

# How To: Marine Solar Panels

Presented by:  
Jeff Cote



Pacific  Yacht Systems  
marine electronics & electrical  
design • installation • service • support

# Passion for Boating



- Systems Design Engineer
- Owner/operator of Pacific Yacht Systems
- NMEA & ABYC certifications
- Published monthly columns
  - Pacific Yachting Magazine: Tech Talk
  - Northwest Yachting Magazine: Hot Wire
- Favorite BC cruising grounds are Barkley Sound and the Broughton Archipelago

# About Pacific Yacht Systems



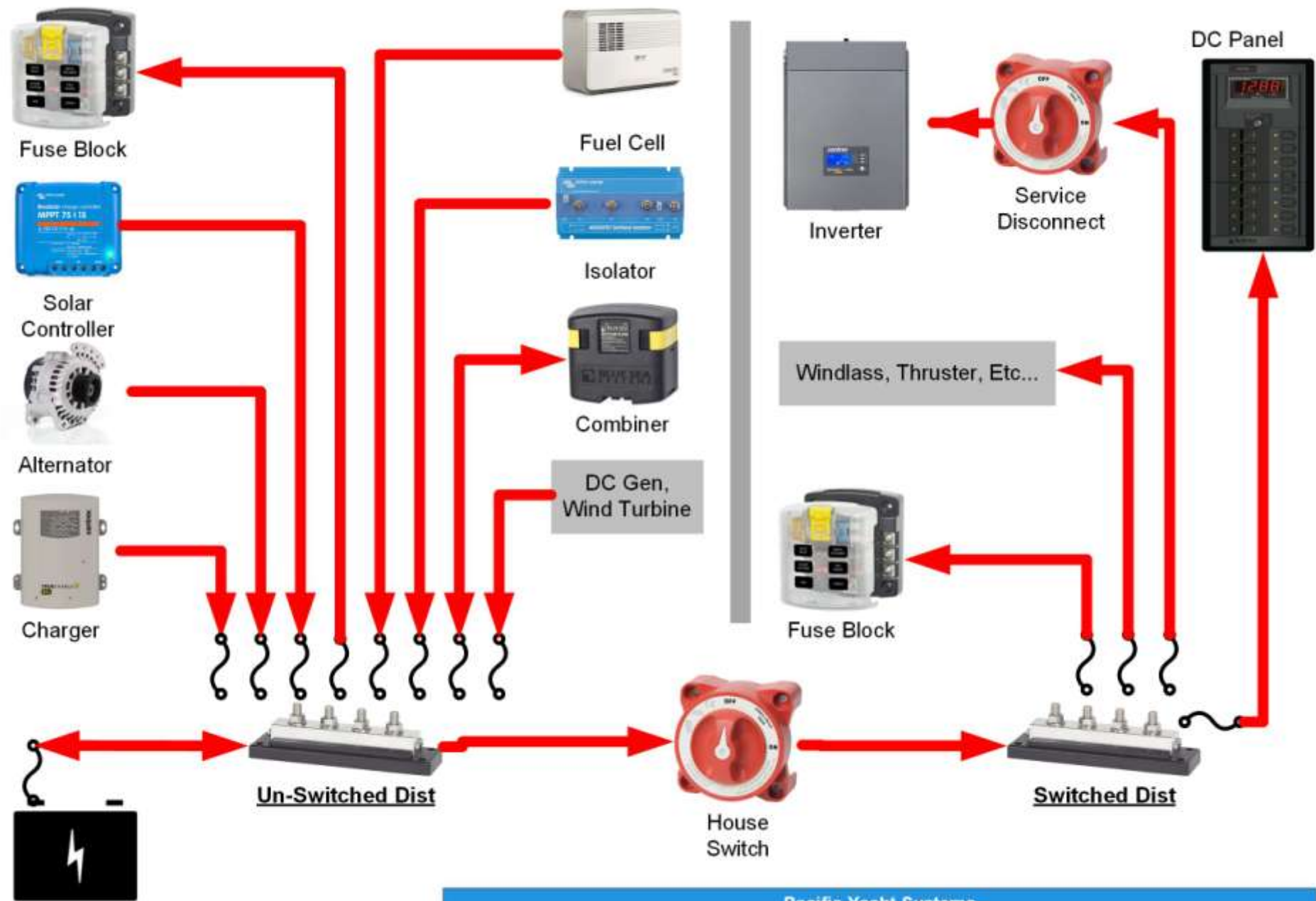
- Specialize in marine electrical and electronics
- Servicing British Columbia and Western Canada
- Worldwide electrical design / consultation
- 2018 Recap:
  - Completed over 1000 boat projects
  - Designed / consulted on over 100 electrical projects
- Over 150 “How To” PYS Videos on YouTube
- [www.pysystems.ca](http://www.pysystems.ca) for schematics, design info, published articles, etc...

# Different Charge Methods



- Ways to create power
  - Charger(s)
  - Alternator(s)
  - Solar
  - DC Genset
  - Wind





House Battery

# Solar Panel Possibilities



- Staying an 1-2 day at anchor
- Offsetting the fridge loads
- Recharging the batteries
  - Without any noise, vibration, smoke
- Running a genset LESS or NOT at all
- Sailing between anchorages
  - Batteries recharging



# Northwest Advantages: Better Solar Output



- Peak summer months:
  - 15 + hrs sunlight/day
- Relatively sunny days during summer



# Solar Innovations



- Flexible panels: similar Wattage per area to rigid panels





# Flexible Solar Panels



- Lightweight
- Mounted on:
  - cabin roof (no air gap needed)
  - canvas (bimini, dodger, cockpit enclosure)
- Zippers, grommets, velcro, snaps, adhesive, peel & stick



# Prepping for Dodger Install



# Hard Top: Flexible Solar Installation



# Flexible Solar: Dimension Examples

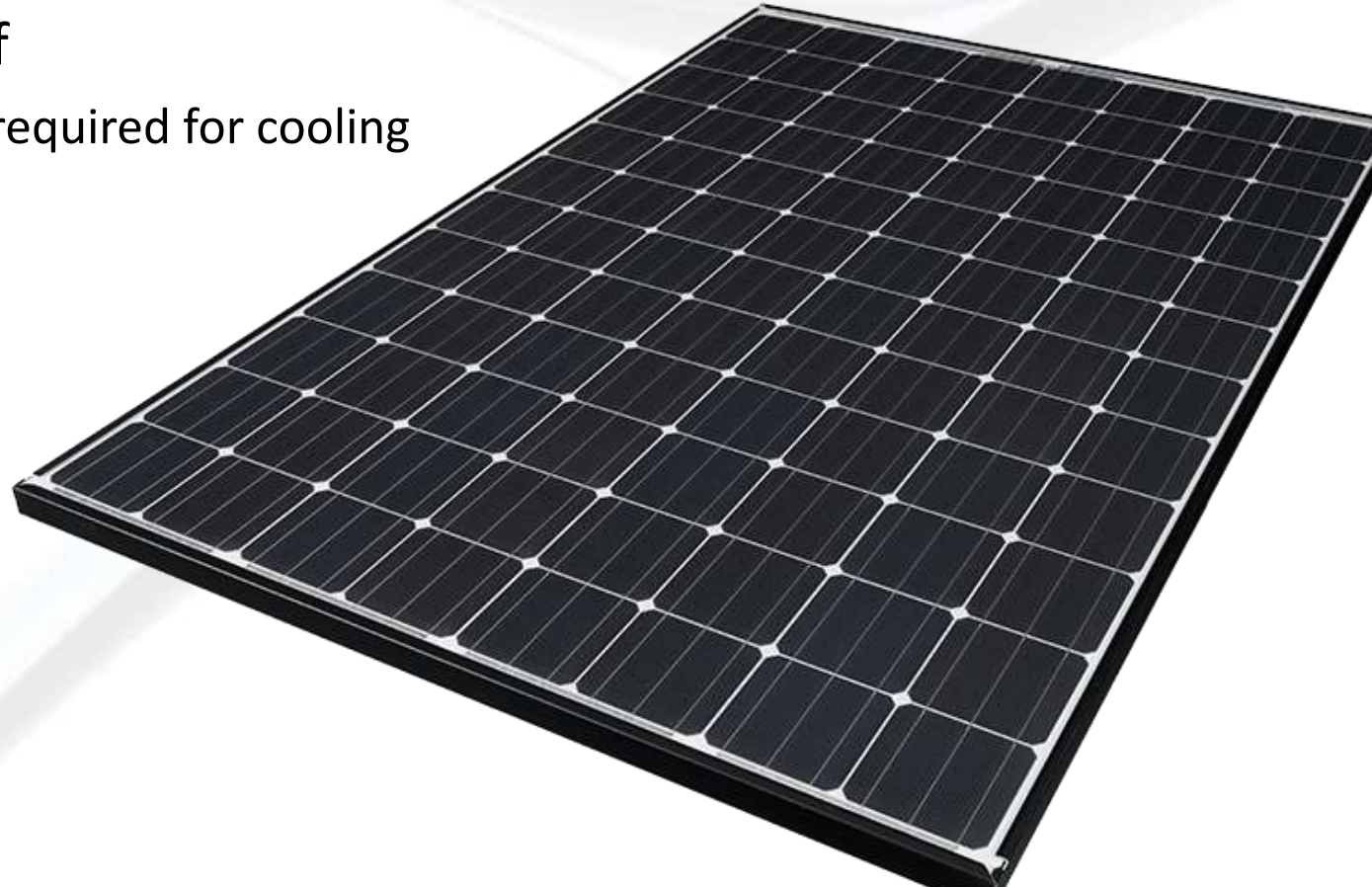


Created by Jeff Cote of Pacific Yacht  
Systems Inc. [www.pysystems.ca](http://www.pysystems.ca)

# Rigid Solar Panels



- Mounted on:
  - Cabin roof
    - Air gap required for cooling
  - Arch
  - Railings



# Rigid Solar: Dimension Examples



# Solar Panel Choice: Mono or Poly?



- Monocrystalline cells
  - Highest efficiency
- Polycrystalline cells
  - Best value



# Solar Power Efficiency Defined: Poly vs Mono



## What do the different efficiencies mean?

- The efficiency of the panel is included in the wattage rating
  - a poly 100W panel **larger** > than a mono 100W panel
  - both will produce the same energy



# Solar Trawler



# What Makes a Great Panel?



- Quality of encapsulation: EVA (Ethylene vinyl acetate)
  - Prevents yellowing <- similar effect to shading
- Connections between cells: silver alloy
- Redundant pathways between cells
- High end solar cells
- Visual and tactile inspection
- Test individually (in-house) for 24 hr before shipping
  - Xenon Sun Lamp

# Aft of Center Cockpit

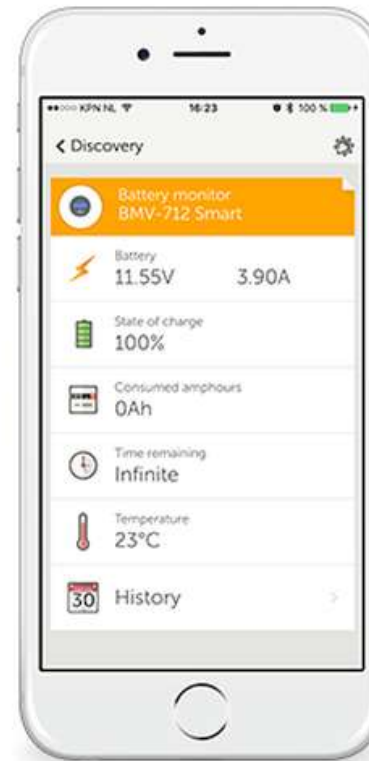


# How Many Watts Needed?



- Typical solar array goals:
  - Keep batteries top-off
  - Offset daily Ah (amp-hour) consumption
  - Offset refrigeration
  - Extend your time at anchorage:
    - e.g. 3 days instead of 2 days

# Battery Monitor: Know your Daily Ah Consumption



# Catamaran Installation



# Sample - Quick Calculation



- Daily Solar Panel Output:
  - Watts X 25% or Watts / 4
  - E.g. A 100 Watt panel will produce 25 Ah/day
    - $100 \times 20\% = 25 \text{ Ah/day}$
- Optimistic: factor of 3 or 33 Ah/day
- Conservative: factor of 5 or 20 Ah/day

# Surface Mount: Adhesive

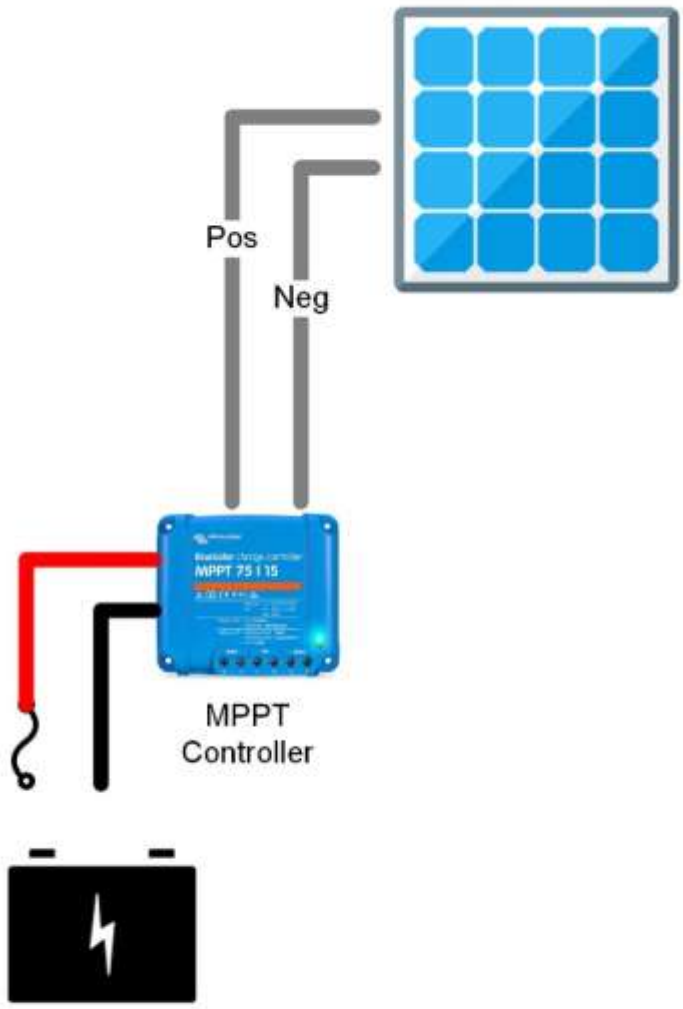




# Hardtop Installation: Peel & Stick

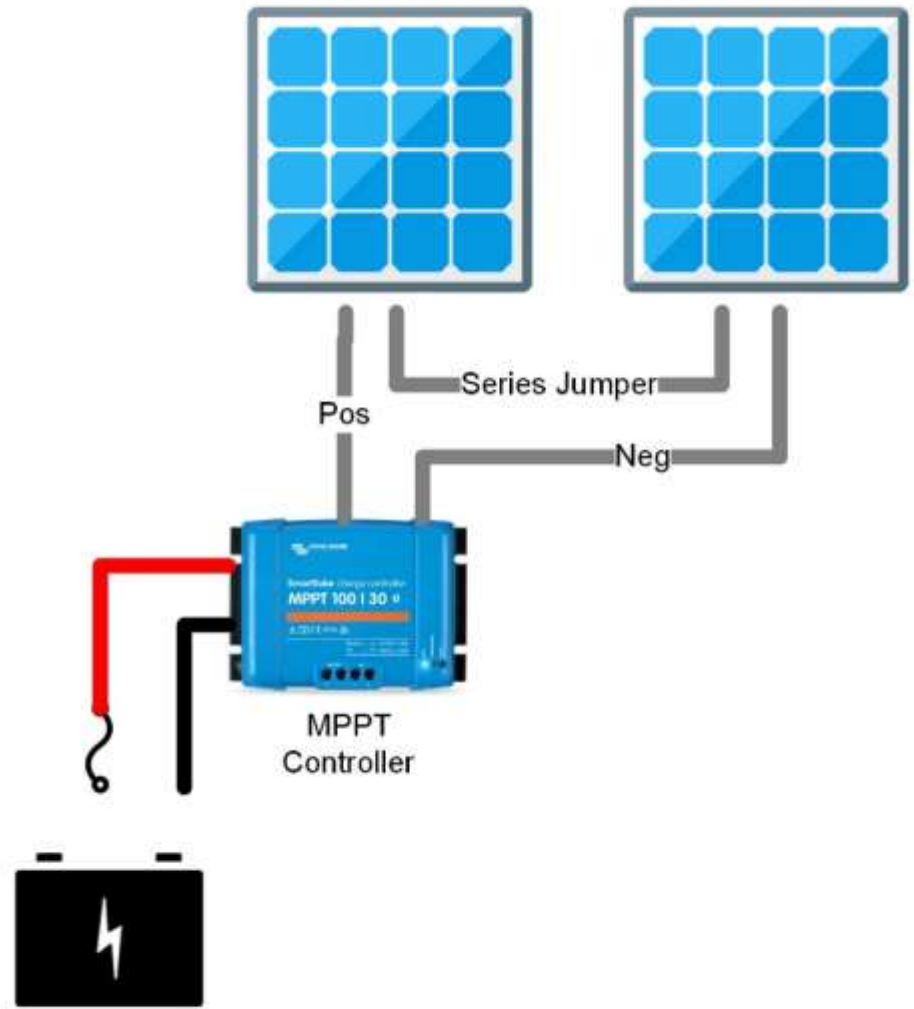


### Single Solar Panel



Battery

### Solar Panels in Series

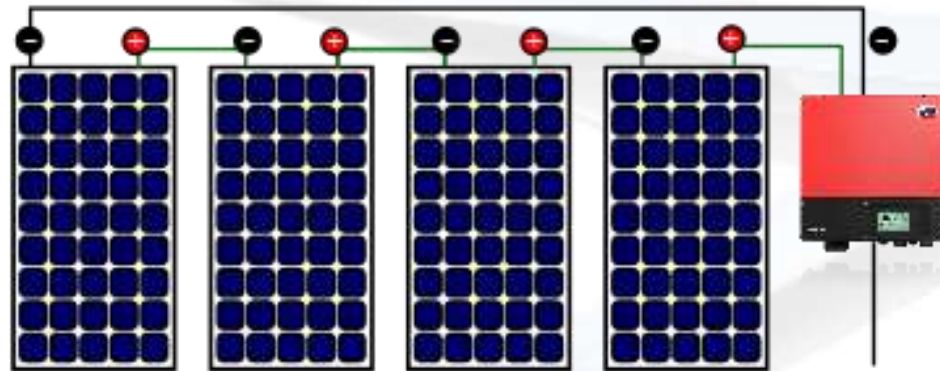


Battery

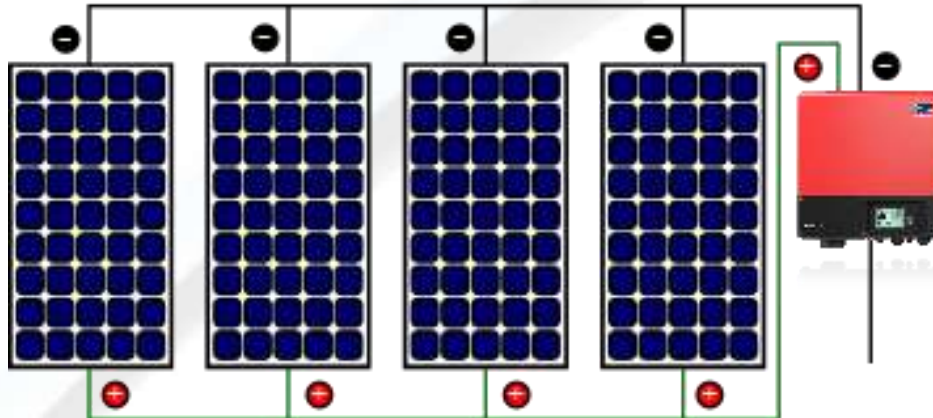
# Solar Panel: Series vs Parallel



Wiring Solar Panels in a Series Circuit



Wiring Solar Panels in a Parallel Circuit





# Make it Pretty: Wire Loom



# Solar MC4 Connectors Disassembled



# Solar MC4 Connectors



# Cable Entry





# Solar Panels Recap



- Size solar panels for
  - Keep batteries topped-off
  - Offset refrigeration
  - An extra day at anchor
  - Daily Ah demand
- Mount options:
  - Flexible: canvas, hardtops
  - Rigid: arch, railing, stainless tubing
- Installation:
  - Use outdoor rated solar wiring
  - Use MC4 connectors



# Selecting Solar Panels Tips



- Create templates (mock-up) to fit on your boat
  - E.g. 26" X 54", 35" X 42", etc...
- Give about 2" around all the edges for zippers
- Decide where the cabling will enter the boat

# Solar Panels Purchasing Tips



- Daily output estimate:
  - Short-hand formula: wattage / 4
- Quality
- Shading “by-pass diodes”
- Mono vs Poly
- Popular flexible models
  - Gioco, Solara, Solbian
- Rigid models
  - Lots of selections



# Solar Controllers: PWM vs MPPT



- Definition:
  - PWM (Pulse Width Modulation)
  - MPPT (Multi Power Point Tracking)
- Differences
  - MPPT are more efficient (up to 30% more) than PWM
  - MPPT \$\$ vs PWM \$
  - MPPT allows for higher input Voltage
    - series wiring
  - Some MPPT models provide boost Voltage

# MPPT Wiring



# Solar MPPT: Purchasing Tips



- Battery Voltage
- Maximum solar array Amperage
- Maximum solar array Voltage
- Battery chemistry
  - FLA, AGM, Lithium, custom

# MPPT

## 75 Volts / 15 Amps



# Genasun – GV-10 LA





# MPPT 100 Volts / 30 Amps

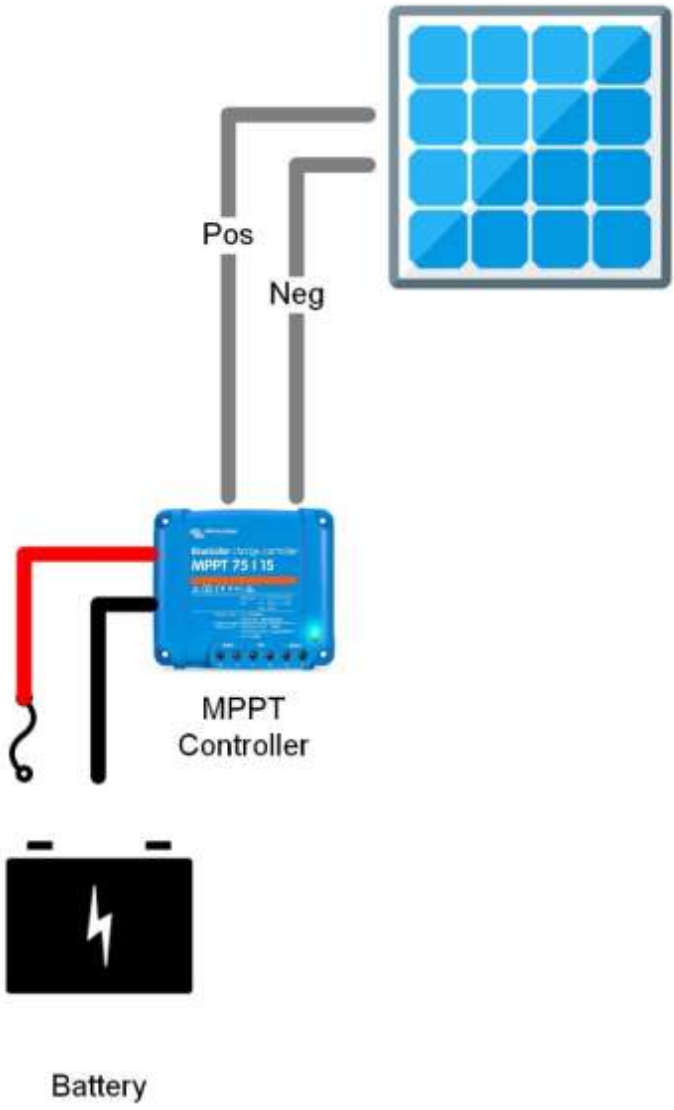


# Solar MPPT: Installation Tips

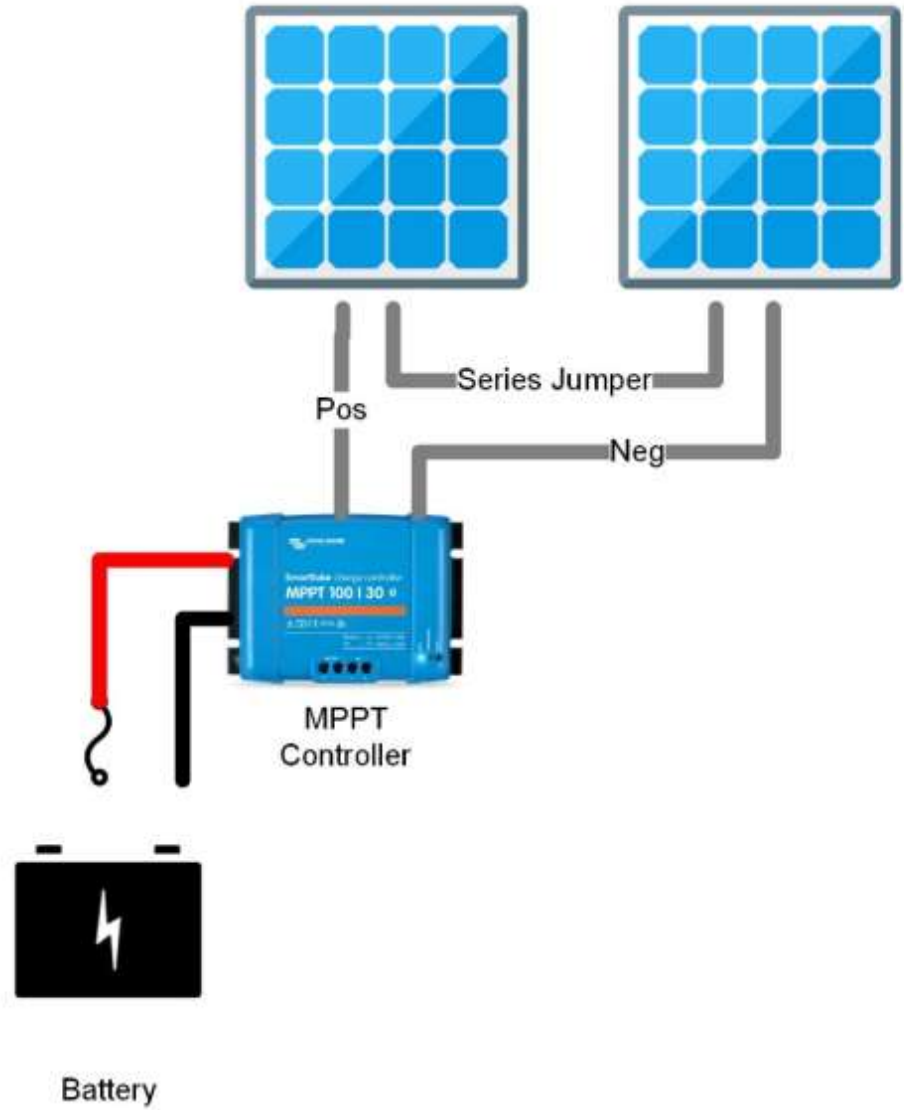


- Shade potential
  - consider one MPPT controller per panel
- Bring 10 gauge wire from panel to MPPT
- Config MPPT for the right battery type:
  - Flooded, AGM, Gel, etc...
- Fuse each panel and each individual load
  - Properly label all fuses and wire runs

### Single Solar Panel



### Solar Panels in Series



# #1: Catalina 36



# #2: Sea Ray



# #3: Beneteau 51



# #4: Camano 31



# Closing Thoughts



- Recharging batteries
  - Without noise, vibration, smoke
- Costs are all front-loaded
- Secondary source for charging while at dock







Questions?

# Connect with PYS



- PYS Electrical Orientation for your boat
  - 90 mins: Batteries, DC distribution, charger, alternator, inverter
- PYS Design Services for DIYers
  - Electrical system designed by PYS (collaborative and to marine code)
  - Installed by yourself or other outfit
- Pacific Yachting magazine - Monthly Tech Talk Column
- Northwest Yachting magazine – Monthly Hot Wire Column
- YouTube – 500K Views
- [www.pysystems.ca](http://www.pysystems.ca) 1000s of articles
- Monthly email newsletter



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