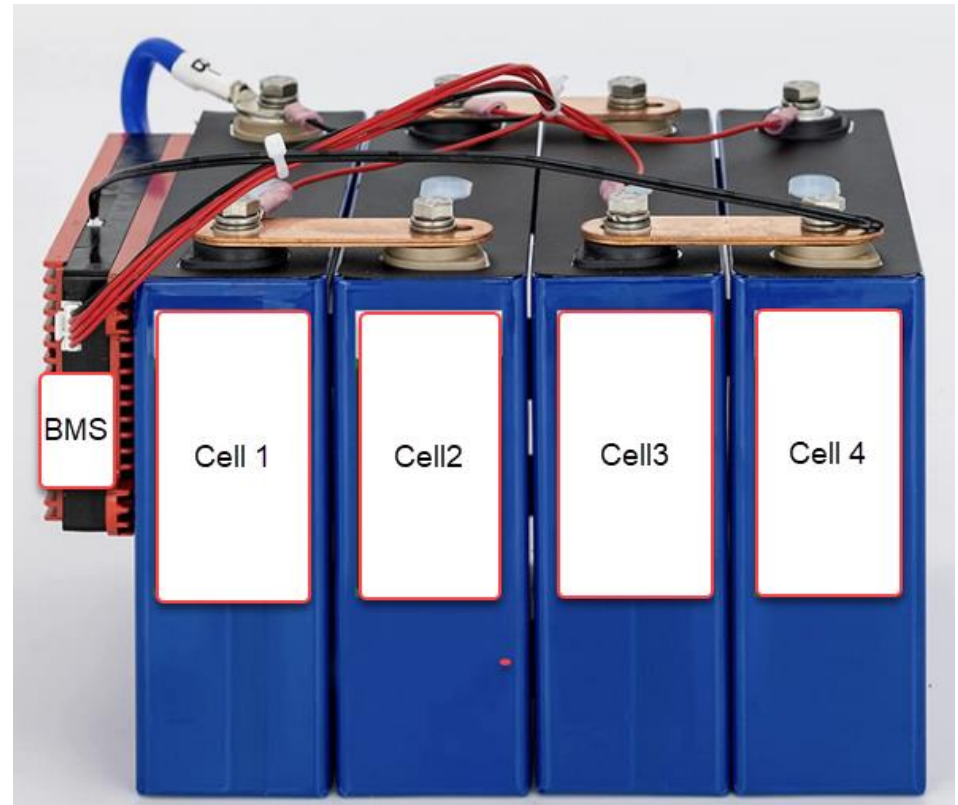
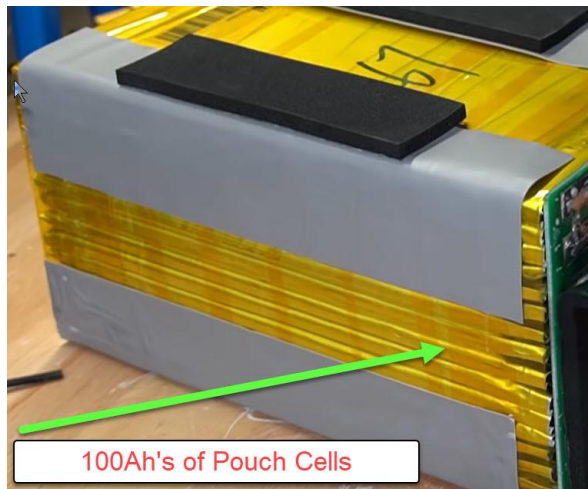
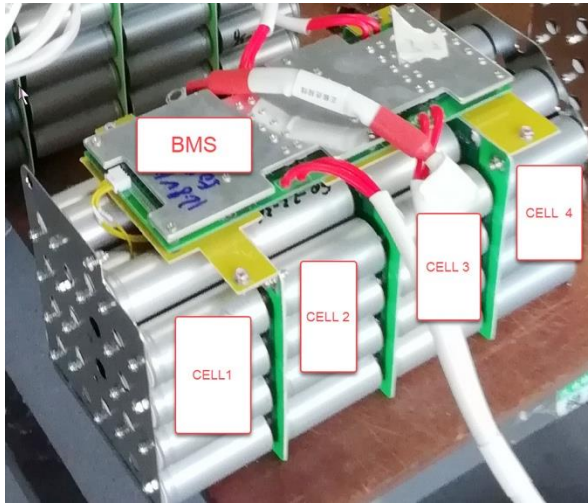


Breaking it Down

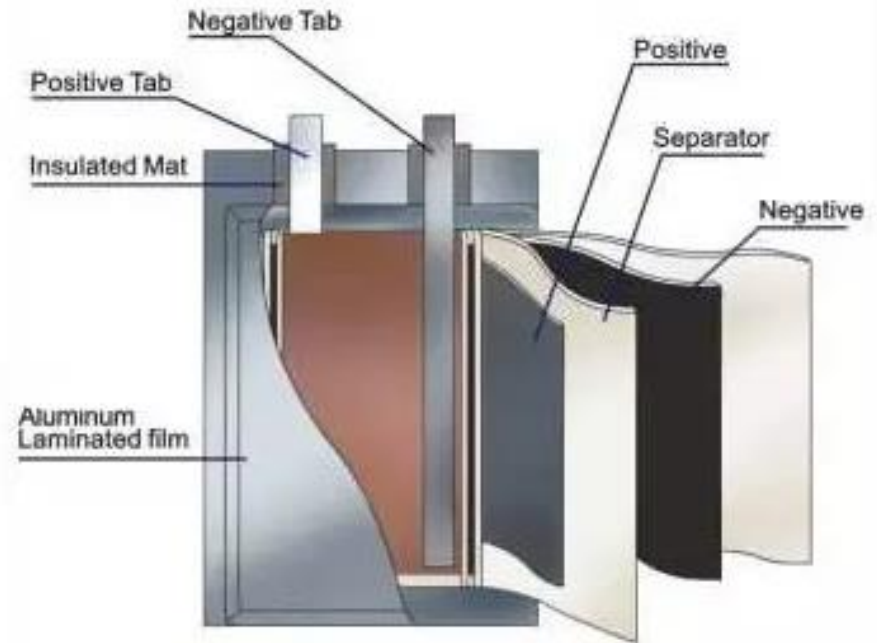
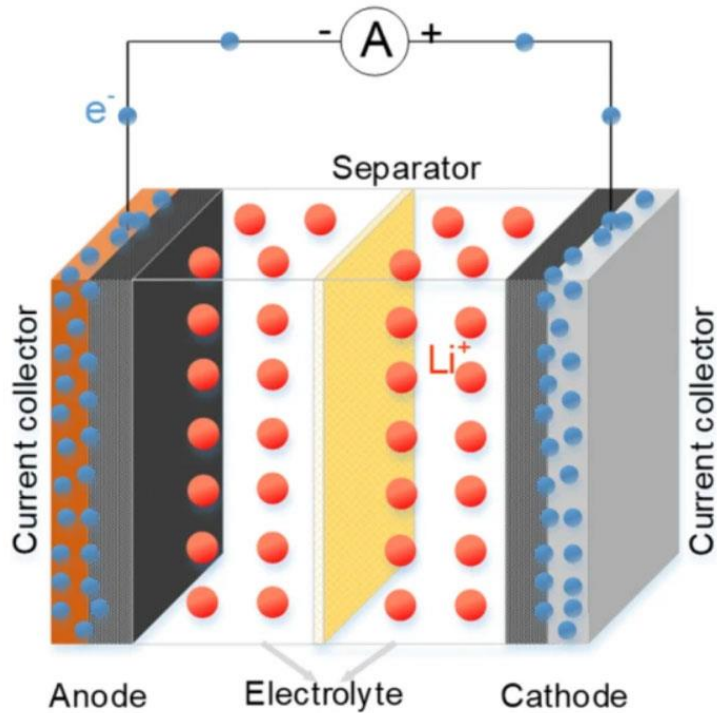
- Cell Architecture & Construction
- Manufacturing Quality
- Sourcing
- Drop-In*, External BMS Modules, DIY
- Marketing vs Engineering
- Safety Issues & Fear Mongering
- Making the Move to Lithium Ion Batteries

**There is NO SUCH THING as a Drop-In LiFePO4 Battery*

Inside an LiFePO4 Battery

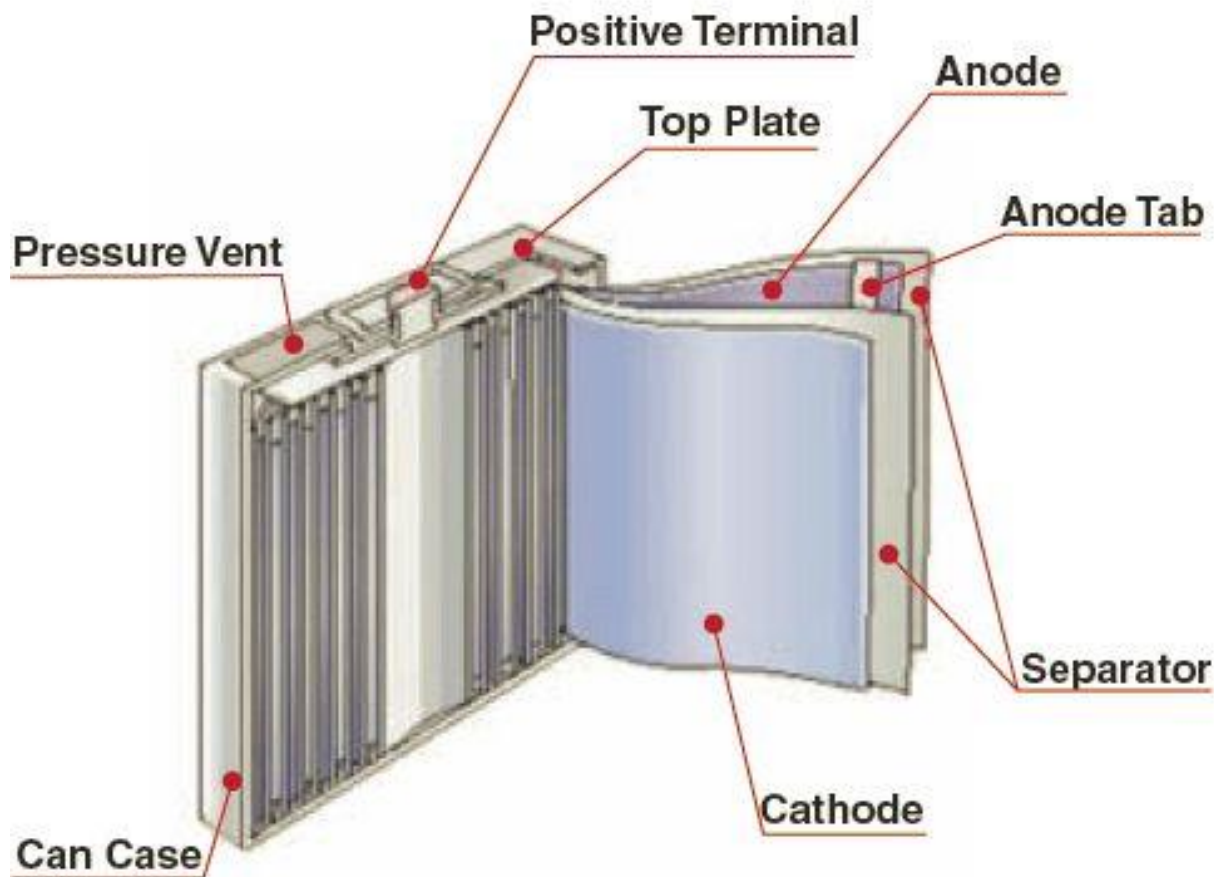
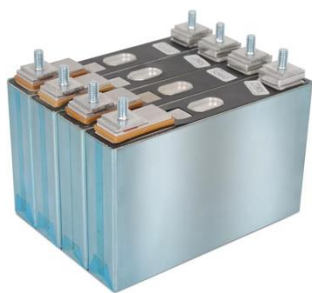


A Closer Look Pouch Cells



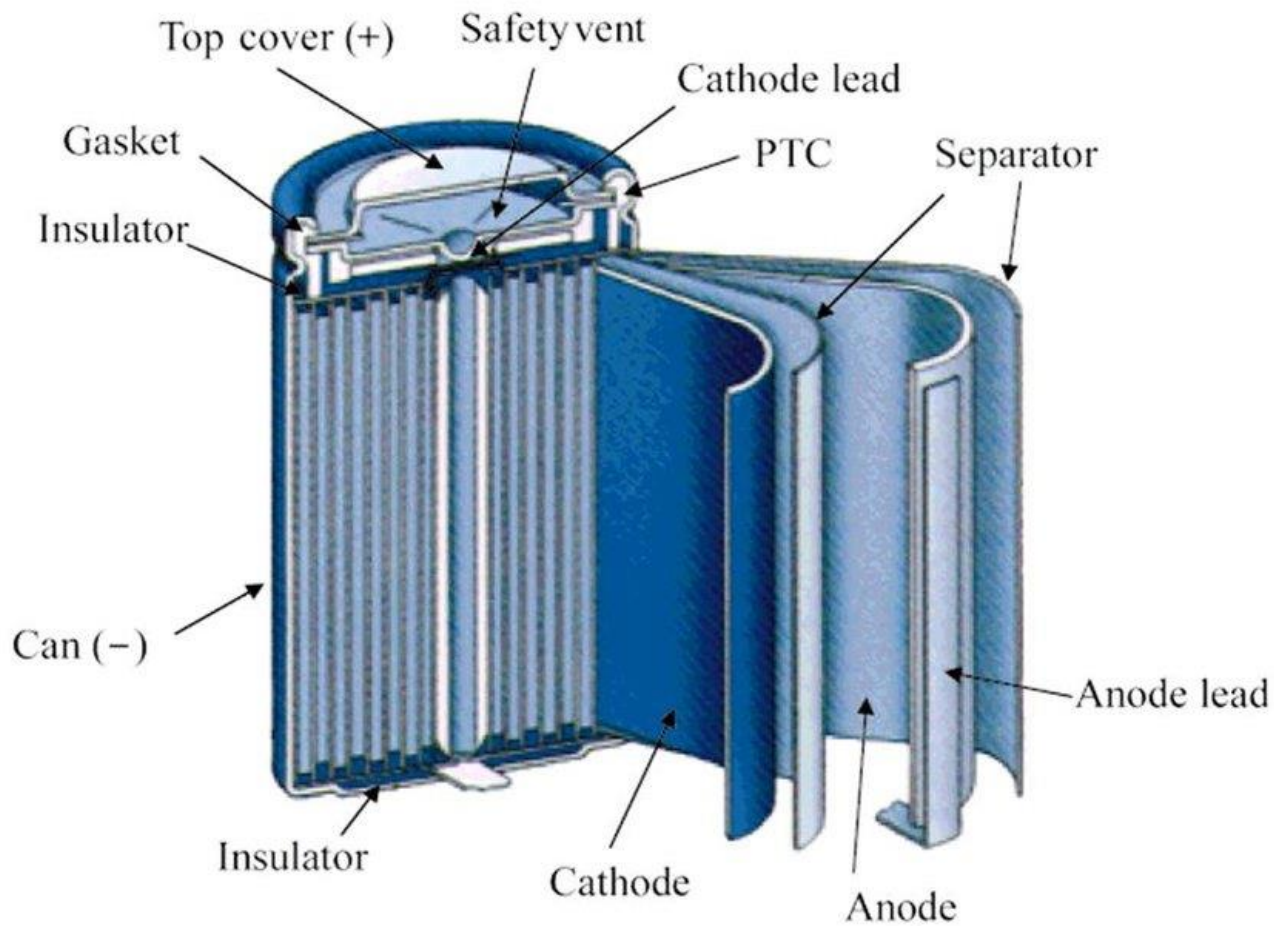


A Closer Look Prismatic Cells





A Closer Look Cylindrical Cells





Making a Choice Or having one Made for You

- New Boat or Refitting an old one
- DIY or Professional Installation
- Survey/Insurance Issues
- ABYC E-13

Application Matters Most

- Engine Starting
- House Loads/Deep Cycling
- Windlass/Thruster
- Radio/Electronics
- Special Needs



Starting Batteries

- More, Thinner Plates
- Short Bursts of Energy
- Measured in Cranking Amps

What are CCA? MCA?

30 Sec
0°F/32°F
7.2V





Choosing The Right Battery



- Start with the APPLICATION
- Then your BUDGET
- Think TCO²
- Starting, House, Windlass/Thruster all have Different Needs
- There is still a role for Pb Batteries



Deep Cycle Applications

- Perfect for LiFePO₄
- They are **ACTUALLY CHEAPER** in terms of cost per a/h over the Entire Lifecycle
- Matching Average & Max Loads to your Battery's Spec's
- **You are Upgrading your SYSTEMS, Not BUYING A BATTERY. Lather, Rinse, Repeat...**



Marketing Fails

Once again:

There is NO SUCHTHING as a
“Drop-”In Lithium Battery!!

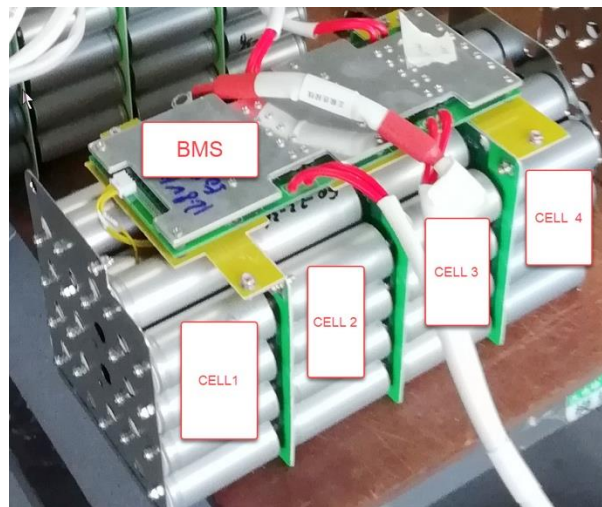
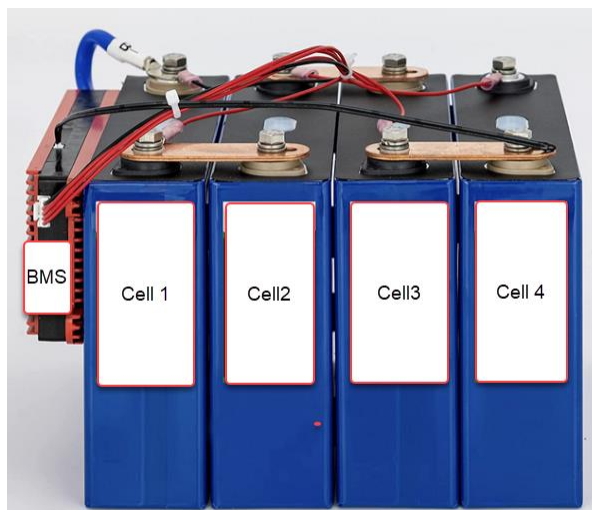
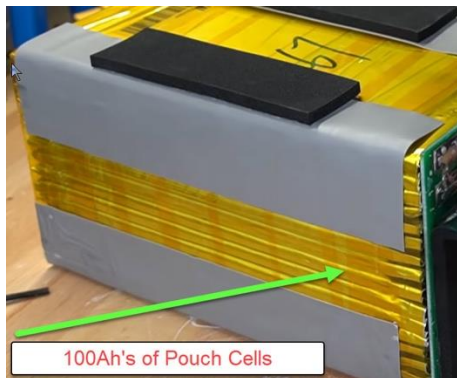
“A” vs “B” Cells is all Marketing
(A is for AUTOMOTIVE, not a top grade!!)

Buy ONLY from Established US* Based
Dealers

*UK, EU, NZ, AU, SA, etc.

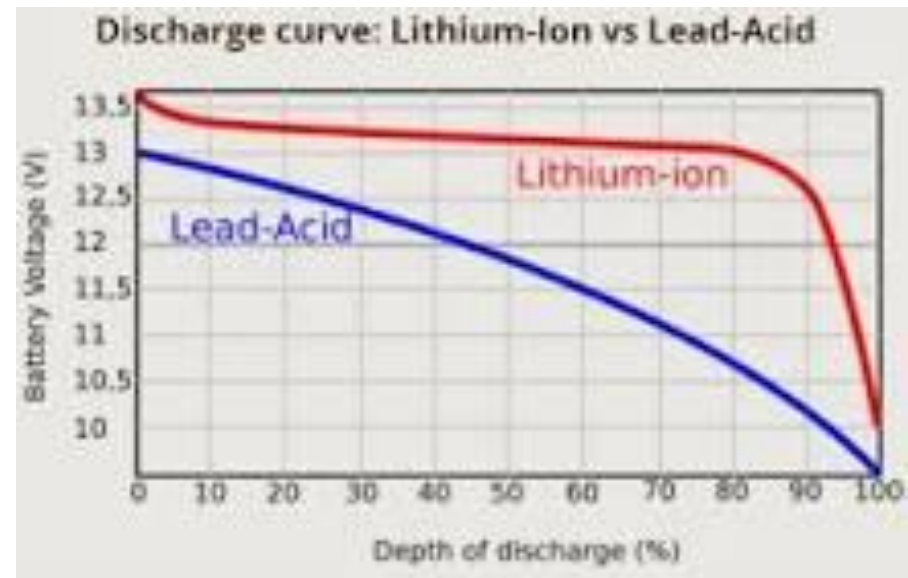


A 100a/h Battery



Discharge Power Curve

- Common Lead Battery (FLA, AGM, Gel)
 - Full Charge 12.7
 - Half Charge 12.2
 - 10% Charge 11.00
- Typical LiFePO4 Battery
 - Full Charge 13.4
 - Half Charge 13.3
 - 10% Charge 13.2





Installing

- Secured: 1" in any direction with 90# Load in all directions
- All B+ connections covered to protect from accidental shorting
- Electrolyte containment
- Wires secured every 18"
- Overcurrent Protection (OCP) within 7/40/72" of battery post
- Switches on all batteries over 800cca

Sample Project:

What about this? Does it pass?



Charging

A LiFePO4 Battery Can Take ALL You can Give It
(And More!)

You **MUST** Match your Charging System to your
Battery Brand and Bank Size





Charging

Lithionics: Charge voltage should be set to 14.4V – 14.6V, equalization and temperature compensation must be disabled, and if the charger supports float mode, set it to 13.4-13.6V.

ReLion

Operational Parameters

PARAMETER	12V SYSTEM	24V SYSTEM	48V SYSTEM
Bulk Voltage	14V - 14.6V	28V - 29.2V	56V - 58.4V
Absorption Voltage	14V - 14.6V	28V - 29.2V	56V - 58.4V
Absorption Time	0- 6 min	0- 6 min	0- 6 min
Float Voltage	13.3V - 13.8V	26.6V - 27.6V	53.2V - 55.2V
Low Voltage Cutoff	11V - 12V	22V - 24V	44V - 48V
High Voltage Cutoff	14.6V	29.2V	58.4V

Note: Charge current must be reduced at temperatures below 0°C (32°F). See details in Charge Temperature section.

AC2DC Chargers

- MUST Be Programmable to the Battery Manufacturers' Specifications
- Must be rated for LiFePO4 Charge Rates



Old chargers are good for battery sales!

Alternators

- Engine Mounted
- External Regulation
- LiFePO4 Settings
- Alternator Cage Temperature

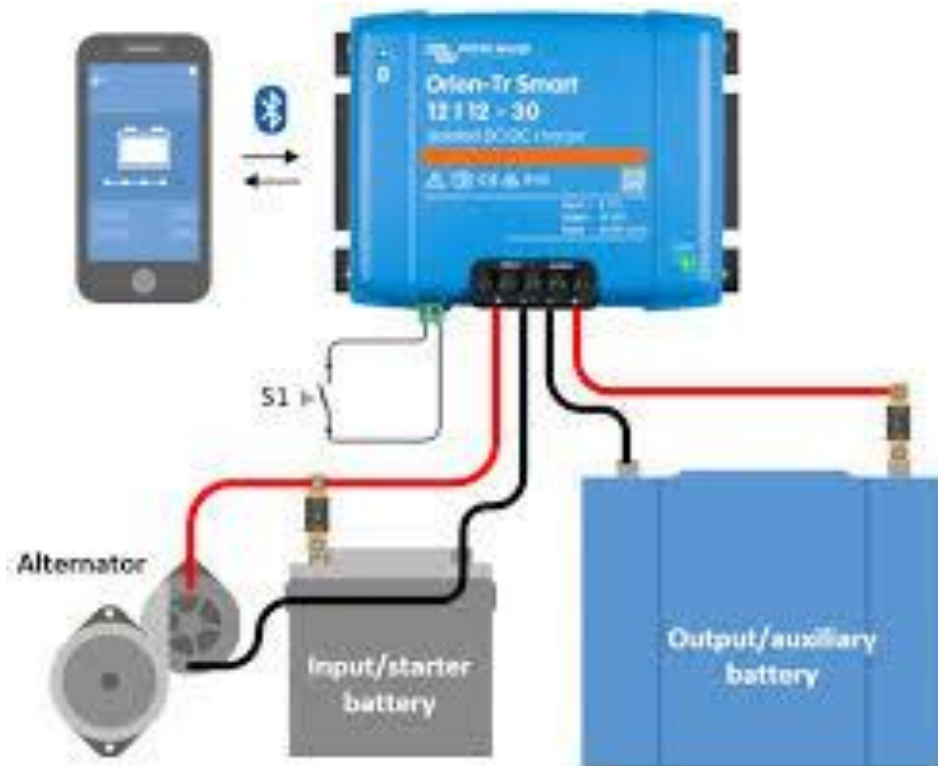


DC2DC

Best Option for Charging
Batteries with Different
Chemistries

Great Debate:

House to Starter
or
Starter to House



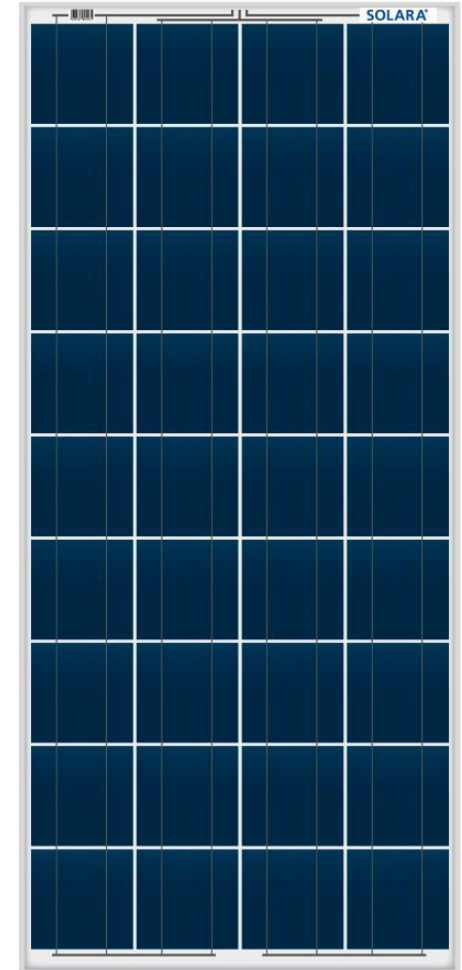


Relays & Isolators



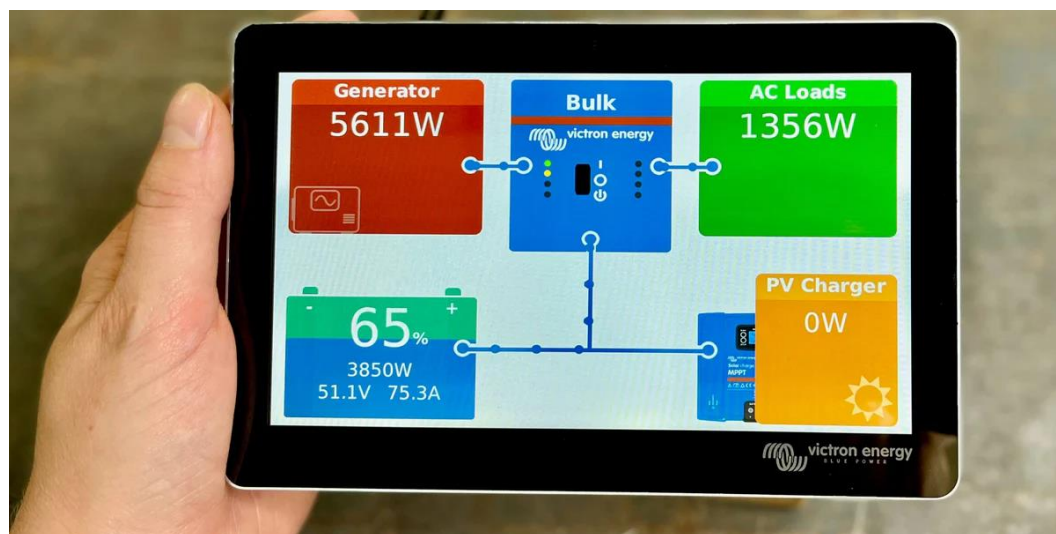
Solar & Wind

- Mating Charging Sources
- Over Voltage Issues
- Protecting Your Investment



Monitoring

- 1 amp for 1 hour is 1 amp/hour (a/h)
- Many Cruising Boats monitor AH used from a House Battery using an Amp Hour Meter that reads all power in and out of the battery bank.





Maintenance





Homework

- Best Site on the WWW
 - *marinehowto.com* (Rod)
- Best Online Classes
 - *boathowto.com* (Nigel & Jan)
- Best Facebook Group
 - *Boat Electrical Systems* (Scott & Rod)
- Best LiFePO4 Battery
 - Lithionics (someone always asks)



QUESTIONS